

### **Operations Sample Proficiency Examination**

The core operations management (OM) course at Stern aims to provide student with the necessary vocabulary and skills for diagnosing and solving problems related to operations. Due to the strong and inevitable ties of OM with other business disciplines, the course fosters an inter-disciplinary problem solving approach. The student taking the proficiency examination is expected to demonstrate such skills. These skills are also necessary to take full advantage of the several popular electives offered by the department.

The topics covered in the examination include: operations strategy, characteristics of manufacturing and service operations, process charting and analysis, process benchmarking, process costing, scheduling and allocation of resources, service system design including waiting line management, quality management, inventory management, and just in time principles.

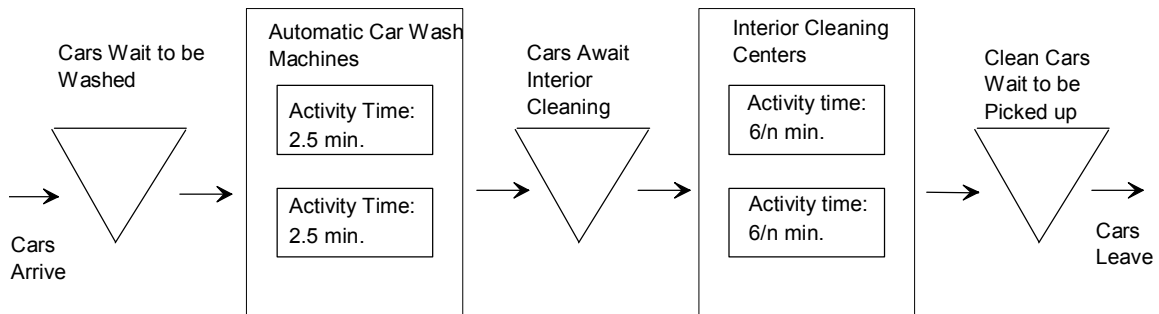
The format of the examination will change from time to time. The sample questions that are given below exemplify the type of analysis that we expect the students to be able to carry out after completing the course. The *actual* questions might differ with regard to technical and analytical difficulty. The students who wish to take this examination should in addition obtain a copy of the syllabus from the web.

#### Texts:

1. *"Managing Business Process Flows"* by Anupindi et als. Second Edition, Prentice Hall, 1999.
2. *"The Goal"*, by E.M. Goldratt and Jeff Cox, second edition, North River Press, 1992 .
3. *"Production and Operations Management: Manufacturing and Services, Eighth Edition"*, by Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs, Irwin-McGrawHill.

## Sample questions and answers

1. Consider the process flow chart of a car wash given below. Answer questions 1-2 based on this flow chart. There are two car wash machines working in parallel in the first workcenter and two interior cleaning centers (ICC) working in parallel in the second workcenter. The activity time at a cleaning center depends on the number (n) of workers in the center.



Note:  $n$  = number of workers in each Interior Cleaning Center, where  $1 \leq n \leq 3$ .  
So for example, if  $n=2$ , then activity time =  $6/2 = 3$  mins.

(i) Calculate the theoretical capacity for each workcenter and for the entire process if, (a) 1, (b) 2, and (c) 3 persons are assigned to each of the ICCs.

(ii) Compute the theoretical flow time for the system if, (a) 1, (b) 2, and (c) 3 persons are assigned to each of the ICCs.

2. Consider the following process diagram for making orders of one dozen cookies (activity times per dozen cookies and the labor content of each step are indicated below each step):

	<b>Mix &amp; Spoon -&gt;</b>	<b>Load &amp; Bake -&gt;</b>	<b>Cool -&gt;</b>	<b>Box -&gt; Pay</b>
Activity time:	8 min.	10 min.	5 min.	2 min. 1 min.
Labor Content	8 min.	1 min.	0 min.	2 min. 1 min.

Draw a Gantt chart depicting the flow of the first two orders, if orders arrive every 12 minutes. Can one person manage this operation given that orders come every 12 minutes?

4. Which of the following (there may be more than one) tend to be characteristics of line flow or continuous production processes:

- High volumes of production per product
- Large variety of products produced
- Customization of the product for each customer
- Standardization
- High automation
- Low volumes of production per product

5. Is the flow time of a system equal to the inverse of the system's capacity? Explain.
6. In a queuing system with 2 servers, will the average waiting time for a customer in a queue be the same under both First In First Out (FIFO) and Last In First Out (LIFO) rules? Explain.
7. The queuing formula,  $\lambda/\mu$  represents which performance measure of a queuing system?
8. A Deli experiences a demand of 40 customers per hour. It takes 4 minutes (on the average) to serve a customer. The Deli owner wishes that a majority (95%) of customers should be served (i.e., the time spent in the Deli) within 24 minutes. Compute the hourly cost of staffing if the wage rate is \$12 per hour.
9. Under a periodic review system, the average demand is 10 units per week, the leadtime is one week, the time between reviews is 4 weeks, the safety stock is 20 units, and the stock on hand is 15 units. What should be the order quantity?
10. Under a continuous review system, the weekly demand is normally distributed with mean of 100 and standard deviation of 50. The leadtime is 2 weeks. What should the inventory position be to trigger an order if the leadtime service level desired is 98%? ( $z=2.055$ )
11. List four problems that can be hidden by excess inventory.
12. What is the appropriate sequence (which should come first, which second, etc.) for using the following quality improvement tools: Pareto Analysis, Brainstorming, and Statistical Process Control. Explain briefly your choice of sequence.
13. Lancom has only one plant in the US. and the plant is located in New Jersey. Currently Lancom ships products to 2200 stores all over the US from a centralized warehouse located in Piscataway, NJ. They are evaluating the decision of opening branch warehouses in California and North Carolina. The central warehouse will continue to operate even when there are branch warehouses. What will be the probable effect (increase, decrease, or remain the same) of opening the branch warehouses on: (i) transportation cost and (ii) total inventory held by Lancom (i.e., total of inventory at warehouses) if the service level to the customer remains the same after opening the branch warehouses. Explain your answers.
14. List three reasons why it is extremely difficult to move to the "ideal" pull one at a time Kanban system for production.
15. Why does Crosby say "Quality is Free"?

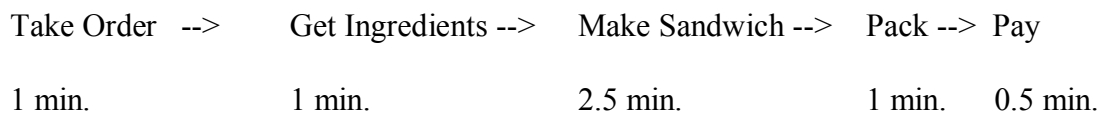
16. How can ABC analysis be used to deduce whether a firm is practicing good inventory management practices based on the data given below:

Item	Annual Sales (\$)	Average Inventory (\$)
1.	200	120
2.	6,000	600
3.	20,000	2,000
4.	350	127
5.	600	400
6.	125	75
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Total	27,275	3,322

17. A firm's annual sales are \$10,000,000 and its average work-in-progress inventory value is \$2.35 million. What can you infer about their delivery time?

Caselet

18. OMISGRT, the famous deli owned by Grace, operates close to a famous university in lower Manhattan. The sandwich counter is currently staffed with one person, and operates three hours from 11:00 AM to 2:00 PM, Monday through Friday. When the university is open, the counter serves on the average 24 persons each day. One of the key ingredients used to make sandwiches is Original American Cheese (OAC). Grace observes while watching the customers come to the Deli that the OAC stock is quite low. She recalls that a previous diner/consultant has established the daily consumption of OAC was normally distributed with a mean of 2 lbs and standard deviation of 0.4 lbs. She then observes the person making sandwiches and draws the following process chart:



All this work is being done by the same person. Grace makes a mental note that making the sandwich can be speeded up by 0.5 minute, by installing a cheese slicing machine, and cutting the slices before the Deli opens. The machine will cost \$200, but would probably be worth the money.

You wander into the Deli with your freshly acquired skills in Operations Consulting. After an intense 10 minutes of conversation with Grace you discover:

1. OAC is ordered every 15 days, and there is a stock of 4 lbs of cheese left in the Deli. It takes one day to deliver the cheese after it has been ordered.



\_\_ Standardization  
\_\_ High automation

5. Not unless it is a single server (machine) system with deterministic inter-arrival and service times.
6. Yes, because the order of service does not affect the average waiting time unless pre-emption is allowed or the server is allowed to idle when there are customers waiting to be served.
7. The average number of busy servers
8. \$48 per hour.
9. 55 units.
10. 345.31.
11. Unreliable supplier, unreliable equipment, unbalanced line, high setup time.
12. Pareto analysis, brainstorming, and statistical process control.
13. Transportation cost may decrease. Total (combined) inventory at warehouses may increase.
14. Large set up time, unreliable machines, unreliable suppliers.
15. Prevention costs remain constant with increasing fraction of defective items.
16. Inventory should roughly be proportional to the square root of the dollar amount of sale (given no other information). The data indicates otherwise.
17. Their delivery time is approximately equal to 3.8 months.