Version 5.0

CPIM

CERTIFIED IN PRODUCTION AND INVENTORY MANAGEMENT

EXAM CONTENT MANUAL

Stock #09051-V50

APICS

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.

8430 West Bryn Mawr Avenue, Suite 1000
Chicago, IL 60631-3439 USA
Phone: 1-800-444-2742 or +1-773-867-1777
Fax: +1-773-639-3000

Stock #09051-V50

Table of Contents

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.

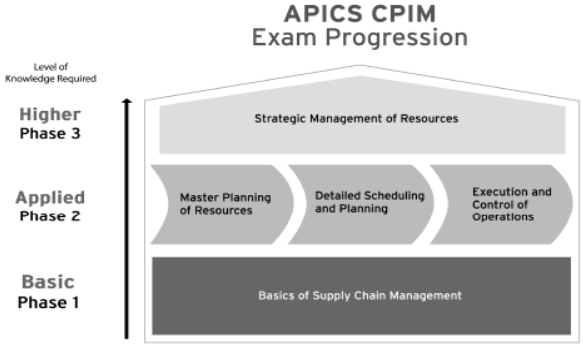
Execution and Control of Operations (ECO)

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 x-xxx. 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.

APICS Certified Fellow in Production and Inventory Management (CFPIM)

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

Examination Committee

Mark C. Hardison, CFPIM, CSCP (Chair)
Joseph Brian Atwater, Ph.D., CPIM, Jonah
Indiana University Southeast
Marilyn M. Helms, D.B.A., CFPIM, CIRM, CSCP,CQM/OE
Dalton State College
Dave Lehman, CFPIM, CIRM, CSCP
DCL Associates, Inc.
Ramona Memmott, CPIM
Morinda, Inc.
Lisa Ozkan, CPIM, CSCP
NetSuite

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 x–xxx 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 ix 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

1. *APICS Dictionary*, 14th ed., 2013.
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.
4. *United Nations Global Compact Brochure: Corporate Sustainability in the World Economy. 2014. UN Global Compact Office. http://www.unglobalcompact.org/docs/news_events/8.1/GC_brochure_FINAL.pdf.
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 38-39.

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

Master Planning of Resources

Examination Committee

Murray Olsen, CFPIM, CIRM (Chair)
Northrop Grumman
Stephen N. Chapman, Ph.D., CFPIM
Karen Pentz, CPIM, CSCP
MEGlobal Americas
Jaap Stumphius, CFPIM
Van de Geijn Partners
Rosemary Van Treeck, CPIM, CIRM, CSCP
Roly J. White, Jr. CFPIM, CIRM, CSCP

Scope of the Subject Matter

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

The subject matter of Master Planning of Resources includes demand management, sales and operations planning, master scheduling, and distribution planning.

Demand management is the function of recognizing and influencing all demands for goods and services to support the marketplace. It includes forecasting, order servicing, demand shaping, and customer relationship management.

Sales and operations planning is a process that brings together all plans for the business, including operations, sales, sourcing, marketing, product development, and finance. The result is an integrated set of plans for each product family.

Master scheduling is the process of disaggregating the production plan into an executable schedule that links shipment of customer orders to materials management. Distribution planning is the process of planning the distribution network and replenishment in the distribution environment. In each of these areas, collaboration within the organization and with direct customers and suppliers is addressed.

The successful candidate will understand and be able to apply the principles of demand management, sales and operations planning, master scheduling, and distribution planning, and to identify conditions that require action. The candidate must be able to apply the concepts and techniques in the content outline, as well as analyze situations to determine which approaches are applicable. Specific techniques required include:

- creating and evaluating a quantitative forecast
- calculating performance measurements relating to customer service policy
- preparing month-end reports and responding appropriately
- calculating a production plan and master schedule
- creating a distribution plan

Master Planning of Resources 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	Demand Management	25%
II	Sales and Operations Planning	25%
III	Master Scheduling	25%
IV	Distribution Planning	25%

Content Outline

I. Demand Management

This section covers the interrelationship of strategic and business planning with the management of demand. The aspects of demand management addressed in this section are forecasting and managing the customer interface. This subject matter includes elements related to the following areas:

A. *General Concepts and Purposes*: Successful planning requires an understanding of how components, concepts, and linkages of the strategic plan, the business plan, and the master planning of resources interact. Knowledge in this area includes:

1. The planning hierarchy
2. Relating the planning process to manufacturing and service environments

B. *Forecasting Demand*: Effective demand forecasting requires an understanding of the uses of a forecast, methods of forecasting, fitting a forecast to the situation, and tracking its performance over time. Knowledge in this area includes:

1. Demand forecasting concepts
2. The relationship between the purpose of the forecast and required timeliness, and accuracy of the data
3. Management considerations related to forecast method selection
4. How to select a time horizon and interval, and a level of aggregation
5. The application of basic qualitative and quantitative techniques
6. Evaluation of forecasting performance
7. Collaboration with customers and suppliers to improve forecast accuracy

C. *Management of the Customer Interface*: Effective management of the customer interface requires an understanding of how to make realistic order delivery promises and maintain positive customer relationships. Knowledge in this area includes:

1. Customer relationship management concepts
2. How to set customer service policies, safety stock, and performance targets
3. How to maintain effective customer communications
4. Techniques for measuring order delivery performance
5. Influence demand to better align with supply

References: 1; 2; 3 (chapters 3–4)

II. Sales and Operations Planning (S&OP)

This section covers the processes, concepts, and techniques used to link strategic goals to operations and coordinate the various planning efforts of the functional areas, including operations, sales, sourcing, product development, marketing, and finance in a variety of business environments. This subject matter includes elements related to the following areas:

A. *General Concepts and Purpose*: S&OP coordinates the various business functions to ensure they support the overall organizational strategy and enhance customer service. At the center of the process are two fundamental issues. First, what is the best way to balance supply and demand? Second, what is the appropriate production volume and mix between product families? The answers depend heavily on the specific type of business environment. Knowledge in this area includes:

1. The role of S&OP in the planning and control hierarchy

2. The key linkages to the S&OP process
3. The different methods for balancing supply and demand
4. The trade-offs related to different volume/mix combinations
5. How to carry out the S&OP process in different business environments including manufacturing and services

B. *Management Considerations*: S&OP is the process executive management uses to control and guide the business. It integrates the multiple plans developed within a business and provides direction for more detailed short-term to medium-term planning. Knowledge in this area includes:

1. How to evaluate alternative plans and associated risks
2. How to assess the financial implications of the plan
3. How to identify stakeholders and their responsibilities in the process
4. How to identify the planning horizon and the appropriate aggregation level
5. The trade-offs between customer service levels and the inventory or backlog levels

C. *S&OP Process*: There are several steps involved in the process of establishing a sales and operations plan. Effective S&OP requires proper execution of each of these steps. Knowledge in this area includes:

1. The various levels of management involved and their roles
2. The sequential steps of the S&OP process and their interactions
3. The various inputs and outputs of each of the S&OP steps
4. The performance measures of the S&OP process

D. *Developing and Validating the Production Plan*: A key output of S&OP is the production plan. Effective S&OP requires an understanding of this key planning document. Knowledge in this area includes:

1. How to develop and validate a production plan in a variety of production environments
2. How to carry out resource planning
3. How to assess the desirability of alternative production plans

References: 1; 2; 3 (chapters 5, 10)

III. Master Scheduling

This section covers the processes of translating higher-level aggregate plans into feasible schedules that operations and suppliers can execute. This subject matter includes elements related to the following areas:

A. *General Concepts and Purpose*: The master scheduling process disaggregates the production plan into an executable schedule that links shipment of customer orders to material management. Knowledge in this area includes:

1. The role of master scheduling in the planning and control hierarchy
2. The linkages with other planning processes within the planning and control hierarchy
3. The relationships between master scheduling, capacity management, and materials management

B. *Linking the Master Scheduling Process to the Business Environment*: The mechanics of master scheduling vary according to the business environment. In every environment, it is necessary to link the master scheduling process with the production plan and the S&OP process. Knowledge in this area includes:

1. How to carry out the master scheduling process in different business environments including manufacturing and services

2. The relationship between the manufacturing environment and product structure

3. How to determine the level in the bill of material where the master schedule should be developed

C. *Master Scheduler Roles and Responsibilities*: The role of the master scheduler is to implement the production plan as agreed upon during the S&OP process. It is the responsibility of the master scheduler to develop a master schedule that promotes operational stability and good customer service while maintaining realistic priorities. Knowledge in this area includes:

1. How to plan and coordinate changes in inventory levels, backlog, capacity, major customer orders, time fences, product and process designs, and suppliers

2. How to maintain the integrity of the master schedule

3. How to deal with the consequences of an unrealistic master schedule

4. Measuring performance against the master schedule

D. *Master Scheduling Process*: The process of developing a master schedule involves numerous decisions related to the mechanics and the selection of techniques and tools. Effective master scheduling requires significant insights into each of these choices. Knowledge in this area includes:

1. How to identify and quantify sources of demand to be considered in the master scheduling process

2. The mechanics of creating, maintaining, and using the master schedule

3. Reviewing capacity requirements and the role of rough-cut capacity planning

4. Developing and using a final assembly schedule

5. Measuring performance of the master scheduling process

E. *Advanced Planning and Scheduling (APS)*: APS systems employ advanced computer capabilities and algorithms to perform many of the functions related to master planning of resources in real time. Knowledge in this area includes:

1. Major components of an APS system

2. Impact of APS techniques on master production schedules

3. APS techniques based on simulation, optimization, or constraints management approaches

References: 1; 2; 3 (chapters 7, 10)

IV. Distribution Planning

This section covers the planning of distribution networks and replenishments in the distribution environment. It also covers concepts and techniques used to plan the location of distribution centers, the transportation logistics between supply sources and outlying locations, and the replenishment of these locations in a variety of business environments. This subject matter includes elements related to the following areas:

A. *Distribution Network Planning*: The methods and elements for logistics planning to establish the supply channel locations and transportation schemes. Knowledge in this area includes:

1. Various distribution strategies and network configurations

2. Transportation planning, controlling and scheduling activities

3. Inventory levels and locations required within the distribution channel

4. Risk management and sustainability considerations

B. *Distribution Requirements Planning*: Knowledge in this area includes:

1. Techniques for developing a distribution location-specific product forecast

2. Techniques for developing the replenishment planning parameters for each stockkeeping unit within the distribution network

3. Methods and techniques of time-phased planning logic inherent in distribution requirements planning

4. Methodologies for linking distribution requirements planning to the S&OP and master scheduling processes

5. Support specific marketing efforts and manage supply shortages

C. *Other Distribution Replenishment Methods:* Approaches to replenishing distribution network inventories and where each is appropriate. Knowledge in this area includes:

1. Pull systems

2. Push systems

D. *Measuring Distribution Performance*: Various approaches and techniques are used to evaluate performance of the distribution network and planning process. Knowledge in this area includes:

1. Data collection methods for effective feedback

2. Key distribution performance indicators

3. Feedback on distribution network design decisions, distribution planning process improvements, and execution of the plan

References: 1; 2; 3 (chapters 14–16); 4 (chapters 6-14)

Key Terminology

An understanding of the list of terms on pages x–xxx 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. Please see page ix in the introduction to this manual for a list of past references that can also be used for study. Also, candidates who have not yet passed the suggested first module—Basics of Supply Chain Management—should familiarize themselves with the basic concepts of materials management presented in this exam content manual. All of these references are available at **apics.org/shopapics**.

References

1. APICS CPIM Master Planning of Resources Reprints, 2010.
2. *APICS Dictionary*, 14th ed., 2013.
3. Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, Manufacturing Planning and Control for Supply Chain Management, APICS/CPIM Certification Edition, McGraw-Hill, 2011.
4. Ross, David F., Distribution Planning and Control, 2nd ed. Springer, 2004.

*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 40-41.

1. The forecast interval would typically be longest for forecasts used as input to which of the following processes?

   (A) Business planning
   (B) Final assembly scheduling
   (C) Sales and operations planning (S&OP)
   (D) Master scheduling

2. Normal uses of a master schedule include which of the following?

   I. To provide a means of planning future production
   II. To drive rough-cut capacity planning
   III. To establish the production plan

   (A) I only
   (B) I and II only
   (C) II and III only
   (D) I, II, and III

3. Producing exactly to demand should result in

   (A) minimum change in inventory
   (B) least total cost
   (C) minimum capacity requirements
   (D) maximum machine utilization

Use the information below to answer questions 4 and 5.

Lead time: 2	Lot size: 30
Demand time fence: 3	On hand: 15
Planning time fence: 7	Safety stock: 6

Period	1	2	3	4	5
Forecast	10	22	20	24	28
Customer orders	5	26	15	6	30
Projected available balance					
Available-to-promise					
Master production schedule					

4. For the master schedule, what is the available-to-promise for Period 4 if the discrete method is used?

   (A) 22
   (B) 24
   (C) 35
   (D) 37

5. Using the same table, what is the projected available balance for Period 5?

   (A) 30
   (B) 35
   (C) 5
   (D) 7

6. In a distribution environment, which of the following will occur if the planner fails to address exception messages during the planning cycles?

   (A) Planned orders are not converted on time
   (B) Replenishment lead times are incorrect
   (C) The statistical order point is increased
   (D) The planning horizon is too short

7. Which of the following would be the most appropriate smoothing constant for a fashion clothing item?

   (A) 0.10
   (B) 0.20
   (C) 0.50
   (D) 1.00

8. Which of the following is an output of the distribution requirements planning process?

   (A) Product forecast
   (B) Statistical order point
   (C) Planned orders
   (D) Safety stock by product

9. The focus of the sales and operations planning (S&OP) process is to balance customer demand and:

   (A) Inventory investment
   (B) Capacity utilization
   (C) Supply plans
   (D) Master scheduling

10. The production plan is performed at which level?

    (A) Product family
    (B) Work center
    (C) End-item level
    (D) Product option level

Detailed Scheduling and Planning

Examination Committee

Carol M. Bulfer, CPIM (Chair)
Parker Hannifin Corporation
Jorge E. Calaf, CPIM, CIRM, CPA
American University of Puerto Rico
Staffan Cederstrand, CPIM
Medius Dynamics AB
Lawrence Ettkin, Ph.D., CFPIM
University of Tennessee–Chattanooga
Andrea Prud'homme, Ph.D., CFPIM, CIRM, CSCP
The Ohio State University
William S. Thurston, CPIM, CIRM, CSCP, PMP

Scope of the Subject Matter

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

The subject matter of Detailed Scheduling and Planning includes inventory management, material requirements planning, capacity requirements planning, and procurement and supplier planning for both producing goods and providing services. Recognizing the importance of supply chain management, this module also covers deployment of supply chain strategies related to scheduling, planning, and sourcing. The emphasis is on applied and higher-thinking questions.

Detailed Scheduling and Planning translates product-level plans and schedules generated at the master planning level into requirements that can be procured or produced in all types of environments, including goods and services industries. This supports the strategies and objectives established by the company, as constrained by lead time, cost, equipment, personnel, sustainability considerations, or other constraints. The subject matter, therefore, encompasses anything required to bridge the master planning area with the execution and control area of the APICS CPIM body of knowledge. This includes understanding the commonalities and differences between producing goods and providing services. Also included is the planning, scheduling, resource allocation, and implementation of projects.

The successful candidates will understand the tools and techniques for planning of inventory, including planning techniques such as material requirements planning, capacity requirements planning, lean, the theory of constraints, and project management.

They will understand the effect of using each technique, know standard measures for inventory, materials, capacity, and supplier performance, and be able to recognize when to escalate issues. The candidates must be able to apply the concepts and techniques in the content, as well as analyze situations to determine which approaches are applicable. This includes the ability to:

- use inventory policies to minimize inventory and yet meet customer service objectives
- recognize when to use which capacity technique and how that technique supports the master schedule and the production plan
- know where to locate and how to apply standard formulae and algorithms for materials and capacity
- understand supplier partnerships and relationships and the best ways to communicate the firm's needs and expectations of the supplier
- explain procurement planning and supply chain options

Detailed Scheduling and Planning 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	Planning the Management of Inventory	25%
II	Planning Material Requirements to Support the Master Schedule	25%
III	Planning Operations to Support the Priority Plan	25%
IV	Planning Procurement and External Sources of Supply	25%

Content Outline

I. Planning the Management of Inventory

Inventory planning concepts, policies, methodologies, and techniques determine part stocking levels, order quantities, safety stocks, forecasts, and handling and storage requirements, including global supply chain risks.

This covers inventory techniques and tools used within the detailed material planning process. These include the effect of inventory accounting decisions on material planning calculations, as well as financial management and accuracy. Objectives that apply to inventory are evaluated with respect to balancing the desired customer service level with inventory reduction techniques. Measures of inventory performance are assessed.

A. *Types and Classifications of Inventory*: Examples include: raw materials, work in process, finished goods, maintenance, repair, and operating supplies, returned goods, excess, inactive, obsolete, scrap, and distressed and perishable inventory. Manufacturing and service industries are assessed from their different requirements and impacts on the planning processes.

B. Inventory Policies

1. Lot-sizing techniques for independent and dependent demand are applied to different types of production and service environments in support of inventory investment strategies.

2. Safety stock and safety lead time techniques and their effects on inventory and customer service objectives are considered.

3. Inventory policies related to trade-offs in stocking levels, customer service, environmental impact, and inventory accuracy targets in different business environments are evaluated.

4. Inventory performance measures as they relate to business objectives. These may include: inventory turnover, customer service levels, and inventory accuracy.

5. Inventory valuation methods include: first in, first out, last in, first out, specific identification, transfer pricing, standard and actual cost, and project and process cost. These are compared for their effect on inventory investment and related replenishment and justification decisions in various business environments.

C. Inventory Planning

1. Appropriate order review methodologies, such as material requirements planning, reorder point, periodic review, visual review, and kanban/pull system triggers, are evaluated for different types of inventory and business objectives.

2. Understanding the differences between dependent and independent demand as related to various inventory models and sources of demand are addressed.

3. Lean concepts that improve throughput and reduce or eliminate inventories, including value-stream mapping techniques and pull systems, are reviewed.

4. The impact of global sourcing risks, such as financial, political, transportation, and environmental, on inventory planning decisions is considered.

D. Accuracy, Handling, Storage, and Traceability

1. Cycle counting, physical inventory, and using ABC classification are presented as methods for improving and sustaining part count and inventory investment accuracy.

2. Alternative storage and material handling options, such as stock location systems and automated storage and retrieval systems, are evaluated.

3. The importance of proper identification, country of origin declaration, documentation, tracking, and traceability of inventory movement is emphasized, including bar coding and radio frequency identification tagging.

References: 1; 2; 3 (chapters 9–12); 4 (chapters 2-3, 6-7, 16); 5 (chapter 4); 6 (chapters 8, 9, 13–14, 16); 8 (chapters 1, 2, 4–6, 8–10); 9

II. Planning Material Requirements to Support the Master Schedule

Planning material requirements driven by the master production schedule, including material requirements planning (MRP), deals with dependent demand parts and interrelationships that require planning at any given time. It also includes independent demand planning for service parts, matching supply with demand, and managing demand at aggregate and disaggregate levels. MRP combines three principles:

- Calculation, as opposed to forecast, of dependent demand for component items
- Netting of requirements for all items
- Time phasing.

A. *Identifying Information Used in the Material Planning Process*: This section describes the inputs used in calculating requirements for inventory items and their importance to the detailed material planning process. Accurate, timely, and complete data are critical.

1. Inventory data describe parts, define current usage rates, stock balances, and track historical demand as required to support the policies, methodologies, and techniques of the material planning process. In a lean environment, this inventory data can be maintained in a plan-for-every-part record.

2. Master schedule data describe types, quantities, sources, priorities, and time phasing of product demand generated as a result of the master planning process, including customer orders and forecasts.

3. Engineering data define the product structure and parent/component relationships and include information on part interdependencies, lead times, and effective management of engineering changes.

B. *Identifying the Desirable Characteristics of the Detailed Material Planning Process*: This section addresses those characteristics that enhance the capabilities of using material planning process outputs. Understanding sources of demand is useful in evaluating the resolution of action messages. Various safety policies are used to minimize the impact of uncertainty on the planning process.

1. Decisions are required that facilitate material planning, establish priorities, resolve conflicts through pegging relationships, and support other decisions and productivity measures based on the type of environment and product life cycles.

2. System feedback mechanisms enable the monitoring of appropriate actions necessary to balance supply and demand.

3. Integration with master planning, final assembly, and configuration processes ensures that material availability matches demand quantities, timing, and priorities.

C. *Mechanics of the Detailed Material Requirements Planning Process*: Planning data calculate gross-to-net requirements by exploding bills of material and determining time-phased inventory needs. The requirements are exploded level by level — accounting for order policies, safety stock, and allocations.

1. Generating time-phased requirements creates a material plan that supports company and supplier needs for longer-range planning and shorter-range tactical information. In a lean enterprise, pull systems are then integrated with enterprise resources planning and material requirements planning (MRP) systems.

2. The format of MRP time-phased data for a given part number is often referred to as an MRP grid. This grid displays gross requirements, scheduled receipts, projected available, net requirements, and planned order receipts and planned order releases.

D. *Maintaining the Validity of the Material Plan*: The output from the planning process recommends the placement and replanning of supply orders to maintain the validity of order priorities. The effects of planning parameters on the process are identified.

1. System replanning of order priorities to respond to changes of demand and supply results in actions that resynchronize the material plan with the current material requirements.

2. Revising planning parameters addresses the options of adjusting lead time, lot size, safety stock quantity, kanban quantity, cycle times, and other parameters to reflect product life cycles, current conditions, and company strategy.

3. What-if analysis and simulation tools, methodologies, and techniques enable planners to evaluate viable alternatives without changing the existing material plan.

E. *Managing the Project Plan*

1. The project planning process is necessary to plan the resources for specific project activities. It includes a statement of work, work breakdown structure, project schedule, responsibility matrix, resource requirements, and budget.

2. The project implementation phase includes selecting the project team, scheduling the work, and managing the team dynamics, schedule, and budget.

References: 1; 2; 3 (chapters 4, 11); 6 (chapters 7–9); 7 (chapters 3–4, 11–13, 17, 22); 8 (chapters 1, 14)

III. Planning Operations to Support the Priority Plan

Capacity is defined as the capability to produce goods or provide services. Capacity requirements planning (CRP) provides a check that the material plan is achievable based on existing orders and available capacity.

Capacity management encompasses planning, establishing, measuring, monitoring, and adjusting levels of capacity to execute the

master schedule and related materials plan. It addresses the approaches for balancing the material plans with available internal and external resources and supporting activities, including constraint management and line and flow balancing. Uncertainty planning is also covered, including variability and capacity in a transient state.

A. *Identifying Information Used in the Detailed Capacity Planning Process:* This section addresses the use of work center and routing data to schedule orders and establish resource load by time period. Efficiency and utilization are used to determine the rated capacity of each work center. The material requirements plan provides the basis for projecting resource load by time period. The impact of unplanned work and quality problems on resources is identified. Also included are scheduling, queuing, and throughput management in various industries, including service.

   1. The availability of theoretical, demonstrated, and rated capacity, qualified by efficiency and utilization factors, is evaluated in different types of environments.

   2. Load from planned and released orders, repetitive schedules, past-due orders, rework, and work in process is calculated.

   3. Impacts of industry-specific conditions, such as remanufacturing, byproducts, co-products, and recycled material, are assessed.

B. *Recognizing the Characteristics and Techniques of the Detailed Capacity Planning Process*: Various approaches for applying the process within different production and service environments are discussed. Attention is given to flow production by addressing process flow scheduling.

   1. System design specifications and techniques include infinite and finite capacity planning, queuing and sequencing, constraint-based finite scheduling, load balancing for scheduling manufacturing operations, and establishing projected load on manufacturing resources.

   2. Simulation and modeling techniques enable a variety of scheduling and loading conditions to be assessed for transformation processes.

   3. Operations are loaded, and adjusted for capacity reductions or increases, to support business and customer service targets and to accommodate process variability.

   4. Recognizing intangible and variable capacity characteristics is necessary to manage load in a service industry.

   5. Pull systems are integrated with material requirements planning and enterprise resources planning systems to align shop floor activity with customer demand and takt time.

   6. Integration with master planning, final assembly, shop floor activities, and configuration processes ensures that capacity availability matches demand.

C. *Using the Detailed Capacity Planning Process*: The output of detailed capacity planning is used to adjust the levels of capacity or load to complete scheduled work within the required timeframe.

   1. Safety capacity is used in environments that must accommodate unplanned load variability.

   2. Methods of balancing capacity and load include rescheduling orders, splitting orders, outsourcing, workforce development, changing capacity through workforce changes, and modifying order quantities and priorities.

3. In process industries, capacity management is used to manage constraints and flow balancing in either batch or continuous mode.

D. *Measuring the Performance of the Detailed Capacity Planning Process*: This section identifies opportunities to measure and monitor the performance of operational objectives. The capacity planning process is measured on the ability to balance workload with available capacity and support on-time performance.

References: 1; 2; 3 (chapters 5–6, 15); 6 (chapters 10–12)

IV. Planning Procurement and External Sources of Supply

Procurement and supplier planning encompass planning and evaluation activities that companies employ to qualify suppliers and establish effective communication channels. Emphasis is on defining mutual business needs, product and process information, the impact of global sourcing, sustainability practices, and quality management required for the ongoing relationship. This includes approaches to communicating forecasts, orders, and schedules to ensure that purchased capacity and materials will be available in the required quantities and at the required time.

A. *Establishing Relationships with Suppliers*: Establishing long-term procurement partnerships is necessary to ensure competitive advantage and continuous improvement. Applying supply chain strategies to actual sourcing techniques will be addressed, including the principle of total procurement costs.

1. Varying degrees of partnership—strategic alliance, joint venture, retailer-supplier, distributor integration, contract manufacturing, and technical and operational partnering—are examined.

2. Supplier selection alternatives include single or multiple sourcing, domestic and foreign providers, and special services. Additional supply chain links may exist, including retail, distribution, and transportation companies.

3. Effective communication techniques are addressed, as are cultural differences, commercial versus government interests, and information technology support. Data necessary for collaboration include risk sharing, technical and quality specs, engineering changes, supply chain inventories, and future demand.

4. Environmentally responsible purchasing— minimizing the impact the organization and its suppliers have on the environment—is examined.

B. *Techniques and Concepts for Supplier Partnerships*: This section explores the elements of supplier relationships in different competitive environments and markets.

1. Supplier involvement in product engineering using techniques such as concurrent engineering provides mutual value to companies and suppliers.

2. Techniques for procurement of materials and services include contracts, kanbans, blanket orders, purchase orders, consignment, and pricing agreements. Additional considerations include supplier relationship management principles and activities, demand forecasting, outsourcing, and e-commerce.

3. Delivery approaches include traditional modes of transportation, third-party logistics (3PL), cross-docking, point-of-use delivery, direct shipment and vendor-managed inventory (VMI).

4. Procurement planning, new product introduction, and engineering change control affect supply chain performance.

5. Supplier participation in the partnership addresses areas of product design, quality requirements, related technology, sustainable business practices, delivery, and accounting processes.

6. Goals and benefits of the partnership include improved technology, reduced inventory, improved customer service, improved quality, reduced lead times, improved visibility, better value-chain forecasting, cost reductions, reduced impact on the environment, damage and loss prevention, process improvement, access to new markets, and reduced time to market.

7. The supplier rating system encompasses quantitative measures, such as cost and on-time delivery, product quality, environmental impact, and qualitative measures such as social performance, including the aspects of workforce diversity, human rights, labor, and anticorruption.

References: 1; 2; 3 (chapters 7, 13, 16); 4 (chapter 16); 5 (chapters 3, 5–9); 7 (chapter 8); 8 (chapters 3, 6–11, 14); 9

Key Terminology

An understanding of the list of terms on pages x–xxx 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.

Material Requirements Planning (MRP) Grid

Many valid variations are used to display the MRP time-phased data. The following chart is the abbreviated grid sometimes used in texts and work problems.

The MRP Grid

Technique	
Order quantity	50
Safety stock	8
Allocated quantity	5
Low-level code	
Lead time	3

			Periods							
			1	2	3	4	5	6	7	8
x	Gross requirements		40	10	30	50	50	20	30	40
	Scheduled receipts				50					
	Projected available	140	95	85	105	55	55	35		
	Net requirements						3			
	Planned order receipts						50			
	Planned order releases			50						

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. Please see page ix in the introduction to this manual for a list of past references that can also be used for study. Also, candidates who have not yet passed the suggested first module—Basics of Supply Chain Management—should familiarize themselves with the basic concepts of materials management presented in this exam content manual. All of these references are available at **apics.org/shopapics**.

References

1. *APICS CPIM Detailed Scheduling and Planning Reprints*, 2010.
2. *APICS Dictionary*, 14th ed., 2013.
3. Arnold, J.R. Tony, S.N. Chapman, L.M. Clive, *Introduction to Materials Management*, 7th ed., Prentice Hall, 2012.
4. Bicheno, J. and M. Holweg, *The Lean Toolbox*, 4th ed., PICSIE Books, 2009.
5. Epstein, Marc J., A. R. Buhovac, *Making Sustainability Work,* 2nd ed., Berrett-Koehler Publishers, Inc. 2014.
6. Jacobs, F.R, W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw-Hill, 2011.
7. Kerzner, H., *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, 11th ed., John Wiley & Sons, Inc., 2013.
8. Simchi-Levi, D., P. Kaminsky, and E. Simchi- Levi, *Designing and Managing the Supply Chain*, 3rd ed., McGraw-Hill, 2008.
9. *The G4 Sustainability Reporting Guidelines https://www.globalreporting.org/resourcelibrary/GRIG4-Part1-Reporting-Principles-and-Standard-Disclosures.pdf.

*Internet links cited in the bibliographic references above can be found at **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 page 42-43.

1. $$\text{Service level} = \frac{\text{1 – Number of stockouts}}{\text{Number of replenishment cycles}}$$

   The expression above is used to measure historical service levels in terms of a percentage for which of the following statistical control procedures?

   (A) Line items shipped on time
   (B) Total quantity filled
   (C) Orders filled complete
   (D) Ordering periods not out-of-stock

2. An organization using time-phased requirements planning has the following net requirements for an item:

Week	Net required
2	350
5	1,200
7	1,000
11	1,500
Lead time	1 week
Unit cost	$1
Setup cost	$30
Carrying cost	0.5% per week

   If it is assumed that sufficient capacity is available in weeks 1 through 11 to order any amount in any period, which of the following is the most economical ordering plan?

   (A) Week 1 4 6 10
   Order 350 1,200 1,000 1,500
   (B) Week 1 6
   Order 1,550 2,500
   (C) Week 1 4
   Order 350 3,700
   (D) Week 1 4 10
   Order 350 2,200 1,500

3. Lot Size: Lot-for-lot
   On Hand: 500
   Allocated: 0
   Safety Stock: 0
   Lead Time: 4

The MRP Grid										
Technique Order quantity Safety stock Allocated quantity Low-level code Lead time										
			Periods							
			1	2	3	4	5	6	7	8
x	Gross requirements			100		300	200		400	
	Scheduled receipts									
	Projected available	500		400		100				
	Net requirements									
	Planned order receipts									
	Planned order releases									

The chart shows the gross requirements for an item in a material requirements planning system. Stock on hand is 500, and there is nothing on order. The item has a lead time of four periods and is being ordered lot-for-lot. Which of the following would be the correct planned order release for the item?

(A) 100 in Period 1, 400 in Period 3
(B) 100 in Period 4, 400 in Period 6
(C) 100 in Period 5, 400 in Period 7
(D) 500 in Period 5

4. Calculation of rated capacity of a work center includes consideration of which of the following?

(A) Efficiency and utilization
(B) Utilization, setup, and run time
(C) Utilization and available work time
(D) Efficiency, utilization, and available work time

5. Which of the following is part of the capacity requirements planning process?

(A) Determining the bill of resources
(B) Determining the planned order release
(C) Calculating load on each work center
(D) Development of a forecast

6. To create an effective customer-supplier partnership, it is essential to

(A) Establish stability in schedules that enable suppliers to react within their lead time
(B) Evaluate the suppliers based on price and then send the purchase order
(C) Establish a delivery schedule with a corresponding purchase order and send them to the suppliers
(D) Establish a preventive maintenance program to avoid quality problems due to machine troubles

7. A drill press operates at 50 percent efficiency and 80 percent utilization. How many clock hours must be worked to produce 80 standard hours?

   (A) 32
   (B) 100
   (C) 160
   (D) 200

8. Which of the following might a planner use to solve an overload problem?

   (A) Multiple setups
   (B) Alternate routings
   (C) Infinite loading
   (D) Adjust loading factors

9. Given the following purchase cost data for product Z:
   0 on hand (December 27)
   100 @ $10 = $1,000 (December 28)
   10 @ $11 = $110 (January 3)
   10 @ $8 = $80 (January 10)

   If this company is using a weighted average costing method and 100 units were sold on January 8, the cost per unit for the sale is:

   (A) $9.17
   (B) $10.00
   (C) $10.09
   (D) $8.00

10. Which of the following is a major use of the bill of material?

    (A) Engineering change control
    (B) Plan for every part
    (C) Costing of the process
    (D) Preventive maintenance schedule

Execution and Control of Operations

Examination Committee

James Caruso, CPIM, CSCP (Chair)
Medtronic
John Bicheno, CFPIM
The University of Buckingham
Joseph Carr, CPIM, CIRM, CSCP
NOG, Inc.
Frank L. Montabon, Ph.D., CFPIM, CIRM, CSCP
Iowa State University
Michael A. Roman, CPIM
Manufacturing Practices, Inc.
Josie Vigil, CPIM, CSCP
B. Braun Medical Inc.

Scope of the Subject Matter

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

The subject matter of Execution and Control of Operations encompasses the principles and practices necessary to execute, control, and manage operations, and participate in design decisions. This module provides feedback about how well plans are being executed, as well as providing information for customers and suppliers about the status of services and products in process.

The importance and emphasis of these approaches are relative to the operation's environment, the labor environment, the physical organization of the facility, and the effectiveness of management and employees.

The successful candidate will be able to translate plans into operational activities and define and apply basic techniques in the operations field. The candidate must be able to apply these concepts and techniques, as well as analyze situations to determine which approaches are applicable. This includes the ability to:

- compare actual output to plans and take appropriate corrective actions
- communicate basic ideas in a group setting and instruct others in tasks
- create basic operational solutions in the face of competing resources
- recognize distribution alternatives and their managerial impacts
- explain the release of work and reporting performance through data collection
- understand the execution of quality initiatives and continuous improvement plans
- evaluate trade-offs and participate in design decisions

Execution and Control of Operations 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	Execution of Operations	30%
II	Control of Operations	30%
III	Quality, Communication and Continuous Improvement	20%
IV	Design Concepts and Trade-Offs	20%

Content Outline

I. Execution of Operations

The execution of operations includes understanding the scheduling processes that translate plans into operational activities. This includes applying methods of authorizing and releasing work, and the management of resources required to accomplish the work. All execution activities rely on an understanding of the decisions made about the organizational environment, strategies, and objectives.

A. *Principles*: An understanding of the key principles of executing activities is necessary for effective operations management. These principles are

influenced by the policies that determine how work will be accomplished, such as push versus pull environments.

1. Flow principles include locating bottlenecks, constraints management, minimizing waste, and coupling operations.

2. Batch principles employ the concepts of process batch, transfer batch, lot size, and reorder point.

3. Scheduling implies commitment of resources to a timetable. Concepts include expediting, resolving imbalances, the effect of time fence policies, lead time components, schedule composition, resource constraints, final assembly scheduling, and preventive maintenance.

B. *Techniques*: A variety of techniques are available to guide the execution of operations plans. It is important to understand the distinctions and applicability of using different techniques based on the manufacturing or service environment. For example, capacity techniques balance supply and demand.

1. In a push environment, techniques are used to prioritize work and to manage capacity. Decisions must be made as to the sequencing of work and the impact on setup time and changeovers, the movement of materials, and the use of alternate routings. Capacity techniques in a push environment include forward scheduling, backward scheduling, load leveling, input/output control, and adjusting constrained resources.

2. The execution of work in a pull environment must be managed to allow work to flow without interruption. Techniques used to prioritize work include mixed-model scheduling, rate-based scheduling, and pulling work to fulfill customer demand, whether internal or external. Capacity techniques in a flow work environment include synchronization, line balancing, and adjustments to constrained resources.

3. Elimination of non-value-added activities reduces the time it takes to process goods and services, lessening cost to the organization and improving competitive advantage.

4. The methodology of the five Ss allows for the organizing, cleaning, developing, and sustaining of a productive work environment.

5. Storage, flow, and management of inventory are critical in achieving the goals of the organization. Appropriate inventory identification and valuation methods must be used, including vendor-managed and consignment. Inventory performance metrics such as accuracy can be measured and improved through the use of cycle counting and transaction management to ensure precise reporting of inventory receipts, movement, and shipments.

References: 1; 2; 3 (chapters 6, 12, 15); 4; 5 (chapters 10, 11, 13, 16, 17); 6 (chapters 11, 18, 24)

II. Control of Operations

Control of operations encompasses the ongoing review and management of operational results in comparison to the established near-term plan, followed by analysis and application of any corrective action required to align performance with the plan. Control includes the principles and techniques to accomplish the plan using both internal and external resources.

A. *Principles*: The principles of operational control focus on the organization's goals, feedback from the process, and management of the control process. An understanding of the operation's environment and the distinction between internal and external elements is essential in establishing appropriate measures.

1. Control goals primarily focus on operational and quality plans. The detailed operational plan may be expressed in units, hours, labor, and inventory objectives. Quality

plans include analysis and review of the capability, stability, and permissible tolerance levels of operations. Additional control goals include product and service design and vendor certification.

2. Feedback is fundamental to the control process. The feedback loop provides the data necessary to maintain valid plans and the ability to evaluate variances to standard performance. Other key elements include the determinants of performance in addition to process stability, process capability, and theoretical and demonstrated capacity.

3. Management of the control process is facilitated through established standards and procedures in support of the organization's goals. The performance measures must be relevant and measurable to the organization's bottom line. Safety standards control and protect the organization and its environment.

B. *Techniques*: The objective of control is to compare actual to planned results. Tools and sources of data vary depending on the environment.

1. Comparing actual to planned, budgeted, or standard costs initiates the control process, aids understanding, and optimizes cost elements. Costing methods include job costing, absorption costing, activity-based costing, and process costing. Variances in cost are also captured through inventory valuation, obsolescence review, scrap, rework, repairs, returns, and defective output. Costs related to quality include internal and external failure costs, as well as appraisal and prevention costs.

2. Process activity measures evaluate and record the levels of activity to determine variation and conformance to standards. Statistical process control methods such as P charts, X-bar charts, R charts, and capability indices measure process variability.

3. Throughput, which depends on the organizational environment, can be evaluated by techniques such as efficiency, utilization, productivity, takt time, cycle time, visual signals, and units of throughput such as quantities of materials, services, hours, or dollars.

References: 1; 2; 3 (chapters 6, 9, 16); 4; 5 (chapters 10, 17); 6 (chapters 5, 6, 7, 8, 13, 15, 18, 19, 20, 23, 28)

III. Quality, Communication, and Continuous Improvement

Management defines the goals and uses meaningful communication to bring about those goals.

A. *Principles*: Management principles address the organization, training, and motivation of work teams and other groups of persons assigned purposeful activities.

1. Group principles include multiple-criteria decision making, consensus-building, gatekeeping, and problem-solving processes. Learning methods to plan and lead a meeting, understanding the capabilities and work of others, engaging in cross-training, and gaining skills in effective group formation and leadership are all vital elements. Understanding that there are a number of different and often conflicting goals within the group enables the group to consider a broad range of possible solutions.

2. Individual principles include task definition and guidance, managing "up" and "down" in the organization, self-assessment, and motivation of self and others. Effective group members should understand the work elements, ask diagnostic questions, and utilize time appropriately.

B. *Techniques*: Techniques apply the principles of effective communication. All include thoughtful problem definition and its impacts, criteria for evaluating solutions, and choice of the most effective solution given the criteria.

1. Some of the basic tools of quality management are check sheets, cause-and-effect analysis, Pareto charting and analysis, the use of histograms, scatter charts, control charting, and flow charting.

2. The define, measure, analyze, improve, control technique, or DMAIC, is an organized six sigma procedure for close examination of a process.

3. The Shewhart/Deming cycle, also known as plan-do-check-action, moves from planning through the observation or data gathering, validation, and execution phases of the problem-solving process.

4. A3 problem solving includes root cause analysis, current and target conditions, implementation, and follow-up plans to ensure an objective has been met.

5. Additional considerations such as management style and contingency planning also have an impact on communication, problem solving, and decision-making.

References: 1; 2; 4; 6 (chapters 1, 5, 6, 7, 8, 9, 11, 12, 13, 23, 26)

IV. Design Concepts and Trade-Offs

Successful execution system design balances competing organizational objectives. Effective execution system design will incorporate the appropriate flow approach, customer definition of quality, market demand for speed, use of available technologies, and the appropriate workforce training, to simultaneously achieve desired system outcomes, profitability, and sustainability.

No single operational design is appropriate for all organizations or standard industry classifications. The operational design must be adapted to deliver competitive manufacturing or service capability to the marketplace. As an organization's operations personnel may be asked for input into new or changing design systems, they must understand general principles and techniques and tradeoffs of the underlying product, organization, and process designs.

A. *Principles*: Design principles are classified as Product Design, Organizational or Plant Layout, and Process Design. Design principles also have a scope: local (inside organization or process), network (throughout the customers and suppliers in the company's value chain), or global (external to the company's value chain, to the society at large).

   1. Local design principles are both product and process in scope. In product design, the selection of the appropriate engineering approach is an execution issue as these decisions impact the execution system flexibility, process choice, and speed to market.

      Local process design trade-offs and improvements may be made in a portion of the workspace, a department, or entire facility. Process design elements include lean principles, quality systems, automation, use of technology, environmental footprint, cost-volume-profit relationships, and other tools that affect process outcomes.

   2. Network principles define and support the relationships of the immediate environment to up-and down-stream customers and suppliers. Use of collaboration technologies, voice of the customer, supply chain management, logistics practices, lean tools, and quality principles shape these relationships.
   3. Global principles form the basis of an organization's relationship to the world at large, including costs and benefits to society, green and sustainable manufacturing, and other corporate social responsibilities.

   4. Any design is a compromise. Underlying the compromise are relationships of variables and design parameters that often compete with each other. Supply

chain and operations managers must be aware of the trade-offs. One key design attribute is the level of product or service customization the execution system will be responsible for delivering.

B. *Techniques*: Design techniques consist of the processes a manager might invoke to arrive at an appropriate trade-off given stated objectives. Product design techniques that influence operations include engineering methods that increase flexibility of service delivery. Process design techniques can include the use of technology, lean principles, inventory, simulation, employee training, quality systems, and automation.

1. Continuous improvement design activities consist of processes intended to enhance the internal performance and relationships with upstream and downstream customers and suppliers. Collaboration technologies, incorporation of the voice of the customer, and supplier feedback create network-based continuous improvements.

2. Work area design activities consist of setting specifications, work orientations, flows, layouts, and changeovers. In evaluating appropriate improvements to products or processes, a company will use many techniques. Simulation, modeling, shop based technology improvements, automation, and additional employee training are effective design improvements.

3. Local work and employee groups use collaboration and visual techniques to improve performance in the workspace, process, and information flow.

4. Quality systems and tools impact execution systems. Tools like quality function deployment, concurrent engineering, modular design, and feature postponement make execution systems more likely to produce desired outcomes. Design of experiments seeks to measure controllable and uncontrollable process variables and their effects on managing satisfactory outputs from the process or system under analysis.

References: 1; 2; 3 (chapters 7, 14); 4; 5 (chapters 13, 15, 17); 6 (chapters 4, 8, 9, 10, 11, 16, 19, 30)

Key Terminology

An understanding of the list of terms on pages x–xxx 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. Please see page ix in the introduction to this manual for a list of past references that can also be used for study. Also, candidates who have not yet passed the suggested first module—Basics of Supply Chain Management—should familiarize themselves with the basic concepts of materials management presented in this exam content manual. All of these references are available at **apics.org/shopapics**.

References

1. APICS CPIM Execution and Control of Operations Reprints, 2015.
2. *APICS Dictionary*, 14th ed., 2013.
3. Arnold, J.R. Tony, S.N. Chapman, L.M. Clive, *Introduction to Materials Management,* 7th ed., Prentice Hall, 2012.
4. Dennis, P., *Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System*, 2nd ed., Productivity Press, 2007.

5. Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E.Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw- Hill, 2011.
6. Juran, Joseph M., J. A. DeFeo, *Juran's Quality Handbook*, 6th ed., McGraw Hill, 2010.

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 44-45.

1. Which of the following is the most viable approach to automating repetitive assembly processes?

   (A) Simplify the processes prior to automation.
   (B) Concurrently establish visual inspection stations and automation implementation.
   (C) Implement automation throughout the processes simultaneously rather than work cell by work cell.
   (D) Apply automation to the final assembly processes first.

2. Cause-and-effect analyses are made with the help of which of the following?

   (A) Fishbone chart
   (B) Statistical process control method
   (C) Critical path method
   (D) Pareto analysis

3. Data collection using bar code technology can provide which of the following?

   (A) Increase data accuracy
   (B) Increased capacity utilization
   (C) Lower scrap rates
   (D) Lower holding costs

4. Company X, a job shop, is a supplier to Company Y, which produces a product continuously. The companies agree to begin a lean program to reduce lead times through all operations in both facilities. To implement the program, which of the following actions should be taken?

   (A) Company X should increase the shipment quantities to Company Y.
   (B) Company X should reduce its manufacturing lot size.
   (C) Company Y should implement 100 percent inspection.
   (D) Company X should set up a warehouse located closer to Company Y.

5. Part number 762-4521 is being processed as an order for a lot of 50 pieces due on day 200. The lot is currently in queue at Operation 3. The facility is currently running one eight-hour shift. Based on routing and status information for part number 762-4521 below, what is the priority for Operation 3 on Day 195 calculated on the basis of slack time (in days) per remaining operation?

Operation	Standard hours per piece	Pieces produced through day 195
1	0.05	51
2	0.15	50
3	0.10	0
4	0.20	0
5	0.02	0

   (A) -3.70
   (B) 0.58
   (C) 1.00
   (D) 3.00

6. Which of the following actions is most appropriate for resolving a capacity shortage at the initial or gateway work center that was detected during order release?

   (A) Add a shift at the gateway work center.
   (B) Expedite in-process orders.
   (C) Hire additional staff for the work center.
   (D) Reschedule orders due for release.

7. Which of the following is a significant factor in determining the level of work-in-process inventory when a pull system is employed?

   (A) Number of open shop orders
   (B) Quantity of parts represented by each signal
   (C) Number of workstations in the process
   (D) Takt time required for the process

8. Which of the following would be used to take a group of information and organize it so that new trends or patterns of information are recognized?

   (A) Run chart
   (B) Cause-and-effect diagram
   (C) Pareto chart
   (D) Flow chart

9. Which of the following statements best demonstrates effective management leadership?

   (A) A reward is established for the manager whose team demonstrates the most improved operations in the next operating year.
   (B) Senior management states that all managers must improve their output by 10 percent within two weeks.
   (C) All levels of management must develop a continuous improvement plan for their group and measure their performance against the plan.
   (D) Creating a quality department and appointing a quality manager with the objective of improving quality by 10 percent.

10. Which of the following is most important to ensure that commitment to quality objectives is maintained?

    (A) Establishing a quality group
    (B) Active management participation
    (C) Allotting resources for quality improvement
    (D) Establishing quality goals

Strategic Management of Resources

Examination Committee

Robert Vokurka, Ph.D., CFPIM, CIRM, CSCP (Chair)
Texas A&M University-Corpus Christi (retired)
Louise Beauchamp, CFPIM
DBM Systems, Inc.
Al Bukey, CFPIM, CIRM, CSCP
ABCAN Inc.
Tammy Culp, CPIM
RTI Surgical Inc.
Matt Drake, Ph.D., CFPIM
Duquesne University
Gary Smith, CFPIM, CSCP
MTA-New York City Transit

Scope of the Subject Matter

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

The subject matter of Strategic Management of Resources includes higher-level thinking on strategic planning and implementation of operations. This requires an understanding of how market requirements and strategic position of the organization drive the resources and processes of an organization. The concepts included in this module apply to manufacturing and service organizations.

The successful candidate will have a thorough understanding of all key terms and concepts contained within the other four modules of the APICS CPIM program, as well as the key concepts and terms within this exam content outline. The candidate must be able to apply the concepts and techniques in the content, as well as analyze situations to determine which approaches are applicable. This includes understanding concepts that require a combination of elements and higher thinking within the entire CPIM body of knowledge, and also

- the relationship of existing and emerging processes and technologies to operations and supply chain functions
- various business environments
- how operation strategies are developed
- how operations strategies are implemented

Strategic Management of Resources Content

The following table identifies the three 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	Understanding the Business Environment and Developing Corporate Strategy	25%
II	Developing the Operations Strategy	45%
III	Implementing the Operations Strategy	30%

Content Outline

I. Understanding the Business Environment and Developing Corporate Strategy

Operations strategy must be integrated with the corporate strategy of the firm, reflecting the external environment, as well as organizational priorities and philosophies. The operations strategy development process must capture and assimilate that information to provide context for alignment with corporate strategy. Corporate strategy development must consider business environmental factors.

A. *Environmental analysis*

1. External environment
2. Industry analysis (five-force model)
3. Internal analysis (core competencies)
4. Value chain analysis

B. *Strategy formulation*

1. Situation analysis (SWOT)
2. Corporate strategy
3. Functional strategies

C. *Sustainability*—Understand the importance and implications of the three parts of sustainability (economic, environmental, and social) to the organization, stakeholders, and supply chain. Implications include:

1. Product and process design
2. Supply chain design
3. Reduce, reuse, recycle

References: 1, 2; 6 (chapters 3–9)

II. Developing the Operations Strategy

The operations strategy development process must align with the business strategy and reflect the analysis of the business environment.

This includes the processes of identifying, evaluating, and choosing among alternatives in the context of the business strategy. Understand the significance of the following factors in developing the operations strategy:

A. *Performance Objectives/Goals*—Choosing how success is determined

B. *Product/Service Design*—Matching firm capabilities and processes to market needs and product life cycles. Considerations include:

1. Competitive priorities
2. Order winners and qualifiers
3. Sustainability

C. *Structure and Infrastructure*—Making capital (structure) and organizational (infrastructure) choices

1. Paradigm or philosophy to provide consistent framework for decision-making (e.g., lean, TOC, ERP)
2. Process design as illustrated by the product-process matrix and the product service design matrix
3. Vertical and horizontal integration alternatives

D. *Coordination Strategy*—Aligning internal operations and external supply chain partners. Examples include:

1. Planning for capacity (lead and lag)
2. Integrating materials strategies across the supply chain (e.g., inventory levels, location, and ownership)
3. Sharing information (e.g., sales forecast, capacity plans, product planning)
4. Planning human resource and technology requirements

E. *Measurement*—Recognize that measurements must support performance objectives. Measurements may be categorized:

1. Financial statement analysis
2. Cash flow
3. Capital investment
4. Costing systems
5. Nonfinancial (e.g., balanced scorecard and operational and process measures)
6. Cost-volume profit analysis

F. *Logistics*—Understand forward and reverse supply chain design, which includes logistics, asset ownership, and outsourcing options such as third- and fourth-party logistics (3PL and 4PL).

G. *Organizational Commitment Process*—Understand issues necessary to gain broad management acceptance of the operations strategy recommendation, as demonstrated by a commitment of resources.

H. *Risk Assessment*—Understanding the sources and probabilities of risk, the risk tolerance of the organization, as well as prevention, recovery, and resiliency strategies in developing the operations strategy.

1. Impacts of potential failures
2. Risk acceptance and risk prevention
3. Assessment of potential failure points

References: 1; 2; 3; 4 (chapters 1–5); 5; 6 (chapters 2, 10, 12)

III. Implementing the Operations Strategy

This section addresses the strategic leadership activities, leadership roles, and responsibilities that lead to the successful implementation of the operations strategy.

A. *Risk Management*—Understand the actions required to offset existing and changing risks.

1. Assessing potential failure points
2. Failure prevention
3. Failure mitigation
4. Failure recovery

B. *Change Management*—Understand the strategic elements of successful organizational change.

1. Roles and responsibilities in leading change
2. Change process activities utilizing typical project techniques
3. Prepare others for change and understand the needs and strategies to involve all stakeholders

C. *Infrastructure Systems*—Configuring the following systems as implementation of the operations strategy:

1. Management: organizational structure, measurement systems, and human resource policies and practices
2. Value creation: product/service, production/delivery
3. Quality: strategies and methodologies
4. Information: technology, visual management, and sharing processes

D. *Structural Deployment*—Implementing required modifications to existing operational structure(s) consistent with the operations strategy

1. Facilities strategy
2. Equipment positioning to support process flow
3. Other assets (e.g., inventory, vehicles)

References: 1; 2; 3; 5 (chapters 7, 9, 10); 6 (chapter 11)

Key Terminology

An understanding of the list of terms on pages x–xxx 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. Also, candidates who have not yet passed the suggested first module—Basics of Supply Chain Management—should

familiarize themselves with the basic concepts of materials management presented in this exam content manual. All of these references are available from the APICS Bookstore at **apics.org/shopapics**.

References

1. *APICS Dictionary*, 14th ed., 2013.
2. Epstein, Marc J., A. R. Buhovac, *Making Sustainability Work,* 2nd ed., Berrett-Koehler Publishers, Inc. 2014.
3. Kotter, John P.*, Leading Change,* Harvard Business Review Press, 2012.
4. Siegel, Joel., J. Shim, *Accounting Handbook,* 5th ed., Barrons, 2010.
5. Slack, Nigel, M. Lewis, *Operations Strategy,* 3rd ed., Prentice Hall Financial Times 2011.
6. Thompson, Arthur, A., M. Peteraf, J. Gamble, A. Strickland, *Crafting & Executing Strategy, Concepts and Readings,* 19th ed., McGraw-Hill, 2014.

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 then check your response with the explanation on page 46.

1. A make-to-order organization competing on delivery speed would consider which of the following to be a significant impact on its competitive position?

   (A) Relocation of suppliers
   (B) Increased labor costs
   (C) Outsourcing of customer service
   (D) Shifts in customer demand

2. Inventories can improve supply chain flexibility by which of the following actions?

   (A) Reducing total supply chain costs
   (B) Decoupling supply and demand
   (C) Improving cash flow
   (D) Increasing asset utilization

3. Which of the following measures is a key indicator of a firm's asset utilization?

   (A) Profit margin
   (B) Current ratio
   (C) Inventory turnover
   (D) Cost of goods sold

4. Generic Foods Corporation's success with its "Healthy Snacks" line of products has encouraged them to introduce a new line of products for upscale restaurants. Which of the following performance objectives would be most appropriate for this new line product line?

   (A) Speed to market
   (B) Production cost per unit
   (C) Conformance to specification
   (D) Number of late deliveries

5. Which of the following approaches would be used to prevent mistakes from becoming system defects in a service operation?

   (A) Theory of constraints
   (B) Poka-yoke
   (C) Lean service methods
   (D) Continuous improvement

6. Low impact failures that happen relatively frequently are:

   (A) a quality management challenge.
   (B) an example of resilience.
   (C) a measure of prevention.
   (D) a high-priority fail safe opportunity.

7. In an engineer-to-order company performing a SWOT analysis, which of the following concepts should be considered?

   (A) Education of management team in product design concepts
   (B) Implementation of a material requirements planning system
   (C) Accuracy of work-in-process inventory and routing data
   (D) A thorough understanding of critical resources

8. Which of the following facility location techniques incorporates qualitative issues in determining operations strategy?

   (A) Factor rating system
   (B) Center-of-gravity analysis
   (C) Mixed integer linear programming
   (D) Balanced scorecard analysis

9. Which of the following is an advantage of using a capacity-lagging (chase) approach in implementing operations strategy?

   (A) High facility utilization rate
   (B) Revenue maximization
   (C) Reaction to short-term demand changes
   (D) Product mix flexibility

10. One role of operations strategy is to reconcile market requirements with operations capacities. Which of the following results in the most profitable relationship between the two when demand is variable?

    (A) Market requirements exceed operations capacities
    (B) Market requirements equal operations capacities
    (C) Market requirements are less than operations capacities
    (D) There is no direct relationship between the two

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.

Answers to Sample Questions

Note: References to the content outline appear in parentheses.

Master Planning of Resources

1. A IB4) Business planning is performed at the highest level of aggregation and over the longest horizon and would typically be done for fiscal quarters or years. The other processes would have shorter horizons and intervals. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw-Hill, 2011, chapter 4.)

2. B (IIIB) The master schedule is a plan of future production and drives the rough-cut capacity plan. The production plan is used as a basis for preparing the master schedule, rather than the master schedule being used as a basis for the production plan. Answer A is incorrect because it excludes option II, which is a valid normal use of the master schedule. Answers C and D are individually incorrect because they include option III, which is not a valid normal use of the master schedule. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw-Hill, 2011, chapter 7.)

3. A (IID) In a chase strategy, production output is changed to "chase" or equal sales demand, which results in minimal changes in inventory levels. The opposite is a level policy, in which production is at a constant rate of output with inventory buildups and depletions. Answer B is incorrect because changing production output to chase demand results in costs of changing the workforce level, overtime, and subcontracting in addition to maintaining plant capacity to meet maximum demand. Answers C and D are incorrect because producing exactly to demand will maximize capacity requirements as capacity will be required to meet the highest demand level, yet this capacity (including machine time) will go unused when the demand is low, resulting in low utilization of capacity. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management* APICS/CPIM Certification Edition, McGraw-Hill, 2011, chapter 5.)

4. B (IIID) Available-to-promise for Period 4 is the master production schedule (MPS) of 30 for that period, less the customer orders of 6 for that period. Because another MPS of 30 will occur in Period 5, demand for that period is not considered by the available-to-promise for Period 4. Based on the explanation for the calculation for discrete available to promise, Answers A, C, and D are incorrect. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw-Hill, 2011, chapter 7.)

5. B (IIID) The projected available balance for Period 5 uses the greater of customer orders or forecast since it is after the demand time fence. The prior period projected available balance of 35, plus the MPS of 30, less the orders of 30, results in a projected available balance of 35 for Period 5. Based on the explanation for the calculation for projected available balance, answers A, C, and D are incorrect. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw-Hill, 2011, chapter 7.)

Lead time: 2	Lot size: 30
Demand time fence: 3	On hand: 15
Planning time fence: 7	Safety stock: 6

Period	1	2	3	4	5
Forecast	10	22	20	24	28
Customer orders	5	26	15	6	30
Projected available balance	10	14	29	35	35
Available-to-promise	10	4	15	24	0
Master production schedule	0	30	30	30	30

6. A (IVB) Answers B, C, and D refer to system parameters that exception messages would not address. Answer (A) is a condition and exception messages address conditions. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw-Hill, 2011, chapter 14.)

7. C (IB5) Theoretically, the valid range for the smoothing constant is 0.0 to 1.0. The higher the smoothing constant, the more responsive the forecast is to the latest demand. Therefore, the highest smoothing constant within the valid range is most appropriate in this situation. (See *APICS Dictionary*, 14th edition, 2013)

8. C (IVB) Answers A, B, and D are parameters, not outputs. C is an output. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS CPIM Certification Edition, McGraw-Hill, 2011, chapter 14.)

9. C (IIA1) S&OP is the process that executive management uses to control and guide the business. The demand and production plans are developed and significant differences are reconciled in the process. Production is one of the sources of supply. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw-Hill, 2011, chapter 5.)

10. A (IIC) The production plan, also referred to as the operations plan, is an output of the S&OP process and specifies the overall manufacturing output level (volume) to be produced—usually as a monthly rate for each product family. Planning at the work center level is done as part of shop floor scheduling and control, which is a more detailed level of planning than production planning. Planning at the end-item and product option levels is done as part of master production scheduling. (See Jacobs, F.R., W.L. Berry, D.C. Whybark, and T.E. Vollmann, *Manufacturing Planning and Control for Supply Chain Management*, APICS/CPIM Certification Edition, McGraw-Hill, 2011, chapter 5.)

Answers to Sample Questions

Note: References to the content outline appear in parentheses.

Detailed Scheduling and Planning

1. D (IB) The percentages of line items shipped on time (A), of the total quantity filled (B), and order filled complete (C) are all incorrect because the formula does not include any of these statistics. The formula (D) includes the number of stockouts that have occurred during some number of replenishment cycles or lead times. One minus the proportion of replenishment cycles in which a stockout occurs is the percentage of ordering periods not out of stock, or service level.

2. D (IID)

   Total cost = setup cost + carrying cost

   Setup cost = number of setups × cost per setup

   Carrying cost = units × unit cost × number of periods × carrying cost per period

   The costs are calculated as follows:

   A. Setup cost = $120 = $30 × 4
      Carrying cost = $0
      Total cost = $120

   B. Setup cost = $60 = $30 × 2
      Carrying cost = $48
      = (1,200 × $1 × 3 × .005)
      + (1,500 × $1 × 4 ×.005)
      Total cost = $108

   C. Setup cost = $60 = $30 × 2
      Carrying cost = $55
      = (1,000 × $1 × 2 × .005)
      + (1,500 × $1 × 6 × .005)
      Total cost = $115

   D. Setup cost = $90 = $30 × 3
      Carrying cost = $10
      = (1,000 × $1 × 2 × .005)
      Total cost = $100

3. A (IIC)

Lot Size:	Lot-for-lot
On Hand:	500
Allocated:	0
Safety Stock:	0
Lead Time:	4

The MRP Grid

<u>Technique</u>
Order quantity ___ ___
Safety stock ___ ___
Allocated quantity ___ ___
Low-level code
Lead time ___ ___

			Periods							
			1	2	3	4	5	6	7	8
x	Gross requirements			100		300	200		400	
	Scheduled receipts									
	Projected available	500		400		100				
	Net requirements						100		400	
	Planned order receipts						100		400	
	Planned order releases		100		400					

4. D (IIIA) Setup and run time are used to calculate required capacity. The rated capacity = time available × efficiency × utilization.

5. C (IIIA) A, and D are related to rough-cut and B is related to the MRP explosion process.

6. A (IVA) Partnerships require a commitment to stability within the agreed-upon response parameters. B and C are short-term and tactical in nature. D is really something that needs to be done without any regard to partnering.

7. D (IIIB) Standard hours = (clock hours) × (utilization × efficiency). Therefore, clock hours = (standard hours) / (utilization × efficiency) = 80 / (0.80 × 0.50) = 200 hours. A is incorrect because 32 = (standard hours) × utilization × efficiency. B and C are incomplete applications of the correct formula, dividing standard hours by utilization alone to arrive at 100 (B), and by efficiency alone to arrive at 160 (C).

8. B (IIIC) If the planner had an alternate route, it could be used to distribute or divide the load between two choices, which makes B the correct answer. Multiple setups (A) add to the load, making it an incorrect choice. Infinite loading (C) detects the overload but does not solve the overload problem. Loading factors should reflect reality. Adjusting accurate loading factors (D) to address an overload will only hide reality from the planner; therefore, it is also incorrect.

9. C (IB) Standard costing is a method of setting a new standard based on various parameters. A is incorrect because of average cost after January 10. B is incorrect because it is the FIFO cost of the product. C is correct because this is the weighted average on January 8. D is incorrect because this is the last cost paid for each item.

10. A (IIIB) For a comprehensive explanation, see page 70 of Arnold, J.R. Tony, S.N. Chapman, and L.M. Clive, Introduction to Materials Management, 7th ed., Prentice Hall, 2012. A is a major use of the bill of material because engineering sometimes changes the design of the products, and a record is required to know what to change. B is an extension of the item master. C uses routing information. D does not use the bill of material.

Answers to Sample Questions

Note: References to the content outline appear in parentheses.

Execution and Control of Operations

1. A (IVA) The effectiveness of automation depends on improving the manufacturing process before you begin automating the process. The approach is to first simplify the process and then to automate the process to eliminate work and improve quality. B, C, and D are incorrect. Improving inspection (B) does not improve the process; it overlooks the first step of simplifying the process. Implementing automation (C and D) before simplifying the process significantly increases the chance of making mistakes.

2. A (IIIB) The fishbone chart is a diagram of the possible causes of a problem. The causes are determined with the aid of brainstorming techniques. The diagram resembles a fish skeleton. B, C, and D are incorrect. Statistical process control (B) focuses on the continuous monitoring of a process. The critical path method (C) is a technique used to plan and control the activities of a project. Pareto analysis (D) is a technique to rank order the relative frequency of occurrences.

3. A (IB) Increased data accuracy is the correct answer because bar coding eliminates the possibility of typing or transposition errors when entering data. B, C, and D are not related to bar-code technology.

4. B (IA) B is correct because it synchronizes with the customer. (A) A company should not increase lot size. (C) A preferred approach is to create a quality at the source program versus 100 percent inspection. (D) creates additional inventory with the additional warehouse.

5. C (IB) The slack time per remaining operation formula is:

   Date due – date now – standard processing days remaining

   The result is divided by the number of remaining operations.

Operation	Standard hours	Pieces produced	Process remaining hours
1	0.05	51	0
2	0.15	50	0
3	0.10	0	5
4	0.20	0	10
5	0.02	0	1

   The priority of Operation 3 is calculated as follows:

$$\frac{(200 - 195) - (16 \text{ hrs.} / 8 \text{ hrs. per day})}{3} = \frac{5 - 2}{3} = 1$$

6. D (IIA) Because the capacity shortage was detected during order release and at a gateway work center, the corrective action needs to be implemented in the very near term. Since the capacity shortage was not detected at the higher levels of capacity planning, it is likely to be a short-lived imbalance. Rescheduling orders that have not yet been released can be done quickly and will provide immediate relief at the gateway work center. A, B, and C are incorrect. Adding a shift or hiring employees (A and C) would increase capacity, but it is unlikely that either could be accomplished in time to address the short-term and immediate problem. Expediting in-process orders (B) will have no effect on the capacity available or capacity required at a gateway work center.

7. B (IIB) The level of work-in-process (WIP) inventory when a pull signal is employed is a function of the number of pull signals and the quantity represented by each pull signal. A, C, and D are incorrect. Shop orders (A) are

characteristic of a push system and are not relevant in a pull system. The number of workstations (C) in the process determines the minimum work in process (WIP) level, but does not determine the total WIP level. The takt time (D) determines the rate at which the process needs to operate. It does not determine the WIP level.

8. A (IIB) Run chart shows the variation trends in a group of information over time. B, C, and D are incorrect. A cause-and-effect diagram (B) is used to collect brainstorming ideas to establish categories of potential causes to an effect. A Pareto chart (C) is used to sort data into groups from most significant to least significant. Activities that are included on a flow chart (D) identify the relationship to one another and do not identify trends or patterns.

9. C (IIIA) Commitment by management is most effective when driven down through the organization. When all levels of management spend time on continuous improvement activities, such as plan-do-check-action, it provides evidence of the leadership and inspires others to do the same. Since leadership programs are meant to inspire others, giving rewards to management (A) does not constitute leadership. Specific goals are important (B and D), but cannot be specified at 10 percent without knowing what the goals are.

10. B (IIIA) Nothing demonstrates commitment more than active participation by management (B) in quality activities. Management may establish groups (A) or other resources (C), and help define goals (D), but handing over all responsibilities to others does not ensure that the management commitment can be maintained. Active involvement is the only way to ensure that established goals are achieved.

Answers to Sample Questions

Note: References to the content outline appear in parentheses.

Strategic Management of Resources

1. D (IIB2) As customer demand shifts, the organization may find itself with capacity in excess or less than required. Neither situation is ideal. If the demand shift leaves capacity short, we see a situation where the operation does not have sufficient capacity to meet market needs. (*Operations Strategy,* chapter 2)

2. B (IID2) Inventory can improve supply chain flexibility by acting as a buffer to decouple supply from demand when appropriate. (*APICS Dictionary*, 14th ed., 2013)

3. C (IIE1) Profit margin is a profitability measure (net income/sales). The current ratio is a liquidity measure (current assets/current liabilities). The price-to earnings (P-E) ratio is a market value measure (price per share/earnings per share). Inventory turnover (cost of sales/inventory level) is one of the principal measures of a company's asset utilization. (*APICS Dictionary*,14th ed., 2013; *Accounting Handbook*, chapter 5)

4. C (IIA) Upscale restaurants will be most concerned with product quality. So, to achieve customer satisfaction, a performance objective that emphasizes quality is needed. *(Crafting & Executing Strategy, Concepts and Readings*, chapter 2)

5. B (IIIC3) Poka yokes are procedures that prevent a mistake from becoming a defect. There are three general methods, involving: (1) warning, (2) physical contact, and (3) visual contact. The other three approaches are more common in manufacturing operations. (*APICS Dictionary*, 14th ed., 2013.)

6. A (IIIA1) These types of failures are the responsibility of quality management. (*Operations Strategy*, chapter 10)

7. D (IB1) SWOT analysis focuses on critical factors affecting competitiveness. Of the four choices, only answer D meets that criteria. (*Crafting & Executing Strategy, Concepts and Readings,* chapter 4)

8. A (IIF) Factor rating systems provide a mechanism to combine diverse factors in an easy-to-understand format. For example: Each site is rated against each factor and a point value is selected from its assigned range. The sum of the assigned points for each site is then compared. (*Operations Strategy,* chapter 4)

9. A (IID1) A pure chase demand plan is usually adopted by operations that cannot store their output such as a call center. Thus, the strategy avoids the wasteful provision of excess staff that occurs with a level capacity plan. (*Operations Strategy,* chapter 4)

10. C (IID1) Operations capacity should be greater than market requirement in order to meet variation in customer demand. (*Operations Strategy,* chapter 4)

apics.org