

Research Brief

I.E./O.R. RESEARCH & DEVELOPMENT OPPORTUNITIES IN DISTRIBUTION AND TRANSPORTATION

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BACKGROUND

Cost-effective physical distribution system is a key element towards continually improving the competitive position of business firms. Likewise, economical, efficient, and safe transportation systems is a key factor towards achieving economic growth and enhancing the overall quality of life in our cities and towns. With these roles and objectives, the fields of physical distribution and transportation provide a wide range of challenging research opportunities for industrial engineers and operations research specialists.

Distribution is a component of total supply chain management or integrated logistics management and involves the areas of transportation, warehousing, customer service/order processing, inventory, and administration. Recent research and development themes in these areas include electronic data interchange, bar coding, outsourcing, reverse logistics, expert systems robotics, scanning technologies, strategic alliances/partnerships, customer driven processes, benchmarking, TQM, etc.

Transportation within the context of distribution is viewed from the perspective of the private sector as transport users or service providers. On the other hand, transportation as viewed from the broader perspective of the government sector involves planning, design, construction, financing, operations, management, and regulation of land, rail, water, and air transport modes and infrastructure. Recent research and development themes in this general field include deregulation policies, financing schemes, air quality, transportation safety, intermodal systems, information technology applications, geographic information systems, imaging systems, etc.

Currently, the most significant developments affecting distribution and transportation are technological advances in telecommunications, computer technology, and information systems. Hence, there is considerable interest in R & D activities which capitalize on these technological advances in developing decision support systems and creating novel solutions to distribution and transportation problems.

CURRENT R & D PROBLEMS AND OPPORTUNITIES

Research opportunities for industrial engineers and operations research specialists in the areas of distribution and transportation are generally oriented towards the application of I.E. and OR tools and methodologies. The more esoteric and purely theoretical types of research are usually undertaken by specialists in their respective fields. For example, OR specialist would advance OR theories, while transportation specialist would advance transportation theories. And cross-fertilization of ideas between the two fields would be generally focused on practical research or application of ideas from one field to another in support of theoretical research. To get a glimpse of current I.E./OR - related R & D activities in distribution and transportation, I summarized below in outline form selected topics from the paper by James R. Stock and David A. Luhrsen entitled Doctoral Research in Logistics-Related Areas (1987-1991) in the Journal of Business Logistics, Volume 14, No. 2, 1993.

Combinatorial Problems

- Vehicle and crew scheduling
- Optimal location of depots/facilities
- Development of heuristic for the vehicle routing problem
- Optimal routing and scheduling with time-window constraints
- The backhaul problem in vehicle routing and scheduling
- Multiple depot, multiple tour, multiple stop delivery problems
- Determining fleet size and vehicle locations in distributed medical service networks
- Freight consolidation and scheduling
- A mixed IP model for solving three-dimensional optimal pallet patterns

Simulation

- Simulating shipper modal selection processes
- Discrete time simulation of transportation queuing networks
- Dynamic models of network traffic assignment

Game Theory

- Game theory applications to optimal management of shared fleet of freight cars
- A game-theoretic approach to pricing congested transportation facilities

Artificial Intelligence/Expert Systems

- An intelligent warehouse layout simulation system
- An expert system approach to the control of an automated storage/retrieval system
- Knowledge-based routing systems using neural networks and genetic algorithms

- Application of Artificial Intelligence and database concepts in equipment maintenance
- Application of Expert systems to bulk cargo movement
- Use of expert systems in forecasting
- An Artificial Intelligence approach to schedule-based Materials Requirements Planning

Multi-objective Mathematical Programming

- Dynamic multi-objective bulk deliveries problem
- Stochastic multi-objective optimization problems for integrated warehouse operations
- Multi-objective mathematical programming models of multi-commodity distribution

Inventory Theory

- Inventory position strategies in multi-echelon distribution systems
- Integrated inventory control and transportation planning
- Minimization of transportation and inventory related costs in distribution

Miscellaneous Topics

- Logistics network modeling
- Network economies of scale in network truckload operations
- Statistical modeling and forecasting of transportation demand
- Transport investment planning under uncertainty
- Multi-criteria evaluation of transport modal alternatives
- Stochastic multi-commodity dynamic vehicle allocation models

TEN BARRIERS TO SUCCESS R & D

Shortsighted R & D strategies/plans
 Ignorance of current research frontiers
 Tunnel vision
 Irrelevant research agenda
 Perceived image of researchers/academicians (ivory tower intellectuals, too theoretical)
 Communication gap between researchers and decision-makers
 Inadequate support from the private and government sectors
 Weak R & D institutional structures
 Uncoordinated research activities
 Lack of resources (personnel, financial, material, equipment, etc.)

RECOMMENDATIONS

Establish long-term research partnerships between the academe and the industry
 Maintain national research clearinghouses
 Establish international tie-ups with research institutions worldwide
 Encourage publications of peer-reviewed research papers

