

29th International Conference on Flexible Automation and Intelligent Manufacturing (FAIM 2019)

Beyond Industry 4.0: Industrial Advances,
Engineering Education and Intelligent
Manufacturing

Procedia Manufacturing Volume 38

Limerick, Ireland
24 - 28 June 2019

Part 1 of 3

Editors:

Alan Ryan
Seamus Gordon
Peter Tiernan

ISBN: 978-1-7138-0764-3

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© (2019) The Authors. Published by Elsevier Ltd.
Creative Commons Attribution 4.0 International License.
License details: <http://creativecommons.org/licenses/by/4.0/>.

No changes have been made to the content of these proceedings. There may be changes to pagination, and minor adjustments for aesthetics.

Printed with permission by Curran Associates, Inc. (2020)

For permission requests, please contact the publisher:

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

PART 1

ADDITIVE, SUBTRACTIVE AND HYBRID MANUFACTURING

A CONTINUOUS PATH PLANNING APPROACH ON VORONOI DIAGRAMS FOR ROBOTICS AND MANUFACTURING APPLICATIONS	1
<i>Melih Özcan, Ulas Yaman</i>	
A STEP-NC IMPLEMENTATION APPROACH FOR ADDITIVE MANUFACTURING	9
<i>Efrain Rodriguez, Alberto Alvares</i>	
ADDITIVE MANUFACTURING OF PLA/HNT NANOCOMPOSITES FOR BIOMEDICAL APPLICATIONS	17
<i>Chaitra Venkatesh, Evert Fuenmayor, Patrick Doran, Ian Major, Declan M Devine</i>	
AUTONOMOUS PREFORMING SYSTEM: AUTOMATED AND SENSOR-AIDED HANDLING OF DRY CARBON FIBRE TEXTILES	25
<i>C. Frommel, M. Körber, M. Mayer, A. Schuster, L. Larsen</i>	
CHARACTERIZATION OF 3D-PRINTED CAPACITORS CREATED BY FUSED FILAMENT FABRICATION USING ELECTRICALLY-CONDUCTIVE FILAMENT	33
<i>Nebojsa I. Jaksic, Pratik D. Desai</i>	
GENERATION OF OPTIMIZED VORONOI BASED INTERIOR STRUCTURES FOR IMPROVED MECHANICAL PROPERTIES	42
<i>Anil Can Öncel, Ulas Yaman</i>	
INVESTIGATION OF VARIABLE BEAD WIDTHS IN FFF PROCESS	52
<i>Bahar Gharehpapagh, Melik Dolen, Ulas Yaman</i>	
USING ADDITIVE MANUFACTURING TO PRODUCE INJECTION MOULDS SUITABLE FOR SHORT SERIES PRODUCTION	60
<i>Conor Whlean, Con Sheahan</i>	

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

FRAMEWORK FOR SELECTION OF ERP SYSTEM: CASE STUDY	69
<i>O Alaskari, R. Pinedo-Cuenca, M.M. Ahmad</i>	
HUMAN-ROBOT COLLABORATIVE RECONFIGURABLE PLATFORM FOR SURFACE FINISHING PROCESSES	76
<i>Fabio Pini, Francesco Leali</i>	
MACHINE LEARNING AND PROCESS MINING APPLIED TO PROCESS OPTIMIZATION: BIBLIOMETRIC AND SYSTEMIC ANALYSIS	84
<i>Ederson Carvalhar Fernandes, Barry Fitzgerald, Liam Brown, Milton Borsato</i>	
A TAILORED MAINTENANCE MANAGEMENT SYSTEM TO CONTROL SPARE PARTS LIFE CYCLE	92
<i>R. Accorsi, A. Gallo, A. Tufano, M. Bortolini, R. Manzini</i>	
DATA-DRIVEN PREDICTION MODEL OF COMPONENTS SHIFT DURING REFLOW PROCESS IN SURFACE MOUNT TECHNOLOGY	100
<i>Irandoakht Parviziomran, Shun Cao, Haeyong Yang, Seungbae Park, Daehan Won</i>	
DYNAMIC PREDICTIVE MODELING OF SOLDER PASTE VOLUME WITH REAL TIME MEMORY UPDATE IN A STENCIL PRINTING PROCESS	108
<i>Hongya Lu, Haifeng Wang, Sang Won Yoon, Daehan Won, Seungbae Park</i>	
OPTIMIZING THE HARDNESS OF SLA PRINTED OBJECTS BY USING THE NEURAL NETWORK AND GENETIC ALGORITHM	117
<i>Guang Hu, Zhi Cao, Michael Hopkins, Conor Hayes, Declan M Devine</i>	
AUTOMATIC PROCESS MODELING WITH TIME DELAY NEURAL NETWORK BASED ON LOW-LEVEL DATA	125
<i>Giovanni Menegozzo, Diego Dall'Alba, Andrea Roberti, Paolo Fiorini</i>	
DIGITALIZED AUTOMATED WELDING SYSTEMS FOR WELD QUALITY PREDICTIONS AND RELIABILITY	133
<i>Emmanuel Afrane Gyasi, Paul Kah, Sakari Penttilä, Juho Ratava, Lin Sanbao</i>	

OBJECT DETECTION USING CONVOLUTIONAL NEURAL NETWORKS FOR SMART MANUFACTURING VISION SYSTEMS IN THE MEDICAL DEVICES SECTOR	142
<i>Kelly O'Brien, Jacqueline Humphries</i>	
INTELLIGENT INJECTION CURING OF BACON	148
<i>Mark P. Philipsen, Thomas B. Moeslund</i>	
INTELLIGENT PROCESS PLANNING FOR SMART MANUFACTURING SYSTEMS: A STATE-OF-THE-ART REVIEW	156
<i>Hossein Besharati-Foumani, Mika Lohtander, Juha Varis</i>	
MULTI-OBJECTIVE OPTIMIZATION APPROACH TO ENHANCE THE STENCIL PRINTING QUALITY	163
<i>Nourma Khader, Jaehwan Lee, Duk Lee, Sang Won Yoon, Haeyong Yang</i>	
SELF-LEARNING PROCESSES IN SMART FACTORIES: DEEP REINFORCEMENT LEARNING FOR PROCESS CONTROL OF ROBOT BRINE INJECTION	171
<i>Rasmus E. Andersen, Steffen Madsen, Alexander B.K. Barlo, Sebastian B. Johansen, Simon Bøgh</i>	
EDGE COMPUTING APPLIED TO INDUSTRIAL MACHINES	178
<i>Anderson Carvalho, Niall O' Mahony, Lenka Krpalkova, Sean Campbell, Pat Doody</i>	
ONE-SHOT LEARNING FOR CUSTOM IDENTIFICATION TASKS; A REVIEW	186
<i>N. O' Mahony, Sean Campbell, Anderson Carvalho, L. Krpalkova, J. Walsh</i>	
PRODUCTION FLOW CONTROL THROUGH THE USE OF REINFORCEMENT LEARNING	194
<i>Tomé Silva, Américo Azevedo</i>	

ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND INDUSTRY 4.0

DEVELOPMENT OF INVERS KINEMATIC METHOD FOR 6-DOF PARALLEL ROBOT USING ANALYTICAL APPROACH	203
<i>Hendriko Hendriko</i>	
METHODS AND CONCEPTS FOR ELABORATING A DECISION AIDED TOOL FOR OPTIMIZING HEALTHCARE MEDICINES DISPATCHING FLOWS	209
<i>Julia Cassim Pinheiro, Paul-Eric Dossou, Joao Chang Junior</i>	
STATISTICAL ANALYSIS FOR COMPONENT SHIFT IN PICK AND PLACE PROCESS OF SURFACE MOUNT TECHNOLOGY	217
<i>Shun Cao, Irandokht Parviziomran, Seungbae Park, Daehan Won</i>	
TOWARDS A ROBOT SIMULATION FRAMEWORK FOR E-WASTE DISASSEMBLY USING REINFORCEMENT LEARNING	225
<i>Christoffer B. Kristensen, Frederik A. Sørensen, Hjalte B. Nielsen, Martin S. Andersen, Simon Bøgh</i>	

BIG DATA ANALYTICS IN MANUFACTURING AND SERVICES

A DEEP LEARNING APPROACH FOR ANOMALY DETECTION WITH INDUSTRIAL TIME SERIES DATA: A REFRIGERATORS MANUFACTURING CASE STUDY	233
<i>Mattia Carletti, Chiara Masiero, Alessandro Beghi, Gian Antonio Susto</i>	
APPLICATION OF LEAN MANUFACTURING IN CONSTRUCTION MANAGEMENT	241
<i>Filipe d'S. Aureliano, Ariellen Ap. F. Costa, Ivan F. Júnior, Roger A. Rodrigues</i>	
DEEP LEARNING-BASED PRODUCTION FORECASTING IN MANUFACTURING: A PACKAGING EQUIPMENT CASE STUDY	248
<i>Luca Brunelli, Chiara Masiero, Diego Tosato, Alessandro Beghi, Gian Antonio Susto</i>	
INVENTORY MANAGEMENT AND COST REDUCTION OF SUPPLY CHAIN PROCESSES USING AI BASED TIME-SERIES FORECASTING AND ANN MODELING	256
<i>Umamaheswaran Praveen, Ganjezadeh Farnaz, Ghasib Hatim</i>	

BIOMANUFACTURING, BIOMATERIALS AND BIOTECHNOLOGIES

EVALUATION OF THE EXTENDED FINITE ELEMENT METHOD FOR THE ANALYSIS OF BONDED JOINTS WITH DIFFERENT GEOMETRIES	264
<i>V. Ramesh, R.D.S.G. Campilho, F.J.G. Silva, R.J.B. Rocha, S. Kumar</i>	
FRAMEWORK FOR ASSESSMENT OF OIL SPILL SITE REMEDIATION OPTIONS IN DEVELOPING COUNTRIES A LIFE CYCLE PERSPECTIVE	272
<i>Obiageli S. Ugwuoke, Chike F Oduoza</i>	

REFINING EARLY STAGE INTERVENTIONAL COMPOSITE CATHETER DESIGN	282
<i>Sean Lynn, Philip O'Malley, David Tanner, Sean Moore</i>	
SELF-DESCRIPTION OF CYBER-PHYSICAL PRODUCTION MODULES FOR A PRODUCT-DRIVEN MANUFACTURING SYSTEM	291
<i>Jesko Hermann, Pascal Rübel, Max Birtel, Florian Mohr, Martin Ruskowski</i>	

CELLULAR MANUFACTURING DESIGN AND CONTROL

OPTIMAL NUMBER OF CELLS FOR A PART FAMILY IN A STOCHASTIC DEMAND ENVIRONMENT.....	299
<i>Omar Alhawari, Gürsel Süer</i>	
CELLULAR DEMANUFACTURING LAYOUT IN A RAIL INDUSTRY: END-OF- LIFE COMPONENTS REUSABILITY.....	307
<i>Humbulani Simon Phuluwa, Khumbulani Mpofo, Johh Alfred Trimble</i>	
THE IMPACT OF LEAN IMPROVEMENTS ON COST-TIME PROFILE	316
<i>Danijela Gračanin, Danijela Ćirić, Bojan Lalić, Jelena Ćurčić, Nemanja Tasić</i>	
DESIGNING A NOVEL AND GREENER TRUCK ASPHALT CONTAINER.....	324
<i>P.V. Lopes, F.J.G. Silva, R.D.S.G. Campilho, F. de Almeida</i>	

COLLABORATIVE ROBOTICS IN SMART MANUFACTURING

A DUAL-ARM COLLABORATIVE ROBOT SYSTEM FOR THE SMART FACTORIES OF THE FUTURE.....	333
<i>Jens F. Buhl, Rune Grønhoj, Jan K. Jørgensen, Guilherme Mateus, Dimitrios Chrysostomou</i>	
AN APPLICATION OF COLLABORATIVE ROBOTS IN A FOOD PRODUCTION FACILITY	341
<i>R. Accorsi, A. Tufano, A. Gallo, F.G. Galizia, R. Manzini</i>	
A ROS2 BASED COMMUNICATION ARCHITECTURE FOR CONTROL IN COLLABORATIVE AND INTELLIGENT AUTOMATION SYSTEMS	349
<i>Endre Erős, Martin Dahl, Kristofer Bengtsson, Atieh Hanna, Petter Falkman</i>	
AN EVALUATION METHODOLOGY FOR THE CONVERSION OF MANUAL ASSEMBLY SYSTEMS INTO HUMAN-ROBOT COLLABORATIVE WORKCELLS.....	358
<i>Luca Gualtieri, Erwin Rauch, Renato Vidoni, Dominik T. Matt</i>	
DISTRIBUTED SOFTWARE ARCHITECTURE FOR AGVS FOR SEPARATION OF DYNAMIC AND STATIC OBSTACLES	367
<i>Michael Scholz, Markus Lieret, Marc Bigott, Jörg Franke</i>	
HUMAN-ROBOT COLLABORATION AS A NEW PARADIGM IN CIRCULAR ECONOMY FOR WEEE MANAGEMENT	375
<i>Arantxa Renteria, Esther Alvarez-de-los-Mozos</i>	
TOWARDS THE DEMOCRATISATION OF DESIGN: THE IMPLEMENTATION OF METAHEURISTIC SEARCH STRATEGIES TO ENABLE THE AUTO-ASSIGNMENT OF MANUFACTURING PARAMETERS FOR FDM.....	383
<i>Mark Goudswaard, Aydin Nassehi, Ben Hicks</i>	
UNIVERSAL INDUSTRIAL INTERFACE - MOBILE	391
<i>Andreea Ciontos, Ioan-Matei Sarivan, Casper Schou</i>	
THE MOBILE ROBOT ANTI-DISTURBANCE VSLAM NAVIGATION ALGORITHM BASED ON RBF NEURAL NETWORK	400
<i>S.F. Wong, Z. Yu</i>	
OBJECT RECOGNITION WITHIN SMART MANUFACTURING	408
<i>Andrew D O' Riordan, Daniel Toal, Thomas Newe, Gerard Dooly</i>	
INSTRUMENTED TOOL BASED ROBOT PROGRAMMING - PARAMETERIZATION OF SCREWING PROCESS MACROS	415
<i>Markus Ikeda, Markus Ganglbauer, Prateek Ashok, Srinivas Maddukuri, Andreas Pichler</i>	

DESIGN AND MANUFACTURING OF PERSONALISED PRODUCTS

BÉZIER CURVE BASED CONTINUOUS AND SMOOTH MOTION PLANNING FOR SELF-LEARNING INDUSTRIAL ROBOTS	423
<i>Christian Scheiderer, Timo Thun, Tobias Meisen</i>	

A CONCEPTUAL FRAMEWORK FOR CYBER-PHYSICAL SYSTEM IN CONNECTED RSW WELDABILITY CERTIFICATION	431
<i>Fahim Ahmed, Noor-E Jannat, Saeed Z. Gavidel, Jeremy Rickli, Kyoung-Yun Kim</i>	
AN FNLP APPROACH FOR PLANNING ENERGY-EFFICIENT MANUFACTURING: WAFER FABRICATION AS AN EXAMPLE	439
<i>Yi-Chi Wang, Tin-Chih Toly Chen</i>	
A BOOSTING-BASED INTELLIGENT MODEL FOR STENCIL CLEANING PREDICTION IN SURFACE MOUNT TECHNOLOGY	447
<i>Haifeng Wang, Hongya Lu, Daehan Won, Sang Won Yoon, Krishnaswami Srihari</i>	
TOWARDS THE DEVELOPMENT OF INTERFACES FOR STUDENTS WITH SPEECH DISORDER AND MOTOR IMPAIRMENTS	455
<i>Francesco Davide Cascone, Massimo Martorelli, Antonio Gloria, Stefano Papa, Antonio Lanzotti</i>	
MANUFACTURE OF STRUCTURAL BLOCKS OF CONCRETE WITH WASTE TIRE RUBBERS	464
<i>Filipe d'S. Aureliano, Ariellen Ap. F. Costa, Ivan F. Júnior, Rafael d' O. Pedrosa</i>	
FROM EGOSYSTEM TO ECOSYSTEM: HOW A 150-YEAR OLD MANUFACTURING FIRM IS TAKING ON THE WORLD OF INTERNET OF THINGS	471
<i>Victor Centerholt, Sandra Mattsson, Frank Rälg</i>	
USING SERIOUS GAMES TO INFORM MASS CUSTOMIZATION PRODUCTION METHODS FROM THE FUZZY FRONT-END OF NEW PRODUCT DEVELOPMENT	478
<i>Michael O'Sullivan, Con Sheahan</i>	

DIGITAL CYBER AND CLOUD MANUFACTURING

AN AUTOMATIC PROCEDURE BASED ON VIRTUAL ERGONOMIC ANALYSIS TO PROMOTE HUMAN-CENTRIC MANUFACTURING	488
<i>Grandi Fabio, Peruzzini Margherita, Zanni Luca, Pellicciari Marcello</i>	
QUALITY ASSURANCE AND PROCESS CONTROL IN VIRTUAL REALITY	497
<i>J. Ratava, S. Penttilä, H. Lund, M. Lohtander, J. Varis</i>	
SIMULATION BASED DRAPING OF DRY CARBON FIBRE TEXTILES WITH COOPERATING ROBOTS	505
<i>A. Schuster, C. Frommel, D. Deden, L. Brandt, L. Larsen</i>	
ON SEMANTIC INTEROPERABILITY OF MODEL-BASED DEFINITION OF PRODUCT DESIGN	513
<i>Arkopaul Sarkar, Dušan Šormaz</i>	
EXPLORATION OF TWO SAFETY STRATEGIES IN HUMAN-ROBOT COLLABORATIVE MANUFACTURING USING VIRTUAL REALITY	524
<i>George-Christopher Vosniakos, Lucas Ouillon, Elias Matsas</i>	
CYBERSECURITY CONCERNS FOR TOTAL PRODUCTIVE MAINTENANCE IN SMART MANUFACTURING SYSTEMS	532
<i>Alireza Zarreh, HungDa Wan, Yooneun Lee, Can Saygin, Rafid Al Janahi</i>	
STEPS TOWARDS DIGITIZATION OF MANUFACTURING IN AN SME ENVIRONMENT	540
<i>Frank Doyle, John Cosgrove</i>	
A MAAS PLATFORM ARCHITECTURE SUPPORTING DATA SOVEREIGNTY IN SUSTAINABILITY ASSESSMENT OF MANUFACTURING SYSTEMS	548
<i>Giuseppe Landolfi, Andrea Barni, Gabriele Izzo, Alessandro Fontana, Andrea Bettoni</i>	

ENGINEERING AND MANUFACTURING METHODS AND TOOLS FOR INDUSTRY

4.0

A DIMENSION REDUCTION METHOD FOR EFFICIENT OPTIMIZATION OF MANUFACTURING PERFORMANCE	556
<i>Ananda Chakraborti, Hari P.N. Nagarajan, Suraj Panicker, Hossein Mokhtarian, Kari T. Koskinen</i>	
FLEXIBLE CALIBRATION OF A STEREO VISION SYSTEM BY ACTIVE DISPLAY	564
<i>Sandro Barone, Paolo Neri, Alessandro Paoli, Armando Viviano Razionale</i>	
DEVELOPMENT OF A NEW FRAMEWORK FOR IMPLEMENTING INDUSTRY 4.0 IN COMPANIES	573
<i>Paul-Eric Dossou</i>	
A DYNAMIC PROGRAMMING MODEL FOR DESIGNING A QUALITY CONTROL PLAN IN A MANUFACTURING PROCESS	581
<i>Eusébio Nunes, Sérgio Sousa</i>	

RECONFIGURATION PROTOCOLS FOR EMBEDDED AGENTS IN WIRELESS CONTROL NETWORKS	589
<i>Mohammed S. Taboun, Robert W. Brennan</i>	
RECONFIGURABLE INSPECTION ROBOT FOR INDUSTRIAL APPLICATIONS	597
<i>A. Pistone, C. Canali, C. Gloriani, S. Leggieri, D.G. Caldwell</i>	
RISK ASSESSMENT FOR CYBER SECURITY OF MANUFACTURING SYSTEMS: A GAME THEORY APPROACH	605
<i>Alireza Zarreh, HungDa Wan, Yooneun Lee, Can Saygin, Rafid Al Janahi</i>	
A DMS TO SUPPORT INDUSTRIAL PROCESS DECISION-MAKING: A CONTRIBUTION UNDER INDUSTRY 4.0	613
<i>M.T. Pereira, A. Silva, L.P. Ferreira, J.C. Sá, F.J.G. Silva</i>	

PART 2

ASSESSMENT OF INNOVATIVENESS LEVEL FOR CHOSEN SOLUTIONS RELATED TO LOGISTICS 4.0	621
<i>Mariusz Kostrzewski, Monika Kosacka-Olejnik, Karolina Werner-Lewandowska</i>	
STATIC STRENGTH IMPROVEMENT OF TUBULAR ALUMINIUM ADHESIVE JOINTS BY THE OUTER CHAMFERING TECHNIQUE	629
<i>L.R.F. Ferreira, R.D.S.G. Campilho, D.R. Barbosa, R.J.B. Rocha, F.J.G. Silva</i>	
A STRATEGIC MODEL TO TAKE THE FIRST STEP TOWARDS INDUSTRY 4.0 IN SMES	637
<i>B. Pinto, F.J.G. Silva, T. Costa, R.D.S.G. Campilho, M.T. Pereira</i>	
A REVIEW OF INTEROPERABILITY STANDARDS FOR INDUSTRY 4.0.	646
<i>Thomas Burns, John Cosgrove, Frank Doyle</i>	

ENGINEERING EDUCATION

A SIMPLIFIED CHANGEABLE LEARNING FACTORY DESIGN BASED ON A GRANULARITY COMPLEXITY MODEL	654
<i>Tarek AlGeddawy</i>	
A MULTIPURPOSE SMALL-SCALE SMART FACTORY FOR EDUCATIONAL AND RESEARCH ACTIVITIES	663
<i>Andrea Ferrario, Matteo Confalonieri, Andrea Barni, Gabriele Izzo, Paolo Pedrazzoli</i>	
DIVERSITY IN ENGINEERING STUDENTS: DO THEY HAVE DIFFERENT EXPECTATIONS OF THEIR LEARNING EXPERIENCE?	671
<i>Nancy Nelson, Robert W. Brennan</i>	
DEVELOPING CDIO PRACTITIONERS: A SYSTEMATIC APPROACH TO STANDARD 10	680
<i>Jason Power, David Tanner, Alan Ryan, Brian Devitt</i>	
NEW MOTION CONTROL MACHINE ELEMENTS REPRESENTATION FOR MECHATRONIC EDUCATION	686
<i>Julio Garrido Campos, David Santos Esterán</i>	
DIMENSIONAL ANALYSIS	694
<i>John F. Mahoney, Sencer Yeralan</i>	
SURVEY ON ARTIFICIAL INTELLIGENCE (AI) APPLIED IN WELDING: A FUTURE SCENARIO OF THE INFLUENCE OF AI ON TECHNOLOGICAL, ECONOMIC, EDUCATIONAL AND SOCIAL CHANGES	702
<i>Emmanuel Afrane Gyasi, Heikki Handroos, Paul Kah</i>	
DESIGNING A NOVEL SYSTEM FOR THE INTRODUCTION OF LUBRICANT IN CONTROL CABLES FOR THE AUTOMOTIVE INDUSTRY	715
<i>R. Ribeiro, F.J.G. Silva, A.G. Pinto, R.D.S.G. Campilho, H.A. Pinto</i>	

ENTERPRISE KNOWLEDGE MANAGEMENT

PROCESS SEQUENCING FOR FEATURES WITH MULTIPLE PROCESSING REQUIREMENTS	726
<i>Dušan Šormaz, Arkopaul Sarkar</i>	
HIDDEN PRODUCT KNOWLEDGE: PROBLEMS AND POTENTIAL SOLUTIONS	735
<i>Lauri Jokinen, Simo-Pekka Leino</i>	

APPLICATION OF THE A3 METHODOLOGY FOR THE IMPROVEMENT OF AN ASSEMBLY LINE	745
<i>J. Pereira, F.J.G. Silva, J.A. Bastos, L.P. Ferreira, J.C.O. Matias</i>	
MAPPING OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEMS IN PORTUGAL: OUTLOOK FOR ISO 45001:2018 ADOPTION	755
<i>L. Morgado, F.J.G. Silva, L.M. Fonseca</i>	

INNOVATIVE MANUFACTURING PROCESSES

THE IMPACT OF THE APPLICATION OF LEAN TOOLS FOR IMPROVEMENT OF PROCESS IN A PLASTIC COMPANY: A CASE STUDY	765
<i>P. Ribeiro, J.C. Sá, L.P. Ferreira, F.J.G. Silva, G. Santos</i>	
A FUZZY-BASED APPROACH TO IMPROVE THE HUMAN PICK-TO-LIGHT EFFICIENCY INCORPORATED WITH ROBOTS BEHAVIOR IN AN INTELLIGENT DISTRIBUTION CENTER	776
<i>Teng-Sheng Su, Su-Shiang Lee, Wei-Hsun Hsu, Shan-Heng Fu</i>	
RE-DESIGN OF A PACKAGING MACHINE EMPLOYING LINEAR SERVOMOTORS: A DESCRIPTION OF MODELLING METHODS AND ENGINEERING TOOLS	784
<i>Giovanni Berselli, Pietro Bilancia, Luca Bruzzone, Pietro Fanghella</i>	
SIMULATOR OF AN ADDITIVE AND SUBTRACTIVE TYPE OF HYBRID MANUFACTURING SYSTEM	792
<i>Ugur M Dilberoglu, Vahid Haseltalab, Ulas Yaman, Melik Dolen</i>	

INNOVATIVE MANUFACTURING SYSTEMS

APPLICATION OF MULTIVARIATE STATISTICAL ANALYSIS FOR CNC MILLING OF LARGE TI-6AL-4V COMPONENTS	800
<i>L. Asensio Dominguez, A. Shokrani, J.M. Flynn, V. Dhokia, S.T. Newman</i>	
AUTOMATED PLANNING AND OPTIMIZATION OF A DRAPING PROCESSES WITHIN THE CATIA ENVIRONMENT USING A PYTHON SOFTWARE TOOL	808
<i>M. Körber, C. Frommel</i>	
ASSESSMENT OF METAL CUTTING TOOLS USING COST PERFORMANCE RATIO AND TOOL LIFE ANALYSES	816
<i>Daniel Johansson, Rebecka Lindvall, Christina Windmark, Rachid M'Saoubi, Jan-Eric Ståhl</i>	
LOW-COST 3D SCANNING IN A SMART LEARNING FACTORY	824
<i>Christian P. Nielsen, Ali A. Malik, David G. Hansen, Arne Bilberg</i>	

INNOVATIVE MANUFACTURING SYSTEMS AND SERVICES

INSUFFICIENT KNOWLEDGE IN INDUSTRIAL DIGITALIZATION – PROMISING PERSPECTIVE FROM FEMALE SUPPLIERS	832
<i>Sandra Mattsson, Victor Centerholt, Peter Bryntesson, Gabriella Banehag</i>	
REMOTE ACOUSTIC ANALYSIS FOR TOOL CONDITION MONITORING	840
<i>James Coady, Daniel Toal, Thomas Neue, Gerard Dooly</i>	
A NOVEL CONCEPT OF A CONDUIT TRANSPORT SYSTEM	848
<i>P.R. Santos, F.J.G. Silva, R.D.S.G. Campilho, G.F.L. Pinto, A. Baptista</i>	
IDENTIFICATION OF RESOURCES AND PARTS IN A PLUG AND PRODUCE SYSTEM USING OPC UA	858
<i>Mattias Bennulf, Fredrik Danielsson, Bo Svensson</i>	
ROBOT-ASSISTED CONCEPT FOR ASSEMBLING FORM COILS IN LAMINATED STATOR CORES OF LARGE ELECTRIC MOTORS	866
<i>Alexander Mahr, Andreas Mayr, Timo Jung, Jörg Franke</i>	
RETHINKING MODULAR JIGS’ DESIGN REGARDING THE OPTIMIZATION OF MACHINING TIMES	876
<i>S. Kumar, R.D.S.G. Campilho, F.J.G. Silva</i>	
SITUATIONAL COGNITIVE ASSISTANCE SYSTEM IN REWORK AREA	884
<i>Rainer Müller, Leenhard Hörauf, Christoph Speicher, Attique Bashir</i>	

LEAN AND AGILE MANUFACTURING

OPTIMIZATION OF THE COLD PROFILING PROCESS THROUGH SMED	892
<i>T. Vieira, J.C. Sá, M.P. Lopes, G. Santos, M.T. Pereira</i>	
INTERACTIONS OF LEAN ENABLERS IN MANUFACTURING SMES USING INTERPRETIVE STRUCTURAL MODELLING APPROACH - A CASE STUDY OF KRI	900
<i>I.S. Mohammad, C.F. Oduoza</i>	
A TPM STRATEGY IMPLEMENTATION IN AN AUTOMOTIVE PRODUCTION LINE THROUGH LOSS REDUCTION	908
<i>M.D.O. dos Reis, R. Godina, C. Pimentel, F.J.G. Silva, J.C.O. Matias</i>	
SIMULATION OF THE STOCHASTIC ONE-DIMENSIONAL CUTTING STOCK PROBLEM TO MINIMIZE THE TOTAL INVENTORY COST	916
<i>Hüseyin Sarper, Nebojsa I. Jaksic</i>	
PROCESS IMPROVEMENT IN THE METALLIC MESH CUTTING OPERATION ASSOCIATED TO TIRE MANUFACTURING	924
<i>J.C.M de Sousa, R.D.S.G. Campilho, F.J.G. Silva, P.M.M. dos Santos</i>	
SCREWING PROCESS ANALYSIS USING MULTIVARIATE STATISTICAL PROCESS CONTROL	932
<i>Humberto Nuno Teixeira, Isabel Lopes, Ana Cristina Braga, Pedro Delgado, Cristina Martins</i>	
COMPARISON OF DIFFERENT TEST CONFIGURATIONS FOR THE SHEAR FRACTURE TOUGHNESS EVALUATION OF A DUCTILE ADHESIVE	940
<i>A.J.S. Leal, R.D.S.G. Campilho, F.J.G. Silva, D.F.O. Silva, F.J.P. Moreira</i>	

LEAN AND SIX SIGMA

THE WAY LEAN STARTS – A DIFFERENT APPROACH TO INTRODUCE LEAN CULTURE AND CHANGING PROCESS WITH PEOPLE’S INVOLVEMENT	948
<i>RF Mascarenhas, C Pimentel, MJ Rosa</i>	
SUPPORT METHODOLOGY FOR PRODUCT QUALITY ASSURANCE: A CASE STUDY IN A COMPANY OF THE AUTOMOTIVE INDUSTRY	957
<i>T.A. Cepeda, I.S. Lopes</i>	
IMPROVING IN-PLANT LOGISTICS FLOW BY PHYSICAL AND DIGITAL PATHWAYS	965
<i>T. Tellini, F.J.G. Silva, T. Pereira, L. Morgado, L.P. Ferreira</i>	
IMPLEMENTATION OF LEAN METHODOLOGIES IN THE MANAGEMENT OF CONSUMABLE MATERIALS IN THE MAINTENANCE WORKSHOPS OF AN INDUSTRIAL COMPANY	975
<i>Tomé Pombal, Luís Pinto Ferreira, J.C. Sá, Maria Teresa Pereira, F.J.G. Silva</i>	

MANUFACTURING ERGONOMICS AND HUMAN FACTORS

INTELLIGENT MATERIAL SUPPLY SUPPORTING ASSISTIVE SYSTEMS FOR MANUAL WORKING STATIONS	983
<i>Patrick Bertram, William Motsch, Pascal Rübel, Martin Ruskowski</i>	
DESIGN OF A MODULAR SOLUTION FOR AN AUTONOMOUS VEHICLE FOR CARGO TRANSPORT AND HANDLING	991
<i>H.D.B.C.L. de Oliveira, R.D.S.G. Campilho, F.J.G. Silva</i>	
FUTUREFIT: A STRATEGY FOR GETTING A PRODUCTION ASSET TO AN INDUSTRY 4.0 COMPONENT – A HUMAN-CENTERED APPROACH	1000
<i>Max Birtel, Alexander David, Jesko Hermann, Florian Mohr, Martin Ruskowski</i>	
AN EXAMINATION OF WATER QUALITY ENTERING IRISH DAIRY PROCESSORS	1008
<i>E. O’Connor, A. Ryan, P. Cronin</i>	
DEVELOPMENT OF A DLP 3D PRINTER FOR ORTHODONTIC APPLICATIONS	1017
<i>Sandro Barone, Paolo Neri, Alessandro Paoli, Armando V. Razonale, Francesco Tamburrino</i>	
THE ANALYSIS OF TOOL WEAR MECHANISMS IN THE MACHINING OF PRE-SINTERED ZIRCONIA DENTAL CROWNS	1026
<i>David Irvine, Wan Tsin Goh, Farid Dailami, Jason Matthews</i>	
USING LEAN MANUFACTURING AND MACHINE LEARNING FOR IMPROVING MEDICINES PROCUREMENT AND DISPATCHING IN A HOSPITAL	1034
<i>Kaio Jordon, Paul-Eric Dossou, Joao Chang Junior</i>	

MANUFACTURING OPERATIONS, SUPPLY CHAIN AND LOGISTICS

MATHEMATICAL MODELLING OF PRODUCTS ALLOCATION TO CUSTOMERS FOR SEMICONDUCTOR SUPPLY CHAIN	1042
<i>Behrouz Alizadeh Mousavi, Radhia Azzouz, Cathal Heavey</i>	
REDUCTION OF SCRAP PERCENTAGE OF CAST PARTS BY OPTIMIZING THE PROCESS PARAMETERS	1050
<i>R. Chandrasekaran, R.D.S.G. Campilho, F.J.G. Silva</i>	
LOGISTICS 4.0 MATURITY IN SERVICE INDUSTRY: EMPIRICAL RESEARCH RESULTS	1058
<i>Karolina Werner-Lewandowska, Monika Kosacka-Olejnik</i>	
THERE IS LOGIC IN LOGIT – INCLUDING WEAR RATE IN COLDING’S TOOL WEAR MODEL	1066
<i>Sampsa V.A. Laakso, Daniel Johansson</i>	
IMPROVING EFFICIENCY IN A HYBRID WAREHOUSE: A CASE STUDY	1074
<i>Andreia M. Freitas, F.J.G. Silva, L.P. Ferreira, J.C. Sá, J. Pereira</i>	
DEVELOPMENT OF A DIGITAL PERFORMANCE ASSESSMENT MODEL FOR QUEBEC MANUFACTURING SMES	1085
<i>Sébastien Gamache, Georges Abdul-Nour, Chantal Baril</i>	
AUTOMATIC GENERATION OF DIGITAL TWIN INDUSTRIAL SYSTEM FROM A HIGH LEVEL SPECIFICATION	1095
<i>Julio Garrido Campos, Juan Sáez López, José Ignacio Armesto Quiroga, Angel Manuel Espada Seoane</i>	

MANUFACTURING PROCESSES AND TECHNOLOGY

REAL-TIME MANUFACTURING OPTIMIZATION WITH A SIMULATION MODEL AND VIRTUAL REALITY	1103
<i>Ojstersek Robert, Palcic Iztok, Buchmeister Borut</i>	
IMPROVING THE CUT SURFACE QUALITY BY OPTIMIZING PARAMETERS IN THE FIBRE LASER CUTTING PROCESS	1111
<i>I. Amaral, F.J.G. Silva, G.F.L. Pinto, R.D.S.G. Campilho, R.M. Gouveia</i>	
INFLUENCE OF THE NATURAL ADDITIVE ON NATURAL FIBER REINFORCED THERMOPLASTIC COMPOSITE	1121
<i>D.K. Selvaraj, F.J.G. Silva, R.D.S.G. Campilho, A. Baptista, G.F.L. Pinto</i>	
DEVELOPMENT OF THE CONSTRUCTION SCHEDULING BASED ON FUZZY DISCRETE EVENT SIMULATION FOR A TFT-LCD PLANT	1130
<i>Teng-Sheng Su, Luh-Maan Chang</i>	
IMPACT OF CONFORMAL COATING MATERIAL ON THE LONG-TERM RELIABILITY OF BALL GRID ARRAY SOLDER JOINTS	1138
<i>Abid-Alrahman Fawzi Abbas, Christopher M. Greene, Krishnaswami Srihari, Daryl Santos, Ganesh Pandiarajan</i>	
CHALLENGES IN RIVETING QUALITY PREDICTION: A LITERATURE SURVEY	1143
<i>Kyoung-Yun Kim, Jaemun Sim, Noor-E Jannat, Fahim Ahmed, Sattar Ameri</i>	
EXPERIENCES AND EXPECTATIONS OF COLLABORATIVE ROBOTS IN INDUSTRY AND ACADEMIA: BARRIERS AND DEVELOPMENT NEEDS	1151
<i>Ina Aaltonen, Timo Salmi</i>	
A NOVEL METHOD USING DS-MCM FOR EQUIPMENT HEALTH PROGNOSIS WITH PARTIALLY OBSERVED INFORMATION	1159
<i>Qinming Liu, Ming Dong, F. Frank Chen, Yongpeng Li, Haoxiang Wang</i>	

MANUFACTURING SYSTEM DESIGN AND ANALYSIS

CONSUMER IMPACT ON SUPPLY CHAIN SUSTAINABILITY	1167
<i>Zlatan Mujkić, Saranda Gashi, Šehida Hamidović</i>	
DEVELOPING KNOWLEDGE ON DIGITAL MANUFACTURING TO DIGITAL TWIN: A BIBLIOMETRIC AND SYSTEMIC ANALYSIS	1174
<i>Suewellyn Krüger, Milton Borsato</i>	
PROJECT MANAGEMENT DURING THE INDUSTRY 4.0 IMPLEMENTATION WITH RISK FACTOR ANALYSIS	1181
<i>Martin Hirman, Andrea Benesova, Frantisek Steiner, Jiri Tupa</i>	

COMPARATIVE EVALUATION OF ADHESIVELY-BONDED SINGLE-LAP AND STEPPED-LAP JOINTS	1189
<i>J.O.S. Silva, R.D.S.G. Campilho, R.J.B. Rocha, F.J.G. Silva</i>	
MATHEMATICAL MODEL FOR MAINTENANCE PLANNING OF MACHINE TOOLS	1197
<i>C.R. Pires, I.S. Lopes, L.P. Basto</i>	
INTEGRATED INSPECTION SYSTEM STEP-COMPLIANT FOR THE EXCHANGE OF DIMENSIONAL METROLOGY DATA	1205
<i>Cristhian I. Riaño Jaimes, Alberto J. Alvares</i>	
USING OPEN-SOURCE MICROCONTROLLERS TO ENABLE DIGITAL TWIN COMMUNICATION FOR SMART MANUFACTURING	1213
<i>E.P. Hinchy, N.P. O'Dowd, C.T. McCarthy</i>	
LOCALIZATION SYSTEM FOR OPTIMIZATION OF PICKING IN A MANUAL WAREHOUSE	1220
<i>M.T. Pereira, J.M.C. Sousa, L.P. Ferreira, J.C. Sá, F.J.G. Silva</i>	
ADVANCES IN MACHINE VISION FOR FLEXIBLE FEEDING OF ASSEMBLY PARTS	1228
<i>Ali Ahmad Malik, Martin Vejling Andersen, Arne Bilberg</i>	

PART 3

NANOFILLERS CAN BE USED TO ENHANCE THE THERMAL CONDUCTIVITY OF COMMERCIALY AVAILABLE SLA RESINS	1236
<i>Guang Hu, Zhi Cao, Michael Hopkins, John G Lyons, Declan M Devine</i>	
EFFECT OF MATERIAL HYBRIDIZATION ON THE STRENGTH OF SCARF ADHESIVE JOINTS	1244
<i>D.L. Alves, R.D.S.G. Campilho, R.D.F. Moreira, F.J.G. Silva, M.G. Cardoso</i>	
FRACTURE ENVELOPE ESTIMATION OF A STRUCTURAL ADHESIVE BY DEDICATED FRACTURE TESTS	1252
<i>F.A.A. Nunes, R.D.S.G. Campilho, M.G. Cardoso, F.J.G. Silva</i>	
PREDICTING REMAINING LIFETIME USING THE MONOTONIC GAMMA PROCESS AND BAYESIAN INFERENCE FOR MULTI-STRESS CONDITIONS	1260
<i>Shah Limon, Om Prakash Yadav</i>	
COMPARATIVE EVALUATION OF DIFFERENT FRACTURE TESTS FOR THE TENSILE FRACTURE TOUGHNESS OF A DUCTILE ADHESIVE	1268
<i>J.M.D. Teixeira, R.D.S.G. Campilho, F.J.G. Silva, F.J.P. Moreira, D.F.O. Silva</i>	

MODELLING AND SIMULATION OF MANUFACTURING AND SERVICES

AUTOMATED HANDLING OF AUXILIARY MATERIALS USING A MULTI-KINEMATIC GRIPPING SYSTEM	1276
<i>Michael Vistein, Jan Faber, Clemens Schmidt-Eisenlohr, Daniel Reiter</i>	
A BUSINESS MODEL TO IMPLEMENT CLOSED-LOOP MATERIAL FLOW IN IOT-ENABLED ENVIRONMENTS	1284
<i>Alperen Bal, Fazleena Badurdeen</i>	
A 6-DOF HAPTIC MANIPULATION SYSTEM TO VERIFY ASSEMBLY PROCEDURES ON CAD MODELS	1292
<i>Paolo Tripicchio, Carlo Alberto Avizzano, Massimo Bergamasco</i>	
AUTOMATED PRODUCTION OF LARGE FIBRE METAL LAMINATE AIRCRAFT STRUCTURE PARTS	1300
<i>Michael Vistein, Dominik Deden, Roland Glück, Stefan Schneyer</i>	
CONTROL OF HVAC-SYSTEMS WITH SLOW THERMODYNAMIC USING REINFORCEMENT LEARNING	1308
<i>C. Blad, S. Koch, S. Ganeswarathas, C.S. Kallesøe, S. Bøgh</i>	
DESIGN OF AUTOMATED EQUIPMENT FOR THE ASSEMBLY OF AUTOMOTIVE PARTS	1316
<i>N.F.M. Veiga, R.D.S.G. Campilho, F.J.G. da Silva, P.M.M. Santos, P.V. Lopes</i>	
COMPUTATIONAL FLUID DYNAMICS (CFD): BEHAVIORAL STUDY AND OPTIMIZATION OF THE BLADES NUMBER OF A RADIAL FAN	1324
<i>Filipe d'S. Aureliano, Luiz Carlos V. Guedes</i>	
DIGITALIZATION IN SEMICONDUCTOR MANUFACTURING- SIMULATION FORECASTER APPROACH IN MANAGING MANUFACTURING LINE PERFORMANCE	1330
<i>Farhain Misrudin, Lee Ching Foong</i>	

PRECISION MANUFACTURING

INFLUENCE OF DYNAMIC TEMPERATURE CONTROL ON THE INJECTION MOLDING PROCESS OF PLASTIC COMPONENTS	1338
<i>Cláudia Macedo, Cláudia Freitas, António M. Brito, Gilberto Santos, Ricardo Simoes</i>	
CREATING DETAILED SHAPES ON THE MOULDING TOOL SURFACES WITH DIFFERENT MANUFACTURING TECHNIQUES	1347
<i>Panu Tanninen, Ville Leminen, Sami Matthews, Antti Pesonen, Juha Varis</i>	
DEXTEROUS GRIPPER FOR IN-HAND MANIPULATION WITH EMBEDDED OBJECT LOCALIZATION ALGORITHM	1354
<i>S. Leggieri, C. Canali, A. Pistone, C. Gloriani, D.G. Caldwell</i>	
ON-MACHINE ERROR COMPENSATION FOR RIGHT FIRST TIME MANUFACTURE	1362
<i>H.M. Eldessouky, J.M. Flynn, S.T. Newman</i>	
THE EFFECT OF SOLDER PASTE VOLUME ON CHIP RESISTOR SOLDER JOINT FATIGUE LIFE	1372
<i>Huayan Wang, Ke Pan, Jonghwan Ha, Chongyang Cai, Seungbae Park</i>	
THE EFFECT OF SOLDER PASTE VOLUME ON SURFACE MOUNT ASSEMBLY SELF-ALIGNMENT	1381
<i>K. Pan, J.H. Ha, H.Y. Wang, V. Veeraraghavan, S.B. Park</i>	
EVALUATING FACTORY OF THE FUTURE PRINCIPLES FOR THE WOOD PRODUCTS INDUSTRY: THREE CASE STUDIES	1394
<i>Steffen Landscheidt, Mirka Kans</i>	
EFFECT OF MECHANICAL PERFORATION ON THE PRESS-FORMING PROCESS OF PAPERBOARD	1402
<i>Ville Leminen, Panu Tanninen, Antti Pesonen, Juha Varis</i>	

PREDICTIVE MAINTENANCE AND CONTINUOUS IMPROVEMENT

MINIMIZING THE NUMBER OF TARDY JOBS ON IDENTICAL PARALLEL MACHINES SUBJECT TO PERIODIC MAINTENANCE	1409
<i>Almasarwah Najat, Chen Yuan, Suer Gursel, Yuan Tao</i>	
ASSESSING THE MATURITY AND BENEFITS OF DIGITAL EXTENDED ENTERPRISE	1417
<i>Antti Pulkkinen, Juha-Pekka Anttila, Simo-Pekka Leino</i>	
KPI DEVELOPMENT AND OBSOLESCENCE MANAGEMENT IN INDUSTRIAL MAINTENANCE	1427
<i>S. Ferreira, F.J.G. Silva, R.B. Casais, M.T. Pereira, L.P. Ferreira</i>	
ORDER FULFILMENT PROCESS IMPROVEMENT IN A CERAMIC INDUSTRY	1436
<i>Mariana Maia, Carina Pimentel, Francisco Silva, Radu Godina, João Matias</i>	

PRODUCTION PLANNING SCHEDULING AND CONTROL

ANALYSIS AND IMPROVEMENT OF AN ASSEMBLY LINE IN THE AUTOMOTIVE INDUSTRY	1444
<i>P. Dias, F.J.G. Silva, R.D.S.G. Campilho, L.P. Ferreira, T. Santos</i>	
BALANCING MULTIPLE OBJECTIVES WITH ANARCHIC MANUFACTURING	1453
<i>Andrew Ma, Aydin Nassehi, Chris Snider</i>	
A COMPREHENSIVE SUPPLIER CLASSIFICATION MODEL FOR SME OUTSOURCING	1461
<i>V. Ferreira, F.J.G. Silva, R.P. Martinho, C. Pimentel, B. Pinto</i>	
SIMULATION BASED ONLINE PRODUCTION PLANNING	1473
<i>Rainer Müller, Leenhard Hörauf, Christoph Speicher, Julian Koch, Miriam Drief</i>	

ROBOTICS AND COMPUTER INTEGRATED MANUFACTURING

TOWARDS SAFETY LEVEL DEFINITION BASED ON THE HRN APPROACH FOR INDUSTRIAL ROBOTS IN COLLABORATIVE ACTIVITIES	1481
<i>Magno Paiva Hippertt, Marcio Lazai Junior, Anderson Luis Szejka, Osiris Canciglieri Junior, Eduardo Alves Portela Santos</i>	

TOWARDS REINFORCEMENT BASED LEARNING OF AN ASSEMBLY PROCESS FOR HUMAN ROBOT COLLABORATION	1491
<i>Sharath Chandra Akkaladevi, Matthias Plasch, Andreas Pichler, Markus Ikeda</i>	
TOWARDS COLLABORATIVE ROBOTIC POLISHING OF MOULD AND DIE SETS	1499
<i>Ke (Brian) Wang, Farid Dailami, Jason Matthews</i>	
TRANSFERRING HUMAN MANIPULATION KNOWLEDGE TO INDUSTRIAL ROBOTS USING REINFORCEMENT LEARNING	1508
<i>N. Arana-Arexolaleiba, N. Urrestilla-Anguiozar, D. Chrysostomou, S. Bøgh</i>	
RHEOLOGICAL BEHAVIOUR OF PP NANOCOMPOSITES BY EXTRUSION PROCESS	1516
<i>F. De Almeida, E. Costa e Silva, A. Correia, F.J.G. Silva</i>	
AUTONOMOUS NAVIGATION OF MOBILE ROBOTS IN FACTORY ENVIRONMENT	1524
<i>Suman Harapanahalli, Niall O Mahony, Gustavo Velasco Hernandez, Sean Campbell, Joseph Walsh</i>	
DEVELOPMENT OF A CLOUD-BASED ADVANCED PLANNING AND SCHEDULING SYSTEM FOR AUTOMOTIVE PARTS MANUFACTURING INDUSTRY	1532
<i>Jen-Li Liu, Li-Chih Wang, Pei-Chun Chu</i>	
EFFECT OF TANGENTIAL MISALIGNMENT IN ULTRASONIC BURNISHING	1540
<i>Juha Huuki, Sampsa V.A. Laakso, Rizwan Ullah</i>	
IMPROVEMENT AND VALIDATION OF ZAMAK DIE CASTING MOULDS	1547
<i>H.A. Pinto, F.J.G. Silva, R.P. Martinho, R.D.S.G. Campilho, A.G. Pinto</i>	
AN AUTOMATED SUPERMARKET CHECKOUT SYSTEM UTILIZING A SCARA ROBOT: PRELIMINARY PROTOTYPE DEVELOPMENT	1558
<i>Yesenia Aquilina, Michael A. Saliba</i>	

SIX SIGMA AND TQM

COORDINATION IN IMPROVEMENTS AT MANUFACTURING PLANTS AND ITS EFFECT ON IMPROVEMENT CAPABILITIES	1566
<i>Yuji Yamamoto, Shumpei Iwao</i>	
IMPLEMENTING TPM SUPPORTED BY 5S TO IMPROVE THE AVAILABILITY OF AN AUTOMOTIVE PRODUCTION LINE	1574
<i>I.M. Ribeiro, R. Godina, C. Pimentel, F.J.G. Silva, J.C.O. Matias</i>	
CONTINUOUS IMPROVEMENT IN MAINTENANCE: A CASE STUDY IN THE AUTOMOTIVE INDUSTRY INVOLVING LEAN TOOLS	1582
<i>G.F.L. Pinto, F.J.G. Silva, R.D.S.G. Campilho, R.B. Casais, A. Baptista</i>	
SIX SIGMA APPLICATION FOR QUALITY IMPROVEMENT OF THE PIN INSERTION PROCESS	1592
<i>J.P. Costa, I.S. Lopes, J.P. Brito</i>	
INTEGRATING QUALITY COSTS AND REAL TIME DATA TO DEFINE QUALITY CONTROL	1600
<i>Sérgio Sousa, Eusébio Nunes</i>	
USING SIX SIGMA TO ANALYSE CUSTOMER SATISFACTION AT THE PRODUCT DESIGN AND DEVELOPMENT STAGE	1608
<i>M.T. Pereira, M. Inês Bento, L.P. Ferreira, J.C. Sá, F.J.G. Silva</i>	
GLOBAL PROCESS EFFECTIVENESS: WHEN OVERALL EQUIPMENT EFFECTIVENESS MEETS ADHERENCE TO SCHEDULE	1615
<i>Rui Oliveira, Sahar Azadi Taki, Sérgio Sousa, Mohammad Amin Salimi</i>	
ASSET PRIORITY SETTING FOR MAINTENANCE MANAGEMENT IN THE FOOD INDUSTRY	1623
<i>T. Santos, F.J.G. Silva, S.F. Ramos, R.D.S.G. Campilho, L.P. Ferreira</i>	

SMART FACTORIES AND INDUSTRIAL INTERNET OF THINGS

A FUZZY KNOWLEDGE-BASED SYSTEM FOR DIAGNOSING UNPREDICTABLE FAILURES IN CNC MACHINE TOOLS	1634
<i>Antony Colasante, Silvia Ceccacci, Abudukaiyoumu Talipu, Maura Mengoni</i>	
A FRAMEWORK CONCEPT FOR DATA VISUALIZATION AND STRUCTURING IN A COMPLEX PRODUCTION PROCESS	1642
<i>Anton Albo, Kristofer Bengtsson, Martin Dahl, Petter Falkman</i>	
FLEXIBLE MANUFACTURING SYSTEMS USING IIOT IN THE AUTOMOTIVE SECTOR	1652
<i>Con Cronin, Andrew Conway, Joseph Walsh</i>	
MODELLING A PLATFORM FOR SMART MANUFACTURING SYSTEM	1660
<i>Hong-Seok Park, Risky Ayu Febriani</i>	

NEXT GENERATION SAFETY FOOTWEAR	1668
<i>D. Janson, S.T. Newman, V. Dhokia</i>	
METRICS TO GAUGE THE SUCCESS OF A MANUFACTURING ONTOLOGY	1678
<i>David Koonce, Dusan Sormaz</i>	
INTEGRATION OF AUTONOMOUS INTELLIGENT VEHICLES INTO MANUFACTURING ENVIRONMENTS: CHALLENGES	1683
<i>Liam Lynch, Fintan McGuinness, John Clifford, Muzaffar Rao, Thomas Newe</i>	

SMART MANUFACTURING AND INDUSTRY 4.0

DETERMINATION OF CHANGES IN PROCESS MANAGEMENT WITHIN INDUSTRY 4.0	1691
<i>Andrea Benešová, Martin Hirman, František Steiner, Jiří Tupa</i>	
VIRTUAL REALITY ASSISTED ROBOT PROGRAMMING FOR HUMAN COLLABORATION	1697
<i>Christos Maragkos, George-Christopher Vosniakos, Elias Matsas</i>	
5-DIMENSIONAL DEFINITION FOR A MANUFACTURING DIGITAL TWIN	1705
<i>Sara Moghadaszadeh Bazaz, Mika Lohtander, Juha Varis</i>	

SUSTAINABLE MANUFACTURING AND ENGINEERING

IMPROVING THE MACHINING PROCESS OF THE METALWORK INDUSTRY BY UPGRADING OPERATIVE SEQUENCES, STANDARD MANUFACTURING TIMES AND PRODUCTION PROCEDURE CHANGES	1713
<i>Carlos Monteiro, Luís P. Ferreira, Nuno O. Fernandes, F.J.G. Silva, Ivo Amaral</i>	
MACHINABILITY EVALUATION OF LOW-LEAD BRASS ALLOYS	1723
<i>J. Johansson, H. Persson, J.-E. Ståhl, J.-M. Zhou, F. Schultheiss</i>	
SCRAP PRODUCTION OF EXTRUDED ALUMINUM ALLOYS BY DIRECT EXTRUSION	1731
<i>A.F. Ferrás, F. De Almeida, E. Costa e Silva, A. Correia, F.J.G. Silva</i>	
ECO-DESIGN AND SUSTAINABILITY IN PACKAGING: A SURVEY	1741
<i>J. Monteiro, F.J.G. Silva, S.F. Ramos, R.D.S.G. Campilho, A.M. Fonseca</i>	

SUSTAINABLE MANUFACTURING AND PROCESS TECHNOLOGY

USING INDUSTRY 4.0 CONCEPTS AND THEORY OF SYSTEMS FOR IMPROVING COMPANY SUPPLY CHAIN: THE EXAMPLE OF A JOINERY	1750
<i>Paul-Eric Dossou</i>	
STUDY OF REACTIVE POWDER CONCRETE USING QUARTZITE TAILINGS FROM THE STATE OF MINAS GERAIS - BRAZIL	1758
<i>Ivan Francklin Junior, Rogério Pinto Ribeiro, Maurício H. da Silva, Filipe S. Aureliano, Vinicius L.G. Garcia</i>	
INFLUENCE OF TEXTILE CORD TENSION IN CAP PLY PRODUCTION	1766
<i>C. Costa, F.J.G. Silva, R.D.S.G. Campilho, P. Neves, S. Ferreira</i>	
BUILDING A MULTI-SIGNAL BASED DEFECT PREDICTION SYSTEM FOR A FRICTION STIR WELDING PROCESS	1775
<i>T.W. Liao, J. Roberts, M.A. Wahab, A.M. Okeil</i>	
INVESTIGATION OF DISTORTION, STRESS AND TEMPERATURE DISTRIBUTION DURING ASSEMBLY OF THE SUSPENSION SYSTEM OF A RAIL CAR	1792
<i>I.A. Daniyan, K. Mpoju, A.O. Adeodu, O.L. Rominiyi</i>	
INTRALOGISTICS AND INDUSTRY 4.0: DESIGNING A NOVEL SHUTTLE WITH PICKING SYSTEM	1801
<i>A. Baptista Fernandes, F.J.G. Silva, R.D.S.G. Campilho, G.F.L. Pinto</i>	
THE EFFECT OF HIGH SPEED MACHINING ON THE CRATER WEAR BEHAVIOUR OF PCBN TOOLS IN HARD TURNING	1833
<i>S. Gordon, P. Phelan, C. Lahiff</i>	

Author Index