Advances in Life Cycle Engineering for Sustainable Manufacturing Businesses

# Table of Contents

Preface .................................................................................................................. v  
Organization ........................................................................................................ xiii  

**KEYNOTE PAPERS**

Transition of Environmental Issues – Fundamental Criteria for LC Engineering – .................. 1  
I. Yasui  
Ricoh’s Approach to Product Life Cycle Management and Technology Development ............. 5  
K. Sakai  

**LIFE CYCLE DESIGN**

[A1 Design Methodology for Life Cycle Strategy]  
Module-Based Model Change Planning for Improving Reusability in Consideration of  
Customer Satisfaction .............................................................................................. 11  
K. Tsubouchi, S. Takata  
Eco-Innovation: Product Design and Innovation for the Environment .................................. 17  
E. Baroulaki, A. Veshagh  
Towards the Use of LCA During the Early Design Phase to Define EoL Scenarios ................. 23  
A. Gehin, P. Zwolinski, D. Brissaud  
Development of Description Support System for Life Cycle Scenario ................................... 29  
R. Suesada, Y. Itamochi, S. Kondoh, S. Fukushige, Y. Umeda  
Conceptual Design of Product Structure for Parts Reuse .................................................. 35  
Y. Wu, F. Kimura  
A Web-Based Collaborative Decision-Making Tool for Life Cycle Interpretation .................. 41  
N.I. Karacapilidis, C.P. Pappis, G.T. Tsoulfas  

[A2 LCD Tools]  
Module Configurator for the Development of Products for Ease of Remanufacturing ............. 47  
G. Seliger, N. Weinert, M. Zettl  
Life-Cycle Assessment Simplification for Modular Products .............................................. 53  
M. Recchioni, F. Mandorli, M. Germani, P. Faraldi, D. Polverini  
The Optimization of the Design Process for an Effective Use in Eco-Design ....................... 59  
M. Fargnoli, F. Kimura  
Research on Design for Environment Method in Mass Customization ................................. 65  
L. Zhang, S. Wang, G. Liu, Z. Liu, H. Huang  
Definition of a VR Tool for the Early Design Stage of the Product Structure under  
Consideration of Disassembly .................................................................................... 71  
P. Zwolinski, A. Sghaier, D. Brissaud  

[A3 LCD Case Studies]  
Green Line – Strategies for Environmentally Improved Railway Vehicles ........................... 77  
W. Struckl, W. Wimmer  
TRIZ Based Eco-Innovation in Design for Active Disassembly ........................................... 83  
J.L. Chen, W.C. Chen
Need Model and Solution Model for the Development of a Decision Making Tool for Sustainable Workplace Design ......................................................... 89
   N. Boughnim, B. Yannou, G. Bertoluci
A Method for Supporting the Integration of Packaging Development into Product Development ................................................................. 95
   D. Motte, C. Bramklev, R. Bjärnemo
Ecodesign: a Subject for Engineering Design Students at UPC .............................. 101
   J. Lloveras
The Human Side of Ecodesign from the Perspective of Change Management ........ 107
   E. Verhulst, C. Boks, M. Stranger, H. Masson

[A4 PLM/PDM]
Integration and Complexity Management within the Mechatronics Product Development 113
   M. Abramovici, F. Bellalouna
Managing Design System Evolution to Increase Design Performance:
   Methodology and Tools ........................................................................ 119
   V. Robin, P. Girard
PLM Pattern Language: An Integrating Theory of Archetypal Engineering Solutions 125
   J. Feldhusen, F. Bungert
About the Integration Between KBE and PLM ........................................... 131
   D. Pugliese, G. Colombo, M.S. Spurio

[A5 Product Service System]
Integrated Product and Service Engineering versus Design for Environment
   - A Comparison and Evaluation of Advantages and Disadvantages .......... 137
   M. Lindahl, E. Sundin, T. Sakao, Y. Shimomura
Service CAD System to Support Servicification of Manufactures ................ 143
   T. Sakao, Y. Shimomura
Design for Integrated Product-Service Offerings – A Case Study of Soil Compactors 149
   E. Sundin
Service Analysis for Service Design Process Formalization Based on Service Engineering .............................................................. 155
   M.I. Boyonas, T. Hara, T. Arai, Y. Shimomura
Leadership - From Technology to Use; Operation Fields and Solution Approaches for the Automation of Service Processes of Industrial Product-Service-Systems 159
   H. Meier, D. Kortmann
Implications for Engineering Information Systems Design in the Product-Service Paradigm ................................................................. 165
   S. Kundu, A. McKay, A. de Pennington, N. Moss, N. Chapman
Life Cycle Management of Industrial Product-Service Systems .................. 171
   J.C. Aurich, E. Schweitzer, C. Fuchs

SUSTAINABLE MANUFACTURING

[B1 Sustainability in Manufacturing]
Development of International Integrated Resource Recycling System ............ 177
   T. Watanabe, H. Hasegawa, S. Takahashi, H. Sakagami
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Financial Approaches for the Economic Sustainability in Manufacturing Industry</td>
<td>183</td>
</tr>
<tr>
<td>Energy Use per Worker-Hour: Evaluating the Contribution of Labor to Manufacturing Energy Use</td>
<td>189</td>
</tr>
<tr>
<td>T.W. Zhang, D.A. Dornfeld</td>
<td></td>
</tr>
<tr>
<td>Framework for Integrated Analysis of Production Systems</td>
<td>195</td>
</tr>
<tr>
<td>C. Herrmann, L. Bergmann, S. Thiede, A. Zein</td>
<td></td>
</tr>
<tr>
<td>Designing Services Based on 'Intelligent' Press-Die-Systems</td>
<td>201</td>
</tr>
<tr>
<td>G. Schuh, C. Klotzbach, F. Gaus</td>
<td></td>
</tr>
<tr>
<td>Business Models for Technology-Supported, Production-Related Services of the Tool and Die Industry</td>
<td>207</td>
</tr>
<tr>
<td>G. Schuh, C. Klotzbach, F. Gaus</td>
<td></td>
</tr>
<tr>
<td>[B2 State-of-the-Art in LCE]</td>
<td></td>
</tr>
<tr>
<td>An Empirical Study of How Innovation and the Environment are</td>
<td>213</td>
</tr>
<tr>
<td>Considered in Current Engineering Design Practise</td>
<td></td>
</tr>
<tr>
<td>J. O'Hare, E. Dekoninck, H. Liang, A. Turnbull</td>
<td></td>
</tr>
<tr>
<td>Using the Delphi Technique to Establish a Robust Research Agenda for Remanufacturing</td>
<td>219</td>
</tr>
<tr>
<td>A. King, S. Barker</td>
<td></td>
</tr>
<tr>
<td>Coherent Design Rationale and its Importance to the Remanufacturing Sector</td>
<td>225</td>
</tr>
<tr>
<td>S. Barker, A. King</td>
<td></td>
</tr>
<tr>
<td>Survey on Environmentally Conscious Design in the Japanese Industrial Machinery Sector</td>
<td>231</td>
</tr>
<tr>
<td>K. Masui, H. Ito</td>
<td></td>
</tr>
<tr>
<td>Survey of Sustainable Life Cycle Design and Management</td>
<td>237</td>
</tr>
<tr>
<td>A. Veshagh, A. Obagun</td>
<td></td>
</tr>
<tr>
<td>[B3 Manufacturing Technologies for Circulation]</td>
<td></td>
</tr>
<tr>
<td>An Approach of Home Appliances Recycling by Collaboration Between the Manufacturer and the Recycling Plant</td>
<td>243</td>
</tr>
<tr>
<td>K. Fujisaki, T. Shinagawa, S. Ogasawara, T. Hishi</td>
<td></td>
</tr>
<tr>
<td>Product Individual Sorting and Identification Systems to Organize WEEE Obligations</td>
<td>247</td>
</tr>
<tr>
<td>C. Butz</td>
<td></td>
</tr>
<tr>
<td>Dynamic Process Planning Control of Hybrid Disassembly Systems</td>
<td>251</td>
</tr>
<tr>
<td>S. Chiotellis, H.J. Kim, G. Seliger</td>
<td></td>
</tr>
<tr>
<td>Development of an Automatic Cleaning Process for Toner Cartridges</td>
<td>257</td>
</tr>
<tr>
<td>H. Hermansson, J. Östlin, E. Sundin</td>
<td></td>
</tr>
<tr>
<td>Study on Disassembling Approaches of Electronic Components Mounted on PCBs</td>
<td>263</td>
</tr>
<tr>
<td>H. Huang, J. Pan, Z. Liu, S. Song, G. Liu</td>
<td></td>
</tr>
<tr>
<td>Product Disassembly Model Based on Hierarchy Network Graph</td>
<td>267</td>
</tr>
<tr>
<td>S. Wang, L. Zhang, H. Huang, Z. Liu, X. Pan</td>
<td></td>
</tr>
<tr>
<td>[B4 Material Design]</td>
<td></td>
</tr>
<tr>
<td>Ecoselection of Materials and Process for Medium Voltage Products</td>
<td>273</td>
</tr>
<tr>
<td>W. Daoud, M. Hassanzadeh, A. Cornier, D. Froelich</td>
<td></td>
</tr>
</tbody>
</table>
Sustainable Design of Geopolymers – Evaluation of Raw Materials by the Integration of Economic and Environmental Aspects in the Early Phases of Material Development ....... 279
M. Weil, U. Jeske, K. Dombrowski, A. Buchwald

Conductive Adhesives vs. Solder Paste: a Comparative Life Cycle Based Screening ....... 285
A.S.G. Andrae, N. Itsubo, H. Yamaguchi, A. Inaba

B. Zhang, F. Kimura

[B5 Environmentally Conscious Manufacturing]

Coolants Made of Native Ester – Technical, Ecological and Cost Assessment
from a Life Cycle Perspective................................................................................. 299
C. Herrmann, J. Hesselbach, R. Bock, T. Dettmer

Investigation of Minimal Quantity Lubrication in Turning of Waspaloy ................... 305
T. Beno, M. Isaksson, L. Pejryd

Improvement Potential for Energy Consumption in Discrete Part Production Machines ..... 311
T. Devoldere, W. Dewulf, W. Deprez, B. Willems, J.R. Duflou

A Variational Approach to Inspection Programs of Equipment Subject to Random Failure...
S. Okumura

Sustainable Machine Tool Reliability Based on Condition Diagnosis and Prognosis ...... 323
J. Fleischer, M. Schopp

Optimizing the Life-Cycle-Performance of Machine Tools by Reliability and
Availability Prognosis ......................................................................................... 329
J. Fleischer, S. Niggeschmidt, M. Wawerla

LIFE CYCLE MANAGEMENT

[C1 Life Cycle Management]
The Role of Warranty in the Reuse Strategy ......................................................... 335
M. Anityasari, H. Kaebernick, S. Kara

Lifetime Modelling of Products for Reuse: Physical and Technological Life Perspective ... 341
F. Rugrungruang, S. Kara, H. Kaebernick

Tackling Adverse Selection in Secondary PC Markets ............................................. 347
S. Hickey, C. Fitzpatrick

Simulation of Network Agents Supporting Consumer Preference on
Reuse of Mechanical Parts .................................................................................. 353
T. Hanatani, N. Fukuda, H. Hiraoka

Perspectives for the Application of RFID on Electric and Electronic Waste ................ 359
D. Seyde, T. Suga

[C2 Life Cycle Evaluation]

Early Design Evaluation of Products Artifacts': An Approach Based on Dimensional
Analysis for Combined Analysis of Environmental, Technical and Cost Requirements ...... 365
E. Coatanea, M. Kuuva, P.E. Makkonen, T. Saarelainen

Total Performance Analysis of Product Life Cycle Considering the Uncertainties in
Product-Use Stage ......................................................................................... 371
S. Kondoh, K. Masui, N. Mishima, M. Matsumoto

Effects on Life Cycle Assessment – Scale Up of Processes ................................. 377
M. Shibasaki, M. Fischer, L. Barthel
Development of a Management Tool for Assessing Environmental Performance in SMEs' Design and Production .......................................................... 383
T. Woolman, A. Veshagh

An Approach to the LCA for Venezuelan Electrical Generation Using European Data ........ 389
O.E. González, P.P. Pérez, J. Lloveras

[C3 Sustainable Consumption]
In Search of Customer Needs for Home Energy Management System in Japan .................. 395
Y. Matsuura, K. Fukuyo

The Influence of Durable Goods on Japanese Consumers' Behaviours ................................ 401
S. Ita

An Experimental Analysis of Environmentally Conscious Decision-Making for Sustainable Consumption .......................................................... 407
N. Nishino, Y. Okawa, S.H. Oda, K. Ueda

An Integrated Model for Evaluating Environmental Impact of Consumer's Behavior: Consumption 'Technologies' and the Waste Input-Output Model...................................................... 413
Y. Kondo, K. Takase

Proposal of a Measuring Method of Customer's Attention and Satisfaction on Services...... 417
Y. Yoshimitsu, K. Kimita, T. Haria, Y. Shimomura, T. Arai

A Life-Cycle Comparison of Clothes Washing Alternatives ........................................... 423
L. Garcilaso, K.L. Jordan, V. Kumar, M.J. Hutchins, J.W. Sutherland

[C4 Supply Chain Management]
Methodology and Application of Parts Qualification for Compliance to Environmental Rules......................................................................................... 429
N. Ninagawa, Y. Hamatsuka, N. Yamamoto, Y. Hiroshige

An Overview of Academic Developments in Green Value Chain Management ............... 433
C. Boks, H. Komoto

Life Cycle Innovations in Extended Supply Chain Networks........................................... 439
C. Herrmann, L. Bergmann, S. Thiede, A. Zein

[C5 Life Cycle Costing]
Evaluating Eco-Efficiency of Appliances by Integrated Use of Hybrid LCA and LCC Tools .......................................................... 445
S. Nakamura

Machine Life Cycle Cost Estimation via Monte-Carlo Simulation ..................................... 449
J. Fleischer, M. Wawerla, S. Niggeschmidt

A. Dimache, L. Dimache, E. Zoldi, T. Roche

Design to Life Cycle by Value-Oriented Life Cycle Costing ............................................ 461
D. Janz, E. Westkämper

A Product Lifecycle Costing System with Imprecise End-of-Life Data ............................... 467
J.G. Kang, D. Brissaud

A Life Cycle Cost Framework for the Management of Spare Parts ................................ 473
M. Carpentieri, A.N.J. Guglielmini, F. Mangione