CPIM

Certified in Production and Inventory Management

Basics of Supply Chain Management

Version 4.4—January 2016

Instructor Upgrade Packet

APICS

Basics of Supply Chain Management
Version 4.4 – January 2016
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All material can be downloaded from the instructor community by selecting the file ***BSCM v4.4 IG Download Packet.pdf***

Page	Change	Page Replaced	Visual Number (if Updated)
All pages of About This Guide	In "About This Guide," page I-iii, under "Exam Content Manual," second paragraph, delete the last sentence: "Candidates should understand the definitions of the key terms in the content outline, as well as the outlined techniques – why and how to apply them and which ones to select for different situations." Add the following new fourth paragraph to this section: "Candidates should understand the definitions of the key terms in the ECM, why and how to apply them, and which ones to select for different situations. The CPIM courseware covers many, but not all, of the key terms in the ECM. Therefore, candidates should supplement their learning by studying the ECM key term list using the APICS Dictionary or other ECM references as a guide." On page I-viii, at the bottom, add a section describing the APICS CPIM Study Tools.	All pages of About This Guide	n/a
1-12	On page 1-12, add "Answer" above the answer to the question.	1-12	n/a
1-22	On Visual 1-16, change the title from "Global Environment" to "Business Environment"	1-22	1-16
1-33	On page 1-33, under "Product Life Cycle," fifth bullet, change first sentence from "Some authors add a phase-out stage, …" to "Some authors add a phase-out (end-of-life) stage, …"	1-33	n/a
1-51	On page 1-51, second set of bullets, second bullet, change "low production efficiency, or the ability to interrupt production schedules, short runs, and so on" to "the ability to interrupt production schedules, short runs, and so on, resulting in low production efficiency"	1-51	n/a

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Page	Change	Page Replaced	Visual Number (if Updated)
1-52	On page 1-52, add a note at the bottom of the page: “Note: The fourth perspective of the balanced scorecard, "innovation and learning," is cited as "learning and growth" by some texts.”	1-52	n/a
1-58, 1-59	On page 1-58 and 1-59, insert a note that the MPC hierarchy shown on Visual 1-49 is enlarged in the appendix to this session.	1-58, 1-59	n/a
1-61	On Page 1-61, delete the first sentence "MPC is IT-driven."	1-61	n/a
1-73	Add a new page 1-73 and place an enlargement of the MPC planning hierarchy from Visual 1-49.	1-73	n/a
2-10	On Visuals 2-9, increase the font size of the first line to match the standard style.	2-10	2-9
2-46	On Visual 2-55, increase the font size of the first line to match the standard style.	2-46	2-55
3-53	On page 3-53, 1st bullet, change "… anticipated build schedule for end items." to "… anticipated build schedule."	3-53	n/a
3-64	On page 3-64, in the answer to number 4, add the closing parenthesis to change "(demand is unpredictable" to "(demand is unpredictable)" and change “…”and *d* (customer requires special engineering” is incorrect” to “…and *d* (customer requires special engineering).”	3-64	n/a
4-14	On Visual 4-12, remove the rows for Base, Frame, and Top from the BOM.	4-14	4-12
5-12	On Visual 5-13, move the first bullet “Demonstrated capacity is calculated from historical data.” to become the second main bullet below the “Rated capacity” bullet and its three subbullets.	5-12	5-13
5-51	On page 5-51, in the last paragraph, last sentence, change "ATP" to "APS"	5-51	n/a
5-72	On Visual 5-77, Change second bullet "Actual hours worked" from "10,400" to "10,440"	5-72	5-77

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Page	Change	Page Replaced	Visual Number (if Updated)
6-6	On Visual 6-5, "Operations" row, right column, change "Maintenance, repair, and operating supplies" to "Maintenance, repair, and operating (or overhaul) supplies"	6-6	6-5
7-34	On page 7-34, last question, change "Ask what happens to safety stock as random variation increases." to "Ask if random variation increases and the service level remains the same, what action should be taken with safety stock? Change the answer to the last question from "Safety stock increases" to "Safety stock should be increased accordingly."	7-34	n/a
7-35	On page 7-35, change the last question from "What happens to safety stock as random variation increases?" to "If random variation increases and the service level remains the same, what action should be taken with safety stock?"	7-35	n/a
7-36	On page 7-36, last question icon, change the second sentence from "Ask what happens to safety stock if the lead time increases." to "Ask if lead time increases and the service level remains the same, what action should be taken with safety stock? In the answer to the last question, second sentence, change "If the lead time increases, safety stock also would increase." to "If the lead time increases, safety stock should be increased accordingly."	7-36	n/a
7-37	On page 7-37, change the last question from "What would happen to safety stock if the lead time were to increase?" to "If the lead time increases and the service level remains the same, what action should be taken with safety stock?"	7-37	n/a
7-40	On Visual 7-33, add "Safety stock = safety factor x MAD =" to the bottom of Step 3.	7-40	7-33

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Page	Change	Page Replaced	Visual Number (if Updated)
7-48	On Visual 7-42, move the target level up and adjust the Q1 lines to correct the graph.	7-48	7-42
7-58, 7-59	On Visual 7-53 and the lower table on page 7-59, expand the values in the "Cumulative percent dollar usage" column to one decimal place.	7-58, 7-59	7-53
8-14	On page 8-14, in the "Discuss" paragraph under Visual 8-14, add the following as a last sentence: "Discuss participant's perspectives on other factors in selecting suppliers, such as regional requirements and health and safety records."	8-14	n/a
9-10	On Visual 9-10, first column, ninth row, change "Total production maintenance" to "Total productive maintenance"	9-10	9-10
9-50	The bar chart on Visual 9-43 will be changed to a true histogram.	9-50	9-43

APICS CPIM
Exam Content Manual

Version 5.0

Visit **apics.org/ecmerrata** for APICS CPIM Exam Content Manual errata.
Internet links cited in the bibliographic references can be found in a more usable format on the APICS website at **apics.org/cpim**.

The references in this manual have been selected solely on the basis of their educational value to the APICS CPIM certification program and on the content of the material. APICS does not endorse any service or other materials that may be offered or recommended by the authors or publishers of books and publications listed in this manual.

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Letter to Candidates

Dear Candidate:

For more than a generation, the Certified in Production and Inventory Management (CPIM) program has been recognized as the international standard for individual assessment in the field of operations managements as it relates to transformation of products and services. Initiated by APICS in 1973, it provides a standard for individuals and organizations to evaluate their knowledge of this evolving field. APICS has administered more than 1 million tests in over 40 countries, and more than 100,000 professionals have earned the APICS CPIM designation—3,000 of them at the Fellow level. The mission of the APICS CPIM program is to be the premier professional certification for supply chain and operations management that tests the candidate's knowledge and understanding of the principles and practices of operations and inventory management. The APICS CPIM program is designed to educate individuals in the various concepts, methodologies, terminology, and integration of topics within the supply chain and operations manage- ment function and to test candidates' in-depth knowledge of these concepts. APICS has worked to ensure that APICS CPIM exams are consistently reliable and that the highest professional standards are used to develop and administer the program.

Because organizations operate in a changing and challenging international environment, the APICS body of knowledge continues to grow to include recognized concepts and tools to improve competiti- veness and effectiveness organizations. The CPIM Exam Content Manual (ECM) is updated regularly to reflect these changes in the body of knowledge and to assist candidates in their understanding of the scope of material covered in the program.

Using a typical business process orientation, the APICS CPIM program integrates individual modules in a progression of increased understanding.

It is **highly** recommended that candidates follow this sequence of examinations to increase both understanding and success:

1. Entry module—Basics of Supply Chain Management: Terminology and basic concepts related to managing the flow of materials from suppliers to customers both internal and external throughout the supply chain
2. Core competency modules—Master Planning of Resources, Detailed Scheduling and Planning, Execution and Control of Operations: Available methodologies and techniques to drive processes and the application of these techniques
3. Capstone module—Strategic Management of Resources: Choosing the appropriate structures and methodologies to achieve organizational strategic objectives and an understanding of the integration of operations within the greater context of the organization

The following is a summary of each of the APICS CPIM modules.

Basics of Supply Chain Management (BSCM)

As the introductory module, Basics of Supply Chain Management introduces the material presented in depth in the other four modules. **Experience has shown us that APICS CPIM candidates who master the material in Basics of Supply Chain Management first find the other modules easier to understand; therefore, we strongly recommend that all APICS CPIM candidates start with this module.**

This module introduces the definitions and concepts for planning and controlling the flow of products and services into, though, and out of an organization. Many of the key terms in this module are expanded in the other modules. This module explains funda- mental relationships among the various activities that may occur in the supply chain network from suppliers to customers. In addition, the module covers types of manufacturing and service systems, forecasting, master planning, material requirements planning, capacity management,

production activity control, purchasing, inventory management, and distri- bution. Four main management philosophies are covered: enterprise resources planning, lean, quality management, and the theory of constraints.

Master Planning of Resources (MPR)

In Master Planning of Resources, candidates explore processes used to develop sales and operations plans, identify and assess internal and external demand management requirements, planning and replenishment in a networked distribution environment, and gain an understanding of the importance of producing feasible master schedules that are consistent with business policies, objectives, and resource constraints. The module focuses on developing and validating a plan of supply; relating management of demand to manufacturing, distribution and service environments; and developing and validating the master schedule.

Detailed Scheduling and Planning (DSP)

In Detailed Scheduling and Planning, candidates focus on the various techniques for inventory, procurement, and material and capacity scheduling. This module includes detailed descriptions of material requirements planning, capacity requirements planning, inventory management practices, and procurement and supplier planning. Techniques, such as material and capacity-constrained scheduling, are included and applicable to a variety of manufacturing and service organizations. Candidates will also become familiar with sustainable practices, supplier partnerships, lean principles, and outsourcing strategies and techniques.

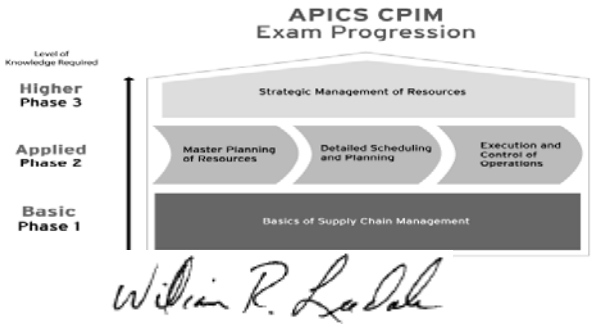
Execution and Control of Operations (ECO)

Execution and Control of Operations focuses on four main areas: execution of operational plans and schedules, control of the work completed and the analysis of results, the management of and communication in the workplace, and the importance of utilizing appropriate design principles. The module explains techniques for scheduling and controlling operations within available capacity and deals with the execution of quality initiatives, cost management, and problem solving. Finally, this module presents techniques for making the most of resources, the environment, and continuous improvement activities.

Strategic Management of Resources (SMR)

In Strategic Management of Resources, candidates explore the relationship of existing and emerging processes and technologies to operations strategy and supply chain-related functions for both manufacturing and service organizations. The module addresses three main topics: understanding the business environment, developing operations strategy, and implementing operations strategy. For maximum comprehension, candidates are strongly encouraged to be familiar with the information and concepts outlined in the other APICS CPIM modules before taking this course. **Historical performance data confirms that candidates who successfully complete the other four modules approximately double their chances of passing the Strategic Management of Resources capstone module.**

The APICS CPIM program continues to evolve, incorporating relevant and current concepts and techniques into the body of knowledge, such as supply chain management, lean, service industries, globalization, theory of constraints, sales and operations planning, outsourcing, critical chain, and sustainability. APICS CPIM is an outstanding educational program, and APICS relies on your comments and suggestions to maintain and improve the program for future candidates. We wish you success in your pursuit of your operations management knowledge.



William R. Leedale, CFPIM, CIRM, and CSCP
Chair, CPIM Subcommittee

Introduction

This ECM provides assistance for those studying in the production and inventory management field, developing and conducting educational courses and workshops, and preparing for the certification examinations. The objective of this manual is to outline the APICS CPIM body of knowledge, which the APICS Certification Committee has organized into five modules:

- Basics of Supply Chain Management
- Master Planning of Resources
- Detailed Scheduling and Planning
- Execution and Control of Operations
- Strategic Management of Resources

In this manual, each exam module begins with a statement of the scope of the subject matter, followed by a descriptive outline of the content as well as a bibliography of the references. Key terminology for the particular exam modules is provided on pages 9–29. Each exam module concludes with sample questions typical of those that appear on the examinations. The correct answers for the sample questions, with brief explanations of why they are correct, appear at the end the manual.

The recommended procedure for mastering the subject matter is to review the content outline, which defines the material, and then to study each topic, using the references. At the end of each major section is a list of the references that apply to the topics in that section. The first number indicates the sequence number for the reference in the Bibliography section, and the numbers in parentheses indicate the chapter(s) within that reference. These outlines form the content and structure for the certification examinations. Candidates should understand the definitions of the key terms in the content outline, as well as the outlined techniques—why and how to apply them and which ones to select for different situations.

New developments in the state of the industry may be described in current literature. Sufficient references are given for each topical area to provide different approaches to material covered in each module and different styles of presenting it. Reading the available APICS periodical material, including *APICS magazine*, the *Production and Inventory Management Journal*, and the *APICS Operations Management Now* e-newsletter will help you maintain an awareness of changes in the state of this discipline.

About the APICS CPIM Examinations

Candidates answer a predetermined number of questions to assess their knowledge in key areas. Each of the APICS CPIM exams (except Basics of Supply Chain Management) consists of 75 multiple-choice questions. The Basics exam consists of 105 multiple-choice questions. There is a three-hour time limit for each APICS CPIM exam. For more information about testing and registration policies and procedures you can download the bulletins from the APICS website at **apics.org/cpim**, or call APICS Customer Service at 1-800-444-2742 (United States and Canada) or +1-773-867-1777.

Students who successfully complete CPIM examinations may be eligible to receive hours of college credit recommendations from the New York State Regents Research Fund, National College Credit Recommendation Service, based on an academic evaluation of student learning outcomes. The semester hours of undergraduate credit per exam are as follows:

- BSCM: 3 semester hours
- MPR: 2 semester hours
- DSP: 2 semester hours
- ECO: 2 semester hours
- SMR: 3 semester hours

Detailed information about the outcomes and credit recommendations is available at **www.nationalccrs.org**. Transcripts are available through APICS.

Question Format

The questions on the CPIM examination are intended to test a candidate's understanding of the CPIM body of knowledge. In addition, it is helpful to understand the various formats of questions on the examination. The following seven examples illustrate the types of multiple-choice questions that may be found on the examination.

For Example 1, choose the response that best completes the statement.

> **Example 1:** The key to a successful production plan is:
>
> (A) capacity requirements planning.
> (B) material requirements planning.
> (C) dynamic priority planning.
> (D) adequate production capacity.
> (The correct answer is D.)

For Example 2, choose the response that best answers the question.

> **Example 2:** Which of the following approaches enables MRP techniques to be used for planning and controlling independent demand items?
>
> (A) pegged orders
> (B) two-bin system
> (C) time-phased order point
> (D) reorder point
> (The correct answer is C.)

For Example 3, choose the one response that does **NOT** correctly complete the statement.

> **Example 3:** Group technology identifies the similarities among all of the following **EXCEPT**:
>
> (A) costs
> (B) parts
> (C) shapes
> (D) processes
> (The correct answer is A.)

For Example 4, another type of multiple-choice question, there are two or more statements, or possibilities. The question, and the statements, are always followed by four-answer choices labeled A, B, C, and D. When answering multiple-choice questions of this type, read each question and the statements carefully to determine whether each statement (I through IV) is true or false.

Next, look at the four choices. While this form of question is increasingly less common, the correct response requires determining if one or a combination of choices best answers the question. In Example 4, you should choose option A if you believe statements I and III are true. You should choose option B if you believe statements I and IV are true. You should choose option C if you believe statements II and III are true. Finally, you should choose option D if you believe statements II and IV are true.

> **Example 4:** If a company changes from make-to-stock to assemble-to-order, the effects on inventory levels are which two of the following?
>
> I. Lower finished-goods inventory
> II. Higher finished-goods inventory
> III. Lower work in process
> IV. Higher work in process
>
> (A) I and III
> (B) I and IV
> (C) II and III
> (D) II and IV
> (The correct answer is B.)

Example 5 is similar to Example 4, but the number of possible combinations is greater. The best strategy for answering these questions is to consider each statement, decide whether it is true, and then search for the correct combination. If the combination you seek is not given, reconsider each statement carefully.

> **Example 5:** Management policies and decisions about which of the following have a direct impact on investment?
>
> I. Customer service levels
> II. Intra-company transportation modes
> III. Placement of distribution centers
> IV. Types of production processes

(A) I and II only
(B) III and IV only
(C) I, II, and IV only
(D) I, II, III, and IV
(The correct answer is D.)

Examples 6 and 7 ask for a judgment or evaluation of the **MOST** or **LEAST** appropriate choice. The judgment is not one person's opinion, but is the accepted choice according to the APICS body of knowledge. Example 6 asks for the **MOST** appropriate choice. Example 7 calls for the **LEAST** appropriate choice.

Example 6: The **MOST** significant advantage of aggregating demand data before they are stored is that:

(A) information about demand is lost.
(B) there is risk of input error in the aggregation process.
(C) data will usually be inconsistent with financial information.
(D) the processing time required to aggregate is extensive.
(The correct answer is A.)

Example 7: Which of the following lot-sizing calculations would be **LEAST** sensitive to changes in unit costs?

(A) least total cost
(B) period order quantity
(C) part period balancing
(D) lot-for-lot
(The correct answer is D.)

Taking the Test

The test is designed to evaluate a candidate's knowledge of the subject matter. Therefore, the key to success is a thorough understanding of the subject matter. All questions are based on the current CPIM body of knowledge as defined in the exam content manual.

When you start your exam, read all the directions carefully. Be sure you understand the directions before you begin to answer any questions.

Read each question carefully and thoroughly. If a question includes stimulus material, such as a table, graph, or situation, be sure to study it before you answer the question. Take care to avoid assuming information not given, as well as assuming you know what is being asked without reading the question completely, or second-guessing the question. Every effort has been made to avoid misleading wording and to provide sufficient information for each question.

Choose the best answer from the choices given. Do not look for hidden tricks or exceptions to the norm. For each question, one and only one of the four choices represents the correct answer.

Once you begin the test, approach the questions in order, but do not waste time on those that are unfamiliar or seem difficult to you. Go on to the other questions and return to the difficult ones later if you have time. If you have some knowledge about a particular question, you may be able to eliminate one or more choices as incorrect. Your score on the test will be based on the number of questions you answer correctly, with no penalty for incorrect answers; therefore, it is to your advantage to guess rather than not answer a question. Avoid changing an answer unless you are absolutely certain that you marked the wrong answer.

Interpreting Test Scores

Scoring is based on your correct responses. There is no penalty for incorrect answers. The omission of an answer will be counted the same as an incorrect answer.

The CPIM scaled score range is 265–330:

265–299: Fail

300–330: Pass

320 and greater: Fellow level

For each examination, you receive a score for the total test. All candidates will also receive diagnostic information on their performance.

Studying for the APICS CPIM Exam

APICS offers a number of resources to help individuals prepare for the APICS CPIM examinations.

APICS CPIM References

Bibliography. The APICS CPIM examination subcommittees have identified a number of references for each APICS CPIM module. These are listed in the bibliography section of each module. All references contain excellent material that will assist in test preparation. For additional information on the APICS CPIM references, visit the APICS website at apics.org/cpim, or call APICS Customer Service at1-800-444-2742 (United States and Canada) or +1-773-867-1777.

A candidate may discover that the material covered in one reference duplicates material covered in another reference. Both sources are included as references to provide candidates some discretion in selecting test preparation materials that they find accessible and understandable. For instance, a candidate who uses a specific reference in preparing for a certification exam that he or she passed may feel comfortable using that same reference to prepare for other certification exams. In deciding if a single reference is sufficient, candidates should assess their own levels of knowledge against both the descriptive examination specifications and the detailed topic list contained in the respective module's content outline. If there are any areas of weakness, the candidate should consult another reference as part of the test preparation process.

References for CPIM Exam Modules

While these references do not cover the CPIM body of knowledge extensively, they do cover the material a successful candidate is required to know.

References	Author(s)	BSCM	MPR	DSP	ECO	SMR
APICS Dictionary, 14th ed., 2013	APICS	X	X	X	X	X
APICS CPIM Detailed Scheduling and Planning Reprints, 2010	APICS Exam Committee			X		
APICS CPIM Execution and Control of Operations Reprints, 2015	APICS Exam Committee				X	
APICS CPIM Master Planning of Resources Reprints, 2010	APICS Exam Committee		X			
Accounting Handbook, 5th ed. 2010	Siegal, Shim					X
Crafting and Executing Strategy: Concepts and Readings, 19th ed. 2014	Thompson, Peteraf, Strickland, Gamble					X
Designing and Managing the Supply Chain, 3rd ed., 2008	Simchi-Levi, Kaminsky, Simchi-Levi			X		
Distribution Planning and Control, 2nd ed. 2004	Ross		X			
Introduction to Materials Management, 7th ed., 2012	Arnold, Chapman, Clive	X		X	X	
Juran's Quality Handbook, 6th ed., 2010	Juran, DeFeo				X	
Leading Change, 2012	Kotter					X
Lean Production Simplified, 2nd ed., 2007	Dennis	X			X	
The Lean Toolbox, 4th ed., 2009	Bicheno, Holweg			X		
Making Sustainability Work, 2nd ed. 2014	Epstein, Buhovac			X		X
Manufacturing Planning and Control for Supply Chain Management, APICS/CPIM Certification Edition, 2011	Jacobs, Berry, Whybark, Vollmann		X	X	X	
Operations Strategy, 3rd ed., 2011	Slack, Lewis					X
Project Management, 11th ed., 2013	Kerzner			X		

It is not practical to list all texts that contain excellent material. Although not currently primary references for the exams, the following chart shows texts that have been used previously for both the CPIM body of knowledge and APICS CPIM courseware. These are still excellent and viable references for APICS CPIM candidates to study.

References	Author(s)	BSCM	MPR	DSP	ECO	SMR
APICS CPIM Basics of Supply Chain Management Reprints, 2009		X				
APICS CPIM Execution and Control of Operations Reprints, 2011					X	
Capacity Management, 2008	Blackstone			X		
A Guide to the Project Management Body of Knowledge, 4th ed., 2008	Project Management Institute Standards Committee			X		
Introduction to Materials Management, 6th ed., 2008	Arnold, Chapman, Clive	X		X	X	
Juran's Quality Planning and Analysis, 5th ed., 2007	Gryna, Chua, DeFeo				X	
Lean Six Sigma, 2002	George			X		
Mainstreaming Corporate Sustainability, 2013	Farver					X
Making Sustainability Work, 2008	Epstein, Buhovac			X		
Manufacturing Planning and Control Systems for Supply Chain Management, 5th ed., 2005	Vollmann, Berry, Whybark, Jacobs		X	X	X	
Master Scheduling in the 21st Century, 2003	Wallace, Stahl		X			
Project Management, 7th ed., 2008	Meredith, Mantel			X		
Project Management, 10th ed., 2009	Meredith, Mantel			X		
Sales & Operations Planning: The How-to Handbook, 3rd ed., 2008	Wallace, Stahl		X			
Sales Forecasting: A New Approach, 2002	Wallace, Stahl		X			
Service Management and Operations, 2nd ed., 2000	Haksever, Render, Russell, Murdick			X		
Strategic Management of Resources References Sourcebook, 2009						X

Content outline. The content outline for each module provides an overview of the major topics included in that module. Each major topic is denoted by a Roman numeral and is followed by a list of the references that are particularly relevant to that topic.

APICS Dictionary. The *APICS Dictionary*, 14th edition, is an essential publication that applies to the exam content manual and exams. Within the profession, terminology varies among industries, companies, and the academic community. Each examination uses standard terminology as defined in the *APICS Dictionary*. Recognizing the terms and understanding their definitions are essential.

Reprints. The committee responsible for the exam content manual and examination selects articles that are particularly applicable to the curricula and exam preparation. These articles then are reprinted in module-specific collections. The reprints are included in the references for each module.

Terminology

Candidates are encouraged to be familiar with all key terms listed below for the corresponding modules. The *APICS Dictionary* is the primary guideline for all definitions of the key terms. Definitions for those terms followed by an * are included in the supplemental glossary listed below the key terms.

In studying for the APICS CPIM certification, candidates may discover multiple terms used to denote the same technique. Examples of this include "sales and operations planning" versus "production planning" and "master production schedule" versus "master schedule." APICS has attempted to provide consistency across all modules with recognized and preferred terminology. However, synonyms are often used by authors in the various references used to compile the body of knowledge.

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
14 Points (Deming's)				X	
A3 method				X	
ABC classification	X				
abnormal demand		X			
absorption costing				X	X
acceptable quality level (AQL)				X	
acceptance sampling				X	
action message			X		
activation			X		
activity-based cost accounting				X	X
activity based management (ABM)					X
actual costs				X	
actual demand		X			
adaptive smoothing		X			
adjustable capacity				X	
advanced planning and scheduling (APS)	X	X		X	
advanced planning system (APS)		X			
advance ship notice (ASN)	X				
aggregate forecast		X			
aggregate plan		X			
agility					X
allocation		X	X	X	
alpha factor		X			
alternate operation				X	
alternate routing			X	X	
analysis of variance (ANOVA)				X	
andon	X			X	
anticipated delay report				X	
anticipation inventories	X				
appraisal costs				X	
assemble-to-order	X				
assembly line	X				
assignable cause	X			X	
attribute data				X	
availability			X		

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
available capacity				X	
available inventory	X				
available time			X		
available-to-promise (ATP)	X				
average cost per unit				X	
average inventory	X				
average outgoing quality limit (AOQL)				X	
back scheduling	X				
backflush	X				
backflush costing				X	
backhauling	X				
backlog	X				
backorder	X				
backward integration					X
backward scheduling				X	
balanced scorecard					X
balance sheet	X				
balancing operations				X	
bar code	X				
baseline measures					X
base series		X			
basic seven tools of quality (B7)				X	
batch	X			X	
batch picking	X				
batch processing				X	
benchmarking		X		X	X
benchmark measures					X
bias	X				
bill of distribution		X			
bill of labor				X	
bill of lading (uniform)	X				
bill of material (BOM)	X				
bill of resources		X			
block scheduling				X	
bonded warehouse	X				
bottleneck	X			X	
bottleneck operation				X	
bottom-up replanning		X			
break-bulk	X				
break-even point	X				X
bucketed system		X			
bucketless system		X			
budgeted capacity			X		
buffer	X			X	
buffer management	X			X	
buffer stock			X		

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
bullwhip effect	X				X
business plan	X				
business process reengineering (BPR)					X
business-to-business commerce (B2B)			X		
by-product		X	X		
calculated capacity			X		
capable-to-promise (CTP)	X	X			
capacity available	X			X	
capacity-constrained resource (CCR)				X	
capacity control				X	
capacity management	X			X	
capacity planning	X				
capacity planning using overall factors (CPOF)		X			
capacity-related costs				X	
capacity requirements				X	
capacity requirements planning (CRP)	X				
capacity strategy					X
capacity utilization				X	
carrying cost	X				
cash conversion cycle					X
cash flow	X				
cash-to-cash cycle time		X			X
cause-and-effect diagram	X			X	
cell				X	
cellular manufacturing	X			X	
centralized inventory control	X				
central point scheduling			X		
certificate of compliance				X	
certification audits				X	
certified supplier	X			X	
changeover				X	
changeover costs				X	
chase production method	X	X			
chase strategy					X
check sheet				X	
closed-loop MRP	X				
collaborative planning, forecasting, and replenishment (CPFR)		X			
common carrier	X				
common causes				X	
common parts bill of material		X			
competitive advantage					X
competitive analysis					X
component	X				
concurrent design				X	
concurrent engineering			X		X

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
conformance				X	
consignment	X				
constraint	X			X	
constraints management				X	
consuming the forecast		X			
continuous improvement				X	
continuous manufacturing				X	X
continuous process control				X	
continuous process improvement (CPI)	X				
continuous production	X	X		X	
continuous replenishment	X				
contract carrier	X				
contribution				X	
contribution margin					X
control chart	X			X	
control limit	X			X	
control points				X	
co-product		X	X		
core competencies					X
core process					X
corporate culture					X
corrective action				X	
correlation		X		X	
cost center				X	
cost of goods sold	X				
cost of poor quality	X				
cost of quality				X	
cost variance				X	
cost-volume-profit analysis				X	
count point				X	
critical chain method	X				
critical characteristics				X	
critical path method (CPM)	X			X	
critical point backflush				X	
critical ratio				X	
critical-to-quality characteristics (CTQs)				X	
cross-docking	X				
cumulative available-to-promise		X			
cumulative lead time	X				
current ratio					X
curve fitting		X			
customer relationship management (CRM)	X	X			
customer service	X				
customer service level				X	
customer-supplier partnership		X		X	X
customs broker	X				

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
cycle counting	X				
cycle stock	X				
cycle time	X				
data governance*	X				
days of supply	X				
decentralized inventory control	X				
decision matrix				X	
decision support system (DSS)					X
decomposition		X			
decoupling				X	
decoupling inventory	X				
dedicated capacity			X		
dedicated line			X		
de-expedite				X	
define, measure, analyze, improve, control (DMAIC) process				X	
delivery lead time	X	X			X
delivery schedule				X	
Delphi method		X			
demand filter		X			
demand forecasting			X		
demand lead time	X				
demand management	X				
demand planning	X				
demand time fence (DTF)		X			
demonstrated capacity	X			X	
demurrage	X				
dependent demand	X				
design for manufacturability					X
design for manufacture and assembly (DFMA)				X	
design of experiments (DOE)				X	
design-to-order		X			
detention	X				
deviation		X			
direct costs				X	
direct labor	X				
direct material	X				
discounted cash flow					X
discrete available-to-promise		X			
discrete manufacturing	X				
discrete order picking	X				
disintermediation					X
dispatching	X				
distressed goods			X		
distribution	X			X	
distribution center	X	X			

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
distribution channel	X	X			
distribution inventory	X				
distribution network structure		X			
distribution of forecast errors		X			
distribution requirements planning (DRP)	X				
distribution warehouse	X				
divergent point				X	
dock-to-stock	X				
downtime				X	
drop ship	X				
drum-buffer-rope (DBR)	X			X	
drum schedule	X				
duty	X				
early manufacturing involvement				X	
early supplier involvement (ESI)				X	
earned hours				X	
echelon		X			
e-commerce			X		
econometric model		X			
economic order quantity (EOQ)	X				
economic value added					X
effective date			X		
efficiency	X			X	
electronic data interchange (EDI)	X				
employee empowerment	X			X	
employee involvement (EI)	X			X	
engineer-to-order	X				
enterprise resources planning (ERP)	X				X
environmentally responsible business				X	
excess capacity				X	
expedite				X	
explode	X				
exponential smoothing forecast		X			
external failure costs	X				
external setup time	X			X	
extrapolation		X			
extrinsic forecasting method	X				
fabricator				X	
failsafe work methods				X	
failure mode effects analysis (FMEA)				X	X
feature		X			
feedback				X	
feeder workstations				X	
field service	X				
fill rate				X	
final assemble schedule (FAS)	X			X	

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
finished goods inventory	X				
finishing lead time		X			
finite forward scheduling	X				
finite loading	X			X	
finite scheduling				X	
firm planned order (FPO)	X				
first-article inspection				X	
first in, first out (FIFO)			X	X	
first-order smoothing		X			
first pass yield				X	
fishbone analysis				X	
fitness for use				X	
five focusing steps	X				
five forces model of competition					X
five Ss	X			X	
five whys	X				
fixed cost				X	
fixed-location storage	X				
fixed order quantity	X				
fixed overhead	X				
fixed-position manufacturing	X				
flexibility			X		X
flexible workforce				X	
floor stocks				X	
flowchart	X			X	
flow control				X	
flow processing	X				
flow rate				X	
flow shop	X				
fluctuation inventory	X				
focused factory				X	X
focus forecasting		X			
forecast	X				
forecast consumption		X			
forecast error	X				
forecast horizon		X			
forecast interval		X			
forecast management		X			
form-fit-function				X	
forward flow scheduling			X		
forward integration					X
forward scheduling	X			X	
four Ps	X				
freight consolidation	X				
freight forwarder	X				
frequency distribution		X			

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
functional layout	X			X	
functional product*			X		
funnel experiment				X	
Gantt chart	X			X	X
gatekeeping				X	
gateway work center			X	X	
gemba	X				
gemba walk*				X	
genchi genbutsu	X				
general and administrative expenses (G&A)	X				
generally accepted accounting principles (GAAP)	X				X
global measurements					X
global reporting initiative (GRI)			X		
global trade identification number (GTIN)*			X		
go/no-go				X	
green manufacturing				X	
green reverse logistics	X				
gross margin	X				
gross requirement	X				
group technology (GT)				X	
hansei	X				
hazmat				X	
hedge		X			
hedge inventory	X				
heijunka	X			X	
histogram	X			X	
horizontal dependency			X		
horizontally integrated firm					X
hoshin	X			X	
hoshin planning	X				
house of quality (HOQ)				X	X
hurdle rate					X
hybrid production method		X			
hypothesis testing				X	
idle capacity	X			X	
idle time			X		
inactive inventory			X		
inbound stockpoint				X	
income statement	X				
incoterms	X				
indented bill of material	X				
independent demand	X				
indirect costs				X	
infinite loading	X			X	
information system architecture					X
input/output control (I/O)	X			X	

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
insourcing					X
intangible costs				X	
intellectual property					X
intermittent production	X				
intermodal transport	X				
internal customer				X	
internal failure costs	X				
internal rate of return					X
internal setup time	X			X	
interoperation time				X	
interplant demand	X	X			
in-transit inventory	X				
intrinsic forecast method	X				
inventory accounting			X		
inventory accuracy	X				
inventory adjustment	X				
inventory buffer	X				
inventory control	X				
inventory investment			X		
inventory management	X				
inventory ordering system	X				
inventory policy			X		
inventory turnover	X			X	
inventory valuation				X	
Ishikawa diagram				X	
ISO 14000 Series Standards					X
ISO 9000					X
ISO 26000			X		
item master record				X	
jidoka	X			X	
jishuken	X				
job analysis				X	
job costing	X			X	
job enlargement					X
job enrichment					X
job sequencing rules				X	
job shop	X			X	
job shop scheduling	X			X	
job status				X	
joint replenishment			X		
Juran trilogy				X	
Just-in-Time (JIT)				X	
kaizen	X			X	
kaizen blitz				X	
kaizen event				X	
kanban	X			X	

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
keiretsu				X	
key performance indicator (KPI)	X				X
key success factors					X
kit				X	
knowledge-based system					X
labor efficiency				X	
labor productivity				X	
labor standard				X	
lag capacity strategy					X
landed cost	X		X		
last in, first out (LIFO)			X	X	
lead capacity strategy					X
leading indicator	X				
lead time	X			X	
lead-time offset	X				
lean enterprise				X	
lean metric				X	
lean production	X	X		X	
lean six sigma*	X				
learning curve					X
learning organization					X
least changeover cost				X	
least-squares method		X			
least total cost				X	
level loading				X	
level of service	X				
level production method	X				
level schedule	X	X		X	
liabilities	X				
life cycle assessment (LCA)			X		
lifecycle analysis		X			
lifecycle costing					X
limiting operation				X	
line				X	
line balancing				X	
line haul costs	X				
Little's law*				X	
load	X				
load leveling	X			X	
load profile			X	X	
load projection			X		
local measures					X
logistics	X			X	
lot	X				
lot control	X			X	
lot cost				X	

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
lot-for-lot	X				
lot size	X				
lot-size inventory	X				
lot sizing				X	
lot splitting			X	X	
lot traceability				X	
lower control limit (LCL)				X	
lower specification limit (LSL)				X	
low-level code			X		
machine center			X		
machine hours			X		
machine-limited capacity				X	
machine loading			X		
maintenance, repair, and operating (MRO) supplies	X			X	
make-or buy decision	X				
make-to-order	X				
make-to-stock	X				
management by walking around (MBWA)				X	
managerial accounting					X
manufacturing calendar	X				
manufacturing environment		X			
manufacturing execution systems (MES)				X	X
manufacturing layout strategies				X	
manufacturing lead time	X			X	
manufacturing order	X				
manufacturing order reporting				X	
manufacturing philosophy	X				
manufacturing process	X				
manufacturing resource planning (MRP II)	X				
manufacturing strategy					X
market driven	X				
marketing strategy	X				
mass customization	X	X			
master planning	X				
master planning of resources		X			
master production schedule (MPS)	X				
master schedule	X				
master schedule item		X			
master scheduler		X			
material-dominated scheduling (MDS)			X		
material requirements planning (MRP)	X				
material safety data sheet (MSDS)				X	
materials handling	X				
materials management	X				
mean		X			
mean absolute deviation (MAD)	X				

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
mean absolute percent error (MAPE)		X			
mean squared error (MSE)		X			
mean time between failures (MTBF)				X	
mean time to repair (MTTR)				X	
measure phase				X	
median		X			
milk run	X				
min-max system	X				
mixed-flow scheduling			X	X	
mixed-model production	X			X	
mixed-model scheduling	X	X			
mix forecast		X			
mode		X			
modular bill of material		X			
modularization	X				
move card				X	
move time	X			X	
moving average		X			
muda (waste)	X			X	
multilevel bill of material	X				
multilevel master schedule		X			
multisourcing	X				
mura	X				
muri	X				
nesting	X				
net present value					X
net requirements	X				
network planning			X		X
nominal group technique				X	
nonconformity				X	
nonevident failure					X
nongovernmental organization (NGO)			X		
non-value-added				X	
normal distribution		X		X	
obsolete inventory			X		
one-card kanban system	X				
one less at a time				X	
one-piece flow				X	
on-hand balance	X				
on-time schedule performance	X				
open order	X			X	
operating expense	X				
operation				X	
operational performance measurements				X	X
operation costing				X	
operation due date				X	

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
operation duration				X	
operation overlapping				X	
operation/process yield				X	
operations management	X				
operations plan		X			
operations scheduling				X	
operations sequence				X	
operations sequencing			X		
operation start date				X	
operations strategy					X
operation time				X	
operator flexibility	X				
opportunity cost				X	
option		X			
option overplanning		X			
order entry	X				
ordering cost	X				
order picking	X				
order point	X				
order policy			X		
order priority				X	
order promising	X				
order qualifiers	X				
order release				X	
order winners	X				
outbound stockpoint				X	
outlier		X			
outsourcing	X				X
overall equipment effectiveness (OEE)				X	
overhead	X			X	
overhead allocation				X	
overlapped schedule	X			X	
overload				X	
overstated master production schedule		X			
owner's equity	X				
pacemaker	X			X	
package to order	X				
pallet positions	X				
panel consensus		X			
parent item	X				
Pareto's law	X			X	
participative design/engineering	X			X	X
participative management				X	X
payback					X
P:D ratio		X		X	
pegging	X				

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
people involvement				X	
perceived quality				X	
performance measure				X	
performance measurement system					X
performance objectives					X
performance standard	X				
periodic replenishment	X				
period order quantity	X				
perpetual inventory record	X				
phantom bill of material			X		
physical inventory	X				
physical supply	X				
picking list	X				
pickup and delivery costs	X				
pipeline stock	X				
plan-do-check-action (PDCA)	X			X	
plan for every part (PFEP)			X		
planned load			X		
planned order	X				
planned order receipt	X				
planned order release	X				
planning bill of material	X	X			
planning horizon	X	X			
planning time fence		X			
point of sale (POS)	X	X			
point-of-use delivery			X		
point-of-use inventory				X	
poka-yoke (mistake-proof)				X	
post-deduct inventory transaction processing				X	
postponement	X	X			X
pre-deduct inventory transaction processing				X	
prevention costs	X				
preventive maintenance	X			X	X
primary work center				X	
priority		X			
priority control	X			X	
priority planning	X			X	
private carrier	X				
probability		X			
probability distribution		X			
probable scheduling			X		
problem-solving storyboard				X	
process batch	X				
process capability				X	X
process capability index				X	
process control					X

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
process costing				X	X
process flexibility	X			X	
process flow				X	
process flow analysis				X	
process flow diagram	X				
process flow production		X			
process flow scheduling			X		
process focused					X
process manufacturing		X	X		
processor-dominated scheduling			X		
process train			X		
procurement	X				
procurement lead time	X				
product configuration catalog		X			
product cost	X			X	
product differentiation	X				
product family	X				
product focused					X
product group forecast		X			
production activity control (PAC)	X			X	
production capability				X	
production forecast		X			
production level		X			
production line	X				
production plan	X	X			
production planning	X				
production rate		X			
production schedule		X			
production scheduling				X	
productive capacity	X		X		
productivity	X			X	
product layout	X				
product life cycle	X				
product line		X			
product load profile		X			
product mix	X	X			
product-mix flexibility					X
product positioning		X			X
product profiling					X
product/service hierarchy		X			
profit margin	X				
program evaluation and review technique (PERT)			X	X	X
project costing				X	X
projected available balance	X				
project management	X		X	X	
project manufacturing		X			

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
project phase			X		
project plan			X		
protective capacity	X				
protective inventory	X				
protective packaging	X				
prototyping					X
pull signal				X	
pull system	X			X	
purchase order	X				
purchase requisition	X				
purchasing lead time	X				
push system	X			X	
pyramid forecasting		X			
QS 9000					X
qualitative forecasting techniques		X			
quality	X				
quality at the source	X				
quality circle				X	
quality control	X			X	
quality costs	X			X	
quality function deployment (QFD)	X			X	X
quantitative forecasting techniques		X			
quantity discount	X				
queue	X			X	
queue time			X	X	
quick asset ratio					X
quick changeover	X				
radio frequency identification (RFID)	X				
random cause				X	
random-location storage	X				
random sample		X			
random variation	X				
rate-based scheduling				X	
rated capacity	X			X	
raw material	X				
receiving	X				
record accuracy	X				
redundancy					X
regression analysis		X			
released order				X	
remanufacturing	X			X	
remedial maintenance				X	
reorder quantity	X				
repair order				X	
repetitive manufacturing	X			X	
replanning frequency			X		

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
replenishment lead time	X				
request for quote (RFQ)	X				
required capacity				X	
requirements explosion	X				
requisition			X		
rescheduling			X		
residual income					X
resiliency					X
resource				X	
resource-constrained schedule				X	
resource leveling				X	
resource-limited scheduling				X	
resource planning	X			X	
resource profile		X			
responsible procurement			X		
return on investment (ROI)					X
reverse auction	X				
reverse logistics	X				
rework			X	X	
risk management*	X				
risk pooling			X		
robust design				X	
root cause analysis	X			X	
rough-cut capacity planning (RCCP)	X				
routing	X			X	
running sum of forecast errors		X			
run time	X			X	
safety capacity		X	X		
safety lead time			X		
safety stock	X				
sales and operations planning (S&OP)	X				
sales plan	X				
sales promotion		X			
sample		X			
sampling distribution		X			
sawtooth diagram	X				
scatter chart	X			X	
scatterplot	X				
scheduled downtime				X	
scheduled load			X		
scheduled receipt	X				
scheduling	X				
scheduling rules				X	
scrap	X				
scrap factor				X	
seasonal index		X			

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
seasonal inventory	X				
seasonality	X				
second-order smoothing		X			
self-directed work team				X	
semifinished goods			X		
sensei	X				
service	X				
service function		X			
service industry	X				
service level agreement (SLA)					X
service parts	X				
setup	X				
setup costs				X	
setup time	X			X	
shelf life			X		
Shingo's seven wastes	X			X	
shipping manifest	X				
shitsuke				X	
shojinka				X	
shrinkage			X		
single-card kanban system				X	
single exponential smoothing		X			
single-level bill of material	X				
single-minute exchange of die (SMED)				X	
single-source supplier	X				
six sigma	X			X	
small group improvement activity				X	
SMART	X				
smoothing constant		X			
smoothing factor		X			
social responsibility					X
special cause				X	
specification				X	
specific identification			X		
split lot	X				
spread	X				
standard				X	
standard costs	X			X	
standard deviation		X	X		
standard time	X				
standardized work*				X	
start date	X				
statistical process control (SPC)	X			X	
statistical quality control (SQC)				X	
stockkeeping unit (SKU)	X				
stockout costs	X				

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
stockout percentage	X				
store	X				
strategic drivers					X
strategic performance measurements					X
strategic plan	X				
strategic planning		X			
strategic sourcing					X
subcontracting	X				
substitution		X			
summarized bill of material	X				
sunk cost					X
super bill of material		X			
supermarket approach			X		
supplier	X				
supplier certification	X				
supplier-input-process-output-customer (SIPOC) diagram				X	
supplier lead time	X				
supplier measurement			X		
supplier partnership	X				
supplier relationship management (SRM)	X				
supplier scheduling				X	
supply chain	X				
supply chain management	X				
surge capacity					X
sustainability	X				X
SWOT analysis					X
synchronized production				X	X
tactical plan(s)	X				
tactical planning		X			
Taguchi methodology				X	
takt time	X			X	
target inventory level			X		
tariff	X				
terminals	X				
terminal-handling costs	X				
terms and conditions	X				
theoretical capacity			X	X	
theory of constraints (TOC)	X			X	
theory of constraints accounting	X				
third-party logistics (3PL)	X		X		
throughput	X			X	
throughput time				X	
time-based competition (TBC)					X
time bucket	X				
time buffer	X				
time fence	X				

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
time-phased order point (TPOP)	X	X			
time series				X	
time series analysis		X			
time standard				X	
tolerance	X			X	
total cost curve	X				
total cost of ownership (TCO)	X				
total costs	X				
total factor productivity					X
total line-haul cost	X				
total productive maintenance (TPM)	X			X	
total quality control (TQC)				X	
total quality management (TQM)	X			X	
traceability	X	X			
tracking capacity strategy					X
tracking signal	X				
trading partner					X
traffic	X				
transaction channel	X				
transfer batch				X	
transfer pricing				X	
transient state			X		
transit inventory	X				
transit time	X				
transportation	X			X	
transportation inventory	X				
trend	X				
trend forecasting models		X			
truckload carriers	X				
two-bin inventory system	X				
two-card kanban system	X			X	
two-level master schedule		X			
U-lines	X				
uniform plant loading	X				
unit cost	X				
UN Global Compact Management Model	X				
United Nations Global Compact	X				
unitization	X				
unit load	X				
unit of measure	X				
unplanned repair			X		
upper control limit (UCL)				X	
upper specification limit (USL)				X	
upstream	X				
usage variance				X	
utilization	X			X	

CPIM Key Terminology

	BSCM	MPR	DSP	ECO	SMR
value added	X			X	
value analysis	X				
value chain					X
value chain analysis	X				
value perspective				X	
value stream	X			X	
value stream mapping	X				
variable cost	X			X	
variable costing					X
variance	X				
VATI Analysis	X				
velocity	X				
vendor-managed inventory (VMI)	X				
vertical dependency			X		
vertical integration					X
virtual cell					X
virtual organization					X
visual control				X	
visual management*				X	
visual review system	X				
voice of the customer (VOC)	X				X
wait time	X				
wall-to-wall inventory	X				
warehouse demand		X			
warehousing	X				
waste	X			X	
wave picking	X				
waybill	X				
ways	X				
weighted moving average		X			
what-if analysis	X				
where-used list	X				
work cell	X				
work center	X			X	
work in process (WIP)	X			X	
work order	X				
workplace organization				X	
yield	X			X	
zone	X				
zone picking	X				

Supplemental Glossary

The following key terms are not found in the *APICS Dictionary*, 14th edition, so definitions have been provided below.

Data governance—The overall management of the accessibility, usability, reliability, and security of data used to ensure data record accuracy.

Gemba walk—The word "Gemba" is a Japanese term meaning the place where value is created and the actual work is done, such as the shop floor in a manufacturing plant. The aim of Gemba walk is to provide a leader with the opportunity to observe floor activities as they happen and ask questions about them, thus becoming more aware of what is going on in the organization.

Global Trade Identification Number (GTIN)—GTINs uniquely identify all products and services that are sold, delivered and invoiced at any point in the supply chain. GTINS are typically found at point of sale and on cases and pallets of products in a distribution or warehouse environment.

Functional product— Goods that are widely available from a range of sources. Typically, they have stable design, low profit margins, steady and predictable demand and long life cycles.

Lean six sigma—A combined approach for process improvement and problem solving based on lean and six sigma methodologies.

Little's Law—Over the long term, inventory equals the process rate (i.e., cycle time) multiplied by the throughput.

Risk management—Risk management is a systematic approach to identifying, analyzing, and addressing an organization's exposure to uncertainty within the supply chain.

Standardized work—Standardized work identifies, defines and documents current best practices for achieving consistent results and forms the baseline for continuous improvement. The standardized work is presented using a combination of pictures and text, which are placed at each workstation where the activity or process is performed and employees are trained to do the tasks as defined in the Standard Work document.

Visual Management—The concept of making the current condition of a workplace obvious at a glance, and hence more effective, by providing real-time information on work status using a combination of visual signs. Examples of Visual Management include kanban cards, tool shadow boards, and storyboards.

Additional Resources for APICS CPIM Candidates

In addition to the cited references, it may be helpful for you to pursue chapter-sponsored courses, college courses, APICS workshops, self-study courses, or courses offered by the APICS network of Authorized Education Providers (AEPs) as a means of learning the body of knowledge that is tested in the certification program. A wide variety of courses are available. As with any investment, you should research various courses before choosing one.

For courses, visit the Partner and Event Finder on the APICS website at **apics.org/finder** or call APICS Customer Service at 1-800-444-2742 (United States and Canada) or +1-773-867-1777.

APICS CPIM Instructor-Led Review Courses

Available for each module of the APICS CPIM program, APICS CPIM review courses are designed for classroom review of the key principles and concepts for each content area. This ECM is used as the basis for the content in the CPIM review courses. It is important to understand that CPIM review courses are intended to assist the candidate in reviewing the body of knowledge and are not necessarily education. There will likely be some content in APICS review courses not covered by the exams. Course developers and/or instructors may believe that additional material needs to be taught or included in the glossary to ensure

understanding of the body of knowledge that can be tested. They also may decide that a concept or term is adequately covered by the definitions in the *APICS Dictionary* or the CPIM ECM Glossary and not cover it in the course. These differences sometime lead candidates to perceive a potential disconnect between the courseware and the exam, when in fact they are both covering the same body of knowledge.

APICS CPIM review courses do not "teach the test" and, in many areas, they review but do not teach concepts. All APICS review courses provide a thorough review of the subject matter, but none should be used without the most current CPIM ECM as a means to direct the candidate's study.

Note: The Review Course Participant Workbook is not a stand-alone reference or comprehensive single source and should be used only by a participant attending an instructor-led review course.

For courses, visit the Partner and Event Finder on the APICS website at apics.org/finder or call APICS Customer Service at 1-800-444-2742 (United States and Canada) or +1-773-867-1777.

Independent Study Courses

APICS correspondence courses offer professionals a unique home-study alternative to the classroom. Correspondence courses are designed and conducted for APICS by the MGI Management Institute. For more information on course availability, contact APICS Customer Service at 1-800-444-2742 (United States and Canada), or +1-773-867-1777.

APICS Educational Programs

APICS offers a variety of educational programs, including workshops in supply chain and operations management and an annual international conference and exposition. For a complete list of APICS learning opportunities and information on course availability, call APICS Customer Service at 1-800-444-2742 (United States and Canada), or +1-773-867-1777.

APICS Online Study Tools

The new APICS CPIM Study Tools are an online resource for APICS CPIM students to complement self-study or instructor-led courses. APICS CPIM Study Tools can be accessed at apics.org. For more information, please contact APICS Customer Service at 1-800-444-2742 (United States and Canada), or +1-773-867-1777.

CPIM Exam Simulator

The CPIM Exam Simulator is designed to increase candidates' learning potential and assist in preparation for the CPIM exams. With over 300 online practice questions for each module, candidates can study with self-paced, timed and final exam simulations. For more information please contact APICS Customer Service at 1-800-444-2742 (United States and Canada), or +1-773-867-1777.

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The distinguishing characteristic of a Certified Fellow in Production and Inventory Management (CFPIM) is the willingness to share acquired knowledge with others through presenting, teaching, publishing, and participating in APICS educational activities. This knowledge sharing must take place above and beyond a candidate's normal job duties and be directly related to the APICS CPIM body of knowledge.

To obtain the APICS CFPIM designation, an application form must be filled out and submitted to the APICS corporate office. Points are awarded based on the following criteria: APICS CPIM exams passed, presentations, high scores on APICS CPIM exams (320 or greater), published works, classroom teaching, and various volunteer or practitioner activities. To apply for the CFPIM Certification visit apics.org/cfpim.

APICS CPIM Certification Maintenance: Continuing Professional Development

The Importance of Certification Maintenance

The growing number of individuals choosing to pursue professional development through the APICS CPIM program indicates a strong awareness that continuing education and skills development are essential to meeting the information and technological challenges in today's rapidly evolving workplace and global marketplace. Professional development opens doors to individual career opportunities and organizational success.

Although APICS CPIM recognition and maintenance are voluntary programs, they equally demonstrate one's commitment to achieving the highest level of professional development and standards of excellence.

Both the APICS CPIM certification and APICS CPIM certification maintenance programs demonstrate one's commitment to achieving the highest level of professional development and standards of excellence.

The APICS CPIM certification maintenance program upholds both the objectives of the APICS CPIM program and the APICS vision to promote lifelong learning. This flexible program recognizes that individuals are at various levels in their careers, come from many industries, have different educational needs and career goals, and have varying degrees of access to continuing education. Thus, requirements for maintaining certification can be met through multiple sources and a variety of professional development activities intended to help prepare for the challenges ahead and maintain a professional edge by:

- preserving the currency of hard-earned certification credentials
- expanding your knowledge of the latest industry practices
- exploring new technology solutions
- reinforcing skills
- improving job performance
- demonstrating commitment to excellence
- increasing competitive advantage

To promote professional growth and lifelong learning, APICS CPIM and CFPIM designees must complete the certification maintenance program every five years. Complete details on how to maintain your designation will be mailed to candidates upon successful completion of the certification requirements.

APICS Code of Ethics

When you start an examination, you will be asked to pledge to abide by the APICS Code of Ethics. Once certified, you pledge to continue your education to increase your contribution to the supply chain and operations management profession. After achieving the fellow level of certification (CFPIM), you pledge also to share your APICS CPIM knowledge with others by participating in APICS research and educational activities at local, district, national, and international levels.

The APICS Code of Ethics is as follows:

- Maintain exemplary standards of professional conduct.
- Not misrepresent your qualifications, experience, or education to APICS or others you serve in a professional capacity.
- Respect and not violate the United States Copyright of all APICS materials, including but not limited to courseware, magazine articles and other APICS publications, APICS conference presentations, and CPIM, CSCP and SCOR-P examination resources. In this same spirit, you must not violate the copyright of other organizations and individuals in your professional capacity.
- Not engage in or sanction any exploitation of one's membership, company, or profession.
- Encourage and cooperate in the interchange of knowledge and techniques for the mutual benefit of the profession.

- In your professional capacity, respect the fundamental rights and dignity of all individuals. You must demonstrate sensitivity to cultural, individual, and role differences, including those due to age, gender, race, ethnicity, national origin, religion, sexual orientation, disability, language, and socio-economic status.
- In your professional capacity, not engage in behavior that is harassing or demeaning to others based on factors including, but not limited to, age, gender, race, ethnicity, national origin, religion, sexual orientation, disability, language, or socio-economic status.
- Adhere to this Code of Conduct and its application to your professional work. Lack of awareness or misunderstanding of an ethical standard is not itself a defense to a charge of unethical conduct.
- Contact the Ethics Committee when uncertain whether a particular situation or course of action violates the Code of Conduct.
- Not become the subject of public disrepute, contempt, or scandal that affects your image or goodwill.

Failure to abide by APICS Code of Ethics policy may result in sanctions up to and including decertification.

Basics of Supply Chain Management

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Scope of the Subject Matter

Please read the introductory materials in this manual for essential information pertaining to the examination.

The subject matter of Basics of Supply Chain Management is assumed as a prerequisite for the other APICS CPIM modules, which cover similar topics but in greater depth.

The first section of the content outline covers basic business-wide concepts, including an understanding of the various supply chain environments. Common management concepts and techniques—supply chain fundamentals, operating environments, financial fundamentals, enterprise resources planning, lean, quality fundamentals, and the theory of constraints—are presented.

The second section of the outline covers demand management, including a basic understanding of how markets shape demand, how customers in these markets define value for the goods and services they desire, then managing all demands to support the marketplace.

The third section of the outline covers transformation of demand into supply and includes the design of products (goods and services), processes, and information systems. The fundamentals of planning, priorities and capacity, execution, controls, and performance measures are discussed.

The fourth section of the content outline is devoted to supply issues covering inventory costs, functions, and metrics. It provides an overview of supplier management, demand management, and monitoring supplier performance. Physical distribution systems encompass transportation, warehousing, reverse logistics, and distribution requirements planning.

The successful candidate will understand and be able to discuss the major management philosophies used in a supply chain. Emphasis is on manufacturing, but the examination also covers the distribution, service, and retail industries. This understanding includes the fundamental relationships in the design, planning, execution, monitoring, and control that occur. The candidate should also understand:

- fundamental relationships among supply chain activities
- enterprise resources planning
- measurement and continuous improvement.

Basics of Supply Chain Management Content

The following table identifies the four main topics of the exam. The relative importance of these topics varies among industries, but the figures show the percentage designated for each section of the exam.

Diagnostic part	Main topic	Percentage of exam
I	Business-wide Concepts	25%
II	Demand Management	25%
III	Transformation of Demand into Supply	25%
IV	Supply	25%

Content Outline

I. Business-wide Concepts

In this section, common management concepts and techniques—supply chain fundamentals, operating environments, financial fundamentals, enterprise resources planning, lean, quality fundamentals, and theory of constraints—are presented.

A. *Supply Chain Fundamentals*: The concept of a global network used to deliver products and services from raw materials to end consumers through an engineered flow of information, physical distribution, and cash. It includes managing conflicts that occur within the supply chain. Businesses are also called upon to voluntarily demonstrate social responsibility in operating their supply chains.

1. A supply chain is a network of retailers, distributors, transporters, storage facilities, and suppliers that participate in the production, delivery, and sale of a product or service to the consumer. It also includes moving items from the consumer back to the producer.

2. Supply chain conflicts and risks exist among trading partners that need to be identified, analyzed, and addressed. Some examples include disruption of supply, synchronizing supply with demand, minimizing inventory investment, maximizing customer service, and managing total cost.

3. Organizational conflicts exist between finance, sales, production, marketing, engineering, and planning functions within a business. Some examples include excessive inventory versus inventory stockouts; setup cost versus economy of scale; and expediting versus not expediting.

4. The United Nations Global Compact addresses corporate sustainability in the world economy by asking companies to embrace, support, and enact a set of core values in the areas of human rights, labor standards, the environment, and anticorruption.

B. *Operating Environments*: The global, domestic, environmental, and stakeholder influences that affect the key competitive factors, customer needs, culture, and philosophy of each individual company. This environment becomes the framework in which business strategy is developed and implemented.

1. The definition and impact of the operating environment depends on customer expectations; cumulative lead times, inventory, sustainability, product design, and life cycles.

2. Process choices for products and services include flow, intermittent, and project.

3. Production environment strategies include engineer-to-order, make-to-order, assemble-to-order, make-to-stock, and remanufacturing.

C. *Financial Fundamentals*: Basic financial statements define the financial reporting common to most businesses. Underlying costs and analysis terms provide further understanding of statement information and often serve as the basis for management decisions.

1. Balance sheets, income statement, and cash flow statement make up the standard financial reporting tools.

2. Financial reporting must take into account the cost of goods sold, general and administrative costs, and fixed versus variable costs.

3. Financial data are used to analyze cash flow, profit and loss, margin and throughput, inventory velocity, and the make-or-buy decision as it relates to total cost.

D. *Enterprise Resources Planning (ERP)*: ERP is a framework for organizing, defining, and standardizing the business processes necessary to effectively plan and control an organization so that it can use its internal knowledge to seek external advantage. The objective for using ERP is the cross-functional integration of planning, executing, controlling, and measuring functions required to effectively operate a business organization to meet customer expectations.

   Key characteristics of ERP include its use as an integrated knowledge and decision-making tool, cross-functional alignment of the organization, the closed loop (feedback) mechanism, what-if simulation capabilities, and integrated financial data and performance measurement functions.

E. *Lean*: Lean is a philosophy that emphasizes the minimization of the amount of all the resources (including time) used in the various activities of the enterprise.

   1. Lean objectives are comprised of the elimination of waste, providing value from the customer's perspective, and continuous improvement.

   2. Key characteristics include flow manufacturing, process flexibility, quality at the source, supplier partnerships, employee involvement, total productive maintenance, pull systems, and work cells.

F. *Quality Fundamentals*: Quality management focuses on customer needs using a variety of tools and techniques. The objective of quality management is to increase profitability and customer satisfaction. It incorporates concepts such as: quality control tools, quality costs, quality function deployment, employee involvement and empowerment, continuous process improvement, six sigma, variation, process capability and control, and benchmarking.

G. *Theory of Constraints (TOC)*: A philosophy that focuses the resources of an organization on managing throughput and financial performance. Key characteristics and techniques include product flow analysis; throughput accounting; constraints management; and continuous improvement.

References: 1; 2 (chapters 1–2, 6, 9, 14–16); 3; 4; 5

II. Demand Management

This section covers sources of demand for goods and services, including a basic understanding of markets, voice of the customer, and an overview of demand planning.

A. *Market Driven*: Consumer needs, competitive sources, economic conditions, and government regulations determine the demand experienced by suppliers.

B. *Voice of the Customer*: Actual customer word descriptions of the functions and features that customers' desire for goods and services

C. *Demand Management*: Demand management is the function of recognizing all demands for goods and services to support the marketplace. Demand management serves as a key input into the sales and operations plan and master production schedule.

   1. Sources of independent demand that must be considered are forecasts along with customer, service, replenishment, and inter-company orders.

   2. Forecast management consists of understanding the principles of forecasting, the characteristics of demand, various forecasting techniques, forecast error measurement, and managing the variability of demand.

   3. Order processing occurs upon receipt of a customer's order. Goods or services will be fulfilled based on the operating environment.

References: 1; 2 (chapters 1, 8, 16)

III. Transformation of Demand into Supply

This section includes the design of products and services, capacity management, planning, execution and control, and performance measurements.

A. *Product and Process Design*: Design affects product and process; the resulting framework of planning system parameters; and the requirement for data appropriate in source, content, and accuracy. Collaboration with customers and suppliers will improve product and process design.

   1. Products and the processes used to make them are designed to create products more appealing to customers, to improve productivity, competitiveness, and sustainability.

   2. Participative design/engineering ensures that the final design meets all the needs of the stakeholders and should ensure products or services can be quickly brought to the marketplace while maximizing quality and minimizing costs.

   3. Information systems should follow product and process design. Data governance is necessary to ensure data record accuracy.

B. *Capacity Management*: The function of establishing, measuring, monitoring, and adjusting limits or levels of capacity to execute all schedules. Capacity management encompasses resource requirements planning, rough-cut capacity planning, capacity requirements planning, input/output controls, and constraints management.

C. *Planning*: The process of setting goals for the organization and choosing how to use the organization's resources to achieve them. These different planning techniques vary depending on traditional, lean, or Theory of Constraints operating environments.

   1. Strategic planning/hoshin planning

   2. Business planning

   3. Sales and operations planning, production planning, and resource requirements planning

   4. Master production scheduling and rough cut capacity planning

   5. Material requirements planning and capacity requirements planning

   6. Final assembly scheduling and input/output control

   7. Advanced planning and scheduling

   8. Project management

D. *Execution and Control*: The interrelationships between production activity control techniques (input/output control, kanban, constraints management) and planning schedules are synchronized to meet customer service requirements.

   1. The output of material requirements planning is used to execute the production plan and material releases.

   2. Operations are executed using forward, backward, finite, infinite, mixed model, kanban, or drum-buffer-rope and constraint scheduling.

   3. Techniques for maintaining and communicating shop floor order status include capacity control, production reporting, priority control, and flow control.

   4. An important part of execution and control is focusing on quality assurance by measuring quality, monitoring process variation, and improving process control.

E. *Performance Measurements*: Key performance indicators are metrics used to assess organizational performance against strategic and tactical goals.

References: 1; 2 (chapters 1–7, 9–11, 14–16)

IV. Supply

This section includes the actual or planned provision of a product, component, or service and its sustainability.

A. *Inventory*: The stocks or items used to support production (raw materials and work-in-process items), supporting activities (maintenance, repair, and operating supplies), and customer service (finished goods and service parts).

1. Inventories can be classified according to their functions. This includes buffer, transportation, lot size, anticipation, fluctuation, hedge, as well as maintenance, repair, and operating supplies (MRO).

2. Inventories are monitored using the following methods: ABC classification, physical inventory, cycle counting, record accuracy, days of supply, and inventory turns.

3. Inventories can be replenished using push or pull systems.

4. Inventory management decisions must consider: item costs, carrying costs, ordering costs, stockout costs, and capacity-associated costs. These include strategies and policies related to customer service and return on investment.

5. There are four methods accounting uses to value inventory: first in first out, last in first out, average cost, and standard cost.

B. *Purchasing Cycle*: The function and responsibility for understanding demand, sourcing, procuring materials, supplies, or services, receiving goods, and approving invoices for payment.

1. The purchasing process begins with any of the following signals: requisition, MRP output, kanban, and buffer.

2. Sourcing includes supplier selection, certification, agreements, and partnerships, including vendor-managed inventory (VMI). Total acquisition costs must be considered.

3. Order processing includes purchase release, defining terms and conditions, and monitoring supplier performance.

4. Order completion includes receipt of goods and approval of invoice.

C. *Distribution*: The activities associated with the movement of material between the supplier, manufacturer, and customer. These activities encompass the functions of transportation, warehousing, inventory control, material handling, order administration, site and location analysis, industrial packaging, data processing, and the communications network necessary for effective management. It includes all activities related to physical distribution, as well as the return of goods to the manufacturer.

1. Global distribution encompasses the movement of goods around the world. Decision factors include lead time, tariffs, and regulatory compliance.

2. Transportation is the function of planning, scheduling, and controlling activities related to mode, carrier type, and movement of inventories across the supply chain.

3. Warehousing consists of the activities related to receiving, storing, and shipping materials.

4. Distribution inventory typically consists of service parts and finished goods located in a distribution system.

5. A distribution channel is the route, from raw materials through consumption, along which products travel. A transaction channel is a distribution network that deals with change of ownership of goods and services including the activities of negotiation, selling, and contracting.

6. Reverse logistics is a complete supply chain dedicated to the reverse flow of products and materials for the purpose of returns, repair, remanufacture, or recycling.

7. The total-cost concept takes the position that all logistical decisions providing equal service levels should favor the option that minimizes the total logistical costs across all areas versus a cost reduction in a single area.

References: 1; 2 (chapters 7, 9–13, 15)

Key Terminology

An understanding of the list of terms on pages 9–29 of this document is strongly recommended. The list is intended to be thorough but not exhaustive. The candidate is also expected to be familiar with the definitions of terms identified in the content outline. Definitions of these terms can be found in the *APICS Dictionary*, 14th edition.

Bibliography

All test candidates should familiarize themselves with the following references for this examination. The recommended references pertaining to the diagnostic areas are listed at the end of each section of the content outline. The text, *Introduction to Materials Management*, covers the majority of the material for this module. The other references provide coverage of some of the topic areas and can enhance candidates' understanding of the body of knowledge. Please see page 8 in the introduction to this manual for a list of past references that can also be used for study. All printed references are available from **apics.org/shopapics**.

References

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2. Arnold, J.R. Tony, S.N. Chapman, and L.M. Clive, *Introduction to Materials Management*, 7th ed., Prentice Hall, 2012.
3. Dennis, P., *Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System*, 2nd ed., Productivity Press, 2007.
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5. *UN Global Compact Management Model: Framework for Implementation. 2010. Deloitte Touche Tohmatsu. Welcome message by Georg Kell. Foreword by John Connolly. http://www.unglobalcompact.org/docs/news_events/9.1_news_archives/2010_06_17/UN_Global_Compact_Management_Model.pdf.

*Internet links cited in the bibliographic references above can be found at **http://www.apics.org/careers-education-professional-development/certification/cpim/primary-references**.

Sample Questions

The following ten questions are similar in format and content to the questions on the exam. These questions are intended for practice—that is, to enable you to become familiar with the way the questions are asked. The degree of success you have in answering these questions is not related to your potential for success on the actual exam and should not be interpreted as such.

Read each question, select an answer, and check your response with the explanation on pages 41-42.

1. The shipping buffer in the drum-buffer-rope scheduling process serves which of the following functions?

   (A) It is used to create the master production schedule.
   (B) It provides protection for the order due date.
   (C) It provides protection to the constraint.
   (D) It is used to release work to the floor.

2. When using the 5S approach, which step is implemented last?

   (A) Sequence
   (B) Sustain
   (C) Straighten
   (D) Self-discipline

3. Which of the following documents is best used to understand a company's ability to pay its bills?

   (A) Cash flow statement
   (B) Income statement
   (C) Balance sheet
   (D) Market-share report

4. Which of the following statements about forecasting is true?

   (A) Forecasts are more accurate for individual products.
   (B) Forecasts are most useful for items with dependent demand.
   (C) Forecasts should include an estimate of error.
   (D) Forecasts typically are more accurate when projected over a longer period.

5. Intrinsic forecast data should be based on which of the following considerations?

   (A) Judgment, intuition, and informed opinions
   (B) Economic indicators
   (C) Shipment history
   (D) Sales history

6. Which of the following approaches represents the longest planning range in capacity management?

   (A) Capacity requirements plan
   (B) Resource requirements plan
   (C) Rough-cut capacity plan
   Input/output control
   (D) Input/output control

7. An order of 10 components requires 16 standard hours. How much time should be allocated if the work center has an efficiency of 80% and a utilization of 80%?

   (A) 22.40 hours
   (B) 10.24 hours
   (C) 16.00 hours
   (D) 25.00 hours

8. The primary objective of a random-location storage system is to improve:

   (A) distribution.
   (B) kitting.
   (C) access to stock.
   (D) use of space.

9. Which of the following types of carriers lease or own their equipment, operate it themselves, and are typically company-owned?

   (A) Common
   (B) Contract
   (C) Private
   (D) Parcel

10. What type of inventory creates independence between supply and the use of material?

    (A) Cycle
    (B) Transit
    (C) Decouple
    (D) Hedge

Answers to Sample Questions

Note: *References to the content outline appear in parentheses.*

Basics of Supply Chain Management

1. B (IG2) A shipping buffer prevents missed due dates. A is incorrect because the drum is the rate of production set by the system's constraint. C is incorrect because a constraint buffer is used to buffer the constraint. D is incorrect because the rope is the communications process for releasing work.

2. B (IE1) The order of the five Ss approach is sort, straighten, shine, standardize, and sustain. A is incorrect because sequence is not one of the five Ss. C is incorrect because straighten is the second step. D is incorrect because self-discipline is not one of the five Ss.

3. A (IC1) A cash flow statement shows the flow of cash and its timing into and out of an organization. B is incorrect because an income statement shows profit and loss over a period of time. C is incorrect because a balance sheet shows the resources owned, the debts owed, and the owner's equity at a given point in time. D is incorrect because a market share report indicates how well a firm is doing in the market.

4. C (IIC2) Forecasts are usually wrong, therefore, every forecast should include an estimate of error. A is incorrect because forecasts are more accurate for families or groups. B is incorrect because forecasts are used for independent demand items. D is incorrect because forecasts are more accurate for near-term periods.

5. D (IIC2) Intrinsic forecast data is based on interior factors such as sales history. A and B are incorrect because these are extrinsic data. C is incorrect because shipment history may not show the actual demand if product was unavailable for shipment.

6. B (IIIB) Resource requirements planning is long-range capacity planning completed at the production plan level. A is incorrect because capacity requirements planning is done at the MRP level. C is incorrect because rough-cut capacity planning is done at the master schedule level. D is incorrect because input/output control is completed during execution of the plan and is the shortest planning range.

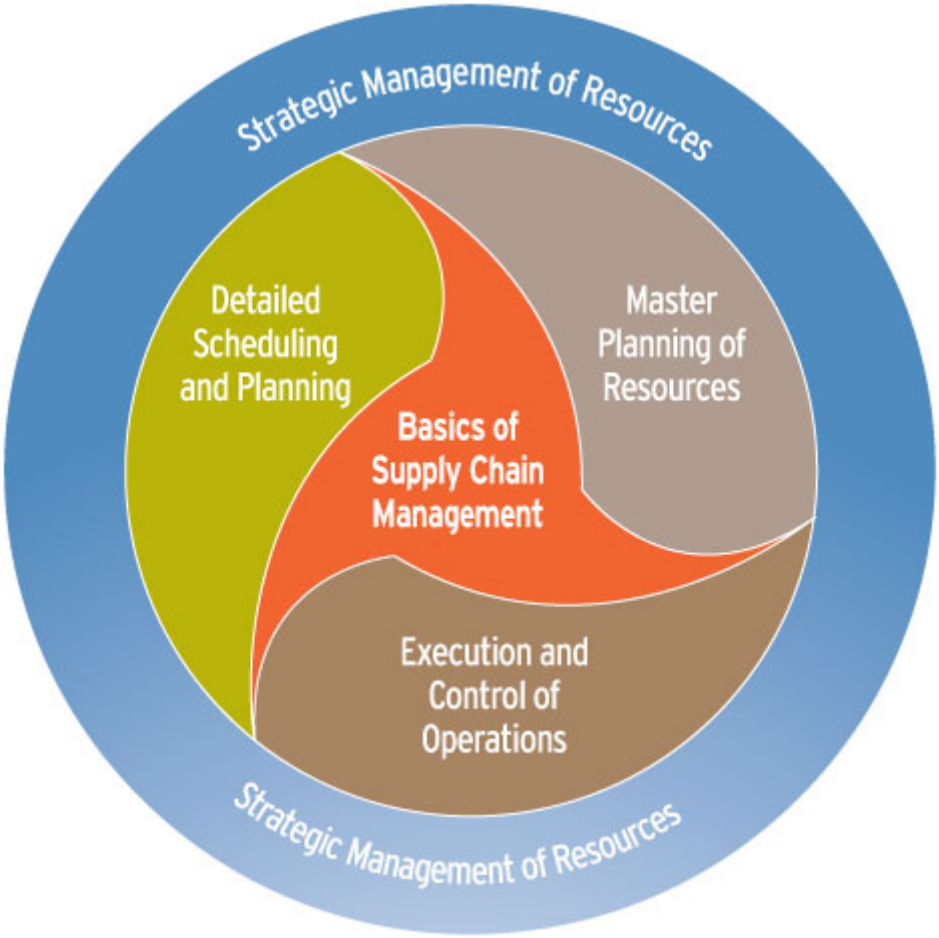
7. D (IIIB) To calculate how much actual time will be needed to complete 16 standard hours of work, divide the capacity required by the efficiency times the utilization (actual time = capacity required / (efficiency) (utilization) (actual time = 16 / (80%) (80%). A is incorrect because it was incorrectly calculated by multiplying the 16 hours required by 40 percent (the difference in the capacity and utilization from 100 percent) and adding the amount to the 16 hours required ((16 × 40% = 6.4), then (16 + 6.4 = 22.4)). B is incorrect because it was incorrectly calculated by multiplying efficiency and utilization and then multiplying the required standard hours (80% × 80% = .64, then .64 × 16 = 10.24). C is incorrect because it is the standard hours required and does not consider the efficiency and utilization of the operation.

8. D (IVC3) Random-location storage enables parts to be placed in any space that is empty. This method often required less storage space than a fixed-location storage method. A is incorrect because distribution is the activities associated with the movement of material from the manufacturer to the customer. B is incorrect because kitting is the process of constructing and staging kits. C is incorrect because access to stock is usually an advantage of fixed-location storage.

9. C (IVC2) Private carriers lease or own their own transportation equipment. Operating costs include not only investment in equipment, but insurance, permits and maintenance expenses as well. Most are company-owned and haul only their own goods. A is incorrect because common carriers carry goods for anyone wanting their services. B is incorrect because contract carriers haul only for those with whom they have a contract. D is incorrect because parcel carriers carry goods for the public.

10. C (IVA3) Decoupling creates independence between supply and use of material. A is incorrect because it is lot size inventory. B is incorrect because it is inventory in transit between locations. D is incorrect because hedge is a form of inventory buildup to buffer against some event that may not happen.

About This Guide



Instructor Guide

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CPIM

Certified in Production and Inventory Management

Basics of Supply Chain Management

Version 4.4 – January 2016

Certification Review Course

Instructor Guide

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APICS would like to thank Pearson Education for granting permission to use *Introduction to Materials Management*, Arnold et al., as a reference throughout this course.

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Module Description

The *Basics of Supply Chain Management* (BSCM) course has been developed to answer the need for fundamental education in chapters and industry. Everyone working in industry needs to have a basic understanding of the planning and control of flow of materials into, through, and out of organizations. This course will provide that understanding. In addition, those who want to become certified by APICS need a fundamentals course on material and resource planning, scheduling, and control. This course will assist them in preparing for the BSCM exam.

Topics covered in the *Basics of Supply Chain Management* course include types of manufacturing systems, demand management and forecasting, master planning, material requirements planning, capacity management, production activity control, purchasing, inventory management, physical distribution, quality management, lean manufacturing, and the theory of constraints.

Exam Content Manual

The APICS CPIM Exam Content Manual (ECM) is an important document that all exam candidates should study and review in preparation for each CPIM exam. Therefore, we are providing the appropriate ECM in every Participant Workbook. The objective of this manual is to outline the APICS CPIM body of knowledge that the APICS Certification Exam Committee has defined for each CPIM exam.

The recommended procedure for mastering the subject matter covered in each certification exam is to review the content outline, which defines the material, and then to study each topic, using the references. At the end of each major section is a list of the references that apply to the topics in that section. The first number indicates the sequence number for the reference in the Bibliography section, and the numbers in parentheses indicate the chapter(s) within that reference. These outlines form the content and structure for the certification examinations. As such, having the most current exam content manual is essential as it is revised annually.

The Participant's workbook has been developed based on the exam content outline and the references listed. Using the exam content manual in conjunction with a CPIM class and this Participant Workbook will help better prepare candidates for the CPIM certification exams.

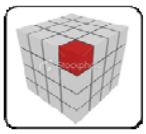
Candidates should understand the definitions of the key terms in the ECM, why and how to apply them, and which ones to select for different situations. The CPIM courseware covers many, but not all, of the key terms in the ECM. Therefore, candidates should supplement their learning by studying the ECM key term list using the *APICS Dictionary* or other ECM references as a guide.

Class Problems and Activities

Throughout the course, there are class demonstrations (in which instructors can introduce/explain concepts), as well as activities for participants. These activities are designed to review, enhance, and deepen the participants' knowledge. The activities may be performed individually, in pairs, or in small groups as indicated.

Several symbols associated with activities/problems and solutions are used throughout the course:

This cube with the question mark in the corner indicates an activity, class problem, or optional homework problem.



This cube with the solid corner indicates a solution to a problem.

This symbol on a slide indicates that the solution is filled in sequentially using the build feature of PowerPoint. Simply advance as you would to move through the visuals and the slide will sequentially build. Build slides offer you a way to explain the solution one part at a time, and to fill in a partial solution and then ask for participant input before completing the solution. If you prefer to modify the sequence of the build slides, use the custom animation feature in PowerPoint.

This symbol indicates learning objectives. The learning objectives have been designed to be measurable, to give participants a guide to what knowledge they will have after taking the course, and to serve as review topics for the instructor at the end of each class.

* An asterisk beside a visual indicates that the visual does NOT appear in the participant workbook. These are typically seen beside solution visuals reserved for the instructor. These solution slides will be found in the APICS CPIM Study Tools.

Instructor Preparation

Instructors should expect to spend an average of two to four hours of preparation for each hour of instruction. They should also read the current Exam Content Manual section on BSCM and be familiar with the references for BSCM. As a review course for exam preparation, it is important to provide an objective presentation of the material, without bias. It is always an excellent idea to provide practical examples of the concepts being taught.

The instructor community is available for communicating with and asking questions of fellow instructors. To be added to this community, please email your request to pdadmin@apics.org.

APICS requires Instructor Development Program (IDP) participation for instructors who teach CPIM courses on behalf of APICS Partners. For additional information, please contact IDPapps@apics.org.

All instructors are also encouraged to attend an APICS sponsored Train-the-Trainer program to enhance their instructor skills. Check with your local APICS partner for more information.

Instructor Materials

Instructors will need:

- A copy of the complete ten-session instructor guide
- The CD-ROM of PowerPoint visuals for each session

Equipment Needed

- Projector and screen
- Two flipcharts with stands, paper, and markers (recommended)
- Whiteboard and markers (recommended)

Guide and Workbook Formats

This instructor guide contains all ten sessions of the BSCM course.

The left-hand instructor pages, or even-numbered pages, in this guide contain images of the visuals to accompany the lecture, notes to shape the content of the lecture, and questions to pose to participants to stimulate discussion. In the participant workbook these left-hand pages contain only the visuals and space to take notes.

The participant pages, or odd-numbered pages, contain the content of the course. These right-hand pages are the same in the instructor guide and participant workbook. This facing-page layout allows an instructor to see what the participants are referencing.

Icons are used throughout the instructor text to give visual cues and draw attention. A list of the icons and their uses appears below.

Instructor Guide Icons and Cues

The following is a list of icons and cues that will indicate upcoming tasks.

Ask: Identifies a question to ask the class

Discuss: Identifies a topic for class discussion

Explain: Indicates that a topic may require further explanation

Flipchart: Identifies an activity for which it may be helpful to write information on a flipchart

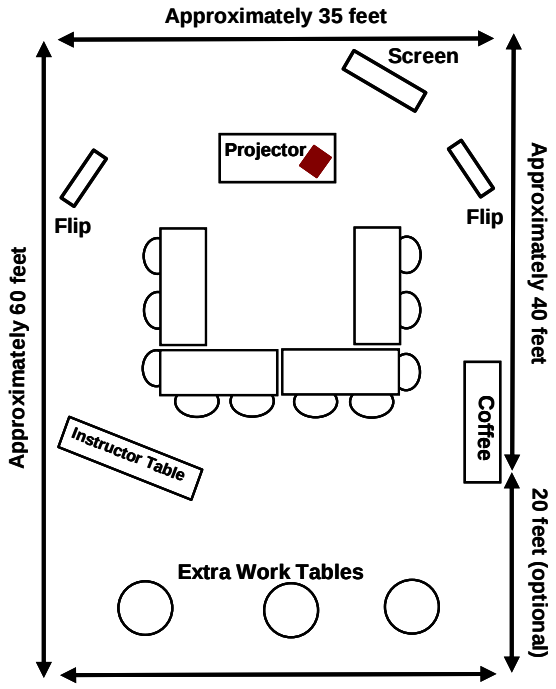
Note: Indicates an item to which special attention should be paid

Time: Indicates how much time to spend on a certain activity

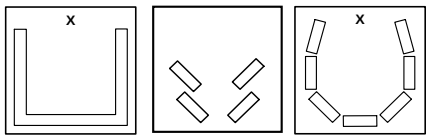
CPIM Study Tools: Indicates that these instructor materials (solution slides and performance check answers) are available to students online in the CPIM Study Tools.

Suggested Training Room Layout

The suggested training room layout shown below is conducive to learning as it promotes interaction among the learners as well as between the learners and the instructor. Ideally, the room should accommodate additional work tables for breakout exercises at the back. However, this is not necessary.



Or, use one of the layouts shown on the right to encourage participation by the class and to involve all learners.



Try to avoid the traditional layout shown to the right when instructing. You will see that it fills from the back as people try to avoid active participation in the class. The focus is on the instructor and not on the learner.

Move around the room during class sessions—especially if you are restricted to using a traditional room layout. This will encourage every participant to take a more active role in the learning environment. When a session ends, put the room back in proper order before leaving.

Visual Aids (Slides)

Visual aids in the form of PowerPoint slides are included and designed to help explain information or to provide visual cues for recalling and understanding information. The course CD contains all the files you need to present the visuals.

If you do not have access to a full version of PowerPoint, a PowerPoint viewer file can be downloaded from Microsoft.

To Move through the Slides

- Click the mouse button to advance from slide to slide.
  - You can also use the arrow keys, spacebar, and the Page Up and Page Down keys to move through the slides.
  - To jump to a specific slide in the presentation, type the slide number, and then press <enter>.

To Draw Freehand on a Slide

- Click the Freeform tool on the bottom left or right corner of the slide (it resembles a pencil).
- Place the crosshair pointer where you want to begin drawing.
- Hold down the mouse button while drawing. A drawing pencil will appear.
- Move the mouse to draw shapes on the slides.
- To end drawing, press the Escape key on the keyboard.
- Alternatives to the Freeform tool on slides that the instructor must fill in include the following:
  - Use traditional overhead transparencies and a second projector for visuals where spaces must be filled in
  - Some projectors allow the user to place a blank transparency over the LCD panel. The instructor can then write on the blank transparency

To End the PowerPoint Slide Show

- Press the Escape key

Equipment

Arrive at least 45 minutes to one hour early for each session to set up and test the equipment—projector, flipchart, whiteboard, etc. Test the equipment; walk to the back of the room to test for focus, clarity, and sight lines. Learn how to dim the lights if necessary.

Blackboards and Whiteboards

Blackboards are one of the oldest visual aids and can be very effective. Whiteboards can be used in much the same way. Use them to work through class problems and for illustration. Be brave! Draw stick people and trucks, etc., to make your point. This can give good memory clues to learners, pace the presentation, and enliven the class at your artistic expense.

Flipcharts

Flipcharts can be used for working problems and will be used in the final review activity. You can also post questions to a flip chart to come back to later. The information on flipcharts is permanent and can be retrieved for later use. They are also great to post around the room during the workshop. Flipcharts require special markers. Whiteboard markers will work, but tend to dry out quickly.

Performance Checks

There is much material to be covered in each session. The performance checks were created to give you an opportunity to assess the participants' learning. The performance checks may be used as evaluation tools or homework assignments. An option is to send them to the participants as a pre-course assignment to assess their knowledge before the course starts. If you are using the performance checks for evaluation or homework assignments, make sure you have a policy and that the participants understand it. The participants are adults with other responsibilities, so you should try to have a flexible policy.

Please note that a progress check answer sheet for the participants' use in recording the correct answers to the performance check questions can be found in the Appendix.

Class Participation

Tell the participants that everyone has a contribution to make, and everyone should participate in class discussions and problem solving.

Icebreaker

Before the first session, have the participants introduce themselves, identify their employer, state their job title/functions, and what they hope to get out of the class.

APICS CPIM Study Tools

In addition to your printed APICS CPIM instructor guide, APICS has developed the APICS CPIM Study Tools—an online learning environment to help your students master the core concepts within the APICS CPIM module and to help you manage your students' progress. This online tool contains presentation slides and assessments to complement your students' APICS CPIM learning experience.

To access APICS CPIM Study Tools, you will need an APICS ID.

- If you currently do not have an APICS ID, simply go to apics.org/newuser to create one.
- If you are a member of the APICS Instructor Development Program (IDP), simply log in to apics.org using your APICS ID.
- If you are not already a member of the APICS IDP, email idpapps@apics.org and inform them that you are an instructor who has purchased an APICS CPIM instructor guide with the intention of teaching an APICS CPIM course. The APICS Professional Development team will help get you set up so that you can access the APICS CPIM Study Tools.

Full instructions on accessing APICS CPIM Study Tools are available online at apics.org/cpimstudytools.

Global Citizenship

United Nations Global Compact

The United Nations (UN) Global Compact is a strategic policy initiative for businesses interested in social justice and sustainable development. Sustainable development balances current resource consumption without compromising the well-being of future generations. Let's look at some of the important aspects of the Compact and its implications for manufacturing and service industry firms. It can be downloaded at www.unglobalcompact.org/docs/news_events/8.1/GC_brochure_FINAL.pdf.

Voluntary

Membership in the Global Compact is voluntary. Through the influence of the UN and large global corporations, there are more than 8,000 corporate participants in the program. Membership requires the signature of a company's chief executive and the endorsement of its highest-level governance body.

Alignment with Global Compact principles

Member companies agree to align their operations with ten key principles in four areas as shown in the visual: human rights, labor practices, environment, and anti-corruption. Note that environmental concerns make up only one of the four areas.

Adoption of the UN Global Compact Management Model

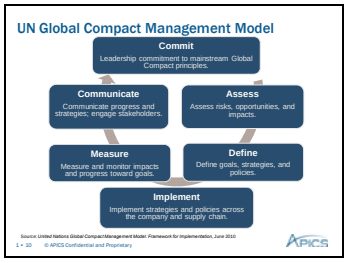
Of particular relevance to manufacturers and service firms with supply chain issues is the UN Global Compact Management Model, which we will discuss shortly. The management model provides detailed guidelines for incorporating the ten principles in business strategies and operations.

Ten Principles

Visual 1-9 shows how the ten universally accepted Global Compact principles have been organized into the four areas mentioned above.

Global Citizenship (cont.)

UN Global Compact Management Model



Visual 1-10

Explain that the objective of the UN Global Compact Management Model is to set guidelines for incorporating the ten Global Compact principles into strategic and operational reality. The six-step management model follows a development life cycle commonly found in process improvement projects executed by manufacturing and service industry firms. Note that the implementation phase mentions working with supply chain partners.

Ask why the Global Compact singles out supply chain partners as an important factor in a firm's ability to comply with the ten principles of the Global Compact.

Answer

The Global Compact sees a firm's business relationships with suppliers—in countries where production is less expensive—as a means of ensuring that those suppliers also are compliant with the ten human rights, labor, environment, and anti-corruption principles.

Encourage participants to download and read the UN Global Compact and its management model.

Providing Customer Service and Support

Customer service and product support are keys to customer retention and loyalty. We likely all know of someone who has said "I'll never buy that again" after receiving poor service. Some companies make customer service a strategic goal and set high performance measures to ensure that customers are satisfied.

Customer service includes

- understanding and meeting customer needs
- two-way communication with customers
- working with customers to solve design and production problems.

The concept of customer relationship management (CRM), which is a philosophy based on putting the customer first, will be reviewed later in this course. CRM involves the collection and analysis of information to support customers. It also includes account management and order management.

Business Environment

Visual 1-16

Global Competition

Explain that businesses have to compete with companies from all over the world. Many companies now have global markets. Companies strive to differentiate their products and services to attract and retain customers.

Ask participants to name organizations that have a global presence. How do these organizations differentiate their product and services from their competition?

Answer:

An example is Apple Inc., which sells and markets electronic products worldwide. They focus on defining their products as higher quality and easier to use than their competition's products.

Economic, Government, and Regulatory Influences

Explain that economic, government, and regulatory agencies influence the global supply chain.

Ask participants why they think the global economy affects products they buy locally.

Answer:

Even though the product is sold locally, it may contain materials sourced in another country. Lower production costs of foreign competitors leads to lower domestic prices.

Product Life Cycle and Manufacturing Environment

Product Life Cycle

Products typically go through a cycle of introduction to phase-out in five stages:

- Introduction—Products are designed and introduced with sales promotion and advertising. Costs can be high in this stage.
- Growth—As the product becomes accepted, production increases and unit cost drops. Competition may arise in this stage.
- Maturity—The product is well-established in the marketplace. Competing products exist. Some products are in perpetual maturity, such as steel and milk.
- Decline—Sales volumes decline and profits are reduced. Organizations may introduce new products or improve production methods to reduce costs.
- Phase-out—Some authors add a phase-out (end-of-life) stage, where the product is taken off the market. Advertising and promotions are discontinued, production ends, and sales and support may be outsourced.

Relationship to Manufacturing Environment

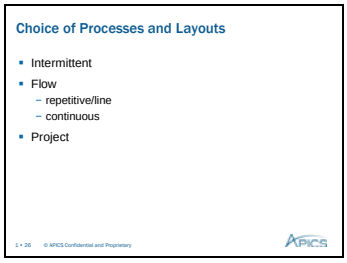
Companies sometimes find it appropriate to migrate to a different manufacturing environment for certain products. Visual 1-25 shows the types of manufacturing environment choices that can be more appropriate in different phases of the product life cycle. For example:

- A product is built in the *introduction* stage as a prototype using ETO and then moves to MTO during the *growth* stage as volume increases.
- A product moves to MTS during the *maturity* stage and then during *decline*, when volume falls, moves back to the MTO to extend its life cycle with adjustments or revisions.

Can you think of a product that has followed this path through the life cycle?

_____

Choice of Processes and Layouts



Visual 1-26

Explain the three basic types of manufacturing process choices.

Supply Chain Organizational Issues

Inherent Supply Chain Conflicts

As mentioned earlier, conventional supply chains often do not properly resolve conflicts or balance the interests of different supply chain functions or departments. This is due to inherent conflicts of interest among various functions in the following areas:

- production efficiency in manufacturing and finance
- high levels of customer service in marketing and finance
- low inventory investment within finance

These conflicts never go away. They affect decisions made at every stage of the manufacturing planning and control (MPC) process that will be introduced in the next section. Note that the conflicts do not always occur between different functions, and sometimes happen within the same function—as in the case of finance.

These conflicts afflict every supply chain—even well-managed, cross-functional supply chains. They are summarized below.

If marketing sets an objective to increase revenue, then it will require

- high customer service
- the ability to interrupt production schedules, short runs, and so on, resulting in low production efficiency
- high inventories in order for products to always be in stock.

If production sets an objective to reduce manufacturing costs, then it will require

- high production efficiency—including long production runs, few products, and few setups, which will result in (1) less flexibility to meet the need for other products and (2) lower customer service
- high inventory of raw materials and finished goods to eliminate production interruptions.

If finance sets a goal to increase profit, increase cash flow, and reduce investment, it will require

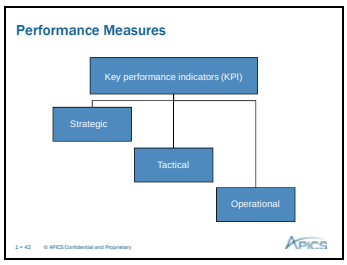
- high customer service to maximize profit
- high production efficiency to minimize costs
- low inventory to minimize investment.

Resolving Conflicts

Supply chain management has the ability to evolve and to apply certain processes for dealing with these conflicts. These processes include

- sales and operations planning to balance inventory, customer service, and production efficiency during the production planning process
- clear responsibility for the materials management function that facilitates planning and manages the day-to-day tradeoffs that are sometimes necessary
- application of productivity systems such as lean, quality systems, and theory of constraints to speed up processes and reduce waste to offset the effects of the conflicts.

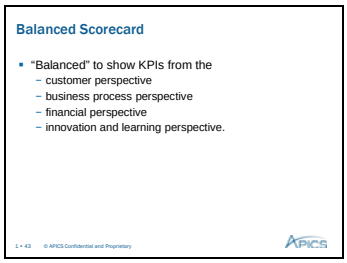
Performance Measures



Visual 1-42

Explain that organizations should determine key performance indicators (KPIs) to measure performance. Describe the three types of KPIs: strategic—high-level, long term; tactical—mid-level, mid-term; and operational—detailed work, daily.

Balanced Scorecard



Visual 1-43

Discuss the use of a balanced scorecard to track organizational performance.

Ask participants to give examples of the four areas of the balanced scorecard.

Answer:

Customer perspective—On-time delivery, satisfaction from surveys, and complaints

Business process perspective—Productivity, successful sales calls, and inventory turns

Financial perspective—Revenue, gross margin, and returns on investment

Innovation and learning perspective—Training hours per person, new products, and patents

End this section by pointing out that the KPIs used in these four areas should not be generic; they need to measure performance in areas critical to a particular company's overall strategic and tactical goals.

Note: The fourth perspective of the balanced scorecard, "innovation and learning," is cited as "learning and growth" by some texts.

Manufacturing Planning and Control (MPC)

Planning is needed to ensure and manage the availability of resources, such as material and capacity, to satisfy customer demand.

Objectives of Manufacturing

As a business function, manufacturing has a number of objectives. These can be summarized as producing the right goods

- of the right quality
- in the right quantities
- at the right time
- at the right cost.

When you look closely at a manufacturing company, you should see that its organization, business processes, and resources generally are structured in such a way as to achieve these objectives.

The challenge for a manufacturing company is to achieve high levels of customer satisfaction by making sure that available production capacity is sufficient to produce the volume, types, and quality of products that customers want—when and where they want them. This is summarized in Visual 1-47 as achieving a balance between the materials needed for production and the capacity required, which is the role of the MPC planning system.

A key aspect of customer satisfaction in a manufacturing company is the management of the vast amount of data that support key decisions. Data governance encompasses the overall management of the accessibility, usability, reliability, and security of data in order to ensure data record accuracy. This is especially important because of the increasing amounts of critical electronic data.

Priority and Capacity Planning

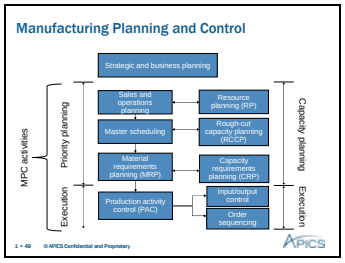
Before addressing MPC, let's review the important concepts of priority and capacity. You will hear a lot about these two terms in the next four sessions of this course.

Priority and capacity are related concepts.

- Priority relates to demand and capacity relates to supply.
- Priority refers to what product or component is needed, how much of it is needed, and when.
- Capacity refers to how much production capacity and other resources are available to meet priorities.
- Priority and capacity planning is the process of balancing resources and demand.

Priority and capacity planning defines the planning phases of MPC.

Manufacturing Planning and Control Hierarchy



Visual 1-49

Discuss the MPC system and the importance of understanding the relationships between the different phases of the planning hierarchy. Emphasize that Sessions 2 through 5 review in some detail the MPC processes that translate independent demand for products into dependent demand for materials, load on production resources, and finally into finished goods through production activity control.

The following points should be reviewed:

- Top-down planning—This links planning and control activities at all levels to the business plan.
- Closed loop system—Plans and controls continually are adjusted to account for events that occur before or during production.
- Capacity planning and management—Resource requirements estimated during the iterative priority or materials planning process are compared at each planning level with projected available resources.
- Cross-functional collaboration—The interests of stakeholder functions, including manufacturing, marketing, finance, and others, are balanced during the sales and operations planning process and during the implementation and control phase of production activity control.

Note that many authors consider strategic and business planning to be a level above MPC, and that the goal of MPC is to align planning, scheduling, and execution with these overarching plans.

The MPC hierarchy shown on Visual 1-49 is enlarged in the appendix to this session.

Manufacturing Planning and Control Hierarchy

Manufacturing's functional role in the supply chain is to produce products and services. This role is defined by strategic business and marketing objectives and is supported by upstream and downstream supply chain operations.

MPC is the system used by manufacturing to recognize the demand for products, plan the resources required to produce them, and execute and control production. MPC also is the framework for more detailed business processes and best practices that have been developed to implement the different aspects of the system.

The following are the salient points of MPC, which will be covered in more detail in Sessions 2 though 5 of this course:

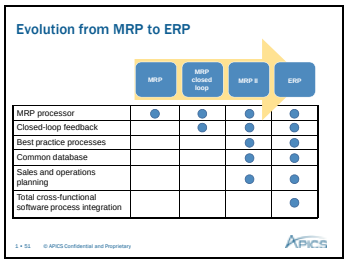
- MPC uses a top-down planning approach in which planning and execution activities are formally related to the organization's strategic and business plans. Note that lean manufacturing uses a similar planning process called *hoshin* planning, which we will discuss further in Session 9.
- MPC applies a layered approach to planning
  - Business planning—long-term planning in dollars or other currencies
  - Sales and operations planning, or the production plan—medium to long-term planning at the product family level; for example, bicycles
  - Master scheduling, or the master production schedule (MPS)—short to medium-term planning at the end-item product level; for example, specific bicycle model or options
  - MRP—short-term planning at the end-item or product-component level; for example, bicycle components
- MPC validates the production plan using resource planning.
- MPC also validates the priority plans developed at the master scheduling and MRP levels against capacity available at those levels.
- MPC is a closed-loop system, meaning that plans continually are adjusted to account for events that occur before or during production, such as
  - internal events, including production delays, material shortages, and quality issues
  - external events, including changes in customer demand, late supplier deliveries of raw materials, and economic conditions.
- Requires cross-functional coordination of three key functions—manufacturing, marketing, and finance—as well as input from engineering, including research and development or product development; human resources; distribution; quality; and supply chain or materials management

The business world requires speed, responsiveness, and flexibility, and MPC cannot succeed without the support of information technology (IT) and applications software. As we will discuss later, advances in IT led to integrated, software-enabled versions of MPC called MRP II. MPC also became the template for the manufacturing modules of ERP systems, which have succeeded MRP II.

Note that the MPC hierarchy shown on Visual 1-49 is enlarged in the appendix to this session.

From MRP to ERP

Reference: *Introduction to Materials Management,* Arnold et al., 7th ed., chap. 2.



Visual 1-51

In the next two pages, we will discuss the evolution of MPC from MRP to ERP in two stages:

- from MRP to closed-loop MRP II
- from MRP II to ERP

Explain that beyond the evolution from MRP to ERP is the growing influence and enabling power of IT to integrate function-specific application software modules into an integrated system.

From MRP to ERP

Manufacturers rely heavily on manufacturing planning software applications that support and integrate the key MPC processes we have just reviewed. In most cases, process and software integration has occurred as companies have implemented ERP systems. Let's review how integration of processes and software applications evolved.

From MRP to MRP II

MRP

As we will learn in Session 4, MRP is one of the most important business processes in MPC. Based on the due dates for end items in the master schedule, MRP establishes the *priority plan* for the due dates and order quantities for the components of end items. MRP software applications for the development and management of the priority plan primarily serve the needs of the production and purchasing departments.

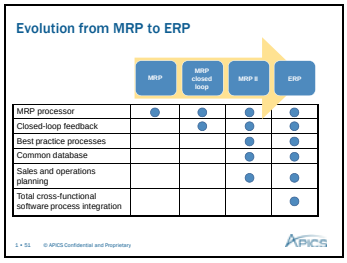
Closed-Loop MRP

It was only matter of time before manufacturing planning software evolved beyond MRP to *closed-loop MRP*, which

- links the production plan to the more detailed MPS in the early stages of the MPC process
- links the production planning, master scheduling and MRP to capacity planning and management to ensure that production resources can accommodate capacity requirements
- supports the closed loop, which provides structured and timely feedback on the status of work orders already released—including start dates, due dates, and quantities—to enable changes and adjustments to priority plans and production schedules by MRP and production activity control
- assists with reporting of cost data for cost and financial accounting purposes.

From an IT standpoint, closed-loop MRP usually is supported by function-specific software applications with their own databases and a low to moderate level of cross-functional integration.

From MRPII to ERP



Visual 1-51, continued

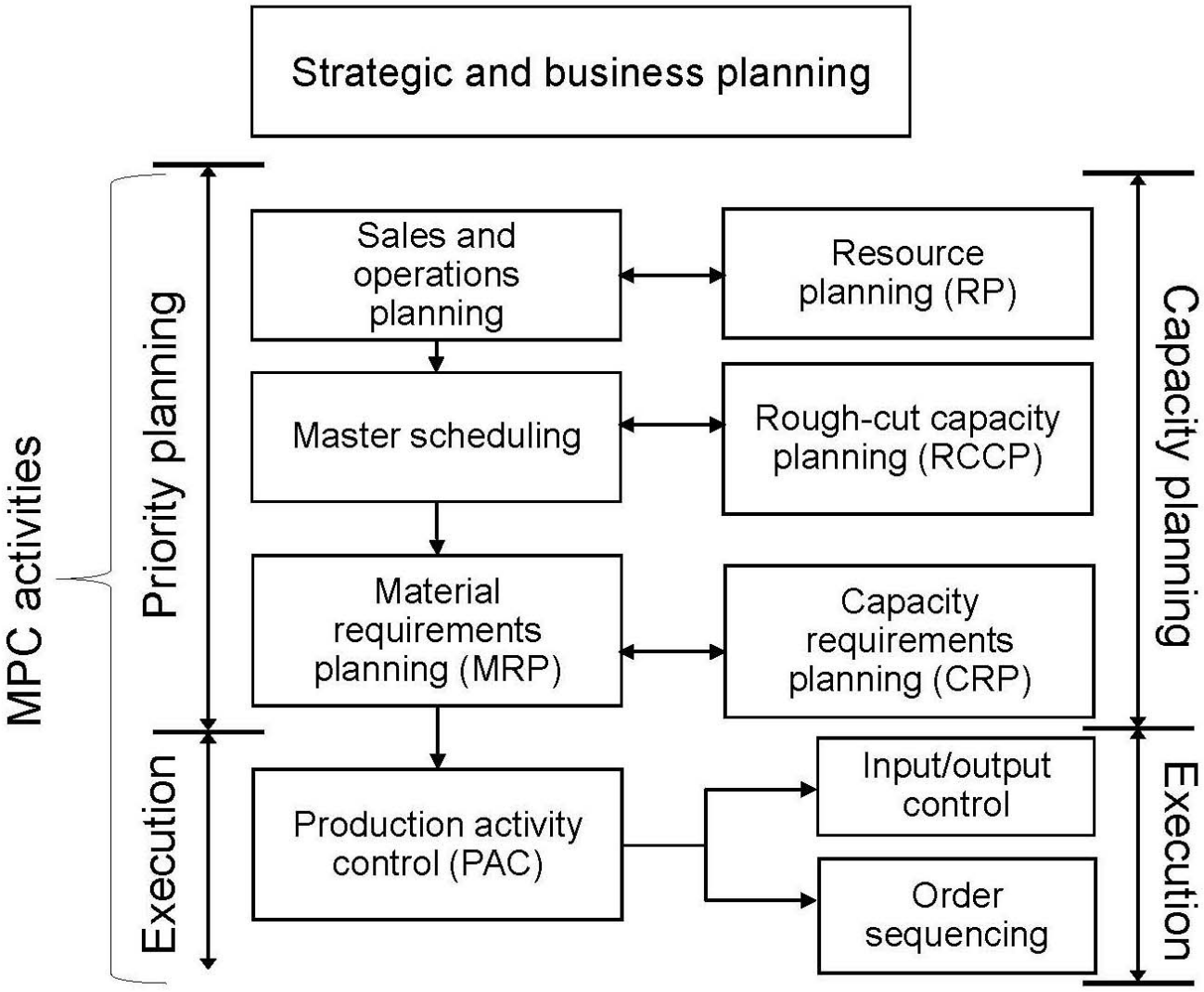
Explain that the MRP acronym caused much confusion. Managers would say "MRP" when they meant "manufacturing resource planning," while subordinates heard "MRP," thinking that material requirements planning was being discussed.

Make the following points as appropriate:

- The key element during this stage was *integration*. In addition, many of the software packages included integration of production reporting with accounting ledgers to provide important cost information.
- In ERP, we see the opportunity for improved supply chain connectivity with customers and suppliers.

Appendix

Manufacturing Planning and Control



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Order Winners and Qualifiers

The characteristics of products and services are a key element of the marketing mix. An important role of marketing management is to develop and implement marketing plans for products and services with order winning or qualifying characteristics.

- *Order qualifying* characteristics must be exhibited by a firm's products and services in order for the firm to be a viable competitor in the marketplace.
- *Order winning* characteristics cause customers to choose a product over its competitors' products.
- Examples of order winning and order qualifying characteristics are quality, speed, dependability, flexibility, and cost. These are sometimes referred to as *performance objectives*.

A useful comparison of the difference between an order winner and an order qualifier is provided in a CPIM reference source, *Operations Strategy,* Slack et al., 2003. The authors cite fast-food retailer Burger King (BK) as an example. BK views the following as order qualifiers that do not significantly differentiate their products and services from those of competitors:

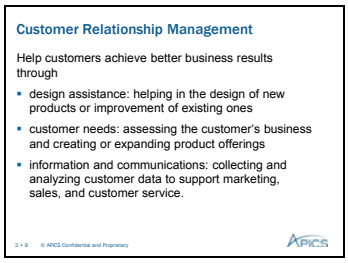
- Speed of service—Key competitors are about as fast in both drive-through service and counter service.
- Dependability—Reliability of BK's full range of product and service availability and its ordering experience consistency also are on par with the industry.
- Flexibility—BK is similar to competitors in its ability to meet changing sales volume and mix, or product option, requirements during the day.
- Cost—BK's prices are not the cheapest but are not much different from their competitors' prices.

From BK's point of view, their order winner is *quality* related: the flame-grilled taste of their Whopper sandwich, when cooked properly, coupled with the order-qualifying characteristics of service quality—including cleanliness, friendliness, and helpfulness of staff—all contribute to their quality output.

Voice of the Customer

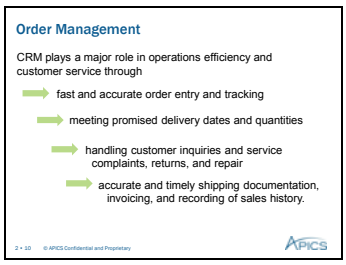
Determining order qualifying and winning characteristics relies to a great extent on the design of products to meet customer expectations: the voice of the customer. Later in this course, we will review a formal method developed for use in quality management and lean manufacturing for determining the voice of the customer during product and process design. This method, quality function deployment, will be addressed in Session 9.

Customer Relationship Management



Visual 2-9

Highlight the three points regarding design assistance, customer needs, and information and communication. CRM plays a strategic role in identifying the customer's strategic and operational needs, working with companies to influence demand and expand offerings, and analyzing customer data. It also has an operational role in order management.



Visual 2-10

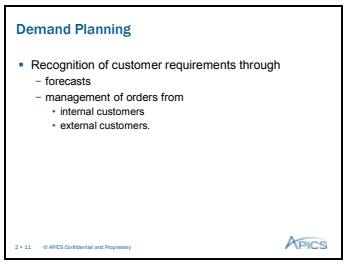
Explain CRM's role in order management and its impact on operational efficiency and customer satisfaction.

Ask for examples of other CRM customer-facing activities.

Answer:

Call center operations

Demand Planning



Visual 2-11

Explain that demand planning is the recognition of demand either as forecasted or as actual customer orders from internal as well as external customers. Note that we will get into the details of customer orders in the next section on characteristics of demand. Demand is then met through inventories, purchase orders, production, and distribution systems. Use this as a transition to the next two sections on the characteristics of demand and forecasting.

Measuring Forecast Error

The degree of deviation from average demand presents a challenge to inventory management. How much safety stock, for example, should be carried to deal with random variations in demand and to achieve desired customer service levels? This is why it is important to measure and evaluate forecast error.

Mean Absolute Deviation (MAD)

Here is a quick, high-level summary of a simple and proven statistical approach to measuring and evaluating forecast error. Remember, forecast error, or deviation, is the actual period demand minus the forecast (A – F). If actual demand exceeds forecast, the error will have a positive value and vice versa. In calculating MAD, however, the MAD is used to determine the dispersion of the forecast error around average demand. Let's illustrate by calculating the value of the MAD using the data and formula below.

Forecast error data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Forecast	500	500	500	500	500	500	500	500	500	500	500	500	-
Actual	460	520	530	490	460	500	530	490	530	480	490	520	-
Absolute deviation	40	20	30	10	40	0	30	10	30	20	10	20	260

$$\text{MAD} = \frac{\Sigma \text{ absolute errors}}{\text{Number of periods}} = \frac{260}{12} = 22 \text{ units}$$

Now let's look at the statistically determined dispersion of forecast error using a normal distribution curve for the data shown above. (See Visual 2-53).

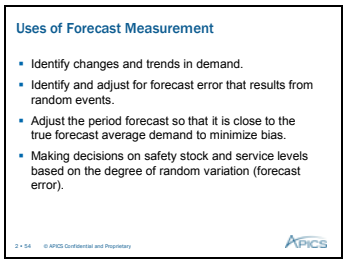
- The center is the central tendency or average, which in this case is the forecast.
- Forecast errors, which are not shown in the visual, are randomly dispersed on both sides of the central tendency.
- Statistically, in a normal distribution, 60 percent of the forecast error will fall within ± 1 MAD of the average, 90 percent will fall within ± 2 MAD, and 98 percent will fall within ± 3 MAD.
- If the actual demand is tightly bunched around the center, then the dispersion is narrow and forecast accuracy is relatively high—and vice versa for demand that is widely dispersed.
- As shown in the Visual 2-53 in the example we just calculated, 60 percent of the errors, or period demand quantities, were within ± 22 units, 90 percent were within ± 44 units, and 98 percent were within ± 66 units of the average.

Measurements such as MAD are important because they indicate the relative cost of different levels of customer service. For example, by using safety factor tables, planners can convert the MAD of 22 units into safety stock requirements for desired service level percentages.

Standard Deviation

Explain that MAD and standard deviation are alternate methods to measure forecast error. Standard deviation is covered in more detail in other CPIM modules.

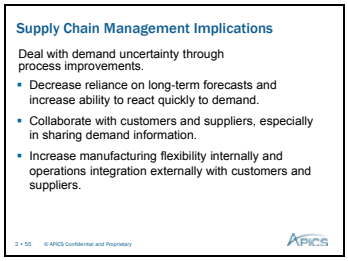
Uses of Forecast Measurement



Visual 2-54

Recap the uses and benefits of forecast measurement.

Supply Chain Management Implications



Visual 2-55

Explain that by improving manufacturing flexibility and collaboration with customers and suppliers, companies can reduce demand uncertainty and reliance on long-term forecasts.

Note that tracking signals are not covered here, but will be in the Master Planning of Resources course.

Master Scheduling and Sales

It is important to understand the relationship between manufacturing, sales, and the MPS. Here are some important points to consider:

- The MPS is manufacturing's anticipated build schedule.
- It is based on end-item demand forecasts and customer orders provided by sales.
- The master scheduler relies on the production plan to make sure that the priority plan—including end-item quantities and due dates—established by the MPS is realistic and achievable, and that materials and operational resources will be available and sufficient.
- Manufacturing does not build directly to the forecast; the MPS factors in available inventory and safety stock requirements.
- The master schedule, of which the MPS is a major component, must be flexible enough to accommodate changes in demand, production delays, and material shortages.

In other words, master scheduling creates a plan for what manufacturing can and will produce based on what sales predicts will sell, subject to the availability of resources.

MPS and Delivery Promises

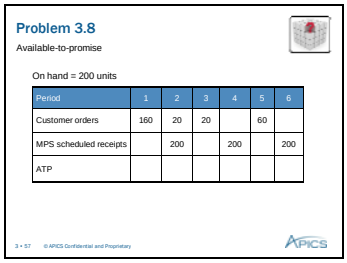
In the management of real customer orders, the interests of manufacturing and sales again intersect in the master schedule. Customers are placing orders for both

- items that are in stock
- items that are in production or are planned.

The MPS is the basis for making delivery promises.

In this short section, we will address the basics of the ATP process.

Class Problem 3.8: Available-to-Promise

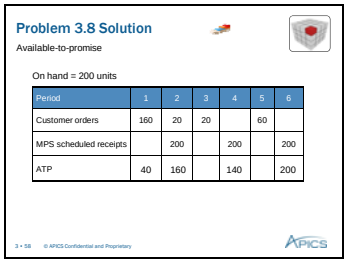


Visual 3-57

Walk through the scenario, procedures, and calculation shown on the participant workbook page. Make sure the class understands the following:

- We are viewing the ATP situation at the very beginning of period 1.
- Customer orders shown at this moment are expected to change often as new or changed orders arrive.

Solution:



Visual 3-58 *

The result should be as follows.

Period	1	2	3	4	5	6
Customer orders	160	20	20		60	
MPS scheduled receipts		200		200		200
ATP	40	160		140		200

Ask how many uncommitted units are expected to be promised to orders in week 1 and from week 4 to 5?

Answer:

Forty in week 1, and a total of 140 in the period covering weeks 4 and 5.

Class Problem 3.10:

Calculate the ATP per the schedule below. There is no opening inventory.

Week	1	2	3	4	5
Customer orders	15	5	25	5	
MPS scheduled receipts	30		30		30
ATP					

Performance Check 

Remind the class that the main purpose of the performance check is to provide feedback. The questions all are multiple choice and are of the same type as on an APICS Basics of Supply Chain Management examination.

If you will be assigning grades, **ask** the class to write their answers on a separate answer sheet.

Give the class the answers and let them mark their own papers. This is a good opportunity to reinforce material from this session. Discussion of the answers is encouraged.

When the discussion is completed, **collect** the papers. If you are assigning grades, you can record from the papers.

Answers

1. **b**—Answer *a* and answer *d* are the same and do not build inventory because they are designed with the capacity and flexibility to match variations in demand over time. Answer *c* is related to inventory record accuracy and control.
2. **b—**Answer *a* is how marketing might group its markets or customers. Manufacturing needs to know what products share the same manufacturing processes, which is why answer *b* correct. Answers *c* and *d*, the availability of materials and machinery, affect production capacity but not the basis for establishing product families.
3. **d—**The equation for determining the production quantity is as follows: Ending inventory + sales forecast – opening inventory = quantity to be produced.
4. **c—**Make-to-order is more appropriate than MTS for answers *a* (demand is unpredictable), *b* (many product options exist), and *d* (customer requires special engineering).
5. **b—**Answer *a*, answer *c*, and answer *d* relate to capacity planning, execution, and priority planning activities that follow the master scheduling process.

Planning Software

Because of the volume and complexity of calculations, most companies rely on application software for MRP. Software applications are a lot faster and more accurate in performing MRP calculations needed to create the priority plan. Example of such calculations are:

- Exploding BOMs for determining an end item's component quantities, down to the component and raw material level
- Checking inventory records for quantities on hand, on order, or allocated
- Offsetting order release and receipt dates for net component and raw material requirements from the end-item due date, which will be covered later in this session.

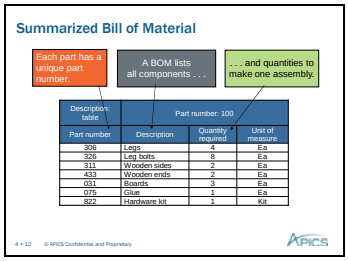
In addition, MRP software keeps track of due dates in the priority plan and the status of materials and production. It also

- advises planners on when to release planned orders
- advises when to expedite or take other actions to maintain the due dates in the priority plan
- replans MRP on a periodic basis to update material requirements, due dates, and inventory status.

Bill of Material

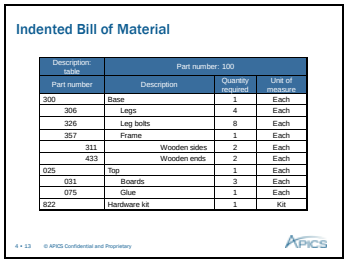
Reference: *Introduction to Materials Management,* Arnold et al., 7th ed., chap. 4.

Introduction



Visual 4-12

Note the *APICS Dictionary* definition of the BOM for a parent assembly. Explain the elements of the bill. Use the summarized BOM or parts list to illustrate that each component has a unique part number and description; the quantity of each component per assembly and the unit of measure are shown.



Visual 4-13

Explain that the indented bill is more commonly used and that it provides an idea of an end item or assembly product structure.

It is important to explain that BOMs come in other forms such as baking recipes and chemical formulas.

What components in the indented bill, in addition to hardware kit 822, are purchased components?

Answer:

Legs and leg bolts, wooden sides and ends, boards, glue, hardware kit

How many assemblies/subassemblies are in the bill?

Answer:

Four, including table 100. The hardware kit is not an assembly.

Definition of Capacity

A measure of available capacity is needed at all levels—plant, department, and work center. There are two major components to the definition of capacity:

- the capability of a system to perform its expected function
- the capability of a worker, machine, work center, plant, or organization as measured in output per time period

Why is capacity often stated in standard hours?

_____

_____

How are standard hours per unit of output determined?

_____

_____

Other parameters, such as units, feet, or kilograms, can be used to measure capacity. Dollars should never be used as a measurement of capacity. Dollars measure the value of throughput.

Capacity Planning Process

The capacity planning process consists of the following steps:

- Determine the capacity available.
- Translate the priority plan into the capacity required for each time period.
- Sum up the capacities for each time period required for each resource in order to compare to capacity available.
- Resolve differences between available capacity and required capacity for each time period.

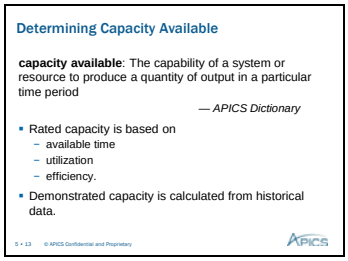
Again, this process takes place at all levels of the priority planning process, from S&OP (production planning) to MRP.

What are two major differences among the priority planning levels?

_____

_____

Determining Capacity Available

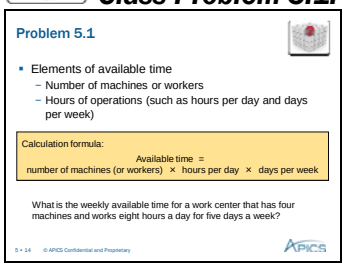


Visual 5-13

Tell the class that we will determine two types of capacity available, rated capacity and demonstrated capacity. In order to calculate rated capacity, we first need to understand available time, utilization, and efficiency. Later we will use some historical data to calculate demonstrated capacity.

Available Time

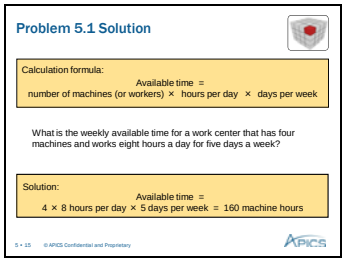
Class Problem 5.1:



Visual 5-14

Ask the class to calculate the weekly available time for a work center that has four machines and works eight hours a day, five days per week.

Solution:



Visual 5-15 *

Available time: 4 machines × 8 hours a day × 5 days a week = 160 machine hours

Ask how available time can be adjusted to accommodate increases or decreases in priority plan requirements. Examples include adding another machine and adding a shift on the sixth day of the week.

Backward Versus Forward Scheduling

Why are most operations backward scheduled?

_____

_____

_____

When would a company forward schedule?

_____

_____

_____

Infinite and Finite Loading

What is the advantage of using finite loading logic in scheduling?

_____

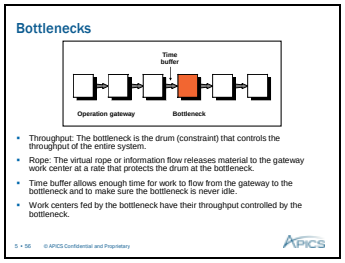
_____

_____

Some companies today use advanced planning and scheduling (APS) software to balance load and capacity and to perform optimization or simulation of finite capacity scheduling, sourcing, planning, and demand management. APS often evaluates multiple scenarios for management to consider for implementation.

Bottleneck Scheduling

Characteristics and Principles



Visual 5-56

Discuss the characteristics and principles of bottlenecks as summarized in the visual. Discuss the points shown in the participant workbook.

Ask if it makes sense for work centers in front of the bottleneck to produce output at a rate faster than the bottleneck can handle.

Answer:

No, it would only build up WIP inventory.

Ask if the bottleneck is relieved by adding more capacity, and what might happen at work centers either before or after the bottleneck.

Answer:

One of them might become the system bottleneck, which underscores the theory of constraints method (continuing to focus on getting all the constraints out of the system so the critical chain and the throughput lead time are the same).

Ask the class, based on the introduction of the concepts of drum, buffer, and rope, if they can explain what drum-buffer-rope scheduling is.

Answer:

Bottleneck is the drum that sets the pace (drumbeat) of production for the whole system. The virtual rope releases materials to the gateway work center (the first operation) at a rate that protects the drum schedule at the bottleneck. The time buffer allows enough time for work to flow from the gateway to the bottleneck and to make sure the bottleneck is never idle.

Ask the class why bottlenecks occur in intermittent manufacturing.

Answer:

Lead times are long, routings are different for different items, operation times for orders will differ, WIP volumes can be high and queues long. It is challenging to schedule work to arrive when it is required.

Clues (from the* APICS Dictionary*)

ACROSS

3 A measurement, usually expressed as a percentage, of the actual output to the standard output expected

5 The resources needed to produce the projected level of work required from a facility over a time horizon

7 A technique where the schedule is computed starting with the due date for the order and working backward to determine the required start date or due dates for each operation

8 Hours available × efficiency × utilization

9 Assigning no more work to a work center than can be expected to execute in a given time period

11 The function of routing and dispatching the work to be accomplished through the production facility and of performing supplier control

12 The ratio of direct time charged (run time plus setup time) to the clock time available

DOWN

1 The capability of a system or resource to produce a quantity of output in a particular time period

2 The amount of planned work scheduled for and actual work released to a facility, work center, or operation for a specific span of time

4 A technique where the scheduler proceeds from a known start date and computes the completion date for an order, usually proceeding from the first operation to the last

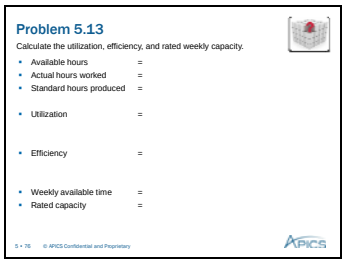
6 Calculation of the capacity required at work centers in the time periods required regardless of the capacity available to perform this work

10 Comparing actual to planned performance and taking corrective action, as needed, to align performance with plan

Optional Problems

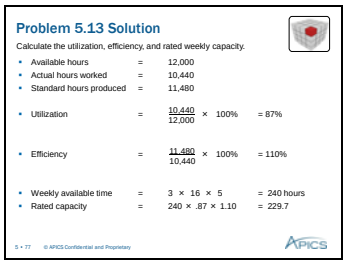
Class Problem 5.13:

A firm wishes to determine the efficiency and utilization of a work center composed of 3 machines, each working 16 hours per day for 5 days a week. A study undertaken by the materials management department found that—while over the past year the work center was available for work 12,000 hours—work was actually being done for 10,440 hours and 11,480 standard hours of work were performed. Calculate the utilization, efficiency, and rated weekly capacity.



Visual 5-76

Solution:



Visual 5-77 *

Available hours = 12,000
Actual hours worked = 10,440
Standard hours produced = 11,480

$$\text{Utilization} = \frac{10{,}440}{12{,}000} \times 100\% = 87\%$$

$$\text{Efficiency} = \frac{11{,}480}{10{,}440} \times 100\% = 110\%$$

Weekly available time = $3 \times 16 \times 5 = 240$ hours

Rated weekly capacity = $240 \times .87 \times 1.10 = 229.7$ standard hours

Learning Objectives

- *Introduction to Inventory*
  - Recognize at least five different classes of inventory that materials are transformed into during their flow through the production and distribution processes.
- *Aggregate Inventory Management*
  - Explain the six functions of inventory.
  - Identify three objectives of aggregate inventory management.
  - Describe the major elements of the five types of inventory costs: item, carrying, ordering, stockout, and capacity-related costs.
- *Financial Statements and Inventory*
  - Explain the relationship between assets, liabilities, and owner's equity on the balance sheet.
  - Explain financial statements and their relationship to aggregate inventory.
  - Describe four inventory valuation methods.
  - Calculate inventory turns and days of supply measurements.

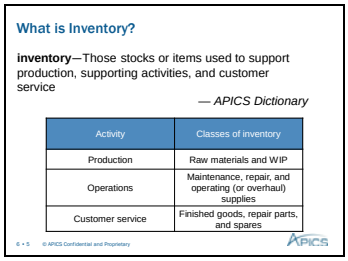
Introduction to Inventory

Reference: *Introduction to Materials Management,* Arnold et al., 7th ed., chap. 9.

Remind the class that so far we have looked at manufacturing planning and control activities. Ask them to recall how inventory was an important factor in these activities. During the next two sessions, we will discuss inventory management at the aggregate, or business, level and item inventory.

Ask the class why we have inventory. Is it possible to plan production at any level without managing inventory as well? Discussion should bring out the point that inventory either results from or supports production, sales, marketing, and customer service. Yet it also represents costs, which we will discuss soon. It is not possible to manage one without the other.

What is Inventory?



Visual 6-5

Ask the class what inventory is. After discussion, show Visual 6-5 and make sure they understand the three different categories shown in the visual. Point out that our focus in this course is on inventory that supports production and customer service.

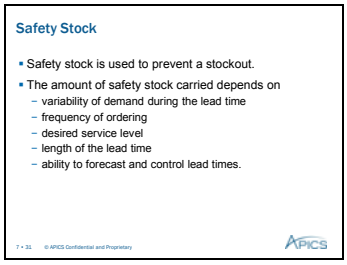
Class Problem 7.3:

The lead time for a particular SKU is four weeks, the average demand is 200 units per week, and safety stock is set at one week's demand. The order quantity is 2,000 units.

Calculate the order point:

Safety Stock

Why Safety Stock?



Visual 7-31

Explain that, in this course, we are concerned with variability of demand during lead time, frequency of ordering, and desired service level. The variation in demand during lead time plays an important role in the determination of safety stock. Buffer stock is a synonym for safety stock.

Variability

Ask the class to remember the two types of forecast error.

Answer:

Bias and random

Ask them which type of forecast error safety stock protects against.

Answer:

Random. When bias is detected, try to eliminate the bias by changing the forecast or changing the company policies that might cause the bias.

Ask how much safety stock would need to be carried if there were no random error.

Answer:

None

Ask if random variation increases and the service level remains the same, what action should be taken with safety stock?

Answer:

Safety stock should be increased accordingly.

Safety Stock

Why Safety Stock?

The purpose of safety stock, also called *buffer stock*, is to protect against uncertainty in supply and demand and to prevent stockouts. The two ways to deal with uncertainty are to

- carry extra stock, or safety stock
- order early, using safety lead time.

Safety stock is the method we will describe here.

The amount of safety stock carried depends on

- variability of demand during the lead time
- frequency of ordering
- desired service level
- length of the lead time
- ability to forecast and control lead times.

In this course, we are concerned with the variability of demand during the lead time, frequency of ordering, and desired service level.

Variability

What are the two types of forecast error?

_____

_____

For which type of forecast error does safety stock provide protection?

_____

How much safety stock would have to be carried if there were no random error?

_____

If random variation increases and the service level remains the same, what action should be taken with safety stock?

_____

Frequency of ordering

Ask the class when it is possible for a stockout to occur. Point out that the only time a stockout is possible is when stock runs low.

Answer:

A stockout can occur when a stock replenishment order has been released and either the volume of demand exceeds the expected demand during replenishment lead time or when the expected replenishment lead time is exceeded by the actual lead time for the arrival of the stock

Ask the class how frequently a stockout could possibly occur if one order is placed each year. Ask how frequently it could occur if one order is placed each week.

Answer:

Yearly = one; weekly = 52 times

Lead time

Ask the class how much safety stock would have to be carried if the lead time were zero. Ask if lead time increases and the service level remains the same, what action should be taken with safety stock?

Answer:

If the lead time were zero, no safety stock would have to be carried. If the lead time increases, safety stock should be increased accordingly.

Frequency of ordering

When is it possible for a stockout to occur?

_____

_____

How often could a stockout possibly occur if one order per year is placed?

_____

_____

How often could a stockout possibly occur if one order a week is placed?

_____

_____

Lead time

How much safety stock would have to be carried if the lead time were zero?

_____

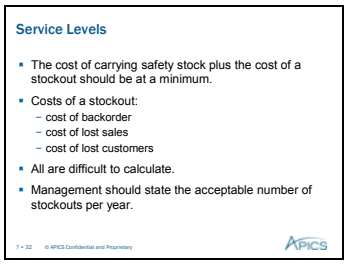
_____

If the lead time increases and the service level remains the same, what action should be taken with safety stock?

_____

_____

Service Levels



Visual 7-32

Tell the class that the service level is the ability to supply the customer with what is wanted when it is wanted. Carrying more safety stock increases the service level.

Explain the points on the visual.

Ask the class if it is always necessary to carry safety stock.

Answer:

It is not.

Ask what kinds of products would probably carry safety stock and what kinds would not.

Answer:

Safety stock would be carried for most make-to-stock items; no safety stock would be carried for special-order items.

Service Levels

The objective of carrying safety stock is to protect against fluctuations in demand and supply.

The service level is the ability to supply the customer with what is wanted when it is wanted. Carrying more safety stock increases the service level.

Enough safety stock should be carried so that the cost of carrying it plus the cost of a stockout will be minimal.

The costs of a stockout, all of which are difficult to calculate precisely, include

- cost of backorder
- cost of lost sales
- cost of lost customers.

Management should state the acceptable number of stockouts per year.

Is it always necessary to carry safety stock?

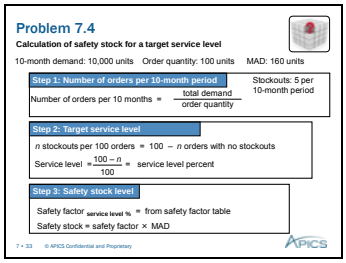
_____

What kinds of products would carry safety stock and what kinds would not?

_____

Class Problem 7.4:

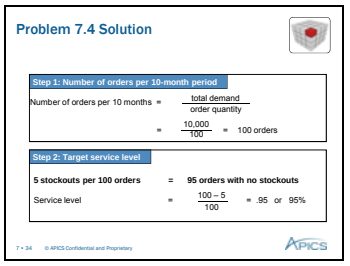
Safety Stock and Service Levels



Visual 7-33

Introduce the problem on developing the safety stock level for a target service level. Highlight the assumptions and explain the three steps of the process. Note that we are using mean absolute deviation (MAD) rather than standard deviation as is illustrated in Arnold, 7th ed., p. 245. Both produce the same results. MAD is referenced in the Exam Content Manual and standard deviation is not. Refer back to Session 2 for a discussion on MAD. Be sure to explain the logic of the safety factor multiplier from the table.

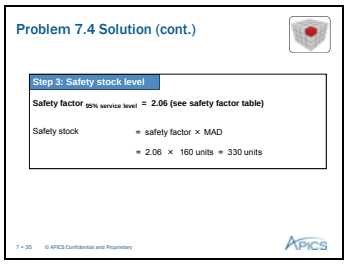
Solution:



Visual 7-34 *

Step 1: 10,000/100 = 100 orders

Step 2: (100-5)/100 = .95 or 95%



Visual 7-35 *

Step 3: 2.06 x 160 units = 330 units

Note: This problem solution provides the basics of determining safety stock, but technically if the order lead time is different from the forecast interval lead time, it would be necessary to adjust this calculation. We have chosen not to confuse the basic formula with this calculation; however, additional data can be found in Arnold et al., *Introduction to Materials Management,* 7th ed., p. 247.

Periodic Review System

The periodic review system also is known by its synonyms: fixed reorder cycle inventory model and fixed interval order system. The synonyms are more descriptive of the fixed interval or cyclical aspect of the periodic review system.

The periodic review system also is the opposite of the order point system.

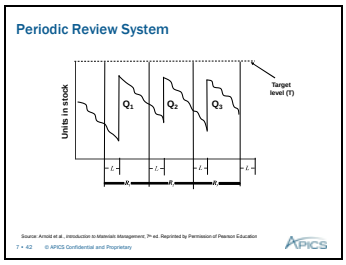
Characteristic	Order point system	Periodic review system
Interval between orders	Varies depending on actual usage	Fixed and constant
Quantity ordered	Usually fixed	Varies by period

Application

The periodic review system is advantageous in the following types of situations:

- A perishable product with a limited shelf life needs its inventory to be replenished on a regular cycle.
- Retail locations and warehouses that are stocked with many different items from a central location find it advantageous to consolidate and receive deliveries on a regular cycle to minimize shipping and handling costs.
- If there are many small issues from inventory and if posting transactions is expensive, a periodic review of inventory for reorder purposes is appropriate.
- Ordering costs are low; ordering once a week or month is not a cost issue.

Logic



Visual 7-42

Discuss the logic of the periodic review system as detailed on the opposite page.

Use Visual 7-42 to explain that, in the periodic review system, orders are placed at fixed intervals and the order quantity varies. The review intervals (t_1, t_2, and t_3) are equal; and Q_1, Q_2, and Q_3 are not necessarily the same. Also point out the demand during lead time and the on-hand inventory at the time of the order.

Remind the class that when an order is placed, the quantity on hand plus the quantity ordered must be sufficient to last until the next shipment arrives.

The quantity equal to the demand during lead time plus the demand during the review period plus safety stock is called the *target level* or *maximum-level inventory*.

ABC Classification

The ABC classification of items is based on a concept entitled Pareto's law.

> Pareto's law—A concept that states that a small percentage of a group accounts for the largest fraction of the impact, value, and so on. In an ABC classification, for example, 20 percent of the inventory items may constitute 80 percent of the inventory value.
>
> —*APICS Dictionary*

Class	Percent of items	Percent of impact
A	20	80
B	30	15
C	50	5

Note: The source for the values in the table above is Arnold et al., *Introduction to Materials Management,* 7th ed., p. 208.

The 80-20 rule is only an approximation. Often, less or more than 20 percent of the items will account for 80 percent of the annual dollar usage.

Many criteria may be used for segregating inventory, but one common method is based on annual dollar usage. Sometimes other factors, such as shortages, will promote an item into the A category.

ABC Process

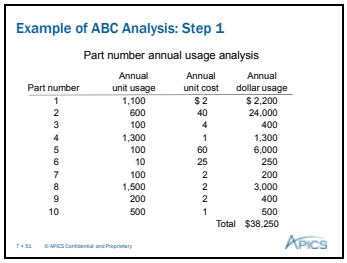
- The general process for ABC inventory control is shown in Visual 7-50. There are three basic steps, as follows:
  - Step 1—Establish and analyze the item characteristics that influence the results of inventory management. These include but are not limited to the following:
    - annual dollar usage
    - scarcity of material
    - quality problems
  - Step 2—Classify items into groups based on the criteria established.
  - Step 3—Apply a degree of control in proportion to the importance of the group.

What are some examples of characteristics that can be used in classifying items?

_____

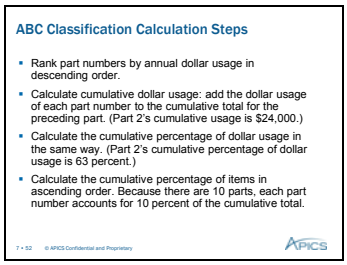
_____

Sample Calculation



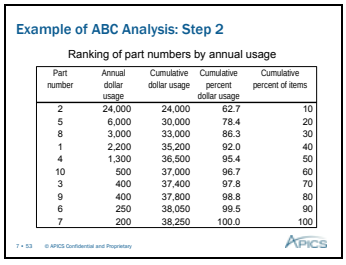
Visual 7-51

Explain that Visual 7-51 shows a raw listing of annual dollar usage by part number. The part numbers are arranged in numerical sequence without regard to usage value. The next step is to list the parts by dollar usage in descending order.



Visual 7-52

Display this visual as you explain how to convert the numerical listing of part numbers and their annual dollar usage into the ranking of part numbers by dollar usage.



Visual 7-53

Display this visual after explaining the calculation.

Sample Calculation

This sample calculation assumes that usage by part number should be a focus of inventory control. The first table shown below is a raw listing of usage data by part number. Preparation of this table is the first step of the ABC inventory control process.

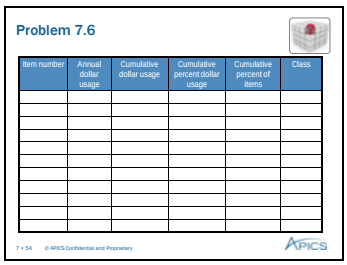
Part number	Usage	Unit cost	Annual $ usage
1	1,100	$ 2	$ 2,200
2	600	40	24,000
3	100	4	400
4	1,300	1	1,300
5	100	60	6,000
6	10	25	250
7	100	2	200
8	1,500	2	3,000
9	200	2	400
10	500	1	500
		Total	$38,250

This second table is a re-listing of the part numbers, but this time in descending order of importance based on annual dollar usage. Refer to Visual 7-52 for the calculation steps required. This is the first part of step 2 in the ABC inventory control process.

Part number	Annual $ usage	Cumulative $ usage	Cumulative percent of $ usage	Cumulative percent of items
2	$24,000	$24,000	62.7	10
5	6,000	30,000	78.4	20
8	3,000	33,000	86.3	30
1	2,200	35,200	92.0	40
4	1,300	36,500	95.4	50
10	500	37,000	96.7	60
3	400	37,400	97.8	70
9	400	37,800	98.8	80
6	250	38,050	99.5	90
7	200	38,250	100.0	100

The second part of step 2 is to classify the items into groups A, B, and C. We will demonstrate this in the Class Problem 7.6 and then review the use of ABC analysis and classification in controlling inventory.

Class Problem 7.6:

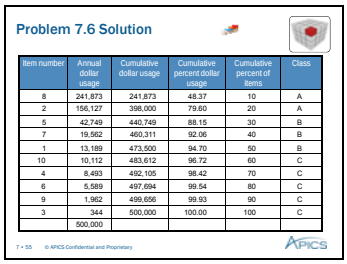


Visual 7-54

Have participants do Class Problem 7.6 from the participant workbook.

Step through the build visual solution with the class. Analyze the following data to produce an ABC classification based on annual dollar usage.

Solution:



Visual 7-55 *

Item number	Annual dollar usage	Cumulative dollar usage	Cumulative percent dollar usage	Cumulative percent of items	Class
8	241,873	241,873	48.37	10	A
2	156,127	398,000	79.60	20	A
5	42,749	440,749	88.15	30	B
7	19,562	460,311	92.06	40	B
1	13,189	473,500	94.70	50	B
10	10,112	483,612	96.72	60	C
4	8,493	492,105	98.42	70	C
6	5,589	497,694	99.54	80	C
9	1,962	499,656	99.93	90	C
3	344	500,000	100.00	100	C
	500,000				

How close does the dollar usage distribution come to 80-15-5?

Answer:

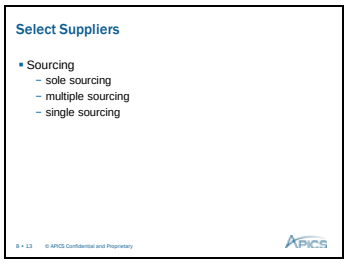
A items are 79.6 percent (versus 80); B items are 15.1 percent (versus 15); C items are 5.3 percent (versus 5)

Establish Specifications (cont.)

Functional specifications can be described by

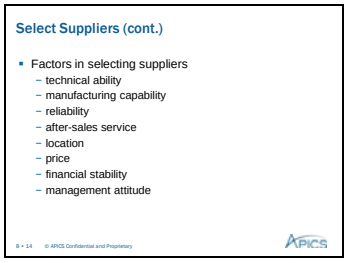
- brand
- specifying physical or chemical characteristics, material, and method of manufacture
- performance requirements
- engineering drawings
- miscellaneous methods, including
  - color or pattern samples
  - The famous phrase "Give me one just like the last one."

Select Suppliers



Visual 8-13

We will review a few of the many ways to partner with suppliers. One of the first decisions to make is about sourcing. Describe the three types of sourcing.



Visual 8-14

Discuss factors in selecting suppliers. Discuss how information about suppliers is obtained, such as supplier salespersons, catalogs, trade journals, site visits, internet and financial rating sites, and so on. Point out that it is not unusual for customers to specify both suppliers and specific parts to be used in the manufacturing process. Discuss participant's perspectives on other factors in selecting suppliers, such as regional requirements and health and safety records.

Ask participants why the selection of a supplier is so important.

Answer:

The selection of suppliers is key to long-term organizational success and allows long-term commitments to provide the right quality, quantity, delivery, and price.

Systems and Methodologies

Productivity and quality systems and methodologies, such as lean and TQM are in use today to increase and sustain quality, improve processes, and reduce costs. The choice and focus of the system used in an organization depends on their products, the needs of the customers, and often on the familiarity of individuals who work in the organization. Some organizations embrace one methodology or philosophy and use it throughout the organization. Others use multiple systems and integrate them in a complementary way.

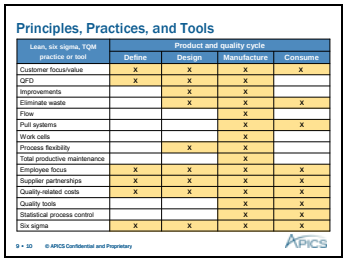
- Lean—A methodology that emphasizes the minimization of activities that do not add value to the customer. The term lean is in wide use today to represent concepts that were previously termed Just-in-Time. The term JIT often is used now in a more narrow scope regarding the production aspects in lean.
- TQM—A term coined to describe management approaches to quality improvement and customer satisfaction. It is a management approach for long-term success through customer satisfaction. According to the *APICS Dictionary*, TQM is based on the participation of all members of an organization in improving processes, goods, services, and the culture in which they work. It is a never-ending process to improve everything an organization does to satisfy customers. Continuous improvement is necessary because the competition will be constantly improving their processes. TQM incorporates problem-solving tools, costs of quality, quality function deployment, employee empowerment, continuous process improvement, six sigma, understanding variability, process capability and control, and benchmarking.

What quality systems and methodologies are used in your organization?

_____

_____

Principles, Practices, and Tools



Visual 9-10

Visual 9-10 shows a number of principles, practices, and tools used in various productivity and quality systems mapped across the four product and quality cycle stages. These are general guidelines for placement within the cycle and may vary depending on circumstances. Discuss the chart.

Ask participants what areas span all stages of the cycle. Do participants disagree with any of the placements?

Answer:

The following span all stages of the cycle: customer focus and value, employee focus, supplier partnerships, quality-related costs, and six sigma.

Explain that it will be useful to mark this page and refer back to it during the session in order to see an overview of where the tools and practices are used in the product and quality cycle.

Statistical process control

Statistical process control (SPC) applies statistical techniques, such as control charts, to monitor and adjust an operation. The goal is to have processes in place that consistently produce products without defects in order to satisfy customers. SPC has two objectives:

1. Select processes capable of producing the required quality products.
2. Monitor processes to ensure they continue to produce the required level of quality.

Process capability

Process capability is a measure of process spread in relation to the upper and lower specification limits. It refers to the ability of the process to produce parts that conform to upper and lower engineering specification limits for the product. In the dowel example above, the mean was set at 1 inch, with upper and lower specification limits set at 0.9 and 1.1 inches. If the manufacturing process for making dowels is capable, then the size of dowels will fall between these limits.

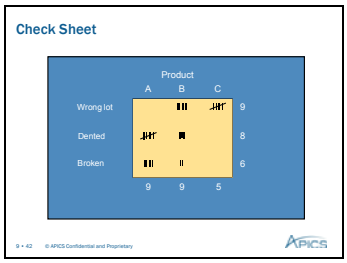
Refer to Visual 9-40, which illustrates the spread of process outputs from the mean for a manufactured product. The goal is to have the population in control, such as the dark-shaded distribution, where products fall within the upper and lower specification limits and are centered on the mean. The light-shaded distribution is not in control due to spread. It is centered on the mean, but has values above and below the specification limits. As we saw in the dowel example, processes can be out of control due to a shift in mean as well.

Statistical process control versus product inspection

SPC monitors processes against statistical control limits and is used to look for trends. SPC can spot changes in variation that may be due to problems in processes, which can then be corrected to prevent defects. Thus, SPC adds value for the customer.

Product inspection assesses products against a specification. Although inspection does find defects after they occur, it usually is viewed as wasteful because the customer is not willing to pay for it. If the product was made correctly, there would be no need for the customer to pay for inspection. Inspection is expensive and does not ensure that the root cause of the defects is corrected.

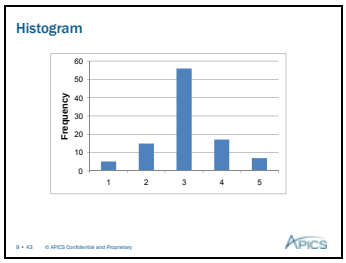
Check Sheet



Visual 9-42

Explain that check sheets are used to tally counts of event occurrences.

Histogram



Visual 9-43

Explain that a histogram is a simple frequency diagram.

Ask participants which type of defect most commonly occurred and which type of defect least commonly occurred.

Answers:

Wrong lot is the most common defect.

Broken is the least common defect.