REMOVING THE BARRIERS BETWEEN EDUCATION AND PRACTICE: TOOLS AND TECHNIQUES FOR LOGISTICS MANAGEMENT

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INTRODUCTION

During the fall 1997 semester at the University of Tennessee, students entering their second year of the MBA program approached the logistics and transportation (L & T) faculty with an unusual request: They wanted to add a course to the graduate L & T curriculum. The students did not need the additional credit hours to graduate, and many were well on their way to securing jobs at the end of the school year. The impetus came from their experiences during summer internships, discussions with logistics professionals at the Council of Logistics Management (CLM) annual conference, and insights drawn from interviews with corporate managers, consultants, and recruiters. Their request echoed messages the faculty were receiving in their interactions with industry. The focus of student interest was expanded knowledge of, and experience with, current management and decision support tools and methods being applied in logistics and supply chain management.

The basis for the students' request was not so unusual. For more than four decades, L & T textbooks and curricula have been teaching concepts and methods to address issues ranging from the calculation of appropriate order quantities (EOQ) to the design of entire distribution network systems.[1] In an effort to provide industry with well-trained logistics managers, university L & T programs have incorporated computer technologies into research and pedagogy in order to help translate these concepts into practical skills and tools for logistics management.[2] Yet, the scenario reported above suggests that graduate education is not meeting industry expectations in this regard.

In an effort to address this gap between industry and education, the Department of Marketing, Logistics and Transportation at the University of Tennessee designed and presented a special topics course, "Tools and Techniques for Logistics Management" (hereafter the tools course), to students entering their final semester of the MBA program as well as to select senior-level undergraduates.

Logistics management and decision support tools are frequently associated with computer-based applications. The purpose of this paper is to review the role of computers and software applications in logistics education, identify barriers that have limited student experience with current logistics planning and management tools, suggest factors which are helping to remove those barriers, address the influence of changes in business and technology on logistics curriculum, and discuss how such changes affected the tools course offered at the University of Tennessee.

The next section reviews the effect of computers and information technology on logistics education. Factors that have limited student exposure to logistics management and decision support systems, that is, barriers between logistics education and practice are identified. Next, a model is presented which illustrates the influence of changing information technology and employment patterns on logistics curriculum, and specifically the tools course offered at the University of Tennessee. An overview of the tools course is then presented. Finally, the authors comment on the outcome of the course along with implications for logistics education and practice.

COMPUTER APPLICATIONS IN LOGISTICS EDUCATION

The logistics literature covers a broad array of topics, from supply chain management to specific algorithm development. Management and decision support tools are generally associated with the application of computers and software in logistics practice. This review incorporates literature which has investigated computers and software applications in logistics education, including articles in industry that discuss implications for logistics education.

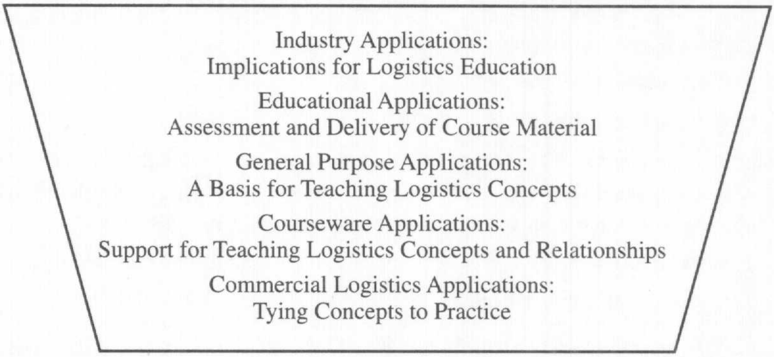
Educators have long recognized the potential for computer applications in logistics practice as well as the need to study them in the classroom:

> The computer, already an important factor in logistics management, will take on more and more responsibilities in the future. It is extremely important for educators, with the help of practitioners, to increase the ability of both current and future logistics managers to deal effectively with computerization. One way to do this is to integrate more computer exercises into the standard course work in undergraduate, graduate, and executive programs.[3]

Figure 1 identifies five roles that computers and software applications have played in logistics education. The following sections discuss each role and its contribution to the development of university courses.

FIGURE 1

THE NARROWING ROLE OF COMPUTERS AND SOFTWARE APPLICATIONS IN LOGISTICS EDUCATION



Industry Applications: Implications for Logistics Education

A significant amount of literature has addressed computer and software use in industry. While a complete review of such material is beyond the scope of this paper, selected articles have investigated industry applications in an effort to identify implications for logistics education at the undergraduate, graduate, and executive levels.

Kling and Grimm discussed microcomputer use in transportation and logistics and its implications for logistics education.[4] They segmented research on computer applications into five categories: overviews of history and application, surveys of application and level of use, case studies demonstrating the effectiveness of microcomputers in logistics, system applications outlining improvements from using microcomputers, and management issues affecting microcomputer application. They identified two key implications for logistics education. First, because of the growing uses of computers in industry, application courses should be considered as part of a logistics curriculum. Second, software chosen for such courses should parallel the types of programs used in transportation and distribution operations.

Pointing to the expanding availability and application of microcomputer technology in industry, the authors suggested the types of "general purpose" and "distribution specific" software to be considered in a logistics software course. Their recommendations included:

General Purpose Software:

1) Spreadsheets
2) Database management programs
3) Micro-based statistical analysis packages

Distribution Specific Software:

1) Distribution management programs
2) Routing programs
3) Motor carrier rate retrieval diskettes
4) Carrier costing programs
5) Consolidation programs
6) Site location programs

Stenger hypothesized that the key to effective logistics integration lies in the application of sophisticated electronic information systems technology.[5] Drawing on the literature to conceptualize past approaches to logistics integration, he proposed three planning levels:

1) network design,
2) aggregate planning and allocation, and
3) flow planning and master production scheduling;

and two operating levels:

1) transaction processing and
2) short-term scheduling.

Within his model, the planning and operating levels were supported by an integrated database management system (IDMS).

Noting the evolution toward this planning approach throughout industry, Stenger discussed implications for the development of logistics managers, including courses provided by universities. He proposed that advanced courses should be based on his planning approach and suggested that current "tool" courses, while teaching a variety of planning techniques, miss important aspects of integration.

Mentzer, Schuster, and Roberts reported on findings from a survey of CLM members which compared microcomputer and mainframe use in logistics.[6] The results indicated that microcomputers were being used more often than mainframes in 11 of 13 logistics management areas. In addition, users were significantly more satisfied with microcomputers than mainframes in a majority of logistics applications. Nevertheless, they pointed out college and continuing education courses were among the worst ranked and least-often mentioned sources for learning about microcomputers. This statement was reasserted in a similar article comparing computer use among marketing and logistics professionals.[7]

Investigations such as these suggest that educators and practitioners have recognized the benefits of computers and logistics tools in industry, but faculty and students have received limited preparation in tool identification and implementation. The next section begins to discuss the role of computers and software applications in logistics education.

Educational Applications: Assessment and Delivery of Logistics Course Material

One role for microcomputer applications in logistics education, which is likely to see more focus in the future, is their use as a means to deliver course content. Though few articles have directly addressed this role, greater storage capacity, components such as compact discs, and communications support such as that found on the internet are helping organizations use computers as a means of offering training for specific applications.

Cook, Helferich, and Schon reported on the development of an expert system used to teach inventory management concepts to automotive dealer parts managers.[8] In this case, the stand-alone system evaluated parts managers' knowledge of basic inventory skills, determined their level of expertise, and provided computer-based training which matched the needs of the individual user.

More recently, Rutner, Kent, and Gibson used a number of technologies to support a collaborative approach to undergraduate logistics education.[9] They incorporated computers, communications, and application software in two ways: as a "tool" to promote collaborative learning, as presented by Thomchick, and as a means to provide students with "real world" experience with selected logistics software.[10]

In this role, computer software applications are providing a more efficient mechanism to introduce employees and students to the operational benefits available through logistics management. The cases presented above also indicate a need for educators to match the tool to the teaching scenario. Stand-alone systems such as that discussed by Cook, Helferich, and Schon may be most appropriate when the operating context and learning objectives are focused and can be clearly defined. If the learning objectives incorporate broader or more ambiguous topic areas, however, then system interaction may be more appropriately used to accompany class discussion when an instructor can address the complexities of questions prompted by the exercise.

General Purpose Applications: A Basis for Teaching Logistics Concepts

While the terms "user friendly" and "intuitive interface" have become important aspects of software design, users generally need some training to operate business applications. Prior to the advent of object-oriented code, visual programming, and graphical user interfaces (GUI), specific application as well as general purpose software frequently required that the user be capable of writing "code" or "macro's" to solve particular problems. For educators, this created both challenges and opportunities in logistics education. The challenges involved their ability to pique student interest in learning basic skills required to use the software. The opportunities stemmed from assignments that asked students to apply logistics concepts in the development of simple computer-based logistics tools. In creating these tools, students were forced to build their understanding of data requirements and conceptual relationships.

Grenoble and Tyworth discussed the application of a spreadsheet model to teach core logistics concepts and integrated decision making.[11] Starting with fundamental models such as the EOQ, they gradually incorporated more sophisticated components to address safety stocks, multiple discounts, variable freight rates, and so forth. They stressed that logistics courses should not take a "black box" approach to model application; instead, they proposed that students should learn to understand the specific interrelationships of the model. Subsequently Grenoble and Tyworth indicated a number of obstacles that may restrict the application of spreadsheets in education.[12] These included inadequate computing facilities, the limited availability of affordable and legally acquired software, a lack of accompanying courseware, and the potential reluctance of faculty to accept new technology.

Rao, Stenger, and Wu reviewed three approaches for integrating computer technology with management education: (1) using special-purpose software as a tool to implement management techniques taught in class, (2) using general-purpose software as a tool to help students analyze relationships among variables and solve problems through model building, and (3) an integrated paradigm using general-purpose software as a system platform, special-purpose software to perform special tasks, and returning to the general-purpose package to integrate results.[13] They proposed that any enhancements to the course they described should first use more spreadsheet templates for analysis and integration, then integrate more special-purpose or commercial software for demonstration, and finally increment the evolution of ideas with courseware.

These articles suggest that educators must consider tradeoffs in breadth and depth when incorporating software tools in the classroom. General-purpose applications, such as spreadsheets, help students learn to apply basic logistics concepts to solve problems. Since such concepts are likely to be used in commercial software, these exercises help students understand some of the capabilities and limitations of systems they may use in the future. At the same time, general-purpose software limits the complexity of issues students can address in the classroom. Individuals with even the most adroit programming skills may be hampered by the length of the class period and semester, technical capabilities of the software, and the artificial nature of classroom assignments. Rao, Stenger, and Wu proposed a method to balance these tradeoffs through their integrated approach to course design.[14] As suggested by Grenoble and Tyworth, the ability to apply such an approach has been limited, in part, by system availability, cost, and other obstacles.[15]

Courseware Applications: Illustrating Logistics Concepts and Relationships

Courseware is defined here as software designed to support a particular course or area of study. Common examples include BULOGA, MSULOGA, and the MAS Simulation, which have been used at a number of universities to help students understand the implications of alternative logistics management strategies. Computer simulations have provided a means of teaching students the complex relationships and tradeoffs found in logistics operations[16] as well as broader implications for integrated logistics management.[17] Logistics simulations have been applied to university education since the 1960s, with earlier versions relying on the cumbersome operations of mainframe computers and batch processing. Simulations now use the power and convenience of microcomputers to give students the opportunity to run multiple simulations and gauge the sensitivity of their decisions.[18]

Some types of decision support systems (DSS) could also be considered courseware when they are used to analyze specific business problems. Sterling and Raj discussed one such DSS, called SM^{2}ILE, for marketing and logistics education at the senior and MBA levels.[19] SM^{2}ILE illustrated the interfunctional issues and opportunities that affect both logistics and marketing operations in business. The authors noted seven advantages associated with the incorporation of DSS in marketing and logistics courses: the exposure of marketing faculty and students to the financial and service results possible from integrated logistics; the opportunity to combine conceptual and hands-on learning experiences; the ability to provide students with a means of quantifying the tradeoffs of marketing mix alternatives; the exposure to information requirements for DSS applications; examples of the effect of different service levels on costs and profitability; insights regarding the marginal effects of changing variables in the distribution/marketing network; and the capability to perform sensitivity analyses which are more complex than those available from spreadsheets.

Simulation courseware offers the ability to model complex phenomena and incorporate variations that may affect logistics analyses and decision outcomes. When used as an environment to apply logistic tools, simulation can add an important aspect of realism to the classroom environment.

Commercial Logistics Applications: Tying Concepts to Practice

Much of the driving force behind the implementation of computer applications in business education stems from the rapid proliferation of computers in industry. While considering who constitutes the "customers" of university logistics programs offers a rich source for philosophical debate, the fact remains that logistics students are in school to prepare for future positions as managers and executives. Therefore, an important aspect of logistics education involves student exposure to "real world" problems and practices.

Recognizing the importance of building the computer skills of future logistics managers, Stenger discussed hardware issues and provided examples of the various types of applications software that may be used in logistics education.[20] He further identified two objectives that have prompted university programs to integrate computer applications into the logistics curriculum: (1) to allow more comprehensive treatment of the complex trade-offs and interrelationships found in logistics management, and (2) to provide the student with "hands-on" experience with some of the commonly used computer tools and techniques. Noting that "we have only touched the surface in applying computers to the education process in logistics,"[21] he pointed out a number of challenges facing educators. These included the absence or relative sparseness of programs in particular logistics areas, the consumption of scarce resources (including faculty, student, and classroom time), as well as hardware and software requirements. He also pointed out the importance for "both practitioners and academics to cooperate to the greatest extent possible in sharing concepts, techniques, and software where feasible."[22]

As part of their experiments using computers to support collaborative learning, Rutner, Kent, and Gibson incorporated three commercially available logistics-related applications: Q-Rate transportation rating software, ArcView geographic information software, and PC Miler routing and scheduling software.[23] They suggested other commercial logistics software for possible inclusion in course design, such as applications dealing with EDI, logistics facility location, and inventory-transportation tradeoffs. They associated an inadequate availability of commercial logistics and transportation software with university budgetary constraints. In closing, they discussed the importance of using commercially available logistics software in courses and reported that 99% of students involved in the course they studied supported an increase in the number and type of logistics and transportation computer assignments.

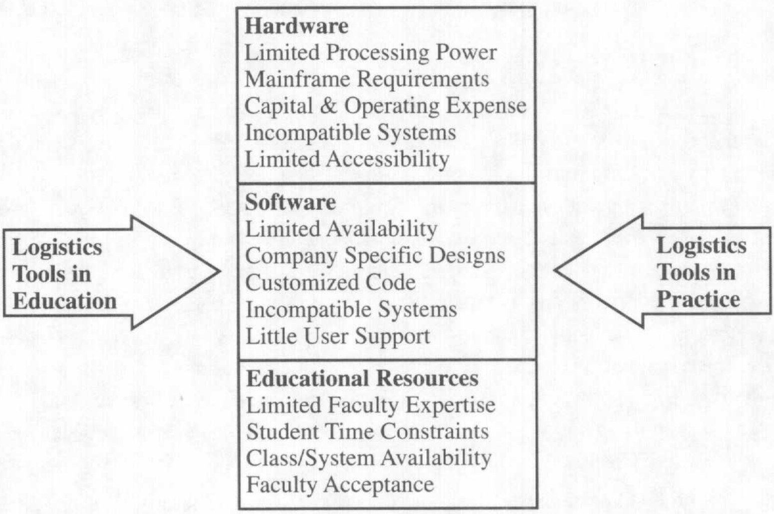
There appears to be little argument concerning the potential benefits of using logistics software in education, and many educators have highlighted the importance of student access to commercially available applications. At the same time, a number of factors have hindered the implementation of logistics management and DSS in education. The topic of the next section.

BARRIERS LIMITING THE INTEGRATION OF EDUCATION AND PRACTICE

Figure 2 conceptualizes the constraints facing educators who attempt to incorporate computers and software applications into logistics management courses. These include hardware and software limitations, a lack of courseware, and a lack of resources.

FIGURE 2

BARRIERS LIMITING THE INTEGRATION OF EDUCATION AND PRACTICE



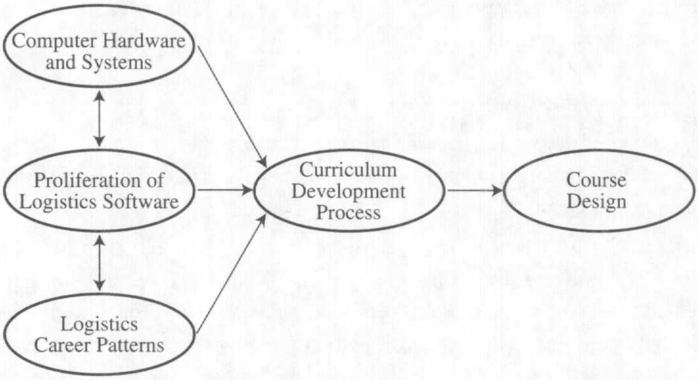
With the exception of the recent presentation by Rutner, Kent, and Gibson,[24] the logistics literature has not addressed the role and application of computer-based logistics management and DSS in education for five years. During those years, dramatic changes in the business environment, computers, and software technologies have significantly reduced many of the barriers to integrating education and practice. The next section outlines these changes and their influence on logistics curriculum development and course design.

FACTORS INFLUENCING CHANGE IN LOGISTICS TOOLS EDUCATION

As shown in Figure 3, the three most notable changes are advances in computer hardware and information systems, a proliferation of software applications designed for specific logistics planning and management activities, and changing career patterns and the nature of competition in today's logistics job market. The influence of each of these on curriculum development and course design is described below.

FIGURE 3

FACTORS INFLUENCING CHANGE IN LOGISTICS TOOLS EDUCATION



Advances in Computer Hardware and Information Systems

The difference between simulations and programs used by businesses and universities five years ago and today has much to do with the revolutions occurring in computing, information systems, and programming technologies. Improvements in computing technology are dramatically affecting the corporate logistics management function. Mentzer, Schuster, and Roberts indicated that in 1990 logistics applications were gradually shifting to microcomputer platforms, with the exception of data-intensive functions (such as order processing) and more sophisticated modeling functions (such as network design).[25] Today, however, even the most data-intensive management applications are shifting from mainframe systems to client-server environments.

"Enterprise systems," which incorporate the concept of a "data warehouse," or more recently a "data distribution center," are being installed in many *Fortune* 500 companies. While they house extensive amounts of corporate information, recent system releases, such as the popular SAP R3, use client-server architecture. Current desktops and even laptops contain enough processing power, storage space, and memory to run some of the most sophisticated network optimization programs available to industry. The net result is a reduction in acquisition, maintenance, and processing costs associated with computer hardware and software.

For university programs, advances in computer hardware are eliminating the capital and operating cost barriers associated with mainframes and are creating the possibility for installing logistics software applications on existing platforms located in faculty offices, computer labs, and in some cases student desktops and laptops. For example, the University of Tennessee recently moved to a university wide client-server network supporting a series of local area networks (LANs) located in various colleges and departments. Four student computer labs are now equipped with 166-mhz pentium PCs connected in LAN and client-server configurations. PCs in each lab are loaded with current versions of general applications software, such as Excel, Word, Access, and Netscape. In some labs, specific applications, such as SPSS statistics and ArcView geographical information system packages, are maintained on the networks.

Proliferation of Logistics Software Applications

Software applications have become more powerful and easier to use. The selection of has increased as logistics experts and programmers combine to create and market applications for all facets of planning and management.

Historically, software applications have been limited by, among other things, structured code requirements and hardware restrictions. The advent of advanced programming languages using object-oriented code is providing developers with a means of creating and modifying programs more efficiently. Open systems architecture is permitting software integration between different applications on the same platform or on a mixed-platform configuration. Graphical user interfaces are providing an informal means of standardization and permitting users to learn basic operating tasks with little training.

In 1989, the CLM guide to distribution software included 150 mainframe, 281 minicomputer, and 334 microcomputer software packages. The 1996 CLM/Andersen Consulting Guide to Logistics Software contained entries for 135 mainframe, 425 minicomputer, 554 microcomputer, and 554 client/server packages segmented into 18 categories of logistics application.

Programming advances such as these are resulting in a proliferation of new software designed to address general as well as specific logistics applications. The ability to integrate systems is providing businesses with the opportunity to mix and match programs to fit their needs. For example, one of the authors has worked with a company that uses an IBM mainframe for order management, accounting, and general business management, an IBM AS/400 minicomputer for inventory management, and a desktop to manage transportation operations.

In addition, new systems are giving third parties immediate access to some of the most advanced logistics management and DSS available. For example, Skyway Systems recently introduced a series of information-based services under the brand name "Concerto." It is designed to orchestrate sourcing, manufacturing, and distribution of products from raw materials through consumer goods. The service will initially provide customers with capabilities for vendor-managed inventory (VMI), order management, and transportation management. While Skyway has organized and packaged the services for customers, the information management system backing the services uses software from three separate vendors: for the order management system Industry Management Internationale (IMI), for the demand management system Manugistics, and for the transportation management system Metasys. This example illustrates an interesting aspect of application development. Both Manugistics and Metasys offer transportation management solutions and are frequently in direct competition for business. In this case, the Metasys system was selected as an alternative to Manugistics, yet it must integrate with the Manugistics system to support this supply chain application.

Another advantage of software proliferation relates to application support and human resources. Traditionally, many logistics management and DSS were designed in house. Companies used internal programming resources to identify application requirements and program solutions specific to their needs. While this may have offered some potential advantage based on system capability, it also required ongoing programming support as well as user training. As an alternative, acquired systems are typically accompanied by service agreements that ensure software maintenance and upgrades as well as user training.

Major logistics consulting firms such as Andersen, KPMG Peat Marwick, and Ernst & Young are actively incorporating commercial software applications into their consulting arrangements. In doing so, they are electing to provide a package solution rather than custom development. As a result, the consulting firms are receiving system implementation and user training to support clients. In this respect, the organization installing the software is not threatened by the possible loss of training and system understanding if an employee involved in system development, maintenance, or application were to leave the organization. This also presents an opportunity for companies to acquire individuals with application experience from the software firm, consulting firm, or other companies using the same system. This last point also leads to the third factor influencing changes in logistics tools curriculum.

Logistics Career Patterns and Competition for Jobs

Both of the previous factors are affecting career patterns and job requirements for current and future logistics managers. In the 1995 Ohio State Survey of Career Patterns in Logistics, La Londe and Masters noted a shift in logistics executives' views regarding information technology.[26] For the first time, executives indicated that information technology, including hardware, software, and telecommunications capabilities, is becoming a dominant factor for logistics management. They further viewed it as a top priority for continuing education and a primary tool for solving logistics problems and seizing opportunities in the future. In the 1996 survey,27 microcomputer skills were rated highly, as were skills and knowledge in such areas as inventory, MRP, and DRP. Again, executives viewed information technology as a primary factor influencing future logistics.

It is important to note that while career patterns are being affected by advances in computer information systems and logistics software, practitioner perspectives of continuous improvement in logistics management are also influencing advances in hardware and software design and application. (This is indicated by the double arrows in Figure 3.) In some cases, user-defined enhancements to software are incorporated into future versions of the package. In other instances, individuals involved in developing leading-edge applications for a logistics organization may leave the company to start or join a software organization in order to profit from their expertise.

For students in logistics, the increased use of packaged logistics management and DSS is shifting the playing field for new jobs. While companies previously expected graduates to have an understanding of logistics concepts and strategies, they now also want graduates to be aware of, and have experience with, systems used in business. This means that students must augment their knowledge of strategy and analysis with an understanding of how systems may be integrated to support logistics planning and management.

All these factors are playing a role in removing barriers to the application of logistics tools in education.

REMOVING THE BARRIERS BETWEEN EDUCATION AND PRACTICE

Advances in computer hardware and information systems, the proliferation of logistics software applications, and changing career patterns in logistics have contributed to removing the barriers identified earlier. Hardware and support costs are declining as system capacities improve. In many cases, existing university platforms are capable of housing a number of the more advanced applications.

The greater selection of software applications in industry has been accompanied by fierce competition among software companies. As a result, firms are eager to expose students to their systems in hopes of affecting their future buying decisions when managers. Many firms are actively soliciting universities to house their systems at no cost and in many cases offer on-site training to encourage faculty use.

Barriers associated with student and faculty time and motivation are being removed as career placement opportunities increase. Logistics is already a significant source of job placement at a few institutions. As future employers, companies are attracted to students who have exposure to and understanding of advanced applications. For students this means a competitive edge for jobs. For university administration and faculty this means competition for the best and brightest students and in some instances competition for corporate-sponsored research.

These factors are working in unison to remove the barrier between practice and logistics tools education. The next section outlines the development of the tools course at the University of Tennessee.

Curriculum Development Process: Tools and Techniques for Logistics Management

Logistic and Transportation 599, Tools and Techniques for Logistics Management (the "tools course"), was created in direct response to student requests and practitioner comments. Because of the timing of the requests, the course had to be prepared quickly. As is frequently the case, necessity is the mother of invention, and the faculty was given an opportunity to test some creative methods for course delivery.

Two members of the faculty who saw particular value in the course offered to oversee a doctoral student in L & T, who developed the curriculum, and coordinated implementation. This team identified key components of the logistics supply chain, which became a focus topic for each week of the course (Refer to Appendix A).

A faculty was formed, consisting of specialists associated with each topic area. The faculty at the University of Tennessee maintains close contact with industry, and members continue to build their practical experience in various functional areas of business. In addition to L & T faculty, course instructors were recruited from the departments of Marketing, Accounting, Management Science, Geography, and Industrial Engineering. Industry executives and consultants also participated as guest lecturers.

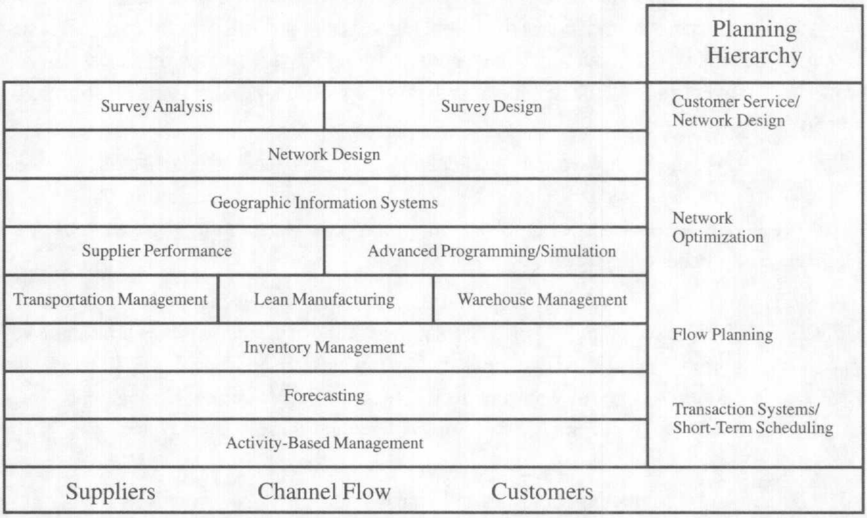
The Department of Marketing, Logistics and Transportation is actively involved in building relationships with select logistics software vendors. In addition, applications not directly associated with logistics, such as activity-based management, were supplied to the course as a result of a relationship between the session instructor and one or more software vendors. For example, students received hands-on experience with a system for activity-based management as a result of a relationship established by Accounting faculty.

The tools course was scheduled to meet for three hours once a week. This allowed material for each topic to be covered in one sitting and also helped recruit faculty, whose commitment was thus limited to one period.

Course Design: Tools and Techniques for Logistics Management

The key focus for the tools course was to expose graduating MBA's to state-of-the-art applications and techniques in logistic management and DSS. Figure 4 shows the topic areas selected and relates them to a modified version of the integrating logistics framework presented by Stenger.[28] In addition to viewing the applications from a planning and operating perspective, the framework considers their location within the logistics system. Therefore, transaction-oriented systems were addressed initially, as a foundation to support higher level planning systems. In addition, the course was designed to introduce tools supporting the customer interface early in the semester, and gradually work back through various aspects of logistic management in an organization as the semester progressed. The final schedule did not hold to this approach, primarily because of faculty scheduling conflicts with other commitments.

FIGURE 4
TOOLS COURSE COMPONENTS AND DESIGN



A related goal was to integrate topics with the students' existing knowledge of logistics management and strategy. This objective did not always presume software as the focus of study. For example, in one early session, students discussed issues associated with survey development and administration, since logistics practice relies increasingly on surveys to measure customer value. In another case, students discussed lean manufacturing management and its implications for supply chain operations. Again, this is not directly system oriented, but a lean enterprise philosophy can dramatically affect logistics management and performance.

Each topic introduced some form of conceptual foundation leading to the software design and application approach when appropriate. In many cases, students were provided hands-on experience with a commercially available software application used to address issues related to the topic. Where system constraints prohibited hands-on training, an attempt was made to present a live system demonstration of a commercial package.

Special opportunities called for scheduling flexibility on the part of students and instructors. Logistics faculty completed an arrangement with CAPS logistics, a software supplier, a few weeks into the semester. CAPS agreed to provide a one-day, on-campus training session, and students agreed to block an entire Friday in order to attend. Similar relationships provided students with training on Insight's, SAILS network design application, and on the Metasys Metafreight transportation management system. In each case, two smaller groups of students received training at the companies' facilities. In addition to this training support, the university was provided with the latest versions of all three software applications for use in education and research.

Operating characteristics associated with the category of application being studied also affected course design. Transportation, inventory, and warehousing management systems are difficult to incorporate into a classroom environment because they are designed to accommodate large numbers of transactions. This constraint was addressed in the tools course through a number of mechanisms.

The warehouse management topic was supported with a tour of the Honda USA distribution center in Loudon, Tennessee. This gave students a first-hand look at the integrating factors to consider in the development and implementation of computerized warehouse management. Company guides discussed the control mechanisms used to direct personnel and materials handling equipment in the management of inbound and outbound freight.

Tours could not be arranged for all systems. As noted above, training with the Metafreight transportation management system was limited to a few students, but the entire class was provided with a demonstration of such systems by Metasys and Manugistics, two leading suppliers of packages to industry. In a similar manner, inventory management training was addressed via a spreadsheet demonstration used to analyze changes in demand, transaction cost, and carrying cost factors, as well as the effect of the number of stocking facilities on total inventory investment. This information was reinforced with a conceptual demonstration of the E3 inventory management system which is used by wholesalers and retailers for purchasing and retail replenishment, as well as by manufacturing firms for vendor-managed inventory applications.

Table 1 lists course topics, the relevant software applications, and the type of exposure students received.

TABLE 1

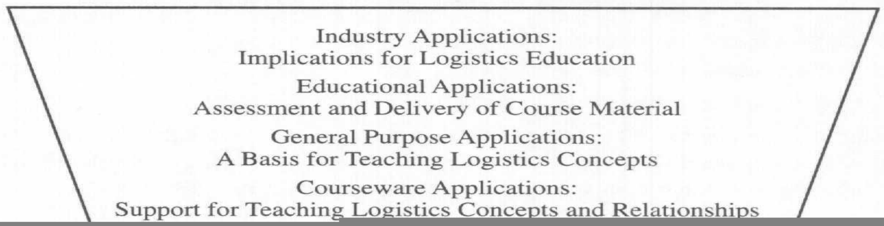
COURSE TOPICS AND EXPOSURE

Topic	Application	Exposure
Activity Based Management	NetProphet II, EasyPlus	Hands-On Training
Forecasting Management	Multicaster	Hands-On Training
Inventory Management	E3/Spreadsheet Models	Conceptual Demonstration
Transportation Management	Metasys Metafreight	Hands-On Training
Lean Manufacturing		Conceptual Demonstration
Warehouse Management	Custom - Honda USA	Site Visit Demonstration
Advance Programming	Internet-Based LP Systems	System Demonstration
Network Design	CAPS Logistics Toolkit	Hands-On Training
Geographic Information Sys	ArcView GIS	Hands-On Training
Survey Design		Hands-On Design Exercise
Survey Analysis	SPSS	Hands-On Training
Supplier Performance		Conceptual Demonstration

A second component of the tools course was semester-long group projects to gain a deeper understanding of a specific software application or category of applications. Various approaches used by students ranged from application training to research. The projects culminated in a series of presentations to the class at the end of the semester, which provided a peer perspective on the issues under investigation, the availability of tool solutions, and the efforts required to apply the tool in practice. Table 2 identifies the topics addressed in student projects, the tools involved, and the approach used.

FIGURE 1

THE NARROWING ROLE OF COMPUTERS AND SOFTWARE APPLICATIONS IN LOGISTICS EDUCATION



Conclusion and Implications

As with any new offering, the tools course will go through some modifications in the coming years. Initial feedback from students and faculty is overwhelmingly in favor of incorporating the course as an MBA elective. In response, the department has moved the course to a regular slot during the fall semester for those students entering the second year of the graduate program.

Some of the suggested changes in design include reducing the number of course topics to six or seven key areas. This indicates a desire on the part of students to increase the depth of investigation associated with each area. Based on student and faculty input, areas proposed for this focus include enterprise systems, forecasting management, inventory management, transportation management, warehouse management, network design, and performance management.

Incorporating varied faculty to take advantage of their particular expertise was also viewed as a tremendous benefit by students. This approach is expected to be used in the coming fall semester offering. Cross discipline course presentation is frequently touted as a means of removing the functional silos from graduate education. To achieve it, some form of coordination, such as that provided by a graduate assistant, may be necessary to help integrate class activities.

Future versions of the course may also benefit from the implementation of a case study designed to incorporate each of the tools as part of a semester-long analysis. This is being investigated by the coordinating team and offers an opportunity for a more integrated course design as proposed by Rao, Stenger, and Wu.[29]

Twenty-four students took the course and eight have been hired by consulting firms, where they will become involved immediately in projects associated with one or more of the systems covered as part of the class. Two students have been hired by separate manufacturing firms, where they will be directly involved in decisions to purchase network design applications (which they have reviewed as part of the tools course). In addition to these employment opportunities, a number of firms that provided software for the course have initiated a recruiting relationship with the university for both internships and full-time positions. Three of these companies also gave the department software that represent a market value of more than $200,000. In some cases, these applications are available for research as well as classroom instruction.

This paper suggests that the development at other universities of courses similar to the tools course discussed here presents an opportunity to investigate the effect of this type of focused education on logistics practice and the diffusion of technology. Introducing students to advanced tools and techniques for logistics management before they enter the work force may lead to quicker adoption of management and DSS technologies and increased productivity in logistics practice. It is also important for researchers to assess industry perspectives regarding student educational requirements. Mentzer, Schuster, and Roberts indicated that universities are not providing the educational support in computer applications needed by logistics managers.[30] The model presented in Figure 3 proposes three influencing factors which may affect curriculum development. While the model is based on previous research and secondary data, it would be interesting to gather practitioner insights regarding these antecedents as well as their opinions regarding topic areas most appropriate for undergraduate, graduate, and executive level logistics education.

Perhaps the most important implication for logistics educators is that changes in technology and job requirements are helping to remove barriers that have limited student exposure to commercial applications. The practical guidance offered here for curriculum development and design, including recommended topics areas, a structure for course progression, a list of applications associated with selected topic, and some creative methods for addressing resource constraints, should be helpful.

For practitioners, this paper illustrates one university's commitment to meeting the needs of industry in the development of future logistics managers and executives. The tools course offered at the University of Tennessee and similar courses elsewhere indicate that logistics educators share industry perspectives regarding the influence of information technology on logistics management. Continuing cooperation between universities and businesses is needed in the development of innovative ways to provide logistics education.

APPENDIX A
COURSE SYLABUS

University of Tennessee
Department of Marketing, Logistics and Transportation

Dr. C. John Langley Jr.
Dr. Ray A. Mundy
Mr. Carlo D. Smith
(Spring Semester, 1997)

LOGISTICS 599
TOOLS AND TECHNIQUES FOR LOGISTICS ANALYSIS

PURPOSE AND OBJECTIVES OF L&T 599:

L&T 599 "Tools and Techniques for Logistics Analysis" is designed to provide you with an understanding of various software applications and analytical methods used by researchers, consultants, and practitioners to address issues related to logistics planning and problem analysis. Our purpose in developing this course is threefold: 1) we want to expose you to logistics related problems and issues commonly faced by managers, consultants, and project analysts, 2) we want to present you with examples of specific software tools and analytical techniques used to investigate and develop solutions to these types of problems, and 3) we want you to become more familiar with the benefits and limitations of a specific software tool, or category of tools currently used in planning and management.

In a similar manner, we have a two part objective in your completion of L&T 599. When you become involved in a project related to topics presented in this course; 1) we want you to be able to understand and articulate problems, potential solutions, and related issues associated with the project, and 2) we want you to be familiar with specific tools, methods, or categories of software available to address such issues.

FACULTY:

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314 Stokely Management Center
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974-1651 (rmundy@utk.edu)

COORDINATOR:

Carlo Smith
Graduate Assistant
218 Glocker Building
974-0595 (cds@utk.edu)

CLASS TIME AND LOCATION:

Tuesday Nights: 6:00 pm to 8:30 pm, Glocker Room G233

Please plan to bring a laptop PC to class.

In some cases, class will be located in one of the campus computer labs.

CLASS ASSIGNMENTS:

Individual assignments may be presented prior to, or in conjunction with the class period dealing with the associated topic. Assignments may be presented at the discretion of teaching faculty. Carlo Smith will coordinate the distribution and collection of specific class assignments.

COURSE PROJECT:

Working in teams of approximately four individuals, you will have a chance to complete an in-depth analysis of one or a category of logistics planning and analysis tools. The goal of this project is for you to build an in-depth understanding of a category of software or specific software program used for logistics planning and analysis, and to present your colleagues with information regarding available tools and their application in logistics. Two approaches are outlined below as possible frameworks for the project and presentation. This semester project will conclude with a 1.25 hour presentation to the class which may include findings, recommendations, demonstrations, and so forth.

1) **Applying a software tool to a specific logistics problem, demonstrating your approach to analysis, system implementation, and recommendation** – As part of this project your group will apply a package used for logistics planning and analysis to a live or case study situation. The Department of Marketing, Logistics, and Transportation currently has access to various "live" and demonstration versions of software used for planning and analysis, (for example, INSIGHT has provided a version of SAILS for network analysis). Considering SAILS as an example, your group will identify a case situation requiring the evaluation and recommendation for changes to a logistics network. Once you complete the analysis, you will be expected to present your case to the class, discuss your approach to the case analysis, information requirements, alternative possible solutions, your recommendation of the best alternative network design, as well as any difficulties you experienced when using the software for analysis. A demonstration of your solution set during your presentation is encouraged.
2) **Evaluating a category of logistics software and presenting a comparison of application strengths and weaknesses, recommending a best solution** – For this project, your group will select a category of logistics software, (for example, routing packages). After identifying the requirements and features of an effective routing package, you should attempt to review currently available packages. This analysis may be based on specific marketing material, input from current users of the software, and whenever possible, the review of a demonstration version of the software. Once reviews are complete you will be expected to present to class

discussing the focus of the application, minimum software requirements to address the situation, features and benefits of alternative packages, and your selection of "best in class." A product demonstration during your presentation is encouraged.

With either alternative, groups are encouraged to approach the assignment as a consultant might. For example, those involved in the assessment of a category of logistics software should investigate the types of requirements and issues that companies must consider when deciding upon the best product. As a result, they may prepare an RFP associated with the application requirements and solicit information, demonstration material, and so forth to address items on the RFP.

GRADING:

The objective of L&T 599 is to provide a learning environment where you can participate in discussions with experts involved in various fields of planning and analysis. Grading for this class is based primarily on your contribution to the class discussion as well as the results of your course project.

CLASS TOPICS AND SCHEDULE:

Class	Topic/Instructor
1/21	Introduction: Dr John Langley, Dr Ray Mundy
1/28	Forecasting: Dr. J. Tom Mentzer
2/4	Survey Design: Dr. Joe Rentz (Marketing)
2/18	Activity Based Management: Dr. Jim Reeve (Accounting)
2/25	Advanced Programming / Visualization in Logistics: Dr. Chuck Noon (Management Science)
2/28	Site Visit: DC Operating Systems / Honda US Mr. Kevin Shea (Practitioner)
3/4	Geographic Information Systems in Logistics: Dr. Bruce Ralston (Geography)
3/7	Order/Transportation Management Systems: Mr. Wesley Burdette (Consultant)
3/18	Lean Manufacturing Management: Dr. Ken Kirby (Industrial Engineering)
3/21	Application Training: CAPS Logistics Toolkit, Ms. Terri Amos (Software Supplier)
4/8	Inventory Management: Dr. Jim Foggin
4/15	Measuring Supplier Performance: Dr. Ray Mundy
4/22	Statistical Analysis of Survey Results: Carlo Smith/Mike Garver
4/24	**Presentations**
4/29	**Presentations**

NOTES

[1]R. H. Ballou, *Business Logistics Management* (Englewood Cliffs, NJ: Prentice-Hall, 1992).

[2]A. J. Stenger, "Building Computer Skills of Current and Future Logistics Managers," 14th Annual Transportation and Logistics Educators Conference, Dallas, TX; 1984. The National Council of Physical Distribution Management.

[3]Same reference as note 2.

[4] J. A. Kling and C. M. Grimm, "Microcomputer Use in Transportation and Logistics: A Literature Review with Implications for Educators," 17th Annual Transportation and Logistics Educators Conference, Atlanta, GA, 1987.

[5]A. J. Stenger, "Electronic Information Systems – Key to Achieving Integrated Logistics Management," 17th Annual Transportation and Logistics Educators Conference, Atlanta, GA, 1987.

[6]J. T. Mentzer, C. P. Schuster, and D. J. Roberts, "Microcomputers versus Mainframe Usage in Logistics," *Logistics and Transportation Review* 26, no. 2 (1990): 115-132.

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[8]R. L. Cook, O. K. Helferich, and S. Schon, "Using an AI-Expert System to Assess and Train Logistics Managers: A parts Inventory Managers Perspective," 16th Annual Transportation and Logistics Educators Conference, Anaheim, CA, 1986.

[9]S. M. Rutner, J. L. Kent, and B. Gibson, "Using a Computer in a Logistics Course to Enhance Collaborative Learning," 25th Annual Transportation and Logistics Educators Conference, Orlando, FL, 1996.

[10]E. Thomchick, "Applications of Collaborative Learning Techniques to an Undergraduate Logistics Case Study Course," 24th Annual Transportation and Logistics Educators Conference, San Diego, CA, 1995

[11]W. L. Grenoble and J. E. Tyworth, "Spreadsheet Modeling in Logistics: Advancing Today's Educational Tools," 19th Annual Transportation and Logistics Educators Conference, Anaheim, CA, 1990.

[12]J. E. Tyworth and W. L. Grenoble, "Spreadsheet Modeling in Logistics: Advancing Today's Educational Tools," *Journal of Business Logistics* 12, no. 1 (1991): 1-26.

[13]K. A. Rao, J. Stenger, and H. Wu, "Using Computer Technology to Enhance the Teaching of Integrated Logistics Management," 20th Annual Transportation and Logistics Educators Conference, New Orleans, LA, 1991.

[14]Same reference as note 13.

[15]Same reference as notes 11 and 12.

[16]C. K. Walter and M. Crum, "Inventory Simulation Model (INVENSIM)," 17th Annual Transportation and Logistics Educators Conference, Atlanta, GA, 1987; and G. E. Germane, "Western Transport Company," 17th Annual Transportation and Logistics Educators Conference, Atlanta, GA, 1987.

[17]K. A. Rao, A. J. Stenger, and H. Wu, "Teaching the Development of Logistics Strategies Congruent with the Firms Corporate Objectives," 21st Annual Transportation and Logistics Educators Conference, San Antonio, TX, 1992; and K. A. Rao, A. J. Stenger, and H. Wu, "Training Future Logistics Managers: Logistics Strategies within the Corporate Planning Framework," *Journal of Business Logistics (1994)*: 249-72.

[18]J. W. Gentry, G. C. Jackson, et al., "PROLOG: A Business Simulation Game for Developing Professional Logistics Managers," 17th Annual Transportation and Logistics Educators Conference, Atlanta, GA, 1987.

[19]J. U. Sterling and P. S. Raj, "Using a Decision Support System to Integrate Marketing and Logistics Education," 21st Annual Transportation and Logistics Educators Conference, San Antonio, TX, 1992.

[20]Same reference as note 2.

[21]Same reference as note 2, p. 19.

[22]Same reference as note 2, p. 20.

[23]Same reference as note 9.

[24]Same reference as note 9.

[25]Same reference as note 6.

[26]B. L. La Londe and J. M. Masters, "The 1995 Ohio State University Survey of Career Patterns in Logistics," Annual Conference Proceedings, San Diego, CA, 1995.

[27]B. L. La Londe and J. M. Masters, "The 1996 Ohio State University Survey of Career Patterns in Logistics," Annual Conference Proceedings, Orlando, FL, 1996.

[28]Same reference as note 2.

[29]Same reference as note 13.

[30]Same reference as note 6.

ABOUT THE AUTHORS:

C. John Langley, Jr. is the John H. Dove Distinguished Professor of Logistics and Transportation at the University of Tennessee. He was a member of the Council of Logistics Management Executive Committee from 1984-1992 and served as president from 1990-1991. He received the Outstanding Alumnus Award from the Business Logistics Program at Pennsylvania State University in 1989, and the Council of Logistics Management Distinguished Service Award in 1993.

Ray A. Mundy is the Taylor Distinguished Professor of Logistics and Transportation and Director, Transportation Management and Policy Studies. Dr. Mundy currently teaches courses in quality, carrier management, and logistics and is the MBA and Ph.D advisor to Logistics graduate students. He has authored numerous industry reports, is an active lecturer at national transportation and logistics seminars, and is a frequent contributor of articles to trade publications and journals.

Carlo D. Smith is a research associate and doctoral candidate in the Department of Marketing, Logistics and Transportation and the University of Tennessee. His dissertation research is focused on the measurement of forecasting management performance and its impact on supply chain operating performance. Prior to starting his doctoral studies, Mr. Smith spent 10 years in industry in logistics consulting, executive education, and corporate logistics management. Mr. Smith received his BS and MBA in Logistics from the Pennsylvania State University. In addition to forecasting management, his research interests include supply chain management, inventory management, and performance measurement.