TRANSPORTATION MANAGEMENT SYSTEMS: AN EXPLORATION OF PROGRESS AND FUTURE PROSPECTS

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ABSTRACT

This research reports the experiences of both adopters and non-adopters of transportation management system (TMS) technology. TMS adopters represent a diverse array of companies, with a surprisingly high percentage of adopters using outsourced services for decision support activities. Motives for adoption tend to align with the firm's strategic needs though functionality focuses on the shipper's day-to-day operational needs. While expectations of system performance and return on investment vary greatly, TMS users illustrate a generally high level of satisfaction. Non-adopters view decision support for transportation activities as a low priority. The article explores future prospects for TMS development and adoption.

INTRODUCTION

Achieving supply chain excellence is far from given. A study conducted by Deloitte & Touche in 2003 found that only seven percent of global manufacturers surveyed believed that they were effectively managing their supply chains (Deloitte & Touche, 2003). The vast majority (84 percent) viewed their supply chain performance as "average" to "poor." These lower performing firms suffered the financial symptoms of an ailing supply chain, including failure to achieve goals for return on capital and return on assets, operating margins of less than 5 percent, and falling short of revenue goals and profitability targets. The study results pointed to the critical need to manage ever-increasing complexity through a holistic approach to the supply chain. Key factors that separated global manufacturers with successful supply chains from others included the way these companies: 1) collabor-ated with customers, 2) effectively managed the product life cycle for their goods, and 3) implemented technology throughout their supply chain operations. Interestingly, the study indicated that while long-term planning tools like enterprise resource planning (ERP) can prove valuable in managing supply chain complexity, so too do the tactical technologies like the advanced planning and scheduling (APS) system, warehouse management system (WMS), and transportation management system (TMS).

Another industry report published by the ARC Advisory Group in 2005 echoes the importance of technology in managing today's extended and complex supply chains. ARC surveyed logistics executives of Global 1000 companies to identify the top ten research interests and priorities of

these executives (Gonzalez, 2005a). While supply chain metrics and benchmark standards topped the list of interests, three of the top six topics involved technology applications in the supply chain, including: the impact of supply chain software on creating strategic value (third), the impact of supply chain optimization on the business (fifth), and the merits of tracking and exception management technology (sixth).

As indication of this increasing interest in supply chain technology, AMR Research estimates that the market for supply chain management applications grew by three percent in 2005, with forecasts suggesting growth of seven percent and five percent in 2006 and 2007, respectively (Bowling, 2006). ARC estimates the worldwide market for supply chain execution technologies[1] at US$5.51 billion in 2005 with an anticipated compounded annual growth rate (CAGR) of 8.6 percent over the next five years, taking the market to over $8.30 billion in 2010 (ARC Advisory Group, 2006). Accelerating growth in this technology segment is the transportation management system. Investments in TMS have more than doubled from 1998 to 2005 (from US$468 million to $956 million), a time in which investment in many technologies cooled (Gonzalez, 2005b). ARC estimates the worldwide market for TMS will grow by 6.4 percent annually through 2009, reaching $1.24 billion in 2009 (ARC Advisory Group, 2005).

Transportation management systems are information technologies used to plan, optimize, and execute transportation operations. A TMS can facilitate transportation management activities that take place before, during, and after the transportation movement by optimizing freight flows among multiple facilities, tracking freight in transit, and managing the freight payment process (Coyle, Bardi and Langley, 2003). While TMS technology has existed for quite some time, the imperative for their adoption has never been greater given logistics managers' concerns of dramatically rising freight costs, capacity shortages, and increasing complexities in transportation management today. Though the trade press is laden with case studies of successful TMS implementations and solution vendors readily publicize the merits of their software, little independent research has examined the motives for adoption, benefits achieved, comparative costs, and challenges of implementation. The purpose of this article is to examine the state of TMS development and adoption, giving particular attention to the motives, means, costs, and benefits of adoption by reporting the experiences of 45 North American firms. The article includes a review of the relevant literature of information technology in logistics and transportation management.

INFORMATION TECHNOLOGY IN LOGISTICS AND TRANSPORTATION

Logistics information systems (LIS) have represented a rich area of research since the ready application of computers to logistics management over the past 25 years. Logistics offers a natural area of application for advanced information technology given the complexity of facilitating physical flow management. As noted by Closs, Goldsby and Clinton (1997), information technology has the potential to improve logistics capabilities while simultaneously reducing costs. Information systems convert data into information to improve managerial decision-making, yielding greater effectiveness, efficiency, and flexibility in logistics activity (Introna, 1991; Rabinovich and Evers, 2002; Rutner, Gibson and Williams 2003). Some even refer to the "information imperative" that exists in logistics management where the company must either invest in advanced technologies or suffer competitive disadvantage in today's "connected economy" (Gustin, Stank and Daugherty, 1994; Ernst & Young, 1999; Closs, Swink and Nair, 2005). This contention is supported by the "World Class Logistics" research conducted by The Global Logistics Research Team at Michigan State University (1995) which found that information technology capabilities served as a key differentiator between "world class" logistics organizations and all others. Subsequent research suggests that enhanced decision-making through information technology remains a key basis of differentiation (Closs and Xu. 2000; Motwani et al., 2000; Shore and Venkatachalam, 2003).

Most research in this area has focused on broad-based application of information

technology to logistics (see Dudley and Lasserre, 1989; LaLonde and Cooper, 1989; Loar, 1992; Bardi, Raghunathan, and Bagchi, 1994; Bowersox and Daugherty, 1995; Closs, Goldsby and Clinton, 1997). Relatively little has examined the application of IT to specific activity areas of logistics. An emerging literature is developing on the topic of warehouse management systems. Nynke Faber, de Koster and van de Velde (2002), for instance, explore the appropriate development strategy for WMS technology. Other works in the WMS arena include those of Mason et al. (2003) and Autry et al. (2005). Mason et al. is notable in its recommendation of integration in warehouse management systems and transportation management systems to improve global inventory visibility and, in turn, reduce costs and improve service in the supply chain.

Upon closer examination, transportation management offers a particularly rich area for technology application. Masters and LaLonde (1994) note that traffic management has long represented an information-intensive undertaking. This observation is particularly true today in light of increasing complexity in the transportation environment, given interest in managing inbound and outbound flows, globalization and extended supply chains, heightened documentation and tracking requirements for international shipping, just-in-time operations with narrow delivery windows, revised hours of service regulations for U.S. motor carriers, and Sarbannes-Oxley (S-OX) compliance, to name a few added complexities. Most research of technology use in transporta-tion management is directed toward communicative technologies. Important work was conducted by Crum et al. (1990, 1996, 1997, 1998) and Williams et al. (1994, 1995, 1996, 1998), among others, on the implementation of electronic data interchange (EDI) throughout the 1990's. More recently, research has examined the roles, benefits and challenges of new Potential respondents were notified by electronic mail that a survey regarding transportation management systems was being conducted and the website hosting the survey was provided. Past research has shown that the quality of the data obtained from surveys of this nature can be considered equivalent to mail surveys while the speed of response is generally quicker (Griffis, Goldsby and Cooper 2003). Notification of the communicative technologies, like the Internet (Murphy and Daley, 2000; Dresner, Yao and Palmer, 2001; Boyson, Corsi and Verbraeck 2003; Patterson, Grimm and Corsi, 2003; Nair, 2005), mobile communications (Manrodt, Kent and Parker, 2003; Giaglis et al., 2004), and satellite-based systems (Rishel, Scott and Stenger, 2003).

Despite the impressive TMS adoption data presented in the introduction, exploration of recently developed decision support tools for transportation management has been limited. Goldsby and Eckert (2003) examine electronic transportation marketplaces and propose the linkage between transportation exchanges and TMS technology. Vannieuwenhuyse, Gelders and Pintelon (2003) illustrate a web-based decision support tool for transportation mode selection. Similarly, Caplice and Sheffi (2003) present an optimization-based transportation procurement approach facilitated by on-line auctions. There has yet to be research that examines TMS technology, in particular, and the current state of TMS adoption.

RESEARCH METHODS

An electronic survey methodology was used to collect the data for this research. A preliminary survey instrument was developed and distributed to three consultants and four logistics researchers familiar with the subject topic area to ensure the survey was thorough and contained content and language consistent with that currently in use. Following modification from this first review, the survey was distributed to a group of practitioners with TMS adoption experience to further assess content and survey length. Once comments from this review were incorporated, the web-based survey was developed and tested.

survey was sent to 1,651 subscribers of *Supply and Demand Chain Executive* magazine in the U.S. This sample frame was chosen because of the anticipated familiarity that potential respondents would have with logistics activity and transportation management systems. Care was taken to contact only one respondent per company, and to seek individuals employed in positions where transportation-related IT would

be a salient issue.

Of the 1,651 contact e-mails that were sent, a significant percentage (32.1 percent) was undeliverable. Of the remaining potential respondents (N = 1,121), 45 individuals completed surveys for an effective response rate of 4.01 percent. Though much lower than desired, the response is sufficient for an exploratory work of this kind involving descriptive rather than inferential statistics. Should the research be focused on testing relationships, the sample would likely prove inadequate for sufficient statistical power and construct validity assessment. However, the sample provides an ample snapshot for preliminary investigation, capturing experiences and opinions of TMS among managers and executives at 45 separate firms. Given that the survey was quite long, contained numerous open-ended questions requiring more than simple yes/no responses, and was targeted toward individuals with both logistics experience and familiarity with TMS, generating a high response rate proved very challenging. Despite these limiting factors, the depth and nature of the survey provided high quality responses. Because of the open-ended nature of many questions, the responses more closely approximate interview data than typical survey data.

RESEARCH FINDINGS

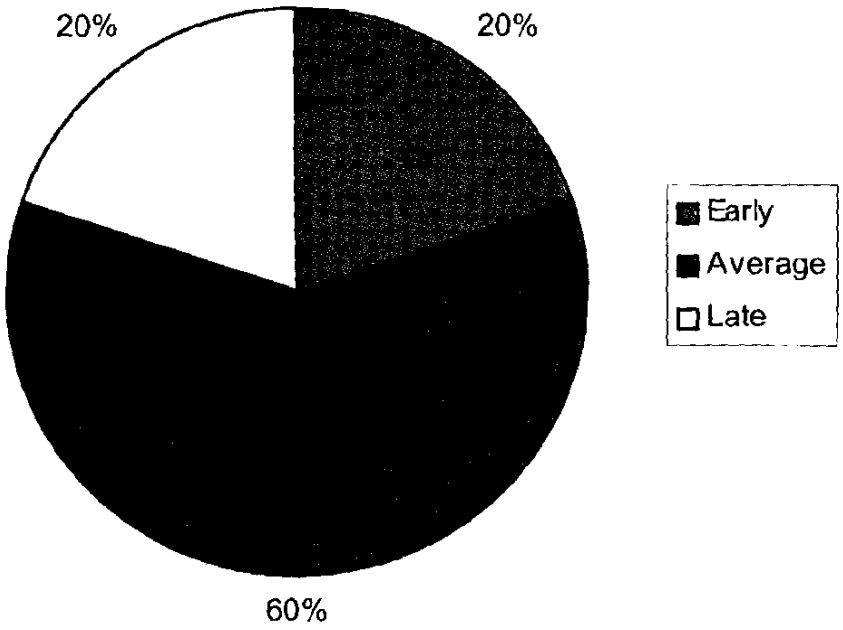
The survey examined six broad areas, including: characteristics of TMS system usage, system development strategies, TMS functions desired and obtained, system performance assessment, implementation issues and their resolutions, and the experiences of TMS non-adopters. These six themes outline the results that follow.

Characteristics of TMS System Users

Survey respondents indicated that their firms were in various stages of consideration when it came to TMS adoption. Twenty-seven percent of respondents had committed in some fashion to a TMS implementation. Another 24 percent of the respondents were actively considering a TMS implementation. Forty-nine percent of the respondents had either entertained the idea previously, but ultimately decided against TMS adoption, or had not considered a TMS.

As for the adopting firms, describing the "average" adopter is a challenging task. The annual revenues of adopting firms in the survey ranged from a low of US$38 million per year, up to $80 billion per year. The transportation budgets of adopters were understandably broad as well, ranging from $1 million to $4 billion per year, with an average annual budget of almost $503 million. The technology mindset of TMS adopters was less aggressive than expected. The results are shown in Figure 1. As can be seen, 20 percent of respondents classified their firms as early adopters of technology, 60 percent classified themselves as average technology adopters, and 20 percent as late adopters. The less aggressive technology mindset appeared to be reinforced in the relative newness of TMS to respondents, with adopters averaging 1.8 years of TMS usage since installation. Meanwhile, respondents' IT spending in general was slightly higher than average (4.4 on a 7-point scale), further implying a seemingly cautious nature among adopting firms.

FIGURE 1
TECHNOLOGY ADOPTION MINDSET OF ADOPTING FIRMS



Interestingly, the degree to which transportation was viewed as a strategic function of the firm did not differ between TMS adopters and non-adopters. When rated on a 7-point Likert-type scale with 1 identified as "Not at all Strategic," 4 as "Neutral," and 7 as "Very Strategic," adopting firms rated their transportation function as slightly more strategic than neutral (4.2). Non-adopting firms rated the transportation function slightly below neutral (3.7). Despite the absolute difference in means, these scores were not significantly different from each other at reasonable alpha levels, and a true difference cannot be statistically supported. However, when comparing those who had fully implemented a TMS to those currently adopting the technology, a significant difference was found (at the 0.10 level of significance) between the groups' assessments of the strategic nature of transportation to the firm. Firms currently implementing a TMS saw transportation as very strategic (6.0) compared to the firms already using a TMS (4.2). This difference was unexpected in light of the lack of a significant difference between adopters and non-adopters, but could result from a "halo effect" brought on by a recent investment of capital in the transportation function.

Firms that had completed or were currently installing a TMS were asked to provide insight into why the technology was pursued. Respond-ents were asked to rank their top five priorities among a set of sixteen possible alternatives, including opportunities for open-ended response. The primary motives for adoption are reported in Table 1. These findings indicate that cost drivers, including fewer shipments as a result of shipment consolidation, lower freight bills, and lower administration costs, are the chief reasons firms pursue a TMS, although customer service issues and lane network analysis also hold sway.

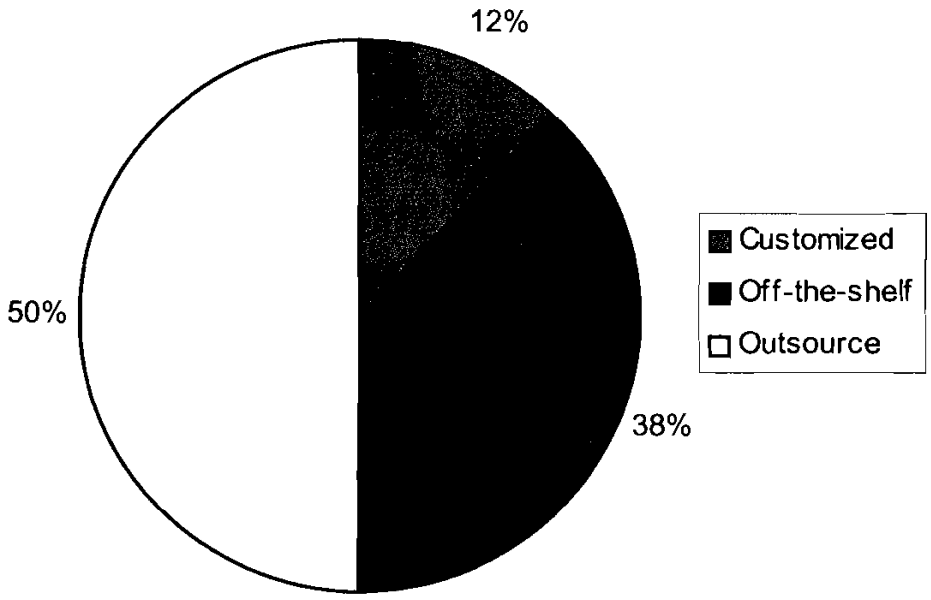
System Development

Firms adopting TMS technology chose to do so in one of three ways. Figure 2 depicts the system development approaches. Approximately 12 percent of respondents chose to install customized systems modified specifically to fit

TABLE 1
PRIMARY MOTIVE RANKING

Motive	Average Rank
Improved shipment consolidation	1.9
Lower freight bill	2.2
Lower administrative costs	2.3
Improved lane analysis	2.4
Lower total logistics cost	2.5
Improved carrier selection	2.7
Improved network analysis	2.8

FIGURE 2
SYSTEM DEVELOPMENT APPROACH



the needs of their firms. A greater number of firms (38 percent) chose to purchase-off-the shelf systems to support their transportation needs, while fully 50 percent of the firms using a TMS chose to outsource the effort completely and allow a vendor or third-party provider to host the needed services. The 50 percent figure for the externally-hosted systems is consistent with the

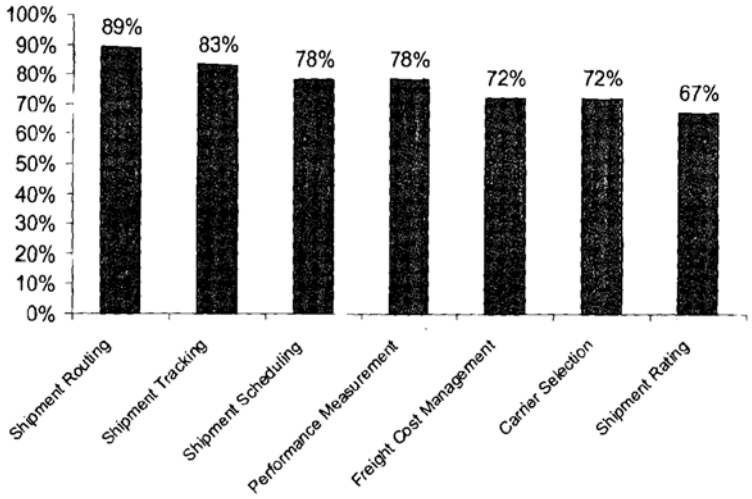
observations of ARC's Gonzalez (Levans, 2006) and the findings of a study conducted by the Aberdeen Group focusing on-demand SCM solutions, in general (Enslow, 2006). The study noted that on-demand TMS is becoming increasingly popular in light of cost concerns and the substantial development time required of hosted systems (McCrea, 2006). On-demand solutions also prove more affordable for small- and medium-sized companies, though companies of various sizes in the sample reported the use of externally-hosted systems.

While the level of investment varied sub-stantially, the cost of TMS technology appears relatively low, when compared to many other logistics information systems. The cost to purchase a hosted TMS ranged from a low of $100,000 to a high of $1,000,000. Similarly, installation costs of these systems exhibited wide disparity, ranging from $20,000 to $450,000. The annual maintenance of these types of systems should be a concern and the study results indicated substantial range in annual main-tenance costs, ranging from $4,000 per year to $400,000 per year.

TMS Functionality

TMS users reported a variety of functions that were important in the systems they installed. Figure 3 illustrates the most popular functions employed by adopting firms. These functions tend to be related to the operational tasks associated with day-to-day management of transportation activity. Shipment routing, deter-mining how and where to route individual shipments during the planning stages, was the most frequently cited function employed by respondents. Shipment tracking, providing the shipper with visibility of in-transit inventory, was a close second among installed functions. Given the impact that enhanced visibility has on service commitment and cost containment, this function's appearance near the top of the list was not unexpected. Shipment scheduling, trans-portation performance measurement, overall freight cost management, and carrier selection

FIGURE 3
MOST COMMON TMS FUNCTIONS



round out the top six functions. It is interesting to note that the functionality most commonly realized does not directly overlap with the motives for TMS adoption. While motives tend to speak of high-level strategic concerns, the functions most commonly employed involve support for operations-based decisions, those involving individual shipments and transactions.

TMS Performance

In general, TMS users feel that the systems are having a positive effect upon the performance delivered by the firm. When asked to answer the question "As a result of our TMS, our total logistics costs are lower," users responded with an average score of 5.2 (standard deviation of 1.3) on a scale where 1 = Strongly disagree, 4 = Neutral, and 7 = Strongly agree. When non-users were asked if a TMS would result in lower total logistics costs, these respondents suggested a general indifference to expectations in this regard with an average score of 4.1 (standard deviation of 1.8).

One key area where a TMS would be expected to show benefit is in the delivery of customer service. TMS users were asked whether the service offered to their customers was better as a result of their TMS. They responded with an average score of 5.4 on the 7-point scale, while non-users reported an average score of 3.7, a difference that was statistically significant at an alpha level of 0.05. This indicates that, in general, adopters believe their service provision is better as a result of TMS and that non-adopters believe that a TMS would not necessarily improve the service they offer to customers.

Better transportation decisions are a presumed benefit of a TMS. TMS users and non-users responded with averages of 5.2 and 4.4 respectively to the question "We now make bet-ter transportation decisions." Again, this difference appears managerially relevant, but failed to achieve statistical significance.

When considering financial measures of performance, TMS users were often satisfied with the performance of their systems. Users reported a range of expected returns on investment (ROI) from as low as three percent to as high as 300 percent. As noted in the discussion of system costs, the range of investment varied greatly. Therefore, it is not unexpected that the reported benefits and subsequent ROI might vary widely as well. Upon achieving system implementation, the level of satisfaction associated with TMS appears to have met most expectations with an average score of 5.6 on the 7-point scale. The data appear to support the claims of TMS users and vendors alike in that these systems' return on investment often makes their consideration very worthwhile.

Implementation Issues and Resolutions

No IT system installation progresses without issues arising that must be addressed. TMS implementations appear normal in this regard. The incompatibility of systems, a perennial IT issue, appeared in 57 percent of the implementa-tions reported by TMS users. Delays in the implementation phase of the project were also an issue for one-half of the respondents. Reluctance among the top levels of the firm to adopt a system presented problems for 43 percent of the firms installing a TMS as senior management and executives questioned the need for or value of these systems. Once management was convinced of the needs and benefits of the system, the issue was not necessarily over as 43 percent of the staff responsible for using the system was also resistant to using a TMS. A lack of quality training was reported also, as 21 percent of the adopting firms reported that insufficient training was a problem with TMS in their implementation.

Despite these challenges, TMS implementation teams found a variety of ways to address these issues. Issues of incompatibility typically generated system modifications to allow the affected systems to communicate more

effectively. Implementation delays, seemingly ever-present in IT installations, were addressed by working more closely with vendors and taking a more hands-on approach in managing the implementation phase. People-related issues, resistance, and the lack of training appeared to be best handled by educating users of the system's capabilities and potential, and training end-users on the actual software to better prepare them for the modified manner in which their individual tasks would be accomplished on the new systems. Unfortunately, in some instances, companies reacted to challenges and implementation issues in a defeated manner—simply accepting the deficiency and expecting no resolution.

THE EXPERIENCES OF NON-TMS USERS

The information reported by those who either had not considered purchasing a TMS or who had considered TMS but chose against installing one was very illuminating. Non-adopters represented almost one-half of the research sample. These firms gave varied reasons for why they had not adopted the technology. These responses ranged from "Not a priority" (54 percent of respondents) to "We do fine without it" and "We do not manage transportation" at 31 percent each. These responses indicate that some firms either view transportation as an area not in need of decision support, or lacking sufficient strategic importance to mandate investment. Of those who do not manage transportation, one reason given for outsourcing was the expectation of their third-party logistics provider having TMS support for operational decision-making. As for those companies that still manage transportation in the absence of a TMS, 30 percent continue to rely upon a legacy IT system of some kind to accomplish the tasks a TMS might otherwise perform. Another 50 percent of non-users reported performing their transportation management activities manually rather than with a TMS. Given this overview of the current state of TMS adoption, attention turns to the future prospects for TMS and transportation-related information technologies.

FUTURE PROSPECTS FOR TMS

This research suggests two broad categories of TMS customers; those that develop and maintain internal systems and those that buy specific services from externally-hosted (outsourced or on-demand) systems. Among internal systems users, TMS will increasingly find intercon-nectivity with other LIS tools to provide comprehensive visibility and improved management of physical flows. Mason et al. (2003) illustrate the benefits of an integrated system of TMS and WMS technologies that provides global inventory visibility. When coupled with an order management system and supply chain event management system, TMS and WMS provide for a more complete order fulfillment suite of systems (Goldsby and Eckert, 2003). Software vendors are recognizing the potential of integrated system architecture and actively expanding the scope of their offerings. ERP and WMS vendors have proven the most aggressive to date by acquiring complementary TMS solutions or building their own capabilities in an effort to provide comprehensive supply chain IT solutions (McCrea, 2006).

At the same time, TMS vendors are responding to customers' needs for greater transportation functionality in their product offerings. To date, most TMS offerings focus on the individual ship-ment as the primary unit of analysis, as indicated by the functions most commonly employed by systems in the current study. In fact, many systems do not have the ability to optimize multi-load shipments, making load consolidation a manual activity. Leading vendors have recognized that shippers want to be able to not only plan and track individual loads but to identify and facilitate opportunities for inbound/ outbound consolidation as well as temporal and vehicle consolidations. Additionally, shippers seek better support for international transportation and multi-modal movements (Levans, 2006).

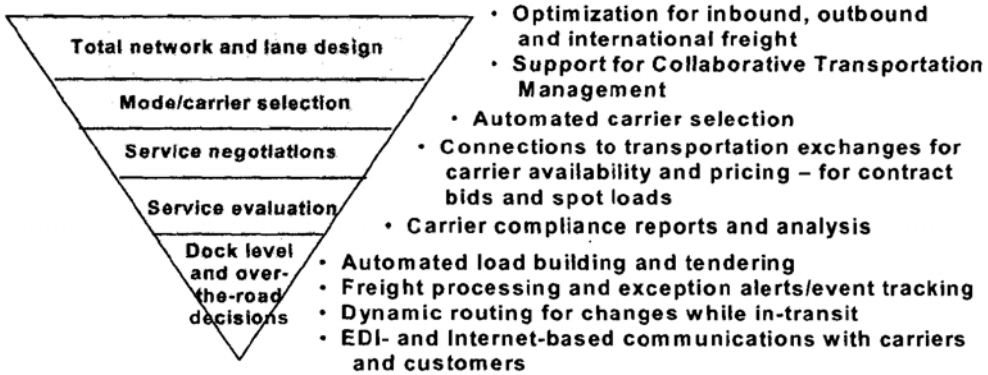
Figure 4 illustrates how TMS functionality is expanding to serve the broader scope of shipper requirements. The figure depicts the various levels of transportation decision-making from most strategic (total network and lane design) to most operational (dock level and over-the-road decisions). While the primary focus among TMS users and vendors is directed toward decision support of operational activity, great potential rests with incorporating strategic analytical

support. By accumulating transactional data, these systems can serve as data warehouses as well. When coupled with optimization and simulation capabilities, the TMS can provide critical support for optimal network design and lane analysis.

TMS can also provide the interconnectedness required of Collaborative Transportation Management (CTM), an initiative developed by the Voluntary Interindustry Commerce Solutions Association (VICS). Sutherland, Goldsby and Stank (2004) define Collaborative Transportation Management as "a holistic process that brings together supply chain trading partners and service providers to drive inefficiencies out of the transport planning and execution process" (p. 193). Though the authors contend that CTM is not a "technology solution," IT is viewed as a critical enabler of the initiative; particularly as higher orders of collaboration involving multiple shipper networks are pursued. Esper and Williams (2003) emphasize the critical roles fulfilled by IT in supporting and enabling CTM. Leading vendors of TMS technology therefore should seek to provide decision support for the whole of the framework presented in Figure 4, adding functionality to support strategic analysis and decision making as interest in these higher-order initiatives calls for capabilities that embrace the inherent challenges of scope and complexity.

Externally-hosted application service providers (ASP's) are expected to enjoy continued adoption by small and mid-sized companies who are unable or unwilling to commit to a fully-functional internal system. These users generally expect to enjoy many of the benefits of internal applications, but at reduced, intermit-tent costs. Still others are expected to use ASP versions of TMS on a trial basis, testing the functionality and gauging the benefits before committing to a full-time solution. The current research appears to indicate that the market for ASP's is quite robust given that half of the TMS adopters in the sample are using a third-party system. While bias could be present in the

FIGURE 4
TMS DECISION SUPPORT



(Figure adapted from Stank and Goldsby, 2000)

relatively small sample found in this research, there is support of a growing interest in externally-hosted systems. Many large third-party logistics companies are expanding their service portfolios by offering pay-as-you-go systems as a supplement to their traditional operations activity. Future research should reflect this two-segment market composition and further examine distinctions in TMS motives, functionality, and satisfaction among users of internally- and externally-hosted systems. Generating a sample of TMS users large enough for more thorough empirical analysis will prove challenging until adoption becomes more pervasive, yielding improved sampling potential. Once adoption reaches this level, it will be more feasible for research to move beyond descriptive data to the testing of critical relationships, such as those between TMS adoption, logistics outcomes, and the overall performance of the firm.

CONCLUSIONS

Given the complexity that today's logistics and supply chain managers face, it is becoming more apparent that logistics information systems can prove effective in making the complexities more manageable. The introduction to this article sug-gested that transportation management systems are separating themselves from other LIS technologies given steady adoption in recent years, with adoption growth expected to continue in the future. This research sought to provide some explanation for why firms are choosing to adopt TMS in light of the varied portfolio of IT investment opportunities. In pursuing this objective, our preliminary analysis serves as a first step toward broader examination of transportation management systems. Though research to date has provided considerable insight on the application of LIS technology, relatively little focus is directed to trans-portation-specific decision support tools.

The general findings of the research indicate that many companies find the risks of non-adoption to be greater than those of adoption. While the levels of investment varied greatly and virtually all implementations faced difficulties of one kind or another, adopting firms were usually satisfied with the performance of their systems given the total price paid for hardware, software and installation. In this regard, TMS seems to be fulfilling the promise of value, yielding efficiency gains that offset the required investment in a timely manner. Though tenable in their determination, expected ROI and payback proved critical in the adoption of TMS. The payback on TMS appears to be relatively quick and more certain than other technologies vying for shares of a company's technology budget, as inferred by TMS' increased rate of adoption.

An interesting finding compares the motives for adoption and the functionality realized ultimately by TMS adopters. The most pressing motives tended to involve high-level, strategic decision-making. Meanwhile, the most common functions utilized by the adopters involved the day-to-day execution of transportation activities. Certainly, the strategic objectives cannot find achievement without sufficient control at the operation level. However, review of open-ended responses suggested that the systems' promised capabilities of strategic decision support went largely unfulfilled as priorities changed or software proved ineffective in high-level analyses.

Providing better coverage of strategic analysis needs represents an opportunity for differentia-tion among TMS vendors in the current and near-term marketplace. In addition, those vendors that can deliver on the promise of inter-operable systems across the domain of supply chain execution and analysis tools should enjoy an advantage in the immediate future and survival in the longer term as industry consolidation activity reduces the number of viable competitors. Future adopters are expected to benefit from heightened competition as technology capabilities improve and pricing remains in check.

ENDNOTE

1. The ARC Advisory Group defines "supply chain execution solutions" as including Collaborative Production Management, Warehouse Management, and Transportation Management systems.

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