

**Final Report for the
National Center for Intermodal Transportation for Economic
Competitiveness**

Mission Intermodal Excellence

Principal Investigator

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NCITEC PROJECT: 2012-06 and 2013-15

Conducted for NCITEC

December 2014

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ABSTRACT

The main objective of this project is to continue educating K-12 students about intermodal transportation. In 2012, NCITEC funded our K-12 project which aimed to develop tools, such as, lesson plans and hands-on activities that would introduce K-12 students to intermodal transportation. We delivered our first summer training program for K-12 teachers during June and August, 2013. Our second year had similar planned outcomes including additional lesson plans which will be developed by the PIs and the teachers. Learning activities were developed and refined through the course of the spring of 2014. A new cadre of teachers were recruited during this time as well and the summer 2014 session was planned and implemented. This second cadre then implemented the curricula in their classrooms.

The outcomes of this program include additional learning materials that will be continually available via the program website. These will continue to impact student learning in grades k-12 nationwide. The teachers trained in the program will continue to implement the curricula in their classroom extending the effect impact from year to year.

Introduction

The goal of the summer training program was to introduce K-12 teachers to the benefits and challenges of using intermodal transportation. This summer program consisted of two phases. Phase 1 took place in June, and phase 2 in August. During phase 1, the teachers were introduced to intermodal transportation. The program for this phase included a number of presentations from experts in different areas of transportation, such as, airline, barge, intermodal and rail transportation. Our speakers came from different engineering departments of MSU, Sociology Department of MSU, FedEx, CN Railway, and Tenn Tombigbee Waterway Development Council. We also implemented field trips to the port of Columbus, the FedEx hub of Memphis, TN, GTR airport, and Amtrak Hub in Meridian. During this phase, the MSU team provided teachers with ideas about incorporating intermodal transportation concepts in their curricula. The team presented a number of hands-on activities to be used in the school classrooms. Each teacher had about 1 month to reflect on the material presented during phase 1 of the summer training and develop at least one lesson plan. During phase 2 the teachers presented their intermodal-related lesson plans to the MSU team and their cadre members. The teachers and the MSU team discussed improvements of the lesson plans, improvements of the hands-on activities, and implementation of these activities in the classroom during Fall semester.

Project Foundations

Intermodal transportation facilitates the movement of freight and passengers. Freight is moved using intermodal containers, and passengers are moved using vehicles. Intermodal containers should seamlessly move from truck, to train, to barge and to ocean vessels. Similarly, passengers should seamlessly move from cars to trains, to airplanes, and to boats.

There are a number of benefits to using intermodal transportation. Using intermodal to move freight, as compared to using trucks, reduces transportation costs for the following reasons. The number of trips to deliver products from an origin to a destination is smaller. As a result, the amount of gasoline consumed, the amount of CO2 (and other gasses) emitted to the environment, the efforts to load/unload the cargo, and the number of labor hours required are smaller. Using intermodal transportation, such as moving containers on a train, or containers on a barge, reduces the number of trucks on the road. This in turn reduces the traffic and improves safety in roads and highways.

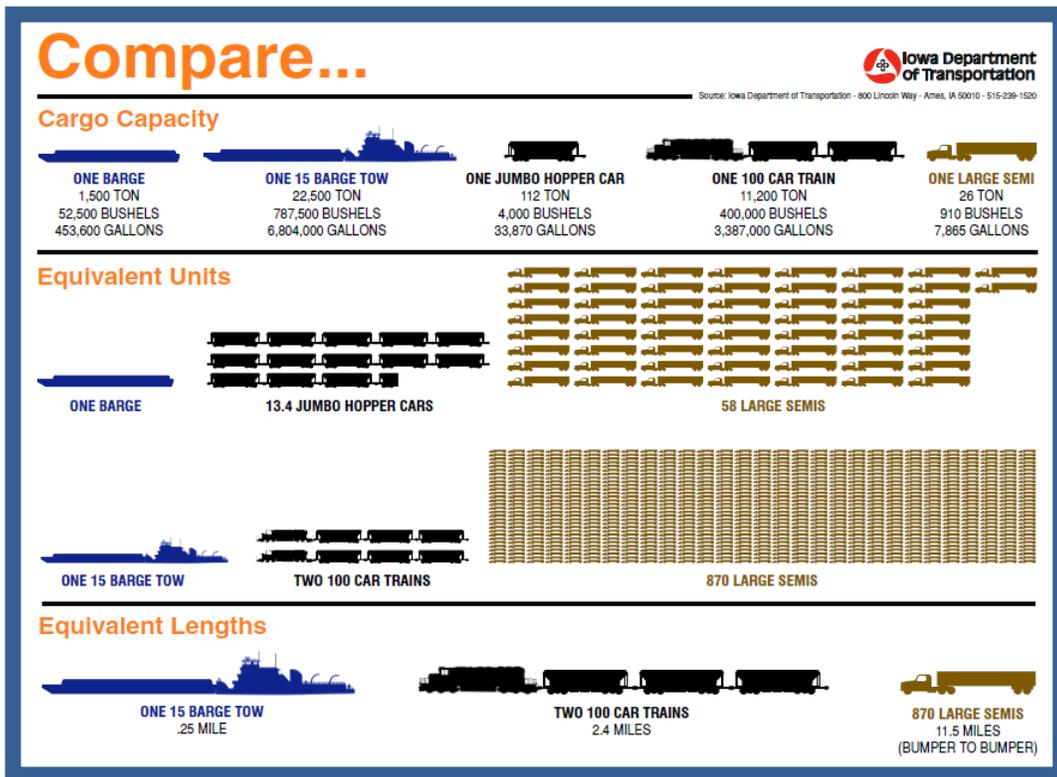


Figure 1: A comparison of cargo load by using different modes of transportation.

Using intermodal to move passengers, as compared to using personal vehicles, has a number of benefits. The number of personal vehicles required to move passengers reduces. As a consequence, less gasoline is consumed and less CO₂ (and other gasses) is emitted to the environment. Reducing the number of personal vehicles reduces the traffic and improves safety in roads and highways.

The goal of this work is to introduce K-12 students to the benefits of using intermodal transportation. The curricula materials developed cover a number of important issues, and performance measures of intermodal transportation. We discussed topics such as transportation safety, traffic flow, transportation emissions, transportation cost analysis, etc. These lectures also reflected the importance of intermodal transportation on the performance of the supply chain for different products. The level of complexity of the lectures and corresponding problems developed was dependent on the groups of students who participated in the program. In order to help students to better understand these topics the designed activities reinforce basic math, science and physics as outlined by the NGSS and common core curriculum.

This program helps K-12 students understand of some important social and environmental issues that can be solved using industrial and civil engineers skills. Through this program we expect to attract K-12 students to these two areas of engineering in the future. In addition, due to the increase in the price of gas and the increase in our awareness about environmental issues, we expect to see an increase in use of intermodal transportation by the participating students in the future. Through this program, the new generation will become aware of the importance of using intermodal transportation. Maybe some of these students will become the leaders and the engineers who will vitalize intermodal transportation.

Methodology

Over the course of the program, we trained K-12 teachers, created unit and lesson plans including integration of topics into existing frameworks with reinforcement activities, problem based learning opportunities, and organized an innovative competition allowing K-12 students to present their new understandings of the benefits and challenges of intermodal transportation usage and planning.

The *training of teachers* will took a total of 5 days, 4 days in June and 1 day in August. During the training sessions in June, we combined in-class instruction with trips to intermodal facilities. These trips contributed to the understanding of intermodal transportation and allowed the participants to enhance their real world understanding of the ideas explained. The morning of the first day were be spent in the classroom talking about issues such as, transportation and society, and the relationship between intermodal and waterway transportation. In the afternoon of the first day we took a trip to the Tombigbee Lock and Dam system in Columbus, Mississippi to allow the teachers direct experience with the importance of transportation planning and systems on waterways within the intermodal systems. Teachers were able to experience the actual use of the Lock and Dam system as they rode atop boats through the system with experiences boat pilots who explained the mechanisms and engineering involved. In the morning of the second day we discussed topics related to air, road and rail transportation in the context of intermodal. In the afternoon, participants learned about safety issues related to intermodal transportation, and reviewed prepared curriculum materials, practiced the hands-on and minds-on activities. During the third and fourth days of the training, we visited the Amtrak hub in Meridian, MS to allow the teachers the opportunity to observe the working of mass transit systems and the FedEx distribution hub in Memphis TN. We have collected videos related too intermodal transportation which we shared on the bus during the trip to and from Meridian and Memphis in order to maximize instructional time.

During the 1 day in August, each teacher shared their prepared lesson plans they developed using the training material handed in June. We held group discussions to identify ways to improve and implement the sample plans. We believe it is essential to get teachers involved in designing the lesson plans since they are the experts on what works in their classroom. During this time we also discussed assessment tools, rubrics for problem based learning activities as well as the opportunities for the teachers to interact with faculty and researchers in order to gain a deeper understanding of intermodal transportation systems. Additional efficacy assurances included a pre- and post-assessments of the teachers' understandings of the curricula topics in order to ascertain the level of comprehension and evaluate the program and delivery.

The *lesson plans and lectures* that were developed covered the intermodal-related topics listed below. Each lesson and exercise was customizable to fit the grade level of the students participating.

1. *The meaning of intermodal transportation.* We used figures and short movies to help students identify/recognize intermodal transportation and its use.
2. *Safety issues related to intermodal transportation.* Discussion and activity topics include the varied types of transportation and the safety concerns of each. This includes triggers such as: “Why do you wear a seat belt in your car, but do not have to wear one on the school bus?”
3. *Costs associated with using intermodal transportation.* We prepared activities asking students to consider and calculate the transportation cost for delivering X amount of products using truck, barge or trains from point A to point B. Similarly, we will prepare activities asking students to consider and calculate modes of transportation for human movement as well.
4. *Time associated with intermodal transportation.* We prepared activities that require students to calculate the time it takes to deliver products from point A to B using different modes of transportation.
5. *Environmental impacts of modes of transportation.* Students learned about the environmental benefits of using intermodal transportation. Through activities, students will gain an understanding of the impacts of various modes as relative to their advantages and costs. Topics include cost/benefit analysis regarding emission levels and exploration of global transit and freight shipping through varied methods.

Finally, during Fall semester we organized a competition with the students who have participated in this program. In order to capitalize on the technological abilities of the young people in the classrooms, the competition consisted of preparation of a Public Service Announcement (PSA) about Intermodal Transportation from the perspective of safety, economics, or environmental impact. Once prepared, the students submitted their final project to the MSU team for evaluation by an independent group of educators and engineers. These PSAs have been made available to multiple media outlets.

Outcomes and Benefits

- (1) This educational project will continue to contribute to attracting/recruiting K-12 students to two areas of engineering: industrial and systems engineering, and civil and environmental engineering.
- (2) This educational project will introduce students to intermodal transportation. It will help students understand some important benefits and challenges of intermodal transportation.
- (3) On several occasions the project team has made transportation-related presentations to K-12 and traditionally underrepresented students through the summer programs organized by Bagley College of Engineering, such as, I AM GIRL, Women in Action, IMAGE Summer Bridge Program, Quest, etc. The team will be using some of the tools developed through this project when offering similar lectures in the future.
- (4) At a personal level, all members of this project team are advocates for engineering education at all levels, and have a genuine interest in increasing participation in engineering education. The work of this project will contribute in achieving these personal goals.

Technology Transfer:

The project team presented the methodology used, and the outcomes of this project in national educational conferences, as well as in local conferences and meetings. Some of the conferences that members of this team have attended in the past are the Annual Meeting of American Society for Engineering Education, and the Southeastern Regional Conference of American Society of Engineering Education. The team plans to continue to disseminate the findings of this project through publication of results in the proceedings of these conferences. The team will also target educational-related journals, such as, the Journal of Engineering Education. The lectures materials developed that were given to the teachers are also part of the technology transfer.

