



DESIGN
2026

B O O K O F A B S T R A C T S

19TH INTERNATIONAL DESIGN CONFERENCE
18 - 21 MAY 2026 · CAVTAT · DUBROVNIK · CROATIA

EDITORS Tomislav Martinec, Marija Majda Škec, Stanko Škec, Mario Štorga

excellence in design



excellence in design

19TH INTERNATIONAL DESIGN CONFERENCE
18 - 21 MAY 2026 · CAVTAT · DUBROVNIK · CROATIA

BOOK OF ABSTRACTS

PROGRAMME CHAIRS

P. JOHN CLARKSON
University of Cambridge

TIM C. MCALOONE
Technical University of Denmark

JULIE STAL-LE CARDINAL
CentraleSupélec

SANDRO J. WARTZACK
Friedrich-Alexander-Universität Erlangen-Nürnberg

STANKO ŠKEC
*University of Zagreb
Faculty of Mechanical Engineering
and Naval Architecture*

MARIO ŠTORGA
*University of Zagreb
Faculty of Mechanical Engineering
and Naval Architecture*



All the papers submitted for the DESIGN 2026 conference have been reviewed by at least two members of the Scientific Advisory Board.

The publisher and authors state that this document has been compiled meticulously and to the best of their knowledge, however, the publisher and authors can in no way guarantee the accuracy or completeness of the information. The publishers and authors, therefore, do not accept any liability for any damage resulting from actions or decisions based on the information in the question. Users of this document are strongly advised not to use this information solely, but to rely on their professional knowledge and experience, and to check the information to be used. The DESIGN 2026 Secretariat cannot guarantee the accuracy of information provided by participating companies and authorities. The publisher reserves the right to combine, delete and change sections, to edit and re-use (parts of) the document and to distribute the information by any means.

This publication is copyright under the Berne Convention and International Copyright Convention. All rights reserved. Apart from any fair dealing for the purpose of private study, research, criticism or review, as permitted under the DESIGN 2026 Conference Copyright and Licensed Agreement, Designs and Patents Act of 1988, no part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, electrical, chemical, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright owners. Unlicensed multiple copying of the contents of this publication is illegal. Abstracting and non-profit use of this material is permitted with a credit to the source.

DESIGN 2026 – BOOK OF ABSTRACTS

ISSN 1847-9162

Editors:

Tomislav Martinec

Marija Majda Škec

Stanko Škec

Mario Štorga

© 2026 University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, Croatia

Published by:

University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, Croatia

The Design Society, Glasgow: DS144

DESIGN conference is an event endorsed by the Design Society.

The Design Society is a charitable body, registered in Scotland, number SC031694.

Registered Company Number: SC401016

Technical Support:

CADLab, University of Zagreb FSB

www.cadlab.fsb.hr

cad lab

Conference organising team:

Mario Štorga (chair), Stanko Škec (co-chair), Tomislav Martinec (assistant chair), Dorian Marjanović, Neven Pavković, Nenad Bojčetić, Fanika Lukačević, Jelena Šklebar, Zvonimir Lipšinić, Lovro Sever, Iris Huić, Marija Majda Škec, Dragan Žeželj, Filip Valjak, Petar Kosec, Stjepan Flegarić, Matea Zadro

University of Zagreb Faculty of Mechanical Engineering and Naval Architecture

Design & prepress: Gordana Radaković, Creayon Studio

Printed and bound by: Sveučilišna tiskara, Zagreb



excellence in design

19TH INTERNATIONAL DESIGN CONFERENCE
18 - 21 MAY 2026 · CAVTAT · DUBROVNIK · CROATIA

is organised
under the auspices of the
President of the Republic of Croatia
Zoran Milanović
and
Ministry of Science, Education and
Youth of the Republic of Croatia

by



fsb

University of Zagreb
Faculty of Mechanical Engineering
and Naval Architecture



in co-operation with
HDESK – Croatian Society for
Mechanical Engineering Design

supported by





- Abi Akle, Audrey, *ESTIA, France*
Achiche, Sofiane, *Polytechnique Montreal, Canada*
Aflatoony, Leila, *Georgia Institute of Technology, United States of America*
Ahmed-Kristensen, Saeema, *University of Exeter, United Kingdom*
Ahrens, Florian, *Technische Universität Chemnitz, Germany*
Ahumada-Tello, Eduardo, *Autonomous University of Baja California, Mexico*
Akaki, Mayu, *Ritsumeikan University, Japan*
Akhtar, Md Haseen, *IIT Hyderabad, India*
Albers, Albert, *KIT Karlsruhe Institute of Technology, Germany*
Arrouf, Abdelmalek, *LEMPAU, University of Batna1, Algeria*
Bartz, Marcel, *TU Dortmund, Germany*
Basan, Robert, *University of Rijeka, Faculty of Engineering, Croatia*
Bauer, Tom, *Arts et Métiers, France*
Baxter, Weston, *Imperial College London, United Kingdom*
Becattini, Niccolo, *Politecnico di Milano, Italy*
Bencetić, Sanja, *University of Zagreb Faculty of Architecture, School of Design, Croatia*
Berglund, Anders, *Mälardalen University, Sweden*
Bertoni, Alessandro, *Blekinge Institute of Technology, Sweden*
Bertoni, Marco, *Blekinge Institute of Technology, Sweden*
Bjelland, Øystein, *Norwegian University of Science and Technology, Norway*
Bojčetić, Nenad, *University of Zagreb FSB, Croatia*
Bordregoni, Monica, *Politecnico di Milano, Italy*
Borg, Jonathan, *University of Malta, Malta*
Borgianni, Yuri, *Free University of Bozen | Bolzano, Italy*
Boujut, Jean-François, *Grenoble INP, France*
Brahma, Arindam, *Chalmers University of Technology, Sweden*
Brisco, Ross, *University of Strathclyde, United Kingdom*
Burgess, Jon, *Arts University Bournemouth, United Kingdom*
Bursac, Nikola, *Hamburg University of Technology, Germany*
Burvill, Colin Reginald, *The University of Melbourne, Australia*
Bylund, Nicklas, *N/A, United States of America*
Cagan, Jonathan, *Carnegie Mellon University, United States of America*
Caldwell, Nicholas, *University of Suffolk, United Kingdom*
Calvo, Rafael A., *Imperial College London, United Kingdom*
Campean, Felician, *University of Bradford, United Kingdom*
Cantamessa, Marco, *Politecnico di Torino, Italy*
Carulli, Marina, *Politecnico di Milano, Italy*
Caruso, Giandomenico, *Politecnico di Milano, Italy*
Casakin, Hernan, *Ariel University, Israel*
Cascini, Gaetano, *Politecnico di Milano, Italy*
Cash, Philip, *Northumbria University, United Kingdom*
Chandra, Sushil, *BML Munjal University, India*
Chantzaras, Christos, *Frankfurt University of Applied Sciences, Germany*
Chiarello, Filippo, *Università di Pisa, Italy*
Childs, Peter R. N., *Imperial College London, United Kingdom*
Chulvi, Vicente, *Universitat Jaume I, Spain*
Clarkson, P. John, *University of Cambridge, United Kingdom*
Cluzel, François, *CentraleSupélec, France*
Čok, Vanja, *University of Ljubljana, Faculty of Mechanical Engineering, Slovenia*
Colombo, Samuele, *University of Strathclyde, United Kingdom*
Conrad, Jan, *Hochschule Kaiserslautern, Germany*
Coskun, Aykut, *Koç University, Türkiye*
Coutellier, Daniel, *INSA Hauts-de-France, France*
Čular, Ivan, *University of Zagreb FSB, Croatia*
D'Amico, Enrique, *National University of La Plata, Argentina*
de Paula, Istefani, *Universidade Federal do Rio Grande do Sul, Brazil*
Deininger, Michael, *University of Cincinnati, United States of America*
Dekoninck, Elies Ann, *University of Bath, United Kingdom*
Del Curto, Barbara, *Politecnico di Milano, Italy*
Del Giorgio Solfa, Federico, *National University of La Plata, Argentina*
Demke, Niels, *Helmut-Schmidt-Universität/Universität der Bundeswehr Hamburg, Germany*
Demoly, Frédéric, *Université de Technologie de Belfort-Montbéliard, France*
Demšar, Ivan, *University of Ljubljana, Faculty of Mechanical Engineering, Slovenia*
Devadula, Suman, *MIT World Peace University, India*
Eckert, Claudia, *The Open University, United Kingdom*
Edel, Fabian, *Fraunhofer IAO, Germany*
Eifler, Tobias, *Technical University of Denmark, Denmark*
Eikevåg, Sindre Wold, *Norwegian University of Science and Technology, Norway*
Eisenbart, Boris, *Swinburne University of Technology, Australia*
Ellman, Asko Uolevi, *Tampere University, Finland*
Elverum, Christer W., *Norwegian University of Science and Technology, Norway*
Eppinger, Steven, *Massachusetts Institute of Technology, United States of America*
Erbe, Torsten, *ASML BV, The Netherlands*
Erden, Zühal, *Atılım University, Türkiye*
Eriksson, Vikki, *Aalto University, Finland*
Eriksson, Yvonne, *Mälardalen University, Sweden*
Eynard, Benoit, *Université de Technologie de Compiègne, France*
Fain, Nuša, *Carleton University, Canada*
Fantoni, Gualtiero, *Università di Pisa, Italy*
Fargnoli, Mario, *Sapienza University of Rome, Italy*
Farrugia, Philip, *University of Malta, Malta*
Favi, Claudio, *Università di Parma, Italy*
Fayyad, Nadine, *University of Petra, Jordan*
Fazelpour, Mohammad, *University of Maryland, United States of America*



Finger Susan, *Carnegie Mellon University, United States of America*

Fortin, Clement, *Skolkovo Institute of Science and Technology, Russia*

Gaha, Raoudha, *Université de Technologie de Compiègne, France*

García-García, Carlos, *Universitat Jaume I, Spain*

Gembarski, Paul Christoph, *Leibniz Universität Hannover, Germany*

Georgiev, Georgi V., *University of Oulu, Finland*

Gerhard, Detlef, *Ruhr-University Bochum, Germany*

Gericke, Kilian, *University of Rostock, Germany*

Gero, John, *Drexel University, United States of America*

Gidel, Thierry, *Université de technologie de Compiègne, France*

Giordano, Vito, *Università di Pisa, Italy*

Giunta, Lorenzo, *University of Bath, United Kingdom*

Göbel, Jens Christian, *Rheinland-Pfälzische Technische Universität, Germany*

Göhlich, Dietmar, *TU Berlin, Germany*

Goker, Mehmet, *N/A, United States of America*

Gomes, Giovana Monteiro, *Technical University of Denmark, Denmark*

Gonçalves, Milene, *Delft University of Technology, The Netherlands*

Gong, Zhengya, *University of Oulu, Finland*

Gooch, Shayne, *University of Canterbury, New Zealand*

Gooding, Luke, *Stockholm Environment Institute - York, United Kingdom*

Gopsill, James, *University of Bristol, United Kingdom*

Götz, Stefan, *Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

Goucher-Lambert, Kosa, *University of California Berkeley, United States of America*

Goudsward, Mark, *University of Bristol, United Kingdom*

Graziosi, Serena, *Politecnico di Milano, Italy*

Gruhier, Elise, *Arts et Métiers, France*

Guagliano, Mario, *Politecnico di Milano, Italy*

Guérineau, Julia, *École de technologie supérieure, Canada*

Guerra, Andrea Luigi, *Université de Technologie de Compiègne, France*

Günay, Asli, *University of Twente, The Netherlands*

Gupta, Ravi Kumar, *National Institute of Technical Teachers Training and Research Bhopal, India*

Guzzo, Daniel, *Technical University of Denmark, Denmark*

Hackenberg, Georg, *University of Applied Sciences Upper Austria, Austria*

Han, Ji, *The University of Exeter, United Kingdom*

Hane Hagström, Malin, *Chalmers University of Technology, Sweden*

Hashemi Farzaneh, Helena, *MTU Aero Engines, Germany*

Hicks, Ben, *University of Bristol, United Kingdom*

Hirz, Mario, *Graz University of Technology, Austria*

Hoftijzer, Jan Willem, *Delft University of Technology, The Netherlands*

Holder, Daniel, *University of Stuttgart, Germany*

Holliman, Alexander 'Freddie', *University of Strathclyde, United Kingdom*

Howell, Bryan, *BYU, United States of America*

Huang, Tao, *East Tennessee State University, United States of America*

Hurst, Ada, *University of Waterloo, Canada*

Husung, Stephan, *Technische Universität Ilmenau, Germany*

I. Hallstedt, Sophie, *Chalmers University of Technology, Sweden*

Ilies, Horea, *University of Connecticut, United States of America*

Inkermann, David, *Technische Universität Clausthal, Germany*

Ion, William, *University of Strathclyde, United Kingdom*

Isaksson, Ola, *Chalmers University of Technology, Sweden*

Jablokow, Kathryn, *Manhattan University, United States of America*

Jagtap, Santosh, *Indian Institute of Technology Guwahati, India*

Jean, Camille, *Arts et Métiers, France*

Jiang, Pingfei, *University of Exeter, United Kingdom*

Johansson, Glenn, *Lund University, Sweden*

Johansson Askling, Christian, *Blekinge Institute of Technology, Sweden*

Johnson, Karl, *The University of Exeter, United Kingdom*

Jonuschies, Ingo, *University of Rostock, Germany*

Jowers, Iestyn, *The Open University, United Kingdom*

Jung, Eui Chul, *Seoul National University, South Korea*

Jurčević Lulić, Tanja, *University of Zagreb FSB, Croatia*

Juuti, Tero Sakari, *Tampere University, Finland*

Kanaya, Ichi, *Nagasaki University, Japan*

Kannengiesser, Udo, *Johannes Kepler Universität, Austria*

Karlsson, Lennart, *Anske AB, Sweden*

Keates, Simeon, *University of Chichester, United Kingdom*

Keldmann, Troels, *Keldmann Healthcare A/S, Denmark*

Keshwani, Sonal, *Indraprastha Institute of Information Technology Delhi, India*

Khan, Mohammed Rajik, *National Institute of Technology Rourkela, India*

Kim, Seoyoung, *Stanford Center at the Incheon Global Campus, South Korea*

Kim, SuKyoung, *Sapporo City University, Japan*

Kim, Yong Se, *Tongji University, China*

Kipouros, Timoleon, *University of Cambridge, United Kingdom*

Kirchner, Eckhard, *TU Darmstadt, Germany*

Klöckner, Hermann Wolfram, *Technical University of Munich, Germany*

Koch, Alexander, *University of the Bundeswehr Munich, Germany*

Koh, Edwin, *Singapore University of Technology and Design, Singapore*

Köhler, Christian, *Hochschule für Technik und Wirtschaft des Saarlandes, Germany*

Koldewey, Christian, *Paderborn University, Germany*

Komashie, Alexander, *University of Cambridge, United Kingdom*

Kopenhagen, Frank, *Hamburg University of Applied Sciences, Germany*

Koronis, Georgios, *University of the Aegean, Greece*



Kossack, Frederike, Ruhr-Universität Bochum, Germany

Kota, Srinivas, Birla Institute of Technology and Science, India

Kovacevic, Ahmed, City ST George's, University of London, United Kingdom

Krause, Dieter, Hamburg University of Technology, Germany

Krauss, Gordon, Harvey Mudd College, United States of America

Kreimeyer, Matthias, University of Stuttgart, Germany

Kromer, Robin, University of Bordeaux, France

Kukreja, Aman, University of Bristol, United Kingdom

Lachmayer, Roland, Leibniz Universität Hannover, Germany

Lakemond, Nicolette, Linköping University, Sweden

Lamé, Guillaume, CentraleSupélec, France

Larsson, Tobias, Blekinge Institute of Technology, Sweden

Lavrsen, Jakob, Aalto University, Finland

Le Masson, Pascal, Mines Paris PSL, France

Legardeur, Jeremy, ESTIA, France

Leroy, Yann, CentraleSupélec, France

Liao, Ting, Stevens Institute of Technology, United States of America

Liu, Ying, Cardiff University, United Kingdom

Liu, Yuan, Beijing Institute of Fashion Technology, China

Livotov, Pavel, Offenburg University, Germany

Lizarralde, Iban, ESTIA, France

Lockett, Helen, The Open University, United Kingdom

López Forniés, Ignacio, Universidad de Zaragoza, Spain

Luo, Jianxi, City University of Hong Kong, Hong Kong

Mahdjoub, Morad, Université de Technologie de Belfort-Montbéliard, France

Maier, Anja, University of Strathclyde, United Kingdom

Majumder, Anubhab, Aarhus University, Denmark

Mandolini, Marco, Università Politecnica delle Marche, Italy

Maranzana, Nicolas, Arts et Métiers, France

Marconi, Marco, Università degli Studi della Tuscia, Italy

Marjanović, Dorian, University of Zagreb FSB, Croatia

Martinec, Tomislav, University of Zagreb FSB, Croatia

Masclat, Cédric, Université Grenoble Alpes, France

Mašović, Robert, University of Zagreb FSB, Croatia

Matsumae, Akane, Kyushu University, Japan

Matthews, Jason Anthony, University of the West of England, United Kingdom

Maurya, Santosh, Hitachi, Ltd., Japan

McAloone, Tim C., Technical University of Denmark, Denmark

McKay, Alison, University of Leeds, United Kingdom

McTeague, Chris, Technical University of Munich, Germany

Meijer, Sebastiaan, KTH Royal Institute of Technology, Sweden

Menshenin, Yaroslav, Université Grenoble Alpes, France

Merlo, Christophe, École Supérieure des Technologies Industrielles Avancées, France

Miehling, Jörg, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Milčić, Diana, University of Zagreb, GF, Croatia

Milislavljevic-Syed, Jelena, Cranfield University, United Kingdom

Millet, Dominique, SEATECH Toulon, France

Mocko, Greg, Clemson University, United States of America

Mohammed, Mazher Iqbal, Loughborough University, United Kingdom

Montagna, Francesca, Politecnico di Torino, Italy

Moon, Seung Ki, Nanyang Technological University, Singapore

Morer-Camo, Maria Paz, University of Navarra, Spain

Morosi, Federico, Politecnico di Milano, Italy

Mörtl, Markus, Technical University of Munich, Germany

Motte, Damien, Lund University, Sweden

Munjulury, Raghu Chaitanya, Linköping University, Sweden

Murakami, Tamotsu, University of Tokyo, Japan

Muschik, Sabine, ISEM Institute for Smart Engineering and Machine Elements, Germany

Nanjappan, Vijayakumar, University College Cork, Ireland

Ndiaye, Yakhoub, Université Cheikh Anta Diop, Senegal

Neramballi, Abhijna, Linköping University, Sweden

Nespoli, Oscar, University of Waterloo, Canada

Nielsen, Brita Fladvad, Norwegian University of Science and Technology, Norway

Nishino, Suzuki, National Institute of Advanced Industrial Science and Technology, Japan

Nordin, Axel, Lund University, Sweden

Novoa Munoz, Mauricio, Western Sydney University, Australia

O'Reilly, Ciarán J, KTH Royal Institute of Technology, Sweden

Obilanade, Didunoluwa, Luleå University of Technology, Sweden

Oehmen, Josef, Technical University of Denmark, Denmark

Oh, David C., North Carolina State University, United States of America

Olsen, Anna, Norwegian University of Science and Technology, Norway

Onkar, Prasad, Indian Institute of Technology Hyderabad, India

Otsuka, Akimasa, Sanyo-Onoda City University, Japan

Otto, Kevin, The University of Melbourne, Australia

Paetzold-Byhain, Kristin, Technische Universität Dresden, Germany

Panarotto, Massimo, Politecnico di Milano, Italy

Panesar, Ajit, Imperial College London, United Kingdom

Pannunzio, Valeria, Delft University of Technology, The Netherlands

Papalambros, Panos Y., University of Michigan, United States of America

Park, Hyunym, The Hong Kong Polytechnic University, Hong Kong

Parolin, Giacomo, Technical University of Denmark, Denmark

Pauwels, Pieter, Eindhoven University of Technology, The Netherlands



- Pavković, Neven, *University of Zagreb FSB, Croatia*
 Pedersen, Signe, *Aalborg University, Denmark*
 Pereira Pessoa, Marcus Vinicius, *University of Twente, The Netherlands*
 Perry, Nicolas, *Arts et Métiers, France*
 Petiot, Jean-François, *École Centrale de Nantes, France*
 Phadnis, Vrushank, *Google, United States of America*
 Phillips, Robert, *Royal College of Art, United Kingdom*
 Pigosso, Daniela C. A., *Technical University of Denmark, Denmark*
 Pinquière, Romain, *University Grenoble Alpes, France*
 Plaumann, Benedikt, *University of Applied Sciences Hamburg, Germany*
 Prabhu, Rohan, *Lafayette College, United States of America*
 Pradel, Patrick, *Loughborough University, United Kingdom*
 Prakash, Raghu Vasu, *Indian Institute of Technology Madras, India*
 Pulm, Udo, *Hamburg University of Applied Sciences, Germany*
 Purwaningrum, Lu'lu', *Universitas Sebelas Maret, Indonesia*
 Quattelbaum, Bastian, *Hochschule Niederrhein University of Applied Sciences, Germany*
 Ranscombe, Charlie, *Swinburne University of Technology, Australia*
 Raudberget, Dag, *Jönköping University, Sweden*
 Rio, Maud, *University Grenoble Alpes, France*
 Ritzer, Katharina, *Hamburg University of Technology, Germany*
 Robin, Vincent, *University of Bordeaux, France*
 Rosnitschek, Tobias, *University of Bayreuth, Germany*
 Rossi, Monica, *Politecnico di Milano, Italy*
 Roth, Daniel, *University of Stuttgart, Germany*
 Roth, Martin, *Chalmers University of Technology, Sweden*
 Rotini, Federico, *University of Florence, Italy*
 Royo, Marta, *Universitat Jaume I, Spain*
 Ruiz-Pastor, Laura, *Universitat Jaume I, Spain*
 S. Watz, Matilda, *Blekinge Tekniska Högskola, Sweden*
 Sadeghi Tabar, Roham, *Chalmers University of Technology, Sweden*
 Sakao, Tomohiko, *Linköping University, Sweden*
 Salustri, Filippo, *Ryerson University, Canada*
 Sassanelli, Claudio, *Politecnico di Bari, Italy*
 Schabacker, Michael, *Otto von Guericke University Magdeburg, Germany*
 Schleich, Benjamin, *TU Darmstadt, Germany*
 Schulte, Jesko, *Blekinge Institute of Technology, Sweden*
 Schulze, Sven-Olaf, *INCOSE, Germany*
 Seering, Warren, *Massachusetts Institute of Technology, United States of America*
 Seibel, Arthur, *Leuphana University Lüneburg, Germany*
 Self, James, *UNIST, South Korea*
 Sen, Dibakar, *Indian Institute of Science Bangalore, India*
 Şener-Pedgley, Bahar, *Middle East Technical University, Turkey*
 Shafiee, Sara, *Technical University of Denmark, Denmark*
 Shea, Kristina, *ETH Zurich, Switzerland*
 Sikhwal, Ravi K, *Royal College of Art, United Kingdom*
 Silva, Arlindo, *Singapore University of Technology and Design, Singapore*
 Singh, Ravindra, *Delhi Technological University, India*
 Singh, Vishal, *Indian Institute of Science Bangalore, India*
 Škec, Marija Majda, *University of Zagreb FSB, Croatia*
 Škec, Stanko, *University of Zagreb FSB, Croatia*
 Smojver, Ivica, *University of Zagreb FSB, Croatia*
 Snider, Chris, *University of Bristol, United Kingdom*
 Sommer, Anita Friis, *Aarhus University, Denmark*
 Sosa, Ricardo, *The University of Sydney, Australia*
 Stal-Le Cardinal, Julie, *CentraleSupélec, France*
 Stanković, Tino, *ETH Zurich, Switzerland*
 Stark, Rainer G., *TU Berlin, Germany*
 Stechert, Carsten, *Ostfalia University of Applied Sciences, Germany*
 Steinert, Martin, *Norwegian University of Science and Technology, Norway*
 Stetter, Ralf, *University of Applied Sciences Ravensburg-Weingarten, Germany*
 Stevanović, Milan, *Markot.tel d.o.o., Croatia*
 Stilwell, George, *University of Canterbury, New Zealand*
 Stolt, Roland, *Jönköping University, Sweden*
 Štorga, Mario, *University of Zagreb FSB, Croatia*
 Styliadis, Kostas, *Chalmers University of Technology, Sweden*
 Sundin, Erik, *Linköping University, Sweden*
 Tahera, Khadija, *The Open University, United Kingdom*
 Tan, James Ah Kat, *independent researcher, Singapore*
 Tan, Linus, *Swinburne University of Technology, Australia*
 Taoka, Yuki, *Institute of Science Tokyo, Japan*
 Tavčar, Jože, *Lund University, Sweden*
 Thoben, Klaus, *Universität Bremen / BIBA, Germany*
 Thoring, Katja, *Technical University of Munich, Germany*
 Tingström, Johan, *Saab AB, Sweden*
 Tiradentes Souto, Virginia, *University of Brasilia, Brazil*
 Todeti, Somasekhara Rao, *National Institute of Technology Karnataka, Surathkal, India*
 Tomiyama, Tetsuo, *International Professional University of Technology in Tokyo, Japan*
 Törlind, Peter, *Luleå University of Technology, Sweden*
 Trauer, Jakob, *:em engineering methods AG, Germany*
 Tsutsui, Yusuke, *Okayama Prefectural University, Japan*
 Tufail, Muhammad, *The Hong Kong Polytechnic University, Hong Kong*
 Tyl, Benjamin, *APESA, France*
 Umeda, Yasushi, *The University of Tokyo, Japan*
 Ura, Sharifu, *Kitami Institute of Technology, Japan*
 Urquhart, Lewis William Robert, *University of Strathclyde, United Kingdom*
 Vaidya, Gaurav, *Indian Institute of Technology Jodhpur, India*
 Valderrama Pineda, Andres Felipe, *Aalborg University, Denmark*
 Valjak, Filip, *University of Zagreb FA, Croatia*



Vallet, Flore, *Université de Technologie de Compiègne, France*

Van der Loos, Mike, *UBC, Canada*

van der Vegte, Wilhelm Frederik, *Delft University of Technology, The Netherlands*

Vaneker, Tom Henricus Jozef, *Universiteit Twente, The Netherlands*

Varadarajan, Sudhir, *Indian Institute of Information Technology, Design and Manufacturing Kancheepuram, India*

Vasantha, Gokula, *Edinburgh Napier University, United Kingdom*

Venkataraman, Srinivasan, *Indian Institute of Technology Delhi, India*

Vieira, Sonia Liliana da Silva, *Alasala, Saudi Arabia*

Vietor, Thomas, *Technische Universität Braunschweig, Germany*

Voelkl, Harald, *Siemens AG, Germany*

Vrdoljak, Milan, *University of Zagreb FSB, Croatia*

Vukašinović, Nikola, *University of Ljubljana, Faculty of Mechanical Engineering, Slovenia*

Vuletic, Tijana, *University of Glasgow, United Kingdom*

Wall, Johan, *Blekinge Institute of Technology, Sweden*

Wang, Yan, *Georgia Institute of Technology, United States of America*

Wartzack, Sandro J., *Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

Watts, Regan, *University of Antwerp, Belgium*

Wenggren, Johan, *Luleå University of Technology, Sweden*

Wever, Renee, *Linköping University, Sweden*

Whitfield, Robert Ian, *University of Strathclyde, United Kingdom*

Wilding, William, *Swinburne University of Technology, Australia*

Wodehouse, Andrew, *University of Strathclyde, United Kingdom*

Wurst-Köster, Johanna, *Leibniz Universität Hannover, Germany*

Yanagisawa, Hideyoshi, *The University of Tokyo, Japan*

Yannou, Bernard, *CentraleSupélec, France*

Yannou-Le Bris, Gwenola, *UMR sayfood, France*

Yildirim, Unal, *University of Leicester, United Kingdom*

Yin, Yuan, *Imperial College London, United Kingdom*

Yip, Man Hang, *University of Cambridge, United Kingdom*

Zainal Abidin, Shahrman, *Universiti Teknologi MARA, Malaysia*

Zancul, Eduardo, *Universidade de São Paulo, Brazil*

Žeželj, Dragan, *University of Zagreb FSB, Croatia*

Zhang, Wendy, *University of Canterbury, New Zealand*

Zhao, Yaoyao Fiona, *McGill University, Canada*

Ziegler, Martin, *Helbling Technik Bern AG, Switzerland*

Zimmermann, Markus, *Technical University of Munich, Germany*

Zorn, Stefan, *University of Rostock, Germany*



SUPPORTED BY



DESIGN2026

SPONSORED BY





DESIGN
2026

excellence in design



The 19th International Design Conference, DESIGN 2026, takes place from May 18 to 21, 2026, in Cavtat–Dubrovnik, Croatia. Organised by the University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, endorsed by The Design Society, and held under the auspices of the President of the Republic of Croatia, the conference continues a tradition established in 1981 of advancing the science and practice of engineering design.

DESIGN 2026 reflects both continuity and evolution within the field. While maintaining its role as a leading forum for rigorous research in engineering design, this edition demonstrates a notable shift in the presence and influence of artificial intelligence. AI is not only visible as a topic and keyword across contributions, but increasingly embedded in the way research is conducted, methods are developed, and design activities are supported. This signals a broader transformation of the discipline, one that challenges established paradigms while opening new avenues for creativity, analysis, and decision-making in complex socio-technical systems.

The conference received over 520 submissions, out of which 334 papers were accepted for inclusion in the proceedings and programme. The review process involved 1,377 individual reviews, with an exceptional completion rate of approximately 92%, reflecting the strong commitment of the community. DESIGN 2026 is expected to gather around 450 participants from across the globe, continuing its role as a truly international meeting point for researchers and practitioners.

The programme features a rich combination of keynote lectures, paper presentations, workshops, and the traditional DESIGN Debate as a signature element of the conference. We are honoured to host keynote speakers Faez Ahmed, Hua Dong, and Darren Henry, who bring perspectives spanning academia, industry, and interdisciplinary work at the intersection of design and emerging technologies. Together with the interactive workshop sessions, the programme aims to foster exchange across disciplines and between research and practice.

We express our sincere gratitude to all active reviewers for their dedication and professionalism in ensuring the quality of the conference. We also thank our sponsors and partners for their continued support, with special recognition of Onshape/PTC as the leading sponsor.

Looking ahead, DESIGN 2026 is situated within a broader reflection on the future of the field, aligned with the ambitions of The Design Society Vision 2040. Engineering design is increasingly called upon to address complex global challenges, ranging from sustainability and resilience to digital transformation and human well-being. In this context, the role of design extends beyond artefact creation towards shaping systems, experiences, and societal transitions. The contributions presented in this conference illustrate both the depth of current research and the emerging directions that will define the discipline in the decades to come.

We hope that DESIGN 2026 will inspire new ideas, collaborations, and perspectives, and continue to strengthen the global engineering design community.

DESIGN 2026 Conference Chairs:

Mario Štorga

Stanko Škec



DESIGN
2026

excellence in design



CONFERENCE VENUE

The conference will take place at the [Hotel Croatia Cavtat](#).

REGISTRATION DESK WORKING HOURS

SUNDAY, 17 MAY	18:00 – 20:00
MONDAY, 18 MAY – THURSDAY, 21 MAY	08:00 – 18:00

SPECIAL EVENTS

MONDAY, 18 MAY	09:00 – 17:30 14:00 – 17:30	CONFERENCE WORKSHOPS PHD FORUM
TUESDAY, 19 MAY	16:30 – 18:00	MEETINGS ORGANISED BY DIFFERENT INTEREST GROUPS
WEDNESDAY, 20 MAY	14:00 – 15:15	DESIGN DEBATE

OPENING SESSION

MONDAY, 18 MAY	17:45 – 18:15	Congress Hall Ragusa A WORD BEFORE Mario Štorga – Conference Chair (University of Zagreb FSB) UNIVERSITY OF ZAGREB FSB WELCOME ADDRESS Igor Karšaj – Vice Dean (University of Zagreb FSB) THE DESIGN SOCIETY WELCOME ADDRESS Kristin Paetzold-Byhain – President of the Design Society (Technical University Dresden)
----------------	---------------	--

CLOSING SESSION AND AWARDS

THURSDAY, 21 MAY	17:45 – 18:30	Congress Hall Ragusa A WORD FROM THE DESIGN SOCIETY Anja Maier – Vice President & Treasurer of the Design Society (University of Strathclyde) DESIGN SCIENCE JOURNAL DISTINGUISHED PAPER AWARDS Anja Maier – Editor-in-Chief of the Design Science Journal (University of Strathclyde) CONFERENCE REFLECTION Tim C. McAloone – Programme Chair (Technical University of Denmark)
------------------	---------------	---

REFRESHMENTS AND LUNCHES

Refreshments and lunches will be served at [Hotel Croatia Cavtat](#) from 18 to 21 May.

SOCIAL EVENTS

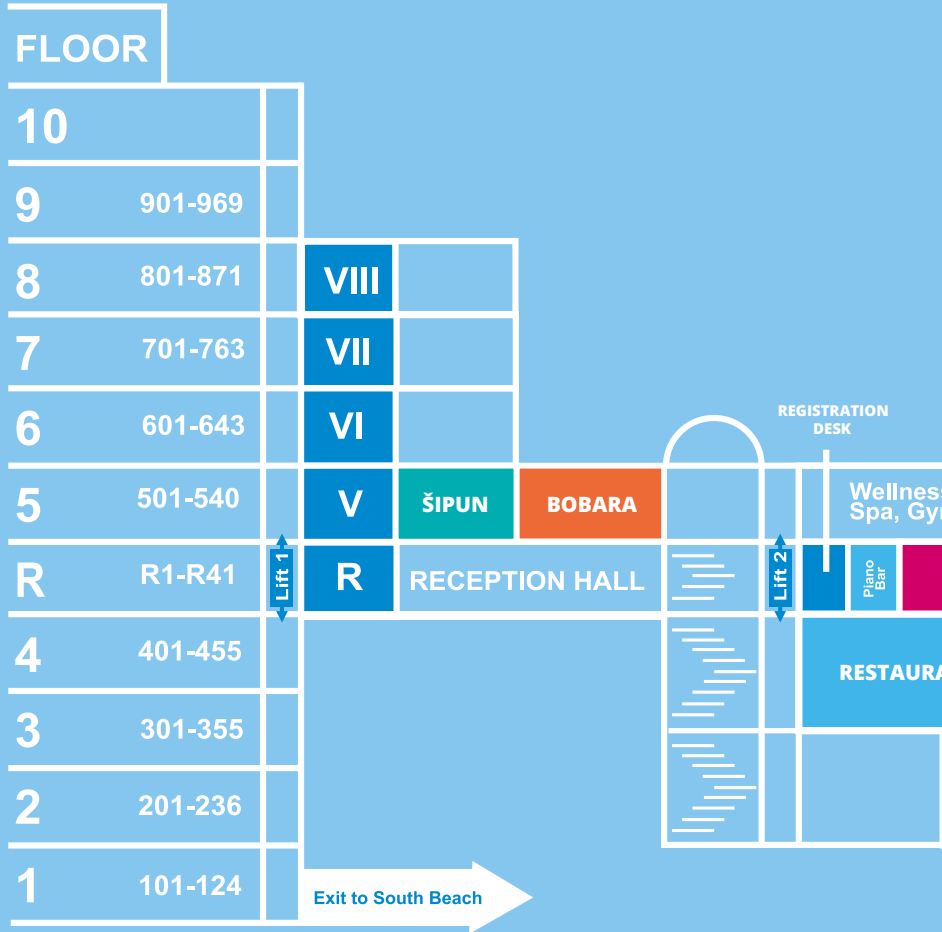
MONDAY, 18 MAY	19:00 – 20:00	WELCOME COCKTAIL – Hotel Croatia Cavtat
WEDNESDAY, 20 MAY	20:00 – 22:00	CONFERENCE DINNER – Hotel Croatia Cavtat
THURSDAY, 21 MAY	20:00 – 22:00	FAREWELL PARTY – Spinaker Beachfront Restaurant, Hotel Croatia Cavtat

GUEST PROGRAMME

Information, schedule, and reservations about excursions are available at the desk. Accompanying guests are very welcome to attend.

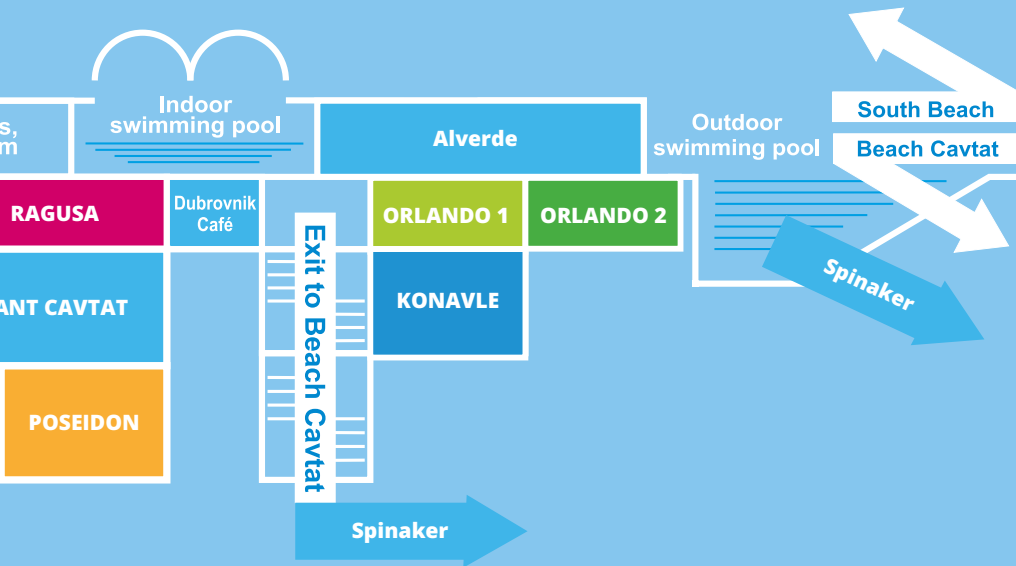


HOTEL CROATIA CAVTAT MAP




 CONFERENCE FACILITIES

RESTAURANTS & BARS





	MONDAY, 18 MAY 2026	TUESDAY, 19 MAY 2026
8:00	REGISTRATION	REGISTRATION
8:15		
8:30		
8:45		
9:00		
9:15		
9:30		
9:45		
10:00		
10:15		
10:30		
10:45		
11:00		
11:15		
11:30		
11:45		
12:00		
12:15		
12:30		
12:45		
13:00		
13:15		
13:30		
13:45		
14:00		
14:15		
14:30		
14:45		
15:00		
15:15		
15:30		
15:45		
16:00		
16:15		
16:30		
16:45		
17:00		
17:15		
17:30		
17:45		
18:00		
18:15		
18:30		
18:45		
19:00		
19:15		
19:30		
19:45		
20:00		
20:15		
20:30		
20:45		
21:00		

	MONDAY, 18 MAY 2026
8:00	REGISTRATION
8:15	
8:30	
8:45	
9:00	
9:15	
9:30	
9:45	
10:00	
10:15	
10:30	
10:45	
11:00	
11:15	
11:30	
11:45	
12:00	
12:15	
12:30	
12:45	
13:00	
13:15	
13:30	
13:45	
14:00	
14:15	
14:30	
14:45	
15:00	
15:15	
15:30	
15:45	
16:00	
16:15	
16:30	
16:45	
17:00	
17:15	
17:30	
17:45	
18:00	
18:15	
18:30	
18:45	
19:00	
19:15	
19:30	
19:45	
20:00	
20:15	
20:30	
20:45	
21:00	

	TUESDAY, 19 MAY 2026
8:00	REGISTRATION
8:15	
8:30	
8:45	
9:00	
9:15	
9:30	
9:45	
10:00	
10:15	
10:30	
10:45	
11:00	
11:15	
11:30	
11:45	
12:00	
12:15	
12:30	
12:45	
13:00	
13:15	
13:30	
13:45	
14:00	
14:15	
14:30	
14:45	
15:00	
15:15	
15:30	
15:45	
16:00	
16:15	
16:30	
16:45	
17:00	
17:15	
17:30	
17:45	
18:00	
18:15	
18:30	
18:45	
19:00	
19:15	
19:30	
19:45	
20:00	
20:15	
20:30	
20:45	
21:00	

WEDNESDAY, 20 MAY 2026						THURSDAY, 21 MAY 2026						
REGISTRATION						REGISTRATION						8:00
REGISTRATION						REGISTRATION						8:15
REGISTRATION						REGISTRATION						8:30
REGISTRATION						REGISTRATION						8:45
D311	D312	D313	D314	D315	D316	D411	D412	D413	D414	D415	D416	9:00
REGISTRATION						REGISTRATION						9:15
REGISTRATION						REGISTRATION						9:30
REGISTRATION						REGISTRATION						9:45
REFRESHMENT BREAK						REFRESHMENT BREAK						10:00
REFRESHMENT BREAK						REFRESHMENT BREAK						10:15
D321	D322	D323	D324	D325	D326	D421	D422	D423	D424	D425	D426	10:30
REFRESHMENT BREAK						REFRESHMENT BREAK						10:45
REFRESHMENT BREAK						REFRESHMENT BREAK						11:00
REFRESHMENT BREAK						REFRESHMENT BREAK						11:15
TRANSITION BREAK						TRANSITION BREAK						11:30
D331	D332	D333	D334	D335	D336	D431	D432	D433	D434	D435	D436	11:45
TRANSITION BREAK						TRANSITION BREAK						12:00
TRANSITION BREAK						TRANSITION BREAK						12:15
TRANSITION BREAK						TRANSITION BREAK						12:30
LUNCH						LUNCH						12:45
LUNCH						LUNCH						13:00
LUNCH						LUNCH						13:15
LUNCH						LUNCH						13:30
LUNCH						LUNCH						13:45
LUNCH						LUNCH						14:00
D3-DD						D4-P						14:15
D3-DD						D4-P						14:30
D3-DD						D4-P						14:45
REFRESHMENT BREAK						REFRESHMENT BREAK						15:00
REFRESHMENT BREAK						REFRESHMENT BREAK						15:15
D341	D342	D343	D344	D345	D346	D441	D442	D443	D444	D445	D446	15:30
REFRESHMENT BREAK						REFRESHMENT BREAK						15:45
REFRESHMENT BREAK						REFRESHMENT BREAK						16:00
REFRESHMENT BREAK						REFRESHMENT BREAK						16:15
TRANSITION BREAK						TRANSITION BREAK						16:30
D351	D352	D353	D354	D355	D356	D451	D452	D453	D454	D455	D456	16:45
TRANSITION BREAK						TRANSITION BREAK						17:00
TRANSITION BREAK						TRANSITION BREAK						17:15
TRANSITION BREAK						TRANSITION BREAK						17:30
TRANSITION BREAK						TRANSITION BREAK						17:45
TRANSITION BREAK						CLOSING AND AWARDS						18:00
TRANSITION BREAK						CLOSING AND AWARDS						18:15
TRANSITION BREAK						CLOSING AND AWARDS						18:30
TRANSITION BREAK						CLOSING AND AWARDS						18:45
TRANSITION BREAK						CLOSING AND AWARDS						19:00
TRANSITION BREAK						CLOSING AND AWARDS						19:15
TRANSITION BREAK						CLOSING AND AWARDS						19:30
TRANSITION BREAK						CLOSING AND AWARDS						19:45
CONFERENCE DINNER						FAREWELL PARTY						20:00
CONFERENCE DINNER						FAREWELL PARTY						20:15
CONFERENCE DINNER						FAREWELL PARTY						20:30
CONFERENCE DINNER						FAREWELL PARTY						20:45
CONFERENCE DINNER						FAREWELL PARTY						21:00



MONDAY, 18 MAY 2026

REGISTRATION

D111: WORKSHOP 1: MAPPING VALIDITY IN DESIGN RESEARCH	D112: WORKSHOP 2: MEDITATIVE REFLECTIVE INTERVENTIONS FOSTERING CREATIVE ABILITY	D113: WORKSHOP 3: DESIGNING RESILIENT CARE PATHWAYS: A HEALTH SYSTEMS DESIGN PERSPECTIVE
---	--	--

LUNCH - RESTAURANT CAVTAT

D131: PHD FORUM	D132: WORKSHOP 6: TWO DECADES OF SUSTAINABLE DESIGN: WHERE ARE WE HEADING AND HOW DO WE GET THERE?	D133: WORKSHOP 7: MIND THE BIAS 2.0: (UN)BIASING THE DESIGNER IN THE AGE OF AI
-----------------	--	--

D1-O: OPENING

D1-P: PLENARY SESSION 1 – BALANCING BREAKTHROUGH INNOVATION AND OPERATIONAL EXCELLENCE WITH CLOUD-NATIVE ENGINEERING TOOLS WELCOME COCKTAIL

TUESDAY, 19 MAY 2026

D211: BEHAVIOURAL ASPECTS OF SUSTAINABLE DESIGN SYSTEMS	D212: MODULAR PRODUCT STRATEGIES AND CONFIGURATION APPROACHES	D213: COLLABORATIVE DESIGN IN DIGITAL ENVIRONMENT
---	---	---

REFRESHMENT BREAK

D221: UNDERSTANDING AND PREVENTING REBOUND EFFECTS IN DESIGN	D222: PRODUCT ARCHITECTURE AND SUSTAINABILITY	D223: CO-DESIGN AND CO-CREATION IN DIVERSE DESIGN CONTEXTS
--	---	--

D231: ORGANISATIONAL AND PROCESS INTEGRATION IN DESIGN FOR SUSTAINABILITY	D232: DIGITAL TWINS IN PRODUCT DEVELOPMENT	D233: STRATEGIC APPROACHES TO INNOVATION AND PRODUCT DEVELOPMENT
---	--	--

LUNCH - RESTAURANT CAVTAT

D2-P: PLENARY SESSION 2 – FROM DATA TO DESIGN: RETHINKING ENGINEERING DESIGN WITH NEXT-GEN AI

REFRESHMENT BREAK

D241: DESIGN FOR WELLBEING, INCLUSIVITY AND SOCIETAL IMPACT	D242: DATA-DRIVEN FRAMEWORKS FOR DESIGN SUPPORT	D243: DECISION SUPPORT IN COMPLEX DESIGN CONTEXTS
---	---	---

D252: MEETING 1: HOW MODERN DESIGN WORKFLOWS ARE CHANGING WITH CLOUD-NATIVE CAD

D253: MEETING 2: AI AND PUBLISHING SCIENTIFIC PAPERS: A DISCUSSION WITH DESIGN JOURNAL EDITORS
--

WEDNESDAY, 20 MAY 2026

D311: CONCEPTS, FRAMEWORKS AND PRACTICES IN CIRCULAR DESIGN	D312: AI INTEGRATION AND PRACTICE IN DESIGN	D313: VISUALISING, COMMUNICATING AND NAVIGATING COMPLEX DESIGN SYSTEMS
---	---	--

REFRESHMENT BREAK

D321: DESIGN FOR CIRCULARITY AND REMANUFACTURING	D322: ADOPTION OF GENERATIVE AI IN ENGINEERING DESIGN CHALLENGES AND PRACTICES	D323: ADVANCING PROTOTYPING METHODS AND PRACTICES
--	--	---

D331: SUSTAINABILITY METHODS, METRICS AND DECISION SUPPORT	D332: AI-AUGMENTED REQUIREMENTS ENGINEERING	D333: PROTOTYPING FOR DESIGN EXPLORATION AND DEVELOPMENT
--	---	--

LUNCH - RESTAURANT CAVTAT

D3-DD: DESIGN DEBATE (6TH EDITION)

REFRESHMENT BREAK

D341: METHODS AND TOOLS FOR PRODUCT CIRCULARITY ASSESSMENT	D342: LLM-SUPPORTED USER RESEARCH	D343: DESIGN RESEARCH METHODS AND COMPLEXITY METRICS
--	-----------------------------------	--

D351: INTEGRATING LCA INTO DESIGN	D352: AI-ASSISTED EVALUATION AND ESTIMATION IN ENGINEERING DESIGN	D353: EXPLORATORY AND SPECULATIVE APPROACHES IN DESIGN
-----------------------------------	---	--

CONFERENCE DINNER

THURSDAY, 21 MAY 2026

D411: DESIGN STRATEGIES FOR SUSTAINABILITY TRANSITIONS	D412: LLM-ENABLED DESIGN METHODS AND ENGINEERING PROCESSES	D413: INCLUSIVE AND WELLBEING-DRIVEN DESIGN FOR HEALTHCARE
--	--	--

REFRESHMENT BREAK

D421: METHODS FOR CIRCULAR AND SUSTAINABLE DESIGN	D422: GENERATIVE AI FOR DESIGN SYNTHESIS AND ENGINEERING APPLICATIONS	D423: HUMAN-AI INTERACTION AND COMMUNICATION IN ENGINEERING DESIGN
---	---	--

D431: CIRCULAR DESIGN FRAMEWORKS, TOOLS AND LONGEVITY STRATEGIES	D432: AI-DRIVEN KNOWLEDGE AND DECISION SUPPORT IN PRODUCT DEVELOPMENT	D433: HUMAN-CENTRED ASPECTS OF AI
--	---	-----------------------------------

LUNCH - RESTAURANT CAVTAT

D4-P: PLENARY SESSION 3 – INCLUSIVE DESIGN: WHO TO INCLUDE?

REFRESHMENT BREAK

D441: AI METHODS FOR SUSTAINABLE DESIGN AND CIRCULARITY	D442: MACHINE LEARNING FOR GENERATIVE DESIGN AND DESIGN SPACE EXPLORATION	D443: DESIGN METHODS AND PROCESSES IN PRACTICE
---	---	--

D451: DESIGN FOR SUSTAINABILITY APPLICATIONS	D452: AI METHODS FOR GEOMETRIC MODELS AND DESIGN DATA	D453: ANALYTICAL CONSIDERATIONS IN ENGINEERING DESIGN
--	---	---

D4-C: CLOSING SESSION

FAREWELL PARTY

MONDAY, 18 MAY 2026

D114: WORKSHOP 4: DESIGNING WITH INTELLIGENCE: EXPLORING THE PRACTICAL IMPLICATIONS OF AI ON DESIGN PRACTICE AND PROCESSES

D115: WORKSHOP 5: DESIGNING BETTER PROJECT-BASED DESIGN ASSESSMENT USING THE D-LAD FRAMEWORK

D134: WORKSHOP 8: THE DATA QUALITY PLAYBOOK FOR ENGINEERING DESIGN

D135: WORKSHOP 9: NUDGE WORKSHOP: SMALL NUDGES, BIG IMPACT

TUESDAY, 19 MAY 2026

D214: UNDERSTANDING DESIGN THINKING AND CREATIVITY

D215: FUNCTIONAL INTEGRATION IN ADDITIVE MANUFACTURING

D216: INNOVATIONS IN ENGINEERING DESIGN EDUCATION AND LEARNING

D224: HUMAN-AI CO-CREATION IN DESIGN PRACTICE

D225: PROCESS UNDERSTANDING AND CONTROL IN ADDITIVE MANUFACTURING

D226: APPROACHES TO ENGINEERING DESIGN EDUCATION AND TRAINING

D234: FRAMING PROCESSES IN DESIGN

D235: VALIDATION AND PERFORMANCE IN ADDITIVE MANUFACTURING

D236: AI-ENHANCED LEARNING IN DESIGN EDUCATION

D244: DESIGN COGNITION STUDIES

D245: METHODS AND TOOLS FOR DESIGN FOR ADDITIVE MANUFACTURING

D246: ADVANCED VISUALISATION AND IMMERSIVE TECHNOLOGIES IN DESIGN

D254: MEETING 3: DS MENTORING PROGRAM MEETING

D255: MEETING 4: DS DFAM SIG COMMUNITY MEETING

D256: MEETING 5: PHYSICAL SPACES IN THE DIGITAL ERA: BUILDING LIVING LABS FOR AI-ENABLED SUSTAINABLE DESIGN

WEDNESDAY, 20 MAY 2026

D314: KNOWLEDGE AND ORGANISATIONAL SYSTEMS IN ENGINEERING DESIGN

D315: DESIGN FOR HEALTHCARE SYSTEMS AND SERVICES

D316: EXPLORING GEOMETRY FOR ADDITIVE MANUFACTURING

D324: AI-DRIVEN KNOWLEDGE DISCOVERY FROM ENGINEERING DOCUMENTS

D325: DESIGN FOR SUSTAINABLE AND CIRCULAR HEALTHCARE

D326: AI-DRIVEN DESIGN AND PERFORMANCE ANALYSIS IN ADDITIVE MANUFACTURING

D334: DESIGN KNOWLEDGE REPRESENTATION AND USE

D335: DESIGNING HEALTHCARE SYSTEMS AND SERVICES

D336: DATA-DRIVEN AND MULTI-MATERIAL DESIGN IN ADVANCED DFAM

D344: STRUCTURAL COMPLEXITY AND INTERFACE MANAGEMENT

D345: INTEGRATING USER INSIGHTS IN DESIGN

D346: ENGINEERING APPLICATIONS IN ADDITIVE MANUFACTURING

D354: RESILIENCE AND COMPLEXITY IN ENGINEERING SYSTEMS

D355: EMOTIONAL, COGNITIVE AND SENSORY ASPECTS OF USER EXPERIENCE IN DESIGN

D356: SIMULATION-DRIVEN DESIGN OF ENGINEERING SYSTEMS

THURSDAY, 21 MAY 2026

D414: KNOWLEDGE INTEGRATION AND METHODS IN MODEL-BASED SYSTEMS ENGINEERING

D415: UNDERSTANDING INTERACTION AND USER DYNAMICS IN SERVICE DESIGN

D416: DESIGN METHODS AND PEDAGOGY

D424: MODEL-BASED SYSTEMS ENGINEERING FOR ENVIRONMENTAL IMPACT INTEGRATION

D425: USER AND CONSUMER PERCEPTION IN PRODUCT DESIGN AND USE

D426: LEARNING ENVIRONMENTS AND APPROACHES IN ENGINEERING DESIGN EDUCATION

D434: MODEL-BASED DESIGN AND SIMULATION FOR RESOURCE-EFFICIENT SYSTEMS

D435: BEHAVIOURAL DESIGN METHODS AND APPLICATIONS

D436: HUMAN FACTORS IN DESIGN EDUCATION

D444: DESIGNING FUTURE MOBILITY SYSTEMS

D445: ORGANISATIONAL AND VALUE MANAGEMENT IN COMPLEX DESIGN SYSTEMS

D446: TEAM DYNAMICS AND AGILE PRACTICES IN PRODUCT DEVELOPMENT

D454: AUTOMATION APPROACHES IN DESIGN

D455: DESIGN THINKING AND CREATIVE APPROACHES FOR FUTURES

D456: MODELLING AND EXPLORING INTERACTIONS IN DESIGN



08:00

REGISTRATION

09:00

D111

WORKSHOP 1: MAPPING VALIDITY IN DESIGN RESEARCH

Congress Hall Poseidon

Chairs:

Philip Cash, Northumbria University, United Kingdom
Katja Thoring, Technical University of Munich, Germany
Roland M. Mueller, Berlin School of Economics and Law, Germany

Romain Pingué, Univ. Grenoble Alpes, CNRS, Grenoble INP, G-SCOP, France

Kai Larsen, University of Colorado, United States of America

HOSTED BY THE DS RESEARCH QUALITY SIG

D112

WORKSHOP 2: MEDITATIVE REFLECTIVE INTERVENTIONS FOSTERING CREATIVE ABILITY

Congress Hall Bobara

Chairs:

Björn R. Kokoschko, Otto von Guericke University Magdeburg, Germany

Maria Uhari-Pakkalin, Aalto University, Finland

Akane Matsumae, Kyushu University, Japan

HOSTED BY THE DS DESIGN CREATIVITY SIG

12:30

LUNCH – RESTAURANT CAVTAT

14:00

D131

PHD FORUM

Congress Hall Poseidon

Chair:

Massimo Panarotto, Politecnico di Milano, Italy

D132

WORKSHOP 6: TWO DECADES OF SUSTAINABLE DESIGN: WHERE ARE WE HEADING AND HOW DO WE GET THERE?

Congress Hall Bobara

Chairs:

Sophie I. Hallstedt, Chalmers University of Technology, Sweden

Els Du Bois, University of Antwerp, Belgium

Gilliam Dokter, Chalmers University of Technology, Sweden

HOSTED BY THE DS SUSTAINABLE DESIGN SIG

17:30

TRANSITION BREAK

17:45

D1-O: OPENING

Congress Hall Ragusa

Chair: **Mario Štorga**, University of Zagreb FSB, Croatia

18:15

D1-P: PLENARY SESSION 1

Congress Hall Ragusa

Chair: **Sandro J. Wartzack**, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

19:00

WELCOME COCKTAIL

20:00

08:00

09:00

D113

WORKSHOP 3: DESIGNING RESILIENT CARE PATHWAYS: A HEALTH SYSTEMS DESIGN PERSPECTIVE

Congress Hall Orlando 1

Chairs:

Valeria Pannunzio, TU Delft, The Netherlands

P. John Clarkson, University of Cambridge, United Kingdom

Anja Maier, University of Strathclyde, United Kingdom

Maaike Kleinsmann, TU Delft, The Netherlands

HOSTED BY THE DS HEALTH SYSTEMS DESIGN SIG

D114

WORKSHOP 4: DESIGNING WITH INTELLIGENCE: EXPLORING THE PRACTICAL IMPLICATIONS OF AI ON DESIGN PRACTICE AND PROCESSES

Congress Hall Orlando 2

Chairs:

Claudia Eckert, The Open University, United Kingdom

Kilian Gericke, University of Rostock, Germany

Sabine Muschik, ISEM Institute for Smart Engineering and Machine Elements, Germany

Ola Isaksson, Chalmers University of Technology, Sweden

Filippo Chiarello, Università di Pisa, Italy

HOSTED BY THE DS DESIGN PROCESS SIG, DESIGN PRACTICE SIG AND AI IN DESIGN SIG

D115

WORKSHOP 5: DESIGNING BETTER PROJECT-BASED DESIGN ASSESSMENT USING THE D-LAD FRAMEWORK

Congress Hall Konavle

Chairs:

Gordon Krauss, Harvey Mudd College, United States of America

Ross Brisco, University of Strathclyde, United Kingdom

Francesca Mattioli, Politecnico di Milano, Italy

Yakhoub Ndiaye, Université Cheikh Anta Diop, Senegal

HOSTED BY THE DS DESIGN EDUCATION SIG

12:30

14:00

D133

WORKSHOP 7: MIND THE BIAS 2.0: (UN)BIASING THE DESIGNER IN THE AGE OF AI

Congress Hall Orlando 1

Chairs:

Niccolo Becattini, Politecnico di Milano, Italy

Filippo Chiarello, Università di Pisa, Italy

Samuele Colombo, University of Strathclyde, United Kingdom

HOSTED BY THE DS COGNITIVE DESIGN SCIENCE SIG

D134

WORKSHOP 8: THE DATA QUALITY PLAYBOOK FOR ENGINEERING DESIGN

Congress Hall Orlando 2

Chairs:

Kostas Styliadis, Chalmers University of Technology, Sweden

Bastian Quattelbaum, Hochschule Niederrhein University of Applied Sciences, Germany

HOSTED BY THE DS DATA-INFORMED SIG

D135

WORKSHOP 9: NUDGE WORKSHOP: SMALL NUDGES, BIG IMPACT

Congress Hall Konavle

Chairs:

Nikola Bursac, Hamburg University of Technology, Germany

Sabine Muschik, ISEM Institute for Smart Engineering and Machine Elements, Germany

HOSTED BY THE DS HUMAN BEHAVIOUR IN DESIGN SIG AND DESIGN PRACTICE SIG

17:30

17:45

A WORD BEFORE – Mario Štorga – Conference Chair (University of Zagreb FSB)

UNIVERSITY OF ZAGREB FSB WELCOME ADDRESS – Igor Karšaj – Vice Dean (University of Zagreb FSB)

THE DESIGN SOCIETY WELCOME ADDRESS – Kristin Paetzold-Byhain – President of the Design Society (Technical University Dresden)

18:15

BALANCING BREAKTHROUGH INNOVATION AND OPERATIONAL EXCELLENCE WITH CLOUD-NATIVE ENGINEERING TOOLS

Darren Henry, Senior Vice President of General Operations at PTC

19:00

20:00



MAPPING VALIDITY IN DESIGN RESEARCH

HOSTED BY THE DESIGN SOCIETY RESEARCH QUALITY SIG

Chairs:

Philip Cash

Northumbria University, United Kingdom

Katja Thoring

Technical University of Munich, Germany

Roland M. Mueller

Berlin School of Economics and Law, Germany

Romain Pingué

Univ. Grenoble Alpes, France

Kai Larsen

University of Colorado, United States of America

Session
D111

Congress
Hall
Poseidon

09:00
12:30

18 May

MON

Validity is a central issue in determining the quality of research. However, it is often not reported or only reported at an overall level in design research publications, preventing effective evaluation of quality concerns as well as limiting the ability of the field to develop deeper quality discussions. Critically, validity is multifaceted and has numerous (often unreported) elements and trade-offs, which typically require specific accommodations being adopted for design research. Hence, in this workshop we will facilitate a mapping of the major validity constructs across the represented span of design research.

To do this, we will build on award-winning work by Larsen et al. (2020) and Larsen et al. (2025) on validity in design science, whose authors are amongst our workshop chairs and organising team. This will also draw together work by e.g., Brubaker and Cash on research quality as well as empirical work carried out by the SIG. This covers the centrality of claim types in validating designs and establishes the relationships between claims, design artifacts, evaluations, and validity types. It further explains the evaluative process's requirement for criterion reference artifacts.

We will aim to examine the variety of validity constructs, how they apply to different branches of design research, such as design science, DRM and intervention type methodologies, as well as more social science aligned design research. At a later point we will expand this to also consider those methodologies linked to research through design and the DRS community.

As part of the workshop, we will develop a mapping of validity constructs and relationships and then examine their application/relevance for different areas of design research. This will form a practical and immediate output for workshop attendees.

Following this, we will further develop the mapping via systematic review of the design literature, follow-up discussions, and further engagement with the community to publish at least one research article mapping validity constructs and concerns across the design research space, as well as a potential methodological follow-up article focused on the implementation of validity concerns when developing research. These will produce practical outputs usable by the wider Design Society community and serve as a landmark for discussion of this topic in the design research field.



MEDITATIVE REFLECTIVE INTERVENTIONS FOSTERING CREATIVE ABILITY

HOSTED BY THE DESIGN SOCIETY DESIGN CREATIVITY SIG

Chairs:

Björn R. Kokoschko

Otto von Guericke University Magdeburg, Germany

Maria Uhari-Pakkalin

Aalto University, Finland

Akane Matsumae

Kyushu University, Japan

This workshop explores the intersection of creativity, awareness, and professional environments, examining how meditative and reflective practices can enhance divergent thinking and creative problem-solving. The session focuses on practical applications within office and professional contexts, investigating how mindfulness-based interventions can be meaningfully integrated into design and creative processes. Drawing on prior research, the workshop examines both the potential and the limitations of awareness-based interventions. Participants will explore how such practices can support cognitive flexibility, challenge habitual thinking patterns, and foster idea generation at both individual and group levels. Attention is given to the transferability of these methods into everyday professional design settings.

The workshop aims to (1) introduce awareness interventions as tools to amplify divergent thinking, (2) examine their effectiveness through comparative testing and participant feedback, and (3) develop an actionable guide for applying these methods in professional contexts for individuals and teams. In doing so, the workshop also seeks to test, refine, and critically assess prior research propositions, strengthening their empirical and practical validity.

In this structured, hands-on workshop, participants are first introduced to the theoretical background of awareness-based creativity interventions and then guided in applying these methods in practice. The emphasis is on learning concrete tools and understanding how and when to use them to support creative work.

The workshop balances practical exercises, guided reflection, and collaborative dialogue. The workshop concludes with reflection sessions in which participants complete short self-assessments and share insights in group discussions, contributing to a collective understanding of mindfulness-based approaches to creativity.

Key outcomes

- Empirical insights into the effects of awareness-based interventions on divergent thinking capacity.
- Replication and critical examination of propositions from prior research, supporting confirmation or refutation.
- Practical knowledge and tools that participants can apply to enhance creativity in individual and group settings.
- Documentation of workshop findings through analysis of group discussions and evaluations.
- A consolidated body of knowledge to support the development of a white paper disseminating the tested interventions and an actionable guide for professional creative practice.

Session
D112

Congress
Hall
Bobara

09:00
12:30

18 May

MON



DESIGNING RESILIENT CARE PATHWAYS: A HEALTH SYSTEMS DESIGN PERSPECTIVE

HOSTED BY THE DESIGN SOCIETY HEALTH SYSTEMS DESIGN SIG

Chairs:

Valeria Pannunzio

TU Delft, The Netherlands

P. John Clarkson

University of Cambridge, United Kingdom

Anja Maier

University of Strathclyde, United Kingdom

Maaïke Kleinsmann

TU Delft, The Netherlands

Health and care systems are increasingly challenged by disruptive events—from pandemics and workforce shortages to climate-related crises. Such disruptions expose vulnerabilities in care pathways and highlight the urgent need for resilience-oriented design approaches. Organised by the Health Systems Design Special Interest Group, this workshop explores how design research and practice can strengthen the resilience of care pathways through collaborative, systems-based approaches.

The workshop is structured around four guiding questions:

- What types of disruptive events most critically affect care pathways?
- What kinds of impacts—clinical, organisational, social, and technological—emerge because of these disruptions?
- Who can and should contribute to building care pathway resilience across academic disciplines and stakeholder groups (e.g. clinicians, patients, policymakers, designers, engineers, and others)?
- What unique perspectives, methods, and tools can design—and members of the Design Society—offer to this challenge?

The session will combine short, invited talks and case examples from health systems design research and practice with interactive breakout discussions. Participants will then engage in mapping exercises to identify key relationships between disruptions and their impacts, as well as opportunities to improve care pathway resilience. A panel discussion will synthesise the insights generated during the workshop and identify directions for future initiatives and joint research projects.

The workshop is open to all conference participants, including those without prior experience in health systems design. It adopts a broad perspective on health systems, encompassing wellbeing and medical technologies, drug development, medical devices, healthcare delivery organisation, and the design of healthcare environments. The session is expected to be particularly relevant for design researchers and practitioners interested in systemic resilience, collaborative innovation, and the design of complex socio-technical systems.

Key outcomes

- Input and foundational material for a future conference paper on care pathway resilience.

Session
D113

Congress
Hall
Orlando 1

09:00
12:30

18 May

MON



DESIGNING WITH INTELLIGENCE: EXPLORING THE PRACTICAL IMPLICATIONS OF AI ON DESIGN PRACTICE AND PROCESSES

HOSTED BY THE DESIGN SOCIETY DESIGN PROCESS SIG, DESIGN PRACTICE SIG AND AI IN DESIGN SIG

Chairs:

Claudia Eckert

The Open University, United Kingdom

Kilian Gericke

University of Rostock, Germany

Sabine Muschik

ISEM Institute for Smart Engineering and Machine Elements, Germany

Ola Isaksson

Chalmers University of Technology, Sweden

Filippo Chiarello

Università di Pisa, Italy

Artificial Intelligence (AI) is increasingly being adopted across a wide range of design activities, from generative ideation to simulation and validation. At the same time, its integration is reshaping roles, skills, responsibilities, and values within design practice. This interactive workshop invites researchers, practitioners, and educators to critically explore how AI is transforming design processes—what it enables, what it challenges, and how it alters the nature, sequencing, and interdependencies of design tasks.

Through short reports from industrial practice and collaborative mapping of AI approaches currently in use, participants will examine both the benefits and potential risks associated with AI-supported design processes. Attention will be given to the interaction of multiple AI applications within a single design process, and to questioning whether existing design process paradigms remain fit for purpose in current industrial contexts and in the decades ahead.

The workshop aims to bridge research and practice by exploring how design processes can evolve while retaining human-centred creativity, judgment, and the ability to assess emerging design states. Ultimately, the session seeks to build a critical mass of researchers and practitioners interested in jointly exploring the future of design processes in industry, both theoretically and in practice.

Key outcomes

- Identify how AI is currently impacting industrial and engineering design processes.
- Strengthen the SIG community of researchers and practitioners interested in design practice and design processes.
- Identify next steps for collaboration and future research and exploration.

Session
D114

Congress
Hall
Orlando 2

09:00
12:30

18 May

MON



DESIGNING BETTER PROJECT-BASED DESIGN ASSESSMENT USING THE D-LAD FRAMEWORK

HOSTED BY THE DESIGN SOCIETY DESIGN EDUCATION SIG

Chairs:

Gordon Krauss

Harvey Mudd College, United States of America

Ross Brisco

University of Strathclyde, United Kingdom

Francesca Mattioli

Politecnico di Milano, Italy

Yakhoub Ndiaye

Université Cheikh Anta Diop, Senegal

Assessment in project-based design education remains a persistent challenge due to diverse institutional contexts, learning objectives, accreditation requirements, and disciplinary traditions. The Design Learning Assessment Dimensions (D-LAD) Framework offers a structured approach for analysing, reflecting on, and redesigning assessment practices across five key dimensions: Output vs. Process; Summative vs. Formative; Teacher-led vs. Student-led; Assessment of Learning vs. Assessment for/as Learning; and Individual vs. Team Assessment.

This interactive workshop introduces participants to the D-LAD framework through hands-on, reflective activities in which they apply the framework to their own courses or modules. Through small-group discussions, guided mapping exercises, and collective reflection, participants will examine how their current assessment strategies align with intended learning outcomes, accreditation standards, and industry expectations. Case examples and shared educator experiences will illustrate how D-LAD can support balanced, transparent, and developmental assessment design in project-based learning contexts.

Each participant will develop a personalised D-LAD assessment map based on a real teaching case. This tangible outcome enables educators to critically analyse and visualise the distribution and balance of assessment practices across the five dimensions, providing a concrete foundation for redesigning assessment strategies, improving feedback and fairness, and strengthening alignment between learning outcomes and professional competencies.

Beyond individual reflection, the workshop creates space for cross-institutional exchange and benchmarking of assessment practices, fostering a shared understanding and a growing community around design education assessment.

Designed for design educators, programme leaders, and researchers seeking to enhance the coherence and transparency of assessment in project-based design education, the workshop also serves as a dissemination and evaluation activity for the D-LAD framework. Participant feedback and workshop outputs will directly inform the framework's ongoing refinement and wider adoption.

Key outcomes

- Participant-generated D-LAD assessment maps based on real teaching cases, directly applicable to participants' own educational practice.
- A synthesis report capturing key insights on the practical use of the D-LAD framework and outcomes of the workshop.
- A journal publication addressing contemporary challenges in design assessment and demonstrating how the D-LAD framework can support improved assessment practices through case-based examples.

Session
D115

Congress
Hall
Konavle

09:00
12:30

18 May

MON



PHD FORUM

Chairs:

Massimo Panarotto

Politecnico di Milano, Italy

Lou Grimal

Institut Arts et Métiers, France

The DESIGN 2026 PhD Forum is designed to create a dynamic and supportive environment for early-stage researchers, fostering both academic development and professional growth. It offers a unique platform for PhD candidates to engage in meaningful discussions, share innovative research ideas, and contribute to a vibrant exchange of perspectives within the engineering design community. Participants will benefit from direct interaction with experienced researchers, receiving personalised feedback on their research topics, methodologies, and challenges—insights that are often difficult to obtain elsewhere. At the same time, the forum encourages networking and collaboration, enabling participants to build lasting connections with peers and established experts that can significantly enrich their academic journey.

The forum is structured around small discussion groups, each consisting of approximately five PhD students and one to two experts, ensuring focused and in-depth dialogue. As part of the programme, each participant will deliver a concise five-minute pitch presenting their research. This pitch should clearly communicate the relevance and impact of the work, its theoretical grounding, the research gap it addresses, the chosen methodology, and any anticipated challenges. Participants are encouraged to support their presentation with visual materials such as slides, figures, or flowcharts to effectively convey their ideas.

DESIGN2026

Session
D131

Congress
Hall
Poseidon

14:00
17:30

18 May

MON



TWO DECADES OF SUSTAINABLE DESIGN: WHERE ARE WE HEADING AND HOW DO WE GET THERE?

HOSTED BY THE DESIGN SOCIETY SUSTAINABLE DESIGN SIG

Chairs:

Sophie I. Hallstedt

Chalmers University of Technology, Sweden

Els Du Bois

University of Antwerp, Belgium

Giliam Dokter

Chalmers University of Technology, Sweden

The objective of this workshop is to examine how current research efforts are addressing contemporary challenges in advancing Design for Sustainability (DfS) in industry and society. The workshop takes as its point of departure the DfS evolutionary framework proposed by Ceschin et al. (2016), marking its ten-year anniversary and using it as a lens to reflect on how the DfS landscape has evolved, how sustainability challenges are currently being addressed, and how future research directions might unfold over the next decade.

The workshop brings together scholars working in the field of DfS, as well as participants with a broader interest in design and sustainability. Through a sequence of reflective and collaborative activities, participants will critically position their own research trajectories within the DfS evolutionary framework, examine how recent research contributions respond to sustainability challenges across different levels, and collaboratively construct future-oriented narratives and actions.

The workshop consists of the following activities:

1. Reflecting on research trajectories: Participants will individually reflect on and discuss in small groups how their own research relates to sustainability and how their focus has evolved over time, using the DfS evolutionary framework to structure the discussion.
2. Mapping current research contributions: Groups will analyse selected DfS-related abstracts submitted to DESIGN 2026, examining how these contributions are positioned within the DfS evolutionary framework and how they address sustainability challenges across different system levels.
3. Building future narratives: Each group will select a key DfS challenge and develop a future narrative outlining how research could contribute to overcoming this challenge between now and 2036.
4. Commitment to action: Participants will identify and write down one or two concrete near-term actions that they commit to pursuing in the six months following the conference. These commitments will be followed up by the conference chairs.

By combining reflection on past developments, critical analysis of current research, and the co-creation of future-oriented narratives and actions, the workshop aims to strengthen the connection between DfS research and societal impact.

Session
D132

Congress
Hall
Bobara

14:00
17:30

18 May

MON



MIND THE BIAS 2.0: (UN)BIASING THE DESIGNER IN THE AGE OF AI

HOSTED BY THE DESIGN SOCIETY COGNITIVE DESIGN SCIENCE SIG

Chairs:

Niccolò Becattini

Politecnico di Milano, Italy

Filippo Chiarello

Università di Pisa, Italy

Samuele Colombo

University of Strathclyde, United Kingdom

Are designers truly objective when they design, or are their judgments systematically skewed? How do cognitive biases influence design processes and outcomes? Can some biases enhance creative problem-solving, while others undermine it? As AI and other forms of technological support become increasingly embedded in design practice, do they amplify existing human biases, introduce new and less visible ones, or offer opportunities to detect and mitigate bias more effectively? And how should we—as design practitioners, researchers, and educators—respond?

These questions lie at the heart of the “Mind the Bias” workshop series organised by the Cognitive Design Science SIG. The workshop explores the role of cognitive bias in design thinking, decision-making, and collaboration, with a particular focus on the evolving interaction between human designers and AI-based tools.

This second edition of the workshop welcomes both new participants and returning attendees from the inaugural event held at ICED 2025. Building on insights emerging from the Dallas workshop—where more than 40 participants contributed—the discussion will focus on how designers interact with emerging AI tools used in design practice, research, and education.

The workshop examines a dual phenomenon:

- The emergence of new biases introduced or reinforced by AI tools, and
- The potential of AI to act as a debiasing mechanism, supporting designers in recognising and counteracting systematic errors in judgment and decision-making.

The workshop invites diverse perspectives, including:

- Designers and practitioners, confronting biases in everyday collaboration and interaction with design tools.
- Educators, reflecting on their own biases in teaching design and recognising biases in students’ decision-making.
- Researchers and PhD students, encountering bias when framing research questions, designing experiments, or interpreting data and results.
- Participants seeking reflection, who are uncertain about the extent to which cognitive biases influence their own thinking and decisions.

Through interactive breakout sessions, participants will exchange personal experiences and examples of bias in design contexts. These exchanges will be followed by collective reflection and synthesis, aiming to build shared understanding, identify recurring patterns, and outline opportunities for future research and practice.

By foregrounding lived experience, open dialogue, and interdisciplinary perspectives, the workshop fosters a reflective and inclusive space in which every viewpoint contributes to a richer understanding of cognitive bias in design.

Session
D133

Congress
Hall
Orlando 1

14:00
17:30

18 May

MON



THE DATA QUALITY PLAYBOOK FOR ENGINEERING DESIGN

HOSTED BY THE DESIGN SOCIETY DATA-INFORMED SIG

Chairs:

Kostas Stylidis

Chalmers University of Technology, Sweden

Bastian Quattelbaum

Hochschule Niederrhein University of Applied Sciences, Germany

Join us for a comprehensive workshop on “The Data Quality Playbook for Engineering Design”, where participants will explore a wide range of techniques and methodologies for effective data collection across different contexts, including academic research, industrial practice, and field studies. The workshop addresses both digital and analogue data collection methods, equipping participants with practical tools adaptable to their specific research and design needs.

A central focus will be placed on data quality criteria—such as accuracy, reliability, validity, and completeness—to support the creation and use of robust and trustworthy data sets. Through hands-on activities, participants will engage with best practices in data collection using surveys, interviews, observational studies, and digital tools such as mobile applications and cloud-based databases.

The workshop will also facilitate discussion on common challenges and practical solutions for maintaining data quality across different collection contexts. Finally, an outlook will be provided on how high-quality data sets can be connected to and leveraged by AI-based agents and tools in engineering design.

Session
D134

Congress
Hall
Orlando 2

14:00
17:30

18 May

MON

Objectives

- To familiarize participants with a variety of data collection methods suitable for different research and design contexts.
- To develop an understanding of key data quality criteria and how to apply them in practice.
- To promote best practices for ensuring high data quality across both digital and analogue data collection approaches.

Key outcomes

- Participants will engage with a curated toolkit of data collection strategies, which will be collaboratively examined and reflected upon during the workshop.
- Participants will demonstrate increased awareness of the role and importance of data quality criteria in engineering design research and practice.



NUDGE WORKSHOP: SMALL NUDGES, BIG IMPACT

HOSTED BY THE DESIGN SOCIETY HUMAN BEHAVIOUR IN DESIGN (HBID) SIG AND DESIGN PRACTICE SIG

Chairs:

Nikola Bursac

Hamburg University of Technology, Germany

Sabine Muschik

ISEM Institute for Smart Engineering and Machine Elements, Germany

This interactive workshop makes the concept of nudging tangible as a practical and effective approach for driving change in design and development contexts. The “Small Nudges, Big Impact” workshop brings together researchers, practitioners, and design enthusiasts to explore how nudging principles can be applied to contemporary challenges in engineering design and product development.

Following a short introductory session with illustrative examples from design research, product development, and behavioural economics, participants will work in thematic breakout groups addressing selected challenges. One focal theme will be bridging research and practice (e.g., “Design Research meets Engineering Practice”, in cooperation with the Industry Practice SIG). Additional themes may include sustainability, user acceptance of new tools and methods, or fostering interdisciplinary collaboration, such as across public-sector contexts.

The aim is to explore how small behavioural interventions (“nudges”) can create new spaces for thinking and action in design processes and organizational settings. Each group will develop concrete, context-specific nudge concepts, identifying the underlying behavioural mechanisms and potential pathways for implementation. The results will be presented and jointly reflected upon in a plenary session.

Through shared experience, discussion, and creative co-creation, the workshop deepens participants’ understanding of nudging and supports its practical application as a catalyst for change in design practice.

Key outcomes

- A concise collection of nudge-based interventions addressing key design and development challenges (e.g., Design Research meets Engineering Practice).
- Documentation of the proposed interventions and their underlying behavioural mechanisms.
- Impetus for continued collaboration across SIGs.
- Input and inspiration for integrating nudging approaches into the organization and activities of ICED 2027 or the DESIGN Conference.

Session
D135

Congress
Hall
Konavle

14:00
17:30

18 May

MON



DESIGN
2026

excellence in design



BALANCING BREAKTHROUGH INNOVATION AND OPERATIONAL EXCELLENCE WITH CLOUD-NATIVE ENGINEERING TOOLS

Darren Henry

Senior Vice President of General Operations at PTC



Breakthrough innovation is a goal for many engineering teams, but in practice, it occurs in cycles. Between those moments, organizations must deliver results through consistent execution, collaboration, and continuous improvement. This session explores why balancing breakthrough innovation with operational excellence is essential, and how modern, cloud-native engineering tools make that balance achievable through greater collaboration, iterative design, improved early-stage decision-making, and AI-enabled automation.

Attendees will learn how teams using Onshape, a cloud-native CAD and PDM platform, apply these new capabilities in real-world workflows. Through examples from industry, attendees will see how Onshape enables teams to explore ideas in parallel, make better decisions earlier, and continuously improve productivity and reliability across the product development lifecycle.

BIOGRAPHICAL SKETCH

Darren Henry serves as Senior Vice President of General Operations at PTC, where he orchestrates diverse teams spanning marketing, technical services, customer success, education, documentation, and training. A degreed mechanical engineer, Darren has held leadership roles at SolidWorks, Atlassian, OpsGenie, InVue, and Copia Automation. An expert in modern product development practices, he brings over 30 years of experience helping manufacturers adopt new technologies to accelerate innovation, improve operational efficiency, and build better products.

DESIGN2026

Session
D1-P

Congress
Hall
Ragusa

18:15
19:00

18 May

MON



08:45

D211: BEHAVIOURAL ASPECTS OF SUSTAINABLE DESIGN SYSTEMS

Location: Congress Hall Ragusa
Chair: **Tim C. McAloone**, Technical University of Denmark, Denmark

D212: MODULAR PRODUCT STRATEGIES AND CONFIGURATION APPROACHES

Location: Congress Hall Bobara
Chair: **David Inkermann**, Technische Universität Clausthal, Germany

D213: COLLABORATIVE DESIGN IN DIGITAL ENVIRONMENT

Location: Congress Hall Orlando 1
Chair: **Yuki Taoka**, Institute of Science Tokyo, Japan

09:45

REFRESHMENT BREAK

10:15

D221: UNDERSTANDING AND PREVENTING REBOUND EFFECTS IN DESIGN

Congress Hall Ragusa
Chair: **Bernard Yannou**, CentraleSupélec, France

D222: PRODUCT ARCHITECTURE AND SUSTAINABILITY

Congress Hall Bobara
Chair: **Dieter Krause**, Hamburg University of Technology, Germany

D223: CO-DESIGN AND CO-CREATION IN DIVERSE DESIGN CONTEXTS

Congress Hall Orlando 1
Chair: **Milene Gonçalves**, Delft University of Technology, The Netherlands

11:15

TRANSITION BREAK

11:30

D231: ORGANISATIONAL AND PROCESS INTEGRATION IN DESIGN FOR SUSTAINABILITY

Congress Hall Ragusa
Chair: **Daniela C. A. Pigosso**, Technical University of Denmark, Denmark

D232: DIGITAL TWINS IN PRODUCT DEVELOPMENT

Congress Hall Bobara
Chair: **Julia Guérineau**, École de technologie supérieure, Canada

D233: STRATEGIC APPROACHES TO INNOVATION AND PRODUCT DEVELOPMENT

Congress Hall Orlando 1
Chair: **Matthias R. Guertler**, University of Technology Sydney, Australia

12:30

LUNCH

Restaurant Cavtat

14:00

D2-P: PLENARY SESSION 2

Congress Hall Ragusa
Chair: **Stanko Škec**, University of Zagreb FSB, Croatia

14:45

REFRESHMENT BREAK

15:15

D241: DESIGN FOR WELLBEING, INCLUSIVITY AND SOCIETAL IMPACT

Congress Hall Ragusa
Chair: **Sophie I. Hallstedt**, Chalmers University of Technology, Sweden

D242: DATA-DRIVEN FRAMEWORKS FOR DESIGN SUPPORT

Congress Hall Bobara
Chair: **Gualtiero Fantoni**, Università di Pisa, Italy

D243: DECISION SUPPORT IN COMPLEX DESIGN CONTEXTS

Congress Hall Orlando 1
Chair: **Francesca Montagna**, Politecnico di Torino, Italy

16:15

TRANSITION BREAK

16:30

D252: MEETING 1: HOW MODERN DESIGN WORKFLOWS ARE CHANGING WITH CLOUD-NATIVE CAD

Congress Hall Bobara
Chair: **Dragos Alexandru Cazacu**, PTC, United Kingdom
HOSTED BY ONSHAPE/PTC

D253: MEETING 2: AI AND PUBLISHING SCIENTIFIC PAPERS: A DISCUSSION WITH DESIGN JOURNAL EDITORS

Congress Hall Orlando 1
Chairs: **Panos Y. Papalambros**, University of Michigan, United States of America
Anja Maier, University of Strathclyde, United Kingdom
HOSTED BY DESIGN SCIENCE JOURNAL

18:00

<p>D214: UNDERSTANDING DESIGN THINKING AND CREATIVITY <i>Location: Congress Hall Orlando 2</i> <i>Chair: Srinivasan Venkataraman, Indian Institute of Technology Delhi, India</i></p>	<p>D215: FUNCTIONAL INTEGRATION IN ADDITIVE MANUFACTURING <i>Location: Congress Hall Konavle</i> <i>Chair: Peter Törlind, Luleå University of Technology, Sweden</i></p>	<p>D216: INNOVATIONS IN ENGINEERING DESIGN EDUCATION AND LEARNING <i>Location: Congress Hall Šipun</i> <i>Chair: Gordon Krauss, Harvey Mudd College, United States of America</i></p>	<p>08:45</p>
<p>D224: HUMAN-AI CO-CREATION IN DESIGN PRACTICE <i>Congress Hall Orlando 2</i> <i>Chair: John Gero, Drexel University, United States of America</i></p>	<p>D225: PROCESS UNDERSTANDING AND CONTROL IN ADDITIVE MANUFACTURING <i>Congress Hall Konavle</i> <i>Chair: Marco Mandolini, Università Politecnica delle Marche, Italy</i></p>	<p>D226: APPROACHES TO ENGINEERING DESIGN EDUCATION AND TRAINING <i>Congress Hall Šipun</i> <i>Chair: Jonathan Borg, University of Malta, Malta</i></p>	<p>09:45 10:15</p>
<p>D234: FRAMING PROCESSES IN DESIGN <i>Congress Hall Orlando 2</i> <i>Chair: Pascal Le Masson, Mines Paris PSL, France</i></p>	<p>D235: VALIDATION AND PERFORMANCE IN ADDITIVE MANUFACTURING <i>Congress Hall Konavle</i> <i>Chair: Marcel Bartz, TU Dortmund University, Germany</i></p>	<p>D236: AI-ENHANCED LEARNING IN DESIGN EDUCATION <i>Congress Hall Šipun</i> <i>Chair: Ross Brisco, University of Strathclyde, United Kingdom</i></p>	<p>11:15 11:30</p>
<p>FROM DATA TO DESIGN: RETHINKING ENGINEERING DESIGN WITH NEXT-GEN AI <i>Dr Faez Ahmed, Associate Professor, Doherty Chair of Ocean Utilization, Department of Mechanical Engineering, Massachusetts Institute of Technology</i></p>			<p>12:30 14:00 14:00 14:45</p>
<p>D244: DESIGN COGNITION STUDIES <i>Congress Hall Orlando 2</i> <i>Chair: Niccolo Becattini, Politecnico di Milano, Italy</i></p>	<p>D245: METHODS AND TOOLS FOR DESIGN FOR ADDITIVE MANUFACTURING <i>Congress Hall Konavle</i> <i>Chair: Christer W. Elverum, NTNU, Norway</i></p>	<p>D246: ADVANCED VISUALISATION AND IMMERSIVE TECHNOLOGIES IN DESIGN <i>Congress Hall Šipun</i> <i>Chair: Eui Chul Jung, Seoul National University, South Korea</i></p>	<p>14:45 15:15</p>
<p>D254: MEETING 3: DS MENTORING PROGRAM MEETING <i>Congress Hall Orlando 2</i> <i>Chairs:</i> Julie Stal-Le Cardinal, CentraleSupélec, France <i>Sophie I. Hallstedt</i>, Chalmers University of Technology, Sweden HOSTED BY DS MENTORING PROGRAM</p>	<p>D255: MEETING 4: DS DFAM SIG COMMUNITY MEETING <i>Congress Hall Konavle</i> <i>Chair:</i> Tino Stanković, ETH Zurich, Switzerland HOSTED BY DS DESIGN FOR ADDITIVE MANUFACTURING SIG</p>	<p>D256: MEETING 5: PHYSICAL SPACES IN THE DIGITAL ERA: BUILDING LIVING LABS FOR AI-ENABLED SUSTAINABLE DESIGN <i>Congress Hall Šipun</i> <i>Chairs:</i> Filippo Chiarello, Università di Pisa, Italy Vito Giordano, Università di Pisa, Italy HOSTED BY ERASMUS+ DETAILS PROJECT</p>	<p>16:15 16:30 18:00</p>



Understanding and preventing behavioural rebound effects: a design tool for sustainable design across contexts

Carlijn M. Aarsen, Imke G. H. Van der Loo, Marie Louise Pollmann-Larsen, Daniela C. A. Pigosso

Technical University of Denmark, Denmark

Solar photovoltaic systems are a key renewable energy solution, but behavioural rebound effects offset their environmental potential. As Solar Home System adoption expands in low- to middle-income countries, understanding how contextual factors (e.g., social norms) shape these effects is crucial, yet research on this topic is scarce. Through a systematic literature review, this study identifies 15 contextual factors influencing behavioural rebound mechanisms (BRM). Findings are integrated into a design tool, helping developers analyse contexts, anticipate BRM, and apply prevention strategies.

<https://doi.org/10.1017/pds.2026.10476>

Encouraging sustainable consumption through digital provisioning platforms: insights from Turkey

Duru Kalaça, Berre Su Demir, Hakan Yilmazer, Aykut Coskun

Koç University, Turkey

Digital platforms for food and mobility offer sustainability and convenience, but their global adoption is context-dependent. This paper analyzes eight platforms in Turkey, contributing to the discourse on sustainable consumption. The analysis reveals diverse platform configurations and identifies key consumer barriers to widespread adoption, including trust issues, platform misuse, power imbalances, and limited service. The paper concludes with recommendations for motivating Turkish users, managing stakeholder trust dynamics, and leveraging existing consumption habits in new platform design.

<https://doi.org/10.1017/pds.2026.10491>

Retrofit as ecological citizenship towards participatory resilient and regenerative design

Luke Gooding¹, Robert Phillips²

1: Stockholm Environment Institute, United Kingdom; 2: Royal College of Art, United Kingdom

Retrofit is often seen as a technical fix to boost efficiency and cut emissions, yet it also reshapes social relations, skills, and material flows. This paper reframes retrofit as participatory design cultivating ecological citizenship, the shared capacity to learn, make, and care for ecological relations through the built environment. Drawing on three cases, The Wild House, Ag. Lab, and the Retrofit Community Champion project, we propose a framework and design implications to scale equitable, circular, neighbourhood-based retrofit.

<https://doi.org/10.1017/pds.2026.10485>

Exploring sustainable practices in smart product development: a field study and analysis in Quebec's entrepreneurial ecosystem

Éléonore Ribalonga, Julia Guérineau, Mariia Zhuldybina

École de technologie supérieure, Canada

The study documents the approaches, processes, methods, and tools used by 11 start-ups to develop their smart products, while focusing on the sustainable concepts and techniques (SCTs) adopted. Although the majority of start-ups demonstrate awareness of the environmental impacts of their products and tend to implement relevant practices, the results indicate a lack of formalised SCT usage. Several start-ups have therefore recognised the value of a bespoke "eco-design toolbox" and aim to work towards reducing the environmental impacts of their later product versions.

<https://doi.org/10.1017/pds.2026.10507>



Towards an impact model of modular product strategies

Luica Pöhlsen, Pascal Inselmann, Dieter Krause

Hamburg University of Technology, Germany

The choice of modular product structure strategies has far-reaching implications for development, production, and other aspects of the product life cycle. So far there is only limited methodological support for the decision process. This contribution proposes a conceptual impact model that illustrates the relationships between modular product strategies, induced effects, and resulting economic targets. The proposed impact model supports the decision making process in the early product development stage and serves as a basis for further methodological development.

<https://doi.org/10.1017/pds.2026.10435>

Evaluating design automation from user input to production – insights from the bike connector tool

Julian Bürkli¹, Simon Ritter^{1,2}, Patrick Beutler^{1,2}, Urs Hofmann^{1,2}, Gaspare Stocker¹, Julian Ferchow^{1,2}, Mirko Meboldt¹

1: ETH Zurich, Switzerland; 2: inspire AG, Switzerland

Design automation (DA) frameworks are often too specialized to be broadly evaluated. This paper proposes the use of deliberately simple, accessible implementations to facilitate the collection of user feedback. The evaluation of a DA framework is demonstrated through the Bike Connector Tool, which automates the design of personalized bicycle accessory connectors. A case study yields valuable insights, including the need for spatial guidance, manual intervention and expanded design options. The results indicate that simple demonstrators can effectively support the evaluation of DA approaches.

<https://doi.org/10.1017/pds.2026.10408>

Structured overview of methodologies for assessing assembly complexity

Havvanur Sirin, Daniel Roth, Matthias Kreimeyer

University of Stuttgart, Germany

This paper provides a structured overview of methods for assessing assembly complexity in manufacturing. A systematic literature review classifies approaches as product-, information-, or system-centered, each reflecting distinct sources of complexity and application contexts. A four-dimensional scheme enables consistent comparison. The results highlight methodological gaps and support future development of scalable, integrable models for planning and decision-making in high-variety production environments.

<https://doi.org/10.1017/pds.2026.10441>

From minimum viable product via size levels to modular product family – case study on air filtration units

Nele Ganze¹, Stefan Jakschik¹, Kristin Paetzold-Byhain²

1: ULT AG, Germany; 2: Dresden University of Technology, Germany

This study presents a structured approach for developing new modular, size-variable product families in small and medium-sized enterprises (SMEs), demonstrated through a case study on air filtration units. Starting from a minimum viable product (MVP), the approach provides a framework for size level definition and systematic generation of alternative modular concepts while considering product-specific design trade-offs. An evaluation combining qualitative criteria assessment with quantitative cost forecasting enables transparent concept comparison.

<https://doi.org/10.1017/pds.2026.10413>

Session
D212

Congress
Hall
Bobara

08:45
09:45

19 May

TUE



From models to impact: a human-AI approach for effective support of collaborative teams in agile product development

*Roman Ognevoj*¹, *Anusch Musawi*², *Milenko Bugueno*¹, *Marcel Busch*², *Mona Batora*², *Katharina Ritzer*², *Nikola Bursac*², *Kristin Paetzold-Byhain*¹

1: Chair of Virtual Product Development, Dresden University of Technology, Germany; 2: ISEM - Institute for Smart Engineering and Machine Elements, Hamburg University of Technology, Germany

Agile teams often encounter obstacles in systematically identifying the underlying root causes of collaboration challenges and deriving effective countermeasures. Grounded in the Design Research Methodology, this study investigates a hybrid AI-human approach for targeted generation of problem-specific reference and impact models to enhance systematic improvement in agile product development. A structured workflow integrates AI capabilities (e.g. scaffolding, consistency) and expert knowledge (causality, context), while a three-stage review ensures methodological rigor and result reliability.

<https://doi.org/10.1017/pds.2026.10385>

Boundary objects in co-designing AI systems: a case study of supporting cross-functional collaboration

*Álvaro Aranda-Muñoz*¹, *Yuji Yamamoto*², *Kristian Sandström*²

1: Research Institutes of Sweden, Sweden; 2: Mälardalen University, Sweden

In the early design stage of AI systems, designers face the challenge of addressing interdisciplinary needs with technical feasibility. This case study presents learnings from engaging a cross-functional team in the early design of an AI Vision System to support operators in the assembly process of electrical equipment. Our approach has been to embed Human-AI guidelines into boundary objects. The findings indicate that boundary objects helped participants reach common understandings, identify needs, and develop plans to mitigate future problems during the development of the AI system.

<https://doi.org/10.1017/pds.2026.10373>

Exploring the preparation of CAD models in collaborative design sessions for mass personalised products: a case study on a custom dental abutment

*Iris Huić*¹, *Petar Kosec*^{1,2}, *Tomislav Martinec*¹, *Stanko Škec*¹

1: University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, Croatia; 2: Neo Dens Ltd., Croatia

This study investigates how clinicians and technicians describe the preparation and use of CAD models in collaborative design sessions for mass personalised products. Semi-structured interviews with ten professionals were analysed using thematic analysis. The findings revealed three themes: the input data required before modelling, the additional information that supports interaction with the CAD model, and the role-specific ways in which contributors evaluate it. These insights guided the development of an initial parametric CAD model intended to support future collaborative work.

<https://doi.org/10.1017/pds.2026.10380>

Employee-centred process analysis for VR integration in product development

Ali Abughalia, *Carsten Stechert*

Ostfalia University of Applied Sciences, Germany

This paper explores the adaptation needs of employees in the context of implementing virtual reality (VR) in product development. Rather than analysing the overall process, the study focuses specifically on the employee aspects, including their roles, tasks, and challenges within the workflow. Existing work-related activities were analysed and visualized to identify inefficiencies. A set of tailored assessment criteria was created to systematically evaluate various sources of waste and process-related challenges.

<https://doi.org/10.1017/pds.2026.10372>

Session
D213

Congress
Hall
Orlando 1

08:45
09:45

19 May

TUE



The impact of semantic feedback on functional connectivity during design ideation: a preliminary study

*Mengru Wang*¹, *John S. Gero*², *Sohail Ahmed Soomro*¹, *Georgi V. Georgiev*^{3,1}

1: Center for Applied Computing, University of Oulu, Finland; 2: Drexel University, United States of America; 3: Japan Advanced Institute of Science and Technology, Japan

This study aims to examine the influence of semantic feedback on the functional connectivity of students' brains in design education. We evaluated functional connectivity using EEG. After the instructor provided feedback, we observed a significant reduction in students' alpha-band activity across 16 channel pairs. It suggests that, after receiving feedback, participants relied more on localized neural circuits rather than on broad, diffuse connections. Semantic feedback potentially facilitates participation in more efficient cognitive processes, thereby assisting design ideation.

<https://doi.org/10.1017/pds.2026.10676>

Assumption-making in ill-structured problems: a reflexive thematic analysis

Kudrat Kashyap, *Vishal Singh*

Indian Institute of Science, Bangalore, India

Designers are often asked to state their assumptions. However, how assumptions are made is not well understood. We administered short and long versions of ill-structured problems to 22 students and analysed their responses using reflexive thematic analysis. Participants constructed analogies from recent experiences and distant memories. Interpretations in the short version often persisted in the long version, indicating assumptive inertia, a tendency to maintain initial assumptions. The findings offer insights into the process of assumption-making and its role in design decision-making.

<https://doi.org/10.1017/pds.2026.10362>

From idea to creation: exploring designers' real-time cognitive and emotional experiences throughout the design process

*Samira Ashari*¹, *Alireza Habibi*², *Saba Moosavinezhad*³, *Babak Amraee*¹, *Stefan Schmidt*⁴, *Gaetano Cascini*⁵

1: Design Department, Tabriz Islamic Art University, Iran; 2: Department of Biomedical Engineering, School of Electrical and Computer Engineering, University of Tehran, Iran; 3: Cognitive Sciences Department, Tarbiat Modares University, Iran; 4: Psychosomatic Medicine and Psychotherapy Department, Medical Center - University of Freiburg, Faculty of Medicine, University of Freiburg, Germany; 5: Mechanical Engineering Department, Politecnico di Milano, Italy

This study examines designers' cognitive and emotional experiences during the design thinking process and the effect of time constraints. Using the MetaCogno tool, 83 participants reported moment-to-moment experiences across Problem Analysis, Ideation, Evaluation, and Sketching. Positive experiences dominated, with time-limited designers showing higher enjoyment, focus, and engagement. Findings highlight the dynamic interplay of cognition and emotion, and suggest that time pressure can enhance focus and motivation during design.

<https://doi.org/10.1017/pds.2026.10452>

A novel approach to design creativity assessment: a comparative evaluation

*Zhengya Gong*¹, *Ummi Latif*¹, *Milene Gonçalves*², *Georgi V. Georgiev*^{3,1}

1: Center for Ubiquitous Computing, University of Oulu, Finland; 2: Department of Design, Organisation and Strategy, Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands; 3: Japan Advanced Institute of Science and Technology, Japan

Various methods are offered to measure design creativity. Nonetheless, a debate continues over the development of a trustworthy and objective method to mitigate the influences on the evaluation. Therefore, we propose and develop a novel tool and approach for evaluating design creativity, which reframes creativity evaluation as a structured and data-driven process. This tool represents a significant advancement in the evaluation of design creativity by mitigating objective factors. Importantly, our tool enables researchers and educators to adopt it freely and objectively for evaluation.

<https://doi.org/10.1017/pds.2026.10460>

Session
D214

Congress
Hall
Orlando 2

08:45
09:45

19 May

TUE



A novel design for the integration of conventional rolling bearings into MEX-manufactured components

Thomas Fürst¹, Dietmar Göhlich¹, Eckhard Kirchner²

1: Technische Universität Berlin, Germany; 2: Technical University of Darmstadt, Germany

Advances in additive manufacturing (AM) enable the use of AM components in demanding complex applications with high functional requirements. As a result, integrating standardized machine elements such as conventional rolling bearings is gaining growing relevance. However, limitations regarding achievable tolerances or surface qualities in the MEX process stand in contrast to strict specifications for bearing integration. This study introduces a novel interface element and a corresponding integration process that considers both bearing requirements and the layered structure of MEX components.

<https://doi.org/10.1017/pds.2026.10549>

Evaluation of electrical contacting approaches for additively manufactured conductive polymer composites

Lukas Schulze, Maximilian Nowka, Karl Hilbig, Thomas Vietor

Institute for Engineering Design, Technische Universität Braunschweig, Germany

This paper presents a methodical investigation of ten types of contacts for electrically conductive polymer composites manufactured using additive manufacturing. The study examines the suitability of three different bonding agents for reducing contact resistance and measures the contact resistance of the contact systems as well as the tensile strength. Based on these results, design guidelines and a design catalogue are developed. The results show that although each contact type is fundamentally suitable, they should be adapted to the respective application using the derived design guidelines.

<https://doi.org/10.1017/pds.2026.10568>

Particle damping optimization and multi-material additive manufacturing of an atom chip bracket: a case study

Marcus Oel¹, Leon Glitt¹, Mirco Jonkeren², Weijia Yu¹, Myriam Maalaoui¹, Lennart Mesecke¹, Jens Niedermeyer¹, Sebastian Tatzko², Ina Meyer¹, Jörg Wallaschek², Roland Lachmayer¹

1: Institute of Product Development (iPeG), Leibniz University Hannover, Germany; 2: Institute of Dynamics and Vibration Research, Leibniz University Hannover, Germany

The powder bed fusion by laser beam of metals (PBF-LB/M) offers the possibility of directly integrating particle dampers during manufacturing. Building on an existing optimization tool, this article investigates the optimization and multi-material additive manufacturing (AM) of a bracket for an atom chip of a quantum inertial sensor. The bracket is optimized in terms of mass, stiffness, and damping properties, and subsequently manufactured using Scalmalloy and tungsten in a PBF-LB/M process. The results provide findings into component design as well as into the pre-processing phase of AM.

<https://doi.org/10.1017/pds.2026.10562>

A novel selection framework of joining technologies for metal additive manufacturing

Christian Gutzler, Eckhard Kirchner

Technical University of Darmstadt, Germany

Additive Manufacturing (AM) faces process limitations such as build-volume restriction and thermal distortion. While AM favors integral design, certain restrictions can be overcome by combining differential design with subsequent joining technologies (JT). Yet little is known about suitable JT selection in AM. To bridge this gap, established JT selection frameworks from conventional manufacturing (CM) were examined and adapted to AM. The resulting framework supports JT selection in AM based on joint design and AM-specific criteria while remaining applicable to CM and enabling combined designs.

<https://doi.org/10.1017/pds.2026.10554>



Mechatronics education with project-based learning supported by e-learning

Sascha Selkmann, Frederike Kossack, Christian Sure, Nikolas Liermann-Koch, Marc Neumann

Biomedical Engineering Lab, Ruhr-University Bochum, Germany

Project-based learning is a key format in engineering design education. However, many students face difficulties due to a lack of prior knowledge required for successful project participation. To address this issue, we developed e-learning content to support students during the self-study time in preparation for the project work. This paper presents an evaluation of the impact of the e-learning content when used alongside project-based activities. The results indicate increased student confidence in developing mechatronic systems and a positive effect on acquiring professional competencies.

<https://doi.org/10.1017/pds.2026.10674>

Exploring the role of product teardown on students' engineering education

Filip Valjak¹, Regina Novak², Nenad Bojčetić³

1: School of Design, University of Zagreb Faculty of Architecture, Croatia; 2: SICK Mobilis, Croatia; 3: University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, Croatia

Product teardowns are a common educational tool in engineering design courses, with many benefits such as hands-on experience and improved engineering knowledge acquisition. This exploratory study investigates the role of product teardown activities on students' engineering education, specifically focusing on technical knowledge acquisition among industrial design students. Results indicate the teardown caused a qualitative increase in students' understanding of product function, components, materials, and manufacturing processes.

<https://doi.org/10.1017/pds.2026.10675>

Educating compliance: a foundation-first, hands-on approach to compliant mechanism design

Alan Air^{1,2}, Andrew Wodehouse¹

1: University of Strathclyde, United Kingdom; 2: National Manufacturing Institute Scotland, United Kingdom

Compliant mechanisms achieve motion through elastic deformation, yet their core ideas are rarely taught before digital tools. This paper presents a foundation-first, hands-on method using lattice structures to introduce compliant mechanism design. In a pilot workshop, students analysed how rigid-body mechanisms move and redesigned them as compliant via tactile exploration and paper-based sketches, producing clear conceptual outputs and reporting improved understanding and confidence. The results show the value of early experiential learning before progression to digital and automated tools.

<https://doi.org/10.1017/pds.2026.10648>

From key users to end users: scaling guideline-based learning for sustainable CAD/PLM adoption

Liliane G. Ngahane Nana, Amaniyel Arslan, Sascha Adamczyk, Onur Bahcaci, Birol Cobanoglu, Varun Salian

ARTECH Consulting GmbH, Germany

A blended learning approach was introduced to extend guideline-based training from key users to the wider end-user community in order to implement a new CAD/PLM environment. By combining asynchronous self-study of guidelines with synchronous, trainer-led sessions, the programme fostered procedural understanding and consistent modelling practices, as well as learner engagement. The results demonstrate how scalable blended learning strategies can bridge the gap between industrial training and academic education.

<https://doi.org/10.1017/pds.2026.10668>

Session
D216

Congress
Hall
Šipun

08:45
09:45

19 May

TUE



Anticipating and preventing rebound effects by design: an action research study of refillable packaging at Beiersdorf

Giácomo Parolin¹, Ellen Helldén¹, Daniel Guzzo¹, Elise Andrew¹, Imke Van der Loo¹, Lukas Mckay¹, Benjamin Triller², Daniela C. A. Pigosso¹

1: DTU Construct, Technical University of Denmark, Denmark; 2: Beiersdorf AG, Germany

Companies lack methods to anticipate rebound effects (RE) in design, jeopardising their sustainability ambitions. This action research at Beiersdorf pilots a framework for ex-ante RE identification, modelling, and prevention. The study found 31 economic, behavioural, and social rebound mechanisms triggered by a refillable packaging innovation, using system dynamics to find leverage points for prevention (e.g., foster non-material practices via packaging design). This paper offers a first attempt at a practical approach to integrate RE analysis into design, towards absolute sustainability.

<https://doi.org/10.1017/pds.2026.10505>



Diagnosing the future social impacts of biowaste treatment facilities during the pre-design phase

Christian Ottini, Renata Barbosa Da Silva, Sandra Domenek, Felipe Buendia, Gwenola Yannou-Le Bris

Université Paris-Saclay, INRAE, AgroParisTech, UMR SayFood, France

The paper assesses the social impacts of composting and anaerobic digestion facilities for household biowaste in France. Using the Social Life Cycle Assessment (SLCA), it identifies 16 indicators that compare workers' conditions, community impacts, and societal benefits. This work proposes a framework for incorporating social dimensions into a multi-criteria assessment of anaerobic digestion and composting facilities in Europe, with a particular focus on France.

<https://doi.org/10.1017/pds.2026.10504>

Design for circular behaviour: a literature-based conceptual model

Jan Jagnow, Bernd Stoehr, Christian Koldewey, Roman Dumitrescu

Heinz Nixdorf Institute, Paderborn University, Germany

The transition to a circular economy requires products that encourage circular consumer behaviour. Despite the central role of designers in this transition, the design for circular behaviour (DfCB) approach remains under-explored. This paper presents a literature-based conceptual model explaining which factors need to be in place, and how they interrelate, in order for designers to facilitate circular behaviours through product design. By pointing out gaps in the current state, future research directions are suggested to foster the establishment of DfCB.

<https://doi.org/10.1017/pds.2026.10490>

Designers' challenges in anticipating and preventing rebound effects: insights from industry interviews

Lukas Mckay, Frederik Høgdal, Tim C. McAloone, Daniela C. A. Pigosso

Technical University of Denmark, Denmark

Rebound effects occur when sustainability interventions trigger behavioural or systemic responses that offset environmental benefits. This paper explores how designers encounter and seek to prevent them in practice, based on nine interviews with sustainability-oriented practitioners. We identify twelve challenges across micro, meso and macro levels, showing that effective prevention requires aligning behavioural literacy, organisational governance and structural incentives across design contexts.

<https://doi.org/10.1017/pds.2026.10499>

Session
D221

Congress
Hall
Ragusa

10:15
11:15

19 May

TUE



Sustainability by design: the impact of product architecture decisions on the sustainability of products – a practitioner qualitative assessment

Robin Grothe, Isaac Mpidi Bitu, Aschot Hovemann, Roman Dumitrescu

Fraunhofer IEM, Germany

Sustainability is a central challenge in engineering. Early architectural design decisions strongly influence a product's ecological footprint and long-term sustainability potential. Addressing these aspects in the concept phase is therefore essential. This paper analyses how architecture decisions - such as modularity, standardisation, redundancy, and updateability - affect ecological sustainability. The qualitative assessment helps practitioners to anticipate environmental impacts and foster sustainability awareness in product architecture development.

<https://doi.org/10.1017/pds.2026.10487>

Extending QFD for smart product-service systems with smartness parameter categorization

Mario Fargnoli¹, Tomohiko Sakao²

1: Sapienza Università di Roma, Italy; 2: Linköping University, Sweden

A key aspect of Circular Economy (CE) is focusing on value creation through customer functionality and service across the entire product life cycle, supported by digitalization tools for improved management. This shift has led to the rise of smart Product-Service Systems (PSS) models. However, designing smart PSS is complex, requiring methodological support for successful implementation. This study explored the feasibility of a novel tool based on the Quality Function Deployment (QFD) framework through its practical application in the photovoltaic industry.

<https://doi.org/10.1017/pds.2026.10484>

Exploring the relationship between attribute centrality and sustainability perception in eco-designed products

Lesly Sierra Fontalvo, Aurora Berni, Yuri Borgianni

Free University of Bozen-Bolzano, Italy

This study explores how users perceive the centrality and sustainability of design attributes associated with modular design, energy efficiency, and design for disassembly, selected as illustrative eco-design strategies. 42 participants evaluated nine products through a bespoke online survey. The results show that salience and clarity of the environmental benefits associated with product attributes outweigh centrality in the perception of sustainability. This stresses the importance of clear and interpretable sustainability cues to improve users' understanding of environmental performance.

<https://doi.org/10.1017/pds.2026.10514>

Design for disassembly in footwear: identification and classification of product requirements

Adriana Amorim¹, Ivo Rodrigues¹, Miguel Terroso¹, Filipe Chaves²

1: Research Institute for Design, Media and Culture [ID+], IPCA, Portugal; 2: Higher Professional Technical School, IPCA, Portugal

This work investigates the development of sneakers designed under Design for Disassembly principles and supported by additive manufacturing to promote a more sustainable and circular product life cycle. By responding to the limitations of traditional footwear assembly, the study identifies and organises 35 technical requirements derived from consumer needs. The proposed model offers a clear and adaptable framework that enhances decision-making in early design stages, guiding the creation of innovative, recyclable and environmentally responsible footwear solutions.

<https://doi.org/10.1017/pds.2026.10479>

Session
D222

Congress
Hall
Bobara

10:15
11:15

19 May

TUE



Design tools as catalysts for shared problem framing in West African entrepreneurial contexts

Kodjo Senam Dola^{1,2}, *Jean-François Boujut*¹, *Chloé Lecomte*²

1: *Université Grenoble Alpes, CNRS, Grenoble INP, G-SCOP, France*; 2: *CIRAD, UMR Innovation, France*

This article explores how design tools can enhance shared understanding of problems within West African entrepreneurial ecosystems, where new product development occurs amidst resource scarcity and intense market opportunities. The findings emphasize that design tools serve as flexible cognitive intermediaries that promote collaboration, uncover underlying assumptions, and foster new perspectives for solution development. Their value emerges through a progressive translation process, where researchers reinterpret these tools to bridge the diverse object worlds of entrepreneurs.

<https://doi.org/10.1017/pds.2026.10376>

Empowering designer-artisan partnership through capability-based co-design

*Jianan Hu*¹, *Eunsuk Hur*², *Xizeng Jia*¹

1: *Tsinghua University, China*; 2: *University of Leeds, United Kingdom*

To bridge capability gaps between designers and artisans that hinder fashion and textile business collaboration and social innovation effects, this study explores how capability-based co-design fosters sustainable partnerships. Based on 20 case studies in China's textile sector, it connects craft values, product features, and capability-based interactions. The model links this approach to make co-design practical amid skill gaps and enhance social innovation. It offers actionable strategies for balancing co-design methods in skill asymmetric partnerships in cultural and creative industries.

<https://doi.org/10.1017/pds.2026.10379>

From scenarios to negotiation games: staging the co-evolution of problem and solution spaces

Signe Pedersen

Aalborg University Copenhagen, Denmark

This paper introduces negotiation games as a method for staging and structuring collaboration in sustainability-oriented engineering design. Building on the Staging Negotiation Spaces (SNS) framework, it shows how scenarios can be re-staged as rule-based artefacts that provoke dialogue and alignment across organisational roles. Drawing on a case in scenographic production, the study demonstrates how negotiation games enable stakeholders to surface divergent concerns, reframe challenges, and co-evolve problem and solution spaces through situated alignment.

<https://doi.org/10.1017/pds.2026.10386>

Co-creation with end-users to respond to the B2B industry: a case study

Sora Lee-Remond^{1,2}

1: *École Supérieure des Technologies et des Affaires (ESTA), France*; 2: *Université Marie et Louis Pasteur (UMLP), ELLIADD Laboratory (U.R. n°4661), Belfort, France*

Co-creation with end-users is a well-known process. While this approach has been widely adopted in B2C, B2B companies have been slower to adopt it due to complex decision-making structures. This case study is based on co-creation sessions with end-users to respond to the needs of B2B industries. The study highlighted the importance of co-creation with end-users in B2B industries to understand real-life use scenarios, and finally to propose a final product that meets their expectations.

<https://doi.org/10.1017/pds.2026.10382>



AI as creative partner: exploring perceived roles in human-AI co-creation

Susanne Dreyer, Chris McTeague, Katja Thoring

Technical University of Munich, Germany

Generative AI (GenAI) tools are getting more and more integrated into creative workflows, evolving from assistants to collaborators, and reshaping human-AI interactions in the creative process. To better understand the human side of this co-creation, an interview study was conducted with 19 architecture students participating in a GenAI-supported design futuring course. The study identified 18 roles humans and AI can take during co-creation, along with tool-specific variations and insights into emotional dynamics, creative experiences, perceived agency, and control during the design process.

<https://doi.org/10.1017/pds.2026.10459>



DESIGN2026

Understanding designers' experiences with generative AI through user interaction pattern analysis

Charlie Ranscombe¹, Linus Tan¹, Nadia Anam¹, James Gopsill²

1: Swinburne University of Technology, Australia; 2: University of Bristol, United Kingdom

This study examines how designers' experiences with text-to-image GenAI relate to their interaction patterns during a design hackathon. Survey data and two contrasting cases show that positive experiences align with shifting prompts and broader command use as designers move from exploration to refinement, while negative experiences correlate with fixed prompting and limited variations. The study demonstrates how interaction data can inform adaptive GenAI support across design phases, offering opportunities to enhance both practice and tool development.

<https://doi.org/10.1017/pds.2026.10468>

Motivation and post-design evaluations of AI usage behind AI-assisted design

Yuan Yin¹, Haoyu Zuo¹, Liuqing Chen², Pan Wang³, Peter Childs¹

1: Imperial College London, United Kingdom; 2: College of Computer Science and Technology, Zhejiang University, China; 3: Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands

This study aimed to detect designers' motivations (Personal Identity, Conformity, Life Efficiency, and Information) in using Generative AI in AI-assisted design and how these motivations related to post-design evaluations of AI (Attitudes, Satisfaction, and Continuance Intention). The results showed that personal identity, conformity, and efficiency motives can predict attitudes and satisfaction for the use of Generative AI in AI-assisted design. No motivation indicated in the study can predict continuance intention, which suggests that long-term AI usage depends on factors beyond motivation.

<https://doi.org/10.1017/pds.2026.10475>

Artificial co-intelligence in multi-domain platform development: what is now and what is next?

Massimo Panarotto, Gaetano Cascini

Politecnico di Milano, Italy

This paper reviews 89 studies on AI in product platform design, further focusing on 21 multi-domain contributions. The dominant archetype is AI as a Tool × Method × Solution Proposal, with AI mainly used for automation and optimization. Collaborative roles remain rare, especially in requirements and architecture phases. Robust evaluation of AI benefits is largely missing, revealing an automation-centric paradigm and key gaps for co-intelligent, cross-domain platform development.

<https://doi.org/10.1017/pds.2026.10367>

Session
D224

Congress
Hall
Orlando 2

10:15
11:15

19 May

TUE



Differential design through adhesive bonding of AM subcomponents

Michael Ascher, [Ralf Späth](#)

University of the Bundeswehr Munich, Germany

Part separation and subsequent adhesive bonding of additively manufactured (AM) subcomponents is a promising strategy to overcome manufacturing constraints and improve cost efficiency of AM processes. This study presents a three-dimensional scarf joint geometry, designed to maximize bond strength at a minimum use of substrate volume. Based on geometrical measurements, measures for improved accuracy of fit between PBF-LB/M substrates made of AlSi10Mg and Ti6Al4V were derived. Static tensile tests confirmed an almost twofold increase in bonding performance compared to conventional scarf joints.

<https://doi.org/10.1017/pds.2026.10541>

Understanding and controlling environmental effects in direct ink writing of upcycled biomaterials

Jamie Quinn Luik, [Jeremy Faludi](#)

Delft University of Technology, The Netherlands

This paper examines how ambient airflow, temperature, and humidity impact the print quality of upcycled biomaterials in Direct Ink Writing, and explores strategies for mitigation. A standardized pecan shell flour ink was used with optimized slicing parameters. Experiments in a controlled climate chamber involved sensor logging and statistical analysis. Airflow improved structural stability, overhang fidelity and bridging, but increased Z-axis shrinkage. Higher temperatures slightly improved bridging, while elevated humidity reduced stability and increased sagging, despite small bridging gains.

<https://doi.org/10.1017/pds.2026.10557>

Thermal process monitoring for layer adhesion by tracking nozzle position in material extrusion

Julie Dupas, [Christer W. Elverum](#), [Sean H. Sasson](#), [Sindre W. Eikevåg](#)

Norwegian University of Science and Technology, Norway

We present a thermal process-monitoring system for MEX tracking layer temperature as a proxy for interlayer adhesion. Python-based hottest-point tracking by infrared thermography is implemented on a chamber-heated desktop printer to track nozzle movements and measure the temperature field millimeters ahead of deposition logging the results on a CSV file. We quantify accuracy versus camera distance ($\Delta d=73\text{mm}$) and probe radius (R2-R5). Where R3-R4 provided just a ΔRMSE of 1.52°C suggesting R3 as the optimal distance. The results can inform mechanical properties in load-bearing AM applications.

<https://doi.org/10.1017/pds.2026.10546>

Development and investigation of a new path-planning design for FLM-3D-printing to reduce anisotropy

[David Grundmann](#), [Tilman Fischer](#), [Michael Mainz](#), [Marcel Bartz](#)

Engineering Design and Product Development, Faculty of Mechanical Engineering, TU Dortmund University, Germany

Fused Layer Modeling (FLM) is one of the most popular additive manufacturing techniques. Its application is often limited caused by the procedurally anisotropy. This work addresses FLM's weakness by examining a new path planning concept that replaces printing several adjacent parallel lines, for example in perimeters. The new technique was compared with conventionally manufactured reference samples in tensile tension and three-point-bending tests. The results show an improvement of the tensile strength in build direction of the samples by up to 40% and a reduction of anisotropy by 28%.

<https://doi.org/10.1017/pds.2026.10552>



Using guidelines to train key users: accelerate skills development during a CAD/PDM software transition

Liliane G. Ngahane Nana, Amaniyel Arslan, Sascha Adamczyk, Nedim Ciftcioglu, Birol Cobanoglu, Dennis Lobb, Senem Özmen, Varun Salian

ARTECH Consulting GmbH, Germany

During the transition to CAD/PLM software, key users underwent guideline-based training aligned with company workflows. This practical approach, which linked tool functions to real design practices, accelerated the acquisition of skills, ensured modelling consistency, and improved understanding of digital engineering. The study identifies key users as knowledge multipliers and reveals how such methods develop competence. The findings emphasise the significance of problem-solving training and the relevance of guideline-based methods for industrial practice and design education.

<https://doi.org/10.1017/pds.2026.10669>

Engineering design and entrepreneurship education: insights from the Design Society

Bernd Michael Weiss^{1,2,3}, Mohamed Elnourani¹

1: Luleå University of Technology, Sweden; 2: Creaternity Aerospace Lab, Sweden; 3: Astromerge, United States of America

The Design Society unites researchers and practitioners to advance innovative engineering design. As entrepreneurship grows in importance, integrate design principles into its education seems necessary. This paper reviews Design Society publications to map how entrepreneurship, education, and sustainability intersect, it identifies the Design Society's contributions in the field to propose strategies and future research to strengthen its influence. It highlights the possible role of the Design Society in leading education advancements in entrepreneurship and sustainability.

<https://doi.org/10.1017/pds.2026.10677>

Enhancing engineering design learning: an educational case study with the systems engineering method matrix

Johannes Meyer, Apoorv Naresh Bhatt, David Inkermann

Clausthal University of Technology, Germany

This paper presents the Systems Engineering Method Matrix (SEMM), a tool that links activities, methods, and artefacts to address gaps in existing method repositories. SEMM enables artefact-consistent process modelling and supports method selection, planning, and documentation in engineering projects. A case study in a project-based engineering design course demonstrates that SEMM enhances students' conceptual understanding, broadens the range of methods, and provides instructors with a coherent framework for project planning.

<https://doi.org/10.1017/pds.2026.10667>

Review of a modular and scalable course concept for sustainable product development: a multi-institutional case study

Daniela Kattwinkel

Westfälische Hochschule, Germany

In order to respond to today's needs, engineers must be able to develop sustainable and environmentally compatible products and systems. To meet this requirement, new or adapted courses and curricula are needed in the field of engineering. This paper reviews the integration of a modular and scalable course concept for sustainable product development. The multi-institutional case study of 18 implementations across four German universities implies two primary models of use: stand-alone courses for specialisation and integrated modules for dissemination.

<https://doi.org/10.1017/pds.2026.10659>

Session
D226

Congress
Hall
Şipun

10:15
11:15

19 May

TUE



Implementation of sustainability in the product development process: a case study in the aerospace industry

Pauline L. Y. Léonard^{1,2}, *Johanna W. Nylander*¹

1: GKN Aerospace, Sweden; 2: Chalmers University of Technology, Sweden

Delving into a case company, this paper provides a practitioner perspective on implementing sustainable product development (SPD). Strategic implementation is achieved when i) tools are integrated at critical stages of product development, ii) awareness and responsibility are spread across the organization and iii) there is cohesiveness between tools sustainability approach and metrics used. While SPD tools are systematically used and help the company in capability building, the current process does not guarantee systematic sustainability improvements, calling for further research.

<https://doi.org/10.1017/pds.2026.10496>

From assessment to agency: designing a learner-led activity to map sustainable transformation in manufacturing organisations

Francesca Mattioli, Xue Pei, Silvia Maria Gramegna, Carmen Bruno, Erminia D'Itria, Michele Melazzini

Politecnico di Milano, Italy

Sustainability transitions in manufacturing require new competences and organisational learning. This paper presents Schedazioni, a learner-led assessment tool that helps companies analyse past sustainable design actions. Developed through case studies and a Research-through-Design process, and piloted in industry, it enables teams to map transformations, identify problems, and reflect on impacts. By shifting assessment to internal sensemaking, it supports shared understanding and strengthens sustainability capability.

<https://doi.org/10.1017/pds.2026.10498>

Driving product innovation for greenhouse gas reduction: insights from European manufacturing

*Thayla Zomer*¹, *Suzana Regina Moro*², *Paulo Cauchick Miguel*^{1,3}, *Rachel Rany Scabora*¹, *Daniel Lacerda*⁴, *Eduardo Zancul*¹

1: University of Sao Paulo, Brazil; 2: State University of Campinas, Brazil; 3: Pontifical Catholic University of Paraná, Brazil; 4: Federal University of Santa Catarina, Brazil

This paper aims to explore and categorize the product innovation initiatives that European manufacturing companies with science-based greenhouse gas (GHG) reduction targets are adopting to advance toward their decarbonization goals. An inductive analysis was conducted on climate change management reports from 326 European manufacturing companies. Two main categories of strategies emerged from the analysis: the development of new low-carbon products and the improvement of existing products. Within these categories, the study highlights specific initiatives adopted by companies.

<https://doi.org/10.1017/pds.2026.10526>

Embedding transdisciplinary conversation in design processes: a method for sustainability-oriented product design

Julia Gritzbach, Daniel Holder, Lisa-Marie Dyka, Wolfram Remlinger

University of Stuttgart, Germany

This paper introduces a method that embeds transdisciplinary conversations as structured reflection phases within the Double Diamond process model. Across two case studies, the approach shows how dialogue with diverse experts stimulates creative idea generation and sharpens the understanding of the interrelationships in sustainable systems. In this way, the method supports more well-founded design decisions and creative solutions for sustainability-oriented products.

<https://doi.org/10.1017/pds.2026.10486>



Expert-based evaluation of digital twin transfer potential for space systems applications

Leonhard Kessler, Emir Gadzo, Alexander Koch

Institute for Technical Product Development, University of the Bundeswehr Munich, Germany

Digital twin implementation in space systems lags behind product development maturity. This study evaluates transfer potential of digital twin approaches to space systems. Expert interviews (n=12) with product development and space specialists validated literature-based solution-challenge mappings. Abstraction level moderates transferability: organizational solutions transfer readily while technical solutions require space-specific adaptations. New Space contexts show higher transfer potential. The framework enables systematic digital twin implementation prioritization for space applications.

<https://doi.org/10.1017/pds.2026.10422>



DESIGN2026

Designing digital twins: a graph-based schema to enable systematic cost-benefit analysis

Adam McClenaghan, James Gopsill, Ben Hicks

University of Bristol, United Kingdom

This paper posits that a Digital Twin can be viewed as a collection of nodes and edges where nodes represent actions on/with data and edges represent the flow of data between nodes. The paper provides a schema whereby the nodes and edges can be defined and the costs and benefits can be attributed, as well as analysis techniques enabled by the schema. The potential of the schema in supporting the design of Digital Twins is then demonstrated through a worked example, in which it is shown that traditional bottom-up cost estimates significantly overestimate costs when compared with this approach.

<https://doi.org/10.1017/pds.2026.10429>

Potentials and challenges of the digital twin for product development: a systematic literature review

Timo Stauss, Linda Jansen, Johanna Wurst, Rayen Hamlaoui, Roland Lachmayer

Institute of Product Development, Leibniz University Hannover, Germany

Building and maintaining a digital twin requires considerable technical and financial effort. Thus, its economic viability depends on creating value across the full product lifecycle to balance the initial costs. Therefore, this study examines what potentials and challenges arise from the use of the Digital Twin throughout the product lifecycle with regard to its benefits for product development, using a systematic literature review. The identified factors were clustered and mapped to key components, highlighting the strengths and weaknesses of the individual components of the digital twin.

<https://doi.org/10.1017/pds.2026.10443>

Utilising 2D tracking to understand individual difference and personalisation in ergometer rowing

Isabelle Ormerod¹, Margo Bellamy¹, Andrea Braschi², Mike Fraser¹, Chris Snider¹

1: University of Bristol, United Kingdom; 2: University of Bath, United Kingdom

This study utilises low-cost 2D pose tracking to analyse individual technique differences in elite rowers. We established key biomechanical metrics, revealing variations linked to anthropometrics, training style and flexibility. A technique mapping tool was developed, providing objective insights that supplemented expert opinion. A pilot demonstrated the utility of this analysis to generate actionable insights for equipment personalisation. This showcases that low-cost automated methods can provide proactive and meaningful insights suitable for individualized training strategies.

<https://doi.org/10.1017/pds.2026.10433>

Session
D232

Congress
Hall
Bobara

11:30
12:30

19 May

TUE



How to develop a venture clienting strategy?

Mohammadhossein Chitsazzadeh ¹, Christian Koldewey ^{1,2}, Roman Dumitrescu ^{1,2}

1: Heinz Nixdorf Institute, Paderborn University, Germany; 2: Fraunhofer IEM, Germany



Venture Clienting enables firms to identify and realize innovation opportunities more rapidly through collaboration with start-ups. However, its implementation remains fragmented and prone to failure because organizations lack a coherent strategic architecture. This paper introduces the Venture Clienting Strategy Canvas, a single-view framework developed through Action Design Research. Fourteen essential elements were identified and organized into a layered structure. Applied in two firms, the canvas improved strategy design, articulation, and internal communication.

<https://doi.org/10.1017/pds.2026.10375>

Design for mission-driven technology maturation

Anita Friis Sommer ¹, Alessandro Pisanu ²

1: Aarhus University, Denmark; 2: University of Southern Denmark, Denmark

This paper investigates how advanced manufacturing firms mature technologies within mission-driven ecosystems. Two multi-partner case studies show how the design across six innovation dimensions—purpose, strategy, leadership, governance, innovation process, and budgeting & planning—enable co-maturation of novel technologies. Findings demonstrate that strategic partnerships with a shared mission, dual iterative/linear processes, and aligned governance accelerate mission-driven innovation from idea to scaled implementation.

<https://doi.org/10.1017/pds.2026.10389>

Development of perpetual innovative products: overcoming uncertainties by testing

Jonas Hemmerich ¹, Khadija Tahera ², Fabian Deeg ¹, Dominik Koch ¹, Gisela Lanza ¹, Sven Matthiesen ¹, Patric Graubeger ¹

1: Karlsruhe Institute of Technology, Germany; 2: The Open University, United Kingdom

Perpetual innovative products (PIPs) enable the reuse of components from previous generations to create new products with improved functionality and performance, supporting a circular economy. However, the concept entails uncertainties in design due to degradation and functional integration. This paper examines how testing can reveal and reduce these uncertainties through the analysis of testing activities. A four-step process is proposed that integrates testing in PIP development. The process strengthens decision-making by translating heterogeneous testing into actionable design knowledge.

<https://doi.org/10.1017/pds.2026.10395>

Bridging academia and industry: the role of consultants in implementing sustainable product development tools

Jesko Schulte ¹, Sophie I. Hallstedt ^{1,2}, Matilda S. Watz ¹

1: Blekinge Institute of Technology, Sweden; 2: Chalmers University of Technology, Sweden

Academic tools for sustainable product development often fail to achieve widespread use in industry. Based on a case study of a consultancy firm, this study explores factors that enable consultants to adopt and adapt such tools and act as intermediaries that translate and integrate academic findings into practice. Interviews and a survey revealed that a solid conceptual foundation, clear client value, result visualization, adaptability, and integration with existing workflows are most important, and the study proposes nine lessons learned to guide future tool development and collaboration.

<https://doi.org/10.1017/pds.2026.10440>



Sequencing idea factories | bridging creativity frameworks and domain-specific design practice

[Björn R. Kokoschko](#)^{1,2}, [Michael K. Schabacker](#)¹, [Keisuke Yamashita](#)³, [Martin T. Wiesner](#)²,
[Ramona Träger](#)¹, [Mas'udah](#)⁴, [Wanyu Xu](#)⁵

1: Otto von Guericke University Magdeburg, Germany; 2: Anhalt University of Applied Sciences, Germany;
3: University of Rostock, Germany; 4: Offenburg University of Applied Sciences, Germany; 5: Texas A&M
University, United States of America

This contribution addresses the lack of a structured framework for idea workshops in the Integrated Design Engineering (IDE) and resource-constrained settings. The current workshops in IDE are based on general creativity literature rather than on the processes and experiences inherent in IDE. This contribution derives a sequenced mode and integrates proposals to overcome helps to overcome common pitfalls. The sequencing shows best-practice in IDE and enables untrained users to enhance idea quality and process efficiency. The contribution offers a foundation for creativity technique assignment.

<https://doi.org/10.1017/pds.2026.10462>

Framing and reframing in design: the use of an NLP-based memory model

[Hernan Casakin](#)¹, [Anat Goldstein](#)¹, [John S. Gero](#)²

1: Ariel University, Israel; 2: Drexel University, United States of America

This study introduces an NLP-based Memory Model that structures how framing and reframing evolve throughout design. Grounded in constructive and situated memory theories, it models memory as a dynamic system of activation and decay, enabling measurement of the number and semantic value of frames in design discourse. Analyses of architecture students' sessions show framing peaks during exploration and declines as solutions stabilize. They also show semantic diversity cycles through expansion and narrowing, revealing framing as a continuous, memory-driven reinterpretive process.

<https://doi.org/10.1017/pds.2026.10456>



Session
D234

Congress
Hall
Orlando 2

11:30
12:30

Framing: a computable principle of design for systems

[Ansh Ranjan](#), [Vishal Singh](#)

Indian Institute of Science, Bangalore, India

Why do all design acts begin by explicating a bounded frame of work? In design ontology, framing is the selection and representation of components and features in a system to guide perception and decision of designers but remains implicit. As a structural abstraction it becomes an explicit principle, formalised by a computational methodology that parameterises bounds and projects elements of a design having weighted attributes, in a relational context. Thus, the cognitive act becomes epistemic to compute for generating and evaluating frames, aligning design reasoning with scientific discourse.

<https://doi.org/10.1017/pds.2026.10467>

19 May

TUE

Exploring design for environmental impact: expanding the context phase and problem framing

[Katerina Krsteska](#), [Els Du Bois](#)

University of Antwerp, Belgium

This paper proposes a practical reframing design thinking as early as possible in the design process, so that sustainability is treated as integral rather something to be retrofitted. We present the broadened context phase as the first part of the Impact Design process. This iterative set of steps help designers exploring environmental problem spaces before committing to a target group. We evaluated the approach with university students, in a sustainability course and a master project. Findings indicate that the method helps select the most impactful problem to address.

<https://doi.org/10.1017/pds.2026.10493>



Thermal process monitoring for part certification in material extrusion additive manufacturing

Sean H. Sasson, Christer W. Elverum, Sindre W. Eikevåg

Norwegian University of Science and Technology, Norway

Thermal history is critical to part performance and reliability in material-extrusion additive manufacturing. Using encoders and an infrared camera, we developed a method to generate thermal clouds, where each node has its distinct spatio-thermal data. Filters removed up to 20.68% of the data while preserving relevant thermal features. This study enables in-situ process monitoring that establishes the basis for part certification, particularly for high-performance polymers, and for predicting material strength from thermal clouds.

<https://doi.org/10.1017/pds.2026.10565>



Dimensional repeatability in additive manufacturing: assessment and design implications

Angelica Dianda, Lorenzo Maccioni, Yuri Borgianni

Free University of Bozen-Bolzano, Italy

This study evaluates the repeatability of print results in FDM through tests made with a generatively designed robotic limb. Five specimen were printed in two build orientations each with the same other process parameters. Deviations were measured via 3D scanning and CMM on both outer surfaces and functional features. Measured deviations exhibit small mean values and a clear orientation-dependent variability. As findings highlight deterministic effects in the propagation of deviations, design guidelines to improve repeatability of 3D prints are formulated as a result.

<https://doi.org/10.1017/pds.2026.10545>

A structured process for iterative DfAM: application to military individualisation

Siddhartha Biswas, Julius Cronau, Florian Engstler, Alexander Koch

University of the Bundeswehr Munich, Germany

Individualisation in military equipment aims to improve performance by aligning design with soldier-specific needs. Existing DfAM methodologies lack structured integration of user variability and iterative evaluation in defence contexts. This study develops an iterative DfAM process linking anthropometric input, additive strategy, constraints, and performance assessment. Demonstrated through a helmet liner case, three iterations addressed geometry, manufacturability, and impact-response behaviour within regulatory limits.

<https://doi.org/10.1017/pds.2026.10543>

Characterising thermal effects on ultimate tensile strength, strain, and tensile modulus by material extrusion of carbon fibre reinforced polyamide 6

Emil Blom Ørnes, Christer W. Elverum, Sean H. Sasson, Sindre W. Eikevåg

Norwegian University of Science and Technology, Norway

We experimentally characterise the effect of layer temperature on the mechanical properties of PA6-CF manufactured by MEX. Ultimate tensile strength (UTS) and tensile modulus was investigated across layer temperatures ranging from 67 °C to 165 °C. UTS increased from 7.55 MPa at 67 °C to 36.04 MPa at 165°, while tensile modulus increased from 1.6 GPa at 67°C to 4.0 GPa at 140 °C. Measurements on a manufactured component show in-process layer temperatures between 88 °C and 123 °C. These findings quantify the attainable performance window and implications for functional component design.

<https://doi.org/10.1017/pds.2026.10563>



More AI means less design? Empirical insights from design education

*Klemens Hohnbaum*¹, *Philipp Schröder*¹, *Josef Ponn*^{1,2}, *Markus Zimmermann*¹

1: TUM School of Engineering and Design, Technical University of Munich, Germany;

2: Hilti Entwicklungsgesellschaft mbH, Germany

Product development increasingly integrates generative AI tools to enhance creativity and efficiency. However, their actual impact on structured design work, particularly on method application and resulting designs, is not well understood. This study examines the effect of (1) method application quality on (2) product concept quality, influenced by (3) potential confounders like AI usage. Statistical analysis reveals that method application quality correlates positively with product concept quality, while higher AI usage correlates negatively with both, indicating limitations in AI usefulness.

<https://doi.org/10.1017/pds.2026.10656>



DESIGN2026

Generative AI adoption in engineering: a cluster analysis of student profiles for designing personalized learning support

Han Jin, Mathew Baby, Runu Prama Das, Tathyana Moratti, Michael B. Pagan, Beshoy W. Morkos

College of Engineering, University of Georgia, United States of America

The integration of Generative AI in engineering education requires a deeper understanding of diverse student adoption patterns. This study applies cluster analysis grounded in the Technology Acceptance Model and extended constructs on survey data to create different user profiles. Four distinct user profiles emerged: Empowered Optimizers, Mainstream Pragmatists, Skeptical Minimalists, and Ethical Achievers. The findings challenge one-size-fits-all approaches, providing a student-centred framework for designing tailored instructional strategies, GenAI training, and ethical guidelines.

<https://doi.org/10.1017/pds.2026.10658>

Drivers and barriers of learning MBSE: design and validation of a RAG-based AI chatbot leveraging smart views

*Felix Förster*¹, *Jaffar Ibrahim*¹, *Alexander Maack*¹, *Juliane Landwehr*^{1,2}, *Lydia Kaiser*^{3,4},

*Nikola Bursac*¹

1: ISEM - Institute for Smart Engineering and Machine Elements, Hamburg University of Technology, Germany;

2: TRUMPF SE + Co. KG, Germany; 3: Technische Universität Berlin, Germany;

4: Einstein Center Digital Future, Germany

Learning MBSE is hindered by abstraction and complex tools. This paper identifies barriers via literature review and interviews to design a RAG-based chatbot acting as a “smart view” for contextual guidance. Evaluated through a semester-long field study and a controlled experiment, the prototype shows high usability and reduces cognitive load. While performance is comparable to traditional e-books, the RAG-enabled system effectively mitigates entry-level barriers and aids authentic project work through stepwise tutoring, offering a scalable, interactive complement to MBSE education.

<https://doi.org/10.1017/pds.2026.10652>

Intelligent narratives: rethinking design education through the use of generative AI as a storytelling tool

Subinay Malhotra, Bruno Oro

Iowa State University, United States of America

This study explores how AI workflows and prompt engineering reshape storytelling in design education. Students utilized tools such as ChatGPT, Midjourney, Runway, and Meta Glasses to reframe existing projects through iterative scripting, image generation, and reflection. Analysis of 88 visual projects and over 80 videos showed a shift from static documentation to multimodal narratives. Findings suggest AI enhances communication fluency, engagement, and reflective practice through adaptive, platform-native storytelling.

<https://doi.org/10.1017/pds.2026.10665>

Session
D236

Congress
Hall
Şipun

11:30
12:30

19 May

TUE

53



DESIGN
2026

excellence in design



FROM DATA TO DESIGN: RETHINKING ENGINEERING DESIGN WITH NEXT-GEN AI

Dr Faez Ahmed

Associate Professor, Doherty Chair of Ocean Utilization, Department of Mechanical Engineering, Massachusetts Institute of Technology

Generative AI is transforming how we create, customize, and accelerate digital content. Yet applying these tools to engineering design introduces unique challenges, from maintaining precision under evolving requirements to working effectively in data-scarce environments and interpreting designer intent. In this talk, I will discuss these challenges and show how emerging engineering-focused foundation models are beginning to address them, reshaping workflows in areas such as vehicle design, CAD automation, and design optimization. I will highlight new opportunities enabled by generative AI that integrates multimodal data with engineering analysis and optimization, and present examples of AI-driven design co-pilots for complex engineering tasks. The talk will conclude with a forward-looking perspective on how AI can broaden design democratization, accelerate innovation cycles, and fundamentally reshape the role of engineers in the decade ahead.



BIOGRAPHICAL SKETCH

Dr Faez Ahmed is an Associate Professor of Mechanical Engineering at MIT, where he leads the DeCoDE Lab. His research focuses on AI for engineering design, including generative models, multimodal representations, and human–AI collaboration. His work has been recognized with the NSF CAREER Award, ASME DAC and DTM Young Investigator Awards, the Google Research Scholar Award, and the Amazon Research Award.

DESIGN2026

Session
D2-P

Congress
Hall
Ragusa

14:00
14:45

19 May

TUE



Addressing wellbeing, health, and inclusivity in sustainable design for mobility: Paris and Cairo

*Flore Vallet*¹, *Ghada Bouillass*², *Sherif Goubran*³, *Nabil Mohareb*³, *Virginia Bassily*³

1: Université de Technologie de Compiègne, France; 2: CentraleSupélec, France; 3: The American University in Cairo, Egypt



Cities play a major role in designing future mobility plans. Our question is how to contribute to sustainable mobility design while effectively accounting for social equity, health, and wellbeing considerations. After defining a list of mobility-related social issues, two stakeholder-based workshops with mobility users from two major cities, namely Paris and Cairo, were conducted. Participants explored mobility problems through eighteen purposive persona models in total. In Cairo, participants mainly reported safety and security issues while in Paris, mobility stress was dominant.

<https://doi.org/10.1017/pds.2026.10521>

Transition design for cultural inclusivity: a systemic service design perspective on the halal ecosystem

*Yasuyuki Hayama*¹, *Sabrina Suhaimi*², *Annisa Dhia Baswedan*²

1: Department of Strategic Design, Faculty of Design, Kyushu University, Japan; 2: Graduate School of Design, Kyushu University, Japan

Transition Design has gained attention for sustainability, yet its cultural dimensions remain underexplored. This paper introduces Transition Design for Cultural Inclusivity, examining the halal ecosystem in Fukuoka, Japan, as a case of cultural transition in a non-Islamic context. Using a systemic service design approach, the study maps the current ecosystem, envisions a 2045 inclusive future, and outlines transition pathways. The research contributes by addressing a gap and extending Transition Design into the cultural domain, highlighting its role in fostering inclusive futures.

<https://doi.org/10.1017/pds.2026.10622>

Designing an interregional innovation community for the circular economy

Svetlana Lange, *Ezgi Erdogan*, *Christian Köhler*

Saarland University of Applied Sciences, Germany



This contribution analyses key factors for establishing innovation communities within the circular economy. A mixed-method approach combines systematic literature review and a stakeholder survey to identify success conditions, governance requirements, and implementation challenges. The results underline the importance of open, interdisciplinary networks and adaptive, participative governance. Recommendations focus on iterative evaluation, stakeholder inclusion, and scalable models for long-term impact.

<https://doi.org/10.1017/pds.2026.10494>

Cultivating sustainable conditions for citizen(s)... through 'engaging design'

*Robert Phillips*¹, *Laura Ferrarello*²

1: Royal College of Art, United Kingdom; 2: École Polytechnique Fédérale de Lausanne, Switzerland

Design is transitioning modalities, from participation to deep engagement, creating active citizen(s). Authors define, communicate, and navigate post-participatory sustainable design, (interviewing 50+ project leaders), catalysing sustainable activities. Engaging Design, enables creative individuals, communities & collective action(s) to craft/design synergies: motivated by mutual respect, designing 'with' not for, shifts understandings' of public engagement, transcending disciplines, providing sustainable value. Analysis and insights, yield recipes to cultivate sustainable active citizen(s).

<https://doi.org/10.1017/pds.2026.10464>

Session
D241

Congress
Hall
Ragusa

15:15
16:15

19 May

TUE



Leveraging extreme-scale simulation data: a workflow framework for multidisciplinary simulator integration

Iris Graessler, Niklas Doehner

Paderborn University, Germany

Engineers simulate system behavior to support decisions in product engineering. Leveraging such engineering simulation data in strategic product planning can support idea generation and early evaluation of design alternatives and limitations. However, limited resources and expertise hinder broader uptake in strategic product planning. This paper investigates simulator integration into automated workflows and key processing components to enable simulation without in-depth expertise. This approach improves strategic product planning by creating data-based decision support.

<https://doi.org/10.1017/pds.2026.10394>

Towards an intelligent design support framework balancing risks and user experience: a case study in pharmaceutical packaging

Alessandra Bianco, Philip Farrugia, Maresca Attard Pizzuto

University of Malta, Malta

This paper presents a design support framework that focuses on linking product design with risk management within the pharmaceutical packaging industry. The framework is intended for use by packaging designers and adopts a multi-user perspective to identify design requirements and integrate them into risk mitigation activities. It promotes safe and effective packaging through proactive design, reducing costly redesign measures. A preliminary version is presented which has been developed through studies with key industry stakeholders, including pharmaceutical packaging designers.

<https://doi.org/10.1017/pds.2026.10392>

Touch experience framework for a data-informed design of textile surfaces

Bastian Quattelbaum¹, Maneesa Gunarathna¹, Kostas Styliadis^{2,3}

1: Hochschule Niederrhein University of Applied Sciences, Germany; 2: Intended Future, Sweden; 3: Chalmers University of Technology, Sweden

The present paper proposes a framework for translating lost haptic cues of textiles into digital environments with a view to reducing perceptual uncertainty in the context of online shopping. The model's integration of touch-related attributes and multimodal representations facilitates reliable customer perception, enhances material communication, and guides designers towards informed decisions. The paper outlines the challenges and opportunities inherent in the domain of multisensory digital textile experiences, while concurrently establishing a foundation for future research in this field.

<https://doi.org/10.1017/pds.2026.10399>

Identifying the right BOM setup in engineer-to-order companies: a focus identification model

Georgios Konstantinos Kourtis, Jonas Drewsen Andersen, Jacob Hedegaard Mortensen, Lars Hvam, Niels Henrik Mortensen

Technical University of Denmark, Denmark

Engineer-to-Order (ETO) companies often grow around ad-hoc know-how, and when they scale, usually they must standardize and choose a BOM setup, yet literature offers options but little guidance on how to decide. We propose a Focus Identification Model, a lightweight, tool-agnostic method that profiles context drivers, asks weighted decision questions, and links answers to a go-to setup with explicit governance. Calibrated on two industry cases, it yields a driver heatmap, decision matrix, and governance card to establish a common language and identify fit-for-purpose BOMs with less friction.

<https://doi.org/10.1017/pds.2026.10381>

Session
D242

Congress
Hall
Bobara

15:15
16:15

19 May

TUE



Why cost estimation matters for design decisions in the early phases of product development and what practitioners expect from artificial intelligence

Claudia Michelberger¹, Kevin Klöpfer², Marco F. Huber^{1,2}

1: Institute of Industrial Manufacturing and Management IFF, University of Stuttgart, Germany;

2: Fraunhofer IPA, Germany

In the early phases of product development, cost estimation is crucial for supporting design decisions. When cost estimates are inaccurate or delayed, design engineers cannot assess economic viability and may pursue concepts that later prove too costly. In this context, artificial intelligence (AI) offers new possibilities for more accurate and timely cost estimates, yet adoption in practice remains limited. Based on an interview study with 22 cost engineers and an online survey of 102 respondents, this study examines practices, challenges, and expectations for AI-assisted cost estimation.

<https://doi.org/10.1017/pds.2026.10430>

Co-designing responses to stakeholder misalignments in a complex infrastructure project: a design science approach

Zeinab Mowlaei, Nina Trauernicht, Jan Braaksma

Twente University, The Netherlands

Large infrastructure projects often face misalignments that Delays outcomes. This paper presents a co-design workshop addressing such challenges in a European railway project. Guided by complexity theory, the workshop enabled participants to reflect and co-create strategies for alignment. Pre/post surveys and facilitator observations show increased confidence and engagement, with notable awareness in addressing misalignments. These findings highlight co-design's value as an adaptive, participatory approach for creating recognition and managing complexity in interorganizational projects.

<https://doi.org/10.1017/pds.2026.10384>

Designing a decision tool to decide between two support methods for culture-sensitive creative problem-solving

Annika Bastian, Julia Fehrenbacher, Albert Albers

IPEK - Institute of Product Engineering, Karlsruhe Institute of Technology, Germany

To support culture-sensitive creative problem-solving in distributed product development, two methods, the CSS Method and the Guideline, were developed. This study presents a Decision Tool to help users select the appropriate method based on team context and goals. Using Design Research Methodology, the tool was developed, evaluated, and refined through initial expert validation. Results show the tool improves method selection and usability while highlighting room for improvements and real-world testing.

<https://doi.org/10.1017/pds.2026.10405>

Decide-Adapt-Reuse: a decision framework to reuse or adapt metamodels for new clinch joint designs

Jonathan-Markus Einwag, Sandro J. Wartzack, Stefan Goetz

Friedrich-Alexander Universität Erlangen-Nürnberg, Germany

Metamodels are replacing costly validation simulations and experiments in clinch joint design. If materials or conditions change, existing metamodels may no longer be reliable. This paper presents an approach that uses model uncertainty, the Coefficient of Prognosis and the R^2 score to decide if a model should be reused or recalibrated, or if fine-tuning is needed. Two case studies show that the framework can provide sufficient recommendations and reused, recalibrated and fine-tuned models can match new models while reducing simulation and training effort.

<https://doi.org/10.1017/pds.2026.10411>

Session
D243

Congress
Hall
Orlando 1

15:15
16:15

19 May

TUE



Comparing neural patterns of high and low performers in adapted alternate-use design tasks for idea generation

Peijing Jian ¹, John S. Gero ², Jiaying Zhang ¹, Alison Olechowski ¹

1: Mechanical and Industrial Engineering, University of Toronto, Canada; 2: Psychological and Brain Sciences, Drexel University, United States of America

This study examines neural differences between high- and low-performing designers using EEG. Participants viewed an image of IKEA furniture and created alternative designs. Performance was evaluated based on the composite of fluency, flexibility and originality scores. Results reveal that high-performing designers exhibited greater beta and gamma frequency band power in frontal and right-frontal regions compared to low-performers. Although these differences did not remain significant after multiple-comparison correction, their large effect sizes suggest meaningful neural distinctions.

<https://doi.org/10.1017/pds.2026.10461>

Neurocognitive assessment of generative AI on designers' creative cognition: evidence from biologically inspired design tasks

Rhea S Shrivastava ¹, Aditi Sharma ¹, Komal Dabas ¹, Deepayan Mukherjee ¹, Gaetano Cascini ², Sonal Keshwani ¹

1: Indraprastha Institute of Information Technology Delhi, India; 2: Politecnico di Milano, Italy

Designers use GenAI tools during bioinspired design (BID) process to understand biological inspiration. We investigate the influence of using ChatGPT with BID on their creative thinking. We present BID stimuli to 30 designers in three modes: BID only, ChatGPT only, and BID + ChatGPT; and record their EEG data across four design phases. Their creativity is analyzed through convergent and divergent thinking (CT and DT), measured by average β and α TRP, respectively. Results show that BID stimuli's influence on CT and DT is mode and phase dependent, indicating CT and DT as continuous processes.

<https://doi.org/10.1017/pds.2026.10469>

The impact of social condition on design cognition: a mixed-methods analysis of individual and group-based design processes

Muhammad Tufail, Hyunyim Park, Jeffrey Chun Fai Ho

School of Design, The Hong Kong Polytechnic University, Hong Kong S.A.R. (China)

We examine how the social condition of work influences design cognition. By applying cognitive load theory, we explore that individual work fosters internal self-regulation and user-centered pragmatism, whereas group work creates the collaborative substitution paradox, in which digital resources supplant interaction, thus encouraging external regulation and experiential narratives. The findings suggest that social conditions act as a moderator of cognitive load, indicating that individual work is beneficial for deep learning, while structured group work help mitigate substitution effects.

<https://doi.org/10.1017/pds.2026.10472>

Structuring the design space while exploring it: a cognitive perspective on design space exploration

Audrey Abi Akle

Université de Bordeaux, ESTIA-Institute of Technology, EstiaR, France

Design Space Exploration (DSE) supports the comparison of alternatives in complex, multi-objective problems. Despite advances in human-in-the-loop and visual analytics, most frameworks still assume a predefined design space. This paper reviews DSE and design cognition literature to reveal this conceptual gap and proposes a dynamic cognitive structure of the design space through an extended DSE framework, framing exploration as a co-evolution between cognition and representation.

<https://doi.org/10.1017/pds.2026.10359>

Session
D244

Congress
Hall
Orlando 2

15:15
16:15

19 May

TUE



AI as a copilot: novice perceptions of expert support in early design for additive manufacturing

Florian Bahr, Pascal Schmitt, Kilian Gericke

University of Rostock, Germany

This exploratory study examines what forms of expert support DfAM novices need and how they perceive AI-based expert systems. The results show that cognitive orientation, transparent communication and reliable information are most valued, while social or emotional expert attributes play a minor role. The study derives requirements for explainable, trustworthy AI support tailored to the early needs of DfAM.

<https://doi.org/10.1017/pds.2026.10542>

An iterative investigation of needs and barriers in deciding when to design for additive manufacturing

Tina Hajali¹, Arindam Brahma¹, Claudia Eckert¹, Ola Isaksson¹

1: Chalmers University of Technology, Sweden; 2: The Open University, United Kingdom

Industrial adoption of additive manufacturing (AM) remains limited, partly due to challenges in determining when AM is more suitable than conventional processes. Since this decision must be made early to enable effective design for AM, understanding the factors that shape such assessments is essential. This study used iterative need analysis and prototype development loops to investigate these factors. The findings identify key needs and barriers influencing early decisions on when to design for AM and show that effective support requires a deep understanding of the underlying problem.

<https://doi.org/10.1017/pds.2026.10555>

A conceptual tool to support the ecodesign of additively manufactured products

Cesare Chiacchietta, Marco Marconi

Università degli Studi della Tuscia, Italy

Additive manufacturing (AM) eases conventional manufacturing (CM) constraints allowing new design freedom. Yet designers still rely on experience and face AM high energy demand and variable waste benefits. This paper introduces an ecodesign approach to AM workflow through a tool comparing AM and CM via lifecycle metrics. The tool anticipates design and sustainability challenges providing environmental insights already at initial stages. This is highlighted with two use scenario: a new design and a redesign task. Future work involves tool development and validation with industrial case studies.

<https://doi.org/10.1017/pds.2026.10544>

Exploring TRIZ contradiction analysis in design for additive manufacturing: insights from expert interviews

Florian Günther¹, Alexander Patrick Schlegel¹, Robert Adunka¹, Theresa Stengel¹, André Goudriaan¹, Alexander Koch¹

1: University of the Bundeswehr Munich, Germany; 2: TRIZ Consulting Group GmbH, Germany

This paper examines whether the empirical knowledge of the TRIZ design theory is suitable for Design for Additive Manufacturing (DfAM). We systematically assess TRIZ engineering parameters (EP) and inventive principles (IP) in the context of contradiction analysis via DfAM, drawing on 11 semi-structured interviews. Findings indicate thematic alignment between DfAM methods and TRIZ IP, but reveal that the original TRIZ engineering parameters inadequately capture the multidimensional design space offered by DfAM. We outline directions to adapt the TRIZ EP for improved applicability.

<https://doi.org/10.1017/pds.2026.10553>



Mobile vs. head-mounted AR for learning additive manufacturing and supporting design creativity

Jinxue Cui ^{1,2}, Fabrice Mantelet ¹, Camille Jean ¹, Ruding Lou ¹, Frédéric Segonds ¹

1: Arts et Métiers Institute of Technology, LCPI, France; 2: Arts et Métiers Institute of Technology, LISPEN, France

This study examines how different AR platforms support learning and creativity in Additive Manufacturing (AM) education. Design students used either a smartphone- or headset-based AR app to explore virtual AM models before completing a design task and questionnaire. Expert reviews and Mann–Whitney U tests showed that headset AR users reported higher usability, better AM understanding, and produced more creative designs. The results highlight the educational value of immersive AR in enhancing technological comprehension and creative performance.

<https://doi.org/10.1017/pds.2026.10651>

Towards 4D instructions: augmented reality assistance for knowledge transfer

Ian Garcia, Jouke Verlinden
University of Antwerp, Belgium

Mixed reality assistance guide posture and hand positioning, and familiarize material behaviour within craft prototyping. The development of the resulting framework focuses on non-intrusive assistance. Barriers include reduced immersion, observing precise hand movements, limited spatial interpretation, and understanding material behaviour. A 3D animation prototype, with roots in embodied knowledge, intends to improve spatial comprehension and enhance process and material understanding. The eventual framework should aid virtual assistance for design skill transfer.

<https://doi.org/10.1017/pds.2026.10653>

A systematic review of myopia compensation techniques in HMDs

Jie Li, Carsten Stechert
Ostfalia University of Applied Sciences, Germany

Myopia remains a major barrier to immersive VR use, causing blur and discomfort. This review compares software, hardware, and hybrid compensation approaches. Software methods offer flexible, low-cost enhancement but limited optical correction. Hardware solutions provide accurate adjustment at ergonomic cost. Hybrid systems combine adaptive optics and real-time rendering, showing promise for personalized correction. Key trade-offs and future design directions are outlined.

<https://doi.org/10.1017/pds.2026.10427>

Evolving design education: mapping the integration of emerging technologies

Sora Lee-Remond ^{1,2}, Houssein Ballouk ^{1,2}

1: École Supérieure des Technologies et des Affaires (ESTA), France; 2: Université Marie et Louis Pasteur (UMLP), ELLIADD Laboratory (U.R. n°4661), Belfort, France

This study employs a hybrid bibliometric analysis and the TCM (Theory, Context, Method) framework to examine the integration of emerging technologies like AR, VR, and AI in design education. Utilizing VOSviewer and CiteSpace on Web of Science data, it identifies pivotal research clusters and trending topics. The analysis reveals a shift toward immersive representational ecosystems and highlights critical research gaps. Consequently, the paper proposes a preliminary conceptual framework for collaborative design, offering a roadmap for pedagogical and curriculum transformation.

<https://doi.org/10.1017/pds.2026.10664>

Session
D246

Congress
Hall
Şipun

15:15
16:15

19 May

TUE



HOW MODERN DESIGN WORKFLOWS ARE CHANGING WITH CLOUD-NATIVE CAD

HOSTED BY ONSHAPE/PTC

Chair:

Alexandru Dragos Cazacu

PTC, United Kingdom

This session explores modern engineering design workflows through an agile, cloudnative lens, focusing on how design teams ideate, iterate, and collaborate in complex product development contexts. Using the Onshape CAD and PDM platform, participants will examine how digital design practices are integrated into agile product development workflows that emphasize rapid iteration, shared ownership, and continuous refinement of design intent. The session highlights how cloudnative environments fundamentally reshape collaboration by enabling realtime codesign, builtin version and data management, and transparent design evolution without the friction of filebased workflows. Participants will also see how design data and analytics can be leveraged to support reflection, feedback, and assessment in educational and professional settings, reinforcing design decisionmaking rather than interrupting it.

Since this will be a hands-on session, please register in advance for a free Onshape account at <https://www.onshape.com/en/education/>.

Session
D252

Congress
Hall
Bobara

16:30
18:00

19 May

TUE



AI AND PUBLISHING SCIENTIFIC PAPERS: A DISCUSSION WITH DESIGN JOURNAL EDITORS

HOSTED BY DESIGN SCIENCE JOURNAL

Chairs:

Panos Papalambros

Editor-in-Chief, Design Science Journal, University of Michigan, United States of America

Anja Maier

Co-Editor-in-Chief, Design Science Journal, University of Strathclyde, United Kingdom

This panel session explores how artificial intelligence is transforming scientific publishing. The Design Science Journal has invited Chief Editors of design journals to share their thoughts and engage in a discussion. The session encourages an open dialogue among researchers and editors on current and future implications and impact of AI on publishing scientific papers, particularly in design. Example topics include conduct and reporting of research, paper composition, reviewing and referencing, ethical and policy questions.

Panel members:

- Jonathan Cagan, Co-Editor-in-Chief, Design Science Journal
- Gaetano Cascini, Editor-in-Chief, International Journal of Design Creativity and Innovation
- Amaresh Chakrabarti, Editor-in-Chief, Artificial Intelligence in Engineering Design and Manufacturing (remote)
- Lin-Lin Chen, Editor-in-Chief, International Journal of Design (remote)
- Roger Jiao, Editor-in-Chief, Journal of Engineering Design (remote)
- Peter Lloyd, Editor-in-Chief, Designing
- Jianxi Luo, Editor-in-Chief, Research in Engineering Design
- Carolyn Seepersad, Chief Technical Editor, ASME Journal of Mechanical Design (remote)

Session
D253

Congress
Hall
Orlando 1

16:30
18:00

19 May

TUE



DS MENTORING PROGRAM MEETING

HOSTED BY DS MENTORING PROGRAM

Chairs:

*Julie Stal-Le Cardinal
CentraleSupélec, France*

*Sophie I. Hallstedt
Chalmers University of Technology, Sweden*

Mentors and mentees from the current cohort will have been invited to share their mentoring experiences from this year in two separate groups. The goal will, then, be to present the findings from these discussions with a view to improving or modifying certain aspects of the program and to learn from one another.

This session is also open to anyone (potential mentors or potential mentees) who is interested in participating in the next mentoring program starting in September 2026.

Session
D254

Congress
Hall
Orlando 2

16:30
18:00

19 May

TUE



DS DFAM SIG COMMUNITY MEETING

HOSTED BY DS DESIGN FOR ADDITIVE MANUFACTURING SIG

Chair:

Tino Stanković

ETH Zurich, Switzerland

The aim of this meeting is to discuss future directions for the development of the DfAM SIG. It will also be an opportunity to meet new potential members. Indeed, anyone who is not yet a member but is interested in knowing more about the DfAM SIG and its initiatives is welcome to join.

DESIGN2026

Session
D255

Congress
Hall
Konavle

16:30
18:00

19 May

TUE



PHYSICAL SPACES IN THE DIGITAL ERA: BUILDING LIVING LABS FOR AI-ENABLED SUSTAINABLE DESIGN

HOSTED BY ERASMUS+ DETAILLS MEETING

Chairs:

Filippo Chiarello

Università di Pisa, Italy

Vito Giordano

Università di Pisa, Italy

An interactive session open to all conference participants on the role of physical spaces and Living Labs in the digital era, focusing on how universities can engage students and companies in AI-enabled sustainable design. The session would not be framed as a project meeting; rather, it would address a broader issue relevant to the DESIGN community, with DETAILLS presented as one case example.

Session
D256

Congress
Hall
Šipun

16:30
18:00

19 May

TUE



DESIGN
2026

excellence in design



08:45

D311: CONCEPTS, FRAMEWORKS AND PRACTICES IN CIRCULAR DESIGN
 Congress Hall Ragusa
 Chair: **Göran Broman**, Blekinge Institute of Technology, Sweden

D312: AI INTEGRATION AND PRACTICE IN DESIGN
 Congress Hall Bobara
 Chair: **Peter R. N. Childs**, Imperial College London, United Kingdom

D313: VISUALISING, COMMUNICATING AND NAVIGATING COMPLEX DESIGN SYSTEMS
 Congress Hall Orlando 1
 Chair: **Jean-François Boujut**, Grenoble INP, France

09:45

REFRESHMENT BREAK

10:15

D321: DESIGN FOR CIRCULARITY AND REMANUFACTURING
 Congress Hall Ragusa
 Chair: **Flore Vallet**, Université de Technologie de Compiègne, France

D322: ADOPTION OF GENERATIVE AI IN ENGINEERING DESIGN CHALLENGES AND PRACTICES
 Congress Hall Bobara
 Chair: **Nikola Vukašinić**, University of Ljubljana, Faculty of Mechanical Engineering, Slovenia

D323: ADVANCING PROTOTYPING METHODS AND PRACTICES
 Congress Hall Orlando 1
 Chair: **Filip Valjak**, University of Zagreb FA, Croatia

11:15

TRANSITION BREAK

11:30

D331: SUSTAINABILITY METHODS, METRICS AND DECISION SUPPORT
 Congress Hall Ragusa
 Chair: **Yuri Borgianni**, Free University of Bozen/Bolzano, Italy

D332: AI-AUGMENTED REQUIREMENTS ENGINEERING
 Congress Hall Bobara
 Chair: **Beshoy Markos**, University of Georgia, United States of America

D333: PROTOTYPING FOR DESIGN EXPLORATION AND DEVELOPMENT
 Congress Hall Orlando 1
 Chair: **Chris Snider**, University of Bristol, United Kingdom

12:30

LUNCH - RESTAURANT CAVTAT

14:00

D3-DD: DESIGN DEBATE (6TH EDITION)
 Congress Hall Ragusa
 Chair: **P. John Clarkson**, University of Cambridge, United Kingdom

15:15

REFRESHMENT BREAK

15:45

D341: METHODS AND TOOLS FOR PRODUCT CIRCULARITY ASSESSMENT
 Congress Hall Ragusa
 Chair: **Luke Gooding**, Stockholm Environment Institute - York, United Kingdom

D342: LLM-SUPPORTED USER RESEARCH
 Congress Hall Bobara
 Chair: **Katja Thoring**, Technical University of Munich, Germany

D343: DESIGN RESEARCH METHODS AND COMPLEXITY METRICS
 Congress Hall Orlando 1
 Chair: **Mario Štorga**, University of Zagreb FSB, Croatia

16:45

TRANSITION BREAK

17:00

D351: INTEGRATING LCA INTO DESIGN
 Congress Hall Ragusa
 Chair: **Mario Fargnoli**, Sapienza University of Rome, Italy

D352: AI-ASSISTED EVALUATION AND ESTIMATION IN ENGINEERING DESIGN
 Congress Hall Bobara
 Chair: **Vishal Singh**, Indian Institute of Science, India

D353: EXPLORATORY AND SPECULATIVE APPROACHES IN DESIGN
 Congress Hall Orlando 1
 Chair: **Gaetano Cascini**, Politecnico di Milano, Italy

18:00

20:00

CONFERENCE DINNER

22:00



<p>D314: KNOWLEDGE AND ORGANISATIONAL SYSTEMS IN ENGINEERING DESIGN Congress Hall Orlando 2 Chair: Thierry Gidel, Université de technologie de Compiègne, France</p>	<p>D315: DESIGN FOR HEALTHCARE SYSTEMS AND SERVICES Congress Hall Konavle Chair: Valeria Pannunzio, TU Delft, The Netherlands</p>	<p>D316: EXPLORING GEOMETRY FOR ADDITIVE MANUFACTURING Congress Hall Šipun Chair: Ajit Panesar, Imperial College London, United Kingdom</p>	<p>08:45</p>
<p>09:45</p>			
<p>D324: AI-DRIVEN KNOWLEDGE DISCOVERY FROM ENGINEERING DOCUMENTS Congress Hall Orlando 2 Chair: Ji Han, The University of Exeter, United Kingdom</p>	<p>D325: DESIGN FOR SUSTAINABLE AND CIRCULAR HEALTHCARE Congress Hall Konavle Chair: Anja Maier, University of Strathclyde, United Kingdom</p>	<p>D326: AI-DRIVEN DESIGN AND PERFORMANCE ANALYSIS IN ADDITIVE MANUFACTURING Congress Hall Šipun Chair: Jonathan Cagan, Carnegie Mellon University, United States of America</p>	<p>10:15</p>
<p>11:15</p>			
<p>D334: DESIGN KNOWLEDGE REPRESENTATION AND USE Congress Hall Orlando 2 Chair: Clement Fortin, Skolkovo Institute of Science and Technology, Russian Federation</p>	<p>D335: DESIGNING HEALTHCARE SYSTEMS AND SERVICES Congress Hall Konavle Chair: Els Du Bois, University of Antwerp, Belgium</p>	<p>D336: DATA-DRIVEN AND MULTI-MATERIAL DESIGN IN ADVANCED DFAM Congress Hall Šipun Chair: Tino Stanković, (ETH Zurich, Switzerland)</p>	<p>11:30</p>
<p>12:30</p>			
<p>DESIGN DEBATE (6TH EDITION): ALL DESIGN RESEARCHERS SHOULD HAVE CLEAR EVIDENCE OF DESIGN PRACTICE DEBATE TEAMS: Maike Kleinsmann (TU Delft, The Netherlands) and Jiwon Jung (TU Delft, The Netherlands) Bernard Yannou (CentraleSupélec, France) and Audrey Abi Akle (ESTIA, France)</p>			
<p>14:00</p>			
<p>D344: STRUCTURAL COMPLEXITY AND INTERFACE MANAGEMENT Congress Hall Orlando 2 Chair: Sven Matthiesen, Karlsruhe Institute of Technology, Germany</p>	<p>D345: INTEGRATING USER INSIGHTS IN DESIGN Congress Hall Konavle Chair: Saeema Ahmed-Kristensen, University of Exeter, United Kingdom</p>	<p>D346: ENGINEERING APPLICATIONS IN ADDITIVE MANUFACTURING Congress Hall Šipun Chair: Eckhard Kirchner (TU Darmstadt, Germany)</p>	<p>15:15</p>
<p>15:45</p>			
<p>D354: RESILIENCE AND COMPLEXITY IN ENGINEERING SYSTEMS Congress Hall Orlando 2 Chair: Panos Y. Papalambros, University of Michigan, United States of America</p>	<p>D355: EMOTIONAL, COGNITIVE AND SENSORY ASPECTS OF USER EXPERIENCE IN DESIGN Congress Hall Konavle Chair: Chajoong Kim, UNIST, Korea, South Korea</p>	<p>D356: SIMULATION-DRIVEN DESIGN OF ENGINEERING SYSTEMS Congress Hall Šipun Chair: Dragan Žeželj, University of Zagreb FSB, Croatia</p>	<p>16:45</p>
<p>17:00</p>			
<p>18:00</p>			
<p>20:00</p>			
<p>22:00</p>			



Analysis of product life cycles in the context of the circular economy and its strategies

Merlin Gerald Stoelzle, Daniel Roth, Matthias Kreimeyer

University of Stuttgart, Germany

The product life cycle (PLC) is the basis for every development task. Its modeling is especially important in the context of the circular economy, as recirculation within the PLC forms its basic concept. To derive requirements for circular products, it must be known which phases are to be passed through within which circular strategy. This paper links R-strategies and life cycle phases by analyzing 56 life cycle models in regard to the number of phases, sequence, and other characteristics. A dependency matrix consolidated from the life cycles allows the findings to be utilized further.

<https://doi.org/10.1017/pds.2026.10516>

Circular design meets environmental sensing: a comparative study

Rachel Thomson, Steven Birnie, Richard Millar

University of Strathclyde, United Kingdom

This design-led study explores how circular economy principles can be embedded in research prototyping while comparing environmental sensing methods. A reusable outdoor prototype, deployed in three contexts, combined embedded sensors and API data. Using proxy indicators (energy, material mass, emissions) and end-of-life planning, API sensing indicated a far lower impact, while embedded sensing offered hyper-local data. All prototype components were either reused or repurposed, demonstrating circular prototyping in practice, with findings intended as design-informing rather than definitive.

<https://doi.org/10.1017/pds.2026.10572>

Towards collaboration in circular ecosystems: barriers, enablers, and insights from European projects

Giliam Dokter¹, Xue Pei², Sophie I. Hallstedt¹

1: Division of Product Development, Department of Industrial and Materials Science, Chalmers University of Technology, Sweden; 2: Department of Design, Politecnico di Milano, Italy

This study examines barriers for circular ecosystems in literature, and identifies 11 enabling factors for collaboration in circular ecosystems. Based on a web-based analysis of 763 European CE projects, the study analyses how factors are addressed in practice. Collaborative processes, trust building, and technological enablers were most frequent, supporting relational foundations via digital tools. Projects often signal collaboration but rarely detail governance or ecosystem orchestration. Findings highlight design capabilities to foster shared-value creation in circular ecosystems.

<https://doi.org/10.1017/pds.2026.10482>

A systematic review on the implementation of Cradle to Cradle in product development

Alexander Roith^{1,2}, Arthur Seibel¹

1: Leuphana University Lüneburg, Germany; 2: Siemens Healthineers AG, Germany

Cradle to Cradle (C2C), as an eco-effective approach to the circular economy, helps mitigate the environmental impacts of the linear economy; however, its implementation in product development remains challenging. Due to limited prior reviews, this research investigates the implementation of C2C in product development. Through a systematic literature analysis, we identify key topics and challenges and examine how eco-efficiency and eco-effectiveness are addressed. Based on these findings, future research should develop a framework for implementing eco-effectiveness in product development.

<https://doi.org/10.1017/pds.2026.10510>



A structural framework for generative engineering and design assistance systems development

Timo Köring, Detlef Gerhard
Ruhr-Universität Bochum, Germany

Engineering software is evolving through the integration of artificial intelligence, creating new opportunities for enhanced assistance within product development. This paper proposes a use context model to systematically align and classify the functionalities of Generative Engineering and Design software with respect to the combination of product development phase, the nature of the task, and the level of support provided. Based on this model, a methodological guideline is proposed, offering a structured framework for the development and application of these tools in product development.

<https://doi.org/10.1017/pds.2026.10596>

Human-AI co-creation: why, what, and how?

Runtao Ren¹, Jian Ma¹, Jianxi Luo²

1: Department of Information Systems, City University of Hong Kong, Hong Kong S.A.R. (China);
2: Department of Systems Engineering, City University of Hong Kong, Hong Kong S.A.R. (China)

The rapid diffusion of generative AI is pushing creative work toward human–AI co-creation (HAIC). This paper designs a conceptual HAIC model that specifies several indispensable elements of effective co-creation: Human, AI, Artifact, Instruction, and Interaction. We demonstrated through a case study of a large-scale management information system development project how the HAIC model helps organizations implement HAIC. The proposed framework offers both an analytical lens for researchers and prescriptive guidance for practitioners seeking to engineer reliable human–AI collaboration.

<https://doi.org/10.1017/pds.2026.10608>

Handling AI-generated knowledge artifacts in generative product engineering

Martin Becker¹, Damun Mollahassani¹, Simon Schleifer², Stefan Goetz², Sandro J. Wartzack², Jens C. Göbel¹

1: RPTU University Kaiserslautern-Landau, Germany; 2: Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Development of complex interdisciplinary products increases engineering challenges, that AI supported engineering approaches attempt to reduce by increasing automation. The resulting AI generated engineering artifacts, however, need to be classified, verified and managed to enable traceability and auditability of engineering decisions. This paper presents a classification and management approach for these artifacts, allowing verification of AI generated engineering artifacts. A use case on the iterative development of an e-bike demonstrates the approach.

<https://doi.org/10.1017/pds.2026.10575>



Reframing AI readiness: a multi-dimensional use case-centered AI readiness framework

Benedikt Müller, Daniel Roth, Matthias Kreimeyer
University of Stuttgart, Germany

A technology-oriented approach to AI predominates in research and practice, yet despite a high level of technological readiness, projects often fail due to poor domain-specific problem framing and data quality in early-stage AI system development. This contribution conducts an analysis of existing AI-related readiness models, to identify gaps in addressing these factors. The use case-centered AI readiness level framework is proposed on the basis of these findings – a unified, evidence-based model that links problem, data, and technology readiness across planning and implementation stages.

<https://doi.org/10.1017/pds.2026.10605>

Session
D312

Congress
Hall
Bobara

08:45
09:45

20 May

WED



Visualizing and structuring complex bills of materials: a framework for enhanced engineering operations in custom manufacturing

*Georgios Konstantinos Kourtis*¹, *Lars Hvam*¹, *Mariana Fernandez Correa*², *Sara Johnsen*²

1: Technical University of Denmark, Denmark; 2: NKT Photonics, Denmark

Custom manufacturers of engineered products face growing challenges in managing complex and variant Bills of Materials (BOMs). This paper proposes a visualization-driven framework for structuring and analyzing overcomplete (150%) BOMs in Engineer-to-Order environments. The framework integrates configurator rule logic, generic BOM structures, and metadata to enable explicit traceability and diagnostic analysis of variant-specific BOMs. A proof-of-concept prototype evaluated in a European fibre-laser manufacturer demonstrates support for variant validation, error detection, and alignment.

<https://doi.org/10.1017/pds.2026.10424>

Virtual reality-supported empathy in design: experimental evidence on problem framing and ideation

Xinhui Hu^{1,2}, *Hernan Casakin*³, *Georgi V. Georgiev*^{4,1}

1: Center for Ubiquitous Computing, University of Oulu, Finland; 2: School of Information Sciences, University of Illinois Urbana-Champaign, United States of America; 3: School of Architecture, Ariel University, Israel; 4: Japan Advanced Institute of Science and Technology, Japan

Gaps in lived experience hinder designers from understanding users. Virtual Reality (VR) may bridge this gap with immersive simulations, but its validity lacks comprehensive examination. This study addresses that gap via a VR scenario simulating the challenges of essential tremor (involuntary hand movements). Following the experience, designers demonstrated significantly enhanced empathy and a deeper user understanding. This translated into more accurate and contextually grounded problem framing. Designers' rationales also suggest they intuitively internalized core design thinking principles.

<https://doi.org/10.1017/pds.2026.10418>

A product-oriented visualization method supporting communication and planning in engineering reviews

*Pascal Kull*¹, *Tjark Sievers*¹, *Michael Schlegel*², *Felix Förster*¹, *Albert Albers*², *Nikola Bursac*¹

1: ISEM - Institute for Smart Engineering and Machine Elements, Hamburg University of Technology, Germany; 2: IPEK - Institute of Product Engineering, Karlsruhe Institute of Technology, Germany

In iterative product development, teams encounter various issues, such as difficulty communicating easily with stakeholders during reviews or internally during sprint planning. The present paper proposes a product-oriented visualization method that highlights engineering changes and deviations, enhances communication, anchors review feedback directly to components, and supports deriving actionable planning steps. Its implementation in development settings has demonstrated the enhancement of transparency, shared understanding, and traceability.

<https://doi.org/10.1017/pds.2026.10426>

A design tool to support the specification of mixed reality prototypes

Chris Cox, *Chris Snider*, *Aman Kukreja*, *Isabelle Ormerod*, *Robert Ballantyne*, *Adam McClenaghan*, *James Gopsill*, *Ben Hicks*

University of Bristol, United Kingdom

Mixed Reality (MR) prototyping offers significant design opportunities but introduces complexity in prototype specification. This paper presents a card-based design tool to support designers in this specification process. The tool is based on a comprehensive taxonomy of MR prototype fidelity and foundational research into the interplay between, and value of, different physical and virtual characteristics. A validation study demonstrates that the developed tool supports and guides designer reasoning, resulting in higher quality MR prototypes with stronger rationale for their implementation.

<https://doi.org/10.1017/pds.2026.10410>





Be yourself – be an engineer: personal strengths and value in an interconnected engineering ecosystem

[Claudia Eckert](#)^{1,2}, [Sophie I. Hallstedt](#)²

1: *The Open University, United Kingdom*; 2: *Chalmers University of Technology, Sweden*

Engineers need to connect knowledge, based on science and technology, with knowledge about humans and society. To operate in a sociotechnical context a variety of different people with different skills are needed. This paper argues that therein lies an opportunity for all who have the skills and interests to find a fulfilling role in engineering that aligns interests in technical task, their role, their identity, their personal strengths and their values, illustrated by women in engineering and sustainability.

<https://doi.org/10.1017/pds.2026.10393>

Navigating knowledge silos and system distrust in cross-sectoral R&D

[Arina Karamova](#), [Clement Fortin](#), [Alexey Nikolaev](#)

Skolkovo Institute of Science and Technology, Russian Federation

Knowledge management (KM) is crucial for efficient cross-sectoral R&D. Our study, performed with academic and industry experts (n=17), reveals a deep distrust in formal KM platforms and a high reliance on personal networks. Based on the findings of how the personal networks serve for knowledge management and exchange, we propose a concept and basic design requirements for an AI-powered 'knowledge orchestrator'. Accounting the promise and the capabilities of the modern AI, this AI-powered 'knowledge orchestrator' may serve as a new generation of KM system for modern cross-sectoral R&D.

<https://doi.org/10.1017/pds.2026.10396>

The seven parameters of organizational change

[Olivier Bertrand](#)^{1,2}, [Ludivine Calamel](#)³, [Mickaël Gardoni](#)⁴, [Julie Stal-Le Cardinal](#)^{1,2}

1: *CentraleSupélec, France*; 2: *Université Paris Saclay, France*; 3: *Grenoble Ecole de Management, France*; 4: *École de technologie supérieure, Canada*

Here we propose seven meta-theoretical parameters of change (7MTPC)—Plannability, Manageability, Stability, Trajectory, Origin, Motor, and Scale—to provide a shared coordinate system for comparing organizational change approaches. Derived from classic and contemporary theories, the 7MTPC make explicit the assumptions about predictability, agency, and causality that underlie them. The framework offers scholars and practitioners a common language to map, contrast, and combine models, towards a systematic and evolutionary understanding of organizational change.

<https://doi.org/10.1017/pds.2026.10374>

Capability-based engineering transformation – the periodic table of engineering capabilities

[Fabian Wyrwich](#)¹, [Fabian Hanke](#)¹, [Malte Trienens](#)¹, [Aschot Hovemann](#)¹, [Roman Dumitrescu](#)²

1: *Fraunhofer IEM, Germany*; 2: *Heinz Nixdorf Institute, Paderborn University, Germany*

The increasing digitalization and connectivity of development processes are forcing companies to transform their engineering comprehensively. The presented engineering reference capability map provides a structured framework for this transformation. The capability map is a four-level hierarchical model, contains essential engineering capabilities and is inspired by the periodic table of elements. Standardized profiles describe the characteristics and dependencies of each capability. The map serves as a reference framework for identifying gaps, potential, and development needs in engineering.

<https://doi.org/10.1017/pds.2026.10402>

Session
D314

Congress
Hall
Orlando 2

08:45
09:45

20 May

WED



Seeing like nature: designing health communication with biomimetic patterns exemplified in COVID-19 prevention

Nicholas Ciccone ¹, Anja Maier ²

1: Independent researcher; 2: University of Strathclyde, United Kingdom

Visual communication plays a vital role in conveying public health messages, yet design quality and effectiveness vary. This online study with 16 designers examined whether applying evolutionary psychology theory enhances designers' understanding, acceptance, visual cohesion of materials, and the effect of embedding biomimetic patterns. COVID-19 posters were used as context. Theory informed posters showed greater cohesion and were rated as more attention-grabbing. Results raise questions over tensions between theory- and creative demands and highlight designers' impact on health communication.

<https://doi.org/10.1017/pds.2026.10530>

Relational design experiments for improved health care access for persons who sell sexual services in Trondheim

Brita Fladvad Nielsen, Milagros Hurtig, Emma Erikstad Rutherford, Vilde Aurora Halle Tvedten, Ole Edward Wattne, June Kyong Trondsen

Norwegian University of Science and Technology, Norway

Nadheim offers healthcare to persons selling sexual services. Using relational, feminist, and system-oriented design, a rich design methodology combined cultural probes, vignette studies, and giga mapping uncovered issues of service fragmentation, stigma, and digital exclusion. A co-created digital tool offering anonymous, centralized access to health, legal, and support services. An added speculative concept imagines a sex worker union to allow for radical change. Findings highlight trust, inclusion, and co-agency, positioning design as a catalyst for social justice.

<https://doi.org/10.1017/pds.2026.10537>

Exploring a regulatory mapping approach for designing digital mental health interventions within the EU context

Heimin Kang ¹, Jiwon Jung ^{1,2}

1: Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands;

2: Surgery Department, Erasmus University Medical Center, The Netherlands

As digital mental health interventions expand, integrating EU regulations into the design process remains essential but challenging due to their complexity. This study explores how the GDPR, AI Act, EHDS, HTA, MDR, and IVDR influence the design of AI-based mental health chatbots by mapping them onto a framework. The proposed mapping approach provides an overview of the regulatory landscape at each stage, revealing tensions between innovation and compliance as well as opportunities to use regulatory principles as structured checkpoints that guide responsible digital mental health design.

<https://doi.org/10.1017/pds.2026.10535>

Data-informed healthcare service design for multiple long-term conditions using online patient stories

Ji Han, Marta Staff, Saeema Ahmed-Kristensen

University of Exeter, United Kingdom

Conventional service design methods are valuable for improving healthcare experience, but are limited in scale and information capture. Based on a constructed database of 2,320 stories from patients and carers with multiple long-term conditions (MLTC), this paper shows how real-life experiences can be used to inform healthcare service redesign. By combining the richness of qualitative insight with the breadth and representativeness of large-scale data, it identifies "Continuity of care", "Care coordination", and "Temporal - Access to services" as the priority redesign opportunities for MLTC.

<https://doi.org/10.1017/pds.2026.10532>



Design for AM: the impact of the shell feature on the residual stress in directed energy deposition components

James Gopsill, Omar Yasin, Aman Kukreja
University of Bristol, United Kingdom

Residual stress is inherent in Additive Manufacturing process due to the heat cycling of the material being deposited on the build plate. The manufacturing toolpath can have a considerable effect on the development of residual stress distribution within a component. This paper examines the impact of the shell feature to generate some design heuristics on whether to include it when residual stress is of concern. The stress feature did increase the residual stressed observed during printing but was mitigated by the cooling regime after the process was complete.

<https://doi.org/10.1017/pds.2026.10551>

Geometry-based estimation of manufacturing complexity of fused filament fabrication printed products

Andreas Kormann, Tobias Rosnitschek, Stephan Tremmel
University of Bayreuth, Germany

We present a geometry-based complexity factor for additive manufacturing that estimates relative printing effort of fused filament fabricated parts from STL geometry alone. A reference effort is derived by slicing thousands of parts and volume-equivalent cubes. Eight interpretable geometric metrics feed a constrained, regularised index with monotonic calibration, achieving robust test accuracy and revealing which shape features dominate structural complexity.

<https://doi.org/10.1017/pds.2026.10556>

Automation of part preparation for PBF-LB/M-based additive repair of turbine blades

*Myriam Maalaoui¹, Hans-Henrik Westermann², Jens Niedermeyer¹, Marcus Oel¹,
Lennart Mesecke¹, Weijia Yu¹, Ina Meyer¹, Roland Lachmayer¹*

1: Institute of Product Development (IPeG), Leibniz University Hannover, Germany;

2: MTU Maintenance Hannover GmbH, Germany

Turbine blades are high-value components whose replacement is costly and slow, increasing the demand for effective repair strategies. Although PBF-LB/M supports precise additive repair, its application is limited by manual and time-intensive part preparation. This work introduces an automated digital workflow for cutting plane definition, repair geometry reconstruction and part alignment, improving reproducibility and reducing preparation time in PBF-LB/M-based turbine blade repair.

<https://doi.org/10.1017/pds.2026.10558>

Session
D316

Congress
Hall
Şipun

08:45
09:45

20 May

WED



Understanding the growing need for design for circularity – investigating remanufacturing profitability barriers in an automotive industry case

Malin Hane Hagström, Ola Isaksson, Dag Bergsjö, Stina Lundin
Chalmers University of Technology, Sweden

For industries transitioning to circular economy, understanding the business case is essential. This paper highlights key business model factors for remanufacturing within a heavy truck manufacturer. Twenty-six interviews were held, the barriers to profitability were identified as cost structure, key resources and cores and key activities. Applying systems engineering principles can help translate business needs into requirements, mitigate complexity and align stakeholders for effective transformation. Recommended future research is to investigate partnerships, profitability, and model design.

<https://doi.org/10.1017/pds.2026.10489>

Operationalising sustainability in engineering design – towards a methodological framework for design for R

Jorin Thelemann, Johanna Wurst, Roland Lachmayer
Leibniz University Hannover, Germany

This paper presents a novel research and development framework for “Design for R” (DfR), which aims to systematically translate R strategies into actionable targets in engineering design. Building on the principles of Design for X and guided by the Design Research Methodology, it outlines a comprehensive research structure for developing, testing, and iteratively refining the DfR approach. The goal is to facilitate specific and robust technical solutions as well as practically applicable sustainability integration at the product level through structured methods, tools, and design principles.

<https://doi.org/10.1017/pds.2026.10517>

LCA simplification in the context of packaging reuse loops

Juan Sebastian Rodriguez Florez, Gwenola Yannou-Le Bris, Juliana Serna
Université Paris-Saclay, INRAE, AgroParisTech, UMR SayFood, France

This paper shows the implementation of the Global Sensitivity Analysis (GSA) as a Life Cycle Assessment simplification (LCA) method to identify the most influential design parameters for the design of packaging reuse loops. The practical execution of GSA relies on Monte Carlo simulations to propagate the input parameter effects in the LCA model and Sobol indexes to quantify the variance contribution of each parameter. This methodology was applied to a case study in the French region of Île-de-France. This method allows identify the key design parameters to prioritize the design key decisions.

<https://doi.org/10.1017/pds.2026.10508>

How do design-related remanufacturing barriers and enablers affect business models? A retrospective analysis of remanufacturing cases

François Haeberle, Tim C. McAloone, Daniela C. A. Pigosso
Technical University of Denmark, DTU Construct, Denmark

Remanufacturing can be facilitated by design activities considering value creation, preservation, and recovery. Design-related decisions for remanufacturing can affect the performance of business models, but there is a lack of literature to identify these barriers or enablers. Through an analysis of selected remanufacturing cases, an initial step to bridge this gap is provided. Findings highlight the potential of design for remanufacturing for enhanced value creation processes and new service offerings, and present recurrent barriers and enablers to remanufacturing in the cases.

<https://doi.org/10.1017/pds.2026.10488>



Challenges hindering the application of GenAI methods in engineering design and the product development process: a meta-analysis

Elias Berger^{1,2}, *Jan Henke*^{1,2}, *Jan Mehlstäubl*², *Kristin Paetzold-Byhain*¹
1: Dresden University of Technology, Germany; 2: MAN Truck & Bus SE, Germany

While studies on generative artificial intelligence for product development have gained momentum, they consistently report recurring challenges. To synthesize these obstacles, we surveyed 1074 papers, resulting in a taxonomy of 27 distinct barriers. The study analyzes their frequency, discusses their interrelations, and contextualizes their root causes. Our findings show that model capability, output validity, and user trust are the most dominant obstacles, while aspects like environmental concerns are often overlooked. The study concludes with recommendations for research and practitioners.

<https://doi.org/10.1017/pds.2026.10576>

How are professional practices adopting generative AI? The case of an engineering design and product development team

*Thom Luke*¹, *David Mesa*², *Linus Tan*¹, *Jo Kuys*¹, *Anita Kocsis*¹
1: Swinburne University of Technology, Australia; 2: Universidad EAFIT, Colombia

Generative Artificial Intelligence (GenAI) is transforming design practice yet research lacks empirical insights into adoption in real-world design organisations. Through the case study of a European automotive OEM, we found that GenAI could accelerate ideation, but adoption was limited due to critical concerns regarding intellectual property, data security, originality, and the risk of skill atrophy. Thus, organisational capabilities like workflow specific training, transparent governance of data protection policies, and cohesive toolchains are needed for successful GenAI integration.

<https://doi.org/10.1017/pds.2026.10600>

What designers need from agentic AI: case of circularity and CMF design

Kostas Styliadis^{1,2}, *Bastian Quattelbaum*³, *Cyriel Diels*⁴, *Rikard Söderberg*¹
1: Chalmers University of Technology, Sweden; 2: Intended Future, Sweden; 3: Hochschule Niederrhein University of Applied Sciences, Germany; 4: Royal College of Art, United Kingdom

Colour, Material and Finish (CMF) designers face rising circularity demands but lack tools that combine reliable data, traceable reasoning and creative control. This paper reports a case study with automotive CMF designers, identifying pain points in data access, evaluation of circular options, authorship and trust in AI. We propose design requirements and a conceptual model for agentic AI systems that support circular CMF work while preserving designer agency, accountability, and confidence in material decisions.

<https://doi.org/10.1017/pds.2026.10615>

Still no smart service? A review of technical barriers to smart service adoption in the GenAI era

*Tim Heuwinkel*¹, *Julian Weller*¹, *Stefan Gabriel*¹, *Christian Kürpick*¹, *Roman Dumitrescu*^{1,2}
1: Fraunhofer IEM, Germany; 2: Chair for Advanced Systems Engineering, Heinz Nixdorf Institute, Paderborn University, Germany

OEMs are shifting from product-centric offerings toward smart services, but adoption is still hindered by technical development barriers. We conduct a systematic literature review of peer-reviewed studies with original industrial evidence and identify eight barrier categories across data, semantics, integration, governance and modularity. We map them onto a smart-service architecture and key analytics roles, and relate them to GenAI building blocks such as LLMs and knowledge graphs, outlining a research agenda for overcoming technical barriers towards scalable OEM smart service development.

<https://doi.org/10.1017/pds.2026.10592>

Session
D322

Congress
Hall
Bobara

10:15
11:15

20 May

WED



The industrial perspective on the value of immersive reality design technologies

*Chris Snider*¹, *Chris Cox*¹, *Aman Kukreja*¹, *Jonny Waller*², *Sam Hyde*³

1: University of Bristol, United Kingdom; 2: Ensera Design, United Kingdom; 3: Advanced Manufacturing Research Centre, United Kingdom

While Immersive Reality (XR) design tools continue to emerge, the industry perspective on their value is unclear. This paper presents outputs of a workshop with 16 design experts testing a wide range of XR design tools. Value exceeding that of traditional tools was reported, driven by human-centric affordances like flexibility, interactivity, and response rate. Perceived detriments were linked to implementation challenges, such as fidelity and skill. Findings validate XR's potential in design and direct future work towards overcoming key technical hurdles to unlock its value.

<https://doi.org/10.1017/pds.2026.10442>

A lean experimental approach for proof-of-concept investigation

Charlotte Breuning, Matthias Kreimeyer

University of Stuttgart, Germany

This study presents a lean experimental method for investigating Proofs of Concept (PoCs) in early product development. By adapting and extending Design of Experiments (DoE) with complementary frameworks, the method enables efficient identification of minimal functional parameter sets. Based on a cube-oriented model and iterative one-factor-at-a-time (OFAT) testing, the design space is systematically refined. Experimental validation on a smart shaft-hub connection demonstrates the method's effectiveness in reducing required samples while ensuring feasibility.

<https://doi.org/10.1017/pds.2026.10407>

Rapid prototyping PCBs: recommendations for utilising PCB production as a design tool

*Jonas Rossavik*¹, *Håvard Vestad*¹, *Carlo Kriesi*², *Martin Francis Berg*¹, *Martin Steinert*¹

1: Norwegian University of Science and Technology, Norway; 2: Vitroscope AS, Norway

Printed circuit boards (PCBs) fix and connect electrical components and are widely used. Current design methods emphasise mature products and do not leverage the potential of PCBs as prototyping tools. Accordingly, an alternative approach using PCBs for prototyping electrical and mechatronic solutions is evaluated through three case studies. Insights formed five concrete recommendations for designers: Increase fidelity deliberately, design for prototyping, iterate incrementally, parallelise prototyping, and prototype and test early. These aim to make prototyping with PCBs more accessible.

<https://doi.org/10.1017/pds.2026.10438>

Evaluating and refining the criticality scale for structured planning of prototype sequences

Stefan Zorn, Kilian Gericke

University of Rostock, Germany

This paper evaluates the criticality assessment within the Criticality-Based Planning of Prototype Sequences method. Two independent application studies investigate whether the existing scale definitions for novelty, technical difficulty and importance are sufficient for systematic and context-independent use. The results show that operationalised criteria and clearer evaluator guidance significantly improve consistency, reproducibility and applicability across different development projects.

<https://doi.org/10.1017/pds.2026.10451>



Object detection in technical drawings for data-driven design: the case of patents

[Marco Consoloni](#)^{1,2}, [Gabriele Marino](#)¹, [Denny Meini](#)¹, [Luciano Socci](#)³, [Vito Giordano](#)^{1,2}, [Gualtiero Fantoni](#)^{1,2}

1: Università di Pisa, Italy; 2: Business Engineering for Data Science (B4DS) research group, Italy; 3: Coesia, Italy

Data-Driven Design (DDD) is emerging as a transformative approach in engineering design, leveraging AI tools to extract knowledge from design data that drive product development and innovation. While large language models have advanced DDD through the analysis of textual data, technical drawings remain largely unexplored. To address the limitations of current vision-language models, this study presents a novel object detection pipeline that automatically identifies components in patent images, enabling data-driven analysis of component geometries, interfaces, and spatial configurations.

<https://doi.org/10.1017/pds.2026.10581>



DESIGN2026

Can large language models understand engineering design patents? An exploratory study

[Pingfei Jiang](#), [Yuxuan Wang](#), [Ji Han](#)

INDEX, University of Exeter, United Kingdom

Patents contain valuable design insights, yet manual analysis remains time-consuming and complex. This study explores Large Language Models' capacity to automate patent analysis for engineering design. GPT-5 and Gemini 2.5 Pro were evaluated across Motivation, Novelty, and Key Invention Features using three patents and expert evaluators assessed outputs through Accuracy & Fidelity, Comprehensiveness, and Analytical Depth. Results indicate LLMs demonstrate proficiency in feature synthesis but exhibit inferential limitations in motivation analysis, underscoring the necessity for human oversight.

<https://doi.org/10.1017/pds.2026.10593>

Evaluating large language models for automated design structure matrix extraction from unstructured documents: an empirical study

[Anubhab Majumder](#), [Sahana Parasuram](#), [Kausik Bhattacharya](#), [Amaresh Chakrabarti](#)

Indian Institute of Science, Bangalore, India

Design Structure Matrices (DSMs) capture dependencies between system entities and help analyze system complexity, but manually creating them from unstructured documents is time consuming. This work proposes an automated DSM extraction framework using LLMs and RAG with an explicit reasoning step before the LLM determines the presence of a dependency between two system entities. Using a hand-curated dataset, we evaluate three LLM models (GPT-4o-mini, GPT-3.5, and GPT-4o) across six performance metrics and cost. The findings show that reasoning length affects LLM's DSM extraction performance.

<https://doi.org/10.1017/pds.2026.10601>

Evaluating large language models for technology-oriented searches in engineering design

[Vasileios Koutsouvelis](#)¹, [Filippo Silipigni](#)², [Niccolò Becattini](#)¹

1: Politecnico di Milano, Italy; 2: Fondazione Politecnico di Milano, Italy

This study evaluates the efficacy of various freely available Large Language Models (LLMs) in conducting semi-automated purpose-oriented technology searches to support design activities as well as Technology Intelligence for innovation management, using a systematic manual search as a baseline for comparison. The case to run the comparison focuses on identifying water purification technologies suitable for mobile systems. The results show that LLMs can target more technologies than human-based searches, reducing time demands and providing wider entry points for additional technology analysis.

<https://doi.org/10.1017/pds.2026.10597>

Session
D324

Congress
Hall
Orlando 2

10:15
11:15

20 May

WED

79



What does a sustainable hospital look like? Patient perspectives on waste, reuse, and information

Charlotte Harding, Ingrid Moons, Els Du Bois

University of Antwerp, Belgium

This study explores patient perspectives on hospital sustainability initiatives. Building on the Theory of Planned Behaviour, 30 interviews with patients reveal support for sustainability such as the use of reusable medical textiles, provided safety and quality are maintained. Patients view sustainability as a hospital responsibility, but value integrating sustainability communication into patient journeys. Informing and engaging patients can help shift sustainability from a background initiative into a trusted part of the healthcare system with patients as informed partners.

<https://doi.org/10.1017/pds.2026.10533>

Adoption of refurbished and upgraded medical imaging equipment: user-centered insights for sustainable design

Valentina Calixto^{1,2}, Ghada Bouillass¹, Francois Cluzel¹, Abdelhamid Boujarif², Robert Heidsieck², Laurent Bourgeois³, Vanessa Brun³

1: Université Paris-Saclay, CentraleSupélec, Laboratoire Genie Industriel, France; 2: General Electric Medical Systems, France; 3: Centre Hospitalier Regional Universitaire Rennes, France

Circular economy strategies like refurbishing and upgrading are gaining interest in healthcare, but their adoption depends on several factors linked to social acceptance, technical and economic feasibility. The study examines these factors through a survey among medical practitioners in a French hospital. Results show that technical reliability, long-term performance, and access to new functionalities are key factors, while environmental, cost benefits and physical appearance are secondary. The study offers insights for designers to enhance sustainability of circular medical devices.

<https://doi.org/10.1017/pds.2026.10529>

A co-design approach to reducing pharmaceutical waste

Laura MacLean¹, Hazar Taissier Marji^{1,2}, Lewis Urquhart¹, Andrew Robinson¹, Andrew Wodehouse¹, Paul A. Rodgers¹

1: University of Strathclyde, United Kingdom; 2: German Jordanian University, Jordan

Pharmaceutical waste (PW) poses environmental, economic and public health challenges, yet effective solutions remain underexplored. This study used a co-design approach across two NHS Scotland workshops to examine medicine-use experiences and generate interventions. Three concepts emerged: transparent patient packaging, a tactile communication aid and a gamified virtual medicine-cabinet app, highlighting the value of bottom-up design methods for addressing PW.

<https://doi.org/10.1017/pds.2026.10536>

Designing reuse models for clinical trial packaging to stimulate the transition towards a circular economy

Kaat Dhondt, Ivo Dewit, Regan Watts, Els Du Bois

University of Antwerp, Belgium

This study explores how designing reuse models for clinical trial packaging can stimulate circular transitions in healthcare logistics. Using a Design Inclusive Research approach, four reuse models were explored, developed and evaluated through a Product-Service System lens together with stakeholders from the value chain. Findings underline the complexity of implementing RPSs in the clinical trial context. Implementing circular solutions therefore demands an added design layer focused on quality assurance, along with new protocols, digitalisation, partnerships, scale, and standardization.

<https://doi.org/10.1017/pds.2026.10531>



A concept for AI supported knowledge extraction in design for additive manufacturing

Pascal Schmitt, Stefan Zorn, Kilian Gericke

University of Rostock, Germany

This paper presents a concept for an AI-supported DfAM framework aimed at supporting knowledge extraction, focusing on early design phases. The concept is derived from a set of objectives and integrates, in addition to the user, an agile DfAM process model, an AI copilot based on a large language model, and a structured knowledge base. A configured GPT is used as a prototype to demonstrate the feasibility of selected required functions. With regard to a full-scale framework, findings from this prototyping process and remaining open questions are discussed.

<https://doi.org/10.1017/pds.2026.10567>

Generative AI in the design for additive manufacturing of orthotic devices – a literature review

Abdul Monim^{1,2}, Didunoluwa Obilanade², Peter Törlind²

1: Politecnico di Milano, Italy; 2: Luleå University of Technology, Sweden

Generative AI and additive manufacturing (AM) are shifting orthotic design from generic devices to data-driven, patient-specific solutions. This paper presents a systematic review of Generative AI in Design for AM (DfAM) for orthotic devices. It examines how AI-driven methods generate customised, lightweight orthoses via 3D printing, improving both design efficiency and anatomical fit. The review identifies biomechanical and workflow challenges that hinder adoption and outlines how Generative AI can advance orthotic DfAM, providing a conceptual workflow and suggestions for future research.

<https://doi.org/10.1017/pds.2026.10560>

Mechanical performance of generative design structures for material extrusion: solid vs shells across mass targets

Sindre W. Eikevåg, Håvard Revheim Martinsen, Christer W. Elverum

Norwegian University of Science and Technology, Norway

This study compares solid and shell generatively designed PLA components for material extrusion (MEX) at matched mass targets (100, 150, 200 g). Geometries were generated Generative Design (GD) and manufactured by MEX, then tested in a 30° quasi-static compression rig representing prosthetic heel strike. Solid designs achieved up to 92% higher peak load, but failed abruptly, whereas shells exhibited lower strength but progressive, energy-dissipating failure. Results show that simple shelling of GD outcomes cannot replace iterative GD refinement for weight-critical, load-bearing parts.

<https://doi.org/10.1017/pds.2026.10547>

Learning impact of CAD geometry change on finite element analysis results

Gaurav Devdikar¹, Thorsten Pohl¹, Daniel Strang¹, Benjamin Schleich¹

1: Stellantis, Germany; 2: Technical University of Darmstadt, Germany

This study examines how CAD geometry variations affect finite element (FE) crash simulations for automotive front rail assembly and motivate the use of combined impact measures that better reflect the physical response. Based on these insights, we outline a machine learning formulation that links geometric modifications to their simulation effects. The study centers on geometric representation, employing UV-based graph encodings to capture local shape changes and provide the basis for advancing and validating the full prediction pipeline.

<https://doi.org/10.1017/pds.2026.10681>

Session
D326

Congress
Hall
Şipun

10:15
11:15

20 May

WED



Designing within planetary boundaries: a systematic review and development of requirements for a design support tool

Lisa-Marie Nettlenbusch, Florian Ahrens, Jan Reißmann, Alexander Hasse
University of Technology Chemnitz, Germany

The study examines integrating absolute sustainability, based on planetary boundaries, into product design and development. A review of current frameworks shows that they focus on relative sustainability and lack mechanisms to encourage innovation within ecological limits. Analysis of fourteen publications shows that a design support tool should facilitate early-stage decision-making, incorporate scientific thresholds and circular economy principles, align with the SDGs and provide guidance on product development to create sustainable and transformative product solutions.

<https://doi.org/10.1017/pds.2026.10501>

Evaluating two approaches for sustainability criteria identification and assessment in support of early product development decisions

Jesko Schulte, Matilda S. Watz, Cecilia Braga, Jennifer Woofter, Patricia Lagun Mesquita
Blekinge Institute of Technology, Sweden

This study evaluates two approaches for sustainable product development and their complementarity through workshops and surveys in four companies. Findings show high perceived usefulness but lower usability, with applicability dependent on integration into existing processes. The study identifies value-carrying characteristics – clarity, adaptability, and process linkage – and highlights improvement needs. Results offer guidance for developing coherent methodological support to enable systemic, systematic, and strategic sustainability decisions in early design phases.

<https://doi.org/10.1017/pds.2026.10512>

Systematic identification of components suitable for additive manufacturing to enhance product circularity and reduce environmental impacts

Nicolas Scherer¹, Kristian König¹, Matthias Duve², Michael Vielhaber¹, Frieder Heieck²

1: Institute of Product Engineering, Saarland University, Germany; 2: Institute of Production and Informatics, University of Applied Sciences Kempten, Germany

This study presents a method for early identification of AM-suitable components and circular design routes. A structured, data-lean questionnaire with AHP-based weighting, combined with rule-based R-strategy identification and an AM-specific feasibility gate, enables transparent screening in early development. Demonstrated on a structural bus component for both diesel and electric operation, the approach proposes a dominant R-strategy and integrates a prospective LCA-in-the-loop workflow, showing how early circularity signals and life-cycle feedback inform robust redesign decisions.

<https://doi.org/10.1017/pds.2026.10566>

Digital product passports and the challenge of product structure granularity: a decision-making framework for the level of DPP integration

Katharina Rohde¹, Finn Budde¹, Bárbara Patrício², Tânia Ferreira², Ana Gonçalves², Manuel Ott¹, Iryna Mozgova¹

1: Paderborn University, Germany; 2: Associação Data CoLAB - Laboratório Colaborativo Para Serviços de Inovação Orientados Para Os Dados, Portugal

Political goals, emerging EU sustainability regulations, and industrial digitalization are driving the introduction of Digital Product Passports (DPPs) to enhance transparency, traceability, and compliance across product life cycles. However, the appropriate granularity of DPP integration across product architectures remains ambiguous. This paper introduces a structured, decision oriented framework that links product structure, regulatory relevance, and information depth to define consistent DPP levels, supporting both industry implementation and future standardization.

<https://doi.org/10.1017/pds.2026.10509>





AI applications in requirements engineering: a systematic mapping study

*Melih Sah Dogru*¹, *Jan Penkert*², *Felix Mahr*², *Tobias Düser*¹

1: IPEK - Institute of Product Engineering, Karlsruhe Institute of Technology, Germany; 2: FAPS - Institute for Factory Automation and Production Systems, Friedrich-Alexander Universität Erlangen-Nürnberg, Germany

Artificial intelligence influences requirements engineering, but it remains unclear which activities benefit and how. This paper reviews 15 studies from the last five years, classifying AI approaches with an established RE framework. Current work focuses on operational tasks: requirements determination, analysis, consolidation, and traceability. About two thirds address single activities rather than integrated solutions. Early-phase tasks like knowledge elicitation receive little support despite being central to practice. The mapping clarifies existing AI support and gaps for future work.

<https://doi.org/10.1017/pds.2026.10584>

An LLM model to guide and enrich the understanding of stakeholder value and development of product requirements

Jonathan Cagan, Vincent Sha

Carnegie Mellon University, United States of America

Leveraging the vast interconnection of language and ideas through Large Language Models, a designer's understanding of the needs, wants and desires of intended stakeholders defines the value proposition and product design requirements of a product or service through implementation of the Value Opportunity Analysis (VOA). The resulting VOA LLM Bot explores emotion, aesthetic and other human-valued attributes, and significantly increases perception of the VOA as a useful method for identifying product requirements, and analyzing opportunity solutions.

<https://doi.org/10.1017/pds.2026.10579>

Context-aware large language models for ambiguity detection in requirements

*Victor Vilhelm Poulsen*¹, *Matthias Guertler*¹, *Boris Eisenbart*², *Laura Tomidei*¹, *Nathalie Sick*¹

1: University of Technology Sydney, Australia; 2: Swinburne University of Technology, Australia

Requirements quality shapes engineering design, yet natural language specifications remain vulnerable to ambiguity. We investigate how LLMs support ambiguity detection using a hybrid dataset combining NASA JWST requirements with systematically injected defects. Using auto-extracted domain knowledge, we compare a domain-agnostic baseline with a context-aware approach. Incorporating domain knowledge helps LLMs better distinguish genuinely ambiguous requirements from acceptable ones, highlighting the potential of context-aware AI assistants for requirements engineering and early-stage design.

<https://doi.org/10.1017/pds.2026.10607>

Enabling AI-supported requirements engineering through model-based systems engineering and characteristics-properties modeling

Fabian Rahn, Anubhab Majumder, Eckhard Kirchner

Technical University of Darmstadt, Germany

High-quality requirements are essential for successful product development. This work proposes a model-based requirements engineering framework and AI-supported tool. The framework links design characteristics and measured properties via an OPM-based system model. This enables the implementation of a tool for systematic verification and validation of requirements in early product development stages, supporting the transition from experience- to data-/evidence-driven decision making and industry 4.0 paradigms. A hydraulic-press case-study demonstrates feasibility of the end-to-end workflow.

<https://doi.org/10.1017/pds.2026.10643>



Session
D332

Congress
Hall
Bobara

11:30
12:30

20 May

WED



Iterative industrial prototyping for Industry 4.0: data collection for factory-design simulation in seafood processing

Benjamin Karlsen¹, Jon Urcelay¹, Magnus Mortensen¹, Ola Jon Mork¹, Irina Emily Hansen¹, Paul Steffen Kleppe¹, Andreas Flem Norman², Lars Andre Giske², Øystein Bjelland¹

1: Norwegian University of Science and Technology, Norway; 2: Optimar AS, Norway

This paper reports iterative industrial prototyping of data collection systems for simulating seafood factories. We identify the data necessary to achieve the level of realism factory designers need for effective design exploration, and propose methods to obtain them. Sixteen physical prototypes showed how prototyping shape dynamic requirements in the design process. Findings indicate that models need 3D shape and texture, which can be obtained from smartphone photogrammetry, and bending stiffness and multidirectional friction from cantilever and inclined plane tests.

<https://doi.org/10.1017/pds.2026.10688>

Design and prototyping exploration of an end effector for automated drug compounding

Lorenzo Giunta, Vimal Dhokia

University of Bath, United Kingdom

Chemotherapy (CTX) is essential for cancer treatment, yet its cytotoxic properties pose significant risks to clinicians. As cancer incidence rises, demand for safe and reliable CTX preparation methods intensifies; Automated Drug Compounding (ADC) promises to address these issues. Nonetheless, technical and operational barriers limit adoption. Foremost, the reliable manipulation of syringes by robotic end effectors remains a challenge. This paper examines limitations of current end effectors for ADC systems, identifies design requirements necessary, and proposes a novel design to address them.

<https://doi.org/10.1017/pds.2026.10686>

Foresight prototyping: developing an evaluation framework and strategy for future-oriented design

Jiayue Wang¹, Lin Zhu², Jiawei Li¹

1: Beijing Institute of Fashion Technology, China; 2: Tsinghua University, China

Foresight prototyping uses speculative artifacts to explore futures and support anticipatory design thinking. This study develops and validates an evaluation framework for HCI design education to support studio critique and assessment. Based on a literature review, author interviews, and quantitative analyses of perceptual ratings, four dimensions are identified: Functional Visibility, Sensory Experience, Future Adaptability, and Creative Divergence. The resulting FPEF supports consistent, evidence-based evaluation and feedback, and motivates future validation in design reviews.

<https://doi.org/10.1017/pds.2026.10371>

Low-fidelity prototypes to clear the fuzzy front end of NewSpace projects

Henrik H. Øvrebø, Brage Sterkeby Hole, Henrik Pedersen Hauge, Martin Steinert, Anna Olsen

Norwegian University of Science and Technology, Norway

The early stages of NewSpace missions can be in the fuzzy front end because of unclear requirements. This paper explores clearing this design phase through low-fidelity prototyping, using a case study of 23 prototypes organized into five concepts. The goal is to enable post-launch deployment and focus of a modified commercial-off-the-shelf (COTS) telescope for an Earth observation hyperspectral imaging satellite mission. A final payload design is developed, and the lessons learned inform the design methodology for the early phases of NewSpace projects.

<https://doi.org/10.1017/pds.2026.10690>

Session
D333

Congress
Hall
Orlando 1

11:30
12:30

20 May

WED



Knowledge representation in product design: a literature review

Yuxuan Wang, Pingfei Jiang, Ji Han

INDEX, University of Exeter, United Kingdom

Aligned with Industry 5.0's human-centred and collaborative design vision, this paper examines how knowledge representation (KR) supports design communication through a dual-function lens, distinguishing knowledge transmission and knowledge generation. Based on a review of 83 studies, we map KR across stakeholder interactions and design stages. Transmission dominates early cross-stakeholder communication, while generation is largely confined to designer-centred ideation, revealing structural imbalances and opportunities for broader KR deployment.

<https://doi.org/10.1017/pds.2026.10401>

A computational framework for design-by-analogy using semantic-network representations

Haoyu Zuo^{1,2}, Yuan Yin¹, Boheng Wang¹, Qingjue Wu¹, Liuqing Chen³, Zebin Cai³, Qianzhi Jing³, Kamyar Hazeri¹, Bowen Zhan⁴, Saul Haydon Rowe¹, Shafina Vohra¹, Peter Childs¹, Ruocong Liu¹

1: Imperial College London, United Kingdom; 2: Tsinghua University, China; 3: Zhejiang University, China;

4: University of Wisconsin–Madison, United States of America

The framework proposed operationalized through four interrelated components: encoding, retrieval, mapping, and evaluation. Semantic networks serve as the underlying knowledge representation that enables information structuring and cross-domain association. By translating cognitive reasoning into a computational architecture, the proposed framework establishes a unified structure for supporting analogical design and provides theoretical and technical guidance for developing future semantic-network-based tools that more effectively facilitate creativity and innovation in conceptual design.

<https://doi.org/10.1017/pds.2026.10403>

Designing a knowledge audit for human-AI knowledge augmentation: a study in a consulting firm

Yixuan Su^{1,2}, Mohammad Reza Mirafzal², Julie Stal-Le Cardinal¹

1: CentraleSupélec, France; 2: Sibylone, France

This study proposes a new design for a knowledge audit, focusing on human-AI knowledge augmentation within a consulting firm's setting. It adopts a mixed-method paradigm, including interviews, quantitative surveys and Social Network Analysis, to identify obstacles, facilitators, and AI-mediated flows within a Community of Practice. Findings show strong motivations and AI readiness coexist with poor documentation and codification. The paper reframes the audit as a design-oriented tool for mapping how human–AI collaboration shapes organisational knowledge maturity.

<https://doi.org/10.1017/pds.2026.10400>

Inventory of design, engineering and analysis tool environments (IDEATE)

Nathan Morris¹, Jonathan Raines¹, Ben Hicks¹, James Gopsill¹, Moriah Sanusi¹, Trevor Robinson², Mark Price¹

1: School of Electrical, Electronic & Mechanical Engineering, University of Bristol, United Kingdom; 2: School of Mechanical and Aerospace Engineering, Queen's University Belfast, United Kingdom

Digital design tools are omnipresent today, but which is right for the job? This study reviews previous approaches to categorise design tools revealing a lack of comprehensive catalogues. Given this gap, a set of requirements, classification schema and prototype catalogue (IDEATE) were developed. A survey explored selection factors, format preferences and evaluated the prototype with IDEATE scoring 6.44/10 compared to 5.28/10 for a table format. This evidenced interest in mapping the ecosystem though future iterations should prioritise refined navigation and enhanced searchability of tools.

<https://doi.org/10.1017/pds.2026.10398>

Session
D334

Congress
Hall
Orlando 2

11:30
12:30

20 May

WED

85



Design practitioners' perspectives on digital health implementation in complex systems

Fredrik Bodell, Dirk Snelders, Maaïke Kleinsmann, Valeria Pannunzio

Delft University of Technology, The Netherlands



The implementation of services into complex systems is not well understood in design. We explore this issue by interviewing 24 design professionals with experience in implementing digital services in healthcare. We asked when they consider such services as implemented, and how they view the relation between design and implementation. Results reveal diverse perspectives on both topics. Given the wide dispersion in views, we propose two categories to describe implementation goals (impact on, and integration with systems), and to view design as a contributor to the implementation phase.

<https://doi.org/10.1017/pds.2026.10528>

Exploring the role of a systems approach in improving long-COVID clinics

Garret Tan^{1,2}, Tom Bashford^{1,3,4}, P. John Clarkson^{1,4}

1: Health Systems Design Group, Department of Engineering, University of Cambridge, Cambridge, United Kingdom; 2: Therapies Department, Whipps Cross Hospital, Barts Health NHS Trust, London, United Kingdom; 3: Department of Anaesthesia, Cambridge University Hospitals NHS Foundation Trust, Cambridge, United Kingdom; 4: Cambridge Public Health interdisciplinary research centre, University of Cambridge, Cambridge, United Kingdom



Long-COVID is a complex, multi-system condition with variable care across the UK. Using a systems and design engineering approach underpinned by Model-Based Systems Engineering (MBSE), this study examined Long-COVID clinic pathways through semi-structured interviews with 15 clinicians and patients. Thematic analysis identified five domains—attitudes, relationships, service integration, technology adoption, and safety netting. The final synthesised swimlane diagram revealed opportunities to improve coordination, operational efficiency, and patient safety within evolving care models.

<https://doi.org/10.1017/pds.2026.10539>

Designing hope-oriented service touchpoints for adolescent oral health in public dental care

Marikken Høiseith^{1,2}, Arefe Jasbi¹, Silje Bøthun²

1: Department of Design, Norwegian University of Science and Technology, Norway; 2: Department of Health Research, SINTEF, Norway

Adolescence is a critical period for establishing oral health habits, yet motivating young people remains challenging. This paper presents a pilot intervention in the Norwegian Public Dental Service, developed through co-design and guided by salutogenic and hope theory. The intervention consisted of three touchpoints: an SMS invitation, an in-clinic goal-setting dialogue, and a follow-up SMS embedded in routine care. Based on interviews with clinicians and adolescents, we explore how hope-oriented communication can be enacted within everyday clinical practice.

<https://doi.org/10.1017/pds.2026.10534>

Collaborative mapping of bottlenecks and opportunities for AI-supported triage in Dutch mental healthcare

David Quijada-Fernandez¹, Hendrikus van Os^{2,3}, Maaïke Kleinsmann^{1,2}, Jiwon Jung^{1,4}

1: Faculty of Industrial Design Engineering, Delft University of Technology, The Netherlands; 2: Leiden University Medical Center, The Netherlands; 3: University Medical Center Utrecht, The Netherlands; 4: Surgery Department, Erasmus University Medical Center, The Netherlands

This paper explores the role of artificial intelligence to reduce resource burden and support service delivery processes in generalist secondary-care mental health services in the Netherlands. Through semi-structured interviews with domain experts and using service blueprinting as a stimulus, we identified challenges and bottlenecks in mental health care pathways and intervention opportunities. We propose four intervention directions for design researchers and developers to prototype and assess how AI technologies may alleviate capacity issues in mental healthcare.

<https://doi.org/10.1017/pds.2026.10538>

Session
D335

Congress
Hall
Konavle

11:30
12:30

20 May

WED



Design for additive manufacturing of multi-material microreactors: a simulative study on specific surface area and thermal management

[Lennart Mesecke](#), [Ina Meyer](#), [Jens Niedermeyer](#), [Myriam Maalaoui](#), [Marcus Oel](#), [Weijia Yu](#), [Roland Lachmayer](#)

Institute of Product Development (IPeG), Leibniz University Hannover, Germany

This study investigates the potential of multi-material additive manufacturing (MMAM) designs for improving microchannel reactors for ammonia decomposition. Using CFD simulations, designs made from stainless steel 316L and CuCrIZr to enhance specific surface area and temperature distribution were analyzed. Results show that MMAM designs can reduce temperature gradients by up to 26.81 K and boost fuel processor efficiency by up to 3.2 percentage points compared to mono-material designs. These findings underscore the potential of MMAM in optimizing the reactor efficiency.

<https://doi.org/10.1017/pds.2026.10559>

Designing for compliance at the microscale: DfAM lessons from a 2PP-printed bellows structure for sensing and actuation

[Vegar Stubberud](#), [Simon Nysæter](#), [Martin Steinert](#), [Håkon Jarand Dugstad Johnsen](#)

Norwegian University of Science and Technology, Norway

AM enables the design of compliant mechanisms that encode functions directly into geometry. Existing DfAM frameworks rarely address microscale AM, such as two-photon polymerisation (2PP). We present the design process of an airtight, monolithic bellows structure in rigid 2PP resin that serves both as a sensor and an actuator. Through co-evolution of problem and solution, we identify 2PP-specific design considerations and opportunities, including fabrication uncertainties, cross-scale iteration, and design for post-processing, contributing to a case-based DfAM framework for microscale AM.

<https://doi.org/10.1017/pds.2026.10571>

Machine-learning-based one-to-many inverse design of multi-material lattices

[Ajit Panesar](#), [Xiaochen Yu](#)

Imperial College London, United Kingdom

This work presents an ML-based inverse design framework for multi-material lattices with curved struts, targeting mechanical and thermal performance. Using cubic-spline parameterization and discrete material assignment, the design space expands beyond conventional lattices. A workflow combining a material classifier, property predictor, and inverse generators addresses one-to-many mapping, enabling probabilistic sampling and diverse designs. The approach supports multi-objective trade-offs and lays the foundation for multi-scale optimization of functionally graded metamaterials.

<https://doi.org/10.1017/pds.2026.10564>

Design guidelines for electrical conductors and Joule-heating structures fabricated additively by material extrusion

[Maximilian Nowka](#)¹, [Marvin Bergner](#)¹, [Till Hecker](#)¹, [Katja Ruge](#)¹, [Karl Hilbig](#)¹, [Wei-Song Hung](#)², [Thomas Vietor](#)¹

1: Institute for Engineering Design, Technische Universität Braunschweig, Germany; 2: Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taiwan

Additive Manufacturing (AM) enables the local adjustment of material properties using multi-material strategies, especially with Material Extrusion (MEX). Electrically conductive structures like conductors, Joule heating structures, and their transitions can be realised with conductive polymer composites (CPC). However, specific Design for Additive Manufacturing (DfAM) guidelines for the aforementioned structures are still missing. This work uses experimental data by thermography and the measurement of resistivity to derive twelve design rules. The rules are applied to an application example.

<https://doi.org/10.1017/pds.2026.10561>



Session
D336

Congress
Hall
Šipun

11:30
12:30

20 May

WED

87



DESIGN
2026

excellence in design



DESIGN DEBATE (6TH EDITION): ALL DESIGN RESEARCHERS SHOULD HAVE CLEAR EVIDENCE OF DESIGN PRACTICE

Chair:

P. John Clarkson

University of Cambridge, United Kingdom

DEBATE TEAMS:

Maaïke Kleinsmann (TU Delft, The Netherlands), and Jiwon Jung (TU Delft, The Netherlands)

Bernard Yannou (CentraleSupélec, France), and Audrey Abi Akle (ESTIA, France)

In the evolving landscape of engineering design, the relationship between research and practice remains a central and often contested issue. The 6th edition of the DESIGN Debate invites the community to engage in a provocative and timely discussion around the motion:

“All design researchers should have clear evidence of design practice.”

As design research continues to mature and expand its theoretical foundations, questions arise regarding its connection to real-world application. Should design researchers actively demonstrate engagement with practice, or does such a requirement risk narrowing the scope of inquiry and limiting methodological diversity?

Building on the tradition of previous DESIGN Debates which have challenged assumptions about products versus systems, the role of methods, and the balance between theory and application, this year's debate turns inward to reflect on the identity and expectations of the design research community itself.

More than a structured exchange of arguments, the DESIGN Debate serves as a platform for critical reflection and collective sense-making. It invites participants to reconsider long-held assumptions and engage in an open dialogue about the role, responsibility, and direction of design research in a rapidly changing world.

As always, the session encourages active participation from the audience, whose questions, perspectives, and final vote will ultimately shape the outcome of the debate.

FORMAT

- The motion will be proposed and then opposed (approximately 8 minutes each side)
- Supporting statements, seconding the two viewpoints, will then be given (4 minutes each side)
- The floor (the audience) will then be invited to question the proposers and opposers
- A single final statement will be given by each side



Holistic product circularity assessment of a balance bike

Dominik Neumann, Simon Moersdorf, Michael Vielhaber
Saarland University, Germany

This paper operationalizes ISO 59020 for product-level circularity by implementing the Holistic Product Circularity Analysis (HPCA) with fixed boundaries and explicit reporting rules. HPCA enables consistent assessment and targeted optimization by combining qualitative ratings with quantitative flows across all stages of the product lifecycle. The approach is demonstrated on a children's balance bike by comparing a reference scenario with an optimized circular scenario and deriving decision-relevant improvement levers.

<https://doi.org/10.1017/pds.2026.10502>

Circular Life Cycle Blueprint: a visual tool for circular product and component design

Rafael Selhorst, Shaleen Shahrin, Arlindo Silva
Singapore University of Technology and Design, Singapore

The Circular Life Cycle Blueprint (CLB) is a four-step design methodology for integrating circular economy principles at the component level in product design. Developed via a design science approach with iterative prototyping and evaluation, the CLB guides design teams from conceptualizing circular strategies to mapping component lifecycles and conducting a sustainability assessment. Pilot evaluation with industry professionals indicates that the CLB is effective and user-friendly, fostering innovative circular design and demonstrating practical viability in sustainable product development.

<https://doi.org/10.1017/pds.2026.10513>

Hierarchical lifecycle modelling in circular product development

Marie Schwahn¹, Lukas Block²

1: Institute of Human Factors and Technology Management (IAT), University of Stuttgart, Germany; 2: Fraunhofer Institute for Industrial Engineering IAO, Germany

As companies face increasing accountability for resource efficiency, circularity measures like repair or remanufacture offer a promising solution. Modeling expected product lifecycles in early design phases is crucial for planning their effective application. This paper introduces a hierarchical lifecycle model to represent component-specific lifecycle paths across all product architecture levels in a single model. Our approach ensures consistency across hierarchy levels and facilitates precise application of component-specific circularity measures, promoting effective circular product design.

<https://doi.org/10.1017/pds.2026.10644>

Analyzing product circularity: a comparative assessment of existing approaches and development of a retention-option-weighted multi-criteria assessment tool

Jonas Mohnke¹, Simon Jochum¹, Vanessa Gebel¹, Tobias Meiser¹, Christian Köhler^{1,2}

1: Saarland University of Applied Sciences, Germany; 2: ECO² Research Group, Fraunhofer IZFP, Germany

The circular economy is central to sustainability, yet many products cannot comply to its principles. Equally, assessing circularity remains challenging due to the multitude and complexity of approaches. This contribution presents a feasible multi-criteria assessment tool, grounded in established DfCE principles, for evaluating product circularity at various system levels. Developed through an exploratory literature review, it integrates qualitative and quantitative indicators with a retention-option-based weighting system. Its applicability is demonstrated through a medium-complex case study.

<https://doi.org/10.1017/pds.2026.10500>



From online reviews to Kano model: a large language model method and case study

Filippo Chiarello, Vito Giordano, Gabriele Marconcini
Università di Pisa, Italy

We introduce a method that turns online customer reviews into design insights. By analysing smartphone reviews, we extract the product features customers talk about and identify the sentiment linked to them. The approach combines Large Language Models (LLMs) with the Kano model, showing how specific features influence satisfaction or dissatisfaction. The results are coherent with the dimensions of the Kano model. The work demonstrates that LLMs can be informed and constrained by established design frameworks, bridging LLMs and design reasoning to provide theory-grounded insights.

<https://doi.org/10.1017/pds.2026.10580>

Can LLM-driven synthetic participants help user research? A case study in designing augmented reality for education

Suyi Xu¹, Rafael Roberto^{1,2}, Manoela Silva³, Ziwei Gao⁴, Qi Liu¹
1: University of Bath, United Kingdom; 2: SENAI Innovation Institute for Information and Communication Technologies, Brazil; 3: Universidade de Pernambuco, Brazil; 4: University of Oxford, United Kingdom

Conventional user research with human participants faces significant challenges, including substantial time and resource requirements, and limited scalability. In response, this study presents an efficient, cost-effective workflow driven by large language models (LLMs) for simulating user research with synthetic participants (SPs) at scale. In a case study in design augmented reality for education, SPs' open-ended answers were plausible and comprehensive, yet semi-open and closed items diverged from those of humans. SPs can augment early qualitative work, but cannot replace human studies.

<https://doi.org/10.1017/pds.2026.10618>

LLM-based voice chatbot surveys as an alternative to post-experience questionnaires: probe-controlled, ultra-short field interviews

Fujian Ding, Yuki Taoka, Momoko Nakatani
Institute of Science Tokyo, Japan

Chatbot-based surveys offer low-burden, in-situ data collection, yet unconstrained LLMs often drift from research aims. We conducted 359 ultra-short, post-experience voice interviews in a public venue to compare a framework-guided LLM, an unconstrained LLM, and fixed questions. The guided approach produced significantly longer responses than fixed questions and yielded the richest diversity of process-specific accounts. These findings show that probe control is essential for eliciting actionable, experience-grounded feedback in real-world, time-limited settings.

<https://doi.org/10.1017/pds.2026.10583>

On using LLM reasoning to support reflection in design thinking

Vaia Giota², Anthony Karageorgos¹, Georgios Koronis², Efthymios Lallas¹
1: University of Thessaly, Greece; 2: University of the Aegean

Design thinking fosters creativity but it's susceptible to cognitive biases. We propose a rule-based framework supported by large language models that uses a Prompt-Reflection-Reframe loop to identify bias mechanisms in designers' verbal reasoning and generate theory-grounded reflective prompts. Through scenario-based evaluations, we validate the framework's theoretical foundations and establish a methodological basis for supporting bias-aware design practice.

<https://doi.org/10.1017/pds.2026.10588>

Session
D342

Congress
Hall
Bobara

15:45
16:45

20 May

WED



Mapping design research methods: foundations for a design research quality hub

*Nikolas Neumann*¹, *Romain Pinqu  *², *Geovana Blayer Ribeiro Assis*³

1: Dresden University of Technology, Germany; 2: Universit   Grenoble Alpes, CNRS, Grenoble INP, G-SCOP, France; 3: Federal University of Uberl  ndia, Brazil

Design research lacks a unified methodological framework, leaving researchers underexposed to diverse approaches and limiting informed method selection. This paper proposes a multidisciplinary cartography of design research methods, mapping research designs, data collection techniques, associated risks, and required resources. It provides a structured overview to support method selection and planning. This non-exhaustive, high-level cartography serves as a proof of concept to demonstrate feasibility and lay the foundation for a future community-driven Design Research Quality ecosystem.

<https://doi.org/10.1017/pds.2026.10366>

Guidelines for dual impact research methodology: a framework for industry-academia collaboration

Marcus Vinicius Pereira Pessoa, *Ian Gibson*

University of Twente, The Netherlands

Industry-academia collaborative research faces a persistent challenge: how to promote effective knowledge transfer while maintaining both scientific rigor and industrial relevance. This paper introduces nine methodological guidelines for a Dual Impact Research Methodology (DIRM). The guidelines include mechanisms such as dual-purpose artifacts, hybrid evaluation criteria, and institutionalized knowledge capture. The paper concludes the guidelines provide a coherent yet adaptable framework for achieving dual impact: advancing theory while delivering actionable industrial value.

<https://doi.org/10.1017/pds.2026.10368>

Toward design for complexity: an integrated framework for iterative co-evolution across complex socio-technical systems

*Mohammed Alrizqi*¹, *Joshua Summers*², *Julia Kramer*³

1: Cornell University, United States of America; 2: University of Texas at Dallas, United States of America; 3: University of Michigan, United States of America

Traditional design methods fall short for complex socio-technical systems where social and technical elements co-evolve and emergent behaviors resist decomposition. This paper proposes a seven-stage Design for Complexity Framework integrating systems science and design theory. Stages 3-6 form an iterative co-evolution space where modeling, architecture, and stakeholder co-design mutually shape problem and solution development. A healthcare example illustrates how the framework's co-evolutionary approach addresses coordination failures that purely technical or purely participatory methods miss.

<https://doi.org/10.1017/pds.2026.10360>

Measure it to manage it - quantitative review of product family complexity metrics

*Lasse Kehrhahn*¹, *Matthias Meyer*¹, *Ole Jan Meers Schmidt*¹, *Thomas Gumpinger*²

1: Hamburg University of Technology, Germany; 2: Odego GmbH, Germany

Product variety increases complexity across product, process, and organizational domains, yet existing complexity measures offer limited guidance for design decisions. This study implements established metrics within a framework to enable consistent assessment across domains. The results reveal substantial redundancies among these metrics - with the notable exception of modularity, emphasizing its central role in complexity management. The consolidated measure set provides practitioners with a systematic basis for evaluating design strategies and managing complexity in product families.

<https://doi.org/10.1017/pds.2026.10363>



Investigating a DSM/graph modeling approach for the interdisciplinary design of data-centric complex systems – a case study on autonomous public transportation

Christopher Langner, Yevgeni Paliyenko, Markus Rehberg, Felix Miller, Daniel Roth, Matthias Kreimeyer

University of Stuttgart, Germany

As systems become increasingly data-centric, interdisciplinary engineering design faces growing complexity and interdependencies. This paper investigates how a combined Design Structure Matrix (DSM) and graph-based modeling approach supports interdisciplinary decision-making by revealing critical data dependencies, compared to standalone DSM or graph models. Based on a case study on autonomous public transportation and expert input, the results illustrate complementary insights enabled by the combined approach and discuss its implications for industrial system design.

<https://doi.org/10.1017/pds.2026.10638>

Managing technical debt at Ubisoft IT: interfaces and change propagation in engineering systems interventions

Jose Bonet Faus^{1,2}, Pascal Le Masson¹, Benoît Weil¹, Antoine Bordas¹

1: Mines Paris - PSL, France; 2: Ubisoft, France

Technical Debt (TD) is a buzzword that has gained traction among IT practitioners and researchers, as a financial metaphor explaining how existing elements can hinder future changes. In engineering design terminology, managing TD can be equated to managing the redesign of existing systems, a task in which change propagation plays a key role. Via a partnership with Ubisoft, a game development firm that owns and operates a global IT network, we present a case study showcasing a novel way to explore interfaces and propagations in engineering systems interventions, analyzed using Axiomatic Design.

<https://doi.org/10.1017/pds.2026.10632>

Modular configuration model for complex engineering products

Qingsong Zhao, Lars Hvam, Moritz Ruhrmann, Niels Henrik Mortensen

Technical University of Denmark, Denmark

Product configuration systems support customized design in complex engineering. However, as products grow in complexity, the configuration model also grows, making it important to manage these models effectively. Based on industrial case studies, this study shows how companies structure their configuration models and how modularization helps improve flexibility, maintainability, and scalability. The results provide empirical insights and practical guidance for structuring robust configuration models in complex engineering contexts.

<https://doi.org/10.1017/pds.2026.10647>

Model context protocol for MBSE: a unified interoperable agentic framework for systems modelling

Mahmoud Bazzal^{1,2}, Simon Schleifer^{3,2}, Adriana Lungu², Benjamin Kruse², Stefan Goetz³, Christian Koldewey^{1,4}, Denis Tissen¹, Sandro J. Wartzack³, Roman Dumitrescu^{1,4}

1: Heinz Nixdorf Institute, Paderborn University, Germany; 2: Audi AG, Germany; 3: Engineering Design (KTmfk), Friedrich-Alexander Universität Erlangen-Nürnberg, Germany; 4: Fraunhofer Institute for Mechatronic Systems Design, Paderborn, Germany

With the introduction of SysML v2—featuring a new metamodel and standardized APIs—new opportunities arise for automating MBSE tasks through generative AI. However, existing LLM approaches lack interoperability due to limited support for complex SysML v2 API operations. This paper presents a framework for implementing Model Context Protocol (MCP) servers for SysML v2, enabling LLMs to interact with system models via the API. This framework provides a foundation for agentic MBSE by allowing automation of modeling tasks while maintaining interoperability across tools and generative AI systems.

<https://doi.org/10.1017/pds.2026.10630>

Session
D344

Congress
Hall
Orlando 2

15:45
16:45

20 May

WED



“P-Heroes”: designing a superhero family for pediatric urinary incontinence care

Lola Bladt ^{1,2}, Anka Nieuwhof-Leppink ³, [Rose-Farah Blomme](#) ^{1,2}, Jiri Vermeulen ¹, Alexandra Vermandel ^{4,5}, Gunter De Win ^{5,6}, [Lukas Van Campenhout](#) ¹

1: Department of Product Development, Faculty of Design Sciences, University of Antwerp, Belgium; 2: Department of Research and Development, Minze Health NV, Belgium; 3: Department of Urotherapy, Psychology and Urology, Wilhelmina Children’s Hospital, University Medical Center Utrecht, The Netherlands; 4: Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Belgium; 5: Department of Urology, University Hospital Antwerp, Belgium; 6: Antwerp Surgical Training, Anatomy and Research Centre (ASTARC), Faculty of Medicine and Health Sciences, University of Antwerp, Belgium

This study presents the “P-Heroes”, a superhero family designed through a Research through Design process to support children with urinary incontinence. Inspired by children’s own superhero drawings, expert input, and validation sessions with children, the design evolved through iterative prototyping. Each hero embodies traits such as persistence, comfort, emotional regulation, resilience and structure. Together, the “P-Heroes” reflect the diversity of children’s journeys toward continence and serve as a playful conversation starter to help them express their needs and experiences more openly.

<https://doi.org/10.1017/pds.2026.10678>

Determining the design dimensions of the conventional electrode fixation methods used in transcranial electrical stimulation

[Aslı Günay](#) ¹, Aykut Coskun ², Hakan Yilmazer ², Ezgi Tuna Erdogan ², [Sacit Karamürsel](#) ²

1: University of Twente, The Netherlands; 2: Koç University, Turkey

The market for transcranial direct current stimulation (tDCS) expands. tDCS is a non-invasive technique that delivers a weak direct electrical current to the scalp via electrodes. It is used for enhancing cognitive functions and mood. Existing research addresses technical aspects; yet, understanding users’ perceptions and broader design issues are crucial for acceptance and usability. This paper investigates the perceptions of tDCS practitioners, volunteers, and designers on commonly used electrode fixation methods. It presents design dimensions and recommendations for novel tDCS designs.

<https://doi.org/10.1017/pds.2026.10687>

A parametric approach to mass customised hand wearable cooling products to improve clinical efficacy for CIPN

[Jonathan Binder](#) ^{1,2}, Ertu Unver ¹, Omar Huerta ², Riley Irving ¹, [Aesha Hamid](#) ¹

1: Paxman, United Kingdom; 2: School of Mechanical Engineering, University of Leeds, United Kingdom

A parametric framework for personalised hand-wearable cooling devices is presented to optimise fluid and thermal performance using patient-specific anthropometrics. Iterative prototyping phases validated improved uniformity and efficacy. The approach bridges ergonomic customisation and thermal optimisation, enabling scalable, clinically effective wearable heat-exchangers for diverse patient populations. This study builds on prior work on personalised scalp cooling with Paxman, applying parametric principles to limb cooling for Chemotherapy-Induced Peripheral Neuropathy prevention.

<https://doi.org/10.1017/pds.2026.10527>

Enabling the coding of affordances based on the UX grammar

[Teresa Monti](#) ¹, [Bernard Yannou](#) ², [Francesca Montagna](#) ¹

1: Politecnico di Torino, Italy; 2: CentraleSupélec, Université Paris-Saclay, France

User-product-environment interaction is a dynamics reflected in the concept of affordance and, consequently, in the user experience. The study of these three concepts is indeed evidently interconnected and mutually dependent. Accordingly, this study presents a tool developed for coding the user experience, namely UX grammar (Dabouis et al., 2024a, 2024b), as a suitable framework for further capturing affordances and their characteristics. An application of the UX grammar model, along with affordances evaluations derived from the coding output, is presented to validate the proposed methodology.

<https://doi.org/10.1017/pds.2026.10431>



From Earth gravity to microgravity: benchmarking additively manufactured particle-damped structures in the Einstein-Elevator

Weijia Yu ¹, [Marcus Oel](#) ¹, Christoph Lotz ², Ina Meyer ¹, Jens Niedermeyer ¹, Myriam Maalaoui ¹, Lennart Mesecke ¹, Roland Lachmayer ¹

¹: Institute of Product Development (IPeG), Leibniz University Hannover, Germany; ²: Institute of Transport and Automation Technology (ITA), Leibniz University Hannover, Germany

Additively manufactured particle-damped (AMPD) beam structures produced by PBF-LB/M are tested in the Einstein-Elevator under microgravity conditions. The first bending mode is evaluated by laser Doppler vibrometry and compared with results from microgravity experiments, using power spectral density inputs resynthesised from those runs and replayed on a shaker. Frequency-domain transmissibility with confidence intervals shows stable mode-specific damping behaviour and supports a validated workflow for future space structures.

<https://doi.org/10.1017/pds.2026.10573>

Secure by design: exploring a minimal Web3.0 trust network to provide de-centralised secure, private, and provenance preserving design and manufacture workflows

[James Gopsill](#) ¹, Oliver Schiffmann ¹, Charlie Ranscombe ², Mark Goudswaard ¹

¹: University of Bristol, United Kingdom; ²: Swinburne University of Technology, Australia

This paper explores the application of Web3.0 technologies to provide de-centralised secure, private, and provenance preserving trust networks for society's increasingly digital design and manufacture workflows. It provides an overview of the key technologies involved and an example of a minimal trust framework required for issuing jobs between actors and machines in a makerspace. A comparison with centralised AM farm platforms is made and demonstrates how Web3.0 can support emergent trust structures compared to fixed centrally managed structures that actors need to agree to.

<https://doi.org/10.1017/pds.2026.10550>

Investigation into the rolling resistance of novel 3D printed e-scooter tyres

[George Stilwell](#), Robbie White, Hunter Sharp, Robert McIntosh, Michael Everett, Shayne Gooch
University of Canterbury, New Zealand

E-scooters have cemented their position as a convenient transport solution in urban areas, with hundreds of millions of e-scooter trips completed globally each year. This study investigates and presents useful tyre performance data for 12 e-scooter tyres, including three novel 3D printed tyres made from 90A TPU. The results highlight the potential of 3D printed tyres to provide comparable performance to existing e-scooter tyres. The information presented in this study is useful to better understand the energy losses associated with these devices.

<https://doi.org/10.1017/pds.2026.10570>

Investigation of TPMS superposition to enhance heat transfer surface area and overhang surface reduction in compact heat exchanger design

[Alexander Seidler](#), Stefan Holtzhausen, Kristin Paetzold-Byhain

Chair of Virtual Product Development, Dresden University of Technology, Germany

Industry is experiencing rising thermal loads, so geometries that improve energy transfer are needed. However, defects arising from overhang in additive manufacturing affect the functionality of triply periodic minimal surface (TPMS) based heat exchangers. This study addresses how TPMS superposition affects heat transferring and overhang critical surfaces. The objective is to quantify the functional and manufacturing trade-offs, and to identify the optimal hybrid cells formed from gyroid, Schwarz and diamond units.

<https://doi.org/10.1017/pds.2026.10569>

Session
D346

Congress
Hall
Şipun

15:45
16:45

20 May

WED



Implementation of LCA-based product design through semantic technologies

Till Tschiltschke, Sebastian Wehking, Theresa Riedelsheimer, Kai Lindow
Fraunhofer IPK, Germany

The paper presents an automated decision support application for sustainability metrics in product design by leveraging semantic technologies. The proposed framework utilizes an ontology for structured representation of design characteristics and correlating lifecycle data. A rule-based approach is investigated for enabling automated reasoning. The implementation showcases real-time impact assessments based on CAD models, supporting sustainable product development. This approach demonstrates significant potential for advancing lifecycle design practices in industrial contexts.

<https://doi.org/10.1017/pds.2026.10519>

A framework for evaluating CAD-integrated environmental assessment tools through the lens of LCA limitations

Maiïna Boudrag-Allée¹, Yacine Baouch¹, Alexandre Durupt¹, Hélène Gonon²
1: Université de Technologie de Compiègne, France; 2: CETIM, France

Common ecodesign tools, such as LCA, remain challenging for designers, limiting their use in product design. At the interface between design and ecodesign, CAD-environmental assessment integration could be a solution. We aim to complement previous assessments of such tools, focused primarily on assessment capabilities, by proposing an evaluation framework based on common LCA limitations. Applied to three commercial CAD modules, it highlights differences in operational capabilities and limitations, providing a differentiated appreciation of CAD-integrated tools.

<https://doi.org/10.1017/pds.2026.10480>

Development of an LCA-based framework for environmental performance interpretation in energy-intensive industries

Micaela Vitti, Claudio Sassanelli, Francesco Boenzi, Raffaello Pio Iavagnilio
Politecnico di Bari, Italy

This paper presents the IMPRINT framework, a structured method to enhance the interpretation of EF 3.1 midpoint indicators in energy-intensive industries. By clustering the 25 indicators into five domains—climate and energy, human health, aquatic quality, air emissions, and resource depletion—the framework improves the readability of LCA results, highlights environmental hotspots and trade-offs, and supports more informed decision-making in industrial technology evaluation and sustainability planning.

<https://doi.org/10.1017/pds.2026.10524>



Development and validation of a parametric model for fast life cycle assessment in early embodiment design

Marco Lo Guzzo^{1,2}, Samuel Rader¹, Alborz Aghamaleki Sarvestani¹, Nada Sahlab¹, Tobias Düser²
1: Corporate Research Center ABB AG, Germany; 2: Karlsruhe Institute of Technology, Germany

Early embodiment design requires sustainability considerations for design alternatives that traditional LCA techniques cannot efficiently support. This paper presents a fast parametric LCA model that expresses environmental impacts as linear functions of material mass, recycled content and recyclability potential, allowing rapid evaluation of design alternatives. Applied to load break switch drives of two generations, the model achieves a MAPE below 5% relative to conventional ISO-compliant LCA results and demonstrates its capability to support design space exploration.

<https://doi.org/10.1017/pds.2026.10497>



Multi-agent generative AI for concept evaluation: consistency, knowledge integration and human alignment

[Mas'udah Mas'udah](#)¹, [Pavel Livotov](#)¹, [Björn R. Kokoschko](#)^{2,3}, [Wanyu Xu](#)⁴, [Immanuel Hendra](#)⁵, [Niklas Hartmann](#)¹

1: Offenburg University of Applied Sciences, Germany; 2: Otto von Guericke University Magdeburg, Germany; 3: Anhalt University of Applied Sciences, Germany; 4: Texas A&M University, United States of America; 5: Singapore University of Technology and Design, Singapore

Early-stage concept evaluation is critical for selecting viable designs. This study introduces a multi-agent generative AI framework for assessing concepts across four configurations: AI with retrieval-augmented knowledge, AI without external knowledge, human experts, and a hybrid approach. The findings show that AI panels tend to produce uniform evaluation patterns, while retrieval-augmented knowledge alters rating behaviour without leading to closer alignment with human judgement. Hybrid setting achieved closest alignment, indicating AI is effective when combined with expert interpretation.

<https://doi.org/10.1017/pds.2026.10603>

The product singularity: universal AI framework for multimodal product understanding, evaluation, and benchmarking

[Rajath S](#), [Muzammil Bagewadi](#), [Tarun R](#), [Puneeth Kannaraya](#)
Indian Institute of Science, Bangalore, India

Suboptimal product design and compliance failures lead to economic losses. While AI excels in domain-specific tasks like defect detection, existing solutions lack cross-domain reasoning and explainability. This paper presents Product Singularity, a universal AI framework that integrates multimodal data (images, text, etc) for comprehensive product evaluation across quality, safety, performance, ergonomics, and compliance. A proof-of-concept in consumer bottles validated by experts achieved 90% agreement and reduced evaluation time. Its modular design supports adaptation to other product categories.

<https://doi.org/10.1017/pds.2026.10610>

Automatic assessment of rust level on screws using convolutional neural networks

[Marco Mandolini](#)¹, [Luca Manuguerra](#)¹, [Sylvain Dimanche](#)², [Giovanni Formentini](#)³
1: Università Politecnica delle Marche, Italy; 2: Polytech Marseille, France; 3: Circular Momentum, Denmark

This paper presents a deep learning-based approach to automatically classify the rust level of screws using ResNet-18 and MobileNetV3 convolutional neural networks. A controlled salt-spray chamber was used to simulate corrosion on metal screws over 0h, 48h, 96h, and 168h of exposure. Images were processed with a circle-detection algorithm to extract individual screws, followed by data augmentation and training. The final models achieved a classification accuracy greater than 94% on the validation set.

<https://doi.org/10.1017/pds.2026.10602>

Life cycle cost estimation in product-service systems: a review of machine learning methods

[Daniel Rosemann](#), [Tobias Löffelholz](#), [Johanna Wurst](#), [Roland Lachmayer](#)
Leibniz University Hannover, Germany

Cost planning for Product-Service Systems faces rising complexity, making life-cycle cost estimates essential. This paper investigates how machine learning (ML) can be applied for life-cycle cost estimation in product development. A literature review was conducted to identify ML-based methods, classify them across life cycle phases, and compare them against traditional methods. Results show that traditional models remain transparent but limited in early stages, while ML methods achieve higher accuracy in data-rich phases. A clear research gap exists for hybrid models and end-of-life costing.

<https://doi.org/10.1017/pds.2026.10609>

Session
D352

Congress
Hall
Bobara

17:00
18:00

20 May

WED



TRL-based mapping of biomimetic projects: identification of development patterns and their influencing factors

Alix Saury^{1,2,3}, *Pierre-Emmanuel Fayemi*², *Thibaut Houette*³, *Jean-Matthieu Cousin*³, *Jérôme Fortin*¹, *Arnaud Dujany*¹

1: UniLaSalle, France; 2: Ilkos Lab, France; 3: Ceebios, Centre d'études et d'expertises en biomimétisme, France

This study proposes a framework to map biomimetic innovation progress along TRLs and identify recurring development patterns. Pilot results reveal stagnation between TRL 2–4, linked to generic upscaling struggles and biomimetic-specific barriers. Emerging hypotheses suggest early onset of upscaling challenges post-POC and influence of biological model knowledge on progress. Study insights open paths for methodological work to bridge POC obtention and validation difficulties, and for further use of the framework on bigger datasets, to build a baseline for biomimetic innovation development.

<https://doi.org/10.1017/pds.2026.10369>

Future Archeologies Canvas: a visual tool for facilitating speculative ideation and revealing limits of futures perception

Alejandro Lecuna, Maria Maciejko

Anhalt University of Applied Sciences, Germany

This paper introduces a visual tool that facilitates engagement with speculative design futures while exposing the boundaries of understanding. Building on the Future Archeologies Method, the canvas guides participants through tactile speculation, scenario-making and reflection via eight components structured around a Line of Speculation. We tested the tool in two workshops with community members and futures experts. Results suggest that the canvas (1) accelerates the process, (2) supports collaboration, and (3) enables accessible yet radically creative futures thinking.

<https://doi.org/10.1017/pds.2026.10365>

Worlding the sense of place: narrative design approach to reimagining regional resources

*Yasuyuki Hayama*¹, *Yoheisuleyman Kilinc*²

1: Department of Strategic Design, Faculty of Design, Kyushu University, Japan; 2: School of Design, Kyushu University, Japan

This paper reconsiders the concept of sense of place through the perspective of worlding. While often defined as the emotional and cognitive bond between people and environments, this study expands it toward a design-oriented view that reinterprets and regenerates local meanings. Based on a design inquiry into regional contexts, it examines how making and storytelling can translate local materials into prototypes that evoke new relations to place. The study suggests worlding as a generative process through which place is continuously reimagined and experienced within dynamic local contexts.

<https://doi.org/10.1017/pds.2026.10361>

Room for critique: spatial and sensory design of constructive feedback environments

Katja Thoring, Chris McTeague, Franziska Thannheimer

Technical University of Munich, Germany

This study explores how spatial and sensory design influence critique interactions. The “Room for Critique” prototype was developed through a research-through-design process grounded in neuroaesthetic research and evaluated across five PhD feedback sessions. Findings indicate that spatial layout and multisensory ambiance shape focus, perceived equality, and comfort. The paper introduces a dual framework of spatial neutrality and affective design and proposes six actionable guidelines for creating feedback environments that support calm, constructive, and balanced dialogue.

<https://doi.org/10.1017/pds.2026.10370>

Session
D353

Congress
Hall
Orlando 1

17:00
18:00

20 May

WED



Resilience-by-design: maturity model for assessing the resilience capabilities of automotive systems architecture in the concept phase



*Isaac Mpidi Bita*¹, *Venkatesh Mellacheruvu*¹, *Elif Ugur*¹, *Aschot Hovemann*¹,
*Roman Dumitrescu*²

1: Fraunhofer Institute for Mechatronic Systems Design, Germany; 2: Heinz Nixdorf Institute, Paderborn University, Germany

Connected and Autonomous Vehicles (CAV) are increasingly complex, making resilience hard to guarantee. Resilience means maintaining functionality and availability despite disruptions while ensuring safety. Designing a resilient system requires system-level analysis early in the concept phase to identify and mitigate risks, thereby securing reliability and availability. This paper introduces the Automotive Resilience Maturity Model (ARMM), which evaluates automotive systems' resilience levels based on their system architecture.

<https://doi.org/10.1017/pds.2026.10640>

For a better understanding of the logical interdependencies of infrastructures and role of human factor: a review of modeling and simulation applications

Tom Baret, Julie Stal-Le Cardinal, Ludovic-Alexandre Vidal
CentraleSupélec, France

Critical infrastructures are complex, interdependent systems on which our societies are reliant. A better understanding of these interdependencies is vital to improving their functioning and resilience. While various studies and surveys have been conducted, we aim to cast a new perspective by focusing on what Rinaldi et al. introduced in 2001, as "logical interdependencies" and their modeling and simulation considering the human factor, and by adopting a cross-area approach to guide future works through the identification of research directions and common design challenges, good practices.

<https://doi.org/10.1017/pds.2026.10629>

Project complexity and cost escalations in the early design of railway megaprojects



Per Persson Schön^{1,2}, *Claudia Eckert*³, *Adam Mallalieu*¹, *Dag Bergsjö*¹

*1: Chalmers University of Technology, Sweden; 2: Swedish Transport Administration, Sweden;
3: The Open University, United Kingdom*

Large railway projects suffer from major cost overruns and delays, partly due to project complexity. This study explores how such complexity emerges in the early design stages and affects the project outcomes. Data from 14 interviews were compared with four project complexity frameworks. The results indicate that complexity is mainly institutional rather than structural. Optimism bias, fragmented requirement governance, and weak coordination create self-reinforcing loops of cost growth, showing that governance and decision processes, not technical uncertainty, drive early-stage complexity.

<https://doi.org/10.1017/pds.2026.10642>

A study on resilience through redundant sensing in autonomous cyber-physical systems

Patrick Kortenbusch, Anubhab Majumder, Hamza Firoud, Eckhard Kirchner
Technical University of Darmstadt, Germany

In recent years, redundant sensing has gained attention as a means to improve the resilience of autonomous cyber-physical systems (CPS). Resilience, however, has not been stringently defined. In this work, a standard-based understanding of resilience was derived, resulting in 11 properties that contribute to resilience. This understanding was used to analyse literature on autonomous CPS, their domains, operating environments, and the disruptions they encounter. A subsequent analysis shows a prevalence of measures acting during the disruption, while anticipating or learning measures are scarce.

<https://doi.org/10.1017/pds.2026.10637>



Emotional design through CMF: a comparative study across visceral, behavioural, and reflective levels

[Elmas Merve Ozyurt](#)

Mimar Sinan Fine Arts University, Turkey

CMF design goes beyond aesthetic enhancement by shaping the user-product relationship through functional, ergonomic, and symbolic dimensions. The qualitative analysis shows that colour and material primarily influence first impressions and emotional engagement, while surface finish reinforces perceived quality, symbolic meaning, and identity expression. Ergonomic performance is closely linked to material and tactile surface properties. Overall, CMF acts as a strategic design tool that strengthens brand identity, product desirability, and long-term emotional attachment.

<https://doi.org/10.1017/pds.2026.10624>

Clustering perceived user experience in manual machine operation: an explorative pilot study

[Judith van Remmen](#), [Gwen Spelly](#), [Sandro J. Wartzack](#), [Jörg Miehling](#)

Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

The aim of this exploratory pilot study is to examine the subjective user experience of operating a pillar drilling machine and a minting machine. Clustering shows three recurring perception profiles: predominantly positive, negative/demanding, and mixed. Operator posture strongly influences experience, while individual factors such as gender are less predictive. Ground-level, medium-reach positions get the most favourable ratings. The findings provide a first basis for extending behaviour cards with perception-based “experience cards” to support user-centred ergonomic design.

<https://doi.org/10.1017/pds.2026.10626>

Cognitive experience design: the effect of luminance change of central light on perceived time

[Mia Kato](#), [Ken-ichi Sawai](#), [Akane Matsumae](#)

Kyushu University, Japan

This study aims to examine the effects of luminance contrast on cognitive experience. An experiment was conducted under controlled conditions with high/low luminance contrast settings. Perceived time was measured by tapping rate, while subjective ratings of astonishment, concentration, comfort, and a semi-structured interview were collected. The results showed that higher luminance contrast elicited greater astonishment, and perceived time was associated with concentration and comfort but limited with astonishment, suggesting that astonishment may involve higher-order cognitive reappraisal.

<https://doi.org/10.1017/pds.2026.10623>

Material attunement in minimal media: designing tactility for information engagement

[Valerie Yan Tong Chua](#)^{1,2}

1: Imperial College London, United Kingdom; 2: Royal College of Art, United Kingdom

Digital news interfaces often prioritise speed and visual intensity, overlooking the material conditions through which information is experienced. This paper investigates how a text-only news device influences perceptual clarity, attention, and emotional tone in everyday use. Using a research-through-design approach with a deployed design probe, findings reveal material and formal qualities shape news engagement, introducing the concept of “minimal media” and informing the design of calmer information devices.

<https://doi.org/10.1017/pds.2026.10621>



Simulation-driven design of a cell-to-pack battery pack for electrified refrigerated vehicles

Luís Garrido¹, Catarina Costa¹, Ricardo Soares², Luís Encerrabodes², Guilherme Martins³, Duarte Mota³, Ângelo Marques⁴, David Serrão⁴, Catarina Rebelo⁴, Flávia Barbosa¹

1: INEGI – Institute of Science and Innovation in Mechanical and Industrial Engineering, Portugal; 2: AddVolt, Portugal; 3: INL - International Iberian Nanotechnology Laboratory, Portugal; 4: PIEP - Pólo de Inovação em Engenharia de Polímeros, Portugal

This work presents the design and simulation-based validation of a next-generation cell-to-pack battery system for hybrid-electric refrigerated transport. The configuration integrates a welded stainless-steel frame, liquid-cooling system, and power-electronics module within a compact modular structure that improves assembly efficiency and adaptability. Finite-element and thermal analyses confirmed compliance with vibration and thermal requirements, achieving improved volumetric efficiency and scalability. The results provide a validated foundation for prototyping and future optimization.

<https://doi.org/10.1017/pds.2026.10685>

An approach to the test design for smart composite vessels enabling remaining useful life estimation

Torben Deutschmann¹, Fabian Laukotka¹, Corentin Ferreira², Racim Radjef³, Jens Schmidt¹, Boris Eisenbart³, Kevin Otto², Dieter Krause¹

1: Hamburg University of Technology, Germany; 2: University of Melbourne, Australia; 3: Swinburne University of Technology, Australia

This paper proposes a methodological approach for designing smart composite hydrogen tanks using strain gauges and finite element analysis for continuous structural health monitoring. Simulation identifies critical stress points to optimize sensor placement. Laboratory burst and cyclic tests provide a baseline and proof of concept for a remaining useful life analysis, improving safety and resource efficiency in hydrogen storage. Results demonstrate that strain data reflect stress patterns and material responses, supporting effective monitoring of tank condition during pressurization cycles.

<https://doi.org/10.1017/pds.2026.10680>

Designing motion: analytical and computational exploration of a kinetic sculpture's behaviour

Marvin Miklosa, Shayne Gooch, Digby Symons

University of Canterbury, New Zealand

This research was initiated to investigate the dynamic behaviour of Len Lye's Kinetic Sculpture Trilogy. Safety concerns and reliability issues have led to the call for a redesign of the original mechanism. Numerical methods including FEA are used to model the artworks dynamic behaviour. Vibratory mode shapes and natural resonance frequencies of the artwork are found. Motion Capturing (MOCAP) is employed to experimentally analyse and record the dynamic behaviour of the artwork. Whirling behaviour in the form of mode shapes was recorded equally below and above the resonance frequencies.

<https://doi.org/10.1017/pds.2026.10689>

Simulation-driven design approach for high power-density electric vehicle power electronics

João Castro¹, João R. Matos¹, Ricardo Soares², Luís Encerrabodes², Guilherme Martins³, Duarte Mota³, Ângelo Marques⁴, Rui Oliveira⁴, Lourenço Bastos⁴, Flávia Barbosa¹

1: INEGI – Institute of Science and Innovation in Mechanical and Industrial Engineering, Portugal; 2: AddVolt, Portugal; 3: INL - International Iberian Nanotechnology Laboratory, Portugal; 4: PIEP - Pólo de Inovação em Engenharia de Polímeros, Portugal

A power electronics pack for refrigerated transport was redesigned to overcome limitations in power density, efficiency, and compactness. An iterative approach combining CAD modeling with thermal and mechanical simulations guided geometry, material selection, and cooling design. Applying Design-for-Excellence principles, multiple submodules were consolidated into a single enclosure with three functional zones. Structural and thermal validations confirmed compliance under extreme conditions. The optimized pack achieved 31 kg (57% reduction) and 671 W/L power density (338% improvement).

<https://doi.org/10.1017/pds.2026.10679>

Session
D356

Congress
Hall
Šipun

17:00
18:00

20 May

WED

101



08:45	<p>D411: DESIGN STRATEGIES FOR SUSTAINABILITY TRANSITIONS Congress Hall Ragusa Chair: Christian Köhler, Hochschule für Technik und Wirtschaft des Saarlandes (htw saar), Germany</p>	<p>D412: LLM-ENABLED DESIGN METHODS AND ENGINEERING PROCESSES Congress Hall Bobara Chair: Vito Giordano, Università di Pisa, Italy</p>	<p>D413: INCLUSIVE AND WELLBEING-DRIVEN DESIGN FOR HEALTHCARE Congress Hall Orlando 1 Chair: P. John Clarkson, University of Cambridge, United Kingdom</p>
09:45	REFRESHMENT BREAK		
10:15	<p>D421: METHODS FOR CIRCULAR AND SUSTAINABLE DESIGN Congress Hall Ragusa Chair: Ola Isaksson, Chalmers University of Technology, Sweden</p>	<p>D422: GENERATIVE AI FOR DESIGN SYNTHESIS AND ENGINEERING APPLICATIONS Congress Hall Bobara Chair: James Gopsill, University of Bristol, United Kingdom</p>	<p>D423: HUMAN-AI INTERACTION AND COMMUNICATION IN ENGINEERING DESIGN Congress Hall Orlando 1 Chair: Arlindo Silva, SUTD, Singapore</p>
11:15	TRANSITION BREAK		
11:30	<p>D431: CIRCULAR DESIGN FRAMEWORKS, TOOLS AND LONGEVITY STRATEGIES Congress Hall Ragusa Chair: Jeremy Faludi, TU Delft, The Netherlands</p>	<p>D432: AI-DRIVEN KNOWLEDGE AND DECISION SUPPORT IN PRODUCT DEVELOPMENT Congress Hall Bobara Chair: Martin Steinert, Norwegian University of Science and Technology, Norway</p>	<p>D433: HUMAN-CENTRED ASPECTS OF AI Congress Hall Orlando 1 Chair: Yuan Yin, Imperial College London, United Kingdom</p>
12:30	LUNCH RESTAURANT CAVTAT		
14:00	<p>D4-P: PLENARY SESSION 3 Congress Hall Ragusa Chair: Julie Stal-Le Cardinal, CentraleSupélec, France</p>		
14:45	REFRESHMENT BREAK		
15:15	<p>D441: AI METHODS FOR SUSTAINABLE DESIGN AND CIRCULARITY Congress Hall Ragusa Chair: Stefan Zorn, University of Rostock, Germany</p>	<p>D442: MACHINE LEARNING FOR GENERATIVE DESIGN AND DESIGN SPACE EXPLORATION Congress Hall Bobara Chair: Tomislav Martinec, University of Zagreb FSB, Croatia</p>	<p>D443: DESIGN METHODS AND PROCESSES IN PRACTICE Congress Hall Orlando 1 Chair: Kilian Gericke, University of Rostock, Germany</p>
16:15	TRANSITION BREAK		
16:30	<p>D451: DESIGN FOR SUSTAINABILITY APPLICATIONS Congress Hall Ragusa Chair: Gwenola Yannou-Le Bris, UMR sayfood, France</p>	<p>D452: AI METHODS FOR GEOMETRIC MODELS AND DESIGN DATA Congress Hall Bobara Chair: Kristin Paetzold-Byhain, Technische Universität Dresden, Germany</p>	<p>D453: ANALYTICAL CONSIDERATIONS IN ENGINEERING DESIGN Congress Hall Orlando 1 Chair: Shayne Gooch, University of Canterbury, New Zealand</p>
17:30	TRANSITION BREAK		
17:45	<p>D4-C: CLOSING SESSION Congress Hall Ragusa Chair: Tim C. McAloone, Technical University of Denmark, Denmark</p>		
18:30	FAREWELL PARTY		
20:00	FAREWELL PARTY		
22:00	FAREWELL PARTY		



<p>D414: KNOWLEDGE INTEGRATION AND METHODS IN MODEL-BASED SYSTEMS ENGINEERING Congress Hall Orlando 2 Chair: Nikola Bursac, Hamburg University of Technology, Germany</p>	<p>D415: UNDERSTANDING INTERACTION AND USER DYNAMICS IN SERVICE DESIGN Congress Hall Konavle Chair: Nuša Fain, Carleton University, Canada</p>	<p>D416: DESIGN METHODS AND PEDAGOGY Congress Hall Šipun Chair: Joshua Summers, The University of Texas at Dallas, United States of America</p>	08:45
<p>D424: MODEL-BASED SYSTEMS ENGINEERING FOR ENVIRONMENTAL IMPACT INTEGRATION Congress Hall Orlando 2 Chair: Eduardo Zancul, Universidade de São Paulo, Brazil</p>	<p>D425: USER AND CONSUMER PERCEPTION IN PRODUCT DESIGN AND USE Congress Hall Konavle Chair: Monica Bordegoni, Politecnico di Milano, Italy</p>	<p>D426: LEARNING ENVIRONMENTS AND APPROACHES IN ENGINEERING DESIGN EDUCATION Congress Hall Šipun Chair: Ahmed Kovacevic, City ST George's, University of London, United Kingdom</p>	09:45 10:15
<p>D434: MODEL-BASED DESIGN AND SIMULATION FOR RESOURCE-EFFICIENT SYSTEMS Congress Hall Orlando 2 Chair: Alexander Koch, University of the Bundeswehr Munich, Germany</p>	<p>D435: BEHAVIOURAL DESIGN METHODS AND APPLICATIONS Congress Hall Konavle Chair: Jiwon Jung, Delft University of Technology, The Netherlands</p>	<p>D436: HUMAN FACTORS IN DESIGN EDUCATION Congress Hall Šipun Chair: Stanko Škec, University of Zagreb FSB, Croatia</p>	11:15 11:30
<p>INCLUSIVE DESIGN: WHO TO INCLUDE? <i>Dr Hua Dong; Professor of Design, Director of Helen Hamlyn Centre for Design, Acting Pro-Vice Chancellor, Research & Innovation, Royal College of Art</i></p>			12:30 14:00 14:00
<p>D444: DESIGNING FUTURE MOBILITY SYSTEMS Congress Hall Orlando 2 Chair: Dorian Marjanović, University of Zagreb FSB, Croatia</p>	<p>D445: ORGANISATIONAL AND VALUE MANAGEMENT IN COMPLEX DESIGN SYSTEMS Congress Hall Konavle Chair: Alessandro Bertoni, Blekinge Institute of Technology, Sweden</p>	<p>D446: TEAM DYNAMICS AND AGILE PRACTICES IN PRODUCT DEVELOPMENT Congress Hall Šipun Chair: Anita Friis Sommer, Aarhus University, Denmark</p>	14:45 15:15
<p>D454: AUTOMATION APPROACHES IN DESIGN Congress Hall Orlando 2 Chair: Roland Lachmayer, Leibniz Universität Hannover, Germany</p>	<p>D455: DESIGN THINKING AND CREATIVE APPROACHES FOR FUTURES Congress Hall Konavle Chair: Georgi V. Georgiev, University of Oulu, Finland</p>	<p>D456: MODELLING AND EXPLORING INTERACTIONS IN DESIGN Congress Hall Šipun Chair: Philip Farrugia, University of Malta, Malta</p>	16:15 16:30
<p>A WORD FROM THE DESIGN SOCIETY <i>Anja Maier - Vice President & Treasurer of the Design Society (University of Strathclyde)</i> DESIGN SCIENCE JOURNAL DISTINGUISHED PAPER AWARDS <i>Anja Maier - Editor-in-Chief of the Design Science Journal (University of Strathclyde)</i> DESIGN 2026 CONFERENCE REFLECTION <i>Tim C. McAlloone - Programme Chair (Technical University of Denmark)</i></p>			17:30 17:45
			18:30 20:00 22:00



Leveraging repair services as systemic interventions in sustainable fashion

Nasira Ahsan, Dirk Van Rooy, Els Du Bois

University of Antwerp, Belgium

This research addresses the perceptual conflict wherein consumers place greater trust in independent repair providers than in brand-led initiatives. Positioned within design for sustainability discourse, this paper, firstly examines repair service providers' perspectives, revealing their challenges & systemic complexities. Secondly it presents their role in shaping the industry through skill transfer, community building etc. Lastly, design interventions are analyzed using systemic leverage points framework to expose varying depths of repair services to bring systemic change of fashion sector.

<https://doi.org/10.1017/pds.2026.10477>

Mapping opportunities for systemic redesign: insights from the circular economy diagnosis of the Brazilian food-service sector

Istefani Carisio de Paula¹, Aline Cafruni Gularte¹, Ghissia Hauser¹, Beatriz Proença², Fernanda Valentini³

1: Federal University of Rio Grande do Sul, Brazil; 2: Vaus Consultoria, Brazil; 3: Trashin, Brazil

This study diagnoses Circular Economy practices in Brazil's food-away-from-home sector using survey data (n=1,002) interpreted through the Design for Sustainability framework. Results show fragmented, technocentric actions and weak collaboration, with minimal regenerative practices. Mapping gaps across DfS levels reveals leverage points for redesign in governance, services, value-chain relations, and ecological loops, highlighting the need for systemic, design-led transitions.

<https://doi.org/10.1017/pds.2026.10481>



Session
D411

Congress
Hall
Ragusa

08:45
09:45

Exploratory study of the integrations of low-tech approaches for sustainability in industrial contexts

Emile Burckard^{1,2,3}, Tom Bauer^{1,2,3}, Tatiana Reyes^{1,2,4}, Améziane Aoussat⁵

1: Université de Bordeaux, CNRS, Bordeaux INP, I2M, UMR 5295, France; 2: Arts et Métiers Institute of Technology, CNRS, Bordeaux INP, I2M, UMR 5295, France; 3: UTOPII, CNRS, AMU, ENSAM, ENPC, INSA Lyon, Sorbonne Université, France; 4: Research Unit InSyTE, University of Technology of Troyes, France;

5: Arts et Métiers Institute of Technology, LCPI, France

Low-tech approaches and practices have developed in recent years, both as a model of strong sustainability in a context of polycrisis, and as an alternative technological discourse opposed to the prevailing techno-solutionism. Various organisations have drawn inspiration from them for the transition or redirection of their system. This article refers to this as "integration of low-tech approaches". It provides an overview of such integrations in industries through the study of seven cases. Then, it discusses the challenges of their definition, which underpin their sustainability potential.

<https://doi.org/10.1017/pds.2026.10620>



Mitigate product obsolescence by design: exploratory review of adaptability, upgradability and flexibility

Bas van de Camp, Ivo Dewit, Jelle Saldien

Department of Product Development, Faculty of Design Sciences, University of Antwerp, Belgium

Increasing e-waste demands design approaches beyond repair and recycling. This study explores adaptability, upgradability, and flexibility, as proposed to mitigate product obsolescence. Processes and guidelines are examined from legislative, academic, and industrial perspectives, complemented by a workshop (n=16). Applications show potential yet remain scarce and uncover rebound effects. A common framework for adaptable design is suggested. Future research is recommended to evaluate it, expand guidelines empirically and address barriers like consumer perceptions and business model challenges.

<https://doi.org/10.1017/pds.2026.10522>

21 May

THU

104



ISOprep: an LLM-driven pipeline for semantics-preserving processing of neutralized requirements according to ISO 29148

Kata Amanda Schiller, Arthur Seibel
Leuphana University Lüneburg, Germany



AI in Requirements Engineering (RE) relies on industrial data, yet safety and privacy risks limit its use. While the GDPR distinguishes only between anonymization and pseudonymization, we use neutralization as a semantics-preserving technique. In AI-supported RE, data heterogeneity and cross-domain variability impede model training. We propose guidelines for semantics-preserving preprocessing for RE datasets based on ISO 29148 criteria, showing that neutralization does not compromise semantics. The approach enables industry-academia collaboration through AI-assisted RE in product development.

<https://doi.org/10.1017/pds.2026.10439>

Evaluating TRIZ with and without LLM support: an experimental study on engineering problem-solving

Vanja Čok¹, Damien Motte², Khadija Hmina³, Ibtiissam El Hassani^{3,2,4}, Ivan Demšar¹, Jože Tavčar², Nikola Yukašinović¹

1: Faculty of Mechanical Engineering, University of Ljubljana, Slovenia; 2: Department of Design Sciences, Lund University, Sweden; 3: ENSAM, University of Moulay Ismail, Morocco; 4: Mathematics, Computer Science and Engineering Department, University of Quebec at Rimouski, Canada

This paper examines integrating Large Language Models (LLMs) into the TRIZ contradiction matrix (TRIZ-C+LLM) to support engineering students in creative problem-solving. Experiments with three problems show that LLMs did not always improve design quality for complex tasks but reduced cognitive workload, improved understanding of contradictions, and increased perceived usefulness. Prompting experience strongly influenced outcomes, highlighting both the promise and limits of combining TRIZ with generative AI.

<https://doi.org/10.1017/pds.2026.10409>

Discover the use of multimodal language models for idea detailing in human-AI collaborative design

Jiazhen Zhang, Ji Han, Saeema Ahmed-Kristensen
University of Exeter, United Kingdom

In this work, we propose a multimodal, language-model-based design assistance framework for the design ideation stage. The framework leverages large language models (LLMs) to interpret user intentions with mood boards, enrich initial ideas with essential contextual details, and produce structured instructions for visual language models (VLMs) to enhance the accuracy and consistency of visual feedback.

<https://doi.org/10.1017/pds.2026.10619>

Structure-based similarity searches to improve the reuse of assemblies and functional units in plant engineering - use cases and implementation verification with a large language model as a search tool

Lorenz Krüger¹, Kristin Paetzold-Byhain²

1: VON ARDENNE GmbH, Germany; 2: Dresden University of Technology, Germany

In plant engineering and industrial solution business, the focus is on developing customer-specific products. At the same time, finding suitable templates from previous projects (adaptation design) is essential for efficient product development. Conventional search tools in PDM/ERP systems are not suitable for this purpose, which is why structure-based similarity search was proposed in an earlier article. In this article, a feasibility study is conducted to determine what typical use cases exist and whether these can be easily SME-implemented with a large language model (LLM) as a search tool.

<https://doi.org/10.1017/pds.2026.10425>



Embodied inclusion: re-materialising digital interaction for age-inclusive design

Stephanie Reynders, Kristof Vaes, Lukas Van Campenhout

University of Antwerp, Belgium

This paper examines the role of product design in digital age-inclusivity. As digitalisation accelerates, older adults face persistent exclusion. We argue that interaction-level tensions between the intangible nature of screen-based systems and embodied human perception contribute to this divide. We introduce the Embodied Inclusion Framework as a structured approach to enhancing physical accessibility, cognitive usability and somatic safety in digital interaction.

<https://doi.org/10.1017/pds.2026.10436>

Designing for subjective well-being: a VDL canvas and insight cards for exploring positive user experiences

Hyunwook Nam, Chajoong Kim

UNIST, South Korea

This research describes a tool based on subjective well-being, value, and practical design. We present a Value-Driven Ladder Canvas and 78 Value Insight Cards to support SWB-oriented practice. Studies 1 and 2 focus on discovering insights based on the user's product experience and converting them into toolkits. Study 3 evaluates and verifies toolkits with SUS, UEQ, PANAS, etc. This research highlights the connection between Needs and positive experiences, providing actionable guidance. Our findings demonstrate that Canvas and Insight cards are designed to improve SWB sufficiently to be useful.

<https://doi.org/10.1017/pds.2026.10432>

A review of web-based toolkits for health and care design and improvement: preliminary results

Tingting Wang¹, P. John Clarkson^{1,2}

1: Delft University of Technology, The Netherlands; 2: University of Cambridge, United Kingdom

We reviewed 36 web-based toolkits supporting health and care design and improvement and identified five classification dimensions: novelty (novel or established tools), scope (specialised or generic), origin (research- or practice-based), motivation for use (risk reduction or benefit enhancement), and application level (individual or group use). We also identified five types of toolkit developers and seven end-user roles. Most toolkits were generic and practice-based, developed by commercial or academic actors, targeted at practitioners and leaders, and supported both individual and group use.

<https://doi.org/10.1017/pds.2026.10448>

Computational design tools for occupational therapists: a framework for integrating assistive technology design, customization, and prescription

Leila Aflatoony¹, Siniša Kolaric²

1: Georgia Institute of Technology, United States of America; 2: Vidiponta Research, United States of America

Providing effective assistive technologies is challenging due to misalignment with users' needs, often leading to product abandonment. Occupational therapists play a key role in prescribing, adapting, and creating personalized ATs, yet technical and marketplace barriers complicate this work. Computational design tools can support OTs, yet no clear design guidelines currently exist. From four case studies, we identify six considerations: workflow integration, intuitive interfaces, real-time visualization, collaboration, customization, and safety, to guide OT-focused design tool development.

<https://doi.org/10.1017/pds.2026.10404>



Semantic fusion of SysML elements for model integration utilizing knowledge graphs

Roman Stephan¹, Zhiwei Zhou², Simon Gottschalk², David Inkermann¹

1: Clausthal University of Technology, Germany; 2: L3S Research Center, Leibniz Universität Hannover, Germany

While top-down System Engineering supports the definition of system boundaries and interfaces, practical implementation often proceeds in a bottom-up manner, resulting in the need for model integration of SysML models. This is currently hindered by inconsistent naming, different abstraction levels, and unclear interfaces. In this work, a novel approach to integration is proposed, utilizing RDF knowledge graphs and LLM-driven entity alignment with similarity thresholds to perform semantic fusion. A practical use case shows correct consolidation based on cosine similarity thresholds.

<https://doi.org/10.1017/pds.2026.10645>

System architecture margins for the ilities

Arindam Brahma¹, David C. Wynn², Ola Isaksson¹

1: Department of Mechanical Engineering, Chalmers University of Technology, Sweden; 2: Department of Integrated Design and IRC for Smart Mobility and Logistics, King Fahd University of Petroleum and Minerals, Saudi Arabia

Engineers often treat margins as buffers or excesses which are added to parameters, appearing much later in the product development process. However, many key lifecycle properties e.g., reliability stem from early architectural decisions which either need margins for their enablement or create margins in the process. These buffers are rarely treated explicitly as margins. This paper argues that there is a clear relationship between architectural objectives and margins and explores four examples of ilities providing a new perspective for reasoning about ilities in early system design.

<https://doi.org/10.1017/pds.2026.10634>

Navigating the landscape of MBSE methodologies: a comparative study of ISO 15288 technical process coverage

Landry Bessault, Julia Guérineau, Louis Rivest

École de technologie supérieure, Canada

This paper compares nine Model-Based Systems Engineering methodologies with ISO 15288:2023 on the basis of their technical process coverage, to assess the extent to which the methodologies and standard are aligned. The technical processes covered include the definition of stakeholders, stakeholder needs, system requirements, architecture, design, verification, and validation. Two comparison criteria are also linked to the standard, namely, traceability and customisation. The results indicate that the definition of system requirements and system architecture are common core components of SE.

<https://doi.org/10.1017/pds.2026.10631>

A systematic literature review on AI-driven systems engineering assistants and the use of interaction design

Benjamin Tülp¹, Christian Koldewey^{1,2}, Roman Dumitrescu^{1,2}

1: Paderborn University, Germany; 2: Fraunhofer Institute for Mechatronic Systems Design, Germany

Systems engineering continues to face challenges such as high manual modelling costs and insufficient tool support. With the rising importance of AI methods, SE assistants, software systems that support engineers in typical SE tasks, are gaining attention. However, there is currently no systematic classification of such assistants. At the same time, their usefulness depends heavily on the quality of the human AI interaction. This paper addresses these gaps by systematically categorising SE assistants and analysing the role of interaction design in their development and application.

<https://doi.org/10.1017/pds.2026.10646>

Session
D414

Congress
Hall
Orlando 2

08:45
09:45

21 May

THU

107



Interaction dynamics for service design: simulating context sharing through collective improvisational dance

Shun Yamazaki ¹, Yuito Mitsuno ¹, Ken-ichi Sawai ¹, Jean-François Boujut ², Akane Matsumae ¹

1: Kyushu University, Japan; 2: Université Grenoble Alpes, CNRS, Grenoble INP, G-SCOP, France

This study modelled service dynamics, specifically focusing on cognitive misalignments among actors, and conducted a multi-agent simulation using Bayesian inference, referring to an improvisational dance experiment. The results revealed that individual cognition influences context convergence: “No decay” condition fixed initial biases and hindered convergence, whereas faster decay increased fluctuation but enabled reconfiguration, suggesting the need for unlearning. When actors weighted others’ expressions less, cognitive misalignments widened despite strong subjective conviction.

<https://doi.org/10.1017/pds.2026.10473>

Assessing induction programme as a service: reflections on assessing organisational services through service design lens

Shivani Ganwani, Sanandan Ratkal, Karthik Konar, Ravi Mahamuni

Tata Consultancy Services, India

This paper explores the assessment of employee induction as a service, through the lens of service design. The service assessment methodology was a multi-method and a multi-stakeholder approach, uncovering how processes, touchpoint interactions and servicescape shape onboarding experiences of new joiners. The paper highlights the researchers’ reflections about using the methodology in organizational context and portrays the value of assessing organizational services through service design lens. The reflections offer practical insights applicable to assessment of other organizations services.

<https://doi.org/10.1017/pds.2026.10378>

Cluster typologies of urban mobility users and their implications for the acceptance of autonomous buses: evidence from a large-scale online survey

Julian Faig ¹, Daniel Roth ¹, Matthias Kreimeyer ¹, Johannes Weyer ², Sebastian Hoffmann ²

1: Institute for Engineering Design and Industrial Design, University of Stuttgart, Germany;

2: Department of Social Sciences, Social Research Center, TU Dortmund University, Germany

This paper addresses the lack of empirically grounded user typologies for understanding acceptance of autonomous buses in the Munich Metropolitan Area. We close this gap through a large-scale online survey and a clustering approach based on mobility preferences and subjective expected utility. The results identify five distinct clusters of users with varying acceptance levels, showing that successful autonomous bus adoption requires tailored communication, service design, and integration strategies.

<https://doi.org/10.1017/pds.2026.10682>

Toward modeling relational expectation misalignments in care: an exploratory extension of the theory of planned behavior for design

Hiroto Miyatake, Naoki Mukawa, Momoko Nakatani, Shigeki Saito, Yuki Taoka

Institute of Science Tokyo, Japan

Human-Centered Design focuses on individuals who struggle to grasp the relational aspects crucial in designing for care. This proposes a relational framework that visualizes the relational expectation misalignments between stakeholders’ perceptions. We extend the Theory of Planned Behavior to model dyadic care relationships. Expert interviews and autoethnographic analysis evaluated the model. Our findings reveal two layers of misalignments: the model’s ability to describe the structure of conflict and its potential as a reflective tool for stakeholders to resolve conflicts.

<https://doi.org/10.1017/pds.2026.10463>





Making inclusion actionable in design studio teaching: a practice-oriented framework for developing inclusive designers

[Bruno Oro, Subinay Malhotra](#)

Iowa State University, United States of America

This paper presents the Designable Inclusive Design Methodology, a modular framework that was tested across two consecutive semesters in a company-sponsored design studio within academic settings. The toolkit provides practical and repeatable methods that embed inclusion throughout the design process. Developed through research through design, it offers a fast and flexible alternative to large-scale curriculum reform. Initial findings indicate that the use of the methodology enhances student confidence, fosters deeper reflection, and promotes inclusive thinking in everyday studio work.

<https://doi.org/10.1017/pds.2026.10671>

Developing design method as teaching tools: the dual role of design methods in practice and pedagogy

[Jakob Lavrsen, Sara Figueiredo](#)

Aalto Design Factory, Aalto University, Finland

This paper draws on Method Content Theory and the Method Teaching framework to analyze the User Testing Toolkit, in its dual role as a design and a teaching tool. The paper shows how the toolkit, by supporting the contextualization of user testing in a broader design context, not only support design activities, but also the critical reflection on design context and actions, necessary for development of appropriate design practices. As such, the paper sheds light on how design methods can be developed to support both effective design action and the development of appropriate design practices.

<https://doi.org/10.1017/pds.2026.10663>

What's the big IDEA? Co-designing engineering outreach with inclusivity, diversity, equity and accessibility in mind

[Isabelle Ormerod](#)^{1,2}, [Ella Maule](#)^{1,2}, [Yael Zekaria](#)^{1,2}, [Edith-Clare Hall](#)^{1,2}, [Chris Snider](#)¹, [Mark Goudswaard](#)¹

1: University of Bristol, United Kingdom; 2: Bristol Robotics Lab, United Kingdom

Engineering outreach helps to address the STEM “leaky pipeline”, yet often lacks inclusive design guidance. This paper presents a methodology for co-designing activities using Inclusivity, Diversity, Equity, and Accessibility (IDEA) principles. Through three workshops integrating pedagogy training and storytelling, the method proved effective: participating engineers’ IDEA knowledge jumped from 20% to 75%, and delivery confidence rose from 24% to 71%. This methodology successfully equips professionals with the confidence and skills to foster a more diverse engineering workforce.

<https://doi.org/10.1017/pds.2026.10670>

Challenges in understanding, using, and teaching design methods: perspectives of design educators

[Mayank Mayookh, Venkataraman Srinivasan](#)

Indian Institute of Technology Delhi, India

This study identifies the challenges design educators face in understanding, using, and teaching design methods and derives features from these challenges for an enhanced methods repository to support design practice and pedagogy. Interviews with 21 educators yielded 14 distinct themes of challenges, based on which the following features are proposed: (a) detailed method information with context-based recommendations and teaching resources, (b) a platform to learn and practice with guidance, and (c) step-by-step walkthroughs with cross-disciplinary examples.

<https://doi.org/10.1017/pds.2026.10666>

Session
D416

Congress
Hall
Şipun

08:45
09:45

21 May

THU

109



The design for recycling of electronics guide: from recycling practice to design method

Dorien C. van Dolderen, Conny A. Bakker, A. Ruud Balkenende
Delft University of Technology, The Netherlands

Electronic waste is one of the fastest-growing waste streams, yet only a small fraction is properly recycled. Many challenges in recycling originate in product design; for example the choice of materials and joining methods. This paper presents the first version of the Design for Recycling of Electronics Guide, developed to bridge the gap between design and recycling practice. Based on case studies, shredding experiments, and method reviews, it provides practical guidance to help designers anticipate and improve recyclability during product development.

<https://doi.org/10.1017/pds.2026.10446>

Set-based design approach for renewable energy integration in social housing: design space mapping with a morphological chart

Saïoa Gartzia^{1,2}, Audrey Abi Akle¹, Michael Hamwi¹, Iban Lizarralde¹
1: Université de Bordeaux, ESTIA-Institute of Technology, EstiaR, France; 2: Comité Ouvrier du Logement (COL), France

The EU 2050 carbon neutrality target drives growing interest in renewable energy (RE) integration in building design, yet social housing organizations face difficulties integrating them early in design due to complexity and high upfront costs. This paper presents a three-step method based on the Set Based Design approach to define the design space using a morphological chart. This offers a robust and adaptable framework to formalize and structure domain-specific knowledge, clarifies design options, and supports informed decision-making for RE integration in social housing design.

<https://doi.org/10.1017/pds.2026.10414>

Bayesian optimal experimental design for circular business models

Eiji Yoshiki, Yudai Tsurusaki, Koji Kimita
The University of Tokyo, Japan

Implementing circular business models (CBMs) like Product-as-a-Service entails high uncertainty, necessitating costly and prolonged business experimentation. To efficiently mitigate this uncertainty, Bayesian Optimal Experimental Design is applied to the CBM context, selecting conditions that maximize the Expected Information Gain for unknown CBM parameters. Applied to an air conditioner subscription case study, the method successfully identified optimal conditions from 124 candidates. This approach facilitates CBM implementation by efficiently minimizing uncertainty under limited resources.

<https://doi.org/10.1017/pds.2026.10450>

Towards a methodical framework for the design of functional surfaces in circular automotive engineering

Umut Volkan Kizgin¹, Denise Püllmann¹, Armin Stein¹, Bastian Nolte¹, Michael Thomas², Thomas Vietor¹
1: Institute for Engineering Design, Technische Universität Braunschweig, Germany; 2: Institute for Surface Technology, Technische Universität Braunschweig, Germany

This paper proposes a methodical framework for developing functional surfaces and coatings for circular automotive applications. It addresses three gaps: the missing classification of surface mechanisms, limited empirical PSPP models, and the lack of an integrated link between microstructural surface design and system-level development. The framework connects top-down design with bottom-up materials engineering, introduces working-principle analogues in design catalogues, and offers the use of DoE and sensitivity analysis to build predictive PSPP models.

<https://doi.org/10.1017/pds.2026.10423>



From geometry to function: towards context-aware generative AI for engineering design

[Elias Berger](#)^{1,2}, [Kevin Herrmann](#)³, [Felix Pusch](#)³, [Tobias Kriesell](#)³, [Paul Gembariski](#)³, [Jan Mehlstäubl](#)², [Roland Lachmayer](#)³, [Kristin Paetzold-Byhain](#)¹

1: Dresden University of Technology, Germany; 2: MAN Truck & Bus SE, Germany; 3: Leibniz University Hannover, Germany

Current generative artificial intelligence for Computer-Aided Design (CAD) optimizes for geometric similarity, neglecting engineering criteria like functionality, manufacturability, and sustainability. This paper addresses this gap and proposes a conceptual framework to reorient generative CAD from replicating shapes to achieving function. We introduce two hybrid training strategies: a pre-learning approach using synthetically labeled datasets (evaluated via FEA, CAM, LCA) and a self-learning approach where GenAI uses these knowledge-based tools as a reinforcement feedback loop.

<https://doi.org/10.1017/pds.2026.10577>

Achievable mechanical performance of generatively designed PA6-CF and PLA components fabricated by desktop material extrusion

[Christer W. Elverum](#), [Håvard Revheim Martinsen](#), [Sindre W. Eikevåg](#)
Norwegian University of Science and Technology, Norway

This study investigates the mechanical performance of PA6-CF and PLA components fabricated with desktop material extrusion additive manufacturing. To define the geometry, low-cost 3D scanning was used in combination with Generative Design in Autodesk Fusion 360. PA6-CF outperformed PLA by 25% in pre-failure peak load (1.85 kN vs. 1.47 kN), despite the datasheet values suggesting a 450% advantage in interlayer strength. Poor interlayer bonding of PA6-CF is attributed to low layer temperatures (87–136 °C) during the printing process, indicating that a chamber temperature of 60 °C is inadequate.

<https://doi.org/10.1017/pds.2026.10548>

Structured prompting for design for multi-X: evaluating LLM support in early prosthetic device design

[Adrian Mercieca](#), [Philip Farrugia](#), [Jonathan Borg](#)
University of Malta, Malta

This paper investigates how prompt structure influences the use of Large Language Models in early engineering design. A structured prompting framework aligned with the engineering design cycle is proposed to support Design for Multi X reasoning and more coherent problem exploration. Using a prosthetic knee-cover case study, six engineering designers engaged with both generic and structured prompting workflows. A mixed methods study examines how prompt organisation shapes LLM assisted reasoning, problem framing and the articulation of design constraints and considerations.

<https://doi.org/10.1017/pds.2026.10604>

In search for working principles using large language models: an experimental study

[Fabio Hanspach](#)¹, [Kilian Gericke](#)², [Ute Dietrich](#)³, [Boris Eisenbart](#)¹

1: Swinburne University of Technology, Australia; 2: University of Rostock, Germany; 3: Hochschule für Technik und Wirtschaft Berlin, Germany

The use of artificial intelligence, especially large language models (LLMs), is increasingly explored to support early system development. This paper evaluates low-threshold LLM-based tools for supporting conceptual design. Through an experiment, two LLM-based tools were compared generating alternative solutions using an existing function model of an electro-mechanical system as input. Functions were provided in natural language and using the Functional Basis. Results show limitations and significant potentials for effective and efficient conceptual design support.

<https://doi.org/10.1017/pds.2026.10591>

Session
D422

Congress
Hall
Bobara

10:15
11:15

21 May

THU

111



Verbal communication in synchronous collaborative CAD activities: empirical evidence from AI-supported teams

Jelena Šklebar, Tomislav Martinec, Stanko Škec, Mario Štorga

University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, Croatia

This study examines how ChatGPT support influences verbal communication in synchronous collaborative CAD activities. Using a verbal protocol analysis of teams solving an embodiment design task, the results show that ChatGPT-supported teams communicated less, devoted less verbal communication to problem- and analysis-related communication, and shifted toward process and solution synthesis, indicating a shortened design co-evolution cycle in which teams move more quickly toward generating solutions. Future work should integrate these findings with broader teamwork and taskwork analyses.

<https://doi.org/10.1017/pds.2026.10612>

How would engineers use LLMs for assembly search if they could? – An empirical study for fostering generative AI-driven design reuse in the future

Jonas Fastabend¹, Irfan Agovic¹, Daniel Roth¹, Roman Neumann², Christoph Hammer², Matthias Kreimeyer¹

1: University of Stuttgart, Germany; 2: Robert Bosch Manufacturing Solutions GmbH, Germany

This study examines how engineers formulate natural language prompts for searching existing assemblies in mechanical design. A survey with 48 engineers produced 169 prompts for different assemblies. Results show that prompts are mostly written as bullet points with an average of three and up to seven requirements. The engineers describe assemblies mainly through implicit functional descriptions and geometric or physical parameters. These findings form an empirical basis for developing generative AI-driven, prompt-based systems to foster design reuse.

<https://doi.org/10.1017/pds.2026.10587>

Engineering design through dialogue: a method for analysing speech-based human-AI conversation

Kieran Gunn, Ross Brisco, Alexander “Freddie” Holliman, Erfu Yang, Rebecca Macfie

University of Strathclyde, United Kingdom

Speech-capable AI systems introduce new possibilities for communication and collaboration in design, yet methods for analysing human-AI interactions through speech remain limited. This paper proposes and applies a method for analysing conversational interactions in speech-based human-AI design activity. Grounded in conversation analysis, this method reveals how conversational structure and designer roles emerge through spoken interaction, offering an analytical framework for examining communication, cognition, and collaboration in design.

<https://doi.org/10.1017/pds.2026.10589>

Design and evaluation of an AI-based application to enhance creativity in design thinking workshops

Mayu Akaki¹, Kazuko Katayama², Ryota Nishioka²

1: Ritsumeikan University, Japan; 2: Smart Process Co., Ltd., Japan

We designed and evaluated an AI-based Application to enhance human creativity in design thinking workshops. The results indicated that AI hindered human creativity, resulting in fewer idea generations. The findings from quantitative and qualitative analyses comparing the only-human and human-AI teams indicated that AI contributed to the usability of ideas during the divergent phase and supported humans in converging on more novel ideas. The further development of the application is necessary to consider how humans can collaborate with AI without relying on it.

<https://doi.org/10.1017/pds.2026.10574>

Session
D423

Congress
Hall
Orlando 1

10:15
11:15

21 May

THU

112



Quality criteria of transdisciplinary engineering design for dealing with wicked problems in design for sustainability and systems transitions

[Florian Ahrens](#)¹, [Katharina Hunger](#)², [Alexander Hasse](#)¹

1: Institute for Design Engineering & Drive Technology, Chemnitz University of Technology, Germany; 2: CIMTT Centre of Production Engineering and Management, Dresden University of Technology, Germany

Transdisciplinary (TD) engineering design is a useful approach for engineers when responding to the wicked problems of sustainability and systems transitions. A research gap lies in understanding the quality criteria for TD engineering design, and in investigating to what extent existing studies in the field exhibit TD qualities. In this semi-systematic literature review we develop a framework of quality criteria for TD engineering design and then analyse relevant literature using the framework. The paper concludes methodological recommendations for future TD engineering design studies.

<https://doi.org/10.1017/pds.2026.10627>

The design of a MBSE enabled ecodesign approach: case of application at a Dutch radar system developer

[Tijn Groeneveld](#)¹, [Marcus Vinicius Pereira Pessoa](#)¹, [Vlad Stefanovici](#)²

1: University of Twente, The Netherlands; 2: Thales Nederland B.V., The Netherlands

As environmental sustainability pushes organisations to integrate sustainable system design into engineering workflows, there remains a gap in translating high-level environmental objectives into actionable design practices. This research addresses the integration gap by developing a Model-Based Systems Engineering enabled ecodesign approach tailored for early-stage product design at a Dutch radar system developer. A ten-step methodology integrates carbon footprint analysis with MBSE functional data to identify architectural hotspots, enabling data-driven decisions within existing workflows.

<https://doi.org/10.1017/pds.2026.10635>



Using model-based systems engineering (MBSE) and SysML for integrated sustainable manufacturing

[Anna M. Nowak-Meitinger](#)^{1,2}, [Alexander Lübke](#)¹, [Sabine Ammon](#)²

1: Technical University of Applied Sciences Wildau, Germany; 2: Technische Universität Berlin, Germany

This article motivates the use of MBSE and SysML for organizational development and argues for a model-based integration of sustainable leadership (SL) into sustainable manufacturing (SM). We discuss whether modeling requirements resulting from SM and SL literature can be met by SysML and introduce an initial black box perspective and meta-model. The work is part of a larger research project aiming to transfer findings from SM and SL research into a model-based integrated SM in order to support a human-centered perspective. This work shows that SysML is suitable for organizational use cases.

<https://doi.org/10.1017/pds.2026.10641>

An MBSE approach for integrating and computing LCA impact indicators within SysML models

[Onur Angin](#), [Detlef Gerhard](#)

Ruhr University Bochum, Germany

Early design decisions are central to many circular economy approaches and largely determine environmental impacts. Yet LCA practice is often fragmented and difficult to integrate into engineering development processes. This paper proposes an MBSE approach that represents and computes LCA-based (LCIA) impact indicators within SysML models using reusable, configurable model elements and automated import of characterization factors. A proof-of-concept implementation demonstrates technical feasibility, illustrates process integration, and discusses limitations and future work.

<https://doi.org/10.1017/pds.2026.10628>

Session
D424

Congress
Hall
Orlando 2

10:15
11:15

21 May

THU

113



Garment longevity through quality perception: bridging subjective and objective quality

*Marie Das*¹, *Ingrid Moons*^{1,2}, *Dirk Van Rooy*¹, *Els Du Bois*¹

1: Product Development, Faculty of Design Sciences, University of Antwerp, Belgium; 2: Marketing, Faculty of Business and Economy, University of Antwerp, Belgium

This study investigates the gap between objective and subjective garment quality and explores how insights from subjective quality can inform industry practices to enhance product longevity. Based on 16 interviews, findings reveal that consumers rely on subjective-intuitive aspects to form quality expectations and subjective-aligned aspects that emerge through experiences. Qualitative use emerges as a crucial connection between subjective and objective quality. These insights inform design strategies promoting garment longevity across three phases: design, primary retail, and secondary retail.

<https://doi.org/10.1017/pds.2026.10458>

Attributes in context: a qualitative study of user understanding and misinterpretations in product design

Aurora Berni, *Yuri Borgianni*

Free University of Bozen-Bolzano, Italy

This study investigates how product attributes shape user interpretation of unfamiliar products in terms of functions and context of use. This was made possible through an experiment involving 71 participants who were administered three unfamiliar end-use products without any additional cue. Findings reveal that visual cues, material semantics, and contextual imagination shape understanding, with misinterpretations often arising from analogical reasoning and partial cue activation. Designers should harmonize cues and leverage material symbolism to guide user perception and acceptance.

<https://doi.org/10.1017/pds.2026.10454>



Session
D425

Congress
Hall
Konavle

10:15
11:15

Investigating consumer behaviour and incentives for slow-the-loop R-strategies in the bicycle industry

Sarah Pinno^{1,2}, *Lisa Petzke*¹, *Angelina Strauch*¹, *Christian Koldewey*^{1,3}, *Roman Dumitrescu*^{1,3}, *René Fahr*^{1,2}

1: Paderborn University, Germany; 2: Heinz Nixdorf Institute, Germany; 3: Fraunhofer IEM, Germany

As concerns about climate change and biodiversity loss intensify, circular economy strategies are crucial for decoupling economic growth from resource depletion. Yet, the consumer behavioural dimension including returning, repairing, and accepting refurbished products remains underexplored, in particular in the bicycle industry. By conducting a survey of bicycle users, this study finds a strong willingness to engage in these slow-the-loop practices, driven by cost savings, convenience, and trust, but hindered by knowledge gaps and quality concerns, implying recommendations for manufacturers.

<https://doi.org/10.1017/pds.2026.10465>

One shape fits all? Exploring how standardised packaging influences brand heritage and consumer perception

Lieke Sikkens, *Jessy Buunk*, *Maaïke Mulder - Nijkamp*

University of Twente, The Netherlands

There is an increasing need to understand how rising environmental pressures and the EU's PPWR (Packaging and Packaging Waste Regulations), which requires more sustainable and standardised packaging, affect brand identity. This paper evaluates how standardisation alters brand recognition and the extent to which visual and verbal cues can preserve brand identity and heritage. Mixed-method case studies show that coherent cues can maintain authenticity, brand meaning, and consumer acceptance emphasising the importance for brands seeking to balance sustainability with consumer perception.

<https://doi.org/10.1017/pds.2026.10470>

21 May

THU

114



Application of an engineering approach to the design of a learning system

Chaimaa Oubali ¹, Ivana Rasovska ¹, Sébastien Dubois ², François Marmier ¹

1: ICUBE Laboratory, Université de Strasbourg, France; 2: ICUBE Laboratory, INSA Strasbourg, France

Industry 4.0 creates a need to transform education to meet evolving labor market skills. This study reviews and compares major instructional design models ADDIE, SAM, ASSURE, MISA, and Dick and Carey using Gropper's framework enriched with Education 4.0 criteria. Results show these models offer structure but remain module-focused and lack a systemic perspective. The research proposes a broader, engineering-based approach using TRIZ principles to create an integrated learning ecosystem that supports agile, flexible, and continuous skills development aligned with Industry 4.0.

<https://doi.org/10.1017/pds.2026.10672>

Establishing an adaptive e-learning environment in engineering design education

Frederike Kossack, Eike Uttich, Marc Neumann

Ruhr-Universität Bochum, Germany

First year students have heterogeneous prerequisites for acquiring competences in engineering design education caused by varying school education or vocational training. Individual support is challenging in large groups and frontal lectures. An approach for individualized support is adaptive e-learning. This paper analyses the impact of offering an adaptive e-learning environment for engineering design education (AdE-Le). Analysis results for data of the same course from three different years give insights into acceptance and impact of using AdE-Le on acquiring professional competencies.

<https://doi.org/10.1017/pds.2026.10660>

Integrating sustainability perspectives into traditional technical courses in Danish design engineering education

Julie Landboe-Christensen Hvid, Andrés Felipe Valderrama Pineda

Aalborg University Copenhagen, Denmark

This paper explores how sustainability is integrated into technical courses across Danish design engineering programmes. It finds a gap between program goals and technical courses, where sustainability remains absent or at best implicit. Structural barriers like outdated materials and traditional teaching hinder integration. We propose three reforms: make sustainability an explicit learning objective, update teaching materials and use design-oriented examples and exercises. This will strengthen sustainable change an integral aspect of design engineers training.

<https://doi.org/10.1017/pds.2026.10662>

A pedagogical tool for the co-design of systemic nature-based solutions applied to carbon removal

Mathieu Combe ^{1,2}, Tristan Briard ¹, Frédéric Segonds ¹, Fabien Harambat ¹, Camille Jean ¹

1: Arts et Métiers Institute of Technology, LCPI, France; 2: Stellantis, France

This paper presents a pedagogical tool for the co-design of systemic and resilient Nature-based Solutions for carbon removal. Tested with nine participants, it significantly improved understanding of NbS dynamics. Wilcoxon tests showed higher scores for all thinking skills derived from Bloom's taxonomy ($p < 0.05$), with notable gains for higher-order skills. Participants reported that the tool was intuitive and engaging, fostering collaborative learning. Results confirm its educational value and potential to engage creative and resilient NbS design.

<https://doi.org/10.1017/pds.2026.10650>

Session
D426

Congress
Hall
Šipun

10:15
11:15

21 May

THU

115



Towards a reference architecture for digital product passports in engineering

Malte Trienens¹, Fabian Wyrwich¹, Luca Schörder¹, Aschot Hovemann¹, Roman Dumitrescu²

1: Fraunhofer IEM, Germany; 2: Heinz Nixdorf Institute, Paderborn University, Germany

Digital product passports (DPP) are intended to provide reliable, interoperable information throughout the product lifecycle, enabling compliance, transparency, and circularity. This paper seeks to address the question of how a DPP can be effectively implemented in the field of engineering, developing a referenced, industry-independent architecture for this purpose. The layers for data, communication, logical architecture, functions, and potential are derived from regulation and practice; integration, interoperability, and validation requirements are discussed using a use case.

<https://doi.org/10.1017/pds.2026.10518>

Inside and outside perspectives on design for circularity: barriers across design producers, consultancies and SMEs

Axel Nordin, Anders Warell

Lund University, Sweden

Despite the many circular economy (CE) design frameworks, implementation is limited. This study interviews six Swedish design firms (producers/consultancies, small/large) to compare CE barriers. Results show small producers face more value chain challenges, while large producers focus on design. Consultancies emphasize economic/legal factors. Organizational silos and perceived costs are universal barriers. The findings highlight the need for tailored CE approaches: SMEs require resources to influence suppliers, while large firms need better methodologies for internal organizational change.

<https://doi.org/10.1017/pds.2026.10503>

A circular economy-oriented early design and optimization approach for structural components of rechargeable energy storage systems

Louisa Türke¹, Jonas Stadler², Amélie Pötzke³, Lars Paschke², Patrick Burger², Thomas Vietor¹, Christoph Herrmann³

1: Institute for Engineering Design, Technische Universität Braunschweig, Germany; 2: ARRK Engineering GmbH, Germany; 3: Institute of Machine Tools and Production Technology, Technische Universität Braunschweig, Germany

This study presents a method to design sustainable structural parts of a Rechargeable Energy Storage Systems using Design for CE and Computational Optimization. Principle solutions are developed and combined with sustainability criteria being a key factor in the concept evaluation. The battery tray, a subsystem of REESS, serves a case study in which intrusion, mass, and LCA are optimized by varying the recycle, UD tapes and design. The resulting Pareto front reveals trade-offs between intrusion, mass and LCA results and highlights the potential to reduce environmental impact in early design.

<https://doi.org/10.1017/pds.2026.10520>

The longevity trinity: a review and framework conceptualisation of design strategies and attributes for value retention and extended furniture life

Petter Alsén

Linköping University, Sweden

This study synthesises interdisciplinary research on design strategies and attributes for extended product life of furniture. Through an integrative literature review, it develops the heuristic Longevity Trinity framework, comprising technical, functional, and emotional orientations. The framework consolidates dispersed design principles and highlight how the physical and psychological properties of furniture interact with the component of time, positioning product longevity as a design problem of continuity; continuity of materials, usefulness, and meaning across multiple lifecycles.

<https://doi.org/10.1017/pds.2026.10478>



Graph retrieval-augmented generation for enhancing LLM-based ML algorithm recommendation in product development

Sebastian Sonntag, Adrian Dörnbach, Arun Nagarajah

University of Duisburg-Essen, Germany

Recent advances in machine learning (ML) offer substantial potential for product development (PD), yet adoption remains limited. A crucial step is identifying suitable ML algorithms for a given PD problem, which requires translating domain-specific formulations into appropriate ML tasks. Prior work indicates that LLMs struggle with this step due to insufficient domain knowledge. Therefore, this study investigates whether a domain-specific GraphRAG approach improves model performance by enriching prompts with structured context from a PD knowledge graph.

<https://doi.org/10.1017/pds.2026.10613>

A data-driven approach to studying dominant designs through patent images

Marco Consoloni^{1,2}, Denny Meini¹, Gabriele Marino¹, Luciano Socci³, Vito Giordano^{1,2}, Gualtiero Fantoni^{1,2}

1: Università di Pisa, Italy; 2: Business Engineering for Data Science (B4DS) research group, Italy; 3: Coesia, Italy

Dominant designs establish de facto standards for all products within an industry, shaping both competition and innovation dynamics. Studying dominant designs enables firms to make informed decisions for new product development and to anticipate technological shifts. This paper presents a computer-based method that automatically extracts the spatial configuration of components from patent drawings to support the analysis of dominant designs and anomaly detection. A case study on eyeglasses validates the approach, demonstrating its potential for data-driven design innovation.

<https://doi.org/10.1017/pds.2026.10582>

AI-based scenario management for SMEs: the need for modular, explainable and reusable foresight pipelines

Jonas Knepler¹, Tobias Seidenberg¹, Khoren Grigoryan¹, Laban Asmar¹, Roman Dumitrescu²

1: Fraunhofer IEM, Germany; 2: Paderborn University, Germany

Small and medium-sized enterprises often lack the time, expertise, and tools for effective scenario management. This paper proposes a modular, AI-enabled scenario architecture integrating a guided wizard and expert environment on a shared knowledge backbone. The design aims to reduce effort and tool fragmentation while preserving human judgment, structural quality, explainability, and traceability. The proposed pattern outlines a provenance-aware foresight pipeline with human-in-the-loop capabilities that aims to transform one-off projects into reusable organizational knowledge.

<https://doi.org/10.1017/pds.2026.10595>

AI-supported variant management activities – insights from an industrial case study

Fionn Winger¹, Benedikt Müller¹, Daniel Roth¹, Bruno Barciela Diaz-Blanco, Fatos Elezi, Matthias Kreimeyer¹

1: Institute for Engineering Design and Industrial Design, University of Stuttgart, Germany

Variant management faces increasing complexity that challenges traditional rule-based configuration approaches. This contribution explores how AI can support the generation of configuration rules (1) by comparing two solution concepts – a deterministic Python-based and an LLM-based approach. Following a structured early-stage AI system development methodology, the research investigates (2) how AI can be methodically integrated into variant management and (3) how implementation factors differ between both approaches. The results reveal distinct trade-offs between transparency and efficiency.

<https://doi.org/10.1017/pds.2026.10616>

Session
D432

Congress
Hall
Bobara

11:30
12:30

21 May

THU

117



Contextualizing sensor data: integrating user voice in data-driven design

Karl Johnson, Saeema Ahmed-Kristensen

INDEX, Faculty of Environment, Science and Economy, University of Exeter, United Kingdom

Data-driven design increasingly relies on sensor data, yet these thin measurements often lack the experiential context needed to explain why events occur or what users feel and need. This limits their value for human-centred design. Passive and active contextualisation are introduced to describe how meaning is produced through inference and user participation. A real-world case study using See. Sense cycling data from Melbourne shows how combining thin and thick data produces more situated understanding and actionable design insight.

<https://doi.org/10.1017/pds.2026.10594>

Interactive visualisation of collaborative dynamics: a VLM-based approach for behavior and affect analysis

Shuyun Liu¹, Chris McTeague¹, Hermann Wolfram Klöckner^{1,2}, Susanne Dreyer¹, Katja Thoring¹

1: Technical University of Munich, Germany; 2: Anhalt University of Applied Sciences, Germany

Collaboration is crucial in design and management, fostering innovation, problem-solving, and decision-making. We explore the use of vision-language models (VLMs) for analyzing collaboration, focusing on detecting social behavior and group affect. By fusing multimodal cues, VLMs enable more context-aware reasoning beyond surface-level perception. We develop a pipeline, a structured prompt and an interactive visualization for integrating VLMs into the analysis workflow. Comparing VLM and human analysis results, we discuss how VLMs can advance collaboration analysis and the remaining challenges.

<https://doi.org/10.1017/pds.2026.10599>

Designing for dignity: a sociotechnical framework for AI-mediated systems

Seneca Perri Moore

University of Utah, United States of America

This paper introduces Dignity-Centered Design (DCD), a sociotechnical framework for AI-mediated systems. While AI ethics often focuses on concepts such as fairness and transparency, DCD evaluates how systems shape lived experience, power dynamics, and human agency. Drawing on healthcare traditions and the Dignity Index, the framework articulates three dimensions (individual, relational, and systemic) alongside five core principles. It includes a Dignity Spectrum in AI System Design to assess design choices and applies these to healthcare AI to support reflective practice.

<https://doi.org/10.1017/pds.2026.10606>

Comparing human, LLM, and LLM-QFD approaches to technical requirement extraction

Nuša Fain¹, Nikola Vukašinić², Vanja Čok²

1: Spratt School of Business, Carleton University, Canada; 2: Faculty of Mechanical Engineering, University of Ljubljana, Slovenia

This study investigates how large language models (LLMs) support extracting technical requirements from early product pitches. Mechanical engineering students worked under three conditions: manual, LLM-assisted, and LLM combined with a QFD interface. Both AI-assisted conditions improved requirement quality and lowered perceived difficulty. Thematic analysis showed cognitive effort shifted from generating requirements to evaluating and verifying AI outputs, while the LLM-only group reported the most positive attitudes.

<https://doi.org/10.1017/pds.2026.10412>



AI-supported implementation of reuse strategies in SysML v2: an MBSE approach using the example of a 3D printer

Yannick Juresa, Damun Mollahassani, Jens C. Göbel

RPTU University Kaiserslautern-Landau, Germany

Early integration of circularity into complex system architectures remains ad hoc and weakly verifiable. Model-based systems engineering (MBSE) can address this issue with precise modeling and early verification. This paper presents an artificial intelligence supported MBSE method to integrate circular strategies based on SysML v2 models, highlighting potential changes and enhancements. Generative suggestions are integrated via a regulated workflow with traceable justifications and context-enhanced queries. A use case modeling the print head of a 3D printer illustrates this approach.

<https://doi.org/10.1017/pds.2026.10636>

Utilisation of SysML models in the lifecycle of remanufacturable products

Zvonimir Lipšinić¹, Stephan Husung², Neven Pavković¹, David Inkermann³

1: University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, Croatia; 2: Technische Universität Ilmenau, Germany; 3: Clausthal University of Technology, Germany

This literature review paper analyses recurring challenges associated with products designed for remanufacturing and links them to areas in which Model-Based Systems Engineering (MBSE) can provide targeted support through the utilisation of SysML models. The paper proposes SysML-based strategies for enhancing requirement traceability, improving lifecycle data and simulation support, enabling compatibility assessment, and facilitating stakeholder data exchange. The conclusion highlights the implications of these insights for future research on MBSE supported Circular Economy (CE) strategies.

<https://doi.org/10.1017/pds.2026.10639>

A simulation framework for evaluating fast charging and battery swapping strategies in electric construction machinery

Hajar Bouraya¹, Alessandro Bertoni¹, Marco Bertoni¹, Giuditta Pezzotta¹

1: University of Bergamo, Italy; 2: Blekinge Institute of Technology, Sweden

The paper presents a simulation framework for evaluating fast charging and battery swapping strategies in battery-electric construction machinery. Developed using discrete-event and agent-based modeling, the framework supports scenario analysis in mining and road construction contexts. Case studies demonstrate how charging strategies impact productivity, energy costs, and battery degradation. Results highlight trade-offs between operational efficiency and long-term sustainability, offering a decision-support tool for electromobility transition in construction machinery.

<https://doi.org/10.1017/pds.2026.10633>



Assessing the effects of product family design strategies on resource consumption and costs: an extended axiomatic design approach

Lasse Kehrhahn, Matthias Meyer, Ole Jan Meßerschmidt

Hamburg University of Technology, Germany

This study presents a simulation-based framework to analyze resource consumption and cost effects of product family design strategies. Drawing on Extended Axiomatic Design (EAD) and 53 documented design cases, we simulate empirically grounded patterns that reveal denser, more homogeneous resource use than benchmarks from cost accounting literature. The findings (1) provide a reusable dataset; (2) demonstrate the value of EAD for standardized product family design and enhanced cost transparency; and (3) support broader generalization of cost accounting insights.

<https://doi.org/10.1017/pds.2026.10364>



Session
D434

Congress
Hall
Orlando 2

11:30
12:30

21 May

THU

119



From reliance to release: designing a behaviourally informed pacifier through an extended double diamond process

[Matt Chiu](#)¹, [Emily Ng](#)²

1: Nanyang Academy of Fine Arts, University of the Arts Singapore (NAFA-UAS), Singapore; 2: Orthodontist, Private Practice, Singapore

This paper explored the Double Diamond design methodology through a low-reliance pacifier case study that reframes parents' needs into a child-led weaning solution. The project integrates artistic design research with engineering design innovation methodology to create an unique aesthetic floral pacifier idea with functional forms. It was found that beyond academic theory, effective real-world design requires dedicated testing and refinement, positioning this work as a practice-led research approach that strengthens both process and outcome for a successful and modular design process.

<https://doi.org/10.1017/pds.2026.10457>

The change factory: a systematic behavioral design methodology for sustainable product experiences

[Juliette Brun](#)¹, [Pierrick Rivière](#)¹, [Emilie Boukaiba](#)¹, [Tevy Sault](#)¹, [Cyrille Lemaire](#)², [Alexandre Dingreville](#)³, [David Morizet](#)¹

1: L'Oréal R&I Evaluation Intelligence, France; 2: L'Oréal Packaging Engineering, France; 3: L'Oréal Luxe Sustainability, France

Bridging the intention-action gap is key to driving sustainable consumer behavior. In this paper, we introduce the Change Factory, a methodology that applies behavioral science to design sustainable product experiences. We detail its four-step CODE framework - Change, Obstacles, Design, and Experimentation - and illustrate its application on fragrance refill. After identifying behavioral barriers, 33 gentle intervention ideas were generated to promote refill adoption, validating the method's efficacy in translating behavioral insights into concrete, behavior-driven design solutions.

<https://doi.org/10.1017/pds.2026.10455>

Creativity in behavioural design: assessing idea characteristics using the Behavioural Design Space as creative assessment framework

[Camilla Kirstine Elisabeth Bay Brix Nielsen](#)¹, [Philip Cash](#)², [Jaap Daalhuizen](#)³

1: Technical University of Denmark, Denmark; 2: Northumbria University, United Kingdom; 3: Delft University of Technology, The Netherlands

To design effective behaviour changing interventions, behavioural designers need to generate ideas that combine both technical and behavioural aspects. However, little is still known about the creative output of ideation in behavioural design. Taking an exploratory approach, this study examines the creative characteristics of brainstormed behavioural design ideas using the Behavioural Design Space (BDS) as creative assessment framework. The findings show uneven distributions across all BDS parameters indicating fixation and lost creative opportunities.

<https://doi.org/10.1017/pds.2026.10453>

When life changes, space should too: participatory insights into designing for residential flexibility across life stages

[Vighneshkumar Rana](#), [Vishal Singh](#)

Indian Institute of Science, Bangalore, India

This study examines how residents perceive and negotiate flexibility in their residential spaces across various life stages through a participatory workshop involving 80 participants. Using modular blocks, participants reconfigured layouts for scenarios such as shared living, marriage, family growth, work, and ageing. Visual and thematic analyses revealed flexibility priorities, trade-offs, and transformation patterns discussed, showing it peaks in early and mid-life and centres on bedrooms and workspaces as a temporal, user-defined phenomenon of adaptable housing.

<https://doi.org/10.1017/pds.2026.10466>

Session
D435

Congress
Hall
Konavle

11:30
12:30

21 May

THU

120



Future engineering workforce – industry-aligned systems engineering education at the Digital Lifecycle Lab

Gerolf Schalk^{1,2}, Hannes Hick¹, Sandro J. Wartzack³, Yannick Hemmmer^{2,3}, Michael Bitzer²

1: Institute of Machine Components and Methods of Development, Graz University of Technology, Austria; 2: Science, Academics & Transfer, Siemens Industry Software GmbH, Germany; 3: Chair of Engineering Design, Friedrich-Alexander Universität Erlangen-Nürnberg, Germany

Engineering education faces growing pressure from rapid technological change, which reshapes professional competencies. Effective knowledge transfer between academia and industry is therefore essential for innovation, yet remains insufficiently integrated. The Digital Lifecycle Lab (DLL) at TU Graz addresses this gap through an industry-aligned, lifecycle-oriented environment for systems engineering education. By integrating academic learning with industrial practice, the DLL functions as both an educational concept and transfer platform preparing the future engineering workforce.

<https://doi.org/10.1017/pds.2026.10673>

Design exercises as confidence equalizers: differences in confidence between male and female students

Gordon Krauss

Harvey Mudd College, United States of America

Do short design exercises boost confidence equally for males and females? In a 7-semester study (n=426; 201F, 225M), females reported lower initial confidence ($p < .001$, $g = 0.31$) but matched males in final confidence and gains after four applied exercises (yield, creep, impact, fatigue). Regression showed no sex differences in final or Δ confidence ($p = .42$, $g = 0.03$). Active design integration in engineering science courses may reduce sex-based disparities in engineering confidence and self-efficacy. Sex balance in the cohort may suppress typical gaps, highlighting context as key to equity.

<https://doi.org/10.1017/pds.2026.10661>

Exploring the link between students' Big5 personality test and design project performance

Immanuel Hendra¹, Lucienne Blessing², Arlindo Silva¹, Lay Kee Ang¹

1: Singapore University of Technology and Design, Singapore; 2: Independent scholar

This paper investigates the relationship between Big5 scores (individual and team level) and team design project performance in SUTD's "Introduction to Design" course. Study reveals that team's final project grades have statistically significant positive correlation with higher team's mean "Conscientiousness", but negative correlation with within-team variety of "Neuroticism" and "Conscientiousness". At individual level, "Conscientiousness" shown positive correlation with the students' grades. However, further qualitative study is needed to understand the reasoning behind the correlation.

<https://doi.org/10.1017/pds.2026.10655>

Identifying barriers and needs for inclusive remote laboratories: a mixed-methods study

Atila Göktas, Carsten Stechert

Ostfalia University of Applied Sciences, Germany

Barriers limit laboratory participation for students with study-impairing conditions. A mixed-methods study via survey (n=43) and interviews (n=9) identified two student clusters with distinct accessibility needs: Cluster 1 requiring flexible scheduling and modular structure for chronic illness and caregiving; Cluster 2 requiring explicit guidance and multi-modal content for visual impairment and neurodivergence. Both required institutional support infrastructure. Results establish evidence-based requirements for inclusive remote laboratory development applicable beyond target populations.

<https://doi.org/10.1017/pds.2026.10654>



Session
D436

Congress
Hall
Šipun

11:30
12:30

21 May

THU

121



DESIGN
2026

excellence in design



INCLUSIVE DESIGN: WHO TO INCLUDE?

Dr Hua Dong

Professor of Design, Director of Helen Hamlyn Centre for Design, Acting Pro-Vice Chancellor, Research & Innovation, Royal College of Art

Inclusive design aims to accommodate the widest range of users possible, within resource constraints. It involves conscious decision-making: who to include? This decision has important impact on the design process and outcomes. Ethics protocols and different methods and tools have been developed to involve older people, disabled people, children, migrants et al in the process; they are often referred to as 'users', 'partners', 'co-designers' – each reflecting a different relationship with the design team. Unique approaches such as 'critical users', 'fix partners', 'designing for one, extending to many' are used for inclusive design, with emerging discussions on AI as co-designers, and including more-than-human to extend care for people to planet. This keynote will share insights into who to include in the design process, how and why, and push thinking for future responsible design.



DESIGN2026

BIOGRAPHICAL SKETCH

Professor Hua Dong is Director of Helen Hamlyn Centre for Design at the Royal College of Art (RCA), the global leader of inclusive design research. She held a research post at University of Cambridge, and professorships at Tongji, Loughborough, and Brunel Universities (as the Inaugural Dean of Brunel Design School). She is the Vice Chair and Fellow of the Design Research Society, and Chairs an advisory committee for the Quality Assurance Agency for Higher Education's Subject Benchmark Statement. Hua was awarded Engineering Heros: the 2021 Top 50 Women in Engineering by Women's Engineering Society, and currently serves as Acting Pro-Vice Chancellor (Research and Innovation) of RCA.

Session
D4-P

Congress
Hall
Ragusa

14:00
14:45

21 May

THU

123



Bridging LCA and design: an LLM-driven pipeline for generating sustainable design alternatives from LCA hotspot analysis

Henning Peitzmeier^{1,2}, *Mohamed Elsafty*², *Claas Tebruegge*¹, *Arthur Seibel*²

1: HELLA GmbH & Co. KGaA, Germany; 2: Leuphana University Lüneburg, Germany

Life cycle assessments identify environmental hotspots, yet translating these insights into design actions remains slow and expert-dependent. Existing AI tools lack a dynamic link to current research. Here, we present an LLM-driven pipeline that interprets LCA hotspots, mines recent literature, and extracts feasible, research-backed design alternatives. In a case study on a headlamp control unit, the method produced relevant and applicable improvements, indicating its value for accelerating sustainable product design.

<https://doi.org/10.1017/pds.2026.10506>

AI-assisted leading sustainability criteria development: a multiple case study

Jennifer Woofter, *Jesko Schulte*, *Matilda S. Watz*

Blekinge Institute of Technology, Sweden

This study examines how AI can support the development of Leading Sustainability Criteria in sustainable product development, comparing AI-generated outputs with human-facilitated workshop results from four Swedish companies. Results highlight AI's ability to accelerate and broaden sustainability framing, but emphasize that contextual relevance and legitimacy depend on participatory inputs. The findings suggest that AI is most effective when integrated into hybrid workflows that preserve human insight and stakeholder engagement—offering practical guidance for future implementation.

<https://doi.org/10.1017/pds.2026.10525>

Human-AI collaboration for repair: designing interactive tools for sustainable consumer electronics

Ravi K Sikhwal

Royal College of Art, United Kingdom

Barriers such as limited repair literacy and design-for-disposability continue to reinforce replacement cultures. This paper introduces AIFixer, an AI-powered interactive tool that guides consumers through electronic repair, promoting sustainable product lifecycles. Using a mixed-methods, user-centred approach, the study evaluates AIFixer's usability and behavioural impact across real-world repair tasks. Findings show that conversational AI lowers barriers, builds confidence, and generates data for circular design, highlighting opportunities for multimodal and community-integrated development.

<https://doi.org/10.1017/pds.2026.10515>



Large language models for identifying repurposing opportunities: a systematic evaluation

Adrian Dörnbach, *Sebastian Sonntag*, *Abinash Selvarajah*, *Arun Nagarajah*

University of Duisburg-Essen, Germany

In a circular economy, repurposing extends product lifecycles and reduces resource use. However, identifying feasible repurposing opportunities remains challenging. This study therefore evaluates the capability of large language models to identify such repurposing scenarios and their relevant properties, using documented repurposing cases from peer-reviewed literature. Three models were tested, revealing potential in identifying repurposing scenarios, but also highlighting the need for structured methods and further research due to systematic limitations in property identification.

<https://doi.org/10.1017/pds.2026.10483>



A deep reinforcement learning approach for the multi-objective, segment-based generative design of sheet metal components

*Christoph Wittig Adão, Saruka Muralitharan, Jiahang Li, Markus Döllken, Sven Matthiesen
Karlsruhe Institute of Technology, Germany*

Current approaches for the generative design of sheet metal parts only take singular optimization goals into account. This paper presents a concept for a deep reinforcement learning approach to train an agent to generate sheet metal parts by combining segments from a predefined library. Through a weighted reward function, agents can be trained for different or combined optimization goals, such as weight, cost, or sustainability. The resulting agents enable the creation of a pareto front of optimal solutions, supporting efficient exploration of the design space for diverse design objectives.

<https://doi.org/10.1017/pds.2026.10617>

Generating vehicle designs using probabilistic programs and reinforcement learning

*Daniel Elenius¹, Aurelien Ghigino², Krishiv Agarwal³, Colin Samplawski¹, Anirban Roy¹,
Susmit Jha¹, Juan Jose Alonso², Adam Cobb¹*

1: Computer Science Laboratory, SRI International, United States of America; 2: Department of Aeronautics and Astronautics, Stanford University, United States of America; 3: University of Florida, United States of America

We present FORGE (Framework for Optimization and Reinforcement-driven Generative Engineering), a probabilistic programming framework for generative design that unifies declarative, symbolic modeling and reinforcement learning (RL). FORGE can learn and refine a design generator through RL based on simulator-derived rewards. We demonstrate FORGE across several vehicle domains. FORGE creates an extensible, interpretable foundation for generative engineering. It can act as both a data generator for machine learning and a design optimizer, offering a practical alternative to purely neural methods.

<https://doi.org/10.1017/pds.2026.10585>

Reinforcement learning for the design of mechanisms using available bars and pins

Maxime Escande, Kristina Shea, Tino Stankovic

*Engineering Design and Computing Laboratory, Department of Mechanical and Process Engineering,
ETH Zurich, Switzerland*

This work explores Reinforcement Learning (RL) for the circular design of planar truss linkages using available bars and pins. A bipartite graph representation and elementary action formulation enable agents to assemble mechanisms in a physics-based environment. Results for a force-inverter design problem show 98.5% success for fixed-stock training and 66.0% for shuffled stocks. The method demonstrates RL's potential for inventory-constrained mechanism synthesis, with future work targeting scalable, indexing-invariant architectures and more flexible connection actions.

<https://doi.org/10.1017/pds.2026.10586>

Comparison of evolutionary, reinforcement and active learning for simulation-based design space exploration

Oliver Bleisinger¹, Mareike Victoria Keil², Martin Eigner³

*1: RPTU University Kaiserslautern-Landau, Germany; 2: University of Mannheim, Germany;
3: EIGNER engineering consult, Germany*

Trade-off studies often use the design of experiments approach, while simulation models enable data-based product optimization by AI. This paper presents a comparison of evolutionary algorithms, reinforcement learning as well as active learning for design space exploration. Based on a real-world case study and hypervolume analysis, the performance of selected algorithms is assessed. The results highlight their ability to identify pareto fronts and provide insights to deepen the understanding of AI-driven design space exploration.

<https://doi.org/10.1017/pds.2026.10578>

Session
D442

Congress
Hall
Bobara

15:15
16:15

21 May

THU

125



Literature-based characterization of SME product development processes

*Armin Stein*¹, *Aaron Dlugosch*^{1,2}, *Niklas Waldmann*^{1,3}, *Thomas Vietor*^{1,2}

1: Institute for Engineering Design, Technische Universität Braunschweig, Germany; 2: Battery Lab Factory Braunschweig, Technische Universität Braunschweig, Germany; 3: Institute of Thermodynamics, Technische Universität Braunschweig, Germany

This study systematically characterizes product development processes (PDPs) in hardware-oriented SMEs. A PRISMA-based literature review identifies twelve empirical case studies and eight development frameworks. The analysis derives key PDP influence factors, synthesizes stage-wise SME PDP activities, and consolidates characteristic challenges. A gap analysis reveals the absence of SME-specific PDP development frameworks and missing integration with technology management. The results establish a structured empirical basis for future research.

<https://doi.org/10.1017/pds.2026.10444>

Developing and validating a user-centric information structure for design methods

Mayank Mayooh, Venkataraman Srinivasan

Indian Institute of Technology Delhi, India

This paper presents the development and validation of a new information structure for design methods for an enhanced repository of design methods to support design practice and pedagogy. The structure is based on features derived from challenges faced by design students, practitioners, and educators in understanding, using, and teaching design methods, and it is experimentally validated. Results show 81.2% of participants had no difficulty in understanding and using design methods based on the proposed information structure. Participants reported 8 improvements in the structure.

<https://doi.org/10.1017/pds.2026.10428>

Rethinking design methods in the age of AI – consequences for practice, education, and research

David Inkermann

Clausthal University of Technology, Germany

This paper proposes a conceptual framework for integrating design methods into Human-AI Co-Creation, redefining methods as mediating structures between task context, procedural logic and results. Two examples illustrate how AI supports both method execution and method selection under varying autonomy levels. The framework highlights implications for transparency, traceability, responsibility and method education, and offers a structured basis for analysing, teaching and developing method-based design practice in AI-rich environments.

<https://doi.org/10.1017/pds.2026.10419>

Dual-advocate reflection cards: supporting multifaceted and critical reflection on the design process

Akira Ito, Yuki Taoka, Shigeki Saito

Institute of Science Tokyo, Japan

To enhance multifaceted and critical reflection, we developed the Dual-Advocate Reflection Cards tool and carried out an empirical study. The eighteen student participants worked in pairs to reflect on their experiences. Transcripts of their discussions were analyzed, and we counted the frequency with which each card and each level of reflection intensity were discussed. The results indicated a strong link between card usage and utterances of multifaceted and critical reflection, as well as the effect of the cards on the reframing of the evaluation or understanding of the design process.

<https://doi.org/10.1017/pds.2026.10420>

Session
D443

Congress
Hall
Orlando 1

15:15
16:15

21 May

THU

126



Designing a modular platform of flying cars for diverse demands

*Chunsheng Zhang*¹, *Xiaolin Liu*¹, *Ling Chi Wong*¹, *Ming Ho Lai*¹, *Tak Shing Wong*¹,
*Yong Hao Yu*¹, *Tsz Kin Cheung*¹, *Zichen Cai*¹, *Shuo Jiang*¹, *Qihao Zhu*², *Jianxi Luo*¹

1: City University of Hong Kong, Hong Kong S.A.R. (China); 2: Massachusetts Institute of Technology, United States of America

Current flying-car designs lack scalability for diverse missions. This paper presents a modular design platform for developing reconfigurable flying-cars, embedding modularity across structural, electrical, and flight control domains. A full-scale sightseeing prototype demonstrates the platform's feasibility and flexibility. The work contributes to design methodology by illustrating how modular architectures improve cross-mission adaptability, scalability, and lifecycle efficiency in complex mechatronic systems. (project introduction video available at <https://www.aidilab.ai/flying-car>)

<https://doi.org/10.1017/pds.2026.10692>

No driver needed? A perspective from standards, laws and regulations on autonomous transit buses

Lukas Fuchs, Julian Faig, Daniel Roth, Matthias Kreimeyer, Thomas Maier
Institute for Engineering Design and Industrial Design, University of Stuttgart, Germany

Autonomous driving is a promising technology for public transportation to solve two main challenges: The driver shortage and the reduction of environmental impact. This contribution investigates if already existing requirements in standards, laws, regulations and guidelines for accessibility, safety, security and bus drivers' tasks of transit buses in Europe and Germany can also be complied to with an autonomous transit bus or if the requirements need an adaption. 54 impactful requirements on autonomous transit buses have been found and their impact and opening design space will be discussed.

<https://doi.org/10.1017/pds.2026.10684>

Insights from knowledge-based engineering in industrial practice – a Saab's perspective

*Johan Tingström*¹, *Raghu Chaitanya Munjulury*^{1,2}

1: Saab AB, Aeronautics, Sweden; 2: Department of Management and Engineering, Linköping University, Sweden

The pilot project initiatives using Knowledge-Based Engineering (KBE), Design Automation (DA), and visual modelling techniques, at Saab Aeronautics, are presented in this work. The aim is to evaluate their practical applicability and outline how organisations can implement accelerated product development methodologies. By integrating organisational knowledge, parametric models, standardized workflows and automation tools, design lead times are significantly reduced, allowing design expertise to focus on innovation, quality, and strategic problem-solving.

<https://doi.org/10.1017/pds.2026.10691>

Demographic profile and usage behavior of public transport users in the Munich Metropolitan Region: findings from a large-scale online survey on current and autonomous transit

*Julian Faig*¹, *Daniel Roth*¹, *Matthias Kreimeyer*¹, *Johannes Weyer*², *Sebastian Hoffmann*¹

1: Institute for Engineering Design and Industrial Design, University of Stuttgart, Germany; 2: Department of Social Sciences, Social Research Center, TU Dortmund University, Germany

This paper addresses the lack of empirical knowledge on which demographic groups are most likely to use autonomous buses in the Munich Metropolitan Region. We analyze this question through a large-scale online survey capturing demographics, mobility behavior, and accessibility needs. Results show that younger, multimodal, and well-educated individuals form the core of potential users, while older and car-dependent groups remain hesitant. The findings highlight that successful deployment requires inclusive design, improved accessibility, and targeted communication strategies.

<https://doi.org/10.1017/pds.2026.10683>

Session
D444

Congress
Hall
Orlando 2

15:15
16:15



21 May

THU

127



Identifying challenges and limitations of interface modeling in multi-brand product engineering processes

Oliver Mitschang, Daniel Roth, Matthias Kreimeyer

University of Stuttgart, Germany

This paper addresses the increasing complexity of interfaces in multi-brand product development processes (PDPs). By conducting a systematic literature review and validating findings through industry expert workshops, we assess and compare existing modeling approaches. Seven criteria for effective interface management are derived and applied to model clusters. The results reveal that only integrated, multi-level modeling strategies can adequately capture technical, organizational, and governance challenges in multi-brand PDPs, highlighting key gaps and future research needs.

<https://doi.org/10.1017/pds.2026.10383>

The static vs. dynamism paradox in value-driven design: a descriptive study of value management challenges in complex system design

Antoine Persehais^{1,2}, Thierry Gidel¹, Pierre-Emmanuel Fayemi²

1: UTC - Université de Technologie de Compiègne, France; 2: Ikos Lab, France

This study investigates the challenges of dynamic value integration in complex innovation projects. Difficulties stem not from a lack of willingness, but from a persistent lack of re-openability in design governance systems. This study identifies a triple closure mechanism that filters out evolving stakeholder values. The paper reframes value integration from a technical problem to a political-institutional process, arguing for an Adaptive Governance Infrastructure designed to manage the necessary tension between static and re-opening.

<https://doi.org/10.1017/pds.2026.10387>

How to select stakeholders for participatory design of social robots: a systematic approach

Ebru Yalçın Ermiş, Zühal Erden

Atilim University, Turkey

Social robots increasingly interact with humans in diverse contexts. In this study, a systematic framework is proposed for selecting stakeholders based on the user requirements in participatory design of social robots. Matching social robot design dimensions with stakeholder fields in the framework, is achieved using Quality Function Deployment (QFD) and Design Structure Matrix (DSM) methodologies. A case study is presented to demonstrate utilization of the framework. The contribution of this paper is to develop an infrastructure towards formalization of participatory design of social robots.

<https://doi.org/10.1017/pds.2026.10449>

12 roles for the organisational design of data-driven product management

Timm Fichtler¹, Lisa Petzke¹, Stephan Skupin^{1,2}, Khoren Grigoryan³, Christian Koldewey^{1,3}, Roman Dumitrescu^{1,3}

1: Heinz Nixdorf Institute, Paderborn University, Germany; 2: OWL University of Applied Sciences and Arts, Germany; 3: Fraunhofer IEM, Germany

This paper conceptualizes data-driven product management (DDPM) as an organisational capability requiring clearly defined roles for effective coordination across technical, analytical, and managerial domains. Based on a systematic literature review and industry workshops, twelve interdependent roles were identified and specified through standardized role profiles. The resulting role architecture provides a structured foundation for organisational design, enabling companies to assign responsibilities, align competences, and operationalise DDPM in practice.

<https://doi.org/10.1017/pds.2026.10377>



Rethinking daily stand-ups: AI analysis to identify improvement potentials in agile development teams

Cedric van der Kamp, Anusch Musawi, Nikola Bursac, Katharina Ritzer

ISEM - Institute for Smart Engineering and Machine Elements, Hamburg University of Technology, Germany

Daily stand-ups often deviate from their intended efficiency. This study shows that challenges like unequal participation, recurring blockers, and lack of goal orientation can be made visible through an AI-based analysis method. Validated in several iterations with real company data, the method provides transparent and data-protection-compliant results. By identifying specific improvement potentials, the approach creates a data-driven foundation for teams to optimize their meetings and their collaboration.

<https://doi.org/10.1017/pds.2026.10391>

Agile alignment in production system development processes

Julia Trolle, Carin Rosio

Jönköping University, Sweden

This study explores the alignment of production system development processes (PSDP) with agile principles in the automotive industry. A multiple case study of eight companies reveals low overall alignment, with OEMs and subcontractors constrained by sequential, stage-gate structures, while engineering consultants show higher agility in early phases. Findings suggest gradual adoption of hybrid models, cultural changes and iterative planning to enhance flexibility and responsiveness.

<https://doi.org/10.1017/pds.2026.10390>

Teamflow in product development teams: designing resilient engineering environments

Katharina Ritzer, Nina Krueger, Anusch Musawi, Noah Ohlmann, Laura Koenig, Artur Krause, Felix Förster, Nikola Bursac

ISEM - Institute for Smart Engineering and Machine Elements, Hamburg University of Technology, Germany

This paper presents a controlled laboratory study investigating how environmental factors influence team resilience and teamflow in product development contexts. It examines which factors shape teams' adaptive responses and collective engagement. In the study, one factor per People–Organization–Technology dimension was systematically manipulated: member unavailability, time autonomy, and material quality. Results reveal distinct effects on performance and collaborative dynamics, providing empirical foundations for designing resilient team environments in engineering work.

<https://doi.org/10.1017/pds.2026.10388>

Decisive design: how spatial arrangements shape group decision-making

Hermann Wolfram Klöckner^{1,2}, Chris McTeague¹, Shuyun Liu¹, Susanne Dreyer¹, Katja Thoring¹

1: Technical University of Munich, Germany; 2: Anhalt University of Applied Sciences, Germany

This paper examines how spatial arrangements affect digitally supported individual and group decision-making. In a controlled within-subjects study, 24 participants completed the NASA Moon Survival Task across three spatial conditions: standing at an interactive table, sitting at the same table with personal zones, and using laptops. By analysing decision quality, speed, and perceived collaboration, the study shows that spatial design meaningfully shapes decision performance, interaction dynamics, and user experience.

<https://doi.org/10.1017/pds.2026.10397>

Session
D446

Congress
Hall
Sipun

15:15
16:15

21 May

THU

129



Who drives sustainability in product design? A case study in aerospace

Pauline L. Y. Léonard^{1,2}, *Sophie I. Hallstedt*², *Giliam Dokter*²

1: GKN Aerospace, Sweden; 2: Chalmers University of Technology, Sweden

To design for sustainability requires systemic change which cannot be carried by design teams alone. Using a case study approach in aerospace, this study investigates stakeholder influence in sustainable product development. It identifies main internal and external stakeholders and discusses how design teams should engage with them. Findings support practitioners to navigate structural barriers and plan design interventions, and highlight the research need to consider organizational structures, decision-making processes, and cross-functional collaboration for sustainable product development.

<https://doi.org/10.1017/pds.2026.10495>

Pure mycelium performance within the design process: an exploratory literature review on the state-of-the-art

Lotte Van den Broeck^{1,2}, *Lars De Laet*², *Els Du Bois*¹

1: Faculty of Design Sciences, University of Antwerp, Belgium; 2: Department of Architectural Engineering, Vrije Universiteit Brussel, Belgium

This review synthesizes the current state-of-the-art knowledge on pure mycelium materials (PMMs) as sustainable design solutions, mapping their essential structural, chemical, and mechanical characteristics, and the factors that drive or hinder their performance in design contexts, while also identifying application fields. Finally, this paper points to gaps in taxonomy and standardized characterization, resulting in a duality between scientists and designers and industry. Therefore, future research is derived to reinforce the synergy between design and material science for PMM adoption.

<https://doi.org/10.1017/pds.2026.10523>

Modelling reuse potential of building end-of-life components: a territorial approach

Thibault Ronzaud^{1,2}, *Edouard Sorin*¹, *Ghada Bouillass*², *Bernard Yannou*²

1: Centre Scientifique et Technique du Bâtiment, France; 2: CentraleSupélec, France

This study proposes a territorial-scale model to estimate flows of reusable building components by sequentially evaluating technical, logistical, and economic feasibility. It translates reuse barriers—such as disassembly potential, residual performance assessment, transportability, storage conditions, and costs—into measurable indicators. By aggregating component-level data into territorial indicators, the model links component-scale characteristics to overall territorial material flows, providing a framework to assess and compare reuse potential across territories.

<https://doi.org/10.1017/pds.2026.10511>

Effects of design decisions on sustainability in product development: a case study for machine tools

*Artur Krause*¹, *Yasin Schneider*², *Mehmet Karaca*², *Steffen Wagenmann*³, *Albert Albers*³,
*Nikola Bursac*¹

1: ISEM - Institute for Smart Engineering and Machine Elements, Hamburg University of Technology, Germany; 2: TRUMPF SE + Co. KG, Germany; 3: Karlsruhe Institute of Technology, Germany

This study examines how product development activities influence the environmental sustainability of complex mechatronic systems using a 2D-flatbed laser cutting system as a case study. Three levels are identified, the machine, operation and part level, at which design changes can affect environmental sustainability during machine operation. Utilizing operational machine data, nine design changes are derived indicating that ~36% of the environmental impact in the use phase can be reduced through technical design solutions, enabling EcoDesign principles supported by data-driven approaches.

<https://doi.org/10.1017/pds.2026.10492>



AI-enhanced computer-aided design: predictive modelling of operations

Sarah Steininger^{1,2}, *Saltuk Kezer*^{1,2}, *Moritz Krüger*^{1,2}, *Robin Richtsfeld*³, *Johannes Fottner*¹

1: Technical University of Munich, Germany; 2: BMW Group, Germany; 3: University of Passau, Germany

This work introduces a graph-based CAD assistant that predicts the next modelling operation in parametric design sequences. Real CATIA V5 models from the automotive domain are converted into directed acyclic graphs capturing feature dependencies, enabling learning directly from structural design data. A four-layer Graph Attention Network achieved a top-5 prediction accuracy of 94%, outperforming a frequency-based non-parametric baseline. The results show that graph representations and attention-based message passing provide a strong foundation for context-aware modelling assistance.

<https://doi.org/10.1017/pds.2026.10614>

Characterizing geometric variability of industrial 3D models to guide preparation of synthetic datasets for machine learning applications

*Lovro Sever*¹, *Petar Kosec*^{1,2}, *Stanko Škec*¹, *Tomislav Martinec*¹

1: University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, Croatia; 2: Neo Dens Ltd., Croatia

This paper presents a characterization approach for analysing geometric variability in industrial 3D model datasets to support the preparation of synthetic datasets for machine-learning applications. By implementing pairwise Hausdorff distances and manifold-based embedding techniques, the study identifies variability ranges required for generating representative synthetic data and demonstrates how targeted augmentation can effectively reproduce real data's variability, ultimately leading to more reliable and robust NN model performance.

<https://doi.org/10.1017/pds.2026.10611>

Automatic feature recognition from imperfect models using a novel workflow of data surrogation

*Aman Kukreja*¹, *Chris Cox*¹, *James Gopsill*¹, *Kristin Paetzold-Byhain*², *Chris Snider*¹

1: University of Bristol, United Kingdom; 2: Dresden University of Technology, Germany

Imperfect CAD models with non-smooth features are common outputs of the latest digital tools. These are unsuitable for the feature recognition needed for end applications like computer-aided manufacturing. This paper proposes to recognise features from imperfect models by contributing a comprehensive dataset, a novel data surrogation method, and ML-based automated feature recognition model. Results show that the data surrogation method accurately replicates manual imperfections with voxel accuracy >0.9 and a Dice coefficient >0.6. Ultimately, feature recognition achieves 92.8% test accuracy.

<https://doi.org/10.1017/pds.2026.10598>

Entity matching for recurring engineering components: a bottom-up enabler for reference architecture reconstruction

*Fabian Hanke*¹, *Markus Feld*¹, *Oliver von Heißen*¹, *Kenneth Tagscherer*¹, *Fabian Wyrwich*¹, *Malte Trienens*¹, *Aschot Hovemann*¹, *Roman Dumitrescu*²

1: Fraunhofer IEM, Germany; 2: Heinz Nixdorf Institute, Paderborn University, Germany

Engineering organisations increasingly aim to reuse historical BOM, CAD, and requirements data to identify recurring components. A key prerequisite is Entity Matching (EM), whose performance on heterogeneous engineering data is unclear. This paper evaluates classical models, zero-shot LLMs, and hybrid EM on Amazon–Google and a multimodal engineering dataset. Random Forest and XGBoost achieve near–state-of-the-art results; LLMs perform well but are costly, hybrids add little. EM transfers under controlled conditions and forms a foundation for reference architecture reconstruction.

<https://doi.org/10.1017/pds.2026.10590>

Session
D452

Congress
Hall
Bobara

16:30
17:30

21 May

THU

131



Proposing a PLM architecture framework for consistency in the engineering of machine tools

Lars Gesmann ¹, Valentin Kallus ¹, Simon Rapp ², Albert Albers ¹

¹: Karlsruhe Institute of Technology, Germany; ²: TRUMPF SE + Co. KG, Germany

Manufacturing companies engineering Cyber-Physical Systems of Systems face growing challenges in maintaining consistent product-related data and processes. This paper proposes a PLM Architecture Framework that integrates concepts from Product Lifecycle Management (PLM) and Enterprise Architecture (EA) along an adapted DevOps lifecycle. The framework enables consistency and transparency across engineering and business domains. A case study in machine tool engineering illustrates its potential to enhance data traceability, stakeholder alignment, and cross-generational digital continuity.

<https://doi.org/10.1017/pds.2026.10415>

Utilizing form-finding in mechanical engineering design using basic structural FEA

Franz Jungreitmayr

Johannes Kepler University Linz, Austria

In this work, we propose an extension of classical form-finding that incorporates non-design space requirements directly into the process. This enables numerical weight optimization of thin-walled structural components. We present a concrete implementation which relies exclusively on standard structural finite element analysis, promoting integration into existing workflows. The method is validated on benchmark problems with known optimal solutions. Finally, its practical benefits are demonstrated through a more realistic engineering case study.

<https://doi.org/10.1017/pds.2026.10421>

A key indicator for integral vs differential design of battery packs in battery electric vehicles under structural dynamic loads

Benedikt Plaumann, Eugen Hein, Ashish Chodvadiya, Martin Knorr

Hamburg University of Applied Sciences, Germany

Battery packs in BEVs are multidisciplinary design challenges balancing cost, weight, volume, range, and charging time. As the heaviest and most expensive component, their reliability and safety under vibration and shock is critical. This contribution presents an indicator to cluster measured vibration data of BEV battery packs based on coupling with the car body, enabling identification of representative designs and generalization of vibration behavior for future, more integrated architectures.

<https://doi.org/10.1017/pds.2026.10434>

Integrating manufacturing constraints in existing generative design workflows: wall thickness and cooling channel considerations

Rick Hentschel ¹, Johannes Soika ², Francesc Roure Pastor ³, Tobias Rosnitschek ¹, Daniel Günther ³, Wolfram Volk ^{2,3}, Markus Zimmermann ², Stephan Tremmel ¹

¹: University of Bayreuth, Germany; ²: Technical University of Munich, Germany; ³: Fraunhofer IGCV, Germany

Generative Design (GD) offers lightweight, manufacturable solutions, but manufacturing constraints often require indirect handling. Using a deflection lever for Additive Casting, we compare PTC Creo GTO and Altair Inspire using identical load cases and mass-minimisation. Both tools achieved -26% mass and -46% inertia while meeting displacement limits. Wall-thickness control and channel integration show clear trade-offs, yet both tools provide viable designs for early development.

<https://doi.org/10.1017/pds.2026.10417>

Session
D453

Congress
Hall
Orlando 1

16:30
17:30

21 May

THU

132



Enhancing design adaptation through an information-enriched reinforcement learning state

Yannick Utz, Sandro J. Wartzack, Stefan Goetz
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

The applicability and scalability of design adaptations utilizing reinforcement learning can be broadened by using graph-based approaches instead of rigid vector- or grid-based ones. However, graph-based approaches often require a high number of simulations to converge. To reduce the simulation effort in the mechanical optimisation, the reinforcement learning setup is enriched with task-specific causal and physically based information. This work systematically investigates the influence of this additional information on the efficiency of design adaptations using a factorial test design.

<https://doi.org/10.1017/pds.2026.10445>



DESIGN2026

Exploration of new actions that could be introduced to workflows for computer-aided form creation

Tijana Vuletic^{1,2}, Chris McTeague^{1,3}, Laura Hay^{1,2}, Gerard Campbell⁴, Madeleine Grealy⁴
1: James Watt School of Engineering, University of Glasgow, United Kingdom; 2: DMEM, University of Strathclyde, United Kingdom; 3: TUM School of Engineering and Design, Technical University of Munich, Germany; 4: Glasgow School of Psychological Sciences & Health, University of Strathclyde, United Kingdom

Implementing novel interaction modalities to CAD systems is raising questions about suitability of types of thinking employed and appropriateness of existing workflows used in CAD in this new context. The study reported in this paper explores the potential for introduction of alternative activities into existing workflows, proposed by designers interacting with 3D shapes using gestural interaction. Findings propose introduction of sculpting and forming paradigms that may reduce the amount of work required to create more complex forms.

<https://doi.org/10.1017/pds.2026.10447>

Compatibility-optimized selection of solution principles using mixed-integer linear programming

Meno-Said Haddad, Arthur Seibel
Leuphana University Lüneburg, Germany

Conceptual design methods rarely optimize both requirement fit and cross-principle compatibility, leaving a gap in generating coherent early-stage solutions. Here, we introduce a mixed-integer linear programming formulation that selects one solution principle per function while jointly minimizing local requirement mismatch and system-level incompatibility. Using a small case study, we show how a trade-off parameter controls the balance between functional quality and integration robustness. The results demonstrate that the approach enables transparent, compatibility-aware conceptual synthesis.

<https://doi.org/10.1017/pds.2026.10416>

Automated quantitative functional decomposition in product design

Philipp Rosenthal, René Heesch, Oliver Niggemann
Helmut Schmidt University, Germany

Functional decomposition shapes early design decisions but is largely qualitative, leaving units and measures implicit. This work introduces the Quantitative Functional Decomposition Problem, which formalizes functions and interfaces with measurable quantities, making decomposition solvable as a quantified planning problem. Two case studies show that the approach gives immediate feedback on the admissibility of functions and their connections. Design engineers get consistent quantified structures, which speed up iteration, reduce work and set targets for subsequent steps in the design process.

<https://doi.org/10.1017/pds.2026.10437>



Session
D454

Congress
Hall
Orlando 2

16:30
17:30

21 May

THU

133



Towards a framework for stimuli in interpreting and envisioning society in collaborative design futuring

*Yuki Taoka*¹, *Momoko Nakatani*¹, *Shiori Fujimaki*¹, *Marianne Kinnula*²

1: *Institute of Science Tokyo, Japan*; 2: *University of Oulu, Finland*

Collaborative design futuring has gained attention as an inclusive approach for envisioning future societies where external stimuli play a crucial role in stimulating imagination. Building on literature on design stimuli, psychological distance, and co-design, we propose and evaluate a five-layer framework through a multiple-case analysis of fifteen workshops and exhibitions. Through comparative analysis of different workshops, we explored how stimulus characteristics, such as modality, richness, and scenario, influence participant engagement and perceived psychological distance.

<https://doi.org/10.1017/pds.2026.10471>

Designing for well-being: a wearable prototype supporting emotional regulation through immersive multisensory interaction

Monica Bordegoni, *Marina Carulli*, *Gaia Zamuner*, *Riccardo Arici*, *Alessandro Chiarion*, *Giovanni Sartorio*

Politecnico di Milano, Italy

The search for effective strategies to support mental well-being has become increasingly pressing in contemporary societies, where stress, anxiety, and cognitive overload are widespread. In this paper, we present a wearable-supported VR system designed to enhance mindfulness through the integration of visual, auditory, and respiratory cues. Drawing on evidence from color therapy, binaural beats, and biofeedback, the system delivers a multisensory environment that supports emotional regulation. We describe the system's design and discuss its potential to improve technology-mediated well-being.

<https://doi.org/10.1017/pds.2026.10406>

ADT: a digital card-based toolkit for AI-augmented design thinking

*Yuan Yin*¹, *Varisara Sungprasit*², *Mingnan Lin*²

1: *Imperial College London, United Kingdom*; 2: *Goldsmiths, University of London, United Kingdom*

This paper presents ADT, a digital card-based toolkit designed to integrate AI into the Design Thinking process. A survey of 204 designers examined AI literacy, usage patterns, and adoption barriers. Results indicated uneven familiarity, with higher use in Prototyping and Testing stages. Key challenges included prompting, trust, ethics, and training gaps. ADT, thus, structures four professional roles across five design-thinking stages, providing reusable prompts, recommended AI tools, exemplar outputs, and ethical reminders to promote informed and responsible human–AI collaboration.

<https://doi.org/10.1017/pds.2026.10474>

Session
D455

Congress
Hall
Konavle

16:30
17:30

21 May

THU

134



Language games in prosthetic design framing: a Wittgensteinian framework

Wildan Trusjji^{1,2}, *Arlindo Silva*¹

1: Singapore University of Technology and Design, Singapore; 2: Institut Teknologi Bandung, Indonesia

This paper argues that disagreements about what counts as an ideal prosthesis arise from tacit framings of disability. Drawing on Wittgenstein's language games within an abductive–deductive–inductive approach, we identify four prosthetic language games: medical, social, relational, and critical. By rendering their distinct grammars explicit, the framework reframes interdisciplinary disagreement as epistemic plurality and supports boundary work, translation, and epistemic fluency, enabling more reflective and dialogical design research without collapsing plural standards of prosthetic success.

<https://doi.org/10.1017/pds.2026.10540>

Towards user-product interaction prediction with musculoskeletal human models: a methodological comparison for posture prediction

Gwen Spelly, Judith van Remmen, Sandro J. Wartzack, Jörg Miehling

Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Digital user tests utilizing musculoskeletal human models facilitate ergonomic assessments in the early phases of the product development process. In the underlying posture prediction models, the various movement strategies of the users need to be represented. Behavior cards are an evaluated tool for the representation of such movement strategies; however, a standardized determination of behavior cards is lacking so far. This study explores a cluster-based and a regression-based method for standardized behavior card determination, demonstrating the applicability of both methods.

<https://doi.org/10.1017/pds.2026.10625>



Food for thought: exploring the future of food through AI-supported design fictions

Elena Jiménez Romanillos, Renee Wever

Linköping University, Sweden

This paper explores how design fiction and generative AI (GAI) were used in a master's course addressing food consumption issues. Data from two course iterations include student outputs, reflections, and prompt records. GAI expanded speculative exploration, supporting rich, detailed futures. Two approaches emerged, exploratory and goal-oriented, highlighting the value of prompt literacy, iteration, and critical curation to sustain creative control and adaptability.

<https://doi.org/10.1017/pds.2026.10657>

The shape of teamwork: visualising collective design dynamics through synergy bands

*Matt Chiu*¹, *Arlindo Silva*², *Tamas Makany*³

1: Nanyang Academy of Fine Arts, University of the Arts Singapore (NAFA-UAS), Singapore;

2: Singapore University of Technology and Design, Singapore; 3: Singapore Management University, Singapore

Divergence and convergence are central to design processes, but can these patterns be made visible, and what might they reveal? This paper examines design team dynamics through NLP by tracing cognitive trajectories in weekly reflections. Textual data are transformed into numerical values and plotted in a Synergy Diagram, enabling instructors to monitor team bands. This paper consists of a four year study covers 48 project teams and 250 participants, comparing team bands across multiple bandwidth measures and showing how they vary against a design outcome, such as total grades (TG).

<https://doi.org/10.1017/pds.2026.10649>

Session
D456

Congress
Hall
Şipun

16:30
17:30

21 May

THU

135



MEET OUR LEAD SPONSOR - ONSHAPE

We are pleased that PTC / Onshape has once again chosen to serve as the Lead Sponsor of the DESIGN Conference.

Following their strong and impactful support of DESIGN 2024, Onshape's continued partnership underscores a shared commitment to advancing engineering design research, education, and practice. Their ongoing involvement plays a key role in strengthening the connection between cutting-edge industrial tools and the evolving needs of the global design research community.

Onshape is the first and only cloud-native product development platform delivering professional-grade CAD together with next-generation product data management (PDM). The platform enables agile, collaborative design processes at lower cost and without the constraints of traditional file-based CAD systems. By allowing multiple stakeholders to work simultaneously or asynchronously on any web-connected device, Onshape ensures that information flows freely across organizations, keeping teams aligned and accelerating innovation.

Across a wide range of engineering and manufacturing sectors, numerous clients and case studies demonstrate the tangible benefits of Onshape's approach to modern product development.

As Lead Sponsor of DESIGN 2026, Onshape aligns seamlessly with the conference's core themes: innovation, collaboration, digital transformation, and future-oriented engineering design. Its cloud-native philosophy and emphasis on real-time collaboration directly mirror the conference's ambition to bridge theory and practice while addressing contemporary challenges such as complexity, sustainability, and AI-enabled design.

Moreover, Onshape's strong engagement with education and research communities makes them an exemplary partner in fostering the next generation of design engineers and researchers.

Building on their successful engagement at DESIGN 2024, Onshape's role as Lead Sponsor of DESIGN 2026 goes beyond financial support: they will share expertise through a keynote speech, offer an introductory session on their platform for deep insights and Q&A, and ensure ongoing engagement at their conference stand for real-time discussions and demos. This continued, multifaceted involvement will further enrich the DESIGN 2026 experience, supporting knowledge exchange, networking, and meaningful dialogue between academia and industry.



onshape®
by ptc

TEACH ENGINEERING THE WAY INDUSTRY DOES IT

Onshape brings the same cloud-native CAD and built-in PDM
used by leading companies directly into your classroom.

NO DOWNLOADS. NO LICENSES. NO LIMITS.

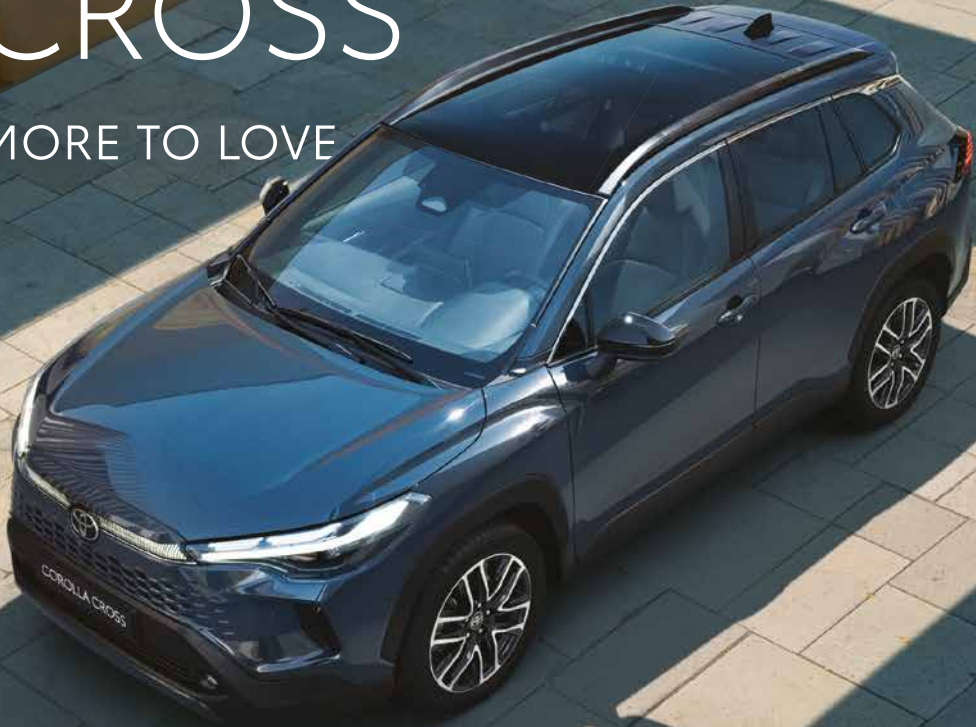


GET STARTED FOR FREE
[ONSHAPE.COM/EDU](https://www.onshape.com/edu)



NEW TOYOTA COROLLA CROSS

MORE TO LOVE



Average fuel consumption for Corolla Cross Hybrid: 5,0 – 5,4 l/100 km and CO₂ emissions: 114 – 122 g/km.
www.toyota.hr

DAČIA BIGSTER



FULL HYBRID OD 155 KS
SUV odvažna karaktera



Otkrijte više na www.dacia.hr

REVOLUTIONIZE DENTISTRY WITH **NEO LAB'S** CAD/CAM MILLING SOLUTIONS

Explore our **cutting-edge services** at Neo Lab, Milling Center, available across Europe. Elevate your practice today.



Quality of each product is supported by **ISO 9001** and **ISO 13485** certifications.



Largest milling center in the region



Each product is inspected in the **Quality Control Department**



We achieve the **satisfaction** of both our clients and their patients



We create **strong bonds** with our clients

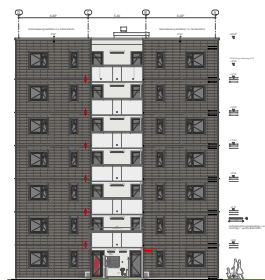
NEOLAB
MILLING CENTER

info@neo-lab.eu
www.neo-lab.eu

construction_sight

Rethinking construction systematically.

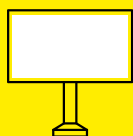
What to do when the demand for affordable housing is rising faster than conventional construction methods can cover? Our solution is called serial construction. B&O Bau constructs future-proof system houses with sustainable materials and prefabricated bathroom modules. This serial format in hybrid wood construction combines prefabricated wall elements in timber construction with ceilings and stairwell cores made of reinforced concrete. This drastically reduces the construction time of the buildings. Therefore, they are particularly suitable for urban densification. Curious? More information at buo.de/bau.



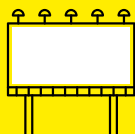
Serial construction
in Erlangen, Germany.

Print Studio

XXL tisak • zastave • reklame



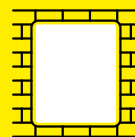
Bigboard



Jumbo plakati



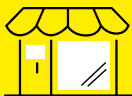
Citylight



Wallscape



Kartonski ljudi



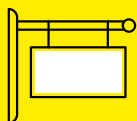
Oslikavanje izloga



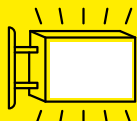
Oslikavanje vozila



Oslikavanje kamiona



Natpisne ploče



Svjetleće reklame



Naljepnice



Putokazi, znakovi



Roll up



SEG

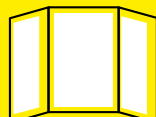


Foto zid



Zastave



Instagram okviri



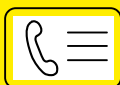
Brošure, letci



Stalci



POS stalci



Posjetnice



Pečati



Canvas



Tisak na majice

info@printstudio.hr

printstudio.hr



A large area of the page is filled with a grid of small, light blue dots, intended for taking notes.



DESIGN2026

A large area of the page is filled with a grid of small, light blue dots, providing a guide for writing or drawing.



fsb



**Design
Society**

cad lab



onshape[®]
by ptc



9 771847 916007

WWW.CADLAB.FSB.HR
WWW.DESIGNCONFERENCE.ORG