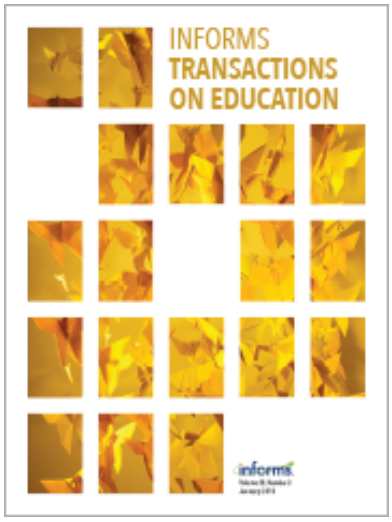

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Case Article

KEY Electronics—Sourcing and Warehouse Analysis

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KEY Electronics is a consumer electronics retailer that generated $1.4 billion in total revenue in 2008. KEY has a limited retail presence in Mexico, which it would like to expand from 30 stores in 2009 to 70 by year-end 2012. As part of its growth strategy, KEY must (1) improve its current sourcing of products for Mexico and (2) revamp its existing warehouse operations. The KEY Electronics case introduces students to a practical inventory modeling scenario with real-life data, where solutions are not solely based on minimum cost but also qualitative factors. By emphasizing a holistic modeling approach, the case demonstrates the interdependencies between sourcing decisions and facility requirements. KEY Electronics can be taught as an in-class discussion, a case write-up, or a course project.

Key words: product sourcing; inventory modeling; global operations
History: Received: February 2010; accepted: December 2010.

1. Case Study Synopsis

Based in Oklahoma City, Oklahoma, KEY Electronics is a consumer electronics retailer with more than 1,500 stores throughout the United States and Mexico. KEY has a limited retail presence in Mexico, which it would like to expand from 30 stores in 2009 to 70 by year-end 2012. As part of its Mexico growth strategy, KEY must (1) improve its current sourcing of products for Mexico and (2) revamp its existing warehouse operations. For each of its 300 stock keeping units (SKUs), KEY has three sourcing options: local purchases from Mexican distributors, replenishments from a KEY U.S. distribution center, or direct purchases from Asian suppliers. KEY has two potential warehousing options to choose from: leasing a 40,000-square-foot warehouse in Mexico City or outsourcing its Mexico warehousing to a third-party logistics provider (3PL).

Based on one author's previous work experience in the consumer electronics industry, KEY Electronics introduces students to sourcing analysis and inventory modeling, emphasizing the link between tactical and operational decisions. Students will be exposed to a practical modeling scenario, where solutions are not solely based on minimum cost, but also on qualitative factors such as end-of-life risk, counterfeit products, and operational capabilities. The case is flexible enough that it can be taught as an in-class discussion, a case write-up, or as a course project. The ideal audience for this case is either operations management/operations research senior-level undergraduate or master's students or MBA students in an operations elective course.

1.1. Teaching Objectives

The main exercise of the KEY Electronics case is the modeling of KEY de México's (KM) sourcing and warehousing requirements. The primary learning objectives from developing the model are to (1) provide students with the opportunity to model a complete end-to-end sourcing and warehousing solution, (2) illustrate the value of modeling sourcing and facility decisions concurrently, and (3) encourage students to reevaluate their quantitative analysis by incorporating qualitative factors.

Primary Concepts:

(1) Studying a global operations problem with an emphasis on holistic decision making

(2) Modeling a sourcing and warehousing problem with both quantitative and qualitative reasoning

(3) Demonstrating the interdependencies between sourcing and warehousing decisions

(4) Demonstrating the value of including inventory costs into a sourcing decision

(5) Incorporating sourcing, inventory, and 3PL qualitative issues into an analytical model

KEY Electronics is a data-rich case that requires students to absorb and process a significant amount of

information. Part of the learning experience for students is working through the data to determine what information is valuable and what is extraneous. For some steps, students will be able to apply formulas and methods taught in class, for others, they will have to develop their own solutions by making assumptions and approximations based on the information provided.

There are a number of case studies and course exercises, which touch on the topics covered in KEY Electronics. For example, Allon and Van Mieghem (2010) design an in-class, Mexico-China sourcing game that allows students to experience the challenges of making sourcing decisions between close but expensive Mexico and inexpensive but remote China. Van Mieghem (2008, pp. 230–232) has a related case study, which requires students to model the Mexico-China sourcing decision. We investigate a similar problem in KEY Electronics; however, our case also incorporates key operational decisions such as inventory requirements and facility choice. Additional material, which can be used to illustrate global sourcing decisions, can be found by Carraway (1991) and Davis and Paige (1991). Regarding distribution network expansion, Laseter and Wu (2005) describe a network design problem for Dollar Tree, which requires students to incorporate inbound and outbound transportation, distribution center operations, and inventory into their recommendations. Also, sections of the well-known Llenroc Plastics case (Muckstadt and Jackson 1994) can be used to demonstrate the link between a network design and a company's inventory. While these cases provide students with practice in modeling a network design, they do not consider the sourcing issues found in our setting.

2. Case Contribution

The case analysis has the following two components; students will:

(1) Develop a sourcing strategy to meet the needs of KM's future growth. For each SKU, students should provide a source location, an order quantity and order frequency, and the expected average inventory on hand in KM's Mexico City warehouse.

(2) Determine if KM should lease a new warehouse or hire a 3PL to manage its warehousing in Mexico based on costs and storage requirements.

For both components, students should incorporate qualitative and quantitative reasoning. The uniqueness of the KEY Electronics case is that the sourcing and warehousing decisions are being made concurrently; therefore there is an opportunity to optimize the entire system, not just each individual component. Often sourcing decisions are made solely based on which source can provide the lowest unit cost. Instead, for KEY, students should develop an end-to-end model that incorporates inventory policy into the sourcing decision and examines the total system cost (sourcing plus warehouse costs). By analyzing the total system, students will gain an appreciation of the interdependencies between sourcing and warehousing decisions and of how optimizing each component separately can lead to incorrect decisions.

3. Analysis and Solution

In the teaching notes we present the complete solution, which incorporates both continuous and periodic review inventory policies. This solution is meant for more technical courses, such as a master's-level industrial engineering course, in which inventory is a major focus of the class. Ideally, students would perform their analysis as part of a course project or group case study. Because the case can be presented at varying levels of difficulty, we also provide suggestions for simplifying the analysis. Additional discussion questions are included in the teaching note that can be used either during an in-class discussion or as report questions. The teaching note also includes a sample outline for an in-class discussion.

4. Teaching Suggestions

A version of this case has been taught three times at Stanford University as part of a master's-level "Introduction to Operations Management" engineering course. Approximately 20% of the students in the course were undergraduates (juniors and seniors). The case was used as a quarter-long course project. For the interim report, student teams provided (1) short-term recommendations for improving the situation and (2) data requests for the sourcing and warehouse analysis (appendix data was not included in the original case provided to students). For the final report, teams completed the sourcing and warehouse analysis, and created a high-level sourcing methodology that summarized their results. In terms of class discussion, the case is flexible and can be taught in many different ways. For example, the first time the case was taught, student teams presented their results to the class in 10-minute presentations. The second and third times the case was taught, the instructor led an in-class case discussion. Overall, the project was both instructive and enjoyable for the students.

Based on our experience with the case, we recommend teaching the full solution method only if the class is properly prepared for the analysis. Approximately one-third of our course was dedicated to inventory management, with the focus being on newsvendor, economic order quantity, (Q, R), and some periodic inventory models. Therefore, students were well prepared for the modeling requirements of the case.

5. Student Response

Students particularly enjoyed the following aspects of the case:

(1) Case realism: Students liked that the case is based on a real-life scenario and a real data set. The project provided them the opportunity to apply many of the tools taught in our course to a practical business setting. One student even used the case to obtain a job after graduation, presenting the project during his interview process with the company.

(2) Qualitative reasoning: Many students enjoyed building on and extending their quantitative analysis with qualitative arguments.

(3) Developing large-scale models: Although most of the students were familiar with Microsoft Excel, for many of them, this was their first experience developing large spreadsheet models. Working through the process of designing a large flexible spreadsheet model proved invaluable for many of them.

Where students struggled with the case was in setting up the analysis. Because the case contains a large amount of data, many teams struggled to determine what data to use and what to discard. Some teams also had trouble determining which theories learned in class to apply to the project, as well as when to use approximations versus exact solutions. The directions given to the students can be tailored to provide more or less guidance regarding these aspects of the analysis, depending on the instructor's teaching objectives. The following are student comments regarding the case:

> (1) The case was very close to a real-world problem . . . . There were many new aspects that we were introduced to that were not (and probably cannot) be covered by standard lectures and studying out of a book. We got a chance to get our hands dirty, process a lot of data and actually get a feel for the subject matter.
>
> (2) I really liked the fact that you gave the students the chance to go beyond the quantitative data and explore the case from a qualitative perspective.
>
> (3) I think the main take-away was how we have to develop a feel for the subject because in a real-world situation you really have to make approximations and develop good heuristics to solve problems like the ones presented to us.
>
> (4) It also helped me work through the relationships between, for example, the (Q, R) and (T, S) policies in a way I wouldn't have simply studying for a test. I think understanding how theories and policies are related helped me a lot to ground what I'd learned throughout the class. Hopefully that exercise will help me remember them down the road as well.

Supplementary Material

Files that accompany this paper can be found and downloaded from http://ite.pubs.informs.org/.

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