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Operations Management

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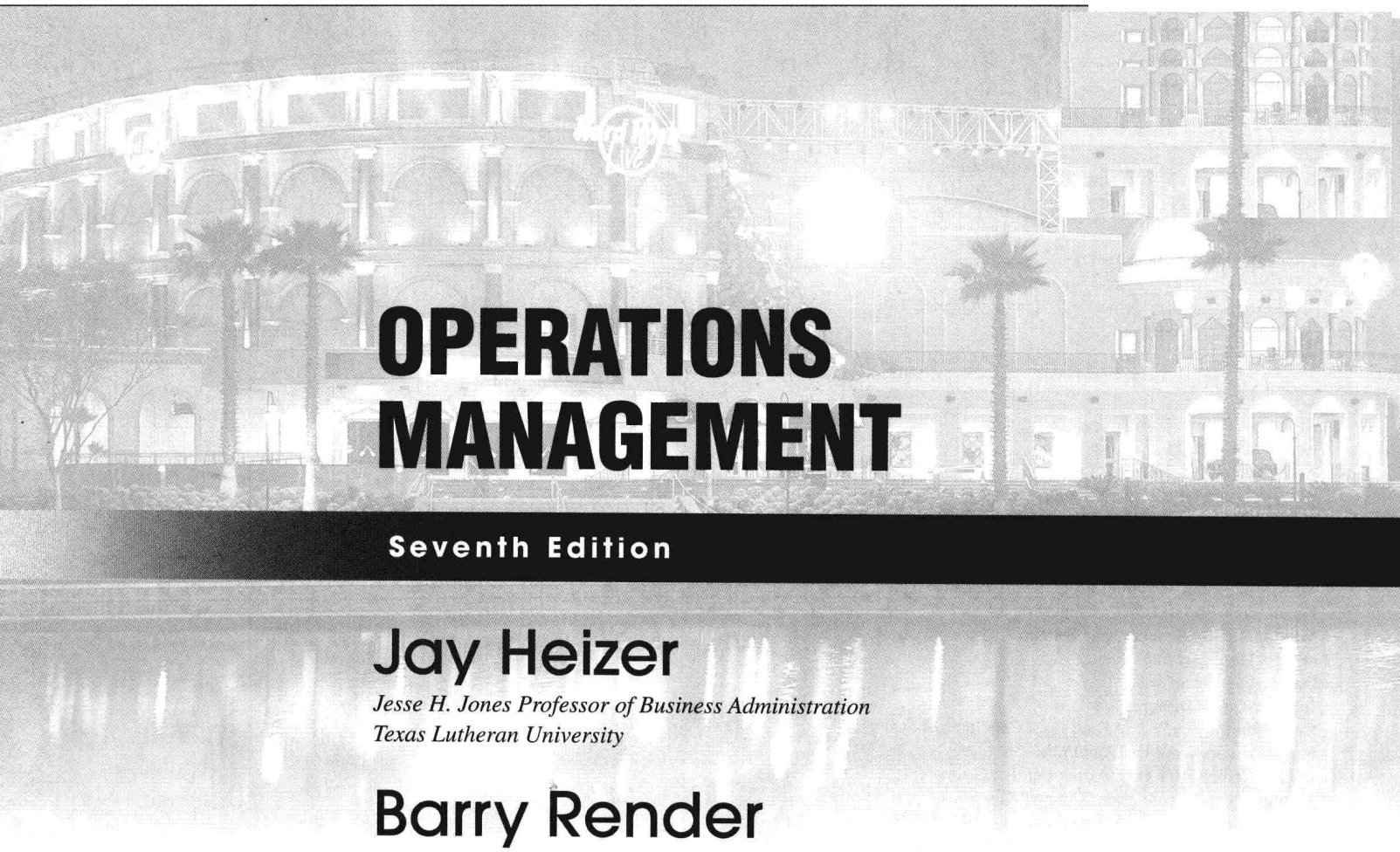

OPERATIONS MANAGEMENT

Seventh Edition

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We wish you a pleasant and productive introduction to operations management.

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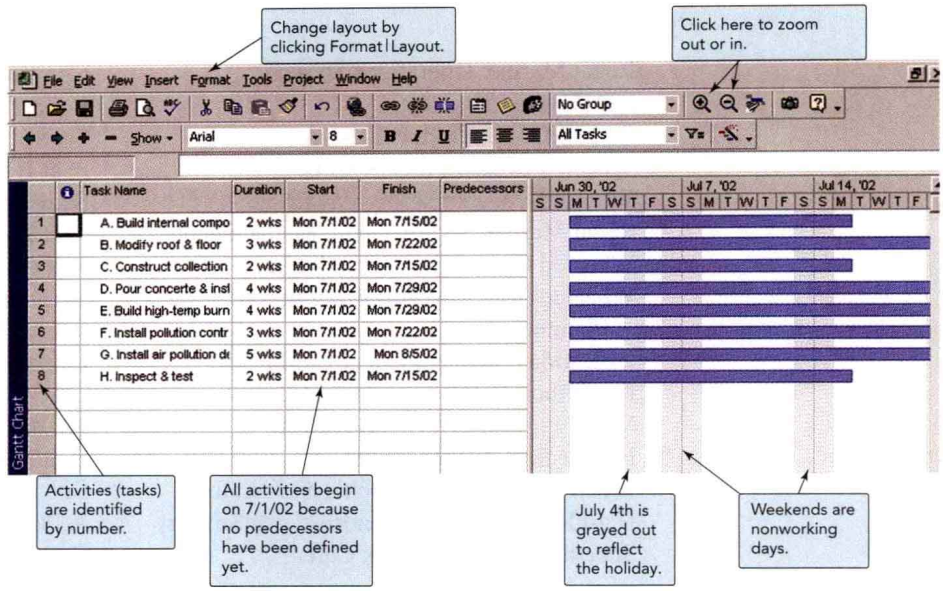

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FOR STUDENTS:

Online Quizzes These extensive quizzes contain a broad assortment of questions, 20–25 per chapter, which include multiple choice, true or false, and Internet essay questions. The quiz questions are graded and can be transmitted to the instructor for extra credit or serve as practice exams.

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GLOBAL COMPANY PROFILE:

Inventory Management Provides Competitive Advantage at Amazon.com

When Jeff Bezos opened his revolutionary business in 1995, Amazon.com was intended to be a "virtual" retailer—no inventory, no warehouses, no overhead—just a bunch of computers taking orders and authorizing others to fill them. Things clearly didn't work out that way. Now Amazon stocks millions of items of inventory, amid hundreds of thousands of bins on metal shelves, in warehouses around the country that have twice the floor space of the Empire State Building.

Precisely managing this massive inventory has forced Amazon into becoming a world-class leader in warehouse management and automation. This profile shows what goes on behind the scenes. When you place an order at Amazon.com, you are not only doing business with an Internet company, you are doing business with a company that obtains competitive advantage through inventory management.

Sources: *New York Times* (January 21, 2002): C-3; *Time* (December 27, 1999): 68–73; and the *Wall Street Journal* (November 22, 2002): A1, A6.

1. ***You order three items, and a computer in Seattle takes charge.*** *A computer assigns your order—a book, a game, and a digital camera—to one of Amazon's massive U.S. distribution centers, such as the 800,000 square foot facility in McDonough, Georgia.*
2. ***The "flow meister" in McDonough receives your order*** *(right). She determines which workers go where to fill your order.*

3. ***Rows of red lights show which products are ordered*** *(left). Workers move from bulb to bulb, retrieving an item from the shelf above and pressing a button that resets the light. This is known as a "pick-to-light" system. This system doubles the picking speed of manual operators and drops the error rate to nearly zero.*
4. ***Your items are put into crates on moving belts*** *(below). Each item goes into a large green crate that contains many customers' orders. When full, the crates ride a series of conveyor belts that winds more than 10 miles through the plant at a constant speed of 2.9 feet per second. The bar code on each item is scanned 15 times, by machines and by many of the 600 workers. The goal is to reduce errors to zero—returns are very expensive.*

- **OM in Action Boxes** Fifty-three half-page examples of recent OM practices are drawn from a wide variety of sources, including the *Wall Street Journal*, *New York Times*, *Fortune*, *Forbes*, and *Harvard Business Review*. These boxes bring OM to life.

OM IN ACTION

What the Marines Learned about Inventory from Wal-Mart

The U.S. Marine Corps knew it had inventory problems. A few years ago, when a soldier at Camp Pendleton, near San Diego, put in an order for a spare part, it took him a week to get it—from the other side of the base. Worse, the force had 207 computer systems worldwide. Called the "Rats' Nest" by marine techies, most systems didn't even talk to each other.

To execute a victory over uncontrolled supplies, the corps studied Wal-Mart, Caterpillar, Inc., and UPS. "We're in the middle of a revolution," says General Gary McKissock. McKissock aims to reduce inventory for the corps by half, saving $200 million, and to shift 2,000 marines from inventory detail to the battlefield.

By replacing inventory with information, the corps won't have to stockpile tons of supplies near the battlefield, like it did during the Gulf War, only to find it couldn't keep track of what was in containers. Then there was the marine policy requiring a 60-day supply of everything. McKissock figured out there was no need to overstock commodity items, like office supplies, that can be obtained anywhere. And with advice from the private sector, the marines have been upgrading warehouses, adding wireless scanners for real-time inventory placement and tracking. Now, if containers need to be sent into a war zone, they will have radio frequency transponders which, when scanned, will link to a database detailing what's inside.

Sources: *Business Week* (December 24, 2001): 24; and *Federal Computer Week* (December 11, 2000): 9.

Other student resources include Critical Thinking Exercises, Solved Problems, Marginal Notes and Definitions, and Solutions to Even-Numbered Problems in Appendix VI.

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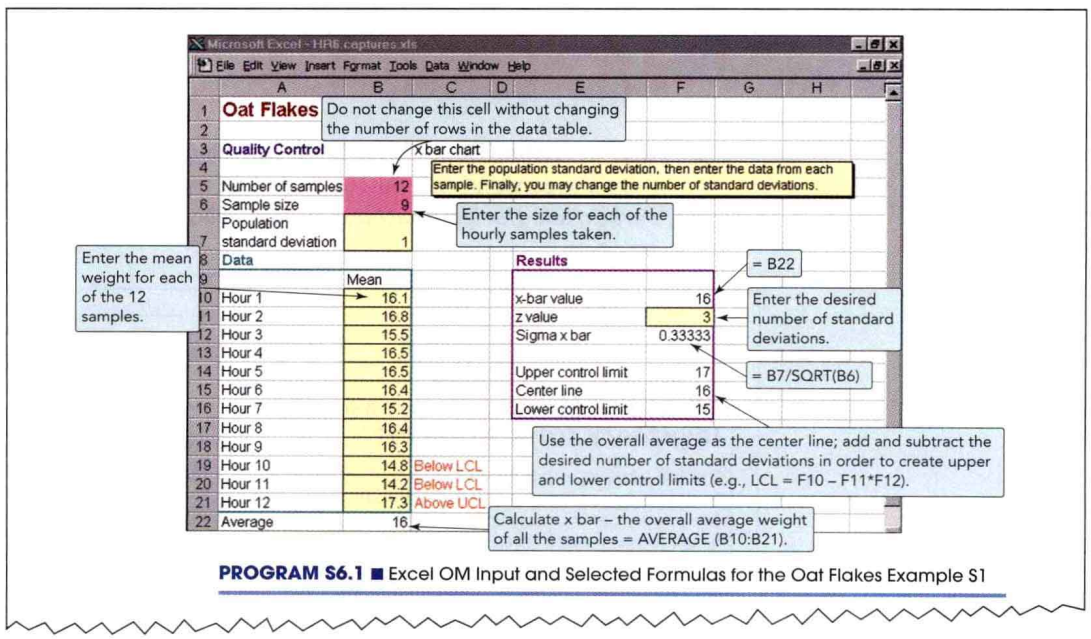
- **CD-ROM Video Clips** Another expanded feature on the student CD-ROM is twenty-nine 1- to 2-minute videos, which appear throughout the book and are noted in the margins. These video clips illustrate chapter-related topics with videos at Harley-Davidson, Ritz-Carlton, Hard Rock Cafe, and other firms.
- **Active Models** The 29 Active Models, described earlier, appear in files on the student CD-ROM. Samples of the Models appear in most text chapters.
- **PowerPoint Lecture Notes** Based on an extensive set of over 1,000 PowerPoint slides, these lecture notes provide reinforcement to the main points of each chapter and allow students to review chapter material.
- **Additional Practice Problems** Provide problem-solving experience. They supplement the examples and solved problems found in each chapter.
- **Self-Review Quizzes** For each chapter, a link is provided to our text Web site, where these quizzes allow students to test their understanding of each topic.
- **Problem-Solving Software** Excel OM is our exclusive user-friendly Excel add-in. Excel OM automatically creates worksheets to model and solve problems. Users select a topic from the pull-down menu, fill in the data, and then Excel will display and graph (where appropriate) the results. This software is great for student homework, "what if" analysis, or classroom demonstrations. Examples in the text that can be solved with Excel OM appear on the data file on the CD-ROM and are identified by an icon in the margin of the text.



PROGRAM S6.1 ■ Excel OM Input and Selected Formulas for the Oat Flakes Example S1

- **Microsoft Project 2002** MS Project, the most popular and powerful project management package, is now on the student CD-ROM. This version is documented in Chapter 3 and can be activated to work for 120 days.
- **Five Bonus Chapters** "Statistical Tools for Managers," "Acceptance Sampling," "The Simplex Method of Linear Programming," "The MODI and VAM Methods of Solving Transportation Problems," and "Vehicle Routing and Scheduling" are provided as additional material.

Chapter 13: Aggregate Planning The topic of yield management is now treated in detail, including a graphical presentation and examples. There are seven new homework problems, including several on aggregate planning in services and on yield management.

Chapter 14: Material Requirements Planning and ERP Enterprise Resource Planning (ERP) is now a major part of the MRP chapter. Some of this ERP material had been in the supplement to Chapter 7 in the previous edition, but the topic is treated in more depth in this edition. A new *OM in Action* box, "There is Nothing Easy About ERP," appears, as well as nine new homework problems, and the case study, "Ikon's Attempt at ERP."

Chapter 15: Short-Term Scheduling A new *OM in Action* box, "Banking and the Theory of Constraints," appears in this edition, along with six new homework problems and a video case study, "Scheduling at Hard Rock Cafe."

Chapter 16: Just-In-Time and Lean Production Systems This new chapter, expanded from the previous edition (where it was the supplement to Chapter 12), includes a *Global Company Profile* on Green Gear Cycling, new material on Kanban and reducing lot sizes, and two new *OM in Action* boxes: "Lean Production at Cessna Aircraft" and "Dell's Lean Production." There are also three new homework problems and a new case study of Toyota's JIT practices.

Chapter 17: Maintenance and Reliability We have added a new *OM in Action* box, "Tomcat F-14 Pilots Love Redundancy," and eight new homework problems.

Quantitative Module A: Decision-Making Tools There are six new homework problems and a new case study, "Ski Right Corp."

Quantitative Module B: Linear Programming There is a new focus on sensitivity analysis, by both the graphical approach and using Excel's Solver. There are also 12 new homework problems.

Quantitative Module C: Transportation Models We added five new homework problems to this module.

Quantitative Module D: Waiting-Line Models There are 10 new homework problems.

Quantitative Module E: Learning Curves We have added nine new homework problems.

Quantitative Module F: Simulation We have added a new *OM in Action* box, "Simulating Jackson Memorial Hospital's Operating Rooms," and nine new homework problems.

CD-ROM Tutorials Four mini chapters from the previous edition are unchanged, but a fifth topic is added. The tutorials are: Tutorial 1, Statistical Tools for Managers; Tutorial 2, Acceptance Sampling; Tutorial 3, The Simplex Method of Linear Programming; Tutorial 4, The MODI and VAM Methods of Solving Transportation Problems. The new CD-ROM Tutorial 5, Vehicle Routing and Scheduling, provides a complete treatment of this valuable topic, including algorithms, discussion questions, and homework problems.

TRADEMARK FEATURES

Our goal is to provide students with the finest pedagogical devices to help enhance learning and teaching.

- **Global Company Profiles** Each chapter opens with a two-page, full-color analysis of a leading global organization. These include Amazon, Volkswagen, Dell, NASA, Delta Airlines, McDonald's, Boeing, and many more.

Chapter 5: Design of Goods and Services Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and Virtual Reality Technology (all formerly in Chapter 7 supplement on Operations Technology) have been moved to Chapter 5. There are four new homework problems.

Chapter 6: Managing Quality ISO 9000 has been expanded, a new section on six sigma is included, and there are nine additional homework problems.

Supplement to Chapter 6: Statistical Process Control Process Capability (C_p) is a new topic, a useful table that helps decide which control chart to use (Figure S6.2) is added, and there are 19 new homework problems, including ones dealing with C_p, C_{pk}, and acceptance sampling. Alabama Airlines is a new case study using *p*-charts.

Chapter 7: Process Strategy Capacity Planning has been moved to a new supplement to Chapter 7 and material on Production Technologies (such as Process Control, Vision Systems, Robots, ASRS, AGV, FMS, and CIM) now appears in this chapter instead of the Operations Technology Supplement in the prior edition. There is a new *OM in Action* box on technology in the hotel industry and two new homework problems. The Rochester Manufacturing case, formerly in the Chapter 7 Supplement, now appears in Chapter 7.

Supplement to Chapter 7: Capacity Planning This new supplement places greater emphasis on the topic of capacity planning, which was covered as part of Chapter 7 in the previous edition. The treatment is expanded, with new examples, text, and numerous additional homework problems. Break-even analysis, decision trees, and strategy-driven investments are included in the supplement.

Chapter 8: Location Strategies There is increased emphasis on global issues affecting location decisions and on graphical information systems (GIS). A new *OM in Action* box looks at Alabama 10 years after it lured Mercedes to open a plant there. There are two new case studies: "Ambrose Distribution Center" and "Where to Place Hard Rock's Next Cafe," as well as eight new homework problems. The global factor rating homework problems that were in Chapter 3 in the previous edition are now in Chapter 8.

Chapter 9: Layout Strategy This chapter now includes the retail layout issue of slotting fees, has a new *OM in Action* box, "Shopping Mall Layout Meets the Internet," and four new homework problems.

Chapter 10: Human Resources and Job Design This chapter has four additional homework problems and two new case studies: "Karstadt vs. J.C. Penney" and "Hard Rock's Human Resource Strategy."

Supplement to Chapter 10: Work Measurement This supplement contains eight new homework problems and a new case study: "Jackson Manufacturing Company."

Chapter 11: Supply-Chain Management Major revisions in this chapter include topics on managing the supply chain, integrating the supply chain, the bullwhip effect, and the cost of shipping alternatives. There are three new homework problems (that deal with shipping alternatives) and a new case study, "Dell's Supply Chain and the Impact of E-Commerce." New *OM in Action* boxes deal with speeding roses to the U.S. market from Latin America, using radio frequency (RF) tags to keep the shelves stocked at Wal-Mart, and DHL's role in the global supply chain.

Supplement to Chapter 11: E-Commerce and Operations Management This supplement is updated with expanded material on the Internet, Internet trading exchanges, and Internet outsourcing. New *OM in Action* boxes are "The Face of Covisint's Online Exchange" and "Internet Keeps Burger King Manager in the Know." There are three new homework problems and a new case study, "E-Commerce at Amazon.com."

Chapter 12: Inventory Management A new *Global Company Profile* on Amazon.com opens the chapter and a new *OM in Action* box, "What the Marines Learned About Inventory from Wal-Mart," appears. The topic of fixed period inventory systems is expanded and there are 14 additional homework problems.

Expanded Homework Problem Sets One of the trademarks of our text has always been a large selection of examples, solved problems, and homework problems. For this edition, each chapter's homework set has been expanded, with scores of new problems. The result is 587 new, existing, and rewritten problems, giving us the largest, clearest, most diverse problem sets of any OM text. These problems focus on problem formulation and interpretation as well as calculation. Each problem is identified as belonging to one of three levels: introductory (one dot), moderate (two dots), and challenging (three dots). To make the transition to this edition seamless, all of the even-numbered problems from the previous edition are unchanged (and their answers appear in Appendix VI.) Plus, solutions to all of the problems appear in the Instructor's Solutions Manual, written by the authors themselves to ensure the quality and accuracy you've come to expect!

New Case Studies There are 55 cases studies, with 18 being new to this edition. The cases are generally one to two pages in length, making them short enough to cover in weekly assignments but detailed enough to add depth to each topic they represent. Forty of the cases focus on the service sector, such as Shouldice Hospital, IKON, Alabama Airlines, Ritz-Carlton, Mayo Clinic, Mutual Insurance of Iowa, and Hard Rock Cafe. In addition, our Web site, at **www.prenhall.com/heizer**, includes over 53 additional case studies. All are solved in the Instructor's Solutions Manual.

Harvard Case Study Links to Our Book Harvard Business School has selected this text as the model for its matching case study program, and has selected two to five cases to "match" to each of our 17 chapters. At the end of each chapter, we briefly describe each Harvard case and provide a link to the Harvard Web site for further details.

Internet Homework Problems In addition to the problems appearing in the text itself, there are now 165 homework problems on the text's Web site, all of which are included in the Instructor's Solutions Manual. These "new" problems are derived from the odd-numbered problems replaced in the previous edition, meaning that instructors who have favorite problems can still find them as Internet Homework Problems.

CHAPTER-BY-CHAPTER CHANGES

To highlight the extent of the revision of our previous edition, here are a few of the changes on a chapter-by-chapter basis. Active Model exercises appear in most chapters.

Chapter 1: Operations and Productivity Hard Rock Cafe is introduced in this chapter with a *Global Company Profile* and a video case study. There is another new case study, "Zychol Chemicals Corp.," and five new homework problems.

Chapter 2: Operations Strategy in a Global Environment Chapter 3 from the previous edition, *Operations in a Global Environment*, is now merged into the *Operations Strategy* chapter. Global issues and critical success factors dealing with location decisions are now in Chapter 8. A new video case study on Hard Rock's global strategy and that firm's strategy of experience differentiation are included.

Chapter 3: Project Management There are major changes to this chapter, which was Chapter 16 in the previous edition but has been moved forward to give the pervasive nature of project management added emphasis. Activity-on-node (AON) is now emphasized more than activity-on-arrow (AOA) and a hospital example of its use is followed throughout the chapter. A major section on Microsoft's Project 2002 software is new, with numerous MS Project screen captures and a version of the program loaded on the student CD-ROM. There is a new *Critical Thinking Exercise* that focuses on the Colorado Rockies baseball team stadium, nine new homework problems, including two on work breakdown structure (WBS), and two new case studies, including one dealing with how Hard Rock manages its annual Rockfest.

Chapter 4: Forecasting The chapter now includes coverage of Mean Absolute Percent Error (MAPE), has two new *OM in Action* boxes (including one on Disney's forecasting methods), 15 new homework problems, and two new case studies: "Analog Cell Phone, Inc." and "Forecasting at Hard Rock Cafe."

NEW TO THIS EDITION

Hard Rock Cafe Integration In this edition, we illustrate how operations management is put into practice at Hard Rock Cafe, one of the most widely recognized company names in the world. Hard Rock invited us to come in and shoot the "behind the scenes" operations functions of their organization, giving students a real inside look at such issues as global strategy, project management, forecasting, location, scheduling, human resources, and more. This modern and exciting corporation, emphasizing operations in a service environment, is featured throughout the text in examples, photos, video cases, and a Global Company Profile. A VHS tape is available to adopters which includes seven 5–7 minute segments of each topic. The student CD-ROM also contains 2-minute, abbreviated clips of these overall topics. This is the perfect way to integrate service application into the OM course.

VIDEO CASE STUDY

Where to Place Hard Rock's Next Cafe

Some people would say that Oliver Munday, Hard Rock's vice president for cafe development, has the best job in the world. Travel the world to pick a country for Hard Rock's next cafe, select a city, and find the ideal site. It's true that selecting a site involves lots of incognito walking around, visiting nice restaurants, and drinking in bars. But that is not where Mr. Munday's work begins, nor where it ends. At the front end, selecting the country and city first involves a great deal of research. At the back end, Munday not only picks the final site and negotiates the deal, but then works with architects and planners, and stays with the project through the opening and first year's sales.

Munday is currently looking heavily into global expansion in Europe, Latin America, and Asia. "We've got to look at political risk, currency, and social norms—how does our brand fit into the country," he says. Once the country is selected, Munday focuses on the region and city. His research checklist is extensive.

Site location now tends to focus on the tremendous resurgence of "city centers," where nightlife tends to concentrate. That's what Munday selected in Moscow and Bogota, although in both locations he chose to find a local partner and franchise the operation. In these two political environments, "Hard Rock wouldn't dream of operating by ourselves," says Munday. The location decision also is at least a 10-to-15-year commitment by Hard Rock, which employs tools such as break-even analysis to help decide whether to purchase land and build, or to remodel an existing facility.

Discussion Questions*

1. From Munday's checklist, select any other four categories, such as population (A1), hotels (B2), or nightclubs (E), and provide three subcategories that should be evaluated. (See item C1 (airport) for a guide.)
2. Why is site selection more than just evaluating the best nightclubs and restaurants in a city?

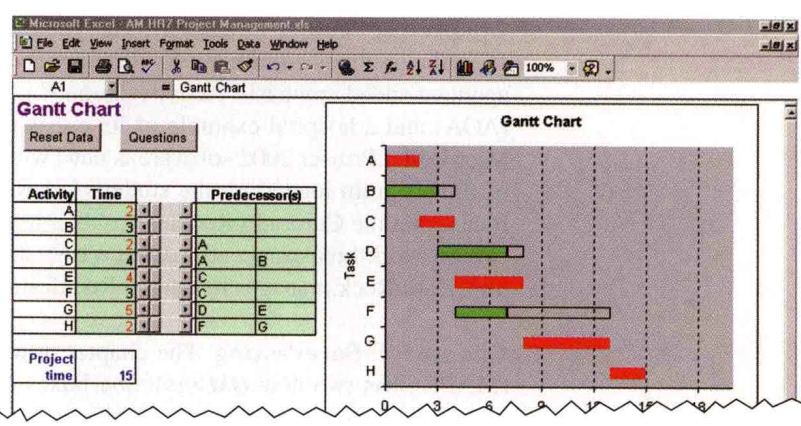
Active Model Exercises Active Model Exercises are interactive Excel spreadsheets of examples in the textbook that allow the student to explore and better understand these important quantitative concepts. Students and instructors can adjust inputs to the model and, in effect, answer a whole series of "what if" questions that is provided (e.g., What if one activity in a PERT network takes 3 days longer? Chapter 3. What if holding cost or demand in an inventory model doubles? Chapter 12. What if the exponential smoothing constant is 0.3 instead of 0.5? Chapter 4). These Active Models are great for classroom presentation and/or homework. Over 25 of these models are included on the student CD-ROM and many are featured in the text.

ACTIVE MODEL EXERCISE

Milwaukee General Hospital. This Active Model allows you to evaluate changes in important elements on the hospital network we saw in this chapter, using your CD-ROM. See Active Model 3.1.

ACTIVE MODEL 3.1 ■

Project Management



Preface

Welcome to your Operations Management (OM) course. In this book, we present a state-of-the-art view of the activities of the operations function. Operations is an exciting area of management that has a profound effect on the productivity of both manufacturing and services. Indeed, few activities have as much impact on the quality of our lives. The goal of this text is to present a broad introduction to the field of operations in a realistic, practical manner. Operations management includes a blend of topics from accounting, industrial engineering, management, management science, and statistics. Even if you are not planning on a career in the operations area, you will likely be interfacing with people who are. Therefore, having a solid understanding of the role of operations in an organization is of substantial benefit to you. This book will also help you understand how OM affects society and your life. Certainly, you will better understand what goes on behind the scenes when you buy a meal at Hard Rock Cafe, place an order through Amazon.com, or buy a customized Dell Computer over the Internet.

Although many of our readers are not OM majors, we know that marketing, finance, accounting, and MIS students will find the material both interesting and useful because we develop a fundamental working knowledge of the firm. Over 350,000 readers of our earlier editions seem to have endorsed this premise.

TWO VERSIONS ARE AVAILABLE

This text is available in two versions: *Operations Management*, Seventh Edition, which is hardcover, and *Principles of Operations Management*, Fifth Edition, a paperback. Both books include the identical core chapters 1–17. However, *Operations Management*, Seventh Edition also includes six quantitative modules in Part IV.