CIRP Encyclopedia of Production Engineering

The International Academy for Production Engineering

Sami Chatti • Luc Laperrière
Gunther Reinhart • Tullio Tolio
Editors

CIRP Encyclopedia of Production Engineering

With 1508 Figures and 110 Tables

Springer

The International Academy for
Production Engineering
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Preface to Second Edition

Mankind has a long and successful history of continuously adapting to its changing environment. One of the key elements of this adaptation process is the development of precise skills to design, shape, and repeatedly produce objects with various materials that also evolve: from stone to bronze, from iron to steel, from composite to nano-materials, the quest never ends. As a result of this long evolution process, today, we live in a world of global production: in 2018, we could very well reach a milestone of 75 million cars produced worldwide, while the number of mobile phone users in the world is expected to reach the 5 billion mark by 2019, requiring a steadily increasing number of produced and sold smartphones (in 2017, there were 1.54 billion smartphone unit sales to end users). Needless to say, the total production of all goods worldwide has simply become intractable.

It is the thesis of this encyclopedia that in a sustainable world, the knowledge about good design practices, materials, and manufacturing technologies used to produce goods should be easily available and shared. Production engineering is a fast-evolving area, and the production map on our little planet, now a global village, has recently undergone very important changes. New technologies are being deployed while manufacturing strategies are constantly changing. Global production networks and supply chains are created, and international cooperation is quickly evolving.

Change is certainly not new, but the speed at which it takes place is. Not surprisingly, the technical vocabulary in this engineering domain also experiences significant expansion. New concepts in the fields of design, optimization, control, and management of processes, machines, and systems continuously emerge, thereby increasing the importance of communication and the need for a rigorous and unified technical terminology.

But one must remember that knowledge, rather than being spontaneous, is an incremental concept. Therefore, right from the beginning, the vision behind this encyclopedia was to bring a good balance between fundamental concepts and new emerging ones. In fact, a good proportion of the terms in this edition is a result of the continuous monitoring and update of established concepts upon which new ones are derived. As such, this encyclopedia is an evolving product where current authors will continuously update their essays based on new technical or economical information, while, at the same time, new authors will continuously be appointed to write about new emerging topics. It is the main objective behind the *CIRP Encyclopedia of Production Engineering* to provide

authoritative, exhaustive, fast, and easy access to such precious, fast-evolving information.

The target audience includes researchers, engineers, managers, graduate students, and many others whom day-to-day work gravitates around production engineering technologies in the global market.

CIRP has a long history of standardizing the terminology for technical terms. Since 1962, CIRP issued a number of trilingual dictionaries of production engineering in English, French, and German. Not surprisingly, technical terms are sometimes interpreted differently in their conceptual contexts in the three languages. The dictionaries took account of this by including both definitions of the terms and, in some cases, explanatory illustrations. In this way, CIRP realized one of its fundamental aims, i.e., to enable correct translation of production engineering terms and to contribute to a clear, unambiguous professional communication in the three languages. Throughout the years, some dictionaries were extended to include Danish, Finnish, Norwegian, Swedish, Italian, Spanish, Portuguese, Chinese, and Turkish translations.

In 2007, CIRP and Springer discussed the idea of creating an electronic web version of the dictionaries, referred to as E-dictionaries, where such things as animations, equations, and cross-links to other relevant terms could be included to further enhance the understanding of the definition of each term. As a natural extension, the idea of expanding the definitions into essays was next discussed. At that time, both parties started to refer to the work as an encyclopedia.

In 2009, a pilot project involving 15 essays, 5 in each section of Forming, Cutting, and Assembly, was initiated. Later on that year, a wiki platform was developed and improved by Springer staff according to the feedback and comments provided by CIRP. After the platform was judged to be at an acceptable level of functionality, editors in chief and section editors were appointed, and authors were invited to start using the platform to submit the 15 pilot essays. A successful demo took place at the CIRP General Assembly in Boston in August 2009. From then on, the editors in chief created a list of 256 most relevant technical terms to include in the first edition of what is now called the *CIRP Encyclopedia of Production Engineering*. The first edition, published in 2014, contained more than 1300 pages, available both in print and online.

The success of the first edition, obviously expressed by, e.g., the high number of downloads motivated the CIRP community and all contributors to publish a second edition with an extended number of terms, from 256 in the first edition to 343 in the second edition. New terms have been added to this edition, exploring new topics of production engineering, and many original terms of the first edition have been revised and updated. Some of the original terms have been even completely rewritten or strongly reworked in order to include the newest developments or new aspects which have meantime arisen.

The 343 entries of the second edition provide more than 1800 pages organized in 11 sections:

- Abrasive Processes
- Assembly
- Cutting
- Design

- Electrophysical and Chemical Processes
- Forming
- Life Cycle Engineering
- Machines
- Precision Engineering and Metrology
- Production Systems and Organizations
- Surfaces

Certainly, the most fundamental aspect behind the *CIRP Encyclopedia of Production Engineering* is quality of content. This comprehensive work involves the contribution of about 300 authors from all around the world, mostly CIRP fellows, associates, corporates, or affiliates considered as leading authorities in their field. A thorough review process of each essay was established under the leadership of each of the 12 section editors. We hope the reader finds it as useful referring to it as it was a great experience for us building it.

Professor Sami Chatti
Professor Luc Laperrière
Professor Gunther Reinhart
Professor Tullio Tolio
Editors in Chief

Preface to First Edition

Mankind has a long and successful history of continuously adapting to its changing environment. One of the key elements of this adaptation process is the development of precise skills to design, shape, and repeatedly produce objects with various materials that also evolve: from stone to bronze, from iron to steel, from composite to nano materials, the quest never ends. As a result of this long evolution process, today we live in a world of global production: in 2012, for the first time, over 60 million cars were produced worldwide, and over 415 million mobile phones were produced only in the first quarter of 2013! Needless to say, the total production of all goods worldwide has simply become intractable.

It is the thesis of this encyclopedia that in a sustainable world, the knowledge about good design practices, materials, and manufacturing technologies used to produce goods should be easily available and shared. Production engineering is a fast evolving area, and the production map on our little planet, now a global village, has recently undergone very important changes. New technologies are being deployed while manufacturing strategies are constantly changing. Global production networks and supply chains are created and international co-operation is quickly evolving.

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Professor Luc Laperrière
Professor Gunther Reinhart
Editors in Chief

A word from CIRP

The International Academy for Production Engineering Research, also known as CIRP[1], is the world's leading organization for production engineering research and is at the forefront of design, optimization, control, and management of processes, machines, and systems for manufacturing. CIRP promotes research and development among its members from the academia and industry to contribute to the global economic growth and well-being of society. In this context, one of the most fundamental roles of CIRP as a global organization is to ensure as far as possible that the terminology used be standardized and common across all nations of the earth.

To date, the main publications of CIRP have been the *CIRP Annals* (Manufacturing Technology) and the *CIRP Journal of Manufacturing Science and Technology*. The *CIRP Annals* are published under ISI standards each year in two volumes: Vol. I with refereed papers presented during the CIRP General Assembly and Vol. II with refereed keynote papers. The *CIRP Journal of Manufacturing Science and Technology* is published each year in four volumes. CIRP also publishes the trilingual *CIRP Dictionaries of Production Engineering*. Besides these main publications, a newsletter is published twice a year, as well as CIRP Internal Documents and Reports from CIRP General Assemblies are available on the CIRP website (www.cirp.net). Finally, the Proceedings of CIRP Conferences are available online on the *Procedia CIRP* website.

Ten years ago, the CIRP Terminology Committee decided to follow a totally new pathway in answer to the new age of advanced communications technology, to the advancing internet age, and to the cloud capabilities. As an outcome of the work undertaken, an online platform was launched in 2012 for the provision of authoritative, exhaustive, fast, and easy access to terms, definitions, and a whole set of information in the field of production/manufacturing engineering. The *CIRP Encyclopedia of Production Engineering* was launched and represents the natural extension of the current *CIRP Dictionaries of Production Engineering*. This encyclopedia consists of a list of entries that describe each term with definitions, theory, and applications. It is available both in print and on a website (http://link.springer.com). The definitions are based on the current content of the *CIRP Dictionaries of Production Engineering*, with new terms being added as required.

[1]The acronym CIRP comes from the French appellation of the academy, namely, Collège International pour la Recherche en Productique, headquartered in Paris.

This is a new and exciting publication, and I believe that it represents an extremely important contribution to the unification of the terminology used in the world. We need easy availability of terms using modern communications devices. With the *CIRP Encyclopedia of Production Engineering* as an important step forward, a significant step building on the past and capitalizing on the capabilities of current and future communications technology has been achieved.

Professor Don Lucca, CIRP President (2017–2018)

Acknowledgments

This encyclopedia was initiated from the experience and long-term vision of Professor Hans Kurt Toenshoff. We sincerely acknowledge his dedication and numerous advices. Thanks to the former CIRP President, Gerry Byrne, who believed in the project right from the start and who never missed a chance to promote it. We also wish to express our gratitude to Thomas Lehnert from Springer, an initial investigator in this project, and to Dr. Jan-Philip Schmidt, Editor Interdisciplinary Applied Sciences at Springer. We finally extend our thanks to other Springer staff, in particular to Barbara Wolf and Audrey Ohlig, for their constant and rigorous involvement and communication with CIRP authors and editors.

List of Topics

Abrasive Processes [STC-G]

Section Editor: ***Konrad Wegener***

Abrasive Material
Bonding Materials for Abrasive Tools
Centerless Grinding
Chip Formation (Abrasive Process)
Creep Feed Grinding
Diffusion Soldering
Dressing
Electrochemical Dressing
Electrochemical Grinding
Electrolytic In-Process Dressing
Finishing
Gear Grinding
Grind-Hardening
Grinding
Grinding Burn
Grinding Fluids
Grinding Machines
Grinding Monitoring
Grinding Parameters
Grinding Tool Structuring
Grinding Wheel
High Performance Grinding
High-Performance Dry Grinding
Honing
Lapping
Nozzle Design
Ploughing
Polishing
Residual Stress (Abrasive Processes)
Silver Sintering
Superabrasives
Superfinishing
Ultraprecision Grinding
Water-Jet Cutting

Assembly [STC-A]

Section Editor: ***Jörg Krüger***

Assembly
Assembly Automation
Assembly Line
Assembly Representation
Automatic X-ray Inspection (AXI)
Bonding
Brazing and Soldering
Durability Test
Electric Test
Ergonomic Assessment
Feeding
Grasping
Handling
Human Centered Automation
Human-Machine Collaboration
Inspection (Assembly)
Laser Welding
Maintenance
Manual Assembly
Material Flow
Optical Inspection
Robot
Sensor (Assembly)
SMD Component Placement
Solder Paste Printing
Wave Soldering

Cutting [STC-C]

Section Editor: ***Garrett O'Donnell***

Design [STC-DN]

Section Editor: ***Eric Lutters***

Electrophysical and Chemical Processes [STC-E]

Section Editor: ***Ludger Overmeyer***

Forming [STC-F]

Section Editor: ***Bernd-Arno Behrens***

Life Cycle Engineering [STC-LCE]

Section Editor: ***Wim Dewulf***

Surfaces

Section Editor: ***Han Haitjema***

About the Editors

Sami Chatti is a professor in the Mechanical Engineering Department of the National Engineering School of Monastir (ENIM), University of Monastir, Tunisia. He is the main coordinator of the flexible modular master program in technology (MasTech), developed within a European project under his leadership for six universities in the three countries Tunisia, Algeria, and Morocco.

Professor Chatti obtained his degree in mechanical engineering with main focus on manufacturing engineering at the TU Dortmund University, Germany, as well as his doctoral degree in forming technology with a dissertation about optimization of the manufacturing accuracy in profile bending. With a habilitation thesis entitled "Production of Profiles for Lightweight Structures," he obtained his postdoctoral degree at the University of Franche-Comté, Besançon, France, in cooperation with TU Dortmund University.

He worked until December 2016 as senior researcher, chief engineer education (director of studies), and member of the direction group of the Institute of Forming Technology and Lightweight Construction (IUL) of TU Dortmund University.

Professor Chatti is, since 2007, guest professor at the Department of Production Engineering, Royal Institute of Technology (KTH), Stockholm, Sweden, and was the main coordinator of the mini symposium "Light Weight Design and Energy Efficiency in Metal Forming" of the European Scientific Association for Material Forming (ESAFORM) conferences from 2011 to 2015.

He is vice-chairman of the CIRP Terminology Committee and member of the international group who revised the "CIRP Dictionary of Production

Engineering," volume "forming" in the languages German, English, and French.

Sami Chatti is married and has three children. He is member of several associations like CIRP and ATM (Association Tunisienne de Mécanique). He has filed 2 patents and has published 9 book chapters and over 100 papers in scientific journals, magazines, and international refereed conferences.

Luc Laperrière is a full-time professor in the Mechanical Engineering Department of Université du Québec à Trois-Rivières since 1991. He received both his master's and Ph.D. degrees from McMaster University, Canada, in 1990 and 1992, respectively. He was also appointed chair of his department from 2010 to 2013 and from 2016 to 2019.

During a sabbatical in 1999, he developed new and original artificial intelligence software. This was done in collaboration with a commercial software distributor. The developed modules are still part of the basic version of this software distributed worldwide.

In 2005, he was leading a multidisciplinary engineering team responsible for the design and implementation of the distributed control system (DCS) of a fully operational pulp and paper mill with a complete paper machine in a new 11,000 m^2 building on campus, representing a total investment of 80M$ Cdn, 10% of which came directly from industry. This DCS manages over 3000 I/Os and 500 control loops. Its flexibility is still unique worldwide.

In 2010, he became the founding director of a new research laboratory on natural fiber composites (NFCs). With his students, he helped develop a full-scale pilot plant dedicated to the manufacturing of a vast variety of NFCs.

He has filed 2 patents, has published over 100 papers in leading scientific journals and international refereed conferences, and has supervised over 40 master's and Ph.D. students.

Gunther Reinhart is full professor for Industrial Management and Assembly Technology and director of the iwb (Institute for Machine Tools and Industrial Management) at Technische Universität München. After studying mechanical engineering with the emphasis on design and development, he was research assistant at iwb from 1982 to 1988 with Prof. Dr. Joachim Milberg. During the last 2 years, he was in charge of the Assembly Automation Department. After receiving his Ph.D. from Technische Universität München, Prof. Reinhart started his industrial career with the BMW Group, initially as head of the Handling and Welding Engineering Department and subsequently as director of the body paint shop. In 1993, he returned to university to become professor and director of the iwb.

From March 2002 to February 2007, Prof. Reinhart took a sabbatical from the university to become a member of the Executive Board of IWKA Corporation, a large German supplier of engineering, robotics, and plant equipment with 13,000 employees worldwide. He was in charge of Technology and Market (CTO) focused on the discovery of new global market opportunities, the establishment of an internal auditing system, and the development of the IWKA packaging technology group.

In 2007, Prof. Reinhart returned to university and has served with Prof. Michael F. Zäh as co-director of the Institute for Machine Tools and Industrial Management (iwb) with more than 100 employees and 2 locations: Garching near Munich and Augsburg. He is also the chairman of the Bavarian Cluster for Mechatronics and Automation e.V. and, since January 1, 2009, head of the Fraunhofer IWU Research Department for Resource-Efficient Converting Machines (RMV).

Gunther Reinhart is member of multiple scientific societies and associations, e.g., acatech, WGMHI, CIRP, WGP, and WiGeP. He has approximately 300 publications in leading trade journals to his credit and is author or editor of 2 books and 2 series. He has also supervised the research projects and the doctoral theses of some 100 research associates.

Tullio Tolio is full professor of "Manufacturing and Production Systems" at Politecnico di Milano (TU-Milan http://www.polimi.it/en/home/). He is the director of ITIA-CNR (Institute of Industrial Technologies and Automation of the National Research Council of Italy http://www.itia.cnr.it/en/).

He has carried out research activities at the Laboratory for Manufacturing and Productivity (LMP) of the Massachusetts Institute of Technology (MIT). He is director of the Flagship project "Factories of the Future Italy," and in his position of director of ITIA-CNR, he has defined the strategy of the institute on more than 40 EU projects.

He has published more than 150 papers in international journals and international conferences. He has been associate editor of the SME *Journal of Manufacturing Systems* (2008–2014); he is currently member of the Editorial Board of the *CIRP Annals*, associate editor of the international *Journal of Manufacturing Science and Technology*, and editor in chief of the *CIRP Encyclopedia*. He is member of the Scientific Committee of five annual or biannual international conferences, and he has been the organizer of four editions of international conferences.

He is fellow of the CIRP (the International Academy for Production Engineering), member of the High Level Group (HLG) on Key Enabling Technologies (KETs) of the EU, member of the HLG Manufuture (EU platform), and member of the Partnership Board of the UE-Factories of the Future (FoF).

He has been head of the Ph.D. program in "Manufacturing and Production Systems" at Politecnico di Milano (TU Milan) (2000–2003), member of the Evaluation Board of Politecnico di Milano (TU Milan) (2002–2005), delegate of the Rector of Politecnico di Milano on "Quality Assurance in Education" (2005–2008), head of the Division "Tecnologie Meccaniche e Produzione (Manufacturing)" of the Department of Mechanical Engineering of Politecnico di Milano (TU Milan) (2001–2003 and 2005–2008), president of the national Cluster Intelligent Factories (2012–2015), and member of the Directory Board of AITEM (Italian Association for Manufacturing) (2009–2017).

Currently, he is director of ITIA-CNR (Institute of Industrial Technologies and Automation of the National Research Council of Italy) (since 2008), president of AITEM (Italian Association for Manufacturing), president of the Scientific-Technical Committee of the Italian Cluster Intelligent Factories (since 2015), and member of the Directory Board of AFIL (Cluster Intelligent Factories Lombardy).

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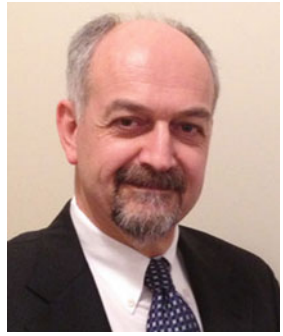

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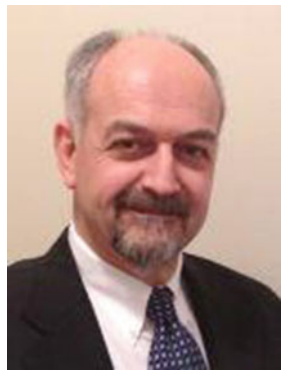

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List of Abbreviations

Abbreviation	Explanation	Term	Section
3DP	Three-Dimensional Printing	Rapid Tooling	Electrophysical and Chemical Processes
AACVD	Aerosol-Assisted Chemical Vapor Deposition	Chemical Vapor Deposition (CVD)	Electrophysical and Chemical Processes
ABC	Activity-Based Costing	Cost	Production Systems and Organizations
AC	Alternating Current	Brazing and Soldering	Assembly
		Coated Tools	Cutting
		Physical Vapor Deposition (PVD)	Electrophysical and Chemical Processes
AC	Adaptive Control	Adaptive Control	Machines
ACE	Automatic Computing Engine	Artificial Intelligence	Production Systems and Organizations
AD	Axiomatic Design	Axiomatic Design	Design
		Design Methodology	Design
ADC	Analog-to-Digital Converter	Sensor Assembly	Assembly
ADI	Austempered Ductile Iron	Machining of Spheroidal Ductile Iron	Cutting
ADRT	Actively Driven Rotary Tool	Turning with Rotary Tools	Cutting
AE	Acoustic Emission	Grinding Burn	Abrasive Processes
		Grinding Machines	Abrasive Processes
		Grinding Monitoring	Abrasive Processes
		Crack Initiation	Surfaces
AES	Auger Electron Spectroscopy	Surface Integrity	Cutting
AFM	Abrasive Flow Machining	Finishing	Abrasive Processes
AFM	Atomic Force Microscopy	Positioning	Precision Engineering and Metrology
		Nanotechnology	Surfaces
		Scatterometry	Surfaces
AGV	Automatic Guided Vehicle	Handling	Assembly
		Material Flow	Assembly
		Complexity in Manufacturing	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations

(*continued*)

Abbreviation	Explanation	Term	Section
AHP	Analytic Hierarchy Process	Decision-Making	Design
		Fuzzy Logic	Production Systems and Organizations
AI	Artificial Intelligence	Artificial Intelligence	Production Systems and Organizations
		Computer-Aided Manufacturing	Production Systems and Organizations
		Cyber-Physical Systems	Production Systems and Organizations
AIEDAM	Artificial Intelligence for Engineering Design, Analysis, and Manufacturing	Function Modeling	Design
AM	Additive Manufacturing	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
		Rapid Tooling	Electrophysical and Chemical Processes
		Machine Tool	Machines
AMF	American Machine and Foundry	Robot	Assembly
AMR	Anisotropic Magnetoresistance	Sensor Assembly	Assembly
ANN	Artificial Neural Network	Cost	Production Systems and Organizations
		Neural Network	Production Systems and Organizations
ANOVA	Analysis of Variance	Measurement System Analysis	Precision Engineering and Metrology
ANSI	American National Standards Institute	Grinding Wheel	Abrasive Processes
		Tolerancing	Design
AOI	Automated Optical Inspection	Optical Inspection	Assembly
AOQL	Average Outgoing Quality Limit	Quality Assurance	Precision Engineering and Metrology
APC	Adaptive Production Planning and Control	Changeable Manufacturing	Production Systems and Organizations
APCVD	Atmospheric Pressure Chemical Vapor Deposition	Chemical Vapor Deposition (CVD)	Electrophysical and Chemical Processes
API	Application Programming Interface	Open Architecture	Machines
APT	Ammonium Paratungstate	Cemented Carbides	Cutting
APT	Automatically Programmed Tool	Five-Axis Tool Path Generation	Cutting
		Computer-Aided Manufacturing	Production Systems and Organizations
APTE	Application des Techniques d'Enterprise (fr); Application of Corporation Methods (en)	Conceptual Design	Design
AQL	Acceptable Quality Level	Quality Assurance	Precision Engineering and Metrology
AR	Augmented Reality	Assembly Representation	Assembly
		Augmented Reality	Design

(*continued*)

Abbreviation	Explanation	Term	Section
ARL	Average Run Length	Statistical Process Control	Production Systems and Organizations
ASA	American Standards Association	Tolerancing	Design
ASPE	American Society for Precision Engineering	Precision	Precision Engineering and Metrology
ASRS	Automated Storage and Retrieval Systems	Computer-Integrated Manufacturing	Production Systems and Organizations
ASU	Actuator-Sensor Unit	Actuator	Machines
AVC	Active Vibration Control	Actuator	Machines
AVDT	Average Downtime per failure	Assembly Line	Assembly
AWC	Automatic Work Changers	Machine Tool	Machines
AWJ	Abrasive Waterjet	Waterjet Cutting	Abrasive Processes
AXI	Automated X-ray Inspection	Automated X-ray Inspection	Assembly
BA	Bend Allowance	Bending (Sheets)	Forming
BCA	Binary Collision Approximation	Ion Beam Machining	Electrophysical and Chemical Processes
BCC	Body-Centered Cubic	High-Speed Cutting	Cutting
		Deformation (Dislocations)	Forming
BDC	Bottom Dead Center	Thixoforming	Forming
BGA	Ball Grid Array	Optical Inspection	Assembly
BHF	Blank Holder Force	Hydroforming (Sheets and Tubes)	Forming
BIPM	Bureau International des Poids et Mesures (fr); International Bureau of Weights and Measures	Metrology	Precision Engineering and Metrology
BN	Barkhausen Noise	Grinding Burn	Abrasive Processes
BNA	Barkhausen Noise Analysis	Surface Integrity	Cutting
BOM	Bill of Material	Cladistics for Products and Manufacturing	Production Systems and Organizations
BON	Bed of Nails	Electric Test	Assembly
BPMN	Business Process Model and Notation	Operations Management	Production Systems and Organizations
BPP	Beam Parameter Product	Laser Welding	Assembly
BSD	Ball Screw Drives	Actuator	Machines
BSE	Backscattered Electrons	Scanning Electron Microscope	Precision Engineering and Metrology
B-spline	Basis Spline	Five-Axis Tool Path Generation	Cutting
BTA	Boring Trepanning Association	Drilling	Cutting
C&CM	Contact and Channel Model	Design Methodology	Design
CAD	Computer-Aided Design	Assembly Representation	Assembly
		Five-Axis Tool Path Generation	Cutting
		Geometric Modeling of Machining	Cutting
		Computer-Aided Design	Design
		Information Management	Design
		Reverse Engineering	Design

(*continued*)

Abbreviation	Explanation	Term	Section
		Computer Numerical Control	Machines
		Geometrical Product Specification	Precision Engineering and Metrology
		Computer-Aided Manufacturing	Production Systems and Organizations
		Computer-Integrated Manufacturing	Production Systems and Organizations
		Cooperative Engineering	Production Systems and Organizations
		Cyber-Physical Systems	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
		Freeform	Surfaces
CAE	Computer-Aided Engineering	Computer-Aided Manufacturing	Production Systems and Organizations
CAM	Computer-Aided Manufacturing	Five-Axis Tool Path Generation	Cutting
		Computer-Aided Design	Design
		Information Management	Design
		Computer Numerical Control	Machines
		Computer-Aided Manufacturing	Production Systems and Organizations
		Computer-Integrated Manufacturing	Production Systems and Organizations
		Cooperative Engineering	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
CAPP	Computer-Aided Process Planning	Chip-forms, Chip Breakability and Chip Control	Cutting
		Computer-Aided Manufacturing	Production Systems and Organizations
		Computer-Aided Process Planning	Production Systems and Organizations
		Computer-Integrated Manufacturing	Production Systems and Organizations
		Manufacturing	Production Systems and Organizations
CAS	Complex Adaptive Systems	Cyber-Physical Systems	Production Systems and Organizations
CASA	Computer and Automated Systems Association	Computer-Integrated Manufacturing	Production Systems and Organizations
CAT	Computer-Aided Testing	Computer-Integrated Manufacturing	Production Systems and Organizations
CBN	Cubic Boron Nitride	Abrasive Material	Abrasive Processes
		Bonding Materials for Abrasive Tools	Abrasive Processes
		Creep-Feed Grinding	Abrasive Processes
		Electrochemical Dressing	Abrasive Processes
		Gear Grinding	Abrasive Processes

(*continued*)

Abbreviation	Explanation	Term	Section
		Grinding Tool Structuring	Abrasive Processes
		Grinding Wheel	Abrasive Processes
		High-Performance Dry Grinding	Abrasive Processes
		High-Performance Grinding	Abrasive Processes
		Superabrasives	Abrasive Processes
		Ultraprecision Grinding	Abrasive Processes
		Waterjet Cutting	Abrasive Processes
		Cemented Carbides	Cutting
		Ceramic Cutting Tools	Cutting
		Cermets	Cutting
		Composite Materials	Cutting
		Cutting Temperature	Cutting
		Machining of Spheroidal Ductile Iron	Cutting
		Superhard Tools	Cutting
CBR	Case-Based Reasoning	Decision-Making	Design
		Cost	Production Systems and Organizations
CBS	Cost Breakdown Structure	Life Cycle Cost	Life Cycle Engineering
CCD	Charge-Coupled Device	Resolution	Precision Engineering and Metrology
CD	Continuous Dressing	Creep-Feed Grinding	Abrasive Processes
		Dressing	Abrasive Processes
CE	Cooperative Engineering	Cooperative Engineering	Production Systems and Organizations
CF	Correction Factor	Cutting Force Modeling	Cutting
CFC	Cubic Face-Centered	Hot Stamping	Forming
CFD	Computational Fluid Dynamics	Mechatronics	Machines
CFRP	Carbon Fiber-Reinforced Plastic	Machinability of Carbon Fiber-Reinforced and GLARE Materials	Cutting
CFT	Cross-Functional Teams	Cooperative Engineering	Production Systems and Organizations
CIM	Computer-Integrated Manufacturing	Computer-Integrated Manufacturing	Production Systems and Organizations
		Cyber-Physical Systems	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
CIPM	Comité International des Poids et Mesures (fr); International Committee for Weights and Measures	Metrology	Precision Engineering and Metrology
CIS	Continuous In-Process Sharpening	Creep-Feed Grinding	Abrasive Processes
CLIP	Continuous Liquid Interface Production	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
CMC	Ceramic Matrix Composites	Composite Materials	Cutting

(*continued*)

Abbreviation	Explanation	Term	Section
CMM	Coordinate Measuring Machine	Tolerancing	Design
		Abbe Error/Offset	Precision Engineering and Metrology
		Accuracy	Precision Engineering and Metrology
		Coordinate Measuring Machine	Precision Engineering and Metrology
		Error	Precision Engineering and Metrology
		Geometrical Product Specification	Precision Engineering and Metrology
		Precision Positioning	Precision Engineering and Metrology
		Traceability	Precision Engineering and Metrology
		Computer-Aided Process Planning	Production Systems and Organizations
CMOS	Complementary Metal-Oxide-Semiconductor	Resolution	Precision Engineering and Metrology
CMP	Chemical-Mechanical Polishing	Polishing	Abrasive Processes
CMS	Coordinate Measuring System	Coordinate Measuring	Precision Engineering and Metrology
CNC	Computer Numerical Control	Wave Soldering	Assembly
		Computer-Aided Design	Design
		Adaptive Control	Machines
		Computer Numerical Control	Machines
		Control	Machines
		Machine Tool	Machines
		Open Architecture	Machines
		Capacity Planning	Production Systems and Organizations
		Computer-Aided Manufacturing	Production Systems and Organizations
		Computer-Integrated Manufacturing	Production Systems and Organizations
		Cyber-Physical Systems	Production Systems and Organizations
		Flexible Manufacturing System	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
		Manufacturing	Production Systems and Organizations
CNP	Contract Net Protocol	Scheduling	Production Systems and Organizations
CoA	Center of Area	Fuzzy Logic	Production Systems and Organizations
CPFR	Collaborative Planning, Forecasting, and Replenishment	ERP Enterprise Resource Planning	Production Systems and Organizations
		Supply Chain Management	Production Systems and Organizations

(*continued*)

Abbreviation	Explanation	Term	Section
CPM	Characteristics-Properties Modeling	Design Methodology	Design
CPPS	Cyber-Physical Production Systems	Cyber-Physical Systems	Production Systems and Organizations
		Production Networks	Production Systems and Organizations
CPS	Cyber-Physical Systems	Smart Products	Design
		Cyber-Physical Systems	Production Systems and Organizations
		Knowledge-Based System	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
		Manufacturing	Production Systems and Organizations
CRM	Customer Relationship Management	Information Management	Design
		ERP Enterprise Resource Planning	Production Systems and Organizations
CS	Cold Spray	Cold Spray	Electrophysical and Chemical Processes
CSCMP	Council of Supply Chain Management Professionals	Logistics	Production Systems and Organizations
CSG	Constructive Solid Geometry	Geometric Modeling of Machining	Cutting
CSI	Coherence Scanning Interferometry	Interferometry	Precision Engineering and Metrology
CSM	Competitive Sustainable Manufacturing	Sustainable Manufacturing	Life Cycle Engineering
CSP	Continuous Sampling Plans	Statistical Process Control	Production Systems and Organizations
CT	Computed Tomography	Automatic X-ray Inspection	Assembly
		Computed Tomography	Precision Engineering and Metrology
CVD	Chemical Vapor Deposition	Ultraprecision Grinding	Abrasive Processes
		Ceramic Cutting Tools	Cutting
		Coated Tools	Cutting
		Steel and Stainless Steel	Cutting
		Superhard Tools	Cutting
		Chemical Vapor Deposition (CVD)	Electrophysical and Chemical Processes
		Peening	Surfaces
CWG	Collaborative Working Group	Learning Factory	Production Systems and Organizations
CWQC	Company-Wide Quality Control	Quality Assurance	Precision Engineering and Metrology
CYGMA	Cycle de vie et Gestion des Métiers et des Applications (fr); Life Cycle Management and the Trades and Applications (en)	Knowledge Management	Design
DAC	Design Augmented by Computer	Computer-Aided Manufacturing	Production Systems and Organizations

(*continued*)

Abbreviation	Explanation	Term	Section
DAE	Differential and Algebraic Equation	Mechanism	Machines
DAI	Distributed Artificial Intelligence	Artificial Intelligence	Production Systems and Organizations
DAT	Digital Audio Tape	Positioning	Precision Engineering and Metrology
DC	Direct Current	Electrochemical Grinding	Abrasive Processes
		Coated Tools	Cutting
		Physical Vapor Deposition (PVD)	Electrophysical and Chemical Processes
DDEs	Delay Differential Equations	Chatter Prediction	Cutting
DDE	Delay Differential Equation	Stability	Machines
DEA	Dielectric Elastomer Actuators	Actuator	Machines
DED	Directed Energy Deposition	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
DEDD	Dry Electro-Discharge-assisted Dressing	Dressing	Abrasive Processes
DFA	Design for Assembly	Cladistics for Products and Manufacturing	Production Systems and Organizations
DfD	Design for Disassembly	EOL Treatment	Life Cycle Engineering
DfE	Design for Environment	EOL Treatment	Life Cycle Engineering
DfEOL	Design for End-Of-Life	EOL Treatment	Life Cycle Engineering
DfLC	Design for Life Cycle	EOL Treatment	Life Cycle Engineering
DFMA	Design for Manufacturability and Assembly	Modular Design	Design
DFMC	Design for Mass Customization	Mass Customization	Production Systems and Organizations
DfR	Design for Recycling	EOL Treatment	Life Cycle Engineering
		Product Life Cycle Management	Life Cycle Engineering
DfS	Design for Sustainability	EOL Treatment	Life Cycle Engineering
DFT	Design for Test	Electric Test	Assembly
DFV	Design for Variety	Cladistics for Products and Manufacturing	Production Systems and Organizations
DfX	Design for X	Design Methodology	Design
DHM	Digital Human Models	Ergonomic Assessment	Assembly
DLP	Digital Light Processing	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
DLRP	Distributed Logistics Routing Protocol	Autonomous Production Control	Production Systems and Organizations
D-MAS	Delegate-Multi-Agent System	Holonic Manufacturing Systems	Production Systems and Organizations
DMD	Design Matrix Decomposition	Modular Design	Design
LMD	Laser Metal Deposition	Rapid Tooling	Electrophysical and Chemical Processes
DMN	Dynamic Manufacturing Network	Logistics	Production Systems and Organizations
DMS	Document Management Systems	Information Management	Design

(*continued*)

Abbreviation	Explanation	Term	Section
DMS	Dedicated Manufacturing Systems	Manufacturing System	Production Systems and Organizations
DMSS	Decision-Making Support Systems	Decision-Making	Design
DMU	Digital Mockup	Assembly Representation	Assembly
DNC	Direct Numerical Control	Computer-Aided Manufacturing	Production Systems and Organizations
		Computer-Integrated Manufacturing	Production Systems and Organizations
DOC	Depth of Cut	High-Speed Cutting	Cutting
DOF	Degree of Freedom	Chatter Prediction	Cutting
		Mechanism	Machines
DP	Dual Property	Cemented Carbides	Cutting
DP	Design Parameters	Axiomatic Design	Design
DPF	Diesel Particulate Filters	Microwave Radiation	Electrophysical and Chemical Processes
DPL	Dip Pen Lithography	Nanotechnology	Surfaces
DRC	Dual-Resource Constrained	Fuzzy Logic	Production Systems and Organizations
DSFD	Dual-Stage Feed Drives	Actuator	Machines
DSM	Design Structure Matrix	Design Methodology	Design
		Modular Design	Design
DSP	Digital Signal Processor	Magnetic Bearing	Machines
DSS	Decision Support Systems	Decision-Making	Design
DTM	Design Theory and Methodology	Design Methodology	Design
		Engineering Design	Design
EADS	European Aeronautic Defence and Space Company	Cold Spray	Electrophysical and Chemical Processes
EAM	Embedded-Atom Method	Molecular Dynamics	Surfaces
EBM	Electron Beam Machining	Electron Beam Machining	Electrophysical and Chemical Processes
		Rapid Tooling	Electrophysical and Chemical Processes
		Specific Energy	Electrophysical and Chemical Processes
EBSD	Electron Backscatter Diffraction	Surface Integrity	Cutting
EC	Electrochemical	Electrochemical Grinding	Abrasive Processes
ECCD	Electrochemical In-process Controlled Dressing	Electrochemical Dressing	Abrasive Processes
ECD	Electrochemical Dressing	Electrochemical Dressing	Abrasive Processes
ECDD	Electro-Contact Discharge Dressing	Dressing	Abrasive Processes
ECDM	Electrochemical Discharge Machining Dressing	Dressing	Abrasive Processes
ECG	Electrochemical Grinding	Electrochemical Grinding	Abrasive Processes
ECM	Electrochemical Machining	Deep Hole Drilling with Small Diameters	Cutting
		Specific Energy	Electrophysical and Chemical Processes
EDD	Electro-Discharge Dressing	Dressing	Abrasive Processes

(*continued*)

Abbreviation	Explanation	Term	Section
EDM	Electrical Discharge Machining	Deep Hole Drilling with Small Diameters	Cutting
		Electric Discharge Machining	Electrophysical and Chemical Processes
		Laser Beam Machining	Electrophysical and Chemical Processes
		Specific Energy	Electrophysical and Chemical Processes
		Microstructure	Surfaces
EDS	Energy-Dispersive X-ray Spectroscopy	Nanotechnology	Surfaces
EDX	Energy-Dispersive X-ray	Machining of Spheroidal Ductile Iron	Cutting
		Surface Integrity	Cutting
EER	Energy Efficiency Ratio	Energy-Efficient Manufacturing	Production Systems and Organizations
EGT	Engineered Grinding Tools	Grinding Tool Structuring	Abrasive Processes
EIA	Electronic Industries Association	Computer-Aided Manufacturing	Production Systems and Organizations
ELCC	Environmental Life Cycle Costing	Life Cycle Cost	Life Cycle Engineering
ELECTRE	Elimination et Choix Traduisant la Réalité (fr)	Decision-Making	Design
ELID	Electrolytic In-process Dressing	Dressing	Abrasive Processes
		Electrochemical Dressing	Abrasive Processes
		Electrolytic In-Process Dressing	Abrasive Processes
		Superabrasives	Abrasive Processes
		Ultraprecision Grinding	Abrasive Processes
		Ultraprecision Machining	Cutting
ELV	End-of-Life Vehicles	EOL Treatment	Life Cycle Engineering
EMF	Electromagnetic Forming	Mechanical Joining	Forming
EMF	Electromotive Force	Sensor (Machines)	Machines
EMG	Electromyography	Ergonomic Assessment	Assembly
EOSL	End-Of-Service Life	EOL Treatment	Life Cycle Engineering
EOU	End-Of-Use	EOL Treatment	Life Cycle Engineering
EP	Extreme Pressure	Cutting Fluid	Cutting
EPD	Environmental Product Declarations	Life Cycle Assessment	Life Cycle Engineering
ERF	Electro-Rheological Fluids	Actuator	Machines
ERP	Enterprise Resource Planning	Information Management	Design
		Computer-Integrated Manufacturing	Production Systems and Organizations
		ERP Enterprise Resource Planning	Production Systems and Organizations
		Operations Management	Production Systems and Organizations
		Planning	Production Systems and Organizations
		Production Networks	Production Systems and Organizations
		Production	Production Systems and Organizations

(*continued*)

Abbreviation	Explanation	Term	Section
ESD	Entrepreneurial System Designer	Lean Design	Design
ESEM	Environmental Scanning Electron Microscope	Scanning Electron Microscope	Precision Engineering and Metrology
ET	Eddy Current Testing	Crack Initiation	Surfaces
EUSPEN	European Society for Precision Engineering and Nanotechnology	Precision	Precision Engineering and Metrology
FACVD	Flame-Assisted Chemical Vapor Deposition	Chemical Vapor Deposition (CVD)	Electrophysical and Chemical Processes
FBD	Free-Body Diagrams	Mechanism	Machines
FBPSS	Function Behavior Principle State Structure	Synthesis	Design
FBS	Function Behavior State/ Structure	Function Modeling	Design
		Synthesis	Design
FCA	Full-Cost Accounting	Life Cycle Cost	Life Cycle Engineering
FCC	Face-Centered Cubic	High-Speed Cutting	Cutting
		Molecular Dynamics	Surfaces
FCEA	Full-Cost Environmental Accounting	Life Cycle Cost	Life Cycle Engineering
FCP	Full-Cost Pricing	Life Cycle Cost	Life Cycle Engineering
FDM	Finite Difference Model	Chatter Prediction	Cutting
FDM	Fused Deposition Modeling	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
FEA	Finite Element Analysis	Computer-Aided Design	Design
		Finite Element Analysis	Forming
FEM	Finite Element Method/ Modeling	Chatter Prediction	Cutting
		Coated Tools	Cutting
		Cutting Temperature	Cutting
		Cutting Temperature	Cutting
		Geometric Modeling of Machining	Cutting
		Modeling in Cutting	Cutting
		Wear Mechanisms	Cutting
		Finite Element Analysis	Forming
		Friction	Forming
		Roll Leveling	Forming
		Vibration	Machines
		Freeform	Surfaces
FFT	Fast Fourier Transformation	Monitoring	Cutting
FIB	Focused Ion Beam	Ultra-Small Micro-End Mills	Cutting
		Ion Beam Machining	Electrophysical and Chemical Processes
FIBID	Focused Ion Beam-Induced Deposition	Ion Beam Machining	Electrophysical and Chemical Processes
FIFO	First In First Out	ERP Enterprise Resource Planning	Production Systems and Organizations
FL	Fuzzy Logic	Fuzzy Logic	Production Systems and Organizations
FLC	Forming Limit Curve	Formability (Damage)	Forming
FLD	Forming Limit Diagram	Formability (Damage)	Forming

(*continued*)

Abbreviation	Explanation	Term	Section
FLM	Fused Layer Modeling	Rapid Tooling	Electrophysical and Chemical Processes
FMEA	Failure Mode and Effect Analysis	Design Methodology	Design
		Function Modeling	Design
		Cooperative Engineering	Production Systems and Organizations
		Industrial Product-Service System	Production Systems and Organizations
FMS	Flexible Manufacturing Systems	Capacity Planning	Production Systems and Organizations
		Computer-Aided Manufacturing	Production Systems and Organizations
		Flexible Manufacturing System	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
		Manufacturing	Production Systems and Organizations
		Planning	Production Systems and Organizations
FR	Functional Requirements	Axiomatic Design	Design
FRF	Frequency Response Function	Damping	Machines
		Vibration	Machines
FRP	Fiber-Reinforced Plastics	Composite Materials	Cutting
FSW	Friction Stir Welding	Welding	Assembly
FTS	Fast Tool Servo	Diamond Machining	Cutting
		Actuator	Machines
FUCE	Function-Based Cost Estimating	Cost	Production Systems and Organizations
GA	Genetic Algorithm	Twist Drill Geometry Optimization	Cutting
GD&T	Geometric Design and Tolerancing	Tolerancing (Kinematic Approach to)	Design
		Tolerancing	Design
		Geometrical Product Specification	Precision Engineering and Metrology
GDM	Gross Domestic Product	Smart Products	Design
GDT	General Design Theory	Design Methodology	Design
GE	General Electric	Superabrasives	Abrasive Processes
GKS	Graphic Kernel System	Computer-Aided Manufacturing	Production Systems and Organizations
GLARE	Glass Laminate Aluminum-Reinforced Epoxy	Machinability of Carbon Fiber-Reinforced and GLARE	Cutting
GM	General Motors	Computer-Aided Manufacturing	Production Systems and Organizations
GPS	Geometrical Product Specification	Tolerancing	Design
		Geometrical Product Specification	Precision Engineering and Metrology
GPS	Global Positioning System	Precision Positioning	Precision Engineering and Metrology

(*continued*)

Abbreviation	Explanation	Term	Section
GUM	Guide to the expression of Uncertainty in Measurement	Tolerancing	Design
		Error	Precision Engineering and Metrology
		Reversal	Precision Engineering and Metrology
HAZ	Heat-Affected Zone	Laser Welding	Assembly
		Cold Spray	Electrophysical and Chemical Processes
HCA	Human-Centered Automation	Human-Centered Automation	Assembly
HCP	Hexagonal Close-Packed	Deformation (Dislocations)	Forming
HDD	Hydromechanical Deep Drawing	Hydroforming (Sheets and Tubes)	Forming
HDMI	High-Definition Multimedia Interface	Product Architecture	Design
HEDG	High-Efficiency Deep Grinding	High-Performance Dry Grinding	Abrasive Processes
		High-Performance Grinding	Abrasive Processes
		Superabrasives	Abrasive Processes
HEG	High-Efficiency Grinding	High-Performance Dry Grinding	Abrasive Processes
HIG	High Isostatic Gas pressure	Cemented Carbides	Cutting
HIP	Hot Isostatic Pressing	Ceramic Cutting Tools	Cutting
HIP	High Ionization Pulsing	Physical Vapor Deposition (PVD)	Electrophysical and Chemical Processes
HIPIMS	High-Power Impulse Magnetron Sputtering	Physical Vapor Deposition (PVD)	Electrophysical and Chemical Processes
		Sputtering	Electrophysical and Chemical Processes
HMD	Head-Mounted Display	Augmented Reality	Design
HMES	Holonic Manufacturing Execution System	Holonic Manufacturing Systems	Production Systems and Organizations
HMS	Holonic Manufacturing Systems	Cyber-Physical Systems	Production Systems and Organizations
		Holonic Manufacturing Systems	Production Systems and Organizations
HNS	High Nitrogen Steels	Bearing	Machines
HPC	High-Performance Cutting	Coated Tools	Cutting
		High-Speed Cutting	Cutting
		Spindle	Machines
HPD	Hardness Penetration Depth	Grind-Hardening	Abrasive Processes
HPDG	High-Performance Dry Grinding	High-Performance Dry Grinding	Abrasive Processes
HPDL	High-Power Diode Laser	Laser Welding	Assembly
HPG	High-Performance Grinding	High-Performance Grinding	Abrasive Processes
HPPMS	High-Power Pulsed Magnetron Sputtering	Physical Vapor Deposition (PVD)	Electrophysical and Chemical Processes
HSC	High-Speed Cutting	Coated Tools	Cutting
		High-Speed Cutting	Cutting
		Spindle	Machines
HSIC	High-Speed Impact Cutting	Billet Shearing	Forming
HSK	Hollow Taper Shank	Tool Holder	Cutting

(*continued*)

Abbreviation	Explanation	Term	Section
HSM	High-Speed Machining	High-Speed Cutting	Cutting
HSS	High-Speed Steel	Abrasive Material	Abrasive Processes
		Broaching	Cutting
		Cemented Carbides	Cutting
		Cermets	Cutting
		Machinability of Carbon Steel	Cutting
HVOF	High-Velocity Oxygen Fuel	Cold Spray	Electrophysical and Chemical Processes
IAD	Intelligent Assist Devices	Human-Machine Collaboration	Assembly
IBC	Isolated Boundary Condition	Molecular Dynamics	Surfaces
IBF	Ion Beam Figuring	Ion Beam Machining	Electrophysical and Chemical Processes
IBIS	Issue-Based Information System	Decision-Making	Design
IBM	Ion Beam Machining	Ion Beam Machining	Electrophysical and Chemical Processes
IC	Integrated Circuits	Optical Inspection	Assembly
		Wire Bonding	Assembly
ICFG	International Cold Forging Group	Cold Forging	Forming
ICT	Information and Communications Technology	Factory	Production Systems and Organizations
		Knowledge-Based System	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
		Manufacturing	Production Systems and Organizations
		Mass Customization	Production Systems and Organizations
		Production Networks	Production Systems and Organizations
		Production	Production Systems and Organizations
		Virtual Reality in Manufacturing	Production Systems and Organizations
IGBT	Insulated-Gate Bipolar Transistor	Wire Bonding	Assembly
IGES	Initial Graphics Exchange Specification	Computer-Aided Design	Design
IM	Information Management	Information Management	Design
IMP	Intermetallic Phases	Diffusion Soldering	Abrasive Processes
IMPACT	Intelligent Manufacturing Planning and Control	Production	Production Systems and Organizations
IMS	Intelligent Manufacturing Systems	Artificial Intelligence	Production Systems and Organizations
		Cyber-Physical Systems	Production Systems and Organizations
INCOSE	International Council of System Engineering	Smart Products	Design
IoD	Internet of Data	Smart Products	Design

(*continued*)

Abbreviation	Explanation	Term	Section
IoH	Internet of Humans	Smart Products	Design
IoS	Internet of Services	Smart Products	Design
IoT	Internet of Things	Smart Products	Design
		Production Networks	Production Systems and Organizations
IP	Integer Programming	Optimization in Manufacturing	Production Systems and Organizations
IPSS	Industrial Product-Service System	Industrial Product-Service System	Production Systems and Organizations
IRDAC	Industrial Research and Development Advisory Committee	Mechatronics	Machines
IS	Information Systems	Information Management	Design
		Knowledge Management	Design
ISO	International Organization for Standardization	Life Cycle Assessment	Life Cycle Engineering
		Geometrical Product Specification	Precision Engineering and Metrology
IT	Information Technology	Information Management	Design
JIT	Just-In-Time	Lean Production	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
		Manufacturing	Production Systems and Organizations
		Production Planning	Production Systems and Organizations
JIT-DM	Just-In-Time Decision-Making	Lean Design	Design
JSPE	Japan Society for Precision Engineering	Precision	Precision Engineering and Metrology
KADS	Knowledge Acquisition and Documentation System	Knowledge Management	Design
KBE	Knowledge-Based Environments	Knowledge Management	Design
KBS	Knowledge-Based Systems	Knowledge Management	Design
		Knowledge-Based System	Production Systems and Organizations
KDD	Knowledge Discovery in Databases	Neural Network	Production Systems and Organizations
KISF	Kinematic Incremental Sheet Forming	Incremental Forming	Forming
KM	Knowledge Management	Information Management	Design
		Knowledge Management	Design
LAN	Local Area Network	Flexible Manufacturing System	Production Systems and Organizations
LBM	Laser Beam Machining	Specific Energy	Electrophysical and Chemical Processes
LBW	Laser Beam Welding	Laser Welding	Assembly
LCA	Life Cycle Assessment/ Accounting	Life Cycle Assessment	Life Cycle Engineering
		Life Cycle Assessment: Goal and Scope Definition	Life Cycle Engineering
		Life Cycle Cost	Life Cycle Engineering
		Life Cycle Impact Assessment	Life Cycle Engineering

(*continued*)

Abbreviation	Explanation	Term	Section
LCC	Life Cycle Costing	Life Cycle Cost	Life Cycle Engineering
		Life Cycle Cost	Life Cycle Engineering
LCCA	Life Cycle Cost Assessment	Life Cycle Cost	Life Cycle Engineering
LCE	Life Cycle Engineering	Life Cycle Engineering	Life Cycle Engineering
LCI	Life Cycle Inventory	Life Cycle Assessment	Life Cycle Engineering
LCIA	Life Cycle Impact Assessment	Environmental Impact	Life Cycle Engineering
		Life Cycle Assessment	Life Cycle Engineering
		Life Cycle Impact Assessment	Life Cycle Engineering
LCL	Lower Control Limit	Statistical Process Control	Production Systems and Organizations
LCS	Local Coordinate System	Five-Axis Tool Path Generation	Cutting
LCSA	Life Cycle Sustainability Assessment	Life Cycle Assessment	Life Cycle Engineering
LDR	Limiting Drawing Ratios	Hydroforming (Sheets and Tubes)	Forming
LED	Light-Emitting Diode	Sensor Assembly	Assembly
LENS	Laser-Engineered Net Shaping	Specific Energy	Electrophysical and Chemical Processes
LFVAD	Low-Frequency Vibration-Assisted Drilling	Materials	Cutting
LFW	Linear Friction Welding	Welding	Assembly
LIDT	Laser-Induced Damage Threshold	Crack Initiation	Surfaces
LLM	Layer Laminate Manufacturing	Rapid Tooling	Electrophysical and Chemical Processes
LMIS	Liquid-Metal Ion Sources	Ion Beam Machining	Electrophysical and Chemical Processes
LMS	Manufacturing Systems and Automation	Cost	Production Systems and Organizations
LoA	Level of Automation	Human-Centered Automation	Assembly
LOC	Logistic Operating Curves	Logistic Curves	Production Systems and Organizations
LODTM	Large Optics Diamond Turning Machine	Ultraprecision	Machines
LOM	Laminated Object Manufacturing	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
		Specific Energy	Electrophysical and Chemical Processes
LPD	Lean Product Development	Lean Design	Design
LPP	Linear Pallet Pools	Machine Tool	Machines
LSL	Lower Specification Limit	Statistical Process Control	Production Systems and Organizations
LSPL	Least-Squares Reference Plane	Flatness	Precision Engineering and Metrology
MAC	Modal Assurance Criterion	Structural Analysis	Machines
MADM	Multiple-Attribute Decision-Making	Decision-Making	Design
MAF	Magnetic Abrasive Finishing	Finishing	Abrasive Processes
MAG	Metal Active Gas	Welding	Assembly
MAI	Multiple Angle of Incidence	Ellipsometry	Surfaces

(*continued*)

Abbreviation	Explanation	Term	Section
MAS	Multi-Agent System	Artificial Intelligence	Production Systems and Organizations
		Cyber-Physical Systems	Production Systems and Organizations
MASK	Method for Analyzing and Structuring Knowledge	Knowledge Management	Design
MBE	Molecular Beam Epitaxy	Nanotechnology	Surfaces
MCDM	Multiple-Criteria Decision-Making	Decision-Making	Design
MD	Molecular Dynamics	Molecular Dynamics for Cutting Processes	Cutting
		Molecular Dynamics	Surfaces
MDOF	Multiple Degree of Freedom	Chatter Prediction	Cutting
		Precision Positioning	Precision Engineering and Metrology
MDP	Markov Decision Process	Neural Network	Production Systems and Organizations
MEMS	Microelectromechanical Systems	Sensor Assembly	Assembly
		Electroforming	Electrophysical and Chemical Processes
MFD	Modular Function Deployment	Modular Design	Design
MHIA	Material Handling Industry of America	Handling	Assembly
MHS	Material Handling Systems	Complexity in Manufacturing	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
MIG	Metal Inert Gas	Welding	Assembly
MILP	Mixed-Integer Linear Programming	Optimization in Manufacturing	Production Systems and Organizations
		Scheduling	Production Systems and Organizations
MJ	Material Jetting	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
MJM	Multi-Jet Modeling	Rapid Tooling	Electrophysical and Chemical Processes
MKMS	Methodology for Knowledge Management System	Knowledge Management	Design
ML	Machine Learning	Artificial Intelligence	Production Systems and Organizations
		Cyber-Physical Systems	Production Systems and Organizations
MLP	Multilayer Perceptron	Neural Network	Production Systems and Organizations
MMC	Metal Matrix Composites	Composite Materials	Cutting
MOCVD	Metal-Organic Chemical Vapor Deposition	Chemical Vapor Deposition (CVD)	Electrophysical and Chemical Processes
MODM	Multiple-Objective Decision-Making	Decision-Making	Design
MOGeP	Multi-Objective Geometric Programming	Decision-Making	Design

(*continued*)

Abbreviation	Explanation	Term	Section
MOGoP	Multi-Objective Goal Programming	Decision-Making	Design
MOKA	Methodology and Tools Oriented to Knowledge Engineering Applications	Knowledge Management	Design
MOLP	Multi-Objective Linear Programming	Decision-Making	Design
MOM	Middle of Maximum	Fuzzy Logic	Production Systems and Organizations
MPE	Maximum Permissible Error	Machine	Precision Engineering and Metrology
		Error	Precision Engineering and Metrology
MQL	Minimum Quantity Lubrication	Nozzle Design	Abrasive Processes
		Cutting Fluid	Cutting
		High-Speed Cutting	Cutting
		Machinability of Carbon Steel	Cutting
		Molecular Dynamics for Cutting Processes	Cutting
		Sustainability of Machining	Cutting
		Spindle	Machines
MR	Mixed Reality	Augmented Reality	Design
MRF	Magneto-Rheological Fluids	Actuator	Machines
MRP	Material Requirements Planning	ERP Enterprise Resource Planning	Production Systems and Organizations
		Operations Management	Production Systems and Organizations
		Planning	Production Systems and Organizations
MRPI	Material Requirements Planning	Information Management	Design
MRPII	Manufacturing Resource Planning	Information Management	Design
		Operations Management	Production Systems and Organizations
MRR	Material Removal Rates	High-Performance Grinding	Abrasive Processes
		Self-Propelled Rotary Tool	Cutting
MS	Manufacturing System	Holonic Manufacturing Systems	Production Systems and Organizations
MSM	Magnetic Shape Memory	Actuator	Machines
MST	Manufacturing Science and Technology	Manufacturing System	Production Systems and Organizations
MT	Magnetic Particle Testing	Crack Initiation	Surfaces
MTBF	Mean Time Between Failures	Assembly Line	Assembly
MTF	Modulation Transfer Functions	Resolution	Precision Engineering and Metrology
MZPL	Minimum-Zone Plane	Flatness	Precision Engineering and Metrology
NACFAM	National Council for Advanced Manufacturing	Sustainable Manufacturing	Life Cycle Engineering
NAPLPS	North American Presentation Level Protocol Syntax	Computer-Aided Manufacturing	Production Systems and Organizations

(*continued*)

Abbreviation	Explanation	Term	Section
NC	Numerical Control	Burr	Cutting
		Five-Axis Tool Path Generation	Cutting
		Adaptive Control	Machines
		Computer Numerical Control	Machines
		Open Architecture	Machines
		Precision Positioning	Precision Engineering and Metrology
		Computer-Aided Manufacturing	Production Systems and Organizations
		Computer-Integrated Manufacturing	Production Systems and Organizations
NGO	Nongovernmental Organization	Management of Production Enterprises	Production Systems and Organizations
NIST	National Institute of Standards and Technology	Traceability	Precision Engineering and Metrology
NITAL	Nitric Acid and Alcohol	Grinding Burn	Abrasive Processes
NMI	National Metrology Institutes	Precision Positioning	Precision Engineering and Metrology
		Traceability	Precision Engineering and Metrology
NN	Neural Networks	Fuzzy Logic	Production Systems and Organizations
NNA	Neural Network Approach	Modeling of Face Milling	Cutting
NURBS	Nonuniform Rational B-Spline	Five-Axis Tool Path Generation	Cutting
		Freeform	Surfaces
ODE	Ordinary Differential Equations	Chatter Prediction	Cutting
OEM	Original Equipment Manufacturers	Biomimetic Design	Design
		Hot Stamping	Forming
		Disassembly	Life Cycle Engineering
		EOL Treatment	Life Cycle Engineering
		Production Networks	Production Systems and Organizations
OFHC	Oxygen-Free High Conductivity	Diamond Machining	Cutting
OLTCM	Online Tool Condition Monitoring	Modeling of Face Milling	Cutting
OMAC	Open Modular Architecture Controller	Open Architecture	Machines
OPD	Optical Path Difference	Adaptive Optics	Precision Engineering and Metrology
		Interferometry	Precision Engineering and Metrology
ORCOS	Organic Reconfigurable Operating System	Open Architecture	Machines
ORESTE	Organization, Rangement Et Synthèse de Données Relationnelles (fr)	Decision-Making	Design
OSACA	Open System Architecture for Controls within Automation Systems	Open Architecture	Machines

(*continued*)

Abbreviation	Explanation	Term	Section
OSEC	Open System Environment for Controller	Open Architecture	Machines
PBF	Powder Bed Fusion	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
PCA	Principal Component Analysis	Statistical Process Control	Production Systems and Organizations
PCB	Printed Circuit Boards	SMD Component Placement	Assembly
		Electric Test	Assembly
		Wave Soldering	Assembly
PCBN	Polycrystalline Boron Nitride	Electrochemical Dressing	Abrasive Processes
		Ceramic Cutting Tools	Cutting
		Hard Material Cutting	Cutting
		High-Speed Cutting	Cutting
		Self-Propelled Rotary Tool	Cutting
		Superhard Tools	Cutting
PCD	Polycrystalline Diamond	Centerless Grinding	Abrasive Processes
		Electrochemical Dressing	Abrasive Processes
		Ceramic Cutting Tools	Cutting
		Composite Materials	Cutting
		Machinability of Aluminum and Magnesium Alloys	Cutting
		Self-Propelled Rotary Tool	Cutting
		Superhard Tools	Cutting
PCM	Photochemical Machining	Etching	Electrophysical and Chemical Processes
PDM	Product Data Management	Information Management	Design
		Production	Production Systems and Organizations
PDMS	Polydimethylsiloxane	Microstructure	Surfaces
PECVD	Plasma-Enhanced Chemical Vapor Deposition	Chemical Vapor Deposition (CVD)	Electrophysical and Chemical Processes
		Microwave Radiation	Electrophysical and Chemical Processes
PEF	Product Environmental Footprints	Life Cycle Assessment	Life Cycle Engineering
PHIGS	Programmer's Hierarchical Interactive Graphics System	Computer-Aided Manufacturing	Production Systems and Organizations
PID	Proportional-Integral-Derivative	Servo System	Machines
		Precision Positioning	Precision Engineering and Metrology
PLM	Product Lifecycle Management	Computer-Aided Manufacturing	Production Systems and Organizations
		Production	Production Systems and Organizations
PPC	Production Planning and Control	Computer-Integrated Manufacturing	Production Systems and Organizations
		ERP Enterprise Resource Planning	Production Systems and Organizations
PRO	Producer Responsibility Organization	EOL Treatment	Life Cycle Engineering

(*continued*)

Abbreviation	Explanation	Term	Section
PROMETHEE	Preference Ranking Organization Method for Enrichment Evaluations	Decision-Making	Design
PSB	Persistent Slip Band	Crack Initiation	Surfaces
PSD	Position-Sensitive Detector	Sensor Assembly	Assembly
PSO	Particle Swarm Optimization	Twist Drill Geometry Optimization	Cutting
PSS	Product-Service Systems	EOL Treatment	Life Cycle Engineering
		Industrial Product-Service System	Production Systems and Organizations
PTP	Peak-to-Peak	Chatter Prediction	Cutting
PV	Process Variables	Axiomatic Design	Design
PVD	Physical Vapor Deposition	Ceramic Cutting Tools	Cutting
		Coated Tools	Cutting
		Hard Material Cutting	Cutting
		Chemical Vapor Deposition (CVD)	Electrophysical and Chemical Processes
		Ion Beam Machining	Electrophysical and Chemical Processes
		Physical Vapor Deposition (PVD)	Electrophysical and Chemical Processes
		Sputtering	Electrophysical and Chemical Processes
		Peening	Surfaces
PWB	Printed Wiring Boards	Disassembly	Life Cycle Engineering
PWJ	Plain/Pure Waterjet	Waterjet Cutting	Abrasive Processes
PWM	Pulse-Width Modulation	Magnetic Bearing	Machines
QCPM	Quick Chatter Prediction Method	Chatter Prediction	Cutting
QFD	Quality Function Deployment	Design Methodology	Design
		Function Modeling	Design
		Cooperative Engineering	Production Systems and Organizations
QFN	Quad Flat No-Lead	Optical Inspection	Assembly
RBM	Risk-Based Maintenance	Maintenance	Assembly
RCM	Reliability-Centered Maintenance	Maintenance	Assembly
RCSA	Receptance Coupling Substructure Analysis	Vibration	Machines
RCWA	Rigorous Coupled-Wave Analysis	Scatterometry	Surfaces
RDBMS	Records and Database Management Systems	Information Management	Design
RE	Reverse Engineering	Reverse Engineering	Design
RE	Requirements Engineering	Cooperative Engineering	Production Systems and Organizations
REBO	Reactive Empirical Bond Order	Molecular Dynamics	Surfaces
REX	Retour d'Experience (fr)	Knowledge Management	Design
RF	Radio Frequency	Coated Tools	Cutting
		Physical Vapor Deposition (PVD)	Electrophysical and Chemical Processes

(*continued*)

Abbreviation	Explanation	Term	Section
RFID	Radio-Frequency Identification	Sensor Assembly	Assembly
		Autonomous Production Control	Production Systems and Organizations
		Factory	Production Systems and Organizations
		Logistics	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
RFW	Rotary Friction Welding	Welding	Assembly
RGB	Red, Green, and Blue	Sensor Assembly	Assembly
RIM	Reconfigurable Inspection Machines	Reconfigurable Manufacturing System	Production Systems and Organizations
RM	Rapid Manufacturing	Rapid Tooling	Electrophysical and Chemical Processes
RMS	Reconfigurable Manufacturing Systems	Capacity Planning	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
		Mass Customization	Production Systems and Organizations
		Planning	Production Systems and Organizations
		Reconfigurable Manufacturing System	Production Systems and Organizations
RoHS	Restriction of Hazardous Substances	EOL Treatment	Life Cycle Engineering
RPP	Reconfigurable Process Planning	Computer-Aided Process Planning	Production Systems and Organizations
		Planning	Production Systems and Organizations
RPT	Rise Per Tooth	Broaching	Cutting
RT	Radiographic Testing	Crack Initiation	Surfaces
RTP	Ready To Press	Cemented Carbides	Cutting
RUM	Rotary Ultrasonic Machining	Machine Tool	Machines
SBCE	Set-Based Concurrent Engineering	Lean Design	Design
SBMF	Sheet-Bulk Metal Forming	Sheet-Bulk Metal Forming	Forming
SCARA	Selective Compliance Assembly Robot Arm	Robot	Assembly
SCC	Structural Classification and Coding	Complexity in Manufacturing	Production Systems and Organizations
SCI	Spheroidal Cast Iron	Machining of Spheroidal Ductile Iron	Cutting
SCM	Supply Chain Management	Cyber-Physical Systems	Production Systems and Organizations
		ERP Enterprise Resource Planning	Production Systems and Organizations
		Production	Production Systems and Organizations
		Supply Chain Management	Production Systems and Organizations

(*continued*)

Abbreviation	Explanation	Term	Section
SCOR	Supply Chain Operations Reference	Supply Chain Management	Production Systems and Organizations
SCP	Screen Printing	Solder Paste Printing	Assembly
SDE	Specific Discharge Energy	Specific Energy	Electrophysical and Chemical Processes
SDG	Sustainable Development Goals	Sustainability	Life Cycle Engineering
SDJST	Sequence-Dependent Job Setup Times	Scheduling	Production Systems and Organizations
SDM	Semi-Discretization Method	Chatter Prediction	Cutting
SDOF	Single Degree of Freedom	Chatter Prediction	Cutting
		Damping	Machines
		Dynamics	Machines
SDT	Small Displacement Torsor	Tolerancing (Kinematic Approach to)	Design
SE	Specific Energy	Specific Energy	Electrophysical and Chemical Processes
SEDD	Sink Electro-Discharge Dressing	Dressing	Abrasive Processes
SEM	Scanning Electron Microscope	Positioning	Precision Engineering and Metrology
		Scanning Electron Microscope	Precision Engineering and Metrology
		Crack Initiation	Surfaces
		Nanotechnology	Surfaces
		Scatterometry	Surfaces
SERS	Surface-Enhanced Raman Spectroscopy	Ion Beam Machining	Electrophysical and Chemical Processes
SFF	Solid Freeform Fabrication	Cleaner Production	Life Cycle Engineering
SFM	Scanning Force Microscopes	Atomic Force Microscopy	Precision Engineering and Metrology
SFP	Single-Factor Productivity	Productivity	Production Systems and Organizations
SHF	Sheet Hydroforming	Hydroforming (Sheets and Tubes)	Forming
SK	Tool Shank	Tool Holder	Cutting
SL	Stereolithography	Rapid Tooling	Electrophysical and Chemical Processes
		Specific Energy	Electrophysical and Chemical Processes
		Additive Manufacturing Technologies	Electrophysical and Chemical Processes
SLCC	Societal Life Cycle Costing	Life Cycle Cost	Life Cycle Engineering
SLID	Solid-Liquid Interdiffusion	Diffusion Soldering	Abrasive Processes
SLM	Selective Laser Melting	Rapid Tooling	Electrophysical and Chemical Processes
		Cleaner Production	Life Cycle Engineering
SLS	Selective Laser Sintering	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
		Rapid Tooling	Electrophysical and Chemical Processes

(*continued*)

Abbreviation	Explanation	Term	Section
		Specific Energy	Electrophysical and Chemical Processes
		Cleaner Production	Life Cycle Engineering
SM	Subtractive Manufacturing	Machine Tool	Machines
SMA	Shape Memory Alloys	Actuator	Machines
		Corrosion	Surfaces
SMC	Sliding Mode Controller	Control	Machines
SMD	Surface-Mount Device	SMD Component Placement	Assembly
		Optical Inspection	Assembly
SME	Society of Manufacturing Engineers	Computer-Integrated Manufacturing	Production Systems and Organizations
SMED	Single-Minute Exchange of Die	Lean Production	Production Systems and Organizations
SMS	Selective Mask Sintering	Rapid Tooling	Electrophysical and Chemical Processes
SMT	Surface-Mount Technology	SMD Component Placement	Assembly
		Wave Soldering	Assembly
SOI	Silicon On Insulator	Ion Beam Machining	Electrophysical and Chemical Processes
SPC	Statistical Process Control	Statistical Process Control	Production Systems and Organizations
SPI	Solder Paste Inspection	Optical Inspection	Assembly
SPIF	Single-Point Incremental Forming	Incremental Forming	Forming
SPM	Scanning Probe Microscopy	Nanotechnology	Surfaces
SPRT	Self-Propelled Rotary Tool	Self-Propelled Rotary Tool	Cutting
		Turning with Rotary Tools	Cutting
SQC	Statistical Quality Control	Statistical Process Control	Production Systems and Organizations
SSS	Slow Slide Servo	Diamond Machining	Cutting
STAGES	Structured Analysis and Generation of Expert Systems	Knowledge Management	Design
STC	Scientific Technical Committee	Life Cycle Engineering	Life Cycle Engineering
STEP	Systems and Standards for Exchange of Product Model Data	Geometrical Product Specification	Precision Engineering and Metrology
STFT	Short-Time Fourier Transformation	Monitoring	Cutting
STL	Stereolithography	Freeform	Surfaces
STL	Solid-to-Layer	Reverse Engineering	Design
STM	Scanning Tunneling Microscope	Scanning Tunneling Microscope	Precision Engineering and Metrology
		Nanotechnology	Surfaces
STP	Stencil Printing	Solder Paste Printing	Assembly
SVDH	Self-Vibrating Drilling Head	Self-Vibratory Drilling	Electrophysical and Chemical Processes
TACVD	Thermally Activated Chemical Vapor Deposition	Chemical Vapor Deposition (CVD)	Electrophysical and Chemical Processes
TC	Thermocompression	Wire Bonding	Assembly
TCA	Total Cost Assessment	Life Cycle Cost	Life Cycle Engineering

(*continued*)

Abbreviation	Explanation	Term	Section
TCF	Tool Coordinate Frame	Process Optimization via Feedrate Scheduling in Milling	Cutting
TCM	Technical Cost Modeling	Cost	Production Systems and Organizations
TCO	Total Cost of Ownership	Magnetic Bearing	Machines
TCP	Tool Center Point	Chatter Prediction	Cutting
		Actuator	Machines
TEM	Transmission Electron Microscope	Deformation (Dislocations)	Forming
		Scanning Electron Microscope	Precision Engineering and Metrology
TEM	Transmission Electron Microscopy	Nanoindentation	Surfaces
		Nanotechnology	Surfaces
THF	Tube Hydroforming	Hydroforming (Sheets and Tubes)	Forming
THT	Through-Hole Technology	Wave Soldering	Assembly
TI	Toughness Index	Abrasive Material	Abrasive Processes
TIG	Tungsten Inert Gas	Welding	Assembly
TIPS	Theory of Inventive Problem Solving	TRIZ	Design
TIR	Thermal Infrared Testing	Crack Initiation	Surfaces
TLPB	Transient Liquid Phase Bonding	Diffusion Soldering	Abrasive Processes
TLPS	Transient Liquid Phase Sintering/ Soldering	Diffusion Soldering	Abrasive Processes
TOC	Total Ownership Cost	Life Cycle Cost	Life Cycle Engineering
TOPSIS	Technique for Order of Preference by Similarity to Ideal Solution	Decision-Making	Design
TP	Technological Process	Conceptual Design	Design
TPIF	Two-Point Incremental Forming	Incremental Forming	Forming
TPM	Total Productive Maintenance	Maintenance	Assembly
		Lean Production	Production Systems and Organizations
TPS	Toyota Production System	Lean Production	Production Systems and Organizations
TQC	Total Quality Control	Quality Assurance	Precision Engineering and Metrology
TQM	Total Quality Management	Cooperative Engineering	Production Systems and Organizations
		Manufacturing System	Production Systems and Organizations
TRIZ	Teoria Reshenia Izobretatelskih Zadatch (rus)	TRIZ	Design
TS	Thermosonic	Wire Bonding	Assembly
TS	Technical System	Conceptual Design	Design
TSP	Traveling Salesman Problem	Logistics	Production Systems and Organizations
TTI	Thermal Toughness Index	Abrasive Material	Abrasive Processes

(*continued*)

Abbreviation	Explanation	Term	Section
TTRS	Technologically and Topologically Related Surfaces	Tolerancing	Design
UAM	Ultrasonic Additive Manufacturing	Additive Manufacturing Technologies	Electrophysical and Chemical Processes
UDT	Universal Design Theory	Design Methodology	Design
UHP	Ultrahigh-Pressure Pump	Waterjet Cutting	Abrasive Processes
UNEP	United Nations Environment Programme	Cleaner Production	Life Cycle Engineering
UP	Ultraprecision	Ultraprecision Grinding	Abrasive Processes
US	Ultrasonic	Wire Bonding	Assembly
USL	Upper Specification Limit	Statistical Process Control	Production Systems and Organizations
USM	Ultrasonic Machining	Actuator	Machines
USM Mills	Ultra-Small Micro-End Mills	Ultra-Small Micro-End Mills	Cutting
UT	Ultrasonic Testing	Crack Initiation	Surfaces
VAM	Vibration-Assisted Machining	Actuator	Machines
VDI	Verein Deutscher Ingenieure	Creep-Feed Grinding	Abrasive Processes
VDI	Virtual Device Metafile	Computer-Aided Manufacturing	Production Systems and Organizations
VGA	Video Graphics Array	Product Architecture	Design
VIM	International Vocabulary of Metrology	Traceability	Precision Engineering and Metrology
VLT	Very Large astronomical Telescopes	Ultraprecision Grinding	Abrasive Processes
VP	Virtual Prototyping	Prototyping	Design
VR	Virtual Reality	Augmented Reality	Design
		Virtual Reality	Design
		Cooperative Engineering	Production Systems and Organizations
		Factory	Production Systems and Organizations
		Production	Production Systems and Organizations
VSD	Value Stream Design	Lean Production	Production Systems and Organizations
VSM	Value Stream Mapping	Lean Production	Production Systems and Organizations
VT	Visual Testing	Crack Initiation	Surfaces
WBCSD	World Business Council for Sustainable Development	Eco-efficiency	Life Cycle Engineering
WCF	Workpiece Coordinate Frame	Process Optimization via Feedrate Scheduling in Milling	Cutting
WCS	Workpiece Coordinate System	Five-Axis Tool Path Generation	Cutting
WEDD	Wire Electro-Discharge Dressing	Dressing	Abrasive Processes
WEDM	Wire Electro-Discharge Machining	Etching	Electrophysical and Chemical Processes
WEEE	Waste Electrical and Electronic Equipment	EOL Treatment	Life Cycle Engineering

(*continued*)

Abbreviation	Explanation	Term	Section
WIP	Work In Process	Material flow	Assembly
		Flexible Manufacturing System	Production Systems and Organizations
WLC	Whole-Life Costing	Life Cycle Cost	Life Cycle Engineering
WMSD	Work-Related Musculoskeletal Disorders	Ergonomic Assessment	Assembly
WT	Wavelet Transformation	Monitoring	Cutting
XPS	X-Ray Photoelectron Spectroscopy	Surface Integrity	Cutting
		Nanotechnology	Surfaces
XRD	X-Ray Diffraction	Surface Integrity	Cutting
ZOA	Zeroth-Order Approximation	Chatter Prediction	Cutting