

MODULE : **SUPPLY CHAIN OPERATIONS MANAGEMENT: A
BUSINESS PROCESS APPROACH**

CODE : **BML9X03**

DATE : **JANUARY 2018 SUPPLEMENTARY EXAM**

DURATION : **08:30 – 12:30**

TOTAL MARKS : **80 Marks**

EXAMINER : **PROF S GUPTA**

MODERATOR : **PROF BADENHORST-WEISS**

NUMBER OF PAGES : **13 PAGES**

INSTRUCTIONS TO CANDIDATES:

- Answer all questions
- Question papers must be handed in.
- This is an open book assessment.
- Read the questions carefully and answer only what is asked.
- Number your answers clearly.
- Write neatly and legibly.
- Structure your answers by using appropriate headings and sub headings.

The general University of Johannesburg policies, procedures and rules pertaining to written assessments apply to this assessment.

General Instructions

This exam is open book / readings, open class handouts and open class notes. Portable computers and/or calculators may be used. However, no form of communication, electronic or otherwise, is permitted during the exam. This includes web access, email or use of cell phones.

If you use your laptop or any software to do the calculations, please make sure to summarize your logic, steps taken to answer the questions, and your answers, in the appropriate space provided in the exam booklet. . **Supporting work must be shown in a clear and logical manner for credit to be given.** Maximum points possible are indicated below for each question.

NAME (print): (sign):.....

My signature attests that I have taken this exam in accordance with the University of Johannesburg Honor Code.

YOU HAVE A MAXIMUM OF THREE HOURS TO DO THIS EXAM.

Q. No.	Maximum Points	Points Scored
1.	20	
2.	20	
3.	20	
4.	20	
Total	80	

1. Read the paragraphs below and answer questions given at the end. (20 points total)

Caterpillar Inc. recently told its steel suppliers that it will more than double its purchases of the metal this year—even if the company's own sales don't rise one iota. In fact, the heavy-equipment maker has been boosting orders to suppliers for everything from big tires and hydraulic tubes to shatterproof glass.

How is that possible? Chalk it up to the "bullwhip effect," which is reverberating across the U.S. economy. This phenomenon occurs when companies significantly cut or add inventories. Economists call it a bullwhip because even small increases in demand can cause a big snap in the need for parts and materials further down the supply chain. The bullwhip has broad implications now as companies rush to fill orders while also restocking warehouse shelves. It touches everyone from retailers to the industrial companies that supply the grease, bolts and coal needed to churn out more products. The manner in which companies, large and small, respond to market shifts determines which ones emerge first from the slump and start growing again.

Most forecasters expect the Commerce Department on Friday will report that the U.S. economy grew at an inflation-adjusted annual rate of better than 5% in the fourth quarter, the fastest pace since 2003. Economists estimate that the bulk of the growth came not because consumers were buying more, but because businesses stopped reducing inventories and, therefore, had to produce more of what they sold. "The inventory burn-off is over," says Caterpillar CEO Jim Owens, a Ph.D. economist who has run the world's largest manufacturer of construction and mining machines since 2004. Caterpillar, which many investors see poised to benefit from the nascent global recovery, is likely to talk about its bullwhip preparations when it reports fourth-quarter results Wednesday.

Going forward, a big question is how well suppliers are positioned to ramp up production. Bottlenecks and other headaches may occur as spot shortages cause unexpected price hikes and hamper companies' ability to meet demand. That's why Caterpillar took the unusual step late last year of visiting with key suppliers to ensure they had the resources to quickly boost output. In extreme cases, the equipment maker is helping suppliers get financing. Caterpillar says that even if demand for its equipment is flat this year—an unlikely projection it calls its "Great Recession scenario"—it would still need to boost production in its factories by 10% to 15%, just to restock dealer inventories and meet ongoing customer demand.

Meanwhile, output at Caterpillar's suppliers would have to rise 30% to 40% in this scenario, because Caterpillar would also be refilling its shelves. Executives at Caterpillar, though, are betting on growth. In that case, demand for parts will jump even more. If Caterpillar increases its production 15%, says Mr. Owens, "many of our suppliers would more than double their shipments" to us. A surge in orders is certainly good news for businesses hungry for work, especially at a time when the revival of economic growth has yet to translate into more jobs. The unemployment rate remains above 10%. Indeed, economists have been revising upward their projections for fourth-quarter growth in gross domestic product in recent weeks, with much of the extra growth attributed to companies' rebuilding inventories or trimming them at a slower rate. During the financial crisis, companies slashed \$207 billion worth of inventory, helping businesses conserve cash to weather the economic storm. The swing of the pendulum became visible in October, when total business inventories grew by \$4.1 billion—the first month of growth since

August of 2008, shortly before the collapse of Lehman Brothers sent global credit markets into a tailspin....

But inventory bullwhips can become too much of a good thing, especially in today's unusual economic environment. That's because the recession created lingering problems that could hamper the ability of suppliers to respond to a sudden jump in orders. Many are smaller companies hurt by the credit crunch as they continue to have difficulty obtaining loans. A flow of new orders to suppliers could encourage banks to start lending to them more freely. But if that doesn't happen quickly, there could be bottlenecks and shortages as suppliers miss shipments or turn away orders because they can't afford to buy the materials or hire more workers to do the job. Prices could spike.

Inventory swings also inspire less confidence than actual demand growth. Some business leaders are likely to fear the uptick will fade once inventories are restored, so they put off adding workers or making other investments until they are certain underlying demand is growing. "This is not going to go smoothly," predicts William Strauss, senior economist at the Federal Reserve Bank of Chicago. "I'd be very surprised if everyone could grow at the rate they desired."...

To smooth the way, Caterpillar this month unveiled a program that allows suppliers to borrow money from a bank, against their receivables, at a favorable interest rate. This means they can tap the loan funds within five days of delivery of goods to Caterpillar—as opposed to a typical 60-day wait. Mechanical Devices Co. is already feeling the crack of the whip. The small factory in Bloomington, Ill., supplies Caterpillar with metal parts. It struggled through last year, shedding about 100 of its 275 workers and scrounging for other clients to keep its machines running. Workers unscrewed most of the factory's exterior lights to save money. "But now it's as if we flipped overnight," says Linda Fillingham, a spokeswoman for the family-owned business, founded by her grandfather in 1914. Orders from Caterpillar have grown 19% in a matter of weeks, she says, albeit from a very low base, with orders set to increase even more in March and April...

The story is much the same at Morton Industries LLC, in Morton, Ill. The company, which supplies Caterpillar with metal tubing for engines and hydraulic systems, filed for Chapter 11 bankruptcy protection in 2008 and was purchased by a local investment group this past June. Morton expects orders from Caterpillar to grow 25% in the first quarter, compared to the last quarter of 2009, and has started hiring...

Caterpillar has turned more pro-active in other ways. The company has promised to stick by "freeze periods" as it transitions to growth: For a three-month span after it places an order, it promises not to change it. The freeze periods will give suppliers greater ability to plan ahead and persuade banks to increase their financing, since there's no chance of the business suddenly falling away again during that three-month span. Once the freeze ends, Caterpillar will be free to increase or decrease what it buys. Caterpillar is also changing how it sells its products. The company offers a dizzying array of features, and until now, that complexity often led to delays in delivering machines to customers. Customers love the variety, but were often frustrated by delivery delays. Mr. Wunning, the group president, says Caterpillar is replacing this with a "lane strategy." The first "lane" is made up of machines that contain the most commonly requested features and typically will be kept in stock by dealers and at Caterpillar staging facilities around the country. At the other extreme is lane four, custom machines that take six months or more to build and deliver.

Q. 1(b): Describe the steps taken by Caterpillar to ensure suppliers' readiness for meeting higher expected demand. Explain how each step would help reduce (or worsen) the adverse impact of bullwhip effect on the supply chain. Limit your answer to no more than 1 page. (10 points)

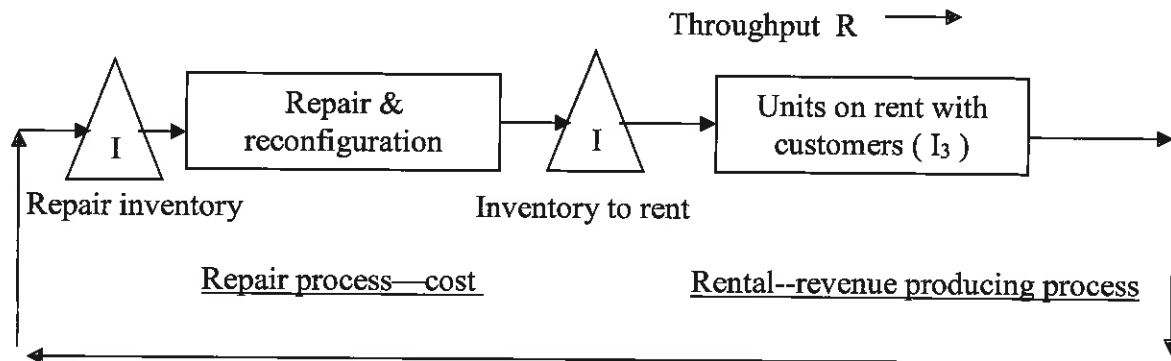
2. In 2003 a management buy-out of ASP Distributors South Africa took place creating Digital Logistics (Pty) Ltd. (a.k.a. Digistics). With an aggressive growth plan, the company pursued new opportunities and secured a contract with KFC in December 2003. This was the first phase of a significant growth period which took the company from 40 to over 400 employees in 3 years. Today they have over 1000 employees and are still privately held.

Digistics now operates seven distribution centres in Johannesburg, Cape Town, Port Elizabeth and Durban and has become the leading player in multi-temperature food distribution operations in ZA. Digistics is strategically placed in the Quick Service Restaurant (QSR) industry and provides an array of service delivery options to its customers. Digistics manages virtually all food distribution for KFC and McDonald's in ZA and has over 30 restaurant chains as customers as well as many more individual restaurants. The QSR sector has seen massive growth over the last few years, and with it, growing pains for Digistics.

In early 2013 Digistics opened a massive new refrigerated warehouse in the Cornubia Industrial and Business Estate outside Durban. Although it is the latest design, it has never lived up to senior management's expectations on virtually any performance metric. The first two managing directors were major disappointments and were released. Last month Digistics' owners transferred Ankia Prinsloo, one of Digistics most experienced distribution center managers, to become the third managing director of the centre in less than three years. Ankia brings a huge amount of experience and energy to the job and is optimistic that she will get the results management expects within six months by applying principles and practices from the Toyota Production System (TPS). Ankia has hired you as a consultant for six months to develop and implement TPS improvements.

In the space provided only, name and describe the TPS methods/techniques that you think hold the most promise for the centre. Then describe in detail how these techniques should be implemented and the results you would expect to see within six months. **(20 points total)**

3. Fast Computer is in the computer rental business. It maintains computers in its “Inventory to Rent” buffer. Customer requests for rentals are satisfied by providing computers from this buffer. Rental durations vary but average about 8 weeks. After the rental period is over, computers are returned to Fast. Fast inspects the computers returned and performs repair & reconfiguration on each unit received. Upon completion of repair and reconfiguration, computers are available to be rented again. A simplified flow chart of the process is depicted below. Additional data for Fast follows the flow chart. (20 points total)



Fast Computer rental base case data	
Rental Revenue	= \$400,000 per week
Rent/unit/week	= \$40
Average rental time	= 8 weeks
Inventory to rent (I_2)	= 20% of units rented
Depreciation/unit/week	= \$15
Profit/week	= \$60,000
Asset value/unit	= \$800
Yearly profit to asset ratio	= 25% (assume 50 weeks/year)

- a) On average how many computers are on rent with the customers (I_3) at any given time? (5 points)

- b) What is the throughput (R) of rented computers per week; That is, on average how many computers are being rented each week? (5 points)
- c) Assume that the only assets in the process are the three inventories: I_1 repair inventory; I_2 inventory to rent, and I_3 units on rent. What is the total dollar value of all assets employed? (5 points)
- d) How many computers are in the repair inventory I_1 ? (Hint: first estimate the total computers Fast owns) (5 points)

4. The primary road route between Springbok, South Africa and Grunau, Namibia crosses the Orange River at the Vioolsdrif (ZA) and Noordoewer (NA) border control stations. This crossing is heavily used by truck traffic and long delays are common due, among other things, to customs inspections of the truckloads. You have been employed as a consultant by a trucking company association, members of which are unhappy about the long delays. Specifically, they have asked you to determine average expected crossing times during the hours of 6 am to 6 pm Monday-Friday if different numbers of custom inspectors are working.

Subsequently, you obtained the following information: The truck interarrival distribution appears to be exponential with a mean time between trucks of 10 minutes. The service time appears to be exponential with mean 29 minutes. There is *a single queue* (first-come-first-served) being served by parallel individually manned custom stations. **(20 points total)**

- a) When three custom officers are working, on average, (i) How many trucks are waiting in queue? (ii) How long do trucks wait in queue? (iii) How long does it take a truck to completely clear customs and continue driving into South Africa? (3 points each; 9 points total)

- b) The trucking association would like the average total time to cross the border into South Africa to be less than half an hour.
- i. What is the minimum number of custom officers needed to make this a reality? (4 points)
 - ii. What other changes would you recommend to reduce waiting time? Be clear and concise. (4 points)

c) One option suggested by the Border Control agents is to re-design the station so that trucks line up individually behind each custom agent, rather than in a single queue as they currently do. Assume 3 custom officers, the demand for each officer is equal and exponentially distributed, and each officer takes on average 29 minutes (exponentially distributed) to clear a truck. Would this suggestion help reduce the waiting time? Justify your answer and show work. (3 points)