## **Table of Contents**

Conference Organisation	I-5
Major Sponsors	I-14
Editorial	I-22
Section 1: DESIGN THEORY, METHODOLOGY AND RESEARCH METHODOLO	GY
Analysing Design Protocols: Development of Methods and Tools John S Gero, Jeff WT Kan and Morteza Pourmohamadi	3
A Technology Selection Process for the Optimal Capture of Design Information Hamish McAlpine, Philip Cash, Alexander Storton and Steve Culley	11
Concept Exploration in New Product Development — An Empirical Study Ananthavalli Ramesh and L. Prakash Sai	19
Biologizing Product Development — Results from a Student Project Katharina Helten, Sebastian Schenkl and Udo Lindemann	27
Design Criteria and Extreme Conditions Narender P. Reddy	35
Understanding the Technical Content of Requirements in Specification Documents Mohd Nizam Sudin and Saeema Ahmed-Kristensen	42
The Propagation and Evolution of Design Constraints: An Industrial Case Study Nair V. V., Howard T. J., Culley S. J., Dekoninck E.A. and McAloone T. C.	50
Methodology for the Creation of Value Chains Adapted to Technical and Radical Innovation François Petetin, Gwenola Bertoluci and Jean-Claude Bocquet	58
A Case Study of How Knowledge Based Engineering Tools Support Experience Re-use Andersson Petter, Larsson C. Tobias and Isaksson Ola	66
Design for Happiness Vatsala Lakhotia	74
The Specificities of Radical Innovation Damien Motte, Bernard Yannou and Robert Bjärnemo	79
On the Interaction between the Engineering Design and the Development Process Models — Part I: Elaborations on the Generally Accepted Process Models Damien Motte, Robert Bjärnemo and Bernard Yannou	87

96
104
115
125
133
143
151
159
171
179
187
195
203
211
220
228

A Model for Visualizing Mechanical Assembly Situations Madhusudanan N and Amaresh Chakrabarti	238
Developing a Virtual Environment for Aiding Assessment Avinash Dawari, Santhi B., Chandana V., Amaresh Chakrabarti, Dibakar Sen, B. Gurumoorthy and Howard Appelman	247
Section 4: ENABLING TECHNOLOGIES & TOOLS	
AR Application for Pre-Post Processing in Engineering Analysis for Non-Expert Users Francesco Ferrise, Monica Bordegoni, Marco Ambrogio and Giandomenico Caruso	259
Simulation of the Interaction with Interfaces of Industrial Products in a Multimodal Environment Francesco Ferrise, Monica Bordegoni, Joseba Lizaranzu and Umberto Cugini	267
Analysis of Current IT Support for Product Development Processes Armin Sharafi, Thomas Wolfenstetter, Petra Wolf and Helmut Krcmar	275
A New Approach to Wearable Systems: Biodesign Beyond the Boundaries <i>Venere Ferraro and Marita Canina</i>	283
Development of Transmission Specifications for an Electric Vehicle Manoj K. Mahala and Anindya Deb	292
Section 5: DESIGN, KNOWLEDGE, AND PRODUCT LIFE CYCLE MANAGEMEN	Т
In-Service Information Required in a Redesign Task: An Analysis of Documents from the Aerospace Industry Santosh Jagtap and Aylmer Johnson	303
Visualization of Knowledge Maturity for Product-Service Development Christian Johansson and Åsa Ericson	312
Systematic Knowledge Transfer Based on Knowledge Correlations Maik Maurer	320
Enhancing the Selection of Methods for Customer Integration Jens Fähling, Stefan Langer, Jan Michael Schölkopf, Jan Marco Leimeister, Helmut Krcmar and Udo Lindemann	329
Temporal Aspects in Lifecycle-Oriented Planning of Product-Service-Systems Clemens Hepperle, Robert Orawski, Stefan Langer, Markus Mörtl and Udo Lindemann	338
Brand Mapping, A Tool for Design Management Shetall Natuu and Anirudh Natuu	347
Enhancing the Role and Use of the Design Brief S. Bolton	352

Knowledge Sharing Across Boundaries: Web 2.0 and Product-Service System Development Koteshwar Chirumalla, Andreas Larsson, Marco Bertoni and Tobias Larsson	360
Review of Design Management Processes and Efficacy Ankit Chhabra and Neelakshi Rathore	368
Section 6: APPLICATIONS IN PRACTICE	
Regenerative Braking System for the Car Venkateswara Reddy Gogulamudi, Uma Valliappan and K. V. Vijesh	379
Product Implications of Design Offshoring Zaza Nadja Lee Hansen and Saeema Ahmed-Kristensen	388
Multibody Dynamics Modeling and Experimental Validation of Fuel-Injection Pump	397
Sundarraman P., Baskaran R., Sunilkumar V., Raghavendra K., Subir K. Saha and Nilesh J. Vasa	
Improvements in ABC Pedal System in Automobile Gogulamudi Venkateswara Reddy, Janga Sree Harsha Reddy and Ullas Kumar TM	405
Design Methods — What Reaches Industrial Practice? Burkhard Wolf	414
Design of User-Centred Wireless Sensor Technology in Sports Dennis Sturm, Vinit Parida, Tobias C. Larsson and Ola Isaksson	422
Using Design Driven Innovation as a Vehicle of 'Eco' Sustainability in Medium Complexity Products Shujoy Chakraborty	430
Linear Guides of Linear Flow Split Components Nils Lommatzsch, Sebastian Gramlich and Herbert Birkhofer	439
Cultural Influence in Aesthetic Design: A Case Study Based on Intermediate Public Transport Vehicle Arun Muthumani and Bishakh Bhattacharya	447
Section 7: ECO-DESIGN, SUSTAINABLE MANUFACTURING, DESIGN FOR SUSTAINABILITY	
Application of QFD for Enabling Environmentally Conscious Design Gopinath Rathod, S. Vinodh and U. R. Madhyasta	457
Conceptual Design Features and Eco-Methods D. Saravana Bavan and G. C. Mohan Kumar	464
Leveraging Energy Efficiency Pathways for the Sustainable Design of Appliances, Buildings and ICT Products S. S. Krishnan, N. Balasubramanian, E. Subrahmanian, Ajay Krishnamurthy, A. Murali Ramakrishnan, V. Venkatesh and G. Ramakrishna	472

Design for the Base of the Pyramid: Issues and Solutions Santosh Jagtap and Prabhu Kandachar	480
Decision Support Tools for Sustainability in Product Innovation in a Few Swedish Companies Anthony W. Thompson, Pia Lindahl, Sophie Hallstedt, Henrik Ny and Göran Broman	489
Assessing the Benefits of Early Stage Design Research Selvan Thandapani and Richard Woodbridge	497
EcoDesign: A Retrofit Design Concept for 3-Axis Gantry, Compatible to Nd: YAG Based Pulse Laser Bhagyesh Deshmukh and Mohan Khond	506
Application of Multi-Domain Matrix Waste Reduction Methodology Fatos Elezi, Martin Graebsch, David Hellenbrand and Udo Lindemann	514
E-Waste Generation from Mobile Phones and Sustainability Issues for Designers Pradeep G. Yammiyavar and Vikash Kumar	523
Reoccurring Cyclic Consideration of End-of-Life Requirements During Product Planning Robert Orawski, Clemens Hepperle, Markus Mörtl, Udo Lindemann	533
Extending the Life Cycle of Under-Utilized Urban Scrap Through Sustainable Design Approach Prakash Kumar and Debkumar Chakrabarti	541
Evaluating Environmental Impacts of Sand Cast Products Using Life Cycle Assessment Durgesh Joshi, Yashwant Modi and B Ravi	551
Evaluating the Effect of Harvesters on Sustainability — A Design Study <i>K Ramani and Monto Mani</i>	559
Section 8: DESIGN CREATIVITY, SYNTHESIS, EVALUATION AND OPTIMISATION	
Generation of Diverse Dynamic Behaviors Using the Emergent Design System Koichiro Sato, Kenjiro Takemura and Yoshiyuki Matsuoka	571
A Tool for Automated Synthesis and Side-Effects Detection in Sensor Designs Amaresh Chakrabarti, Riccardo Regno, Biplab Sarkar and Srinivasan V.	581
Physical Models and Design Cognition Vimal Viswanathan and Julie Linsey	590
A Case Study of Open-Ended Creative Practice Based Research Yukari Nagai, Georgi V. Georgiev and Ian Gwilt	599
Computational Exploration of Design Spaces Sambit Datta and Bernard Rolfe	607

Creative Lean Design Process Alok Kumar Verma, Lalit Kumar Das and Ameya Surendra Erande	615
Can a Virtual Design Environment Enhance Group Creativity and the Use of Stimuli? Elias E. W. A., Chamakiotis P., Howard T. J., Dekoninck E. A. and Culley S. J.	623
Investigation of Creative Experience of Creator Aneesha Sharma	631
Semi-Automatic Synthesis of Conceptual Technical Systems Janez Rihtaršič and Roman Žavbi	639
NOVELTY — Not in Harmony, But in Unity Saleem Ahmed	646
Section 9: DESIGN COLLABORATION AND COMMUNICATION	
The Use of Graphic Representations in Semiconductor Engineering Team Problem Solving Tali Surasky and Gabriela Goldschmidt	655
Time Design for Building Trust in Communities of Systems and People <i>Caroline Nevejan and Frances Brazier</i>	663
Integral Design and C-K Theory for Concept Generation in the Building Industry <i>Wim Zeiler</i>	671
Tools as a Systematic Intervention: Integral Design Wim Zeiler	679
Learning to Collaborate During Team Designing Jeff WT Kan and John S Gero	687
Setting Up a Research Experiment — How Does Personal Motivation Affects Problem Setting? Johan Holmqvist, Johan Wenngren, Charles Cox, Åsa Ericson and Mattias Bergström	695
Shape Language Describes More Than the Body Lau Langeveld and Tjamme Wiegers	703
Assessment of Team Based Innovation in a Product Service System Development Process Mattias Bergström, Vinit Parida and Christian Johansson	711
Various Kinds of Networks of Partners: A Proposal for a Classification Scheme Nicolas Maranzana, Nathalie Gartiser and Emmanuel Caillaud	719
Towards Open Innovation Practices in Aerospace Industry Vinit Parida, Tobias C. Larsson, Ola Isaksson and Pejvak Oghazi	728
The Importance of Prototyping for Education in Product Innovation Engineering Anders Berglund and Martin Grimheden	737

## Section 10: DESIGN AESTHETICS, SEMIOTICS, SEMANTICS

Window Display as Communication Isabel Guimaraes	749
The Construction of My Perspective <i>K. P. Hari</i>	758
Investigation of Form Clusters Made of Smallest Semantic Units and Patterns Parag K. Vyas and V. P. Bapat	766
Design Approach to Kundan Jewellery-Development Parag K. Vyas and V. P. Bapat	775
Semantics Communicated by the Graphical Symbols Used in Vehicle Control Systems Saneef Ansari	784
Characterizing and Evaluating Aesthetic Features in Vehicle Design Charlie Ranscombe, Ben Hicks, Glen Mullineux and Baljinder Singh	792
Correlation between Intrinsic Characteristics of Industrial Products and User's Perception Sara Colombo, Roberta Gorno and Valentina Rognoli	800
Temporality in Static Visual Narratives: Based on Event, Time, Space & Place relation Sherline Pimenta K and Ravi Poovaiah	809
Perception of Form: A Peep on the Eye Susmita Sharma Y and B. K. Chakravarthy	818
Image Making of the Letterforms: Inspiration from Indian Image making for Font design Prasad Bokil and Shilpa Ranade	826
Structure Sharing in Logo Design Amaresh Chakrabarti and Kumari MC	834
Section 11: DESIGN TRAINING AND EDUCATION	
Master project Integral Design: start up for students based on workshops for professionals a comparison <i>Wim Zeiler</i>	845
Creating Participatory Design Tools: A Didactic Experience Marita Canina and Elisabetta Coccioni	853
Author Index	863