EFFECTIVE PORT MANAGEMENT IS THE FOCUS OF NCTIP

The last decade has seen a remarkable growth in the volume of containerized cargo. On average, the volume grew 6% annually in the United States, 1.5% in Canada, and 10% worldwide, a trend likely to continue through the next decade.

Experts estimate that by the year 2010, 90% of the world’s liner freight will move in containers (USDOT 1998). This growth has been fueled by strong U.S. and, until recently, Asian economies, elimination of international trade barriers, and shifting patterns in global manufacturing and consumption. Growth has also been facilitated by the substantial technological developments in maritime intermodal transportation.

Introduction of high-speed hull designs and larger container ships capable of carrying over 3,000 TEU (twenty-foot equivalent units) containers substantially increased the productivity of water line haul. On-dock rail facilities expedited the transfer of containers between ship and rail, and contributed to the increased productivity of terminal operations by decreasing the amount of container handling. Direct rail access to on-dock facilities induced a mode shift from truck to rail in the delivery of containers. Approximately 300 trucks for each double stack train that comes to the port have been eliminated, thus reducing congestion at the gates. Automation of terminal gates has further alleviated truck congestion by providing impeded truck access and equipment interchange.

Research Project
Recognizing the fact that the ports are critical engines of the U.S. economy, The National Center for Transportation and Industrial Productivity (NCTIP) has initiated a set of research projects designed to improve the seamless interface between land and water modes at an intermodal port. The objective is to improve the productivity of the terminal container handling operation and customer service quality.

The project is a joint effort with Maher Terminals Inc., a Jersey City-based company that operates terminals in New Jersey, New York and Florida. The company handles approximately 400,000 of the containers that come through the port of New York/New Jersey. Maher Terminals, Inc. has been a leader in the use of information technology and management of cargo-related information flows to enable seamless transfers of containers between modes. Its subsidiary, Maher Terminals Logistics Systems, is a major developer of software for port management and logistics applications.

Port Operation
Ports in the United States are usually publicly owned facilities leased to private operators. In general, ports fulfill many functions, some of which create significant challenges. These include:

- Transport—including trans-shipment, storage, warehousing and related commercial activities
- Distribution—including physical and non-physical or business-linked distributions as a function of a variety of hinterland connections, and
- Large scale employment, community, and environmental issues.

Effective port management must take these characteristics into consideration as much as possible in planning an operation that satisfies the economic objectives of the port. Where a terminal is privately operated, maximizing profits, or maximizing throughput subject to minimum profit and service requirement constraints, is the goal. Complexities of supply and demand for port services require a managerial effort that goes beyond the technological advancements designed to speed up the transaction processes.

The Challenge
In order to provide high-quality service to a customer whose trucks are calling at the port, the terminal operator must be able to predict the level of activity at the terminal — measured in the number of truck or container arrivals — so that container handling equipment can be assigned accordingly. Insufficient equipment will result in longer service times, delays and, ultimately, congestion as the trucks first queue up at the terminal gates and then start spilling onto the local streets. Excess equipment will result in an unproductive operation draining the terminal operator’s resources.

Two types of container moves need to be forecasted. Export containers are those that arrive by a land mode and leave the port by...
As I write this column, my first as Director of NCTIP, two thoughts cross my mind. I am compelled to share them with you.

First is the realization that things have come full circle. Not long ago I sat in Prof. Edward Morlok’s office at the University of Pennsylvania, a young Ph.D. student looking for advice on a carrier in transportation from a well-known educator in the field. The year was 1987 and Congress had just authorized the University Transportation Centers (UTC) Program. Prof. Morlok described the program as an excellent opportunity for students to pursue graduate education in transportation. I took his advice.

I can report that the UTC program profoundly impacted my career choice and professional development. The program provided me with a scholarship funded through the Mid-Atlantic University Transportation Center at Penn State, enabling me to continue my doctoral studies and pursue a career in transportation. Equally as important, the program created a sense of belonging to the transportation community. It gave students an opportunity to interact with colleagues, learn the trade, and meet transportation professionals. I worked with Ed writing proposals and learning the ropes of securing matching funds. This experience led to a short stint in railroading, working for Dr. John Betak, AVP at Conrail at the time. John is a wonderful person and a champion of the UTC program in the railroad industry.

As an educator who grew up professionally with the UTC Program, it is both an honor and obligation for me as a Director of a UTC center of excellence, to carry out the UTC Program’s mission and provide students the same opportunity I was afforded 12 years ago.

This brings me to my second thought. As an adage goes, …time flies when you are having fun. And these last 12 years have been a wonderful learning experience that I have enjoyed beyond measure.

As Director of NCTIP, I succeed Prof. Louis Pignataro. Lou has been a mentor and friend for many years. I expect to work closely with him in the future and rely on his counsel. Dr. Pignataro will continue to serve as Executive Director of the Institute for Transportation at NJIT, and Director of the TIDE Center and the TELUS Project.

The Spring 1998 issue of On Route featured an article on HOV lanes. Since then the state of New Jersey eliminated the HOV lanes on I-80. While HOV lanes can be an important tool for reducing congestion and air pollution, it is clear that the marketing campaign and other strategies designed to encourage their use need to be revisited.

NCTIP and the Interdisciplinary Program in Transportation measure their success through students and alumni working in the transportation industry. As such, several students have made us especially proud. Ms. Lucie S. Thibeaud, an M.S. student received the 1998 UTC Student-of-the-Year award. She is featured in the article on page 7 of this newsletter.

Mr. Alex Sideris received a $1,000 scholarship from the Council of Logistics Management’s New Jersey Roundtable, and attended the CLM’s Annual Conference in Anaheim, California as an M.S. student. Alex has chosen to continue his Ph.D. studies. He is the person behind the research efforts in the area of seamless land and intermodal port interface. An aspect of this research is featured in our lead article.

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Lazar N. Spasovic, an associate professor of management and transportation at NJIT, has been appointed Director of the National Center for Transportation and Industrial Productivity (NCTIP) as of October 1998. In this position, he assumes responsibility for a U.S. Department of Transportation (USDOT) grant with a budget of $3 million, and will be responsible for leading NCTIP’s educational, research and technology transfer activities into the next millennium.

An expert in the areas of freight transportation, business logistics and transportation systems analysis, Dr. Spasovic has been a leader in NJIT’s transportation research and education programs and has more than ten years of corporate and academic transportation experience. Having worked within both the public and private sectors, he has a proven track record in funded research and scholarly activities, and has more than 60 refereed journal and proceedings papers and professional presentations to his credit. Spasovic has taught courses in multi-modal freight transportation systems analysis, urban transportation planning, urban systems engineering, demand forecasting, and quantitative methods for business. He is currently principal investigator on two major research efforts in freight transportation.

A member of the NJIT faculty since 1990, with a dual appointment to the School of Management and the Interdisciplinary Program in Transportation, Spasovic is also a faculty member at the Graduate School of Management at Rutgers University-Newark. He is a member of the Transportation Research Board’s Committee on Freight Transportation Planning and Logistics, and the Transportation Research Forum.

Dr. Spasovic holds a Ph.D. degree in Systems Engineering from the University of Pennsylvania, an M.S. in Civil Engineering from the University of Maryland at College Park, and Diploma in Transportation Engineering from Belgrade University.

NCTIP is one of four national transportation centers funded under the University Transportation Centers Program of the Research and Special Projects Administration of USDOT. Since its establishment in 1990, NCTIP has been a leader in the areas of passenger and freight movement efficiencies, as well as facility, institutional and regulatory efficiency.

Francis Vanek, a 1998 graduate of the University of Pennsylvania, is the winner of the annual Student Paper Competition sponsored by The National Center for Transportation and Industrial Productivity.

Dr. Vanek’s entry, entitled “Freight Transportation, Logistics Activities, and Efficient Environmental Regulation: A Leaner, Greener Approach,” was chosen unanimously by a committee of NJIT Transportation faculty from numerous papers submitted from across the United States. He received an award of $1,000.

Vanek received his bachelor’s degree in Mechanical Engineering and Asian Studies from Cornell University in 1991. After two years’ employment with Nissan Motors as a technical translator and interpreter, he undertook graduate studies at the University of Pennsylvania, earning a masters degree in Systems Engineering in 1995 and a Ph.D., also in Systems Engineering, in 1998. His doctoral research focused on the environmental impact of freight transport and logistics activities, using the breakdown of freight flows by commodity and spatial pattern in the United States.

Vanek’s current research focuses on the connection between freight transport and logistics management on the one hand, and the adequacy of infrastructure, congestion and air pollution, and energy efficiency on the other, as applied to the United Kingdom, United States, and the European Community. He is also an instructor in the areas of freight transport, warehousing, and green logistics for business and logistics students at Heriot-Watt and Edinburgh Universities, at both undergraduate and masters levels.

The Student Paper Competition is open to those enrolled in a transportation or transportation-related academic program, or conducting associated research. It is held each year at the end of spring academic term.
ship. They are associated with a particular vessel and they enter the port following an arrival-time diagram. Import containers are those that arrive by ship and upon unloading are picked up by truck or rail mode. Import containers follow a similar pick-up time diagram. Thus, the in-port traffic demand for a vessel voyage may be described as a distribution of daily container arrivals before, and a given vessel, and limiting information to the estimated voyage date at the port, a terminal operator is able to estimate the number of arrivals for the current date, presuming that there are less than \( k \) operating days before or after the vessel’s arrival.

Combining previous voyages of the ship in a general model, a demand pattern is developed. More specifically, the derived model represents a probability distribution expressing the probability \( P(i) \) \( [i=1…k] \) that a container will arrive on day \( i \) before the scheduled voyage date. Additionally, the total number of expected arrivals is required, information readily available for the import section. A better organizational effort, however, is required for the export section, although an accurate estimation is feasible.

The more sophisticated model pursues a more dynamic approach by utilizing real-time information on inventory conditions to revise the forecasts. The current progress of arrivals/pick-ups for a given voyage is taken into account to dynamically adjust the forecast for the next day of operation. The derived estimate represents a conditional probability \( P(i|A) \) that a container assigned to a particular voyage will arrive on day \( i \) before the scheduled voyage date, on the condition that \( A \) units have already arrived the days before \( [k…i+1] \).

Acquiring a reliable model for distributions of the container arrivals during the terminal operation was the critical point in the successful development of the proposed forecasting model. A more challenging issue in this respect was the need to construct a unique arrival/departure pattern for any containership scheduled to call at the port. Since the project is targeted towards a real-time operation application, the development of general theoretical probability distribution is deemed insufficient.

Maher Terminals’ Fleet Street Terminal in Port Newark consists of 10 shipping berths and a land area exceeding 500 acres. Transaction files for this site were used for the study. The data included detailed keys to track each and every container movement occurring at the port during a specified time period. A considerable amount of time and effort in collaboration with terminal officers was required to formalize the data loading, scrubbing and conversion. Imported records are stored in two main data record-sets, one each for the export and import moves.

A major requirement for the data-driven technique was the development of a management information system to allow for quick retrieval of historic voyage patterns. Built on form layers, each accessible from the other via a defined button click, this consistent and
carefully designed system facilitates ease of use and self-documentation.

**The System**

The system was developed in Microsoft (MS) Access 97 and runs under Windows NT®. Source code is written in MS Visual Basic for Applications (VBA) and references the MS DAO 3.0 Object Library. Auxiliary objects created in MS Excel 97 and MS Graph 8.0 are linked to the ACCESs application through OLE Automation. All procedures are fully automated and no programming or software familiarity is required of the user. The database program is capable of directly importing files provided from the terminal in text format. This feature allows for frequent data updating to include the most recent voyages.

Two similar but separate analytical modules, which facilitate the concurrent analysis of past voyages for a particular vessel, are available for the retrieval of information for respective export and import sectors. Finally, a module provides additional functionality through a process of forecasting the total daily demand for a given sequence of scheduled voyages and corresponding shipment loads.

Fig. 1 shows the initial form in which the user selects the code (from a library of codes) for the vessel under consideration. The vessel code is a two-digit string, unique for each vessel. The vessel in question is the Atlantic Concert (Code: A1), operated by ACL. Consequently, the control is transferred to the next form, shown in Fig. 2, which gives all voyage dates for the selected vessel.

Two options are currently available for the analysis. By selecting a particular voyage date, the user can retrieve from the database the demand pattern observed in any of the voyages available in the database. Results of the query are shown in Fig. 3. The general demand profile is constructed from all the available voyages for a particular vessel occurring within the previous seven months, an average of 4 to 6 voyages for most vessels calling at the port. Assuming that the current distribution is more likely to follow the pattern observed in the recent past, the weighted average of the daily demand is calculated to count for the deviations in shipment size. Results are shown in Fig. 4.

**Forecast Accuracy**

For a particular voyage, the accuracy of a forecast was evaluated by comparing the observed data with the constructed data from the historical information profile. The practical nature of the followed approach precluded the use of a formalized statistical test.

The evaluation process is fully integrated within the voyage information retrieval tool. Once a voyage date is selected, observed data associated with the particular voyage are transferred from the database to a new spreadsheet by clicking the corresponding button. In this case, the vessel under question is Atlantic Companion (Code: A0), operated by ACL. The forecast distribution model is then developed to allow for comparison. Figs. 5 and 6 illustrate graphically the evaluation report for a sample voyage. The light shaded bars represent the forecasted arrivals.

Twenty-four export voyages of different vessels were examined. In most cases the correlation coefficient is relatively high, indicating a sufficient adjustment of the derived model to the actually observed values. The standard error was found acceptable in practice. For the import section, the analysis included twenty-nine recent voyages, with similar results.

The last step involves the use of vessel profiles to forecast total daily demand. For a given sequence of scheduled voyages, overlaying in time the associated vessels’ profiles develops a projection of the total daily container arrivals. The process stipulates that the terminal operator know the schedule of the upcoming vessel calls. Each voyage attribute is associated to a field in the table. Each entry corresponds to a particular voyage. Fig. 7 displays a sample.
Fourteen graduate students from the Interdisciplinary Program in Transportation at NJIT recently attended the 78th Annual Meeting of the Transportation Research Board (TRB), which was held in Washington D.C. from January 10 to 14, 1999.

TRB is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. Its Annual Meeting, one of the largest forums in the world for information exchange among transportation professionals, draws approximately 4,000 engineers, scientists and other transportation researchers and practitioners from the public and private sectors and academia.

From both practical and research perspectives, every area and mode of transportation is represented at this conference through numerous sessions, workshops, and committee meetings. Students could attend presentations on topics of particular interest to them, and meet field leaders and transportation professionals. TRB sponsor exhibits, showcasing recent research projects and product development, provided additional resources for information on current technological advancements.

Attending TRB has become an eagerly anticipated Transportation tradition at NJIT, with students organizing the trip for the third consecutive year. Their participation was made possible by funds allocated from the three active GSA-sponsored Transportation clubs, in addition to the financial support and encouragement of Professor Lazar N. Spasovic, Director of NJIT’s National Center for Transportation and Industrial Productivity (NCTIP), a U.S. Department of Transportation Center of Excellence.

An informal reception was held at the Omni Shoreham Hotel on Tuesday, January 12, 1999. This year, for the first time, students organized and hosted a hospitality suite, designed to enhance the visibility of the academic and research programs available at NJIT through NCTIP and the Institute for Transportation. The hospitality suite provided a casual forum for students and their academic advisors to interact with faculty members, researchers and fellow students from academic institutions around the world.

Enjoying their own hospitality suite, Transportation students, Abir Thakurta, Jakub Rowinski, Dominick Minneci and Yanni Maris are joined by Dr. Lazar Spasovic, NCTIP director, at the annual TRB convention.

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Corporation has acquired Conrail’s assets in the east, detailed what it will mean for New Jersey in terms of new opportunities for shippers, impacts on residents, and challenges for public agencies seeking to ensure adequate infrastructure for both passenger and freight rail traffic.

The 1999-2000 Seminar Series will begin October, 1999. Anyone who is not on our seminar mailing list and wishes to be notified, please e-mail: omalley@megahertz.njit.edu. Seminars are also posted on our web page: http://Kimon.njit.edu/nctip/seminars.

Unless otherwise specified, seminars are held on Thursdays, from 3-5 p.m., in the Guttenberg Information Technologies Center, Room 3710, on the NJIT campus in Newark.

voyage sequence. Fig. 8 graphically presents the report generated by running the model. The 3-D graph shows the temporal distribution of container arrivals/pick-ups before and after each voyage. The highest bar chart shows the total daily expected container demand.

Conclusions

Potential gains from the improved productivity of port operations, terminal access and services are obvious, and are likely to be shared among a number of entities. Research results provide for better service for trucks by decreasing their wait time at the gate, thus improving fleet productivity and reducing congestion from spillover truck traffic waiting at the gates to be processed to the highway network, New Jersey Turnpike, and local roads in the port area. The operator will improve its productivity by assigning the proper number of cargo handling equipment. These combined impacts and the use of the technology may translate to an increase in global competitiveness for the U.S. business entities at the port.

Since her arrival in the United States from Haiti more than ten years ago, a long list of achievements and honors have accrued for Lucie Thiebaud. To these she adds NCTIP’s designation as 1998 Student of the Year. The award was presented at the 78th Annual Meeting of the Transportation Research Board (TRB) in Washington D.C. in January 1999.

Ms. Thiebaud’s list of accomplishments began in high school, where she was named to Who’s Who Among American High School Students, received the Distinguished Scholar Award, a four-year scholarship towards undergraduate studies, and the Edward J. Bloomstein Scholarship. As an NJIT undergraduate, she achieved recognition in Who’s Who Among Students in American Colleges, the Estrin Leadership Award, and a Community Service Merit Award; was chosen for the Housing Scholar Program, named Scholar Athlete and Undergraduate President of the Year for Alpha Kappa Alpha Sorority in the North Atlantic Region.

During her time in the master’s program, Thiebaud served as president of the student chapter of the Intelligent Transportation Society of America, was an active member of the Institute of Transportation Engineers and helped organize the initiation proceedings for a Women’s Transportation Seminar’s NJIT chapter. She was involved with the Society of Women Engineers, the American Society of Civil Engineers, the Black Association of Student Engineers, the National Society of Black Engineers, and the Haitian Student Association, and was inducted into Alpha Epsilon Lambda, NJIT’s Graduate Honor Society. She continues as an active member of several of these organizations.

"My journey into the transportation planning industry has been such an enlightening experience that keeps on triggering different aspects of my yearning for knowledge. Furthermore, enjoying my work and having a constant challenge make my growth in the industry easier and more interesting,” she says.

Thiebaud received her master’s degree in Transportation Engineering in 1998, and her bachelor’s degree in Civil Engineering in 1995, both from NJIT. She is currently employed with the North Jersey Transportation Planning Authority, a metropolitan planning organization responsible for thirteen of the twenty-one counties in New Jersey, as Senior Transportation Planner for Modeling Applications. She plans a 1999 return to NJIT to pursue a doctorate in the area of operation management, which basically examines management of the processes and resources that produce products and deliver services. Her long-term goal is to combine her learning experiences with teaching basic transportation planning and network modeling.
Mr. M. Shoaib Chowdhury, a Ph.D. candidate, received a $2,000 George Krambles Transit Scholarship for 1998. The scholarship, administered by the George Krambles Foundation, seeks to encourage students to pursue careers in public transit. In addition to his generosity, George Krambles, former General Manager of the Chicago Transit Authority, is known for his beautiful collection of historic photos of transit facilities in the Chicago area.

Our alumni are an enormous asset to the transportation profession, the university, and the state as a whole. We invite them to get in touch with us by filling out the form on page 6 and returning it to us. With your help we can organize networking events and keep you informed of our activities.

NJIT is offering all 35,000 alumni life-long computer e-mail accounts and access to the Internet. "The service demonstrates that being a member of the NJIT family does not end at graduation," said Saul K. Fenster, NJIT president. "By extending this free service, we can further erode the traditional divisions between current and graduated students - thereby fostering contacts among faculty, students and graduates that could increase collaboration with industry." Visit the NJIT web site at http://www.njit.edu/Alumni/alumni_online/life_long_email/life_long_email.html to take advantage of this offer.

For the second consecutive year, Yahoo! Internet Life magazine has ranked New Jersey Institute of Technology the "most wired" public university in the nation in its annual ranking of America's most wired colleges. Yahoo! Internet Life ranked NJIT the second most wired technological university in the nation, second to Massachusetts Institute of Technology, and the 4th most wired university overall. NJIT is one of only three universities - the other two being MIT and Rensselaer Polytechnic Institute - to consistently rank among Yahoo's top 10. Students at NJIT already use e-mail and the Internet to submit class assignments, register for classes and access library journals.

Finally, we welcome the new additions to NJIT's administration team. William C. Van Buskirk, a prominent biomedical engineer and former Dean of Engineering at Tulane University, has been named Provost and Senior Vice President for Academic Affairs; and S. T. Mau, a distinguished professional engineer, educator, researcher and academic administrator, has been appointed Dean of Newark College of Engineering. They are great supporters of the transportation effort in general and NCTIP in particular.

Please visit our web site for descriptions of the activities sponsored by NCTIP. Current and recent research projects are detailed, as are the interdisciplinary graduate program in transportation and research-related publications. Courses for fall 1999 are also listed, or can be obtained by e-mail.

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