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Teaching Retail Operations in Business and Engineering Schools

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This paper describes the organization and teaching of retail operations at The Wharton School at the University of Pennsylvania and the School of Industrial Engineering at Eindhoven University of Technology. We present the course outlines and discuss how differences in the schools' environments affect the way retail operations is taught at each school.

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1. Retail Operations and Retail Operations Courses

Research on retail operations examines the operational processes in the retail supply chain. It is concerned with analyzing, understanding, and potentially improving the processes in each part of the chain, from distribution centers to stores, including transportation and other distribution activities. Evidence of growing interest in retail operations includes a focused issue of M&SOM devoted to the topic edited by Fisher and Raman (2001), the establishment of dedicated retail operations research groups (e.g., Eindhoven Retail Operations Group), and numerous publications in premier journals pertaining to retail operations (see, for example, Gaur and Fisher 2006, Van Donselaar et al. 2010, Fisher 2009).

This body of research was the genesis of retail operations courses at the University of Pennsylvania's Wharton School and Eindhoven University of Technology's School of Industrial Engineering. The Eindhoven course was created by the first and third authors of this paper, who were inspired by the Wharton course. This paper describes the courses at each school and reviews how perceived differences in the students at the two schools are reflected in the organization of the respective courses.

We believe that retail operations courses are useful to students in two ways. First, because retailers play a dominant role in many supply chains, it is important that not only retailers but also manufacturers and distributors understand retail processes and how they influence the overall supply chain. Second, the problems faced by retailers (e.g., data availability, reducing lead-times, and complexity, etc.), being generic, are common to many other firms. Hence, the knowledge disseminated via these courses can be applied across a variety of industries. In all cases, retail operations courses contribute significantly to increasing interest in retailing and operations management research topics.

The paper is organized as follows. Sections 2 and 3 provide descriptions of the courses taught at The Wharton School and Eindhoven University of Technology, respectively. Section 4 presents our discussion of the similarities and differences between the courses as well as concluding remarks. Recent syllabi for the two courses are provided as supplementary files on the journal website.

2. The Retail Operations Course as Taught at The Wharton School, University of Pennsylvania

First taught at The Wharton School in January-February 2002, Retail Supply Chain Management is an elective course taken by both undergraduate students and MBAs. It is one of two required courses (the other is a marketing course) for an undergrad concentration in retailing and, for MBA students, it counts toward a major in operations management. The course examines how retailers determine customers' preferences and respond, through effective supply chain management, with appropriate products. Supply chain management is vitally important to retailers, having been central to the success of Amazon, Dell, Wal-Mart, and Zara, among many other firms.

Below, we describe the course in terms of positioning, themes, and content; discuss the insights expected to emerge for students; and review the course's evaluation and lessons learned by instructors.

2.1. Positioning

The Wharton curriculum allows for minicourses consisting of 13 80-minute sessions. Retail supply chain management is one of many courses taught in this format. The course is usually offered in two sections, in September–October, and is taken by more than 100 students, approximately two-thirds of them pursuing an MBA, and one-third undergraduate students. It is the only operations course in the MBA program that deals with retailing. Many of the MBA students who take the course have some retail experience or have held a marketing position in industry. The course builds on aspects of inventory management theory, such as the newsvendor model, imparted in the core supply chain course.

2.2. Content and Materials

The course is organized around six broad themes, namely, (1) linking finance and operations in retailing; (2) planning product assortments for individual stores; (3) optimizing, by stockkeeping unit (SKU), the inventory held in each store; (4) pricing, especially during the end-of-life markdown period; (5) store execution; and (6) supply chain design. These are fundamental operations issues for retailers closely related to the research on retail operations done at The Wharton School. The course follows the sample outline presented in Table 1. Actual timing may vary year-to-year, but the organization of topics is as presented.

As seen in Table 1, this course uses a combination of lectures, case discussions, and guest speakers to address the six broad retail supply chain management themes. In addition, students read select chapters from Fisher and Raman (2010) to supplement their classroom experience. For example, the lecture classes (classes 1, 2, and 5) are based on Chapter 2, Assortment Planning, and Chapter 3, Product Life Cycle Planning, of Fisher and Raman (2010). Chapter 1, Retail Valuation, and Chapter 6, Store-Level Execution, are assigned as background readings for classes 3 and 8, respectively. Classes 4, 6, 8, 10, 11, and 12 are case discussions. Classes 3, 7, 9, and 13 are devoted to guest speakers, who discuss from their professional perspective either their company or, in the case of class 3, an issue. Guests present at some of the case discussions (classes 4, 6, 8, 10, 11, and 12) offer observations during, and wrap-up remarks at the conclusion of, the discussions. Class sessions run from 10:30–11:50 A.M. and 1:30–2:50 P.M., enabling guests to take lunch with students between classes and students to interact informally with and ask questions of the guests. Fisher et al. (2000) and Fisher (2004) are assigned as background readings for classes 1 and 4. The complete course outline and additional references are provided in the sample syllabus.

Table 1 Topics Covered in the Retail Operations Course at The Wharton School

Class	Topic
1	Lecture: course overview, assortment optimization
2	Lecture: forecasting and inventory optimization for new products
3	Linking finance and operations for publicly traded stocks Guest: Colin McGranahan, Senior Research Analyst, Sanford C. Bernstein & Co., LLC
4	Store execution: the role of the store manager Case: Store Level Execution at Wawa (Fisher and Krishnan 2004) Guest: David Johnston, EVP and COO, Wawa, Inc.
5	Lecture: End-of-life management, pricing
6	Network design: configuring the network of distribution centers Case: Amazon.com's European Distribution Strategy (Hammond 2005)
7	Competing on product availability Guest: Kevin Freeland, COO, Advance Auto Parts
8	Store execution: links between operations and finance Case: The Home Depot (Ton and Ross 2008)
9	Customer targeting and assortment planning Guest: Glen Senk, CEO, Urban Outfitters
10	Supply chain design: achieving speed and flexibility Case: Supply Chain Management at World Co., Ltd. (McClelland et al. 2001) Guest: Masaharu Isogai, Management Consultant, former board member at AEON and Talbots, advisor to World Co.
11	Store execution: the role of store design Case: McDonald's Corporation: Launching McCafé (DeHoratius et al. 2008) Guest: John Reinersten, Senior Director, Operations Innovation Center, McDonald's Corporation
12	Supply chain design: discount retailing Case: Supply Chain Management at Wal-Mart (Johnson 2006) Guest: Myron Burke, Director, Store Innovation and Operations Execution, Wal-Mart Stores, Inc.
13	Soft goods forecasting and planning, retail entrepreneurship Guests: Rebecca Matthias, Founder and President, Lisa Hendrickson, VP and Head Merchant, Destination Maternity, Inc.

2.3. Insights

The insights derived from the course are valuable to students with and without a background in retailing. Students find the retail context a useful one in which to apply their analytical skills, and the six themes enumerated above constitute a useful framework for thinking rigorously about retailers.

Even for students who do not expect to work for a retailer, the insights derived from the course can be useful. The processes retailers use need to be understood not only by manufacturers and distributors but also by the consultants and bankers that serve retailers and their suppliers. Moreover, retailers share with firms in other industries the challenge of making accessible and interpreting large amounts of data, reducing lead-times, and eliciting the best efforts of employees. These issues are more easily understood in the context of case studies in retailing because everyone experiences the industry as consumers.

Research having revealed that managers in operations-intensive settings spend little time reading, and even less time writing, reports, the development of speaking and listening skills is accorded a high priority in this course. The classroom is treated as a laboratory in which students are afforded an opportunity to test their ability to present their analyses and recommendations clearly, convince their peers of the correctness of their approach to complex problems, and demonstrate their ability to achieve the desired results through implementation of their approaches. This requirement is reflected in the course evaluation, discussed below.

2.4. Evaluation

Grading is 30% class participation, 40% individual write-ups of the discussion questions for four of the case class sessions, and 30% team projects in which three to five students compare two retailers that compete for the same customers in a given segment. The latter leverages the fact that two or more retailers frequently compete head-to-head for the same customers in a given product segment, e.g., Borders versus Barnes & Noble and CVS versus Rite Aid versus Walgreen, presenting an exceptional opportunity to learn about retail supply chain management by examining the different choices made by competing firms facing similar challenges. The project involves the following steps.

1. Choose two competing retailers with stores accessible to you for a visit. Ideally, they should be publicly traded to make getting information easier.

2. Compare their stock performance over the last few years.

3. Scan their financial reports and gather information on as many as possible of the metrics discussed in class. The most important are sales growth, comparable store sales[1] increase, new store openings, gross margin %, inventory turns, asset turns, etc. Be able to identify the major differences between the two retailers in terms of these metrics and try to explain the differences based on your observations of the retailers' operating practices.

4. Read articles about the companies, browse their websites, and scan their annual reports.

5. Visit one or more stores of each retailer. One of the great advantages of studying retail supply chains is that many aspects are on public display in stores that can be compared along many dimensions (e.g., product, people, execution, store design, etc.).

6. Analyze the data gathered to provide answers to the following questions. Which retailer is more successful and why? What is the more successful retailer doing differently? Can it be copied? What advice can be given to the less successful retailer? The deliverable for this project is a crisp, 10-minute final presentation (including the associated slide deck) to be given at the end of the term.

2.5. Lessons for Instructors

One lesson many instructors learn from the experience of teaching retail operations is that many business school students have a keen interest in retailing and retail supply chain management, some because they are considering working in retail, others because they expect to interact with retailers in various ways, such as selling products or providing consulting services to them or investing in them. Instructors also discover how well the mix of lectures, cases, guest speakers, and the store visit project work together. The fact that many retailer operating practices are immediately visible during a store visit is a great plus in teaching this material. Instructors find that the novel store comparison project instills in students greater enthusiasm for studying retail operations.

It works well to have guests from case study companies present during case discussions. Case protagonists are especially valuable resources during the class discussions and for offering observations and answering questions during the concluding 20–25 minutes of class. In some instances, entire classes have been devoted to discussions led by guests. This promotes lively debate and validates the applicability of the course concepts in the real world. Instructors who adopt this approach need to cultivate potential guests from, and possibly even case writing opportunities with, local retailers.

[1] Comparable store sales, also known as comp store sales, measure the change in sales from the preceding year among stores open for a chosen period of time.

3. The Retail Operations Course as Taught at the School of Industrial Engineering, Eindhoven University of Technology

The Retail Operations Group at Eindhoven has been involved in research and educational projects, mainly from a supply chain perspective, with European retailers, both food and nonfood, since 2002. In 2005, these research efforts were consolidated into a five credit elective course in the two-year Master of Science program of operations management and logistics in the School of Industrial Engineering. The program prepares students for two career paths: industry and academia. Most students enter industry as industrial engineers, in primarily operations management-related jobs (e.g., engineers, analysts, or managers). Approximately 10% of students continue as researchers pursuing Ph.Ds. In Europe, a complete Master's degree is usually required to enter the Ph.D. program. This dual objective of the Eindhoven Master of Science program is common across industrial engineering (IE) programs in the United States and Europe. Although the Master of Science program in the School of Industrial Engineering has a strong research focus, and few of the students in it pursue an academic career, most students value the program philosophy and see its benefits for both industry and academia.

Below, as for The Wharton School, we describe the course in terms of positioning, themes, and content (see also the complete syllabus, which lists additional references), discuss the insights expected to emerge for students, and review the course's evaluation and lessons learned by instructors.

3.1. Positioning

Faculty from the Retail Operations Group teach the retail operations course over the course of 15 weeks. This includes 10 contact weeks of class sessions of straight lectures (two hours per week each) and five weeks of dedicated project work. The focus of the course is on operational processes rather than on marketing issues (although some marketing issues are discussed as background material). Students are expected to be able to understand and be able to model these processes.

Over the years the course has been taught, students' evaluations have shown the highest appreciation for the course. The course has a stable annual enrollment of approximately 60–70 students from the School of Industrial Engineering (cohort is around 120 students). Typically, students follow this course in their first year of the M.Sc. program.

Various concepts covered earlier in the Bachelor's program are used but are framed within and adapted to the retail environment. More specifically, the course builds on forecasting models (e.g., regression, ARIMA, etc.), stochastic inventory models with lost sales, capacity utilization models, data collection methods (e.g., time and motion studies, interviews, etc.), information systems tools (data warehousing), and simulation studies, etc. In the Master's program, considerable attention is given to designing and building operational systems. In the retail operations course, this translates into taking an explicit design perspective that reflects the application of the theories, methodologies, and skills developed in the Bachelor's and Master's programs.

3.2. Content and Materials

As the course is closely related to the research carried out in the School of Industrial Engineering, the focus is mainly on food retailers and general merchandise (e.g., fashion), that is, retailers in bricks-and-mortar settings. The topics covered in the course are enumerated in Table 2. Although operations management aspects are emphasized, a marketing perspective is helpful for framing the operational decisions. For example, inventory management decisions are a function of what marketing decides should be the minimum displayed quantity on the shelf. Differences across the strategic, tactical, and operational levels are not always clear-cut. For example, inventory policy might be set at the strategic or tactical level, but setting parameters and applying the policy are operational issues. Additionally, managers can deviate from the inventory policy in the course of operations, possibly precipitating changes at the tactical or even strategic level (e.g., different use of personnel).

This course does not use a text but relies instead on many published papers, references to which may be found in the course syllabus.

Table 2 Topics Covered in the Retail Operations Course in Eindhoven

Marketing	Operations
Strategic level	
Target markets	Retail supply chain strategies
Products	Grocery retailing vs. fashion retailing
Tactical level	
Assortment planning	Supply chain coordination
	Warehousing and transportation
	planograms*
Operational level	
Demand forecasting	Forecasting demand based on point-of-sale
Customer service	Checkout counters and backrooms
Minimum on display	Inventory management for regular products
	Inventory management for perishable products
	Inventory handling and shelf stacking
	RFID applications
	Promotions inventory management
Advertising	Data accuracy and data management

*A planogram identifies the exact location and number of facings of the stock keeping unit on the shelf in the store.

3.3. Insights

The course is intended to acquaint students with both the Dutch and international retail sectors. Students are provided with an overview of the relevant research questions in the retail sector and study the most important papers in different decision areas of retailing (i.e., seminal papers on inventory control, distribution, and store operations, etc.). Students should be able to read and position retail operations management papers within the framework of the course.

Throughout the course, students use quantitative and empirical modeling skills to educe managerial insights relevant to the retail sector. The use of research papers and models fits well with the course (as well as program) objectives. Students are expected to be able to construct and implement the models and problems they are studying. This goes far beyond the typical MBA objective of gaining an appreciation for the insights and goes much deeper into course matter than the typical undergraduate textbook course with relatively simple models.

3.4. Course Evaluation

Students are evaluated on the basis of two assignments: the practice assignment and the final assignment. Both are closely related to the course objectives. The practice assignment is intended to acquaint students with the retail sector as a whole and is identical to the assignment described in §2.4, with one exception. The deliverable for this course is not a presentation but rather a short report detailing the major differences between the chosen retailers. The final assignment focuses on the development of students' modeling skills as framed in the retail environment, i.e., based on specific research questions.

3.4.1. The Final Assignment. No class lectures are delivered during the last five weeks of the semester to leave time for the students to work on their final assignment. This final assignment is a research exercise that is completed in groups of two. Students receive a group-specific assignment focused on a select research question in the area of retail operations. The objective of the final assignment is to cover a specific class concept (e.g., inventory management, shelf space allocations, people, etc.) in greater depth. The starting point is generally a leading academic paper, which the students are expected to extend, adapt, and criticize (e.g., critique the assumptions made). Examples of papers that have been used as starting points for the final assignment include Berman and Larson (2004), Cachon (2001), Gupta et al. (2006), or Kapalka et al. (1999).

Students are explicitly directed to take a modeling perspective for the final assignment. Specifically, they are expected to tackle the assigned problem by describing and analytically modeling the process. The final assignment is thus typically quantitative and empirical, involving the use of mathematical and statistical models. The models are to be subsequently analyzed via either a simulation or the use of optimization tools available from faculty. If needed, students are provided with subsets of the extensive data sets available from the various retailers with which the faculty collaborate. Each group is assigned a tutor (i.e., the faculty teaching the course) who follows the students closely and provides feedback at regular intervals. The tutors are available during specific times every week for the duration of the assignment to provide feedback, clarification, and answer questions about the models.

The following are examples of final assignments.

- Study the paper from Berman and Larson (2004). Study the model proposed in the paper and implement it as an Excel spreadsheet. Set up a numerical experiment to assess the value of the model. Relate the value of the model to its sensitivity to assumptions, ability to support decision making, and robustness, etc. Evaluate the assumptions made in this paper using the accompanying data set on checkout counters. What are the pitfalls, advantages, etc. of using this model?
- Study the paper from Hackmann and Rosenblatt (1990). Study the model being proposed and implement it in MS Access, MS Excel, or Matlab. Set up a numerical experiment to assess the value of the model for planogramming purposes (minimizing the number of backroom replenishments) based on a set of point of sales (POS) data from the retail group (available upon request). Relate the value of the model to its sensitivity to assumptions, ability to support decision making, and robustness, etc.
- Compare and evaluate an $(R, s, \eta Q)$-reorder-policy[2] with two different ways of forecasting sales with a week pattern using exponential smoothing: (1) using only historic data for a specific weekday t if weekday t has to be forecasted and (2) using all weekdays. Consider the differences between these options for three scenarios: no trend, small trend, and large uptrend followed by large downtrend, in sales per week.

Students are expected to write a short paper (max. 2,000 words) and prepare a poster on the implementation and conclusions of their analysis. They are also expected to submit the model and any associated files.

[2] At each review moment R, if inventory is less than s, then order the minimum number of case packs η of size Q required to reach the reorder level s.

3.5. Lessons for Instructors

One critical issue we have experienced is that because we rely on, in lieu of a final exam, a very specific final assignment completed by students working in groups, students do not know much about the work of the other students. Consequently, we found organizing a closing session in which all students present their work in a series of poster sessions to be extremely valuable. The posters are also circulated via the online student learning system. In this way the students are afforded a broader picture of the field of retail operations at the closing of the course.

4. Discussion and Concluding Remarks

Retailing is an exciting environment and a great setting in which to explore different operations management concepts. Many topics taught in operations management courses are also treated in these two retail operations courses but with the retail environment as the primary context. Moreover, both the Wharton course and the Eindhoven course make good use of the fact that students, as consumers, participate in this context.

Students of both courses are expected to compare different retailers and identify differences in retail strategy, store execution, and drivers of financial success. Students appreciate that it is easy to access retail stores and to observe their operational practices firsthand.

Conversations with students suggest that reasons for choosing the course differ between the schools. Eindhoven students choose the course mainly to apply, in a familiar setting, many of the concepts they have learned in different operations management courses. Wharton students, on the other hand, having faced many of the issues presented in the course in real life, are seeking a structured, scientific framework for discussing and analyzing them. This may reflect the differences between the students who take the course at each school. Students in Eindhoven's School of Industrial Engineering have little practical professional experience but do possess a strong analytical background from their industrial engineering coursework. Students at The Wharton School, on the other hand, are primarily MBA candidates. Therefore, these students typically have more professional experience but may not have had as much exposure to operations management analytics.

We presented two realizations of a retail operations course, one targeted to business school students and the other to industrial engineering students. Regardless of the audience, both courses are grounded in theory and practice. As a result, these courses have changed as research in retail operations has advanced and retail executives have adopted new operational practices and faced different challenges. We look forward to incorporating additional changes as more faculty conduct research in retail operations and elect to offer retail operations courses.

Supplementary Files

An electronic companion to this paper is available at http://ite.pubs.informs.org/.

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