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Atlanta Traffic Optimization Final Design Review

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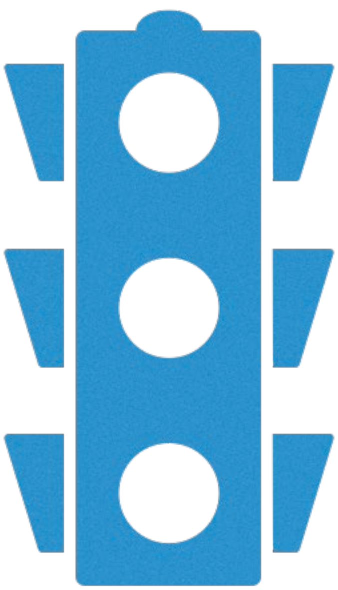
TEAM OPTIMIZE

Atlanta Traffic Optimization
Final Design Review

ISYE 4900

Spring 2018

04/30/2018



***PROJECT MANAGER*:** BIRAM NICOL

Team Member Names and Titles

- PROJECT MANAGER: BIRAM NICOL
- TECHNICAL EXPERT: VICK ABWAVO
- SOFTWARE LEADER: BRANDON HARRIS

Executive Summary

To solve the Metro-Atlanta traffic problem, we have embarked in numerous efforts to find feasible goals that had worked in other states with similar situations. In dealing with the traffic problem around the Metro area, we have designed a rail system to counter if our proposed idea of eliminating trucks within the Metro area is realized. This will be a more cost-effective area as the rail system is set to pay for itself after a decade and half of operation.

This idea might be considered radical, but our findings showed that 39.50% of freight is transferred by rail according to the National Rail Plan Progress. Significant travel times can be realized if our model sees daylight. Furthermore, traffic accidents has been on the steady risen but our model also show good promise on reduce that steadily reverse that trend year after year.

The overall economic impact can only be for better because of immeasurable gains such as confidence in our local transportation systems. The commercial gains could lead to economic boom if our proposals is put into practice. Moreover, consumer confidence has a chance of gaining momentum if transportation is not a hassle any more.

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Chapter 1

1.1 Introduction

The traffic of Atlanta has worsened. There have been various strides in many areas, but the traffic congestion persists. Events such as traffic fatalities have seen a steady rise. Oversized truck accidents are one of the fastest growing causes of fatalities in Fulton County according to the National Highway Traffic Safety Administration. Furthermore, traffic congestion is caused by an out of date and unreliable metro rail service.

Meanwhile, the cargo rail systems are outdated and overwhelmed, which in turn contributes towards more traffic on the roads. Traffic fatalities correlates with traffic congestion. A steady improvement in traffic fatalities made almost a decade ago saw a decline three years ago. This provides an opportunity to address the growing number of oversized trucks in the metro area. Unlike many major metropolitan cities in the United States, Atlanta has little to reduce trucks in the metro areas making it one of the most dangerous cities when it comes to traffic fatalities.

1.2 System Overview and Major Developments

A possible solution is to build another cargo rail system through the metro area that will significantly reduce the number of these oversized trucks on the roads. Trucks carry Eighty-four percent of the goods shipped annually from sites in Georgia and another ten percent are carried by courier services or multiple mode deliveries, which include trucking. The problem of this project is traffic congestion strongly influenced by too many heavy trucks which results in more fatalities.

1.3 Objectives

1.3.1 Minimum Success Criteria

- **Less than one-hour round-trip system requirement:** We can define our success in this scenario by comparing the round-trip time using the I-285 route to the I-75 route, which averages 50 minutes round trip. The I-75 route can serve as our constant or control experiment in this case. So, if the round-trip travel time is below an hour using the I-285 whilst the I-75 route is at a constant (50 minute round-trip), barring any major roadwork or traffic accidents, then we can declare success.
- **Fatalities Requirement**: If we are able to reduce the number of highway fatalities in Georgia by 25 persons, then we can declare success.

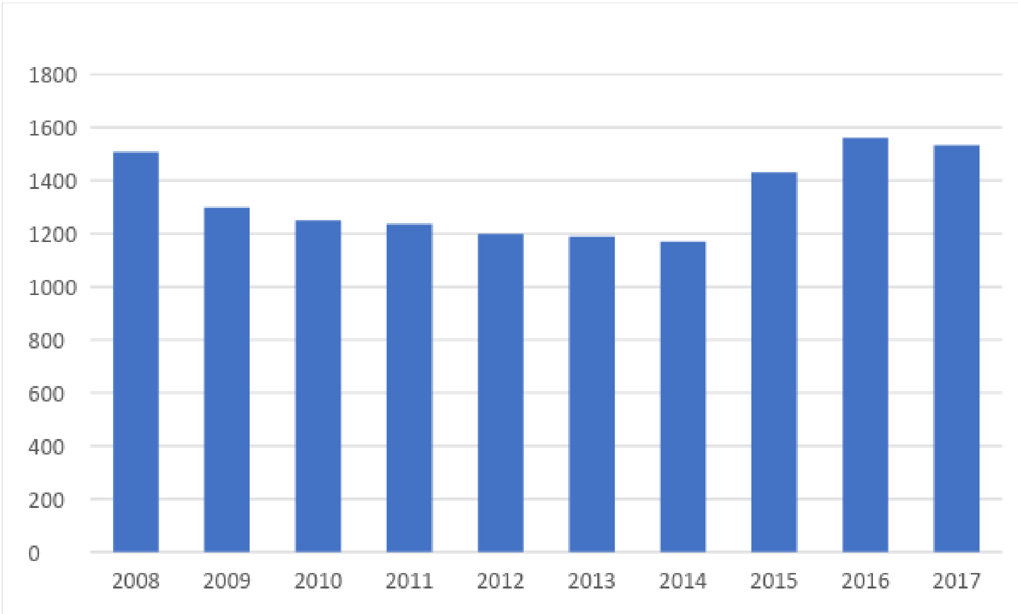


Table 1.1: Annual Fatality Traffic Trend by year. (Source: GDOT)

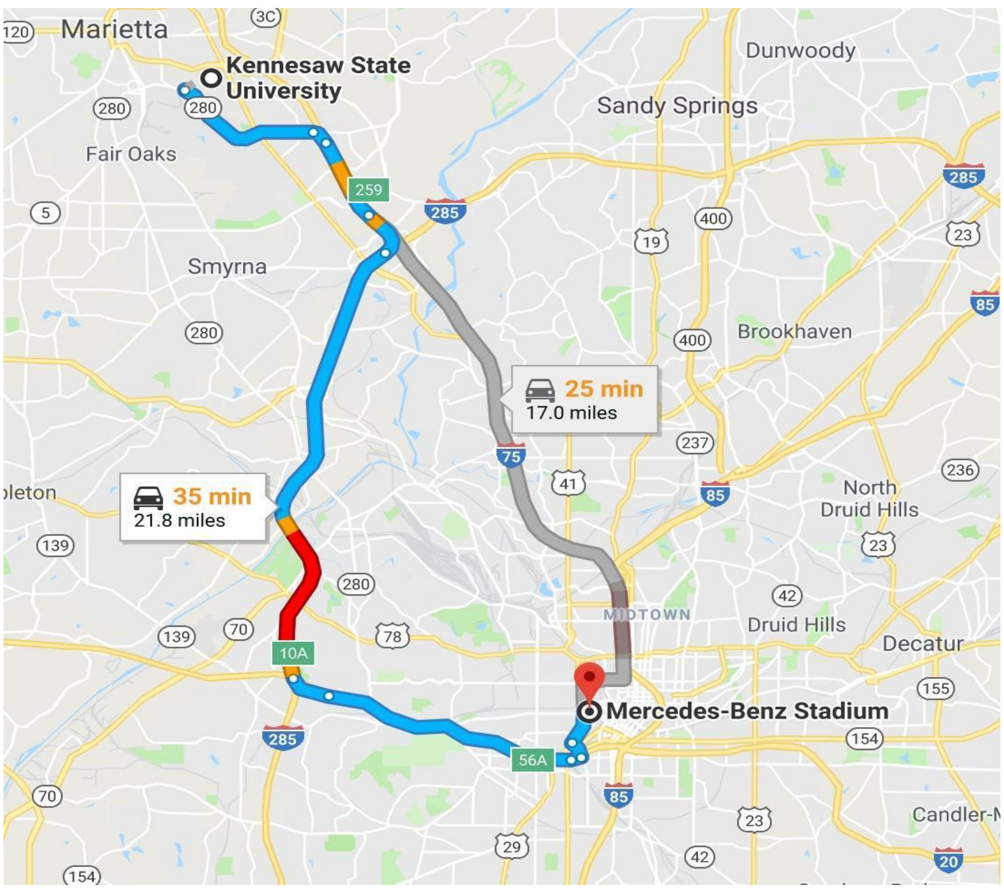


Figure 1.1: Travel distance between KSU and Mercedes-Benz Stadium at 1:30 pm.
(maps.google.com)

1.3.2 Flow Charts

System Block Diagram

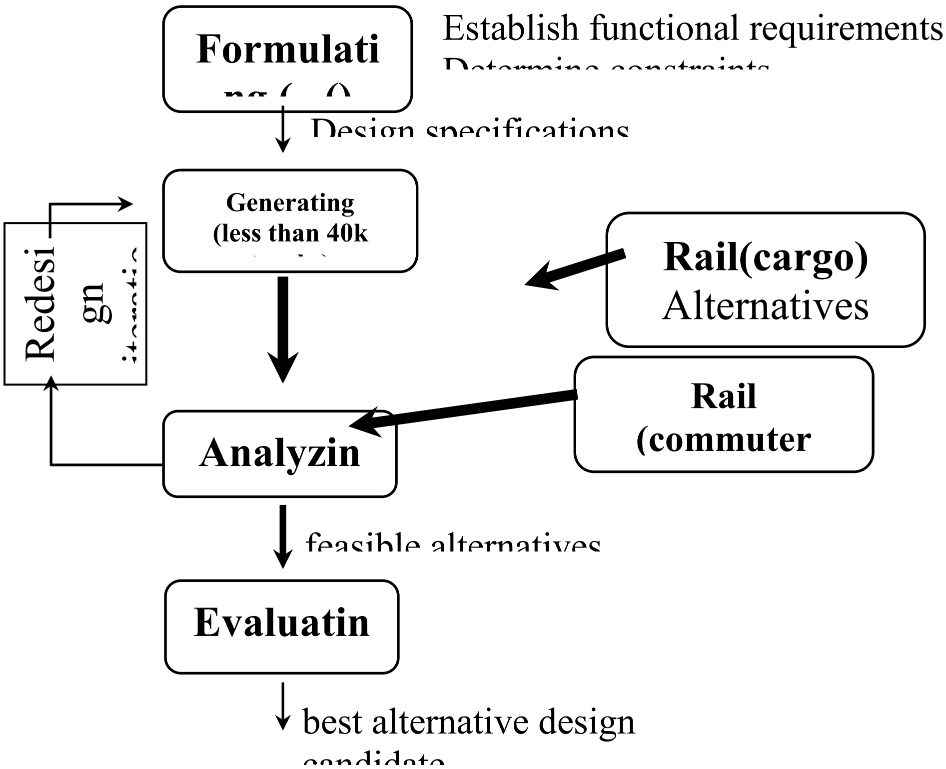


Figure 1.2: System Block Diagram

Gantt chart

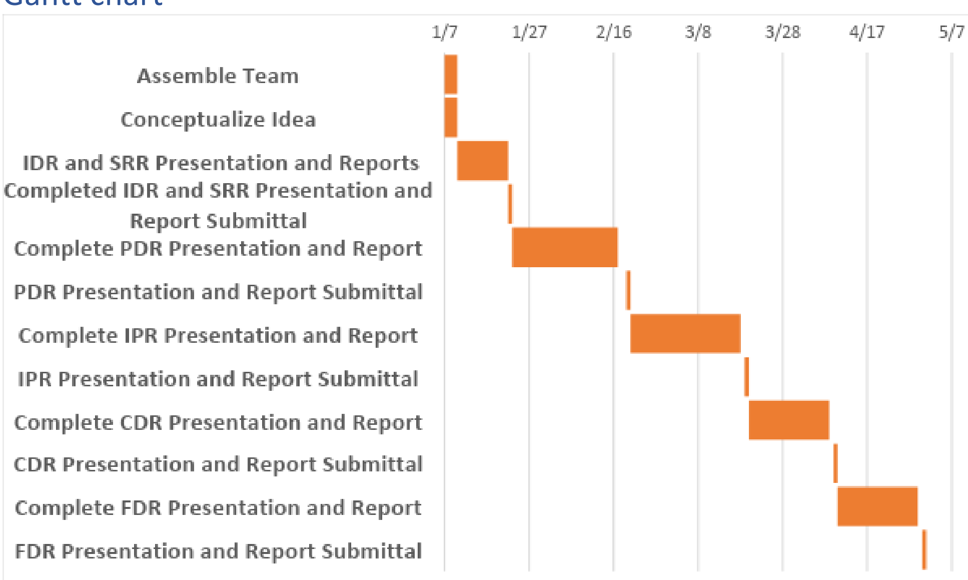


Figure 1.3: Task Schedule Gantt chart.

Task	Start Date	Duration	End Date
Assemble Team	1/7	3	1/10
Conceptualize Idea	1/7	3	1/10
IDR and SRR Presentation and Reports	1/10	12	1/22
Completed IDR and SRR Presentation and Report Submittal	1/22	1	1/22
Complete PDR Presentation and Report	1/23	25	2/17
PDR Presentation and Report Submittal	2/19	1	2/19
Complete IPR Presentation and Report	2/20	26	3/18
IPR Presentation and Report Submittal	3/19	1	3/19
Complete CDR Presentation and Report	3/20	19	4/8
CDR Presentation and Report Submittal	4/9	1	4/9
Complete FDR Presentation and Report	4/10	19	4/29
FDR Presentation and Report Submittal	4/30	1	4/30

Table 1.2: Schedule Team Assignment and Overall Schedule

1.3.3 Responsibilities

Biram Nicol: Managing the project and implement optimizing tools for Traffic problem.
Us Engineering economy tools to evaluate cost and benefit analysis. Also tried other tools to simulate traffic including MATLAB but to no results.

Brandon Harris: Worked on attempting to make Arena simulation for our problem to no success. Setup Gantt chart for project management. Determined our educational lessons and challenges with the project. Also determined our verification approach. In addition, I also used deductive reasoning when using the vehicles miles traveled data to extrapolate our results to show that travel time would be reduced.

Vick Abwavo: Devise a benefit cost analysis to determine whether it is better to invest in building a railroad vs. building more highways. Find out the yield utilizing a breakeven analysis for investing in a railroad. From a private company perspective, determine the operating costs and whether it is better to invest on a locomotive or a tractor trailer.

1.3.4 Materials Required

Available and Required Resources

- Simulation Software:
    - Darkwell Traffic Data and Analysis Software
- Optimization Software:
    - Microsoft EXCEL
    - Lingo
- Word Processor:
    - Microsoft Word
    - Latex
- Equipment:
    - Desktop Computer
    - Laptops
- Internet:
    - Google Maps
    - DOT Data

Chapter 2

Problem Solving Approach

2.1 Design Concepts

The metro does not by any means lack rail for carrying cargo, as the figure below shows. Nevertheless, large amounts of trucks come from the Savannah Ports towards the Metro-Atlanta area. A solution is to link these two cities by rail for transportation, instead of 52 feet trailers that contribute towards heavy traffic.

Figure 3.1: Atlanta Metro Rail Map

CSX has a station in Chatsworth that will be connected to the proposed railed to Savannah port. Our design concept is a to link a two-way cargo rail system between these two cities in order to reduce traffic into the metro Atlanta area.

Allowed	Prohibited
Emergency vehicles	48’-52’ trucks
Ambulances	Double Trailers
Fire Truck regardless of size	Atlanta Street Cars

Table 3.1: What is and what is not allowed in our system (roads)

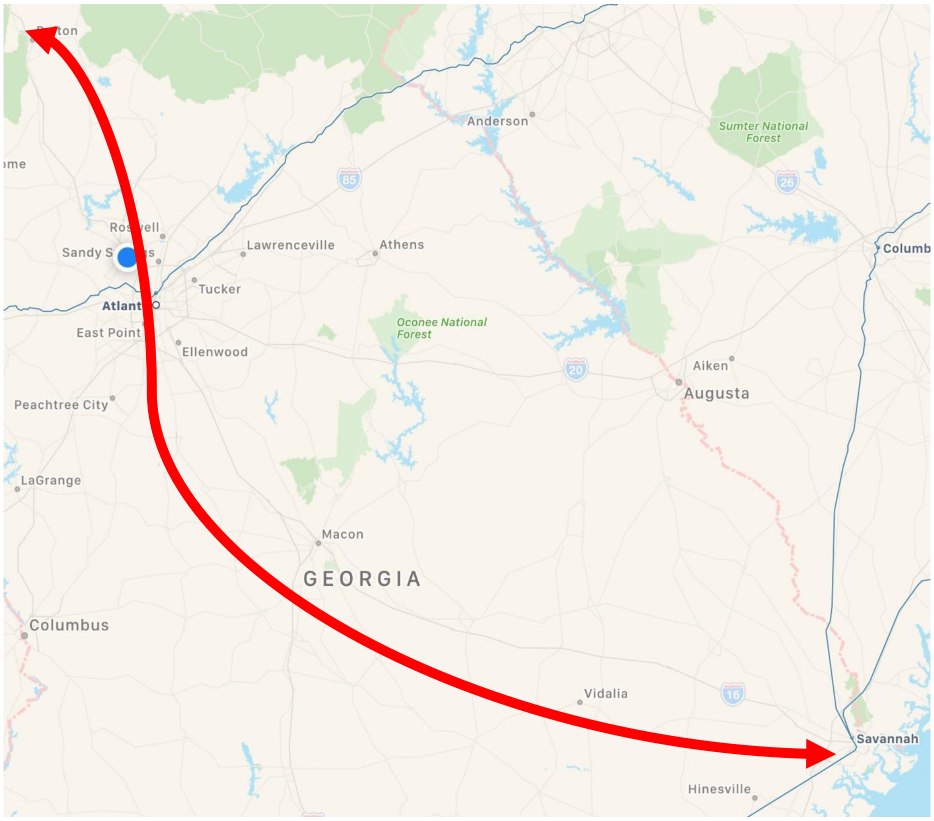


Figure 3.2: Proposed Cargo Train Line from Chatsworth to Savannah

2.2: Verification Approach

We planned to use Arena Simulation software as a tool. We planned to input collected data from the DOT and time studies to set up a proper model to replicate Atlanta road travel at 1:30 PM during the week. After running the model to completion, we wanted to analyze our data and make the necessary changes to the model, so it matched real life conditions as close as possible.

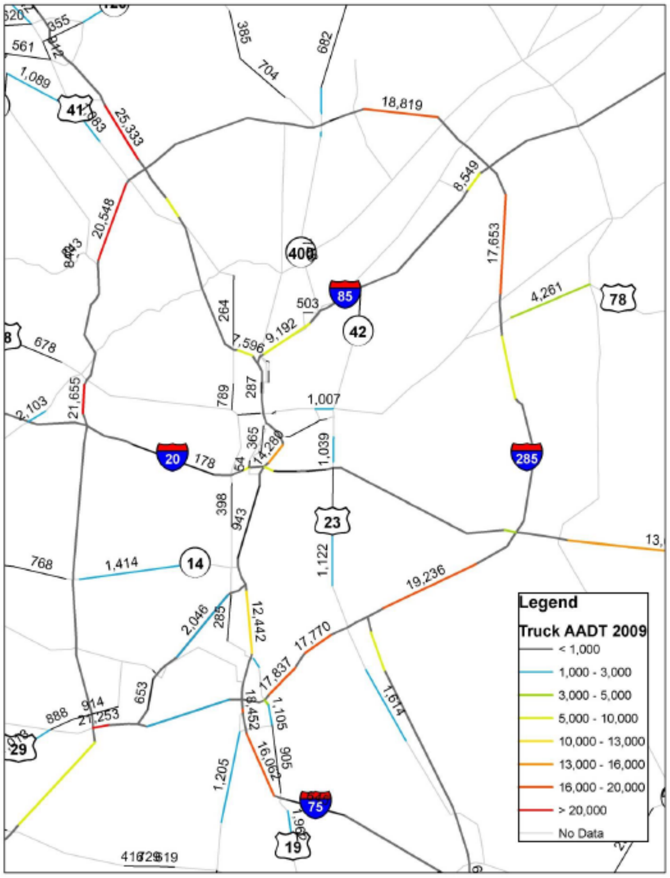
However, we ran into the issue of not being able to use Arena simulation software because our cargo train model was too complex. We would not be able to accurately model our results to present in a favorable manner. The system is devised for process modeling, not network modeling. We ran into the issue of not being able to provide enough detail into our model.

We then looked into other software and could not find a feasible and affordable solution until we found the Darkwell Traffic Data and Analysis Software. This software showed us the amount of traffic on our route at specific times of the day, provided by the GDOT. We used this in combination with vehicles miles traveled data from the US DOT to simulate what would happen to traffic with and without trucks on the planned route from KSU to Mercedes Benz Stadium.

When verifying this data, we used a transportation model built in EXCEL to show that we were reducing the travel time. We used a comparison between a model with trucks on the metro Atlanta highway to a model without trucks on the Atlanta highway. The model without the trucks proved to have a reduced travel time that met our minimum success criteria. Our verification showed that we were able to reduce travel time by 14 minutes.

2.3: Traffic Evaluation

We were able to successfully obtain the data from the GDOT's database and based on the information available, we can conclude that the information is sufficient to make a simulation. The data is an estimation from extrapolating shorter duration counts to get the "average annual daily traffic for trucks on hundreds of road segments in the state" (31). In figure 3.4, the region with the highest truck count data is I-75 north, north of I-285, this possibility has to do with trucks coming in from out of state to satisfy demand in the Atlanta region.



Source: GDOT Classification Count Data, 2009.

Figure 3.3: Truck average annual data in Metro Atlanta (2009)

We were able to determine that the highest volume of trucks were located on I-75 North of the I-285 perimeter from figure 3.3. Since we will be trying to reduce the traffic from Kennesaw to the new Mercedes Benz stadium, this data proves that the concentrated volume of large trucks in this area are a major factor to the traffic delays. Other factors include accidents, which will be addressed in chapter 4. Our theory is that, by removing these large trucks off the road, traffic should reduce and the commute time from Kennesaw to the new Mercedes Benz stadium should reduce by 20 minutes or more as stated earlier. Although this is the annual average count of data, we plan to investigate further to determine the exact number of large trucks between noon and 3pm to get a more accurate count when evaluating the root cause of the traffic.

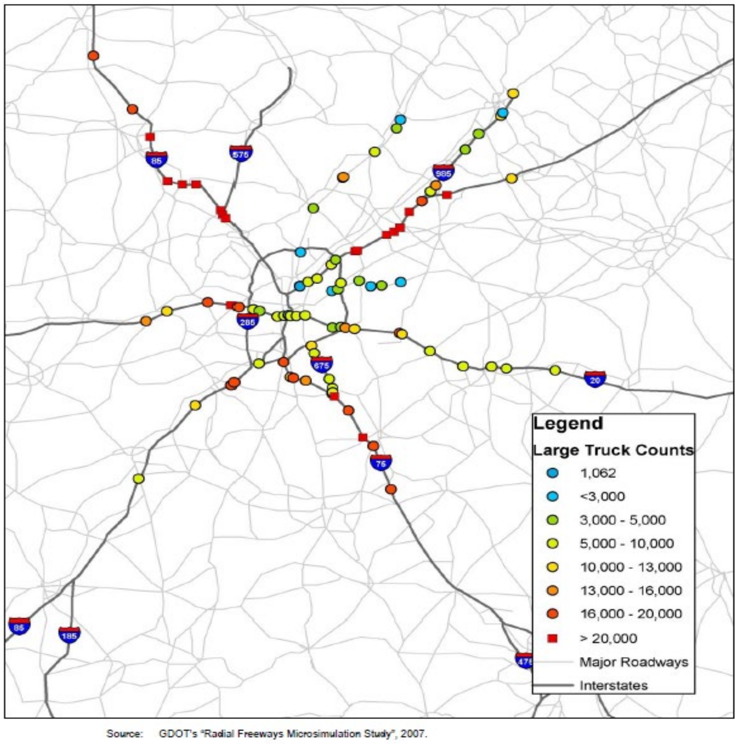


*Figure 3.4: Counts of large trucks on the roads**__2.4: Cost Benefit Analysis__***

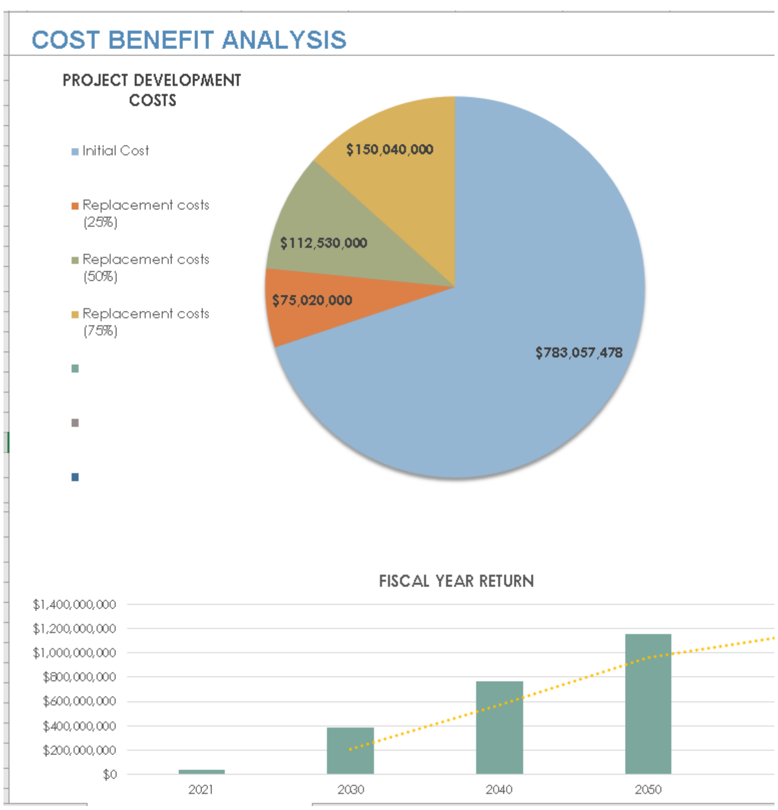


Figure 3.5: Cost benefit analysis calculate in excel

Figure 3.5 shows the total fixed and variable costs associated with the construction and maintenance of building a train. The fixed costs associated with the total fixed cost of this project and the purchasing of a truck are shown in figure 3.7 which we were able to find from online resources such as the “Aberdeen Carolina & Western Railway Company” and the “Quick Transport Solutions, Inc.” which was helpful in determine the costs of purchasing and maintaining a train.

PROJECT COSTS						
DESCRIPTION	2021	2030	2040	2050		TOTAL
DEVELOPMENT						
Initial Cost	$ 783,057,478					$ 783,057,478
Replacement costs (25%)		$ 75,020,000				$ 75,020,000
Replacement costs (50%)			$ 112,530,000			$ 112,530,000
Replacement costs (75%)				$ 150,040,000		$ 150,040,000
						$ -
						$ -
						$ -
TOTAL DEVELOPMENT COSTS	$ 783,057,478	$ 75,020,000	$ 112,530,000	$ 150,040,000		$ 1,120,647,478
SUPPORT						
						$ -
						$ -
						$ -
						$ -
						$ -
						$ -
						$ -
TOTAL SUPPORT COSTS	$ -	$ -	$ -	$ -		$ -
TOTAL COSTS	$ 783,057,478	$ 75,020,000	$ 112,530,000	$ 150,040,000		$ 1,120,647,478

BENEFITS / SAVINGS						
PROCESS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
CURRENT						
TOTAL ANNUAL PRICE	$ 783,057,478	$ 75,020,000	$ 112,530,000	$ 150,040,000	$ -	$ 1,120,647,478
NEW						
TOTAL ANNUAL PRICE	$ 75,020,000	$ 112,530,000	$ 150,040,000	$ -		$ 337,590,000
ANNUAL SAVINGS	$ 708,037,478	$ (37,510,000)	$ (37,510,000)	$ 150,040,000	$ -	$ 783,057,478

Table 3.2: Costs for cost benefit analysis

PROCESS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
CURRENT						
TOTAL ANNUAL PRICE	$ 783,057,478	$ 75,020,000	$ 112,530,000	$ 150,040,000	$ -	$ 1,120,647,478
NEW						
TOTAL ANNUAL PRICE	$ 75,020,000	$ 112,530,000	$ 150,040,000	$ -		$ 337,590,000
ANNUAL SAVINGS	$ 708,037,478	$ (37,510,000)	$ (37,510,000)	$ 150,040,000	$ -	$ 783,057,478
CUMULATIVE SAVINGS	$ 708,037,478	$ 670,527,478	$ 633,017,478	$ 783,057,478	$ 783,057,478	$ 1,566,114,956
CUMULATIVE COSTS	$ 783,057,478	$ 858,077,478	$ 970,607,478	$ 1,120,647,478	$ 1,120,647,478	$ 2,241,294,956
CUMULATIVE TOTAL NET SAVINGS	$ (75,020,000)	$ (187,550,000)	$ (337,590,000)	$ (337,590,000)	$ (337,590,000)	$ (675,180,000)

FUTURE VALUE			
PRESENT VALUE	INTEREST RATE	YEARS PROJECT WILL LAST	FUTURE VALUE
$ 783,057,478	0%	30	$783,057,478

NET PRESENT VALUE		
FISCAL YEAR	FISCAL YEAR RETURN	PRESENT VALUE
2021	$38,379,575	$39,147,167
2030	$383,795,745	$391,471,660
2040	$767,591,491	$782,943,321
2050	$1,151,387,236	$1,174,414,981
TOTAL	$2,341,154,047	$2,387,977,128
	PROJECT DEVELOPMENT TOTAL	$1,120,647,478
	NET PRESENT VALUE	$1,267,329,650

Table 3.3: Total net value of project

We were able to determine that our project is in fact feasible due to the model generating $1,267,329,650 over the next thirty years shown in table 4.2. These values came from an initial cost of $783,057,478 and regular maintenance of 25% replacement, 50% replacement and 75% replacement in 2030, 2040 and 2050, respectively over the 341 miles shown in table 4.1. Fuel is a negligible cost for this problem because we account for fuel in the revenue/benefit of the state. This is based on 30% of 426,439,717 tons-per-mile (and increasing by 185,963,366 tons-per mile every 10 years) of that travel from Savannah though Atlanta at 3 cents per gallon. These costs were acquired from the truck annual average daily traffic data provided by the GDOT.

	Total cost	Return
2021	$783,057,478.00	$38,379,575.00
2030	$858,077,478.00	$422,175,320.00
2040	$970,607,478.00	$1,189,766,811.00
2050	$1,120,647,478.00	$2,341,154,047.00
		0.478673105
		14.36019316
		2035.36

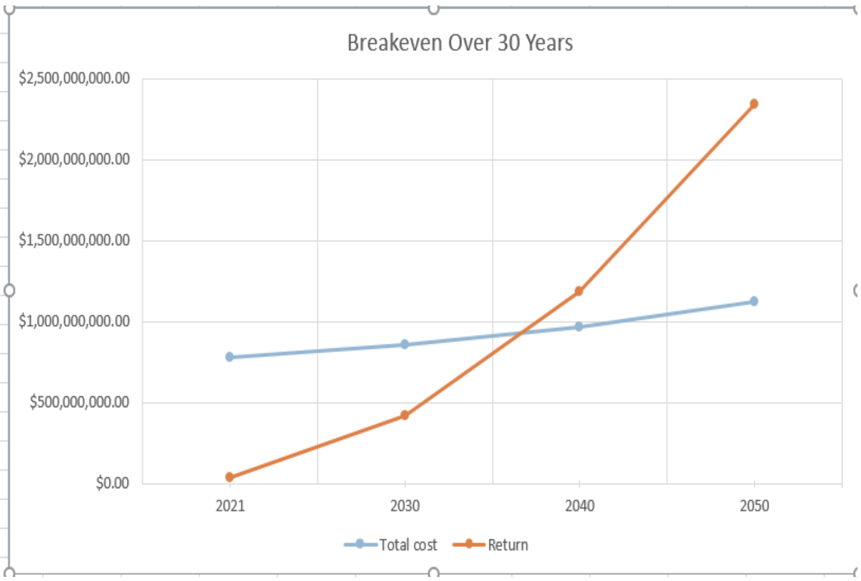


Figure 3.6: Breakeven analysis

We were able to determine the point at which the government broke even, given they chose to invest in a railroad track 341 miles from Chatsworth to Savannah to be in the year 2036. This value only includes the cost of building the railroad and its cost of maintenance every 10 years, shown as total costs in figure 3.6, as well the revenue generated every 10 years, which is the return in figure 3.6. We expect them to generate revenue through charging by the ton-mile of 3 cents per gallon.

pplementary Cost		**Salaries Paid**		**Costs (Truck)**	
st of locomotive	$1,500,000.00	Train Conductor	$55,180.00	Truck	$0.24
st of Cargo	$2,000.00	Truck Driver	$40,260.00	Fuel per ton-mile (tru	$0.37
uck Year maintenan	$180,000.00			Insurance per mile	$0.05
ew Truck Cab	$100,000.00			permits and licenses	$0.02
ailer	$50,000.00			Efficiency	59 miles/gallon
				Costs (Train)	
				Efficience	202 ton-miles per gallon
				Fuel per ton-mile	$0.03
				Annual Repair	$42,028.00
				maintenance	$0.29

Figure 3.7: Private sector perspective

Upon looking at the individual costs associated with a private company, we neglected the cost of actually building the railway and focused on the costs that would be associated with the company itself such as maintenance, salaries, gas, insurance, cost of cargo, cost of a trailer and etc. all shown in figure 3.7 above at a per mile basis. A train conductor makes more annually than a truck driver does although the average cost for operating a truck is more than the cost of maintaining a train annually. Although it costs more to operate a fleet of trucks, a train company also costs a substantial amount due to factors such as onboard service crews, train crews and engine crews that add on to the variable costs, which are determined by the volume of activity. The fixed costs are stable which include the route that is traveled and overhead costs such as "headquarters management, call center, accounting [...] and other corporate costs" which are separate from the costs we are focusing on due to "an allocation issue that raises equity concerns." (Rocky Mountain Rail Authority)

2.5 Requirements

Design Requirements and Specifications

Our design aims to improve the transportation system of the Metro-Atlanta area, our design requirements are that transportation in the Metro-Atlanta area needs to be:

- Viable for commuters: This means that more commuters will find commuting by road through the metro area more viable and effective than before the change. In other words, the amount of people road commuting will be more moderate, thereby encouraging reduced traffic congestion.
- Less than one-hour round-trip: Our model should be able to accommodate for a round-trip from Kennesaw State University (Marietta Campus) to Mercedes-Benz Stadium in less than one hour. This is infeasible in the current conditions with the large number of oversized trucks using the I-285 route; which is notorious for heavy truck presence. The average currently is about 70 minutes, at 1:30 PM during weekdays.
- Safety: A significant reduction in fatalities caused by trucks will improve commuter confidence in the metro roads. Accidents by trucks is among the highest in Fulton County (for example) according to National Highway Traffic Safety Administration (NHTSA).
- Reduce Oversized trucks: A rough estimate of about fifty thousand trucks could be removed a year if another cargo rail is built.

Chapter 3 - Evaluating Road Fatalities

3.1: Evaluation Introduction

In this chapter, we aim to evaluate how the reduction of trucks will reduce the number of road fatalities. We were able to obtain historical data from the Governor's Office of Highway Safety in Georgia and utilize that to analyze trends over the years, the type of vehicles that are prominently involved in road fatalities, the type of vehicles that cause said road fatalities and the people (i.e. occupants, motorcyclist and nonoccupants) involved shown in figure 7.1 and 7.2. From this, we will be able to evaluate the number of trucks that are involved and cause road fatalities, then from determining the ratio of trucks to other road fatalities we should be able to statistically exclude trucks from the road and re-evaluate the number of road fatalities to determine just how much that value will decrease.

Georgia Fatalities by Crash Type

Crash Type	2012	2013	2014	2015	2016
Total Fatalities (All Crashes)*	1,192	1,180	1,164	1,432	1,554
- (1) Single Vehicle	692	710	665	777	857
- (2) Involving a Large Truck	153	163	155	182	179
- (3) Involving Speeding	180	197	213	268	266
- (4) Involving a Rollover	348	317	313	336	402
- (5) Involving a Roadway Departure	675	646	624	761	849
- (6) Involving an Intersection (or Intersection Related)	268	272	282	370	362

Figure 4.1: Georgia Fatalities by Crash Type

Georgia Fatalities by Person Type

Person Type		2012		2013		2014		2015		2016	
		#	%*	#	%*	#	%*	#	%*	#	%*
Occupants	Passenger Car	453	38	447	38	445	38	561	39	583	38
	Light Truck - Pickup	179	15	178	15	174	15	213	15	216	14
	Light Truck - Utility	158	13	138	12	144	12	184	13	210	14
	Light Truck - Van	38	3	47	4	31	3	50	3	39	3
	Light Truck - Other	1	0	2	0	1	0	0	0	2	0
	Large Truck	24	2	26	2	28	2	26	2	33	2
	Bus	0	0	1	0	0	0	0	0	4	0
	Other/Unknown Occupants	17	1	16	1	21	2	20	1	30	2
	Total Occupants	870	73	855	72	844	73	1,054	74	1,117	72
Motorcyclists	*Total Motorcyclists*	134	11	116	10	137	12	152	11	172	11
Nonoccupants	Pedestrian	167	14	176	15	163	14	194	14	232	15
	Bicyclist and Other Cyclist	17	1	28	2	19	2	23	2	29	2
	Other/Unknown Nonoccupants	4	0	5	0	1	0	9	1	4	0
	ï¿½ï¿½Total Nonoccupants	188	16	209	18	183	16	226	16	265	17
Total	*Total*	1,192	100	1,180	100	1,164	100	1,432	100	1,554	100

Figure 4.2: Georgia fatalities by Person Type

3.2: Further data collection and Calculations

The average annual road fatalities over the past 5 years was determined to be 1304.4 while the average annual road fatalities caused by or involve a large truck over the last 5 years was determined to be 166.4 per year, which is roughly 12.76% of all road fatalities; this data is from figure 7.1. In order to determine root causes of the deaths involved in each fatality, we looked further to assign causes. The data we found shows the "Deaths in large truck crashes by road type, time of day, …deaths in two-vehicle crashes involving a large truck and a passenger vehicle, Motor vehicle crash deaths occurring in large truck crashes and other crashes" from 2016 shown below in figure 4.3, figure 4.4, figure 4.5 and figure 4.6 respectively.

3.2.1: Evaluating Data to Assign causes and narrow down calculations

Deaths in large truck crashes by road type, 2016

Road type	Deaths	%
Interstates and freeways	1,277	32
Other major roads	2,373	60
Minor roads	281	7
Unknown	55	1
All road types	3,986	100

Figure 4.3: Deaths in large truck crashes by road type, 2016

From the data above, we were able to determine how many of the total large truck deaths actually occur on the interstate and freeways. From this data, we can see that 32% of all deaths caused by large trucks are on interstates and freeways therefore as we do further calculations, this 32% will be factored in to determine the true value of all road fatality deaths.

Deaths in large truck crashes and other crashes by time of day, 2016

Time of day	Large truck crashes		Other crashes		All crashes	
	Deaths	%	Deaths	%	Deaths	%
Midnight - 3 a.m.	362	9	4,019	12	4,381	12
3 a.m. - 6 a.m.	461	12	2,804	8	3,265	9
6 a.m. - 9 a.m.	593	15	3,053	9	3,646	10
9 a.m. - noon	668	17	2,825	8	3,493	9
Noon - 3 p.m.	667	17	4,120	12	4,787	13
3 p.m. - 6 p.m.	575	14	5,406	16	5,981	16
6 p.m. - 9 p.m.	350	9	5,905	18	6,255	17
9 p.m. - midnight	303	8	5,070	15	5,373	14
Total*	3,986	100	33,475	100	37,461	100

Figure 4.4: Deaths in large truck crashes and other crashes by time of day, 2016

Trucks operate all throughout the day, morning, afternoon and night in order to reach their destination by a certain time. The data provided in figure 7.4, shows that high volumes of deaths occur between 6 a.m. and 6 p.m. This could be because commuters are likely heading to or from work. Since we are focusing on the traffic between 1 p.m. and 2 p.m., the data provided confirms that the ratio of large trucks to other crashes around this time is higher than any other time of the day other than from 9 a.m. to noon. This means that 32% reduction in of all large truck deaths, equating to 214 deaths, occurred between noon and 3pm on the interstate in the year 2016.

Occupant deaths in two-vehicle crashes involving a large truck and a passenger vehicle, 2016

Occupant type	Deaths	%
Passenger vehicle occupants	2,056	97
Large truck occupants	56	3
All occupant deaths	2,112	100

Figure 4.5: Occupant deaths in two-vehicle crashes involving a large truck and a passenger vehicle, 2016

Some of the deaths in the year 2016 included fatalities involving a single vehicle, two-vehicles and in some cases more than 2 vehicles. For this particular problem, we chose to evaluate accidents involving two vehicles, a large truck and passenger vehicle, as they accounted for 52.99% of all truck accidents, other factors, such as time of day and road type, remain constant.

Motor vehicle crash deaths occurring in large truck crashes and other crashes, 2016		
Crash type	**Deaths**	**%**
Large truck crashes	3,986	11
Other crashes	33,475	89
All crashes	37,461	100

Figure 4.6: Motor vehicle crash deaths occurring in large truck crashes and other crashes, 2016

Of all the crashes in the year 2016, 11 percent of those crashes involved a large truck. We were able to determine that out of 37,461 total crashes, 3,986 involved a large truck, of which 667 occurred between noon and 3pm resulting in 214 deaths on the interstate and freeway. If we were to remove large trucks off the interstate between noon and 3pm, there we would be able to meet a goal of our minimum success criteria, exceeding 25 deaths.

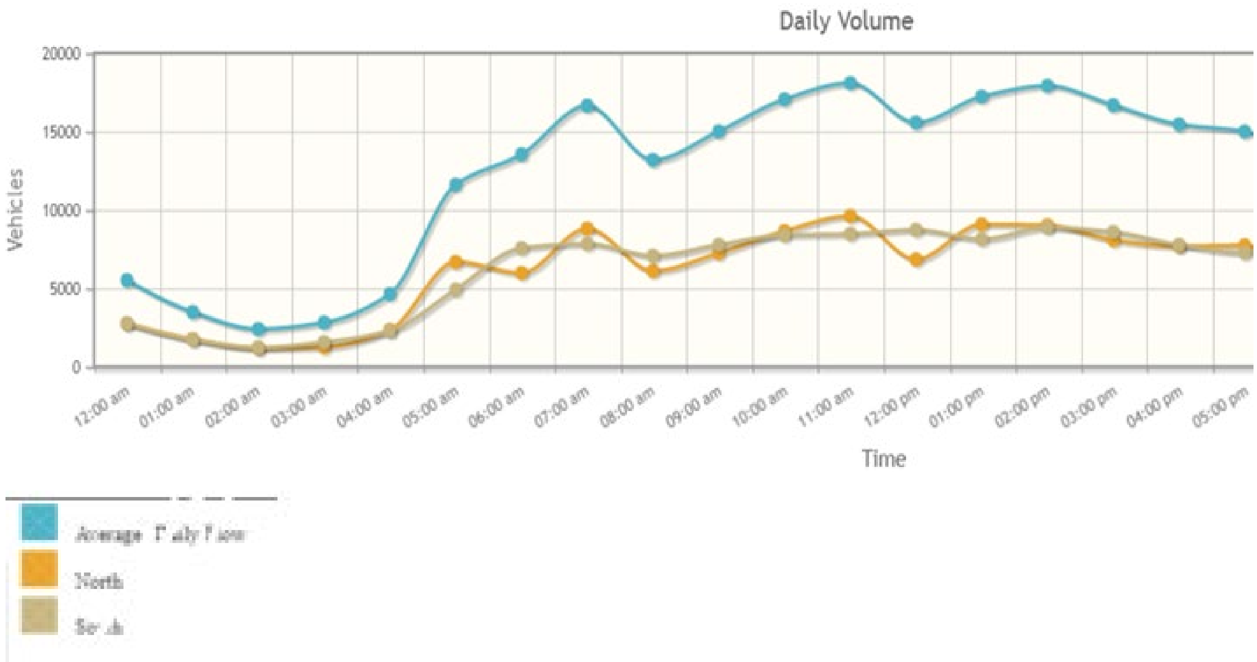
Chapter 4

Traffic Congestion Reduction

The increasing levels of congestion add significant costs to consumers, transportation companies, manufacturers, distributors and wholesalers. Increased levels of congestion can reduce the attractiveness of a location to a company considering expansion or relocation of a new facility. Congestion costs can also increase overall operating costs for trucking and shipping companies, leading to revenue losses, and higher consumer costs. The Atlanta Regional Commission, which coordinates among the 20 counties in the metropolitan area, forecasts the region will add 2.5 million people by 2040.

When approaching our problem, we wanted to simulate to see what would happen to travel times from KSU Marietta to the Mercedes Benz Stadium in Atlanta by analyzing the daily volumes on the highways between our start and finish with trucks on the road. We would use vehicle miles traveled data from the US DOT to determine the approximate amount of trucks on the road.

Then we will use this data to predict the effect of removing these trucks from the collected volumes and seeing if the travel time can be reduced. The figure below shows the current daily volumes of all vehicles for the highways between KSU and our destination, including truck traffic. The Drakewell Traffic Data and Analysis software (TADA) on the GDOT website made this figure. The second figure shows the highway vehicle miles traveled by type.



Time	Car Count	Percentage of all cars on road
01:00 pm	8138	47.2%
02:00 pm	8890	49.6%

Figure 5.1: Graph of Daily Traffic Volume on highways in April 2018 between KSU Marietta and Mercedes Benz Stadium

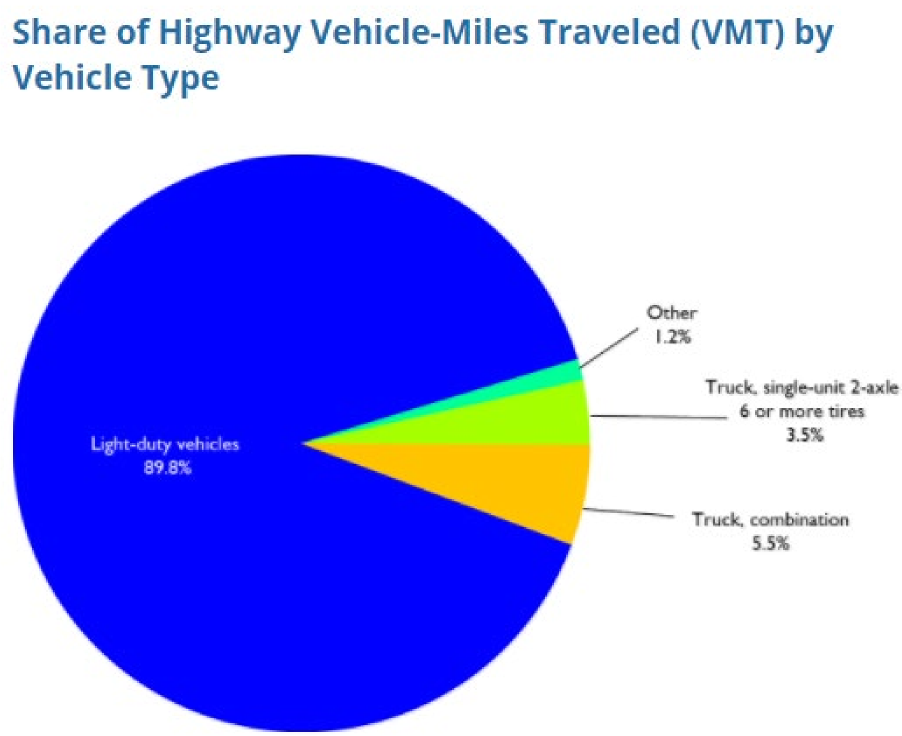


Figure 5.2: Share of Highway Vehicle-Miles Traveled (VMT) by vehicle type in USA in 2015

As we can see in figure 8.1 above, the critical times that we focused on were between 1:00 PM and 2:00 PM. During these times on I-75 south, there are around 8138 and 8890 total cars on this part of the highway, and this includes trucks. By analyzing data from the US Department of Transportation, we can see in figure 8.2 that the total percentage of trucks on the road in the whole country is around 9%. If we take 9% of the vehicles off the road, then the total amount of cars on the highways between KSU Marietta and the Mercedes Benz Stadium will be around 7,405 and 8089. The percentage of trucks off the highway will also increase as years pass, as the amount of trucks on highways is to double by 2040. Our project will produce better results as the years go on, this will prove to be very beneficial to all parties involved for a long term.

In addition, GDOT claims that a similar project to make a truck only lane will reduce delays by 40%. Our project would also be removing all the trucks from highways, so we would be able to produce similar or better results. These results would satisfy our time savings minimum success criteria. In addition, with the fast increase of population in the state of Georgia, our project could benefit all drivers and state workers in several areas, including reduction of maintenance costs and time of travel reduction.

Chapter 6:

Results and Discussions

KSU - Mercedes Benz Stadium Round Trip: The time travel by road from Kennesaw State University to The Mercedes Benz Stadium will be significantly reduced if all truck traffic is neglected. In fact, the results showed that we could save even more than double the amount of travel we initial aimed at. 28 minutes versus 10 minutes has not only exceed our expectation by 180% , but it also has the potential of even affected our other requirements that were initial set.

The Figure below showed a significant reduction in time travel by road on a round trip from Google Maps data. The measurement in red is the travel time from KSU-Marietta to Mercedes Benz Stadium and the green is simulated road conditionS based 40% of road congestion numbers obtain from GDOT in parallel proposed project to add a dedicated lane for trucks. The results below shows that we save about 8:04 minutes through the I- 285 route. Similar savings can be realized if the I-75 route is taken one can save over 6 minutes. The reason why we have more via the I-285 route is because large trucks mostly travel through that route because of restrictions via the I-75 route.

Figure 5.3: Travel Time from KSU-Marietta to Mercedes Benz Stadium

TRUCKS		NO TRUCKS	
14:30	28	14:30	20
18:30	35	18:30	24
14:30	32	14:30	12
18:30	45	18:30	27

I-75

I-285

Figure 5.4: Real time Google Data KSU-Marietta to Mercedes Benz Stad

Chapter 7

Conclusions

Our model has shown numerous promises for improvement including the possibility of reducing commute time significantly. If the cargo rail is built to exclusively transport freight and other goods, a swift Return of Investment will be ensue. The combinations of these expectations will contribute to unimaginable results. This may include consumer confidence that may spur spending and investment, a reduction in greenhouse emission, and an overall confidence in the transportation systems.

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Georgia Statewide Freight and Logistics Plan: Truck Modal Profile. *Georgia Statewide Freight and Logistics Plan: Truck Modal Profile*.

Appendix : Reflections: The Educational Experience, Challenges Faced and Resolutions)

The Educational Experience

When we began this traffic optimization problem in August, we knew that the project would be very challenging. However, we were very aware that we have been given the proper tools needed to successfully complete the project over the course of the last 3-4 year. The courses that we have taken in the ISYE program at Kennesaw State University significantly prepared us to fully understand, interpret, analyze, and present our results to likeminded and unlike minded individuals.

We used tools that we learned in some of our earliest courses, such as Engineering Economy. The

We also began to realize that tools we learned recently in Engineering Optimization II, could be used to prove our design to be feasible. The transportation model was a later addition to our report and is a great visual. The model shows that the reduction of trucks equates to a decrease in travel time.

One of the most important courses that we have seen useful is the Project Management for Engineers course. We constantly used our Gantt chart over the semester to keep track of different tasks and deadlines for our project. It also came in hand when having to do multiple parts of a project at the same time. Being able to concurrently manage our time and priorities proved to be very beneficial.

Challenges Faced and Resolutions

We ran into our largest issue when we realized that we would not be able to use Arena for our simulation. This was to be a big portion of our project, and without it we assumed there would be no way to provide results. However, we were able to find a similar project and use data provided from the GDOT to design our own transportation model to verify that we would be saving travel time with trucks off the road.