Hudson Jewelers (A)

"Welcome to Hudson Jewelers," the Naples, Florida jewelry store attendant said with a smile. "I'm Bill; let me know if I can answer any questions you may have." "I'm browsing with my fiancé," the customer responded. "Oh! So, you two are getting married. Congratulations! What's your name?" as Bill extends his hand to shake hands. "My name is Lilly and this is my husband to-be, Lester. "Well, if you need my help, please let me know," Mr. Hudson said as he walked behind the counter at about 1:30 pm. "Would you like a glass of wine while you browse?" Mr. Hudson asked. "No, thank you," as Lester noticed for the first time a small wine rack and comfortable leather chairs in the back corner of the store. Lilly and Lester continued looking at engagement rings, as Bill gave them space.

After about ten minutes, Lester asked Mr. Hudson, "I noticed your big high-definition television with that beautiful wedding ring rotating. What is this?" "It is a 3D software system that allows you to co-design your own ring. You can pick out the diamond(s) and mount them on any ring you want. Once the entire ring is finalized our manufacturer will produce it."

"Can we sit down and see how it works?" Lilly asked Mr. Hudson. The three of them began to design a prototype ring, with Mr. Hudson answering questions. Mr. Hudson and Lilly were beginning to establish a friendly relationship based on trust. All of the ring designs could be stored on the computer for future reference.

A diamond became a symbol of social status and wealth in India about 3,000 years ago. De Beers, a diamond mining and production company, began to market diamonds in the 1900s with slogans like "A diamond is a girl's best friend," and "A diamond is forever." De Beers's advertisements promoted the idea that those who do not buy diamond jewelry must not love their partners as much as those who do. One modern De Beers ad states, "She already knows you love her. Now everyone else will, too." A century of advertising and branding, and billons of dollars in industry advertisements, has made a diamond a symbol of "eternal love."

While Mr. Hudson and Lilly exchanged ideas about alternative ring designs, Lester

asked Mr. Hudson's daughter, Jasime, what was the time. "It's 3 pm," Jasime replied. "Whew! I need a break," Lester responded as he stood up from his chair. Everyone laughed at Lester's comment as the clock kept ticking. "OK, I'll hurry," Lilly said as she glanced at Lester. Lester walked around the store for a few minutes and then sat back down to reenter the "design your own ring" conversation.

By 4 pm everyone was exhausted after discussing an array of ring design questions, answers, and 'what ifs'. However, Lester and Mr. Hudson now had a much better idea of what Lilly wanted in an engagement ring. Jasime had been listening to the three-way discussion but decided not to join the conversation at this time. Two ring designs were stored on the computer. "I'll have my daughter Jasime work on these designs," Mr. Hudson said. "I am good with the software but my daughter is the CAD expert. She will call our diamond and ring dealers and make sure what we have designed can be manufactured at your target price," Mr. Hudson continued.

"Mr. Hudson," Lester asked as he was walking toward the door, "Is your inventory lower because of this custom design capability?" Mr. Hudson replied with a positive nod, "Yes, definitely. It is a high-risk business to stock lots of diamonds and jewelry at the store. With the 3D/CAD system, I think we do a better job of matching our physical inventory to customer needs and trends. We have less security, loan, and insurance risk using CAD. We also see new trends that our customers may want using CAD. And the customers seem to enjoy designing their own unique jewelry." Exhibit 1.1 provides example customer comments during one month.

As Lilly and Lester began to leave the store, thanking Mr. Hudson and Jasime for their help, Betty, Mr. Hudson's wife entered the store and was introduced. Hudson Jewelers was a true one-store, family business. Lilly and Lester crossed 5th Avenue to a restaurant and discussed their first computer-aided engagement ring design experience. Lilly was excited about the prospect of having a one-of-a-kind ring as they drank a glass of wine.

After three more visits to Hudson's Jewelers the final ring design was done with everyone's approval. Jasime and Mr. Hudson carefully went over every aspect of the ring design to assure agreement. For example, the CAD technology allowed Lilly and Lester to

see several alternative designs with gold or platinum prongs to hold a yellow diamond. Checks were written and the final ring design was electronically sent to the manufacturer.

One month later Hudson Jewelers called Lilly and Lester, and they went to the store to pick up their engagement ring. As they entered the store Betty and Bill Hudson and Jasime greeted Lilly and Lester by name. "Are you ready to see your ring?" Jasime asked in a joyful voice. "Yes, we are so excited," Lilly responded. Mr. Hudson asked Lester to come to the backroom safe. He unlocked the safe and gave the ring to Lester. "Can we put it in a box?" Lester asked. "Sure." Lester took the box and ring and walked into the storefront and gave Lilly the ring with a kiss on the cheek. Lilly opened the box and the ring sparkled under the high intensity lights of the store. "Oh! It is so perfect," Lilly said as she hugged Lester.

Mr. Hudson then said, "We have some presents for you," as he handed Lester a bottle of champagne and Lilly a small picture album that summarized how the ring was designed and manufactured step by step. It showed a 3D line drawing of the ring, a wax model of the ring that was used in production, the raw casting with platinum and gold prongs without the diamonds, and finally the completed ring from several viewpoints. The couple thanked everyone and walked across the street to their favorite restaurant to celebrate this memorable experience.

Hudson Jewelers is open from 10 am to 5 pm Monday through Saturday and closed Sunday. Two nights per week (usually Tuesday and Friday) they stay open until 8 pm. Also, customer appointments are made at any time the customer wants. Customer visits, as documented in Exhibit 1.2, are seasonal; the hot summer months being the lowest demand and the winter months the highest. Customers (called snowbirds) from northern countries or states move to the southern tip of Florida to avoid harsh winters. Snowbirds begin to arrive in October, followed by a pause during the holiday season of November and December. Peak season is January to April when the population of Lee and Collier counties almost doubles.

Mr. and Mrs. Hudson, their daughter Jasime, and sometimes her husband, Thomas Navey, work in the store. Mr. Hudson and Jasime Navey are the expert jewelers with Mrs. Hudson and her son-in-law filling in with friendly service but no particular jewelry expertise. Thomas Navey works full-time for the Collier County government. A typical staffing

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schedule for Tuesday is shown in Exhibit 1.3. The current store "staffing schedule" is based on two criteria. The first criterion is that either Bill or Jasime must be on duty at the store so an expert jeweler is always available for customers. Second, Hudson Jewelers is a family-owned business with no other hired staff.

Store inventory follows demand, with an average inventory in low season of $1 to $3 million, and in high season, $3 to $6 million. During some weeks in peak season jewelry inventory can peak at $15 to $20 million for short periods, due to customer special orders. Store display space is limited with the CAD system taking up floor space. Mr. Hudson would like to have more jewelry display space to show more moderate priced jewelry. Insurance rates are high and dependent on store security arrangements and inventory levels. The store has two fireproof safes bolted to the floor that weight over 8,000 pounds each. Security cameras are numerous and directly tied into a 24-hour security firm.

Computer-Aided Design

Since the 1970s, computer-aided design (CAD), computer-aided-engineering (CAE) and computer-aided-manufacturing (CAM) enable corporations to design and/or manufacture a wide variety of items such as industrial parts, buildings, furniture, airplanes, landscapes, and kitchens. Today, many firms have achieved complete integration of their design and production functions into what we now call computer-integrated systems. Designers can design, analyze, test, and simulate product design options before products physically exist, and then actually produce them, such as with Boeing's 777 Dreamliner airplanes. Also, 3D/CAD and 3D printing are expanding the frontier of designing parts almost instantaneously such as gears, toys, heart values, and even building materials.

Today CAD technology has made its way into the design of custom jewelry either on-line or in-the-store. The customer and/or in-store CAD expert go through a step-by-step computer led process to co-design the jewelry. For a diamond wedding ring, for example, the size, clarity, color, cut, price, and shape of the diamond are first selected; followed by choosing the setting, such as a single gold band of a certain thickness with matching prongs to hold the diamond. Once the virtually designed ring is created, it can be rotated to any angle and even placed on a virtual male or female hand. This ring design can be stored as

'design option 1', followed by other design options; and then portrayed side-by-side on the high-definition television screen. And of course, alternative ring designs can be e-mailed to friends and family worldwide. Once the ring design is finalized, the customer provides a deposit before Hudson Jewelers sends it to the manufacturer.

The Global Value Chain for Diamonds

A simple way to view the major stages of the diamond value chain is exploration, mining, rough diamonds, polished diamonds, and customer jewelry. It is normally 18 to 36 months from the time a diamond is mined until it reaches a retail store. Rare or large stones often reduce this processing time by one-half. The supply chain is global since no one country or company performs all the work required to bring a diamond to its final resting place – customer jewelry. About one-half of rough diamonds are used in industrial applications such as oil and gas drilling equipment and metal cutting tools. The major stages of the global value chain for diamonds can be defined in numerous ways but usually consists of the following stages.

Exploration

A diamond is a unique pyramidal structure of carbon atoms. Billions of years ago heat and pressure deep inside the earth created natural diamonds. The ancient Greek word for diamond means "unbreakable." Historically, much of the diamond industry involves African countries and sometimes the exploitation of native people. Russia and Africa account for 70 percent of the world's diamond reserves.

Major corporations that focus on diamond mining, production, and sales include DeBeers, with about 37% market share. *DeBeers* is a Kimberley, South Africa based corporation with mines and facilities in South Africa, Tanzania, Botswana, and Namibia. *ALROSA* is a Russian state-owned corporation with about 30% market share, and with mines and facilities in Russia and Angola. *Rio Tinto* is an Australian corporation that mines diamonds, iron, copper, uranium, aluminum, gold, and coal, with about a 5% global market share in diamonds. Its mines and facilities are in Australia, Zimbabwe, Africa, and Canada. Other firms such as *Aber*, *BHP Billiton*, and *Leviev* compete in the diamond industry.

Mining

The two major ways to mine rough diamonds are an open-pit method, where rock and soil at the surface are excavated; and underground mining. First-level sorting is done at this stage, to separate gem-quality stones from obvious industrial grade stones.

The controversies begin at this stage of the diamond value chain. The 2006 movie *Blood Diamond*, for example, starring Leonardo DiCaprio, Jennifer Connelly, and Djimon Hounsou, highlighted militant groups and corrupt governments trying to get their share of "blood diamond" revenues to fund revolutions and wars. Conflict-free diamonds are supposed to be free of other injustices such as child labor, smuggling, worker exploitation, and sexual violence. And, of course, ethical supply chains try to prevent all of the previous cited issues, plus worker accidents, environmental pollution, deceitful grading of diamonds, deforestation, poverty, low wages, and so on.

Sorting and Grading

The basic criteria for grading diamonds include size (carats), color, shape, and quality. At this stage second-level sorting and grading begins at separate locations from the mines. About 20-25 percent of rough diamonds are used in the retail value chain while the rest are used for industrial proposes. Human eyes, hands, and expertise assess the quality and value of most diamonds. Advanced machines do some of the sorting and grading process for smaller stones. But sorting and grading diamonds is not an exact science even with current industry regulations and quality standards.

Cutting and Polishing Centers

The Four C's – Cut, Color, Clarity, and Carat weight – are used to further classify diamonds at a production facility, located in cities like Dubai, New York, Johannesburg, Hong Kong, London, Tel Aviv, Antwerp, and Mumbai. Diamond defects and errors can take many forms in this industry: impurities, optical flaws, mixed colors, crystal flaws, cutting mistakes, and non-ethical diamonds. The cutter must decide how best to cut the rough diamond to remove defects, keep the most carat weight possible, and make the diamond as perfect as possible.

Normally, by the end of this stage one-half to two-thirds of the rough diamond is waste. For example, a ten-carat rough diamond might result in a three- to five-carat diamond

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that can be set in customer jewelry. Much of the waste is used in industrial diamond applications or by the cutters themselves for cutting and polishing.

During the Great Recession smaller diamond cutters and polishers went out of business while larger firms gained market share. Cutting and polishing costs-per-carat range from about $100 in Antwerp, New York, and Tel Aviv; to $10 to $50 in India, China, and Thailand. The quality of a rough diamond can be enhanced or hindered by the way the rough diamond is cut and polished. High-quality rough diamonds of over 20 carats almost always go to the world's best cutters and polishers.

Trading Centers

A current industry trend is the consolidation of cutting and polishing with trading centers into a "diamond hub" in cities like New York, Tel Aviv, Antwerp, Dubai, and Mumbai. Major producers like DeBeers sell most of their diamonds based on long-term contracts to a select group of buyers and sellers. Long-term contracts provide price and demand stability, predictable buyers and sellers, and large sales volumes. Trading centers and producers are sometimes accused of forming price-controlled cartels by holding back diamond stocks (reserves) to maintain retail prices. Another way to limit supply in the global diamond market is for major producers to sell diamonds only to their "site holders." A site holder can be a company or individual who can only buy direct from major producers. If all reserves of diamonds were released, supply would greatly exceed demand, and diamond prices would plummet.

However, new sales channels are emerging that take advantage of Internet capabilities such as on line auctions and virtual sales platforms. Sales take many forms such as face-to-face negotiations, take-it-or-leave it on line offers at fixed prices, live on line auctions with multiple bidding rounds, and time limited on line auctions. In addition, physical diamond auctions take place at Sotheby's and Christie's.

Jewelry Manufacturing

Manufacturing transforms cut, polished, and graded diamonds into customer jewelry. Often a custom setting for the stones includes pouring hot metal into a ring or jewelry mold; and/or metal machine fabrication, milling, and polishing. Standard diamond ring production

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exhibits both job and flow shop characteristics while custom jewelry is a job shop. Diamond defects can be hidden by the clever design of customer jewelry. Here the jewelry artist or customer designs how the finished diamond will be displayed. Over $50 billion in value is added at the jewelry manufacturing and retail store stages.

Retailing

In the diamond value chain, Tiffany & Company and Cartier are two examples of luxury goods retailers that enjoy high margins. The price per carat (value) of a typical diamond usually increases eight to ten times from mining to retail store as each stage of the value chain adds its profit margin. After the original sale, most diamonds don't wear out so they are resold (recycled) many times within the value chain. The "diamond is forever" slogan also applies to generating repeat sale profits.

To further complicate customer- and trading-center buying decisions, diamond buyers must cope with whether the diamond is synthetic. In one audit by the International Gemological Institute with a sample of 1,000 stones over one-half were found to be synthetic diamonds. Moreover, the synthetic diamonds had human-engineered flaws to make them appear as natural stones. Only expert gemologists with special equipment can tell the difference between a natural and synthetic stone.

From the viewpoint of natural diamond producers, synthetic diamond pollution is an ever-increasing industry problem. A four-carat synthetic diamond might sell for a few hundred dollars. In addition, synthetic diamond producers argue their diamonds are brighter and clearer than natural stones, and the only true ethical diamonds.

The Kimberley Process Certification Scheme (KPCS)

A multitude of industry-related associations, governments, and corporations have adopted quality and sustainability standards, trade regulations and laws, and certification programs to ensure no conflict or blood diamonds enter their value chain. But diamond traceability along the value chain is very poor. Few diamond producers or retailers actually investigate the route their diamonds take along the supply chain. Diamond smugglers and corrupt governments often certify diamonds without complete investigations while worker exploitation and environmental pollution continues.

In 2003 in Kimberly, South Africa the KPCS was designed to certify rough diamond shipments as "conflict-free" and prevent conflict diamonds from entering the value chain. This initiative has been somewhat successful but fake KPCS certification documents have been found throughout the value chain. A recent initiative is to etch a serial number on each non-conflict diamond with a laser that is not visible to the human eye. The KPCS process is criticized for focusing on front-room customer perceptions, not back-room supply chain practices.

Note: The instructor must assign the case question(s) below depending on what topics you have covered, what the instructor wants to emphasize, and whether the questions are for individual or team assignments or a capstone course project.

Case Discussion Questions and Chapter

I. <u>Chapter 1: Operations Management and Value Chains</u>

1. Use one of the three value chain frameworks discussed in this chapter to characterize the diamond value chain. How does this value chain gain a customer? How does it create value? How does it keep a customer?

2. Research what major diamond producers are doing regarding social, environment, and financial sustainability practices. Visit corporate annual reports, for example. Provide two or three examples.

3. Write a short two-page paper on "blood diamonds" and/or "ethical diamonds." Define each and explain the positives and negatives for this social sustainability issue. What should be the role of diamond producers? What is the role of operations managers in this industry?

<u>Chapter 2: Measuring Performance in Value Chains</u>

1. What is the value of a loyal customer for a billionaire who frequents Hudson Jewelers every February given the following information? She buys jewelry for her extended family every other year when they visit Naples. Assume the following:

    Customer retention rate – 80%
    Contribution Margin = 0.55
    Price per purchase = $200,000

<u>Chapter 3: Operations Strategy</u>

1. Define and draw the customer benefit package and state Hudson Jewelers' strategy; rank order its competitive priorities, order qualifiers, and order winners; and state the ways they gain competitive advantage.

2. Evaluate a customer's retail store experience in terms of search, experience, and credence attributes. Provide some examples and explain why they can be classified as search, experience, and credence attributes.

3. Define in detail the attributes of "value" when buying and co-designing a $50,000

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wedding ring. What creates a buying experience that would delight the customer?

Chapter 4: Technology and Operations Management

1. **What are the advantages and disadvantages from the service provider's (jeweler's) perspective of using "design your own ring" 3D/CAD technology at the retail store level? What are the risks from the customer's viewpoint?**

2. **Research jewelry retail store software programs and summarize their capabilities in terms of customer relationship management, accounting, point of sale, inventory management, payment systems, and customer loyalty programs. Provide references.**

Chapter 5: Goods and Service Design

1. **Hudson Jeweler's current layout design includes the CAD system and television screen in the front room of the jewelry store. Walk-in customers enjoy seeing jewelry designs rotate on the television screen. Customers have little privacy as they co-design and discuss their custom-designed jewelry in the front room. Other customers in the store can listen to the conversation, and sometimes stand right behind them. Evaluate the following three-store design and layout remodeling options by answering questions (a) to (c). See the case study for break-even details.**

(I) Keep the Current Layout

Fixed Cost = $5,000 based on CAD square footage to total store square footage.

Variable Cost = $0.20 cents per customer visit ($2,620/year divided by 13,104 visits/year) to update CAD software, insurance, maintenance, and employee CAD training.

(II) Move Current CAD into a Single New Private Design Room

Fixed Cost = $12,000 to build a new CAD design room inside store and move current CAD system to the new room and furnish.

Variable Cost = $0.24 cents per visit ($3,145/13,104) to update CAD software, insurance, maintenance, and employee CAD training, and room stero speaker and music, fire sprinkler maintenance, and lighting in the design room.

Option II frees up 49 square feet of store space for one additional front room jewelry display case but decreases the space for comfortable leather chairs by one-half, so there would be space for only one chair plus the wine rack. Fourteen square feet of extra display space

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would be available in the store. Based on last year's revenue, each square foot of jewelry display space generated $30,090.

(III) Do Option II Plus Build a Second CAD Design Room & Buy a Second CAD System

Fixed Cost = $27,000 to build two new CAD design rooms inside the store and move current CAD system into one new room, and buy a second new CAD system and install in the second room.

Variable Cost = $0.38 cents per visit ($4,980/13,104) to update two CAD software, insurance, maintenance, and employee CAD training, and two room stero speakers and music, two fire sprinklers maintenance, and lighting in the two design rooms.

Option III frees up 49 square feet of store space for one additional front room jewelry display case but eliminates the space for the wine rack or any comfortable leather chair(s). The space currently dedicated to the wine rack and two leather chairs plus the CAD system, desk, and chair located in the front room is now two private CAD design rooms.

(a) Use economic analysis to evaluate these three options.

(b) What are the economic and non-economic advantages and disadvantages of each of the three options?

(c) What is your final recommendation to Mr. Hudson? Justify. Explain.

2. **Define (a) the servicescape for Hudson Jewelers using the three dimensions as subheadings, and (b) the nature of Hudson Jewelers' service encounters.**

3. **Propose a "service guarantee" for Hudson Jewelers. What exactly will you guarantee? Should it be explicit in writing or simply an implicit, non-written guarantee, or is it better not to do it at all? Explain and justify your logic.**

Chapter 6: Supply Chain Decisions

1. **Explain whether the global diamond supply chain a push or pull system, and whether the global diamond supply chain is an efficient or responsive system for make-to-order and make-to-stock jewelry. Provide examples to justify your reasoning.**

2. **Research the extent of vertical integration in the global (seven-stage) diamond supply chain? Provide examples of forward and backward integration and the extent to which this is practiced in today's value chain? In this industry, what is the impact of vertical integration?**

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Chapter 7: Process Selection, Design, and Analysis

1. Research the parts of the diamond value chain and then answer the following question: How would you describe the type of process used for (a) exploration, (b) diamond mining, (c) sorting and grading, (d) cutting and polishing centers, (e) trading centers, (f) jewelry manufacturing, and (g) retail stores? You might want to use the terminology of the product-process matrix and service positioning matrix, for example.

2. Given the simplified process work activities shown in Case Exhibit 1.4, draw the process flowchart, and then answer the following questions. You must allocate the work content in Case Exhibit 1.4 to manufacturing, CAD, service, front room, and back room to gain insights into where and how this work is accomplished.

    a. For this process, what is the total time in minutes (or equivalent fraction of a day) to create one woman's codesigned wedding ring?
    b. For this process, what is the total manufacturing time in minutes (or equivalent fraction of a day) to create one woman's codesigned wedding ring?
    c. For this process, what is the total CAD time in minutes (or equivalent fraction of a day) to create one woman's codesigned wedding ring?
    d. For this process, what is the total service (other than CAD) time in minutes (or equivalent fraction of a day) to create one woman's codesigned wedding ring?
    e. For this process, what are the total front room and back room times in minutes (or equivalent fraction of a day) to create one woman's c-designed wedding ring?
    f. What insights do you gain by evaluating the work content of this process and answering questions (a) to (e)?
    g. What is the maximum number of customers per hour that can be served for Activity B (CAD Demo & Jewelry Concept) if two employees are in the store? Assume each employee works at 100% utilization.

3. Write a job description for a new employee at this store.

4. Assume that during Lilly's and Lester's last visit to the retail store everything was as described in the case, except the final bill was not ready and Mr. Bill Hudson had lost some of the paperwork documenting the price of the ring and diamonds. After a 45-minute wait, Lilly and Lester had figured out a final bill. What is the impact of this "billing service upset" at the end of the customer's buying experience? Is billing a primary or peripheral process?

5. Design an ideal diamond-ring customer experience from beginning to end (i.e., make a list of 10 to 20 steps in the job and process design). Explain what must happen and what must not happen.

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Chapter 8: Facility and Work Design

1. **Design and draw the layout for your high-end jewelry store. Critique its strengths and weaknesses. (Make use of concepts in Chapters 4, 5, 7 and 8.)**

Chapter 9: Forecasting and Demand Planning

1. **Given the seasonal nature of demand at Hudson Jewelers depicted in Case Exhibit 1.2, how would you forecast future demand for customer visits? What criteria will you use to determine a "good" forecast? What methods would you use, and why? What is your final recommendation with respect to a forecasting method?**

Chapter 10: Capacity Management

1. **Explain how capacity is measured at the following stages of the diamond value chain: (a) mining, (b) cutting and polishing, (c) jewelry manufacturing for custom and standard jewelry, and (d) the retail store?   (There can be multiple measures so make sure you define the unit of measure.)**

Chapter 11: Managing Inventories

1. **Research global supply and demand for diamonds and how it affects prices. What role do "diamond reserves" (inventory) play in determining prices? Explain. What do you think the demand-supply curves for diamonds looks like? Try to sketch it out.**

2. **What are the detailed components of inventory holding costs in this situation? What other factors might influence holding costs, such as security costs, obsolescence costs, and others. What is your estimate of inventory carrying costs as a percentage of item value? Explain your reasoning.**

Chapter 12: Supply Chain Management and Logistics

1. **Research short- and long-term risks in the global diamond supply chains and write a short paper (maximum of 3 pages) defining what these risks are and how they are mitigated by major diamond producing corporations.**

2. **Obtain the annual report of a major diamond producer such as DeBeers, ALROSA, Rio Tinto, BHP Billiton, and perform a cash-to-cash conversion cycle analysis of their business. What did you find out? Explain. Implications?**

Chapter 13: Resource Management

1. **Customer demand at Hudson Jewelers (i.e., customer visits) is highly seasonal, as case Exhibit 1.2 illustrates. In the context of aggregate planning options (Section 13-2 and Exhibit 13.2), what types of decisions concerning resources does this service business have to make? Write a short paper of no more than two typed pages on these issues.**

Chapter 14: Operations Scheduling and Sequencing

1. **Develop a staff schedule like case Exhibit 1.3 for *ONLY Tuesday during peak demand* (*i.e. week 8 in case Exhibit 1.2*). Assume the *maximum* service standard (rate) is *ten customers per hour per store employee*. (You will have to allocate Tuesday's demand over the day and time periods) What are the advantages and disadvantages of your store-staffing schedule? Would you hire non-family employees to staff this single store? Justify.**

Chapter 15: Quality Management

1. **What "cost of quality" criteria (i.e., prevention, appraisal, internal failure, and external failure costs) might be included in an analysis at the following stages of a global diamond supply chain---mining, cutting and polishing centers, and retail jewelry store? Explain. Provide examples.**

Chapter 16: Quality Control and SPC

1. **Research and acquire the criteria for diamond appraisals and critique these criteria in terms of objectivity, measurement, and overall accuracy. Are diamond quality criteria as specific and measureable as for manufactured parts? Explain.**

2. **Develop a p-chart for the diamond blemish and inclusion data found in case Exhibit 1.5 documenting the quality of the diamonds on "clarity and defects" coming from two different diamond mines (suppliers) – one in Asia and one in Africa. What do you conclude?**

Chapter 17: Lean Operating Systems

1. **Write a short paper (maximum of two pages) on how the four principles of lean operating systems are applied to diamond mining.**

2. **If you were to design a jewelry store based only upon the four principles of lean operating systems - elimination of waste, increased speed and response, improved quality, and reduced cost - what would it look like? Incorporate OM concepts and methods used throughout this textbook, such as mission and strategy, competitive priorities, process type, service guarantees, supply chain, and so on as appropriate, into your discussion.**

Chapter 18: Project Management

1. **The exhibit below shows the project work activities for designing custom jewelry using computer aided design (CAD). Draw the network diagram and determine the project completion time, critical path(s), activity slack times, and a Gantt chart for the project. Summarize you insights. What is missing from the activity time estimates?**

Activity	Immediate Predecessors	Activity Times (Days)
START		
CO-DESIGN		
A. Conceptualize Design	-	3
B. Deposit Made	-	2
C. CAD Program	A	2
D. CAM Process	A	2
PAYMENT		
E. Payment Balance	B	3
MANUFACTURING		
F. Lost-Wax Casting Process	C,D	6
G. Finishing By Hand	D,E	2
H. Final Polish	G	2
DELIVER		
I. Quality Control & Inspection	F	3
J. Packaging	I	2
K. End Costumer Delivery	H,J	1

Exhibit 1.1 Example Hudson Jewelers Customer Comments (Source: store comment cards)

No one has a ring like our custom-designed wedding rings. Thanks so much!
I thought it was too risky to design our rings on-line by ourselves with no expert knowledge, so that is why I bought from Hudson Jewelers. Mr. Hudson's daughter, Jasime, is great with this software, and she helped us through several improvement cycles until we got the design "perfect."
The Hudson's work with you on price. You set a target price and they will help you discover designs that match that price. And they can help you finance the ring(s). Thank you.
Mr. Hudson and his family are friendly and let you set the pace. They don't rush you. And they know the jewelry business inside and out. They called diamond dealers in New York and London on our behalf to check on prices and cuts.
Although I bought from you, I forgot to ask if your store only sells certified non-conflict diamonds. I hope so.
I was disappointed with the paperwork your store provided me on my new wedding ring appraisal. There was no conflict-free certification and when I asked you said "No, none came with the diamonds."
The high definition 3D pictures are stunning and bring the ring to life.
When Jasime took a picture of my left hand and then put our ring on my hand virtually, I was sold. She changed colors (gold or platinum) and diamond pin locations virtually on that high definition TV so I could see what I liked best. Wow!
Bill was rather shocked when I ask him, "Have you ever sold a blood diamond?" His answer was "Not to my knowledge."
We co-designed the ring that fit my personality perfectly. Stunning and unique forever!

Exhibit 1.2 Hudson Jewelers Customer Visit Counts (Demand)

Week	No. Visits	Week	No. Visits	Week	No. Visits
1 (January)	171*	19	211	37	103
2	268	20	143	38 (Oct)	114
3	467	21	108	39	148
4	490	22 (June)	80	40	194
5	564	23	57	41	165
6 (February)	479	24	91	42	228
7	445	25	63	43 (Nov)	239
8	587	26 (July)	97	44	279
9	576	27	86	45	314
10 (March)	524	28	57	46	342
11	547	29	68	47	251
12	462	30 (August)	51	48 (Dec)	211
13	456	31	74	49	325
14 (April)	422	32	51	50	291
15	450	33	103	51	262
16	393	34 (Sept)	108	52	97*
17	342	35	91		
18 (May)	291	36	68		

*Limited store hours

Total Customer Visits = 13,104
Average/Week Visits = 252.0
Maximum Visits = 587
Minimum Visits = 51
Standard Deviation = 169.7

Exhibit 1.3 Hudson Jewelers Tuesday Store Staff Schedule+

Staffing	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	Totals
Bill Hudson			Start	-------	-------	-------	-------	-------	-------	(Lunch	Lunch)	-------	-------	
Jasime Navey								Start	-------	-------	-------	(Lunch	Lunch)	
Betty Hudson										Start	-------	-------	-------	
Thomas Navey														
Possible Staff A														
Possible Staff B														
Current Staff Minutes	0	0	30	30	30	30	60	60	60	60	60	60	60	540
Current # Staff	0	0	1	1	1	1	2	2	2	2	2	2	2	18
Customer Visits	0	0	2	4	6	8	8	6	7	9	11	11	6	78
Target # Staff											2.2*			
Short/Excess (-/+)											-0.2			

Staffing	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30	8:00	Totals	Grand Total
Bill Hudson	-------	-------	-------	End								
Jasime Navey	-------	-------	-------	-------	-------	-------	-------	-------	-------	End		
Betty Hudson	-------	-------	-------	End								
Thomas Navey					Start	-------	-------	-------	-------	End		
Possible Staff A												
Possible Staff B												
Current Staff Minutes	90	90	90	90	60	60	60	60	60	60	720	1260
Current # Staff	2	3	3	3	2	2	2	2	2	2	23	41
Customer Visits	3	3	4	4	5	6	7	6	4	2	44	122
Target # Staff												
Short/Excess (-/+)												

+An Excel model of all case exhibits accompanies the case and can be provided by the instructor.

*Using Equation 7.2 Utilization = Demand Rate/[Service Rate*Number Servers) or assume 100% = 11/[5*N] or N = 2.2 employees

Exhibit 1.4 Hudson Jewelry Simplified Process Work Activities and Flowchart

Activity	Predecessor		Fraction of a Work Day%*	Total Minutes*
A	none	Customer 1st Store Visit	0.025	12
B	A	CAD Demo & Jewelry Concept	0.04	19.2
C	B	3 Co-Design Jewelry Sessions^	0.36	172.8
D	B	Price Quote and Discussion	0.03	14.4
E	C, D	CAD Jewelry Design Approval	0.08	38.4
F	E	Partial Payment	0.02	9.6
G	F	Release Final Jewelry Order	0.025	12
H	G	Stone (Wholesale) Jeweler	0.2	96
I	G	Wax Jewelry Mold	0.3	144
J	I	Metal Pouring & Polishing	0.25	120
K	H, J	Final Production Completed	0.25	120
L	K	Delivery - Customer Pickup	0.04	19.2
M	L	Final Payment	0.02	9.6
N	M	Celebration (Wine, Toast, etc)	0.05	24
		Total	1.69	811.2

^Assumes 3 co-design improvement cycles (3 times 0.12).
*Assumes a 480 minute work day (i.e., 0.025*480 = 12 minutes).
%The 480 minute workday is computed from 420(4/6) +600(2/6) =
         480 average minutes/day.

Exhibit 1.5 Blemish and Inclusion Count Data for p-chart for Asia versus Africa Suppliers*

Sample Number	Asia Supplier	African Supplier
1	33	22
2	24	36
3	30	19
4	40	32
5	27	23
6	36	20
7	21	26
8	29	35
9	33	25
10	41	30
11	38	33
12	22	22
13	44	26
14	29	34
15	30	31
16	28	24
17	23	23
18	29	27
19	39	32
20	20	19

*The sample size for each sample is 50 diamonds in the 1.0 to 1.5 carat range.