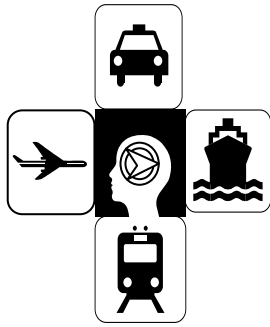


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Tech Brief

Study to Determine the Need for Innovative Technologies for Container Transportation System

FHWA/NJ-2004-011

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SUMMARY

New Jersey ports have been experiencing tremendous growth in container volumes in recent years and it is anticipated that this trend will continue in the future. This presents a serious challenge for the regional transportation network supporting the traffic related to port facilities' operations. Port authority and port operators look for the ways to avoid problems that can emerge as the result of the traffic growth. One way to do so is to investigate the feasibility of using innovative transportation modes as the alternative to trucks and trains. This study identifies innovative technologies that should be considered as candidates for container movement from and to the port, considering different locations of staging points around Port Newark/Elizabeth. Economic and multicriteria analysis show that some of the innovative technologies are very competitive with existing rail and truck service, especially in case of increased transportation demand. Evaluation of alternative technologies considers direct financial effects, as well as external effects such as pollution, reduction in congestion, landuse disruption, socio-economic effects, and impacts on transportation system performance.

BACKGROUND

In order to accommodate the increase in container traffic, and to capitalize on the tremendous economic growth opportunities, the Port Authority of New York and New Jersey (PANYNJ) and other regional transportation agencies, as well as port operators, initiated a number of improvement projects designed to increase the port capacity. While these projects focus primarily on improving waterborne access and terminal operations, there is serious concern as to the ability of the existing regional highway and rail network to handle the anticipated increase in goods movement. Under these conditions, the regional transportation network requires a major expansion to create the much needed additional freight transport capacity.

Having these trends in mind and knowing the ability to expand current highway and rail network is limited, the New Jersey Department of Transportation (NJDOT), the Port Authority of New York and New Jersey (PANYNJ), and the port terminal operators, are seeking innovative ways to improve land access to and from New Jersey's principal port terminals.

RESEARCH APPROACH

This study, initiated by the NJDOT, is an effort to examine "unconventional" transportation modes to move intermodal containers in New Jersey. Study objectives are threefold:

1. To identify and describe innovative transportation technologies that can be used to move freight, with a focus on those systems that are suitable for transport of intermodal containers.
2. To develop a methodological framework for evaluation and comparison of the innovative technologies.

3. To apply the evaluation framework to test feasibility and applicability of selected innovative technologies using several case studies in New Jersey.

The reviewed technologies include those currently in commercial operation, emerging technologies that are undergoing prototype tests, and those that are still in design and conceptual stage. Some of the technologies have been applied in people mover systems (conveyors, amusement parks, manufacturing facilities), and, if modified, could have a high potential for use in container transport.

The innovative technologies were classified into three major categories:

1. Technologies utilizing fixed guideway – rail and monorail.
2. Automated guided vehicles (AGV).
3. Fast freight ferry technologies.

There are several innovative designs of vehicles utilizing fixed guideway. Three of them were selected as the most promising ones: AutoGo (suspended monorail utilizing linear induction motors), CargoRail (rubber-tired vehicles on the steel guideway with rotary electrical motors), and CargoMover (automated, self-propelled flatbed railcar developed by Siemens). AGV technology is already in full commercial operation in European Container Terminal (ECT) in Port of Rotterdam, and is also selected for the analysis.

Technologies were compared among themselves and with “conventional” rail and truck service. The evaluation framework and methodology used to compare alternative technologies are based on multicriteria decision analysis model. This approach allows the analysis and evaluation of investment alternatives over multiple objectives using different decision criteria, both monetary and non-monetary.

Using proposed methodology, alternative technologies were compared based on cost, safety, travel time, reliability, intermodal compatibility and expandability of the system,

environmental and ecological impacts and socio-economic impacts. Each criterion is assigned a weight based on its relative importance



a)



b)



c)



d)

Figure 1. a) CargoMover; b) Fast freight ferry; c) AutoGo; d) AGV

In order to test the applicability of innovative technologies for container transport four case studies have been developed. Each case study represents a different geographic area adjacent to Port Newark/Elizabeth. In each case study route alignments are defined for each alternative technology. Technologies are then analyzed based on their

technical characteristics. Innovative technologies were compared to each other and to conventional transportation modes - truck and rail, to determine both their feasibility and competitiveness. Evaluation methodology was used to evaluate, score, and rank alternatives for each case study.

Since all proposed case study route alignments are located in a very challenging region from the geological, engineering, and ecological point of view, it was very important to examine geo-technical and ecological properties of the underlying terrain in order to determine its impacts on construction of the infrastructure related to innovative technologies. It was also important to examine complex environmental impacts arising from construction and implementation of each technology. For this purpose, the project team conducted a rather comprehensive geo-technical and engineering study of the proposed alignment that helped in understanding the problems associated with the construction of transportation infrastructure in the studied region. The results of the geo-technical study are used to estimate construction costs and environmental impacts. Comprehensive geotechnical database in GIS format was also produced and is available as part of the project's final report.

FINDINGS AND CONCLUSIONS

The following conclusions are reached as the result of the study:

1. Analyzed innovative technologies have very good potential to be efficiently used for container transfer between port terminals and inland intermodal stations.
2. CargoRail, an automated system with fixed guideway and rubber-tired vehicles, has the highest overall scores. Based on this, it can be considered the most promising of all tested technologies.
3. All of the innovative technologies evaluated become more attractive as the container volume increases. There is a definite presence of economies of

scale of traffic density wherein the unit cost will decrease as the result of an increase traffic volume on the route.

4. The criteria weighting scheme has some impact on the ratings, however the scheme used in the analysis appears to yield robust results.

Findings from one of the case studies are schematically presented in figures 2 and 3.

RECOMMENDATIONS

Research efforts following this study should concentrate on several aspects of implementation of innovative technologies for container transport:

- Look with some more detail into technical and economic characteristics and performance of innovative technologies. Lack of accurate and reliable information is probably the most sensitive part of this analysis.
- Extend the routes and analyze the characteristics of innovative freight transportation systems in longer haul.
- Develop a detailed analysis of actual applications for the most promising innovative technologies. This analysis should include optimization of operating regimes, simulation of system operations, and detailed cost analysis.
- Examine potential interactions between innovative technologies and existing and planned transportation improvement projects and initiatives in the region, such as Portway, Brownfields Redevelopment, Port Inland Distribution Network (PIDN) concept, etc.

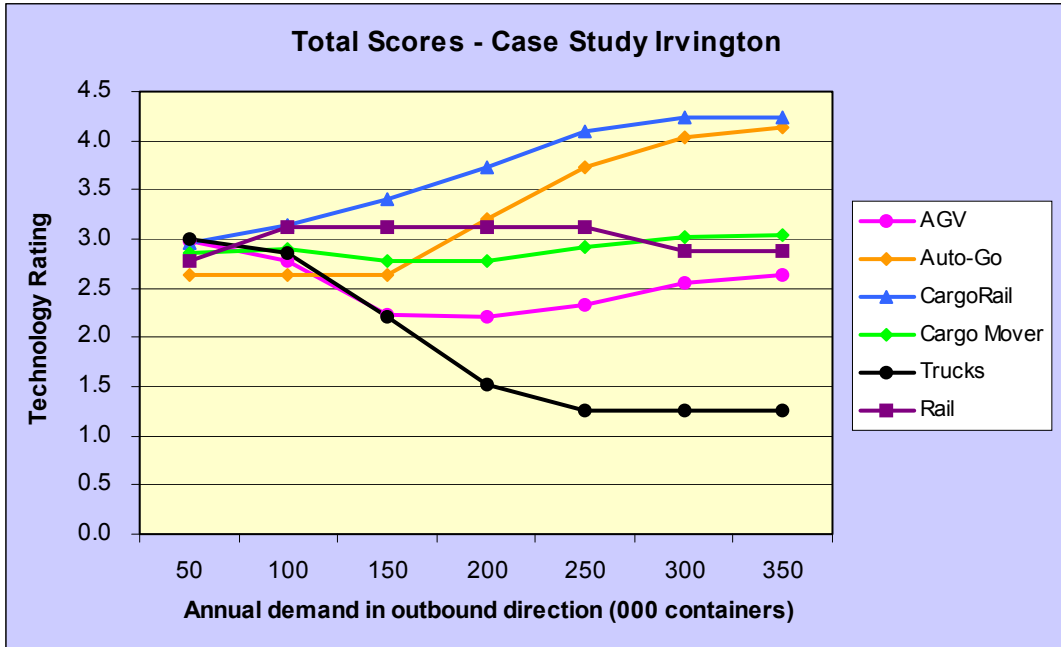


Figure 2. Total scores for alternative technologies – Case Study Irvington

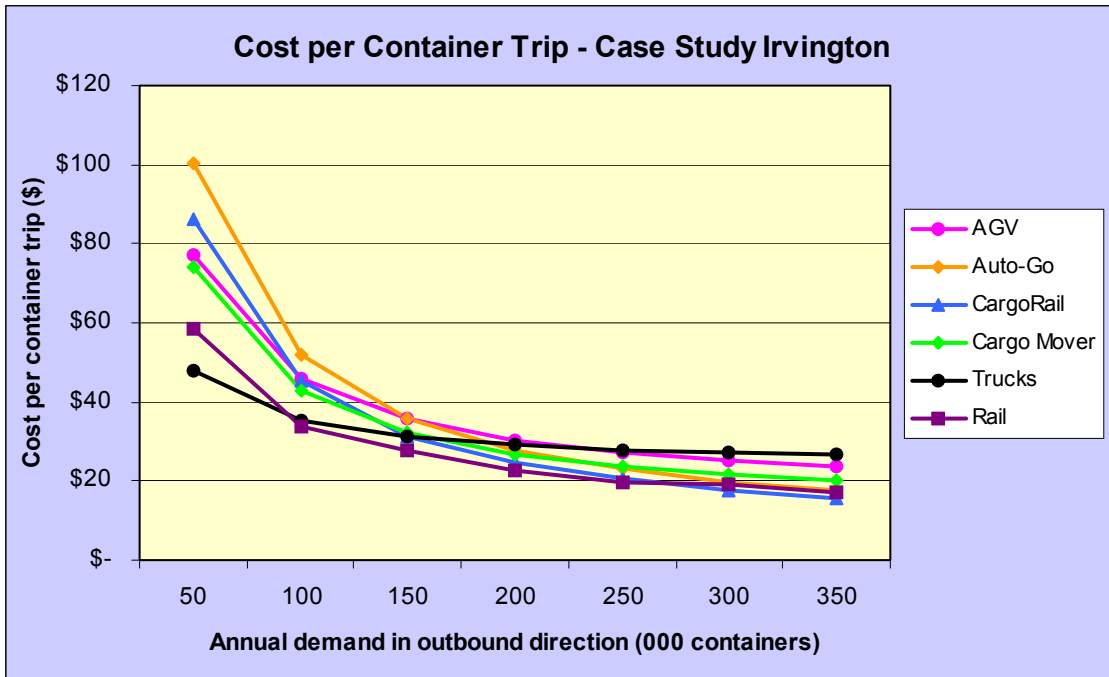


Figure 3. Total system cost per container trip for alternative technologies – Case Study Irvington

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A final report is available online at:

<http://www.state.nj.us/transportation/research/research.html>

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research Technology Transfer Group at (609) 530-3722, or send an e-mail to Research.Division@dot.state.nj.us and ask for:

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