Subject: Operation Management.

Instructor: Zeeshan Ibrahim

Important Note.

Paper should be done in MS word.

Attempt all questions. In your own words.

Q.No.1: Services versus manufacturing: which matters more for growth and jobs? (10)

Ans: In addition to increasing globalization, which has been key to rapid growth for many countries, an emerging debate is which sector, services or manufacturing, could be the main source of growth for developing countries today. The East Asian middle and high income countries globalized through manufacturing-led activities, having followed the traditional development path from agriculture through manufacturing and only later to services. South Asia (particularly India) on the other hand, appears to be eschewing the traditional path by globalizing through service-led activities. They are also aided by information technology and outsourcing that enable services to overcome their former constraint as non- tradable activities. For the Middle East and North Africa (MENA) countries, which sector path to growth, services or manufacturing, could emerge and be fostered?

A valid question is whether the sector source of growth matters at all, and if so, why? For manufacturing, key advantages include: the possibility of scale economies which drive down production costs; the generally negative correlation between manufactured goods prices and demand; and the possibility to export the sector's output to richer developed countries, thereby expanding the output base and counteracting the effects of any labor-saving productivity gains.

For services, the conventional wisdom perceives the sector to have limited potential to export or achieve economies of scale, and thus unable to benefit from expanding global trade (haircuts or

restaurant meals, for example, can only be consumed locally). Furthermore, consumption of more services was seen linked to a state of affluence rather than to technology-driven price declines. A characteristic that, in the absence of a global trade outlet, limited the scope of services growth through domestic demand.

The traditional services—trade, hotels, restaurants and public administration—remain largely characterized by the constraints above. Modern services, however, can engage in cross-border trade as well as (in some cases) benefit from scale economies and cost-reducing technological advances. Modern services include business processes which can be outsourced (e.g. insurance claims, transcribing medical records, call centers), as well as transport, logistics and communication services.

The World Bank MENA Economic Development and Prospects (EDP) report of Sept 2011 finds that **MENA's growth and job creation profile** is characterized as follows:

- The **services sector** has been an important source of value added growth and job creation in MENA countries during the latter half of the 2000s, irrespective of whether the country was an oil exporter or importer.
- **Manufacturing** is starting to make sizable contributions to value added growth in some MENA countries (Jordan, Egypt, Tunisia, Iran and Qatar), but made an impact on job creation in a few countries only (Algeria and Qatar).
- In addition to services, the **oil sector** (together with electricity, gas and water utilities) was the other major engine of value added growth in 6 of 12 MENA oil exporters,but the sector's direct job creation impact was negligible. Nonetheless, the oil sector has enabled the growth of the non-oil economy through transfers and public investment programs.

- **Agriculture** played an important role in value added and employment growth in one developing oil exporting country only (Algeria). It was important for job growth in another MENA developing oil exporter (Iraq), and for value added growth in a few MENA oil importing countries (Morocco, Egypt, Tunisia).
- **Construction** has less important role in value added growth but is playing an important job creating role in some GCC oil exporters, although it and many of the sector's jobs have gone to noncitizens.

Decomposing services into traditional and modern components are limited by the available data. A decomposition of services employment into government and nongovernment components serves as a proxy. The EDP report finds that the contribution of non-government services (especially the trade, tourism, logistics and communications sector and, in the case of Egypt, the combined financial, insurance and real estate sector) to value added growth was large relative to the contribution of government services. The same is the case with regards to job creation for most MENA countries, (especially oil importers which have relatively limited fiscal space) which have experienced limited growth in government employment.

The non-government sector created the most services sector jobs, led especially by the trade and tourism sector and, in the case of Qatar and some other GCC countries, the combined financial, insurance and real estate sector. Thus with traditional services leading service sector job creation, MENA is so far not replicating India's so-called "services revolution."

With regards to manufacturing, it's not yet evident that MENA could follow the traditional East Asia path of manufacturing-led growth. However, this assessment bears watching since MENA's

manufacturing sector, although representing a low share of value added, compares favorably in size to East Asian countries at the time of their growth takeoff half a century ago (see figures below).

In the last decade MENA countries have expanded their global trade presence, with an increase in the region's share of world exports by 20 percent (World Bank, MENA EDP Sustaining the recovery and looking beyond, January 2011). Trade openness alone, however, is insufficient for positive employment impact in the medium and longer run from manufacturing, without accompanying FDI enabling better linkage with global product markets and progression up the product value ladder ("Making trade work for jobs: international evidence and lessons for MENA," in Nabli, M. ed., *Breaking barriers to high Economic Growth: better governance and deeper reforms in the Middle East and North Africa, World Bank,* 2008).

Given the importance of broad globalization to a sector's potential to contribute to sustained long term growth, an interesting finding of the EDP is that while MENA countries attracted relatively little foreign direct investment (FDI) to the manufacturing sector relative to other sectors, this FDI created disproportionately more jobs than FDI in other sectors. This suggests potential for MENA manufacturing growth if the countries become more engaged in global trade and more open to inflows of investments from abroad.

The bottom line? Nongovernment services and manufacturing can serve as engines of both job creation and income growth in MENA. However, the jury is still out on which of the two sectors will emerge as a sustainable source of long term growth. The details of the respective country policy reform programs will determine which, if either, of the two sectors comes out on top.

Q.No.2: how one increases the productivity in manual assembly line? (20)

Ans: Assembly lines are one of the most widely used production systems. Productivity of a manufacturing system can be defined as the amount of work that can be accomplished per unit time using the available resources. Pritchard (1995) defines assembly line productivity as how well a production system uses its resources to achieve production goals at optimal costs. The conventional productivity metrics, namely throughput and utilization rate gives a substantial measure of the performance of an assembly line.

These two metrics alone are not adequate to completely represent the behavior of a production system Huang *et al* (2003). A set of other measures such as assembly line capacity, production lead time, number of value added (VA) and non-value added (NVA) activities, work-in-process, material handling, operator motion distances, line configuration and others, along with the throughput and utilization rate, completely characterize the performance of a production system. An assembly line yields optimal performance by an optimal setting of all these factors.

Flexibility and agility are the key factors in developing efficient and competitive production systems. For products involving light manufacturing and assembly, this level of flexibility can be easily achieved through the use of manual assembly systems. Manual assembly lines are most common and conventional and still provide an attractive

and sufficient means production for products that require fewer production steps and simple assembly processes. Global competition is forcing firms to lower production costs and at the same time improve quality with lower production lead times.

With the introduction of Lean Manufacturing, this systematically and continuously identifies and eliminates waste at all levels of a production system, many improvement opportunities which

substantially increase the assembly line productivity can be successfully implemented. Lean Manufacturing or simply Lean is a production philosophy that targets the identification and elimination of any waste in the production processes; especially reduce waste in human effort, inventory, time to produce and production space etc. The concept of Lean was originally developed by Toyota (TPS) for their automobile manufacturing replacing mass production Womack and Jones (1990). According to Womack, the primary focus of Lean is to maintain the value of the product with less work. Lean drives a self-directed work-force and is driven by output-based goals aligned with customer satisfaction criteria Elizabeth and Cassandra (2010).

Waste is generally caused due to unnecessary delays, processes, costs and errors. The seven types of wastes associated with Lean are overproduction, transportation, processing, inventory (work-in-process and finished goods), waiting, motion and defects. These wastes are also associated with support functions involved in a production system. The main focus of Lean is to address the value-added and non-value added activities. A non-value added activity (NVA) is most commonly defined as any activity for which the customer is not willing to pay. Lean necessitates the reduction of these NVA"s by making the system perform better while consuming lesser resources Czarnecki and Loyd (2001). Some of the widely recognized benefits of Lean manufacturing include:

 Productivity Improvement.

 Reduced production lead times.

 Reduced inventory (Work-in-process and finished goods).

 Quality Improvement.

 Better utilization.

 Organized work flow and

 Safer operations.

The most commonly used Lean manufacturing improvement methodologies are Value Stream Mapping (VSM), 5-S (housekeeping), Visual Management, Standard Work and Mistake Proofing (Poka-Yoke).

Since its introduction to manufacturing, the concept of Lean with its fascinating principles has become a dominant strategy in managing the production systems (Womack and Jones, 1990). Shah and Ward (2003) explore the concept of Lean manufacturing and summarize that most of the modern manufacturing practices commonly associated with Lean production show strong operational performance. Implementing each of the Lean practices such as Continuous Improvement (Kaizen), Cycle time reduction, Pull System (Kanban), bottle neck removal, JIT, etc. contribute largely to the operating performance of a production system.

Felhann and Junker (2003) discuss about the developments of software tools that assist managers in planning human resources to meet with the variability in product demand and their changing volumes. The paper proposes a tradeoff between manual assembly systems and highly automated assembly lines. Manual assembly lines are more versatile and manual operators are more adaptable to changes in product demand and production structure. The author highlights the importance of ergonomic considerations while operating manual assembly systems. 5

Today‟s market environment demands for high quality products with low costs with a greater variety in products and at faster response times. The manufacturer faces the challenge to meet these demands while maintaining a profit. Implementing Lean is an ongoing and long term goal. Proper defining of the goals suitable to a production process and setting baselines is the key to productivity improvement.

Assembly Line Balancing

Moberly and Wyman (1973) propose the approach of using simulation two compare two assembly line configurations. According to Moberly, the study of production line configurations along the length of the line is called „assembly-line‟ balancing. The set of work stations along the line that results from this balancing is the generated line configuration.

Bartholdi (1993) designs a computer program to balance a two-sided assembly line. The paper mainly focuses on the case study of a small utility vehicle manufacturing line. The important point to be noted about two-sided assembly lines is that the operators at each pair of work stations (mated-station) work on different tasks but on the same individual component. Hence, Bartholdi puts forward that two-sided assembly lines are more practical for large products like vehicles and heavy machinery than small products.

In contrast to Kim et al ‟s (2009) proposition Bartholdi‟s model tries to minimize the number of work stations for a given cycle time, by restricting the positions where tasks can be placed. The standard ALB problem considers assigning tasks only based on the processing times. This paper poses constraints on certain tasks that they should be always kept together. By doing so, the operator can learn more quickly and perform a particular set of tasks efficiently. This is good as long as the model yields sufficient results. The author mainly focuses on balancing two sided assembly lines where the operators at each station share the work elements assigned to that station

and work on the same component simultaneously. This does not discuss about station imbalances and their impact on assembly utilization.

The objective of this project was to improve the productivity of the manual assembly line. The three step methodology incorporating Lean principles is applied to a case study problem and two different assembly configurations are developed and compared, namely Single Stage Parallel Line and Five Stage Serial Line. Based on the simulation performance results, the Single Stage Parallel Line is suggested to be implemented. From Figure 23 it can be observed that the proposed system results in doubled productivity. The original assembly line has a target output of 35 boxes/operator/hour, whereas the actual measured output came up to 29.8 boxes/operator/hour.

The improved assembly line gives an output of 59.8 boxes/operator/hour, which is about a 100% increase in operator productivity from the original method. Also, with this Single Stage Parallel Line, the floor space usage is reduced by half compared to original method. The material handling requirements as well as the input and output buffer sizes are also determined for this new assembly line. When having an assembly line with multiple stations, the impact of having station imbalances on the individual operator performance is also recognized.