

THE ENCYCLOPEDIA OF OPERATIONS MANAGEMENT

A FIELD MANUAL AND GLOSSARY
OF OPERATIONS MANAGEMENT
TERMS AND CONCEPTS

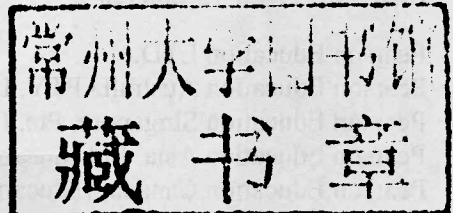
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*The Encyclopedia
of Operations Management*

*A Field Manual and Glossary
of Operations Management Terms
and Concepts*

Arthur V. Hill



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To the author of all truth.

PREFACE

Purpose – The *Encyclopedia of Operations Management (EOM)* is an ideal “field manual” for students, instructors, and practicing managers. For students, the *EOM* is a useful guide for developing an integrated mental map for the entire field of supply chain and operations management. It has also proven useful as a reference for students preparing for case discussions, exams, and job interviews. It is particularly helpful for students new to supply chain and operations management and for international students who need precise definitions of specialized terms. For instructors, the *EOM* is an invaluable desk reference and teaching aid that goes far beyond the typical dictionaries. Many instructors and doctoral students find the numerous figures, graphs, equations, Excel formulas, VBA code, and references helpful for their lectures and research. For practicing managers, the *EOM* is a valuable tool for black belt and green belt training programs and a powerful tool for helping organizations build a precise standard language.

This encyclopedia has proven to be a useful text for core undergraduate and graduate courses in both business and engineering schools. It is also useful for second-level courses in supply chain management, quality management, lean manufacturing, project management, service management, operations strategy, manufacturing management, industrial engineering, and manufacturing engineering.

Coverage – The *EOM* covers a wide range of operations and supply chain management disciplines, including:

- Accounting
- Customer service
- Distribution
- e-business
- Economics/finance
- Forecasting
- Healthcare management
- Human resources management
- Industrial engineering
- Industrial relations
- Inventory management
- Lean sigma (six sigma)
- Lean thinking
- Logistics
- Maintenance/reliability engineering
- Management information systems
- Manufacturing management
- Marketing/sales
- New product development
- Operations research
- Operations strategy
- Organizational behavior/management
- Personal time management
- Production planning and control
- Purchasing/supply management
- Quality management
- Reliability engineering
- Service management
- Simulation
- Sourcing
- Statistics
- Supply chain management
- Systems engineering
- Theory of Constraints
- Transportation
- Warehousing

Format – This book is designed to be an easily carried “field manual.” Each entry begins with a short formal definition followed by a longer description and ends with references to additional resources and cross-references (links) to related terms. The links (cross-references between terms) help the reader develop a complete mental map of the field. Essential terms are marked with a star (★) at the end of the short definition.

History – As a faculty member at IMD International in Lausanne, Switzerland, I gave my MBA students a one-page list of about 50 essential operations management terms. Several students requested help defining those terms. This encyclopedia grew out of my response to those requests. As shown in the table below, the *EOM* has grown in size over the years. This 2012 edition has 540 new entries and nearly twice the number of links. More importantly, the *EOM* has grown in clarity and precision. About 30% of the entries were completely rewritten and many photos, figures, graphs, tables, examples, references, and footnotes were added and improved. We compressed the 2012 edition by about 50 pages so it is still a handy “field manual.” We did this by removing white space, shrinking figures, shortening longer entries, and combining entries to reduce redundancies.

Comments, additions, and edits are welcomed and should be sent to the author at ahill@umn.edu. Substantive contributions will be acknowledged in the next edition.

Edition	Terms	Links	References	Pages
2001	291	0	~20	32
2005	533	~500	~50	97
2007	1,089	2,917	~100	288
2010	1,250	3,500	170	360
2012	1,790	6,992	281	400

Arthur V. Hill, Associate Dean for MBA Programs, John & Nancy Lindahl Professor, Operations & Management Science Department, Curtis L. Carlson School of Management, University of Minnesota

HOW READERS CAN USE THIS ENCYCLOPEDIA

Most students, instructors, and managers struggle to build a simple framework for the supply chain and operations management discipline. Although most standard texts offer some type of framework, none of these frameworks has been widely accepted. The SCOR framework has gained wide acceptance for supply chain management, but less so for operations management. (See the *SCOR* entry.) This author helped create an award-winning framework published in Hays, Bouzdine-Chameeva, Meyer Goldstein, Hill, and Scavarda (2007). (See the *operations management* entry.) More recently, this author developed the much simpler “Better-Faster-Cheaper-Stronger” framework that is based on the following four fundamental premises:

Premise 1: All work is a process.

Premise 2: All processes can be improved.

Premise 3: Processes are improved by making them better, faster, cheaper, and stronger.

Premise 4: Improved processes add more value to customers, shareholders, employees, and society.

Better processes create products and services that more reliably meet customer requirements for both tangible and intangible product attributes. **Faster** processes require less time and provide more customization. **Cheaper** processes reduce cost by achieving a better balance between supply and demand and by improving the product and service design. **Stronger** processes are better aligned with higher-level strategies, are more sustainable, and better mitigate risks. This framework has a logical order. We start with customer requirements for performance and reliability (**better**); then we reduce cycle time for both standard and customized products by reducing non-value added activities (**faster**); then we reduce cost by balancing supply and demand and improving product design (**cheaper**); and finally we make sure that our processes are aligned with our strategic intent, sustainability goals, and safety requirements (**stronger**). It is important to select a limited set of **balanced metrics** to support organizational efforts to make processes better, faster, cheaper, and stronger. Note that this framework is consistent with the sand cone model developed by Ferdows and De Meyer (1990).

In this author’s experience, students and managers enthusiastically embrace the four premises and quickly become passionate about making their processes (and lives) better, faster, cheaper, and stronger. This framework is simple, compelling, easy to remember, and easy to apply to any process in any business function (e.g., marketing, sales, finance, MIS, HR, accounting, operations, logistics) in any organizational context (e.g., healthcare, government, education, not-for-profits, distribution, retailing, transportation, and manufacturing).

This *Encyclopedia of Operations Management* can help you quickly develop a complete mental map of the entire supply chain and operations management discipline – and help you learn how to make your processes better, faster, cheaper, and stronger. Start by studying the bulleted topics in the framework below. Then follow the links at the end of each entry to the related entries to master the entire subject. Also, make sure you have a clear understanding of the performance metrics needed to support each of the four dimensions. Pay particular attention to the essential terms marked with a star (★) at the end of the short definition and listed in this preface.

	Better	Faster	Cheaper	Stronger
Topics	<ul style="list-style-type: none"> Voice of the customer New product development Quality management Service quality Process design Process improvement programs 	<ul style="list-style-type: none"> Project management Theory of Constraints Mass customization Time based competition Learning & job design Lean thinking Setup reduction (SMED) 	<ul style="list-style-type: none"> Sourcing/purchasing Supply Chain Management Logistics & transportation Inventory management Demand management Capacity management Design for Manufacturing 	<ul style="list-style-type: none"> Operations strategy Hoshin planning/X-Matrix Risk management Failure Mode and Effects Analysis (FMEA) Safety Green supply chain
Metrics	<ul style="list-style-type: none"> Product performance Customer satisfaction and loyalty metrics Process capability and performance metrics Service related metrics 	<ul style="list-style-type: none"> Time metrics (e.g., cycle time, customer leadtime) Learning rate metrics Theory of Constraints metrics Lean metrics 	<ul style="list-style-type: none"> Cost metrics Inventory metrics Forecast error metrics Equipment metrics Warehousing metrics Transportation metrics 	<ul style="list-style-type: none"> Income statement Balanced scorecard metrics Environmental metrics Triple bottom line metrics Risk assessment metrics Safety metrics

HOW INSTRUCTORS CAN USE THIS ENCYCLOPEDIA

Instructors have found the *Encyclopedia of Operations Management (EOM)* to be a valuable “field manual” for a variety of courses and training programs. These include:

- **Case courses without textbooks** – The *EOM* is an authoritative supplement for a case course. The *EOM* provides a precise “language” for supply chain and operations management to help students learn key terms in the context of a teaching case.
- **Case or lecture courses with textbooks** – Even if your course uses a textbook, the *EOM* is a valuable supplement to provide precise definitions for important terms that are not always defined in standard textbooks. No textbook can provide the depth and breadth found in the *EOM*. The extensive linked lists help the reader develop a complete mental map of the field.
- **Lean sigma training courses** – The *EOM* defines nearly all terms used in lean sigma, lean six sigma, and lean training programs. Many *EOM* entries include examples and references that go well beyond what is offered in any other lean sigma book available on the market today. The *EOM* is an indispensable reference for lean sigma training programs and is the only reference that pulls together all major tools and concepts in a precise and easy-to-use “field manual.”

Instructors have found practical ways to use the *Encyclopedia of Operations Management*, including:

- Use the terms in the context of class discussions and refer students to the *EOM* for precise definitions.
- Assign key terms to be studied as a part of the syllabus, case studies, and homework assignments.
- Hold students accountable for mastering the key terms used in classroom discussions, exams, and homework assignments. Use homework assignments and exams to test student understanding of the terms and concepts and their ability to apply concepts and tools to solve practical problems.

ABOUT THE AUTHOR



Arthur V. Hill is the Associate Dean for MBA Programs in the Carlson School of Management and the John and Nancy Lindahl Professor for Excellence in Business Education in the Operations and Management Science Department at the University of Minnesota. He holds a B.A. in Mathematics from Indiana University, an M.S. in Industrial Administration, and a Ph.D. in Management from the Krannert School of Management at Purdue University. Professor Hill was the Co-Editor-in-Chief of the *Journal of Operations Management*, a leading academic research journal in the field. He is a Fellow of the American Production Inventory Control Society and wrote the APICS CPIM and CIRM certification exams for many years. He served two terms on the board of POMS (VP Education and VP Finance), the world’s leading society for operations management professors. Dr. Hill has been a professor at the Carlson School of Management for more than 30 years and currently teaches supply chain and

operations management for courses for full-time MBA, executive MBA, and doctoral students. He has held visiting faculty positions on four continents – Visiting Associate Professor at Indiana University, Professor at IMD International in Lausanne, Switzerland, Guest Professor at Wits Business School in Johannesburg, South Africa, and a Distinguished Visiting Professor at the National University of Singapore. He also helped found a management institute in Moscow. He has won numerous teaching awards, authored more than 90 research articles, and consulted for over 100 firms including 3M, Allianz, Bank of America, Best Buy, Boston Scientific, Cargill, CentraCare, Ceridian, Delta Air Lines, Deutsche Bank, Easter Seals/Goodwill, Ecolab, FMC, General Mills, GMAC, Goodrich, Home Depot, Honeywell, Honeywell Bull (Switzerland), Imation, JPMorgan Chase, Land O’Lakes, Mayo Clinic, Medtronic, Methodist Hospital, Nestlé, Park Nicollet Health Services, Prime Therapeutics, Radisson, SPX, St. Jude Medical, Staples, Target, Toro, Tyco/ADC, United Healthcare, U.S. Bank, and Wells Fargo. His current research focuses on process improvement and supply chain management.

QUOTES FROM EXECUTIVES

Phillip Brooks, CEO and owner of H. Brooks and Company

"Art Hill has played a key role in the development of our continuous improvement teams. Art is a master teacher and mentor and his *Encyclopedia of Operations Management* serves as a cornerstone reference and tool kit for our company."

Dr. Richard Chua, Executive Vice President, Juran Institute, Inc.

"An excellent, quick but thorough reference for anyone involved in managing or improving operations in any organization. The only book of its kind!"

Lee Cockerell, Executive Vice President, Walt Disney World Resort (Retired)

"The *Encyclopedia of Operations Management* is very well done and I am enjoying reading it."

Joe Dehler, Vice President, Business Process Improvement, Carlson Companies (Retired)

"The *Encyclopedia* will take a place on my office bookshelf next to the quality handbook by Dr. Juran as one of my go-to references. This book has packed so much into one reference. Nicely done!"

Connie Fuhrman, Senior Vice President, Operations Transformation, Best Buy (retired)

"With the pace of change in the business world today, crystal clear communication has become an important management tool. Lack of clarity leads to more waste and errors than any other single factor. This definitive encyclopedia of terms and frameworks should become THE industry standard."

Doug Glade, Vice President, Operations, NestléHealthScience, N.A.

"An excellent resource for both operations professionals and business leaders that provides a common language and definitions to use in improving value chain processes."

James Green, President and CEO, Kemps, LLC

"We have experienced Art Hill's effective training first-hand in our lean sigma program at Kemps, where his program has had an immediate and sustainable impact. Art's new book will be a great resource for all participants in our lean sigma program going forward."

Rick Heupel, Vice-President, Asia Operations, Seagate (retired)

"An invaluable tool for effectively navigating and understanding the rapidly developing technologies in today's modern age of operations."

Adam Hjerpe, Senior Vice President – Distribution Operations, United Health Group

"In today's fast-paced and complex environment, Art's encyclopedia is a must-have reference for any operations manager, new or experienced."

Michael Hoffman, Chairman and CEO, The Toro Company

"Art Hill's new encyclopedia is an excellent source of information for all who are involved in operations management – from business professionals to students. Having both worked and studied under Professor Hill, I know the quality of his work and teaching."

Charlie Honke, Partner, Product Lifecycle Management, IBM Global Business Services

"An excellent, comprehensive, and complete reference that students, consultants, supply chain practitioners, and professionals can use to quickly and easily obtain value to support their educational and professional endeavors."

Paul Husby, Vice President, 3M Supply Chain and Logistic Operations (retired)

"A valuable resource for supply chain professionals, executives, and managers from all business functions."

Tim Larson, Chief Procurement Officer, Michael Foods, Inc.

"Finally, a definitive and comprehensive source of supply chain terminology. This book should be within reach of everyone involved with leading, managing, or learning about supply chain management."

Sandy Meurlot, Vice President of Operations, The Toro Company

"Finally, a comprehensive tool that will aid both the new and experienced operations practitioner in understanding the evolving technological landscape of manufacturing."

Tom Platner, Vice President, Global Product Engineering, HID Global

"We've all heard the terms and like to think we can keep them straight, but in this increasingly complex world, having this ready reference is absolutely essential for practitioners and managers alike."

Mike St. Martin, VP of Express Operations, FedEx Express

"It's a great resource to quickly reference specific operations management terms and acronyms for anyone in business or academics. I will use it!"

QUOTES FROM PROFESSORS AND STUDENTS

Professor Tatiana Bouzdine-Chameeva, Head of the Department of Information, Decision and Management, Bordeaux Business School, France

"This is a GREAT book – fascinating, rich in contents, covering a wide range of disciplines. It will become one of the most precious books in my professional library and will become THE REFERENCE for my students."

Professor Rodney A. Erickson, Executive Vice President and Provost, The Pennsylvania State University

"I'm thoroughly impressed with everything about it, the scope, the attention to detail, the clarity of explanations, and the references for further reading. I can certainly understand why students have reacted so positively to it."

Professor Nancy Hyer, Owen Graduate School of Management, Vanderbilt University

"What an amazing reference! I'm preparing a new reading for my MBA students and the *Encyclopedia* provided the perfect place for me to check definitions. This was really, really helpful."

Professor Amitabh Raturi, Professor and Director of Industrial Management, University of Cincinnati

"A fantastic effort ... the first major effort in our field to systematize the knowledge domains in a concise and lucid style."

Professor Kalyan Singhal, McCurdy Professor of Operations Management, Editor-in-Chief, Production and Operations Management, Merrick School of Business, University of Baltimore

"It is an excellent resource for students and operations managers."

Professor Sum Chee Chuong, Associate Professor, National University of Singapore Business School

"An essential, authoritative resource for students, professors, and practitioners. This is a timely effort and Art has done an excellent job in putting together a much-needed reference. Given the pervasiveness of operations, this reference will be extremely useful to managers and executives from all functional areas."

Professor D. Clay Whybark, Macon G. Patton Distinguished Professor of Operations, Technology and Innovation Management (OTIM), University of North Carolina – Chapel Hill

"Art has done us a great service with this comprehensive, completely cross-referenced, and clearly communicated collection. It is required reading for all operations professionals."

Peter Anderson, CSOM BSB Marketing & Entrepreneurial Management 2011

"The well-thought-out definitions and detailed summaries of the various terms and concepts in this encyclopedia made operations a much easier subject to learn and understand."

Nathan Breuer, CSOM BSB 2012

"I really enjoyed the *Encyclopedia*. It was helpful to have the terms in one convenient book. I liked how the explanations and examples helped me comprehend the terms. I will definitely keep this to use in the future."

Ceci Marn, CSOM MBA 2011

"The *Encyclopedia* is my go-to-source for starting research, looking up business terminology, and finding ideas. I used it throughout my summer internship and it's the one book that will find a permanent place in my office."

Brent Miller, CSOM BSB 2011

"I really liked the *Encyclopedia of Operations Management*. It helped me get through my operations class quite easily! I highly recommend this book. It offers excellent, in-depth insight into modern operations issues."

Kathryn Pahl, CSOM BSB 2013

"I loved using this encyclopedia. It was very descriptive and I found it more helpful than our class textbook."

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ESSENTIAL SUPPLY CHAIN AND OPERATIONS TERMS

Every supply chain and operations student and manager should have a good understanding of these essential terms. These are marked with the symbol ★ at the end of the short definitions in this encyclopedia.

5S
 8 wastes
 A3 Report
 ABC classification
 acceptance sampling
 Activity Based Costing (ABC)
 affinity diagram
 appraisal cost
 assemble to order (ATO)
 automation
 balanced scorecard
 bathtub curve
 benchmarking
 bill of material (BOM)
 bottleneck
 break-even analysis
 bullwhip effect
 capacity
 carrying charge
 carrying cost
 causal map
 cellular manufacturing
 commodity
 commonality
 control chart
 control plan
 core competence
 cost of quality
 critical path

Critical Path Method
 customer leadtime
 cycle counting
 cycle stock
 cycle time
 decision tree
 Delphi forecasting
 demand
 demand management
 Design for Manufacturing (DFM)
 direct labor cost
 diseconomy of scale
 distribution
 distribution channel
 Drum-Buffer-Rope (DBR)
 Economic Order Quantity
 economy of scale
 economy of scope
 effectiveness
 efficiency
 employee turnover
 engineer to order (ETO)
 Enterprise Resources Planning (ERP)
 ergonomics
 error proofing
 exponential smoothing
 facility layout
 facility location

Failure Mode and Effects Analysis (FMEA)
 financial performance metrics
 finished goods inventory
 flexibility
 focused factory
 forecast error metrics
 forecasting
 Gantt Chart
 half-life curve
 industrial engineering
 inspection
 inventory management
 inventory position
 inventory turnover
 Ishikawa Diagram
 jidoka
 job design
 job enlargement
 job shop
 Just-in-Time (JIT)
 kaizen
 kanban
 leadtime
 lean sigma
 lean thinking
 learning curve
 learning organization
 linear regression

Little's Law	periods supply	standard cost
logistics	picking	standard deviation
lotsizing methods	postponement	standard time
make to order (MTO)	preventive maintenance	standardized work
make to stock (MTS)	probability density function	starving
make versus buy decision	probability distribution	Statistical Process Control
Malcolm Baldrige National Quality Award (MBNQA)	process	stockout
manufacturing order	process capability and performance	Strategic Business Unit
manufacturing processes	process design	strategy map
mass customization	process improvement program	sunk cost
Master Production Schedule	process map	supplier
Materials Requirements Planning (MRP)	product design quality	supply chain management
Mean Absolute Deviation (MAD)	production planning	sustainability
Mean Absolute Percent Error (MAPE)	productivity	switching cost
median	product-process matrix	system
min/max inventory system	program management office	takt time
modular design (modularity)	project charter	tampering
moment of truth	project management	Theory of Constraints
moving average	pull system	time series forecasting
muda	purchase order (PO)	time study
Murphy's Law	purchasing	time-based competition
Net Present Value (NPV)	push-pull boundary	Total Productive Maintenance (TPM)
New Product Development (NPD)	Quality Function Deployment (QFD)	Total Quality Management (TQM)
newsvendor model	quality management	Transportation Management System (TMS)
Nominal Group Technique (NGT)	queuing theory	trend
normal distribution	Radio Frequency Identification (RFID)	utilization
normal time	reorder point	value added ratio
offshoring	respond to order (RTO)	value chain
on-hand inventory	Root Cause Analysis (RCA)	value stream map
on-order inventory	safety stock	variance
open order	Sales & Operations Planning (S&OP)	vendor managed inventory
operations management	SCOR Model	vertical integration
operations performance metrics	service failure	voice of the customer
operations research (OR)	service guarantee	wait time
operations strategy	service level	warehouse
opportunity cost	service management	Warehouse Management System (WMS)
outsourcing	service quality	work breakdown structure
overhead	service recovery	work measurement
Pareto Chart	setup cost	Work-in-Process (WIP) inventory
Pareto's Law	setup time reduction methods	x-bar chart
Parkinson's Laws	setup time	yield
part number	shop floor control	yield management
PDCA	simulation	
periodic review system	slack time	
	sourcing	

NEW ENTRIES IN THIS EDITION

The list below the 540 new entries in this edition. Revised entries are not listed here.

1-10-100 rule	ANOVA	backward pass
3Gs	anticipation inventory	balance sheet
6Ps	antitrust laws	Baldrige Award
7S Model	Application Service Provider (ASP)	bar chart
8 wastes	assembly	barter
80-20 rule	asset turnover	batch
acquisition	autocorrelation	Bayes' Theorem
ad hoc committee	Automated Data Collection (ADC)	Bernoulli distribution
ADKAR Model for Change	Automated Identification and Data Capture (AIDC)	beta function
aftermarket	Automatic Call Distributor (ACD)	bid rigging
allocated inventory	autonomous workgroup	big box store
allocation	back office	bill of material implosion
Analysis of Variance (ANOVA)	back scheduling	bimodal distribution
Analytic Hierarchy Process (AHP)		bin

blind count	customer service	factorial
blow through	customization flexibility	family
box and whisker diagram	dampened trend	Fast Moving Consumer Goods (FMCG)
box plot	days on hand	fast tracking
Box-Muller method	days supply	FED-up model
bribery	Decision Support System (DSS)	field service
broker	decomposition	firm order
business capability	defect	firm planned order
business process mapping	Defective Parts Per Million (DPPM)	first article inspection
buy-back contract	deliverables	five forces analysis
cap and trade	demonstrated capacity	fixed price contract
capacity cushion	design quality	float time
capacity management	devil's advocate	floor stock
carbon footprint	die	flow rack
cargo	die cutting	FMCG
carousel	digital supply chain	focus group
carrier	dimensional weight	force field analysis
cash cow	direct cost	force field diagram
casting	directed RF picking	forecast consumption
catchball	discounted cash flow	forging
category captain	discrete order picking	forklift truck
category validator	discrete probability distribution	forming-storming-norming-performing model
causal forecasting	dispatch list	formulation
caveat emptor	distribution network	forward pass
CEMS (Contract Electronics Manufacturing Services)	distributor	forward pick area
CGS (Cost of Goods Sold)	diversion	foundry
chain of custody	dock	fractile
change management	dollar unit sampling	front office
changeover	downtime	frozen schedule
channel	DPPM	fulfillment
chargeback	dual source	full truck load
Chebyshev's inequality	due diligence	future reality tree
checklist	dunnage	futures contract
checksheet	DuPont STOP	gap model
child item	durability	gateway workcenter
chi-square distribution	Durbin-Watson Statistic	GATT
cloud computing	earliness	gauge
coefficient of determination	early detection	gemba walk
combinations	earned hours	General Agreement on Tariffs and Trade (GATT)
committee	effective capacity	genetic algorithm
competitive analysis	Efficient Consumer Response (ECR)	geometric progression
consignee	eighty-twenty rule	geometric series
consolidation	e-kanban	Global Data Synchronization Network (GDSN)
constraints management	Electronic Product Code (EPC)	Good Manufacturing Practices (GMP)
continuous probability distribution	Electronics Manufacturing Services (EMS)	goodwill
Contract Electronics Manufacturing Services (CEMS)	empathy	gravity flow rack
contract warehouse	empowerment	gray market
control limit	EMS (Electronics Manufacturing Services)	gray market reseller
coordinate the supply chain	energy audit	green supply chain
cost center	engineering change review board	gross weight
covariance	Erlang C formula	Growth-Share Matrix
crashing	error function	help desk
cross-functional team	error proofing	hoshin planning
cross-selling	ethnographic research	human resources
Croston's Method	Everyday Low Pricing (EDLP)	implementation
CRP (Capacity Requirements Planning)	executive sponsor	implied shortage cost
cube utilization	expatriate	inbound logistics
cumsum control chart	expedite	income statement
cumulative distribution function	expert system	incoming inspection
cumulative sum control chart	extrinsic forecasting model	Incoterms
current reality tree	extrusion	incremental cost
Customer Effort Score (CES)	fabrication	

indented bill of material	locator system	on-time delivery (OTD)
indirect cost	lockbox	open order
indirect labor	logistics network	operation
indirect materials	Lorenz Curve	operation overlapping
industry analysis	lot	Optical Character Recognition (OCR)
infinite capacity planning	lot traceability	optimization
infrastructure	lot tracking	order cycle
input/output control	low level code	order entry
in-stock	Maintenance-Repair-Operations (MRO)	order fulfillment
intellectual property (IP)	Management By Objectives (MBO)	order quantity modifier
interchangeable parts	management by walking around	order-up-to level
intermittent demand	manifest	ordinal scale
intermodal shipments	Manufacturing and Service Operations	organizational design
internal setup	Management Society (MSOM)	organizational structure
interoperability	manufacturing order	Original Design Manufacturer (ODM)
interplant order	manufacturing processes	OSHA
interpolated median	manufacturing strategy	outbound logistics
interquartile range	marginal cost	outlier
interval notation	market pull	Over/Short/Damaged Report
interval scale	master scheduler	overlapping
in-transit inventory	materials handling	pacing process
intrinsic forecasting model	matrix organization	packing slip
inventory valuation	mean	pallet
investment center	Measurement System Analysis (MSA)	parent item
invoice	Mergers and Acquisitions (M&A)	Pareto efficiency
islands of automation	Metcalf's Law	Pareto optimality
ISO	milestone	parking lot
ISO 26000	min-max inventory system	part period balancing
ISO 9001:2008	mix flexibility	Parts Per Million (PPM)
issue	mode	pay for performance
issue log	mold	pay for skill
item master	MRO	percentage bill of material
job	multiple source	performance-based contracting
job design	multiplication principle	period cost
job enrichment	NAFTA	periods supply
jobber	nanotechnology	permutations
Joint Commission (JCAHO)	nearshoring	phantom
joint venture	necessary waste	physical inventory
just do it	negative binomial distribution	piece work
kaizen workshop	negative exponential distribution	pilot test
kickback	net change MRP	planned obsolescence
KISS principle	net weight	planning bill of material
kitting	neural network	planning horizon
KJ method	new product flexibility	point of use
knowledge work	newsvendor problem	Porter's Five Forces
knowledge worker	Newton's method	post-project review
kurtosis	nominal scale	predatory pricing
labor grade	normalization	premium freight
lagging indicator	North American Free Trade Agreement	prevention
landed cost	(NAFTA)	price fixing
late configuration	np-chart	primary location
late customization	objective function	Principal Components Analysis (PCA)
lateness	obsolete inventory	private label
legacy system	Occam's Razor	probability density function
level	Occupational Safety and Health	probability distribution
level loading	Administration (OSHA)	probability mass function
level of service	Ockham's Razor	process flowchart
level strategy	OCR	product family
Lewin/Schein Theory of Change	ODM (Original Design Manufacturer)	product life cycle management
life cycle cost	one-minute manager	product mix
life cycle planning	on-hand inventory	product proliferation
linearity	on-order inventory	product rationalization
load	on-the-job training (OJT)	production activity control
load report	on-time and complete	production line

production linearity	run chart	supplier
production order	runs test	SWOT analysis
production plan	SaaS	systems engineering
production smoothing	safety	tare weight
profit center	Sales Inventory & Operations Planning (SI&OP)	target market
project management triangle	sampling distribution	tariff
project network	sand cone model	task interleaving
project team	satisfaction	technology push
promotion	scale count	technology transfer
prototype	scales of measurement	telematics
pseudo bill of material	scheduled receipt	theoretical capacity
public warehouse	scope	tier 1 supplier
pull system	scree plot	time bucket
purchase order (PO)	scrum	time burglar
pushback	self-check	time management
put away	self-directed work team	Time Phased Order Point (TPOP)
Pythagorean Theorem	serial number traceability	time series forecasting
qualitative forecasting methods	service management	tolerance
quantitative forecasting methods	service marketing	tooling
quantity flexible contracts	service operations	TPOP
queue	serviceability	trade barrier
quick hit	setup time reduction methods	trade promotion allowance
RACI Chart	shop calendar	traffic management
rack jobber	shop packet	trailer
random variable	shortage cost	transfer price
RASCI	shortage report	transportation
rated capacity	single-piece flow	traveler
ratio scale	skewness	trimmed mean
reality tree	skid	truck load
real-time	slotting	true north
receiving	slotting fee	turnaround time
reconciliation	slow moving inventory	turnkey
regeneration	SMART goals	two-minute rule
reintermediation	Software as a Service (SaaS)	two-second rule
Reliability-Centered Maintenance (RCM)	Spearman's Rank Correlation	u-chart
repatriate	spend analysis	unfair labor practice
repetitive manufacturing	sponsor	unnecessary waste
replenishment order	sprint burndown chart	value stream
repositioning	square root law for safety stock	VBA
request date	stabilizing the schedule	Vehicle Scheduling Problem (VSP)
Request for Information (RFI)	staging	version control
Request for Quotation (RFQ)	stakeholder	Visual Basic for Applications (VBA)
requisition	stamping	Voice of the Process (VOP)
reserve storage area	standard hours	volume flexibility
resilience	Standard Operating Procedure (SOP)	waiting line
restocking charge	standard parts	warehouse
Return Goods Authorization (RGA)	standard products	waste walk
Return Material Authorization (RMA)	statement of work (SoW)	weeks supply
return to vendor	steering committee	weighted average
revenue center	stock	what-if analysis
revenue sharing contract	stock position	where-used report
revision control	stratified sampling	white goods
revision level	Student's t distribution	wholesale price
rework	subassembly	wholesaler
right of first refusal	subcontracting	work design
risk management	Subject Matter Expert (SME)	work order
risk sharing contract	subtraction principle	workflow software
root cause tree	successive check	X-Matrix
R-squared	super bill of material	

0-9

1-10-100 rule – See *cost of quality*.

3Ds – The idea that an evaluation of a potential automation project should consider automating tasks that are dirty, dangerous, or dull.

The picture at the right is the PackBot EOD robot from the iRobot Corporation designed to assist bomb squads with explosive ordinance disposal. This is a good example of the second “D.”

See *automation*.

3Gs – A lean management practice based on the three Japanese words *gemba*, *genbutsu*, and *genjitsu*, which translate into “actual place,” “actual thing,” and “actual situation” or “real data.”

- *Gemba* (or *genba*) – The actual place where work takes place and value is created.
- *Genbutsu* (or *genbutsu*) – The actual things (physical items) in the *gemba*, such as tools, machines, materials, and defects.
- *Genjitsu* (or *jujitsu*) – The real data and facts that describe the situation.

In Japanese, *Genchi Genbutsu* (現地現物) means to “go and see” and suggests that the only way to understand a situation is to go to the *gemba*, which is the place where work is done.

See *gemba*, *lean thinking*, *management by walking around*, *waste walk*.

3PL – See *Third Party Logistics (3PL) provider*.

5 Whys – The practice of asking “why” many times to get beyond the symptoms and uncover the root cause (or causes) of a problem.

Here is a simple example:

- Why did the ink-jet label system stop printing? *The head clogged with ink.*
- Why did the head clog with ink? *The compressed air supply had moisture in it.*
- Why did the compressed air supply have moisture in it? *The desiccant media was saturated.*
- Why was the desiccant media saturated? *The desiccant was not changed prior to expiration.*
- Why was the desiccant not changed prior to expiration? *A change procedure does not exist for the compressed air desiccant.*

Galley (2008) and Gano (2007) argue persuasively that problems rarely have only one cause and that assuming a problem has only single root cause can prevent investigators from finding the best solution.

The focus of any type of root cause analysis should be on finding and fixing the system of causes for the problem rather than finding someone to blame. In other words, use the 5 Whys rather than the 5 Who’s.

See *Business Process Re-engineering (BPR)*, *causal map*, *error proofing*, *impact wheel*, *kaizen workshop*, *Root Cause Analysis (RCA)*.

5S – A lean methodology that helps organizations simplify, clean, and sustain a productive work environment. ★

The 5S methodology originated in Japan and is based on the simple idea that the foundation of a good production system is a clean and safe work environment. Translated from Japanese words that begin with the letter “S,” the closest English equivalents normally used are Sort, Set in order, Shine, Standardize, and Sustain. The following list is a combination of many variants of the 5S list found in various publications:

- **Sort** (separate, scrap, sift) – Separate the necessary from the unnecessary and get rid of the unnecessary.
- **Set in order** (straighten, store, simplify) – Organize the work area (red tag, shadow boards, etc.) and put everything in its place.
- **Shine** (scrub, sweep) – Sweep, wash, clean, and shine everything around the work area.
- **Standardize** – Use standard methods to maintain the work area at a high level so it is easy to keep everything clean for a constant state of readiness.
- **Sustain** (systematize, self-discipline) – Ensure that all 5S policies are followed through the entire organization by means of empowerment, commitment, and accountability.

