

49th CIRP Conference on Manufacturing Systems (CIRP-CMS 2016)

Factories of the Future in the Digital
Environment

Procedia CIRP Volume 57

Stuttgart, Germany
25 - 27 May 2016

Editors:

**Engelbert Westkamper
Thomas Bauernhansl**

ISBN: 978-1-5108-3493-4

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© by Elsevier B.V.
All rights reserved.

Printed by Curran Associates, Inc. (2017)

For permission requests, please contact Elsevier B.V.
at the address below.

Elsevier B.V.
Radarweg 29
Amsterdam 1043 NX
The Netherlands

Phone: +31 20 485 3911
Fax: +31 20 485 2457

<http://www.elsevierpublishingsolutions.com/contact.asp>

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

EDITORIAL 49TH CIRP INTERNATIONAL CONFERENCE ON MANUFACTURING SYSTEMS (CIRP CMS)	1
<i>Engelbert Westkämper, Thomas Bauernhansl</i>	
INDUSTRIE 4.0 - FROM THE PERSPECTIVE OF APPLIED RESEARCH	2
<i>Reimund Neugebauer, Sophie Hippmann, Miriam Leis, Martin Landherr</i>	
ECOSYSTEMS, STRATEGY AND BUSINESS MODELS IN THE AGE OF DIGITIZATION - HOW THE MANUFACTURING INDUSTRY IS GOING TO CHANGE ITS LOGIC	8
<i>Dominik Paulus-Rohmer, Heike Schatton, Thomas Bauernhansl</i>	
STUDY BASED ANALYSIS ON THE CURRENT DIGITALIZATION DEGREE IN THE MANUFACTURING INDUSTRY IN GERMANY	14
<i>Eva Bogner, Thomas Voelklein, Olaf Schroedel, Joerg Franke</i>	
ENABLERS FOR INTEGRATION TO ENABLE MORE ADAPTABLE VALUE CHAINS	20
<i>Inger Gamme</i>	
THE APPLICATION CENTER INDUSTRIE 4.0 - INDUSTRY-DRIVEN MANUFACTURING, RESEARCH AND DEVELOPMENT	26
<i>Martin Landherr, Ulrich Schneider, Thomas Bauernhansl</i>	
CYPROF – INSIGHTS FROM A FRAMEWORK FOR DESIGNING CYBER-PHYSICAL SYSTEMS IN PRODUCTION ENVIRONMENTS	32
<i>D. Kolberg, C. Berger, B.-C. Pirvu, M. Franke, J. Michniewicz</i>	
A FRAMEWORK FOR INFORMATION-DRIVEN MANUFACTURING	38
<i>Marko Friedemann, Thies Uwe Trapp, Johannes Stoldt, Tino Langer, Matthias Putz</i>	
THE TEACHING FACTORY: A MANUFACTURING EDUCATION PARADIGM	44
<i>G. Chryssolouris, D. Mavrikios, L. Rentzos</i>	
LEARNING AND KNOWLEDGE SYSTEMS IN PRODUCT DEVELOPMENT ENVIRONMENTS	49
<i>Geir Ringen, Torgeir Welo, Emma Østerbø</i>	
OPTIMIZED ADAPTIVE SCHEDULING OF A MANUFACTURING PROCESS SYSTEM WITH MULTI-SKILL WORKFORCE AND MULTIPLE MACHINE TYPES: AN ONTOLOGY-BASED, MULTI-AGENT REINFORCEMENT LEARNING APPROACH	55
<i>Shuhui Qu, Jie Wang, Shivani Govil, James O. Leckie</i>	
A PERFORMANCE MEASUREMENT SYSTEM FOR GLOBAL MANUFACTURING NETWORKS	61
<i>Benedikt Sager, Sven Hawer, Gunther Reinhart</i>	
ROBUSTNESS- AND COMPLEXITY-ORIENTED CHARACTERIZATION OF SUPPLY NETWORKS' STRUCTURES	67
<i>Judit Monostori</i>	
MULTI-CRITERIAL SELECTION OF TRACK AND TRACE TECHNOLOGIES FOR AN ANTI-COUNTERFEITING STRATEGY	73
<i>E. Gossen, E. Abele, M. Rauscher</i>	
A META-MODEL FOR ANALYZING THE INFLUENCE OF PRODUCTION-RELATED BUSINESS PROCESSES	79
<i>Christopher Lock, Gunther Reinhart</i>	
QUANTIFYING THE DEGREE OF ASSEMBLY-READINESS OF HIGH-VARIANT LOW-VOLUME PRODUCTS DURING THE NEW PRODUCT DEVELOPMENT PROCESS	85
<i>Tobias Steinhäusser, Gunther Reinhart, Carsten Intra</i>	
INCREASE OF CAPACITY FLEXIBILITY IN MANUFACTURING SYSTEMS BY SUBSTITUTION OF PRODUCT FUNCTIONS	92
<i>Philipp Holtewert, Thomas Bauernhansl</i>	
EFFICIENCY POTENTIALS AND THE EXTENDED REGIONAL INFRASTRUCTURE: REQUIREMENTS FOR A MANAGEMENT MODEL	98
<i>B. Kuch</i>	
RISK EFFICIENT MIGRATION STRATEGIES FOR GLOBAL PRODUCTION NETWORKS	104
<i>E. Moser, Nicole Stricker, G. Lanza</i>	
DETERMINATION OF THE OPTIMAL DEGREE OF AUTONOMY IN A CYBER-PHYSICAL PRODUCTION SYSTEM	110
<i>Norbert Gronau, Hanna Theuer</i>	

ADVANCED COMPLEXITY MANAGEMENT STRATEGIC RECOMMENDATIONS OF HANDLING THE “INDUSTRIE 4.0” COMPLEXITY FOR SMALL AND MEDIUM ENTERPRISES	116
<i>Jens Jäger, Oliver Schöllhammer, Michael Lickefett, Thomas Bauernhansl</i>	
A NOVEL METHODOLOGY FOR MANUFACTURING FIRMS VALUE MODELING AND MAPPING TO IMPROVE OPERATIONAL PERFORMANCE IN THE INDUSTRY 4.0 ERA	122
<i>F. Tonelli, M. Demartini, A. Loleo, C. Testa</i>	
ANALYSIS OF CRITICAL FACTORS FOR AUTOMATIC MEASUREMENT OF OEE	128
<i>Richard Hedman, Mukund Subramaniyan, Peter Almström</i>	
A VIRTUAL REALITY APPLICATION TO ATTRACT YOUNG TALENTS TO MANUFACTURING.....	134
<i>Antoniou Stratos, Rentzos Loukas, Mavrikios Dimitris, Georgoulas Konstantinos, Mourtzis Dimitris, Chryssolouris George</i>	
THE LEAN BRAIN THEORY. BRAIN-LIKE LEAN MANUFACTURING SYSTEMS	140
<i>Javier Villalba-Díez, Joaquín Ordieres-Meré, Susana Rubio-Valdehita</i>	
TOWARDS THE INVESTIGATION OF PRODUCTION ORDER INTERDEPENDENCY EFFECTS ON LOGISTICS PERFORMANCE	146
<i>Victor Vican, Julia Bendul</i>	
INTEGRATED PRODUCTION AND TRANSPORTATION SCHEDULING FOR MULTI-OBJECTIVE GREEN SUPPLY CHAIN NETWORK DESIGN	152
<i>Yoshitaka Tanimizu, Katuhumi Amano</i>	
CONTROLLING MYOPIC BEHAVIOR IN DISTRIBUTED PRODUCTION SYSTEMS — A CLASSIFICATION OF DESIGN CHOICES	158
<i>H. Blunck, J. Bendul</i>	
MONETARY QUANTIFICATION OF SUPPLY RISKS OF MANUFACTURING ENTERPRISES - DISCRETE EVENT SIMULATION BASED APPROACH.....	164
<i>Philipp Von Cube, Lasse Härtel, Robert Schmitt, Christophe Ponsard, Philippe Massonet, Renaud De Landsheer, Gustavo Ospina, Stephan Printz, Sabina Jeschke</i>	
MODEL-BASED DECISION SUPPORT IN SUPPLY CHAINS – REQUIREMENTS FOR MONETARY SUPPLY RISK QUANTIFICATION.....	171
<i>Johann Philipp Von Cube, Lasse Härtel, Robert Schmitt</i>	
SIMULATION-BASED FLEXIBLE LAYOUT PLANNING CONSIDERING STOCHASTIC EFFECTS	177
<i>Dávid Gyulai, Ádám Szaller, Zsolt János Viharos</i>	
RESILIENCE OF PRODUCTIONS SYSTEMS BY ADAPTING TEMPORAL OR SPATIAL ORGANIZATION	183
<i>Ulf Bergmann, Matthias Heinicke</i>	
DRIVERS AND BARRIERS OF LEAN IMPLEMENTATION IN THE GREEK MANUFACTURING SECTOR	189
<i>Konstantinos Salonitis, Christos Tsinopoulos</i>	
MANUFACTURING SYSTEM LEAN IMPROVEMENT DESIGN USING DISCRETE EVENT SIMULATION.....	195
<i>Oleghe Omogbai, Konstantinos Salonitis</i>	
LEAN AUTOMATION SYSTEM RESPONDING TO THE CHANGING MARKET	201
<i>Yasuhiko Yamazaki, Shozo Takata, Hisashi Onari, Fumio Kojima, Shigeya Kato</i>	
INDUSTRIE 4.0: USING CYBER-PHYSICAL SYSTEMS FOR VALUE-STREAM BASED PRODUCTION EVALUATION	207
<i>Erdal Tantik, Reiner Anderl</i>	
TOWARDS A RULE-BASED MANUFACTURING INTEGRATION ASSISTANT.....	213
<i>Matthias Wieland, Pascal Hirmer, Frank Steimle, Christoph Gröger, Bernhard Mitschang, Eike Rehder, Dominik Lucke, Omar Abdul Rahman, Thomas Bauernhansl</i>	
AGILE SERVICE-ORIENTED ANALYSIS AND DESIGN OF INDUSTRIAL INTERNET APPLICATIONS.....	219
<i>Thomas Usländer</i>	
MODULARITY AS KEY ENABLER FOR SCALABILITY OF FINAL ASSEMBLY UNITS IN THE AUTOMOTIVE SECTOR.....	224
<i>Jakob Weber, Markus Stäbler, Sebastian Thielen, Kristin Paetzold</i>	
MANUFACTURING SYSTEM FLEXIBILITY: SEQUENCE FLEXIBILITY ASSESSMENT.....	229
<i>Meriem Lafou, Luc Mathieu, Stéphane Pois, Marc Alochet</i>	
A COMPARISON OF THE MANUFACTURING RESILIENCE BETWEEN FIXED AUTOMATION SYSTEMS AND MOBILE ROBOTS IN LARGE STRUCTURE ASSEMBLY	235
<i>Spartak Ljasenko, Niels Lohse, Laura Justham</i>	

AUTOCLAVE CYCLE OPTIMIZATION FOR HIGH PERFORMANCE COMPOSITE PARTS MANUFACTURING	241
<i>Luigi Nele, Alessandra Caggiano, Roberto Teti</i>	
SITUATION-BASED METHODOLOGY FOR PLANNING THE COMMISSIONING OF SPECIAL MACHINERY USING BAYESIAN NETWORKS	247
<i>Sebastian Poeschl, Frank Wirth, Thomas Bauernhansl</i>	
CONDITION-BASED MAINTENANCE: MODEL VS. STATISTICS A PERFORMANCE COMPARISON	253
<i>Marc Engeler, Daniel Treyer, David Zogg, Konrad Wegener, Andreas Kunz</i>	
A HOLISTIC APPROACH FOR QUALITY ORIENTED MAINTENANCE PLANNING SUPPORTED BY DATA MINING METHODS	259
<i>Robert Glawar, Zsolt Kemeny, Tanja Nemeth, Kurt Matyas, Laszlo Monostori, Wilfried Sihm</i>	
MANAGEMENT AND PLANNING OF TOOLS MAINTENANCE ACTIVITIES IN A METALWORKING	265
<i>C. R. Pires, I. S. Lopes, J. A. Oliveira</i>	
A PROPOSAL SIMULATION METHOD TOWARDS CONTINUOUS IMPROVEMENT IN DISCRETE MANUFACTURING	270
<i>Victor Emmanuel De Oliveira Gomes, Luis Gonzaga Trabasso</i>	
USAGE OF ANALYTICAL SERVICES IN INDUSTRY TODAY AND TOMORROW	276
<i>Eduardo Colangelo, Thomas Bauernhansl</i>	
A TELEMETRY-DRIVEN APPROACH TO SIMULATE DATA-INTENSIVE MANUFACTURING PROCESSES	281
<i>Gianfranco E. Modoni, Marco Sacco, Walter Terkaj</i>	
A NOVEL APPROACH FOR MISSION RELIABILITY MODELING OF MANUFACTURING SYSTEM BASED ON THE STATE CHANGE OF MACHINES AND MATERIALS	286
<i>Changchao Gu, Yihai He, Xiao Han</i>	
RECOGNITION OF ONE CLASS OF QUADRICS FROM 3D POINT CLOUDS	292
<i>Zivana Jakovljevic, Veljko Markovic, Radovan Puzovic, Vidosav Majstorovic</i>	
IMPROVING MANUFACTURING PROCESS CHANGE BY 3D VISUALIZATION SUPPORT: A PILOT STUDY ON TRUCK PRODUCTION	298
<i>Liang Gong, Jonatan Berglund, Zhiping Wang, Jon Larborn, Anders Skoogh, Björn Johansson</i>	
VIRTUAL REALITY BASED TIME AND MOTION STUDY WITH SUPPORT FOR REAL WALKING	303
<i>Andreas Kunz, Markus Zank, Thomas Nescher, Konrad Wegener</i>	
A COMPUTATIONAL FRAMEWORK FOR CLOUD-BASED MACHINE PROGNOSIS	309
<i>Peng Wang, Robert X. Gao, Dazhong Wu, Janis Terpeny</i>	
OPC UA & INDUSTRIE 4.0 - ENABLING TECHNOLOGY WITH HIGH DIVERSITY AND VARIABILITY	315
<i>Miriam Schleißen, Syed-Shiraz Gilani, Tino Bischoff, Julius Pfrommer</i>	
A SYSTEMATIC APPROACH TO OPC UA INFORMATION MODEL DESIGN	321
<i>Florian Pauker, Thomas Frühwirth, Burkhard Kittl, Wolfgang Kastner</i>	
PLANNING OF WORKSTATIONS IN A MODULAR AUTOMOTIVE ASSEMBLY SYSTEM	327
<i>Wolfgang Kern, Fabian Rusitschka, Thomas Bauernhansl</i>	
COMPLEXITY-FOCUSED PLANNING AND OPERATING OF MIXED-MODEL ASSEMBLY LINES IN AUTOMOTIVE MANUFACTURING	333
<i>Stefan Keckl, Antoin Abou-Haydar, Engelbert Westkämper</i>	
METHOD FOR A CROSS-ARCHITECTURE ASSEMBLY LINE PLANNING IN THE AUTOMOTIVE INDUSTRY WITH FOCUS ON MODULARIZED, ORDER FLEXIBLE, ECONOMICAL AND ADAPTABLE ASSEMBLY PROCESSES	339
<i>Christian Küber, Engelbert Westkämper, Bernd Keller, Hans-Friedrich Jacobi</i>	
EMPLOYING ORDER ALLOCATION FLEXIBILITY IN CYBER-PHYSICAL PRODUCTION SYSTEMS	345
<i>Dennis Horstkemper, Bernd Hellingrath</i>	
ADAPTIVE JOB-SHOP CONTROL USING RESOURCE ACCOUNTS	351
<i>M. Niehues, P. Sellmaier, T. Steinhäusser, G. Reinhart</i>	
A HEURISTIC OPTIMISATION APPROACH FOR THE SCHEDULING OF INTEGRATED MANUFACTURING AND DISTRIBUTION SYSTEMS	357
<i>Jens Ehm, Michael Freitag, Enzo M. Frazzon</i>	
AGENT-BASED CONTROL SYSTEM METHODOLOGY FOR RECONFIGURABLE BENDING PRESS MACHINE	362
<i>Olukorede Tijani Adenuga, Khumbulani Mpofo, Adeyeri Michael Kanisuru</i>	

VACUUM ASSISTED MULTIPOINT MOULDING – A RECONFIGURABLE TOOLING TECHNOLOGY FOR PRODUCING SPATIALLY CURVED SINGLE-ITEM CFRP PANELS	368
<i>Matthias S. J. Wimmer, Mario Lušić, Christoph Maurer</i>	
COMPUTATIONAL DESIGN SYNTHESIS OF RECONFIGURABLE CELLULAR MANUFACTURING SYSTEMS: A DESIGN ENGINEERING MODEL.....	374
<i>Johannes Unglert, Juan Jauregui-Becker, Sipke Hoekstra</i>	
CONSISTENCY CHECK OF THE FUNCTIONAL SOLUTION MODEL IN SPECIAL PURPOSE MACHINERY.....	380
<i>Tobias Helbig, Johannes Hoos, Engelbert Westkämper</i>	
A FRAMEWORK FOR VALUE-OPTIMIZED DESIGN OF PRODUCT FEATURES	386
<i>Payam Amini, Björn Falk, Robert Schmitt</i>	
SYSTEMATIC IMPROVEMENT OF SUPPLIER INTEGRATION WITHIN THE PRODUCT DEVELOPMENT PROCESS.....	392
<i>Uwe Dombrowski, Alexander Karl</i>	
A MODEL BASED VISUALIZATION FRAMEWORK FOR CROSS DISCIPLINE COLLABORATION IN INDUSTRY 4.0 SCENARIOS	398
<i>Johannes Herter, Jivka Ovtcharova</i>	
FUTURE TRENDS IN HUMAN WORK AREA DESIGN FOR CYBER-PHYSICAL PRODUCTION SYSTEMS	404
<i>Till Becker, Hendrik Stern</i>	
A MODULAR ARCHITECTURE FOR THE DESIGN OF CONDITION MONITORING PROCESSES.....	410
<i>Hans Fleischmann, Johannes Kohl, Jörg Franke</i>	
HYBRID MULTI-OBJECTIVE OPTIMIZATION METHOD FOR SOLVING SIMULTANEOUSLY THE LINE BALANCING, EQUIPMENT AND BUFFER SIZING PROBLEMS FOR HYBRID ASSEMBLY SYSTEMS.....	416
<i>Jonathan Oesterle, Thomas Bauernhansl, Lionel Amodeo</i>	
LINEAR CONSTRAINT PROGRAMMING FOR COST-OPTIMIZED CONFIGURATION OF MODULAR ASSEMBLY SYSTEMS.....	422
<i>Paul Danny Anandan, Vikrant Hiwarkar, Mohamed S. Sayed, Pedro Ferreira, Niels Lohse</i>	
HYDROGEN FUEL CELL PICK AND PLACE ASSEMBLY SYSTEMS: HEURISTIC EVALUATION OF RECONFIGURABILITY AND SUITABILITY.....	428
<i>Mussawar Ahmad, Bilal Ahmad, Bugra Alkan, Daniel Vera, Robert Harrison, James Meredith, Axel Bindel</i>	
EVENT-DRIVEN PRODUCTION PLANNING AND CONTROL BASED ON INDIVIDUAL CUSTOMER ORDERS.....	434
<i>Georg Kasakow, Nicole Menck, Jan C. Aurich</i>	
SIMULATIVE ASSESSMENT OF AGENT BASED PRODUCTION PLANNING AND CONTROL STRATEGIES.....	439
<i>Denis Kurle, Stefan Blume, Tobias Zurawski, Sebastian Thiede</i>	
SIMULATION-BASED PRODUCTION PLANNING AND EXECUTION CONTROL FOR RECONFIGURABLE ASSEMBLY CELLS	445
<i>Dávid Gyulai, András Pfeiffer, Botond Kádár, László Monostori</i>	
MODEL FOR CUTTING TOOLS USAGE TRACKING BY ON-LINE DATA CAPTURING AND ANALYSIS.....	451
<i>Juergen Lenz, Dominik Brenner, Engelbert Westkaemper</i>	
SYSTEM OF HIGH-PERFORMANCE CUTTING WITH ENHANCED COMBINED EFFECT OF COOLING AND LUBRICATION MEDIUM BASED ON RANQUE-HILSCH EFFECT	457
<i>Alexander Naumov, Alexey Vereschaka, Andre Batako, Anatoly Vereschaka</i>	
TRAJECTORY PLANNING FOR RECONFIGURABLE INDUSTRIAL ROBOTS DESIGNED TO OPERATE IN A HIGH PRECISION MANUFACTURING INDUSTRY	461
<i>Oliver Avram, Anna Valente</i>	
APPROACH FOR AN INTEGRATED PLANNING OF MANUFACTURING SYSTEMS BASED ON EARLY PHASES OF PRODUCT DEVELOPMENT.....	467
<i>Chantal Steimer, Marcel Cadet, Jan C. Aurich, Nicole Stephan</i>	
ASSESSMENT OF AERO ENGINE ASSEMBLABILITY DURING PRELIMINARY DESIGN	473
<i>Jochen Rendle, Stephan Staudacher</i>	
ASSESSING THE IMPACT OF CHANGES AND THEIR KNOCK-ON EFFECTS IN MANUFACTURING SYSTEMS	479
<i>Christian Plehn, Florian Stein, Richard De Neufville, Gunther Reinhart</i>	
AUGMENTING MILLING PROCESS DATA FOR SHAPE ERROR PREDICTION.....	487
<i>Berend Denkena, Marc-André Dittrich, Florian Uhlich</i>	

ANALYTICAL APPROACH FOR THE EXAMINATION OF THE FEASIBILITY OF REWORK IN FLOW ASSEMBLY LINES	492
<i>Wolf Tönnes, Johann Hegel, Engelbert Westkämper</i>	
A DATA-BASED APPROACH FOR QUALITY REGULATION	498
<i>Quoc Hao Ngo, Robert H. Schmitt</i>	
STATIC VERSUS DYNAMIC PROVISION OF WORKER INFORMATION IN MANUAL ASSEMBLY: A COMPARATIVE STUDY USING EYE TRACKING TO INVESTIGATE THE IMPACT ON PRODUCTIVITY AND ADDED VALUE BASED ON INDUSTRIAL CASE EXAMPLES	504
<i>Mario Lušić, Christian Fischer, Konrad Schmutzer Braz, Marina Alam, Rüdiger Hornfeck, Jörg Franke</i>	
USAGE FREQUENCY AND USER-FRIENDLINESS OF MOBILE DEVICES IN ASSEMBLY	510
<i>Susanne Vernim, Gunther Reinhart</i>	
TOWARDS FEATURE-BASED HUMAN-ROBOT ASSEMBLY PROCESS PLANNING	516
<i>Csaba Kardos, András Kovács, József Váncza</i>	
A NEW MODEL FOR SUSTAINABLE CHANGEABILITY AND PRODUCTION PLANNING	522
<i>S. Ghanei, T. Algeddawy</i>	
A RESEARCH ON OPTIMIZATION METHOD FOR INTEGRATING COMPONENT SELECTION AND PRODUCTION SCHEDULING UNDER MASS CUSTOMIZATION	527
<i>Shota Suginochi, Toshiya Kaihara, Daisuke Kokuryo, Swee Kuik</i>	
CUSTOMER-ORIENTED PRODUCTION SYSTEM FOR SUPPLIER COMPANIES IN CTO	533
<i>Patrick Dallasega, Peter Rally, Erwin Rauch, Dominik T. Matt</i>	
INTELLIGENT TOOLS FOR PREDICTIVE PROCESS CONTROL	539
<i>H.-C. Möhring, Q. P. Nguyen, A. Kuhlmann, C. Lerez, L. T. Nguyen, S. Misch</i>	
DETECTION OF WORKPIECE SHAPE DEVIATIONS FOR TOOL PATH ADAPTATION IN ROBOTIC DEBURRING SYSTEMS	545
<i>Alexander Kuss, Manuel Drust, Alexander Verl</i>	
ON A HUMAN AND DUAL-ARM ROBOT TASK PLANNING METHOD	551
<i>Panagiota Tsarouchi, Sotiris Makris, George Chryssolouris</i>	
THE USE OF ENGINEERING TOOLS AND METHODS IN MAINTENANCE ORGANISATIONS: MAPPING THE CURRENT STATE IN THE MANUFACTURING INDUSTRY	556
<i>Jon Bokrantz, Anders Skoogh, Torbjörn Ylipää</i>	
E-CATALOGUE LIBRARY OF MACHINES FOR CONSTRUCTING VIRTUAL PRINTED- CIRCUIT ASSEMBLY LINES	562
<i>Michiko Matsuda, Sota Matsumoto, Naoaki Noyama, Yasuhiro Sudo, Fumihiko Kimura</i>	
QUALITY MANAGEMENT FOR BATTERY PRODUCTION: A QUALITY GATE CONCEPT	568
<i>Joscha Schnell, Gunther Reinhart</i>	
VIRTUAL OPTIMISATION OF CAI PROCESS PARAMETERS FOR THE SCULPTURED SURFACE INSPECTION	574
<i>Tatjana V. Sibalića, Srdjan P. Zivkovic, Nikolaos A. Fountas, Vidosav D. Majstorovic, Jelena Z. Macuzic, Nikolaos M. Vaxevanidis</i>	
VIRTUAL METROLOGY CONCEPT FOR PREDICTING DEFECT LEVELS IN SEMICONDUCTOR MANUFACTURING	580
<i>A. Ul Haq, D. Djurdjanovic</i>	
METHOD FOR CLASSIFICATION OF BATTERY SEPARATOR DEFECTS USING OPTICAL INSPECTION	585
<i>J. Huber, C. Tammer, S. Krottil, S. Waidmann, X. Hao, C. Seidel, G. Reinhart</i>	
DEVELOPMENT OF SIMULATION SYSTEM FOR COMPLIANCE FUNCTION AND RESIDUAL STRESS MEASUREMENT FOR AL 2124-T851 PLATE	591
<i>Xiaoming Huang, Jie Sun, Chang'An Zhou, Jianfeng Li</i>	
BARRIERS TO LEAN IMPLEMENTATION: PERCEPTIONS OF TOP MANAGERS, MIDDLE MANAGERS AND WORKERS	595
<i>Eirin Lodgaard, Jonas A. Ingvaldsen, Inger Gamme, Silje Aschehoug</i>	
LINK MECHANISMS WITHIN THE LEAN ENTERPRISE	601
<i>Uwe Dombrowski, Philipp Krenkel, David Ebentreich</i>	
IMPACT ANALYSES OF LEAN PRODUCTION SYSTEMS	607
<i>U. Dombrowski, D. Ebentreich, P. Krenkel</i>	
THE ECO LEAN METHOD – A COMBINED APPROACH FOR LOW COST ECONOMIC AND ECOLOGIC OPTIMIZATION IN THE MANUFACTURING INDUSTRY	613
<i>Robert Mieke, Ivan Bogdanov, Ralph Schneider, Marius Hirsch, Thomas Bauernhansl, Elzbieta Pawlik, Remigiusz Horbal</i>	

DESIGNING MANUFACTURING DASHBOARDS ON THE BASIS OF A KEY PERFORMANCE INDICATOR SURVEY	619
<i>Henri Tokola, Christoph Gröger, Eeva Järvenpää, Esko Niemi</i>	
RECORDING SHOP FLOOR MANAGEMENT COMPETENCIES – A GUIDELINE FOR A SYSTEMATIC COMPETENCY GAP ANALYSIS	625
<i>C. Hertle, M. Tisch, H. Kläs, J. Metternich, E. Abele</i>	
GLOBAL TRUCK PRODUCTION – THE IMPORTANCE OF HAVING A ROBUST MANUFACTURING PREPARATION PROCESS	631
<i>Pierre E. C. Johansson, Frida Delin, Sofie Jansson, Lena Moestam, Åsa Fast-Berglund</i>	
ENERGY CONSUMPTION ESTIMATION FOR MACHINING PROCESSES BASED ON REAL-TIME SHOP FLOOR MONITORING VIA WIRELESS SENSOR NETWORKS	637
<i>Dimitris Mourtzis, Ekaterini Vlachou, Nikolaos Milas, George Dimitrakopoulos</i>	
MODE DECOUPLED CUTTING FORCE MONITORING BY APPLYING MULTI ENCODER BASED DISTURBANCE OBSERVER	643
<i>Yuki Yamada, Yasuhiro Kakinuma</i>	
DEVELOPMENT OF TURNING MACHINE OPERATION INTERFACE THAT USES HAPTIC DEVICE (APPLICATION TO COMPLICATED CUTTING BY SPECIAL BYTE)	649
<i>Koichi Morishige, Miharuru Nakada</i>	
BURR MINIMISATION IN FACE MILLING WITH OPTIMISED TOOL PATH	653
<i>György Póka, Gyula Mátyási, István Németh</i>	
SENSORLESS TOOL COLLISION DETECTION FOR MULTI-AXIS MACHINE TOOLS BY INTEGRATION OF DISTURBANCE INFORMATION	658
<i>Tetsuya Shigematsu, Ryo Koike, Yasuhiro Kakinuma, Tojiro Aoyama, Kouhei Ohnishi</i>	
PRODUCTION SUPPORT MODEL TO MANAGE MARKET DEMAND VOLATILITY RISKS	664
<i>Anders Johansson, Lars Pejryd, Linn Gustavsson Christiernin</i>	
RESOURCE OPTIMIZED PRODUCT DESIGN – ASSESSMENT OF A PRODUCT'S LIFE CYCLE RESOURCE EFFICIENCY BY COMBINING LCA AND PLM IN THE PRODUCT DEVELOPMENT	669
<i>Nathanael Ko, Roberta Graf, Tom Buchert, Marcus Kim, Daniel Wehner</i>	
MAINTENANCE DECISION SUPPORT FOR MANUFACTURING SYSTEMS BASED ON THE MINIMIZATION OF THE LIFE CYCLE COST	674
<i>Alice Reina, Ádám Kocsis, Angelo Merlo, István Németh, Francesco Aggogeri</i>	
A CALCULATION METHOD OF EMBODIED CARBON-ENERGY FOR LOW-CARBON PRODUCTS	680
<i>Qi Lu, Guanghui Zhou, Jiakai Zhu</i>	
UNDERSTANDING SUSTAINABILITY DATA THROUGH UNIT MANUFACTURING PROCESS REPRESENTATIONS: A CASE STUDY ON STONE PRODUCTION	686
<i>Laurie Rebouillat, Ilaria Barletta, Björn Johansson, Mahesh Mani, William Z. Bernstein, K. C Morris, Kevin W. Lyons</i>	
ENERGY FLEXIBLE MACHINE TOOL COMPONENTS – AN INVESTIGATION OF CAPABILITIES	692
<i>Richard S.-H. Popp, Corinna Liebl, Michael F. Zaeh</i>	
INVESTIGATION OF DEVIATIONS CAUSED BY POWDER COMPACTION DURING 3D PRINTING	698
<i>Christoph Schmutzler, Clarissa Boeker, Michael F. Zaeh</i>	
DISTRIBUTED MANUFACTURING OF SPARE PARTS BASED ON ADDITIVE MANUFACTURING: USE CASES AND TECHNICAL ASPECTS	704
<i>Luiz Fernando C. S. Durão, Alexander Christ, Reiner Anderl, Klaus Schützer, Eduardo Zancul</i>	
A DESIGN FRAMEWORK TO REPLACE CONVENTIONAL MANUFACTURING PROCESSES WITH ADDITIVE MANUFACTURING FOR STRUCTURAL COMPONENTS: A FORMULA STUDENT CASE STUDY	710
<i>Harry Bikas, John Stavridis, Panagiotis Stavropoulos, George Chrystolouris</i>	
A FRAMEWORK FOR INTEGRATION OF ADDITIVE MANUFACTURING TECHNOLOGIES IN PRODUCTION NETWORKS	716
<i>Patrik Spalt, Thomas Bauernhansl</i>	
OPERATION-ORIENTED ONE-PIECE-FLOW MANUFACTURING: AUTONOMOUS AND SMART SYSTEMS AS ENABLER FOR A FULL-MESHED PRODUCTION NETWORK	722
<i>Michael Scholz, Saskia Kolb, Christopher Kästle, Jörg Franke</i>	
DYNAMIC AGENT-BASED BI-OBJECTIVE ROBUSTNESS FOR TARDINESS AND ENERGY IN A DYNAMIC FLEXIBLE JOB SHOP	728
<i>Abdulaziz Alotaibi, Niels Lohse, Tuong Manh Vu</i>	

MANAGEMENT OF SOCIAL AND ETHICAL IMPACTS FROM THE PRODUCT LIFE CYCLE OF HIGH END WROUGHT ALUMINIUM PRODUCTS.....	734
<i>Silje Helene Aschehoug, Kjersti Øverbø Schulte, Marit Moe Bjørnbet</i>	
DISASSEMBLY LINE PLANNING THROUGH THE GENERATION OF END-OF-LIFE HANDLING INFORMATION FROM DESIGN FILES	740
<i>G. Pintzos, M. Matsas, N. Papakostas, D. Mourtzis</i>	
METHOD FOR ASSESSING THE TOTAL COST OF OWNERSHIP OF INDUSTRIAL ROBOTS	746
<i>Steffen Landscheidt, Mirka Kans</i>	
ENABLING ENERGY-FLEXIBILITY OF MANUFACTURING SYSTEMS THROUGH NEW APPROACHES WITHIN PRODUCTION PLANNING AND CONTROL.....	752
<i>Fabian Keller, Cedric Schultz, Stefan Braunreuther, Gunther Reinhart</i>	
IMPLEMENTING KEY PERFORMANCE INDICATORS FOR ENERGY EFFICIENCY IN MANUFACTURING.....	758
<i>Christopher Schmidt, Wen Li, Sebastian Thiede, Bernard Kornfeld, Sami Kara, Christoph Herrmann</i>	
THE INFLUENCE OF RAW MATERIAL ON THE WOOD PRODUCT MANUFACTURING.....	764
<i>Roaa Salim, Jimmy Johansson</i>	
INCREASING COST AND ECO EFFICIENCY FOR SELECTIVE TAPE PLACEMENT AND FORMING BY ADAPTIVE PROCESS DESIGN.....	769
<i>C. Brecher, R. Schmitt, F. Lindner, T. Peters, M. Emonts, M. Große Böckmann</i>	
INCREASING PRODUCTIVITY IN GRASPING ELECTRODES IN LITHIUM-ION BATTERY MANUFACTURING.....	775
<i>Robert Schröder, Arne Glodde, Muhammed Aydemir, Günther Seliger</i>	
INVESTIGATION ON DISTORTION MECHANISM AND CORRECTING LOAD CALCULATION METHOD FOR ALUMINUM BEAM STRUCTURE BY BILATERAL ROLLING PROCESS.....	781
<i>Laixiao Lu, Jie Sun</i>	
Author Index	