

Transportation & Logistics Systems

Instructions

- Failure to return this within the specified time period will result in severe penalty (at least 50%).
- You are free to use any book or any other reference material, including the Internet.

This assignment has five questions, each carrying 60 points. Total points is 300. Note that there are

- multiple parts for some questions. You should answer each of these parts separately. In order to receive partial credits, you must show the details of your work/calculation.
- The acceptable formats for the submission of your work are Word, PDF, and/or Excel.
- Please show the full details for all of your calculations. This implies that any submitted Word/PDF document should show the formula used and steps followed in calculations. Any submitted Excel file should have cell formula. An Excel file without formula (i.e., where cell entries are hard-coded values, rather than formula) or a Word/PDF document without supporting calculations will incur a minimum of 50% penalty.

703 Infrastructure Consulting Ltd.

We will consider the supply chain redesign problem of **703 Infrastructure Consulting Ltd** (henceforth abbreviated as **703INF**), a wholly owned subsidiary of a large global Swedish heavy engineering firm. 703INF provides design, consulting, and turnkey execution of construction projects to a diverse range of engineering industries including highways, buildings and townships, bridges, airports, locomotive and automobile factories, power plants, petroleum refineries and offshore oil rigs, etc. While the parent company of 703INF has been in business for more than a hundred years, the infrastructure consulting arm of it is relatively new. With a humble beginning in Europe during the late-1980s, 703INF underwent a rapid global expansion during the late-1990s, capitalizing on the technology boom of the dot com era. By 2015, 703INF has established itself as a premier global infrastructure consulting firm with operations in the Americas, Europe, Africa, Middle East, and the Asia Pacific regions. The top management at 703INF considered its highly qualified and motivated engineers, ability to keep a tight rein on costs and quality, and “do-whatever-it-takes” attitude to be its critical success factors. Because 703INF often acted as the lead contractor for many of its consulting projects, it kept a large inventory of engineering equipment and parts needed for its projects at its distribution centers (DCs) around the world. Upon completion of construction projects, many of 703INF’s customers retained it as the sole maintenance provider of the facilities it constructed. These maintenance contracts often required parts and specialized equipment as well.

703INF’s Supply Chain

The supply chain management (SCM) group at 703INF was responsible for all procurement and materials management activities. Led by K. Jayhawker, an alum of the University of Kansas, the group primarily maintained offices at the company headquarters in Sweden but traveled often to interact directly with the DCs and the customer sites. The SCM team was also responsible for negotiating and maintaining contacts with third-party logistics (3PL) providers who supplied a wide array of transportation services to 703INF, such as delivering 703INF’s equipment and parts to project sites and providing shipments from supplier DCs to 703INF DCs, and from 703INF DCs to its customer sites. Coordinating the complex web of supply chain partners across many countries was difficult, particularly since much of 703INF’s territory covered remote locations with relatively poor infrastructure and relatively unskilled labor.

With supplier lead times for the parts and supplies that 703INF sold/needed ranging anywhere from a few days to several months. Jayhawker’s SCM group was constantly under scrutiny to manage the inventory held at the DCs, to control transportation costs, and, above all, to maintain high levels of customer service. In recent months, inventory holding costs and transportation costs associated with the DCs had been increasing, while at the same time making customers unhappy because their service levels were decreasing from the target of 98% that 703INF had always held itself to. Jayhawker was not sure of the root cause of these seemingly incompatible problems; after all, if inventory was going up, wouldn’t customer service levels rise as well? Upon further examinations, Jayhawker’s team realized that the inventory within their network of DCs in the Asia Pacific (APAC) region was more than sufficient. The problem was that they had too much of one item at one DC and not enough at another one; the DC with too little would request a transshipment from the one with too much in order to fulfill a customer order (note that the word “transshipment” refers to moving inventory between two 703INF DCs, rather than shipment from a supplier to a 703INF DC). This practice led to increasing transportation costs and decreasing customer service levels because the transshipment often meant 703INF would miss the promised delivery date.

When Jayhawker’s team investigated the ordering process at each of the DCs, they found that there was no set system in place, except that every DC placed orders with suppliers on a periodic basis of every four weeks. Beyond that, however, the quantity that any one DC ordered for a given part appeared to be more

dependent on who called the supplier than on how much inventory was on hand. Furthermore, since the DCs used transshipments as a regular means to adjust for the ad-hoc ordering policy, a DC that had sufficient inventory to satisfy forecasted demand could quickly lose that inventory as a result of a transshipment.

Jayhawker's team had surmised that the APAC region was the dominant contributor to the disparity between inventory, total supply chain cost, and customer service levels. As of 2016, 703INF maintained six DCs in the APAC region: **Shanghai** (China), **Chengdu** (China), **Bangkok** (Thailand), **Kuala Lumpur** (Malaysia), **Chennai** (India), and **Mumbai** (India). The locations of DCs allowed the use of relatively inexpensive surface transportation (trucking) for almost all transportation needs within the 703INF network. Jayhawker's team had run a number of scenarios that focused on reconfiguring the APAC supply chain to increase customer service levels and decrease supply chain costs. The team decided to evaluate one part that was most representative of 703INF's overall supply of parts - specifically, a KXN24 drill, as pictured below - based on the data that had been collected (Exhibits 1-5 of the accompanying spreadsheet). The team could then extrapolate its analysis of this one part to estimate the impact on 703INF's overall inventory. Once the cost estimates for each of the scenarios were completed, the team would meet to discuss the risks and merits of each and offer recommendations for Jayhawker to present to 703INF's senior leadership team. These scenarios are described below.



**The KXN24
drill**

Options for 703INF's Supply Chain

Jayhawker remembered the lessons from his SCM classes at the University of Kansas: geographical consolidation may result in reduction of inventory without altering the service level. Is this something that exists only in an academician's imagination or can this actually be implemented in real life? If 703INF were

to consolidate inventory, where will it be? Should they start with standardizing the ordering rules across the six DCs and optimizing the current state first? Based on the collected data (Exhibits 1-5 in the spreadsheet), the team came up with the following options.

Baseline: The Current state

Currently, there were six DCs operating in the APAC region (see Exhibit 1 for weekly demand information). Each DC placed orders directly with the supplier. The purchase price was identical for each of the six DCs as it was based on a single, company-wide contract. The supplier-to-DC transportation cost, however, varied based on the location of a DC. The current state captured all costs resulting from the lack of a systematic ordering policy and the high number of transshipments. The team was also able to determine that the KXN24 drill could reasonably be assumed to represent 2.6% of the APAC region's costs and would serve as a baseline for comparing the inventory, transportation, and labor cost savings of each of the subsequent options.

Scenario 1: Optimized current state

Inventory: Under this scenario, inventory costs were based on a periodic review system to achieve their target 98% customer service level. The team assumed that putting a systematic ordering process in place would ensure that each DC had sufficient inventory on hand and eliminate the need for transshipments. Each DC will continue to place orders directly with the supplier.

Inbound transportation: The inbound transportation cost would be linked to the periodic review inventory policy that would be put in place, which established a four-week interval between orders. The lead time between the suppliers and 703INF was three weeks, irrespective of the location of the DC. In order to determine the transportation costs, the team needed to know the different costs of various types of carriers. For the ease of transportation and to minimize the chance of damage during transportation, the KXN24 was shipped in pallets. Only one KXN24 drill could be shipped per pallet, and that a full truckload (TL) consisted of 32 pallets. Following this logic, the team assumed that a TL carrier would be used for every 32 pallets ordered. Whenever the order contained fewer than 32 pallets, KXN24 drills would be transported via less-than-a-truckload (LTL) carrier at far greater cost. To illustrate, if a DC placed an order for a quantity of 34 KXN24 drills, one TL carrier (carrying 32 pallets) and one LTL carrier (carrying 2 pallets) would be required. Similarly, if 22 pallets were ordered, a LTL carrier (carrying all 22 pallets) would be required. Exhibit 3 provides the in-bound transportation cost information for Scenario 1, as well as for Scenarios 2(a) and 2(b) described below.

Outbound transportation: Once the proper inventory system was in place, the team assumed that the need for transshipments would be eliminated. With transshipments eliminated, the cost of outbound shipping will decrease. Through a set of detailed calculations (the supporting data for which are confidential), the team determined that under this scenario, the total outbound transportation cost during a year at any DC will be approximately 35% of its total inbound transportation cost that year.

Labor: The elimination of transshipments, along with the implementation of a systematic and streamlined inventory ordering policy, allowed for substantial reduction of overtime and temporary labor costs. This is reflected in the labor cost calculations shown in Exhibit 5.

Scenarios 2(a) and 2(b): Consolidate distribution to a centralized DC (in Shanghai or Mumbai)

Inventory: This scenario is built on the periodic review policy implemented in Scenario 1 but with further geographical consolidation of the inventory into a single DC (instead of the six) located either in Shanghai (Scenario 2a) or in Mumbai (Scenario 2b).

Inbound transportation: Centralizing all items in a single location allowed the inbound transportation to be consolidated as well. The team hoped this would allow for a greater proportion of TL, as opposed to LTL, carriers on inbound shipments. However, for each of the two potential locations, the average distance the carrier would travel would increase, resulting in an increase in transportation rate, as shown in Exhibit 3. The team was hopeful that the increased distance would be offset by the increased utilization of TL carriers. The team further assumed, for the reasons of simplicity, that replenish lead-time will remain unchanged.

Outbound transportation: Despite the consolidation of DCs, shipments to customers would still have to travel to their distinct regions because it was not possible to consolidate a customer shipment to Chengdu and Bangkok into a single truckload. In fact, once the DCs were consolidated, many of the outbound shipments would now be more costly as a result of a longer average distance from the consolidated DC to the respective region. The percentage increase (over Scenario 1) in transportation cost for outbound shipments to each region are shown in Exhibit 4.

Labor: Under a centralized DC, 703INF could expect to realize substantial savings on labor due to the consolidated operations. The extent of these savings was dependent on the labor rate of the respective location. Jayhawker's team performed the analysis on the labor savings, which is shown in Exhibit 5.

The Recommendation

As the team completed analyzing the problem based on the collected data, Jayhawker wondered about the final recommendation the team would make to the senior leadership. Are there any non-quantifiable factors that the team might have missed? How will such factors affect the final recommendation?

Questions (five questions)

1. What key factors should Jayhawker consider when deciding about 703INF's network of DCs? Be as specific as you can with your answer and avoid being verbose. The preferred answer for this question is a bulleted list. No calculations are needed to answer this question.
2. What is the total annual inventory holding cost for 703INF under Scenario 1? Under Scenarios 2(a) and 2(b)? Show your calculations.
3. What are the total annual inbound and outbound transportation costs under Scenarios 1, 2(a), and 2b? Show your calculations.
4. Based on the calculations for questions 1 and 2 above, and labor cost calculations in Exhibit 5, what should Jayhawker recommend to the senior leadership team?
5. What are the non-quantifiable factors that might influence Jayhawker's decisions? What would your recommendations be based on both quantifiable and non-quantifiable factors? Why? Be as specific as you can with your answers and avoid being verbose. The preferred answers for these questions are bulleted lists. No calculations are needed to answer these questions.