Operations Management

CREDIT HOURS: 3
LEVEL: UPPER

EXAM CODE: 420
CATALOG NUMBER: BUSx425

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www.excelsior.edu/contentguides
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Before You Choose This UExcel Exam

Uses for the Examination

• Excelsior College, the test developer, recommends granting three (3) semester hours of upper-level undergraduate credit to students who receive a letter grade of C or higher on this examination. The examination may be used to help fulfill the course requirement for the BS in General Business or as a free elective for all Excelsior College degree programs that allow for free electives.

• Other colleges and universities also recognize this exam as a basis for granting credit or advanced standing.

• Individual institutions set their own policies for the amount of credit awarded and the minimum acceptable grade.

Exam-takers who have applied to Excelsior College should ask their academic advisor where this exam fits within their degree program.

Exam-takers not enrolled in an Excelsior College degree program should check with the institution from which they wish to receive credit to determine whether credit will be granted and/or to find out the minimum grade required for credit. Those who intend to enroll at Excelsior College should ask an admissions counselor where this exam fits within their intended degree program.

Examination Length and Scoring

The examination consists of approximately 80 questions, most of which are multiple choice; for samples of all the item types on this exam, see the sample items in the back of this guide. Some items are unscored, pretest items. The pretest items are embedded throughout the exam and are indistinguishable from the scored items. You will have two (2) hours to complete the examination. Your score will be reported as a letter grade.

UExcel Exam Resources

Excelsior College Bookstore

The Excelsior College Bookstore offers recommended textbooks and other resources to help you prepare for UExcel exams.

The bookstore is available online at: www.excelsior.edu/bookstore

UExcel Practice Exams

The official UExcel practice exams are highly recommended as part of your study plan. Once you register for your UExcel exam, you are eligible to purchase the corresponding practice exam, which can be taken using any computer with a supported Web browser. Each practice exam includes two forms that you may take within a 180-day period.
Excelsior College Library

Enrolled Excelsior College students can access millions of authoritative resources online through the Excelsior College Library. Created through our partnership with the Sheridan Libraries of The Johns Hopkins University, the library provides access to journal articles, books, websites, databases, reference services, and many other resources. Special library pages relate to the nursing degree exams and other selected exams. To access it, visit www.excelsior.edu/library (login is required).

Our library provides:

- 24/7 availability
- The world’s most current authoritative resources
- Help and support from staff librarians

Online Tutoring

Excelsior College offers online tutoring through SMARTTHINKING™ to connect with tutors who have been trained in a variety of academic subjects. To access SMARTTHINKING, go to www.excelsior.edu/smarthinking. Once there, you may download a copy of the SMARTTHINKING Student Handbook as a PDF.

MyExcelsior Community

MyExcelsior Community enables Excelsior College students and alumni to interact with their peers online. As members, students can participate in real-time chat groups, join online study groups, buy and sell used textbooks, and share Internet resources. Enrolled students have automatic access from their MyExcelsior page. Visit www.excelsior.edu/myexcelsiorcommunity.

Preparing for UExcel Exams

How Long Will It Take Me to Study?

A UExcel exam enables you to show that you’ve learned material comparable to one or more 15-week college-level courses. As an independent learner, you should study and review as much as you would for a college course. For a 3-credit course in a subject they don’t know, most students would be expected to study nine hours per week for 15 weeks, for a total of 135 hours.

Study Tips

Become an active user of the resource materials. Aim for understanding rather than memorization. The more active you are when you study, the more likely you will be to retain, understand, and apply the information.

The following techniques are generally considered to be active learning:

- **preview or survey** each chapter
- **highlight or underline text** you believe is important
- **write questions or comments** in the margins
- **practice re-stating content** in your own words
- **relate what you are reading** to the chapter title, section headings, and other organizing elements of the textbook
- **find ways to engage** your eyes, your ears, and your muscles, as well as your brain, in your studies
- **study with a partner or a small group** (if you are an enrolled student, search for partners on MyExcelsior Community)
- **prepare your review notes** as flashcards or create recordings that you can use while commuting or exercising

When you feel confident that you understand a content area, review what you have learned. Take a second look at the material to evaluate your understanding. If you have a study partner, the two of you can review by explaining the content to each other or writing test questions for each other to answer. Review questions from textbook chapters may be helpful for partner or individual study, as well.
Using UExcel Practice Exams

We recommend taking the first form of the practice exam when you begin studying, to see how much you already know. After taking the first practice exam, check your performance on each question and find out why your answer was right or wrong. This feedback will help you improve your knowledge of the subject and identify areas of weakness that you should address before taking the exam. Take the second form of the practice exam after you have finished studying. Analyze your results to identify the areas that you still need to review.

Although there is no guarantee, our research suggests that students who do well on the practice exams are more likely to pass the actual exam than those who do not do well (or do not take advantage of this opportunity).

About Test Preparation Services

Preparation for UExcel® exams and Excelsior College® Examinations, though based on independent study, is supported by Excelsior College with a comprehensive set of exam learning resources and services designed to help you succeed. These learning resources are prepared by Excelsior College so you can be assured that they are current and cover the content you are expected to master for the exams. These resources, and your desire to learn, are usually all that you will need to succeed.

There are test-preparation companies that will offer to help you study for our examinations. Some may imply a relationship with Excelsior College and/or make claims that their products and services are all that you need to prepare for our examinations.

Excelsior College is not affiliated with any test preparation firm and does not endorse the products or services of these companies. No test preparation vendor is authorized to provide admissions counseling or academic advising services, or to collect any payments, on behalf of Excelsior College. Excelsior College does not send authorized representatives to a student’s home nor does it review the materials provided by test preparation companies for content or compatibility with Excelsior College examinations.

To help you become a well-informed consumer, we suggest that before you make any purchase decision regarding study materials provided by organizations other than Excelsior College, you consider the points outlined on our website at www.excelsior.edu/testprep.

Preparing for This Exam

Prior Knowledge

No specific business knowledge is assumed for this exam. A strong understanding of business statistics and high school algebra are assumed.

Using the Content Outline

Each content area in the outline includes (1) the recommended minimum hours of study to devote to that content area and (2) the most important sections of the recommended resources for that area. These annotations are not intended to be comprehensive. You may need to refer to other chapters in the recommended textbooks. Chapter numbers and titles may differ in other editions.

This content outline contains examples of the types of information you should study. Although these examples are numerous, do not assume that everything on the exam will come from these examples. Conversely, do not expect that every detail you study will appear on the exam. Any exam is only a broad sample of all the questions that could be asked about the subject matter.

Using the Sample Questions and Rationales

Each content guide provides sample questions to illustrate those typically found on the exam. These questions are intended to give you an idea of the level of knowledge expected and the way questions are typically phrased. The sample questions do not sample the entire content of the exam and are not intended to serve as an entire practice test.
Recommended Resources for the UExcel Exam in Operations Management

The study materials listed below are recommended by Excelsior College as the most appropriate resources to help you study for the examination. For information on ordering from the Excelsior College Bookstore, see page 1 of this guide. You may also find resource materials in college libraries. Public libraries may have some of the textbooks or may be able to obtain them through an interlibrary loan program.

You should allow sufficient time to obtain resources and to study before taking the exam.

Textbooks

The following textbook was used by the examination development committee to verify all questions on the exam. These study materials may be purchased from the Excelsior College Bookstore.

www.excelsior.edu/bookstore


These study materials may be purchased from the Excelsior College Bookstore.

Open Educational Resources

The Saylor Foundation provides free, high quality courses through online, self-paced, free learning resources.

Saylor Foundation: Operations Management
http://www.saylor.org/course/bus300/

Reducing Textbook Costs

Many students know it is less expensive to buy a used textbook, and buying a previous edition is also an option. The Excelsior College bookstore includes a buyback feature and a used book marketplace, as well as the ability to rent digital versions of textbooks for as long as students need them. Students are encouraged to explore these and the many other opportunities available online to help defray textbook costs.
General Description of the Examination

The UExcel Operations Management examination is based on material typically taught in a one-semester, three-credit, lower-level course in operations management.

This examination measures knowledge of facts and terminology and understanding of concepts essential to designing, creating, managing, and improving supply chains and operations, and the ability to apply the concepts to typical business situations. The exam does not test spreadsheet skills.

Those beginning to study for this exam should have a strong understanding of business statistics and high-school level algebra, but no prior knowledge of business is required before beginning study for this exam.

Learning Outcomes

After you have successfully worked your way through the recommended study materials, you should be able to demonstrate the following learning outcomes:

1. Explain the strategic importance of deploying the basic functions of operations management in an effective manner.
2. Describe the role of operations management in organizations.
3. Demonstrate an understanding of how products, services, and facilities are designed.
4. Explain how a supply chain is created and managed.
5. Explain the various methodologies of planning, scheduling, and forecasting.
Content Outline

The content outline describes the various areas of the test, similar to the way a syllabus outlines a course. To fully prepare requires self-direction and discipline. Study involves careful reading, reflection, and systematic review.

The major content areas on the Operations Management examination, the percent of the examination, and the hours to devote to each content area are listed below.

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Percent of the Examination</th>
<th>Hours of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. The Operations and Supply Chain Environment</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>II. Designing and Improving Operations and Supply Chains</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>III. Creating and Managing the Supply Chain</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>IV. Planning and Control</td>
<td>25%</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Occasionally, examples will be listed for a content topic to help clarify that topic. However, the content of the examination is not limited to the specific examples given.

I. The Operations and Supply Chain Environment

25 PERCENT OF EXAM | 34 HOURS OF STUDY

Ch. 1, Introduction to Operations and Supply Chain Management

Ch. 1-S1, Operational Decision-Making Tools: Decision Analysis

Ch. 2, Quality Management

Ch. 3, Statistical Process Control

Ch. 3-S3, Operational Decision-Making Tools: Acceptance Sampling

Ch. 9, Project Management

A. Introduction to operations and supply chain management

1. Operations function
2. Evolution of operations and supply chain management
3. Globalization
4. Productivity and competitiveness
   a. Single-factor productivity
   b. Multi-factor productivity
   c. Total factor productivity
5. Strategy and operations
   a. Core competencies
   b. Order winners and qualifiers
   c. Positioning the firm
   d. Strategy deployment
      1) Policy deployment
      2) Balanced scorecard
6. Decision making framework
   a. Decision making under uncertainty
b. Decision making under risk
c. Decision trees

B. Management of quality
1. Defining quality
   a. Dimensions of product quality
   b. Dimensions of quality for services
2. Quality management systems
   a. Evolution of quality
   b. Quality gurus
      1) Shewhart
      2) Deming [not the 14 points]
      3) Other gurus
3. Quality tools
   a. Process flowcharts
   b. Cause-and-effect diagrams
   c. Checksheets and histograms
   d. Pareto analysis
   e. Scatter diagrams
   f. Process control charts
   g. Statistical quality control
4. Total quality management (TQM) and quality management systems (QMS)
5. Customers
6. Employees
   a. Kaizen
   b. Quality circles
   c. Process improvement teams
7. Quality and services
8. Six Sigma
   a. DPMO
   b. Six Sigma process
   c. DMAIC
   d. Black and Green Belts
   e. Design for Six Sigma
   f. Lean Six Sigma
   g. Profitability
9. Cost of quality
   a. Prevention, appraisal, internal failure and external failure costs
   b. Quality-cost relationship
10. The effect of quality management on productivity
11. Quality awards and standards
   a. Malcolm Baldrige Award
   b. ISO Standards

C. Monitoring and controlling quality
1. The basics of statistical process control
2. Control charts
   a. Control charts for attributes
      1) p-chart
      2) c-chart
   b. Control chart for variables
      1) Mean chart
      2) Range chart
   c. Control chart patterns
3. Process capability
   a. Measures

D. Project Management
1. Project planning
   a. Project return
   b. Project team
   c. Scope statement
   d. Work breakdown structure
   e. Responsibility assignment matrix
2. Global and diversity issues
3. Project scheduling
   a. Gantt charts
4. Project control
5. Critical path method (CPM)
   a. Network diagrams
      1) AOA network
      2) AON network
   b. Critical path
   c. Activity scheduling
II. Designing and Improving Operations and Supply Chains

25 PERCENT OF EXAM | 34 HOURS OF STUDY

Ch. 4, Product Design
Ch. 5, Service Design
Ch. 6, Processes and Technology
Ch. 7, Capacity and Facilities Design
Ch. 7-S7, Operational Decision-Making Tools: Facility Location Models

A. Product design
   1. The design process
   2. Rapid prototyping and concurrent design
      a. Form design
      b. Functional design
         1) Reliability
         2) Maintainability
         3) Usability
      c. Production design
   3. Technology
   4. Design quality reviews
      a. Failure mode and effects analysis (FMEA)
      b. Fault tree analysis (FTA)
      c. Value analysis (VA)
   5. Design for environment
      a. Green sourcing
      b. Green manufacture
      c. Recycling and reuse
   6. Quality function deployment (QFD)

B. Service design
   1. Service economy
   2. Characteristics of services
   3. Service design process
      a. Service process matrix
   4. Tools for service design
      a. Service blueprinting
      b. Front office activities
      c. Back office activities
      d. Servicescapes
   5. Waiting line analysis
      a. Elements
      b. Operating characteristics
      c. Cost relationship
      d. Psychology of waiting
      e. Waiting line models
         1) Single-server model
         2) Advanced single-server models

C. Processes and technology
   1. Process planning
      a. Outsourcing
      b. Process selection
      c. Breakeven analysis
      d. Process plans
   2. Process analysis
      a. Process flowcharts
   3. Process innovation
   4. Technology decisions

D. Capacity and facilities design
   1. Capacity planning
      a. Lead strategy
      b. Lag strategy
      c. Average strategy
      d. Economies and diseconomies of scale
   2. Facilities
   3. Basic layouts
      a. Process layout
      b. Product layout
      c. Fixed position layout

E. Facility location models
   1. Site selection
2. Global supply chain factors
3. Location analysis
   a. Location factor rating
   b. Center of gravity method
   c. Load distance technique
4. Designing process layouts
   a. Block diagramming
   b. Relationship diagramming
   c. Computerized layout solutions
5. Designing service layouts
6. Designing product layouts
   a. Line balancing
7. Hybrid layouts
   a. Cellular
   b. Flexible manufacturing systems
   c. Mixed-model assembly

III. Creating and Managing the Supply Chain

25 PERCENT OF EXAM | 34 HOURS OF STUDY

Ch. 10, Supply Chain Management Strategy and Design
Ch. 11, Global Supply Chain Procurement and Distribution
Ch. 13, Inventory Management
Ch. 16, Lean Systems

A. Supply chain strategy and design
1. Supply chains
2. Management of supply chains
   a. Supply chain uncertainty
   b. Bullwhip effect
   c. Risk pooling
   d. Green supply chains
3. Information technology
   a. e-business
   b. EDI
   c. Bar codes
   d. RFID
   e. BTO
   f. ERP
4. Supply chain integration
   a. CPFR
5. Measuring supply chain performance
   a. KPI
   b. SCOR

B. Global supply chain procurement and distribution
1. Procurement
   a. Selection of suppliers
   b. Outsourcing
   c. e-procurement
d. e-marketplaces
e. Reverse auctions
2. Distribution
   a. Postponement
   b. Warehouse management systems
c. Vendor managed inventory
d. Distribution outsourcing
3. Transportation
   a. Internet transportation exchanges
4. Global supply chain
   a. Obstacles
   b. Duties and tariffs
c. Landed cost
d. Recent trends in the supply chain
e. Reverse globalization
f. Effects of terrorism

C. Inventory management
1. Role of inventory in supply chain management
2. Elements of inventory management
   a. Demand
   b. Inventory costs
3. Inventory control systems
a. Continuous inventory systems  
b. Periodic inventory systems  
c. ABC classification system

4. Economic order quantity models  
a. EOQ model  
b. Quantity discounts

5. Reorder point  
a. Safety stocks  
b. Service levels  
c. Reorder point with variable demand

D. Lean systems  
1. Basic elements of lean production  
a. Flexible resources  
b. Cellular layouts  
c. Pull system  
d. Kanbans  
e. Small lots  
f. Quick setups  
g. Uniform production levels  
h. Quality at the source  
i. Visual control  
j. Kaizen  
k. Jidoka  
l. TPM  
m. Supplier networks

2. Benefits of lean production

3. Implementing lean  
a. Drawbacks of lean

4. Lean services  
a. Lean Six Sigma  
b. Value stream mapping

IV. Planning and Control

25 percent of exam  |  34 hours of study

Ch. 12, Forecasting
Ch. 14, Sales and Operations Planning
Ch. 15, Resource Planning
Ch. 17, Scheduling

A. Forecasting  
1. Strategic role  
a. Supply chain management  
b. Quality management  
2. Components of forecasting demand  
a. Time frame  
b. Demand behavior  
3. Forecasting methods

4. Forecasting process

5. Time series methods  
a. Moving average  
b. Weighted moving average  
c. Exponential smoothing  
d. Linear trend line  
e. Seasonal adjustments  
6. Forecast accuracy  
a. Mean absolute deviation  
b. MAPD  
c. Cumulative error  
d. Mean square error  
e. Forecast control

7. Regression methods  
a. Linear regression

B. Sales and operations planning  
1. Sales and operations planning process

2. Strategies for adjusting capacity  
a. Level production  
b. Chase demand  
c. Peak demand  
d. Overtime
e. Undertime
f. Subcontracting
g. Part-time workers
h. Backlogs, backordering, and lost sales

3. Strategies for managing demand
4. Quantitative techniques
   a. Pure strategies
   b. Mixed strategies
   c. Transportation method
5. Aggregate planning for services
   a. Revenue management

C. Resource planning
   1. Material requirements planning (MRP)
      a. When to use MRP
      b. Master production schedule
      c. Product structure file
      d. Time phased bills
      e. Item master file
      f. MRP process
      g. Lot sizing in MRP systems
      h. MRP outputs
   2. Capacity requirements planning (CRP)
   3. Enterprise resource planning (ERP)
   4. Customer relationship management
   5. Connectivity, integration, and services

D. Scheduling
   1. Objectives in scheduling
   2. Assignment
   3. Sequencing
      a. Sequencing through one process
      b. Sequencing through two serial processes
      c. Guidelines to selecting a sequencing rule
   4. Monitoring
      a. Gantt charts
      b. Input output control
6. Advanced planning and scheduling systems
7. Theory of constraints
8. Employee scheduling
Sample Questions

The sample questions give you an idea of the level of knowledge expected in the exam and how questions are typically phrased. They are not representative of the entire content of the exam and are not intended to serve as a practice test.

Rationales for the questions can be found on pages 15−17 of this guide. In that section, the correct answer is identified and each answer is explained. The number in parentheses at the beginning of each rationale refers to the corresponding section of the content outline. For any questions you answer incorrectly, return to that section of the content outline for further study.

1. How do job responsibilities of green belts differ from those of black belts?
   1) Green belts will lead more projects than black belts.
   2) Green belts are more highly trained than black belts.
   3) Green belts are part-time members of a project team.
   4) Green belts monitor, review, and mentor black belts.

2. What is the first step of the lean approach to process improvement?
   1) determining what creates value for the customer
   2) making the process responsive to customer needs
   3) removing waste along the value stream through process improvements
   4) identifying the sequence of activities that create value and eliminating those that do not add value

3. Consider the following workstations with their respective measurements for quality outcomes

<table>
<thead>
<tr>
<th>Workstation</th>
<th>Process Measurement</th>
<th>Control Chart</th>
<th>Population Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting</td>
<td>Length (in inches)</td>
<td>$\bar{X}$-chart and $R$-chart</td>
<td>20 inches</td>
</tr>
<tr>
<td>Grinding</td>
<td>Thickness (in inches)</td>
<td>$\bar{X}$-chart and $R$-chart</td>
<td>1.5 inches</td>
</tr>
<tr>
<td>Final Inspection</td>
<td>Proportion defective</td>
<td>$p$-chart</td>
<td>1.5% defective</td>
</tr>
<tr>
<td>Packaging</td>
<td>Defects</td>
<td>$c$-chart</td>
<td>0.5 defects</td>
</tr>
</tbody>
</table>

Which sample sizes would be appropriate? (Select the 3 that apply.)
1) sample size of 50 for the final inspection
2) sample size of 20 for the final inspection
3) sample size of 2 for the cutting operation
4) sample size of 5 for the grinding operation
5) sample size of 1 for the packaging operation
4. Base your answer to this question on the information below:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Normal Time (hours)</th>
<th>Crash Time (hours)</th>
<th>Normal Cost</th>
<th>Crash Cost</th>
<th>Total Allowable Crash Time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>$500</td>
<td>$500</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>2</td>
<td>$1,800</td>
<td>$2,800</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>$650</td>
<td>$850</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>$2,400</td>
<td>$3,200</td>
<td>1</td>
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<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>$1,200</td>
<td>$1,500</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>$425</td>
<td>$425</td>
<td>0</td>
</tr>
</tbody>
</table>

What is the maximum number of hours by which this project can be crashed?

1) 0  
2) 1  
3) 2  
4) 3

5. In a house of quality matrix, who makes the competitive assessment?

1) the engineer  
2) the manager  
3) the customer  
4) a competitor

6. Which production process is highest in volume and standardization?

1) project  
2) batch production  
3) mass production  
4) mass production

7. Which correctly describes the business climate in Mexico?

1) The wage rate in Mexico is half that of China.  
2) Trade regulations are being lowered in Mexico.  
3) Mexico is currently the largest exporter of goods to the United States.  
4) Quality management systems are similar to those in the United States.

8. Which is an effect of 9/11 on the global supply chains of American firms?

1) Lead time to deliver products has decreased.  
2) Documentation requirements have been reduced.  
3) Bills of lading are required to be written in French and English.  
4) Increased security measures have been put in place on US imports.

9. What will be the forecast for the month of October using a 3-period moving average and weights of 0.2, 0.3 and 0.5, if the demand during the months of May, June, July, August, and September was 200, 180, 210, 200, and 220 respectively?

1) 200  
2) 207  
3) 212  
4) 225

10. Which of the following seeks to minimize costs where the hiring and firing options are not included as a managerial option?

1) linear decision rule  
2) transportation method  
3) linear programming model  
4) chase demand
11. General Dynamics, Inc. uses a computer algorithm to identify a combination of labor and costs in order to develop a low-cost plan for the production of a battleship. This is most likely an example of which decision rule?
   1) linear decision rule
   2) search decision rule
   3) linear programming model
   4) transportation method

12. Which type of bill groups small, loose parts under one pseudo-item number?
   1) phantom
   2) K
   3) time-phased
   4) modular

13. Top Wheels Bike is a motor bike manufacturing company that can design motor bikes according to customer’s specifications. The following options are available:

   Sizes of engine: 3
   Number of colors: 8
   Number of front wheels: 4
   Number of headlights: 6

   How many modular bills of materials are available for Top Wheels Bike?
   1) 15
   2) 21
   3) 210
   4) 576
SECTION FOUR

Rationales

1. (IB8d)
   1) Green belts are project members, not project leaders.
   2) Green belts receive similar training as black belts, but the training is not as extensive.
   *3) Green belts are part-time project members who do not spend all of their time on projects.
   4) Master black belts monitor, review, and mentor black belts.

2. (IB8f)
   *1) Determining how the customer perceives value is the first step of the lean approach.
   2) Making the process responsive to customer needs is the fourth step.
   3) Removing waste along the value stream is the third step.
   4) Identifying the value stream is the second step.

3. (IC2c)
   1) Sample size of 50 is not suitable for use for the p-chart in this situation, since the population mean is only 1.5% defective. 1.5% of 50 is even less than 1 defective out of 50, and therefore the SPC analysis would not yield useful results.
   2) See 1).
   *3) Sample size of 2 is suitable for use in variable control charts.
   *4) See 3).
   *5) In using a c-chart, we would be simply counting the number of defects out of a sample size of 1 (i.e., from each end product).

4. (ID6)
   1) See 4).
   2) See 4).
   3) See 4).
   *4) The critical path is 1-2-6 for a total time of 7 hours. In order to crash the project, activity 1 on the critical path is the least expensive option, costing $600 to crash by one hour. Then activity 2 can be crashed by an hour at an additional cost of $500 per hour for a total of $1100 to crash both activities. At this point there are 2 critical paths, 1-2-6, and 1-4-6. In order to crash further, we therefore need to crash activity 2 by one hour and activity 4 by one hour. No more activities can possibly be crashed. Hence the total project can be crashed by a maximum of 3 hours.

5. (IIA6)
   1) In a house of quality, customers, not engineers, evaluate a firm’s product against that of its competitors.
   2) In a house of quality, customers, not managers, evaluate a firm’s product against that of its competitors.
   *3) In a house of quality, customers, not competitors, evaluate a firm’s product.
   4) In a house of quality, customers, not competitors, evaluate a firm’s product.

*correct answer
6.(IIC1b)
1) Projects are extremely low in volume and standardization. They produce one item at a time.
2) In batch production, products are typically made to order, volume is low, and demand fluctuates.
3) Mass production produces large volumes of a standard project for a mass market.
4) Continuous production is used for very high-volume commodity products and is highly automated.

7.(IIIB4d)
1) Mexican workers earn double what the Chinese make.
2) Trade regulations are increasingly being lowered in Mexico.
3) Mexico is the third largest exporter to the United States.
4) Mexican quality systems are far worse than American quality systems.

8.(IIIB4f)
1) Lead time has increased since 9/11.
2) Just the opposite is true.
3) The language of bills of lading has nothing to do with 9/11.
4) Security has been increased with more inspection of goods coming into the United States.

9.(IVA5b)
1) See 3).
2) See 3).
3) Weighted moving average =
4) See 3).

10.(IVB4c)
1) Linear decision rule is a mathematical technique used in aggregate planning that allows for hiring and firing workers.
2) An aggregate planning technique that uses linear programming to optimize the workforce and does not allow for hiring and firing of workers is referred to as the transportation method. This method seeks to minimize costs.
3) This is an optimizing approach that can be used to develop a plan that also considers hiring and firing options.
4) Using the chase demand strategy for aggregate planning matches the planned production with the demand. There is a lot of variability in the employment levels as they fluctuate up and down to meet customer demand.

11.(IVB4c)
1) Linear decision rule is a mathematical technique used in aggregate planning.
2) This involves a computer algorithm that will search for many possible realistic models to reduce costs.
3) This is an optimizing approach that can be used to develop a plan.
4) This method is a special case of linear programming that results in an optimal aggregate.

12.(IVC1c)
1) Phantom bills are used for transient subassemblies that never see a stockroom because they are immediately consumed in the next stage of manufacture.
2) K-bills group small, loose parts such as nuts and bolts together under one pseudo-item.
3) A time-phased bill is a graphic representation that shows the lead time required to purchase or manufacture an item.
4) Modular bills are used to reduce the number of bills of material that need to be processed by the MRP system.

*correct answer
13.(IVC1c)

1) See 2).

*2) Modular bill = Number of engine types +
    Number of colors + number of front wheels +
    Number of headlights  = 3 + 8 + 4 + 6 = 21.

3) See 2).

4) See 2).
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