Improving the MTA System and the Effects

Muhammad Chhaidan, JunYong Hu, and Danny Weng

Ms. Stephanie Jean-Stern

English 21007

May 13th, 2019

TABLE OF CONTENTS

LIST OF GRAPHICS

ABSTRACT:

Currently, in North America, the MTA holds the record for having the largest transportation network. The MTA serves up to 15.3 million people daily across New York and Connecticut. In addition, the MTA has more subway and commuter rails that all of US transit system combined together. Many benefits flow from the MTA network. The MTA has committed to a 117.8 billion budget between 1982 and 2017 to help improve and expand their public assets. Some of these work include: extension of the 7th line to the Javits Convention Center and the expansion of the LIRR main line. If you take a look at the work the MTA has done, it has been mostly to improve train carts and expand railway lines. As a result, this proposal is intended to focus on the broader picture. We will seek to find solutions to improve signalling and track related issues, aerodynamics and materials and space efficiency. We will demonstrate our solutions in the research results section of our report and try to explain the feasibility of our solutions. The content of our proposal can be summarized by answering the following questions: (1) What are the major issues that the MTA is faced with on an everyday basis, (2) What can be a possible solution to improve these issues? (3) how cost effective will it be?

INTRODUCTION:

The New York City subway system has been controlled by the Metropolitan Transport Authority, also known as the MTA since 1968. The subway system now has 26 lines and 468 stations in operation. Since 1968, the MTA has only done minor repairs on the subway system. Their main focus has been to improve the train cars to hold more passengers and improve its aesthetics. Improving train cars to hold more passengers is a thoughtful idea because since 1977 to present day, New York City subway ridership has doubled from 917.2 million riders to a recent peak of 1.8 billion dollars in 2015. However, improving space is not the only major problem affecting the New York subway system.

Apart from the need to increase the size of train cars to hold more passengers, there have many ongoing discussions between top members of the MTA. From this discussion, subway leader, Mr. Byford said in a meeting held in 2017 that he could upgrade most of the subway system in the next few years, which would improve reliability and allow more trains to run closer together. Mr. Byford has offered an overview of how he would accelerate the signal work. Since 2017, no work has started. So far there has been all talk and no actions according to a New Times article written in 2017. As a result, this proposal is intended to focus on the broader picture of improving both infrastructure and train cars with a feasible approach in mind. Our approach will be to focus on the more important issues first and then narrowing it down to issues of less importance. The contents of this proposal will include solutions on how to improve the following: Signalling and railway tracks, Space, efficiency, material and aerodynamics of train cars.

RESEARCH RESULTS:

Improving Space and Efficiency

The plight of the New York subway is impossible to reconstruct because it has a huge and complex subway system. Improving the carrying efficiency of trains has become a more feasible method. One of the options is improving the train carrying capacity by doubling the length of the train and adjust the train stop method. After guiding the passengers into the correct compartment, the trains are alternately standing in the station. When the train arrives at station A, it will open the door of the first half. When the train arrives at the next station it will open the door of the second half. This means half of the train will always skip a station. Doubling the length of the train means that the carrying capacity is doubled directly. This method does not require extensive modifications to the station and rails. All that needs to be done is to use the appropriate smart equipment on the train. This circumvented the difficulty of extending the New York subway.

According to a Spectrum News article published by Jose Martinez, he mentions that: “It's going to be harder to find a seat on one of the city's busiest subway lines: the MTA has begun removing them from some trains. NY1 Transit Reporter Jose Martinez has the exclusive details”. Removing trains should not be a possible solution to provide adequate space. The MTA should be looking at alternatives. The second solution to increase space could be to make the space of the train more flexible. This will improve space utilization. One of the options is collecting passenger flow information by intelligently modifying the train compartment. Guide passengers into the corresponding compartment. Increase or decrease the number of train cars by analyzing passenger flow. Separate the corresponding cars at the corresponding stations. The other cars continue to move forward. This classification compartment method, greatly reducing the time to stop. In other words, this method improves the carrying capacity of the subway.

Improving Railway tracks and Signaling

New York Subway tracks have been built for more than fifty years. Since its existence, there have been no records to show that there have been efforts to rebuild a new system. Records only show upgrades. Upgrades are good but some new strategies can be implemented. One example of an upgrade that was done by the MTA was to seal leaks that were caused by water to prevent corrosion of the tracks. Sealing was done by chemical grouting. This would help but only it is for a period of time. There needs to be something that will have a longer life span. One way to do this is by having a smooth track with less or no joints across the entire system. In addition, continuous welded rail would be better than having a weld in small pieces. This would reduce the noise that we hear when the train is in motion. However, replacing the tracks with continuous welded track means much more money. What is the advantage? The advantage would be seen in the long term because there would not be a need to pay workers every year to do maintenance work.

Signaling is currently the second major issue that the MTA is faced with. Delays that occur on a regular basis are blamed on signal problems. This issue is quite complex because it requires serious discussions with MTA and the government. This is so because the signals require a constant and certain amount of power supply to work. Any interruptions in the power can result in shutdowns, and surges in power can destroy electrical equipment. What should be noted is that the MTA is dependent on public utilities for power supply. One such public utility is Con Edison. Public utilities supply power not only to one place but they many other places where they supply power to. This provides a challenge for the MTA.

One possible solution that we came up with was to have a discussion with the MTA board members and Members of Con Edison. From this discussion, talks will be for Con Edison to try and supply more power to the MTA. What is the feasibility of this solution? This solution accounts for a 50/50 probability. There is a possibility that Con Edison to would agree to the negotiations or they would not. Second possible solution would be for the MTA to cutback on the amount of lights they use in subway stations. A normal fluorescent bulb uses about 60 watts.

So just imagine if the MTA were to take off about 20 light bulbs, then this would be 1200 watts not in use. This solution could have major gains for the MTA because by applying these cutbacks the MTA would save money and also they would have additional power to use.

Improving the Speed of the Trains using Better Materials

In general, improving the speed of trains is an efficient way to improve the train system. For example, the A trains tops out on 55 mph and takes 8 mins to get from 59th St to 125th St. By increasing the speed of the train, it is capable to cut the time it takes by half. Some of the issues with the trains that the MTA have are the materials that manufacture the trains. Although MTA trains like the A are made from stainless steel, which is lighter than steel, they are not as strong. There are still better alternatives out there. Also, trains after being constructed are left with the bare metal exposed leading to a high coefficient of friction.

To address the alternative to the stainless steel, a recommendation is to retrofit the front of the trains with a new more aerodynamic one. Something as simple as making the front smoother looking can make the train cut through the air in a more efficient way reducing the drag force. Also, the material of the front can be made with a composite material which is stronger and lighter than steel. Furthermore, Feifei Wang, who studies as a railroad technologist, talks about the development of carbon composite material on trains and how it can affect the trains in a positive way. The author believes that carbon fiber composite can be built near the front of the train which interns increase the stiffness of the train and the weight of the train. The laminate may be made of a single layer of different materials or of an anisotropic monolayer of the same material in different laying directions. Both the former and the latter have macroscopic anisotropy in the thickness direction of the laminate. In addition, laminates are usually anisotropic, and due to the diversity of the laminate, the laminates do not necessarily have a definite principal orientation. Of course, for some special form of pavement, but also can have a definite main direction. Tests were conducted to show the improvement of the carbon composite materials.

Lastly, a coating can be applied to the bare material to aid in reducing friction. This will allow the train to accelerate faster at increasing speed. For example, both Aerospace and Mechanical engineer, Mitsugu Hasegawa and Hirotaka Sakaue revealed the effects of microfiber coating for drag reduction by using flocking technology. This experiment microfiber coating which are hair-like structures that consist of an array of microfiber that is introduced as a passive drag reduction system. To prove the experiment, they both test two identical objects through the wind tunnel to test for drag. The microfiber coatings were on the identical object with on that had the coating and one without the coating. In the former case, the microfiber coating was applied at an angle of 40, and a drag reduction of 32% was achieved. They were able to achieve a cleaner air with the coating and the smoke extensions showed the extension of the attached flow-zone, and corresponding separation delay was seen by applying the microfiber coating.

In conclusion, the introduction of carbon composite material in the trains can help in multiple ways. Like the experiment conducted in the article, it can help stiffen up the train which can improve the strength of the train, which help improve the safety of the train. Also, carbon fiber is a lot lighter than metal that is used in MTA trains and reduction in weight can improve the speed of the train reducing the time you need to wait for a train. this article made the microfiber coating made it a convincing statement that it is an easy and efficient way to decrease drag. In the world where everything costs money, it is simply a huge budget for the MTA to replace their trains with new more aerodynamic trains. It is more cost efficient for the MTA to adopt this technology and apply at the front of the train where it has contacted the air first. This means a reduction in the drag force and through simple physics formula. It will increase the acceleration of the trains meaning the train will be faster. Since the trains are now faster it also means less waiting periods for the trains.

DISCUSSION:

Figure 1 is a bar graph showing the cause of delays obtained from a survey conducted by the NYCT and Bus materials in 2017. The areas targeted were Brooklyn, Manhattan, Queens, and Bronx. The data was originally in a table form and then made into a bar graph. Issues such as the speed of train cars, work equipment, signals, track, and overcrowding are responsible for about 80 percent of the New York Subway system. As shown below in recent years Overcrowding has been the primary driver jumping from 62,492 in 2012 to 299,301 in 2016, which gives a 379% increase. Delays caused by signals, Switches and track malfunctions accounted for a 41% increase from 2012 to 2016. Issues surrounding the speed of train cars and work equipment also showed significant increases.

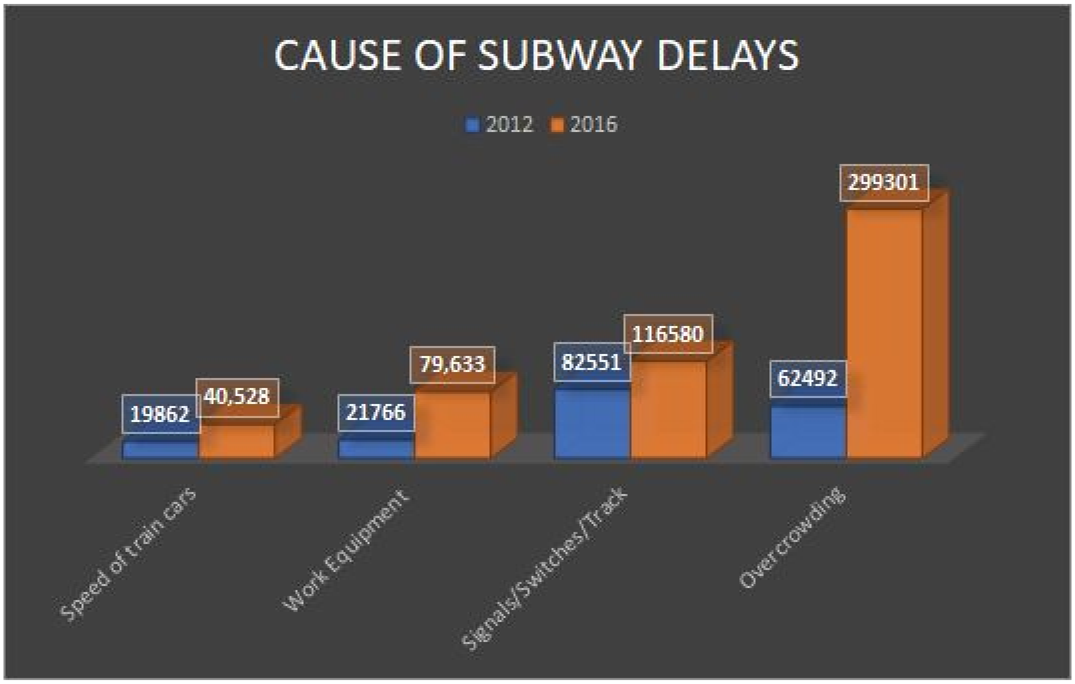


Figure 1 shows the cause of subway delays for the years 2012 and 2016.

Table 1 shows the decline in on time performance of seven lines from 2012 to 2017. On the seven subway lines, on-time performance fell by 31%. The most significant drop found was 34% in the 5 train which was followed by a 33% drop in the J/Z train, 32% for the F and D and 31% for the C and 6.

J/Z		**C**		**D**		**6**		**F**		**5**	
2012	2017	2012	2017	2012	2017	2012	2017	2012	2017	2012	2017
96%	62%	90%	60%	88%	56%	80%	49%	80%	48%	67%	32%

Table 1: shows the decline in on time performance by line, Source: MTA

Figure 2 shows train ridership for the years 2012-2017. As can be seen for 2012-2015, there has been a significant increase in passengers on trains. If we take the difference between the years, there has been an impressive 52 million increase. As we look further to 2016-2017 there has been a steady drop. This can be due to an excessive number of delays that occur on the NYC Subway system. However, if we take a look at the slope of this graph we can see that there has been an overall increase in passengers.

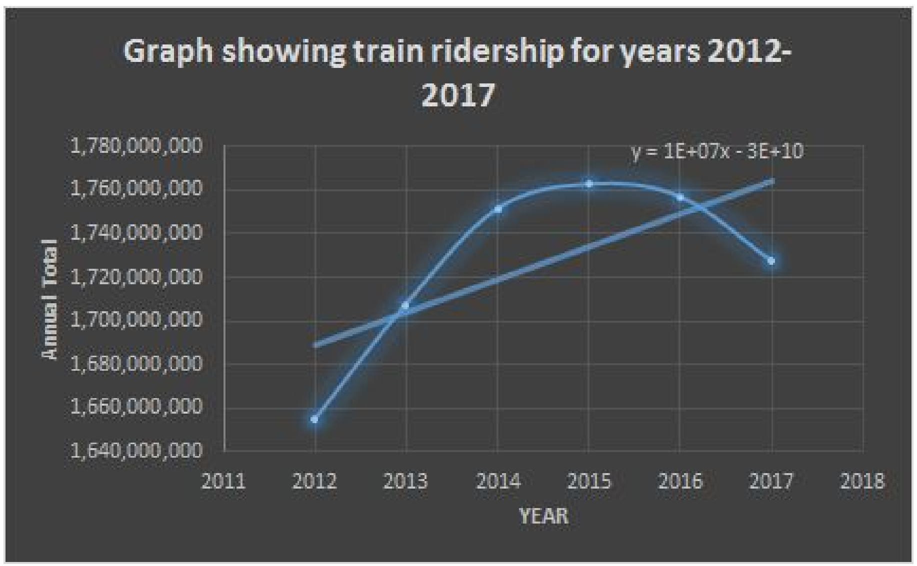
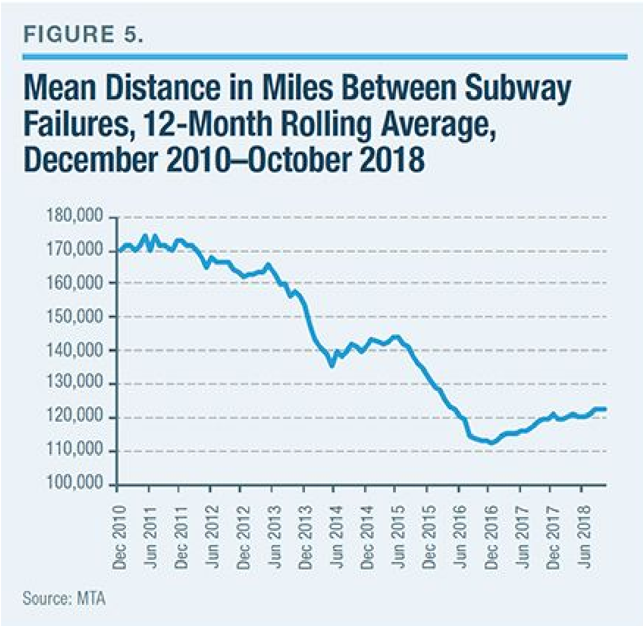
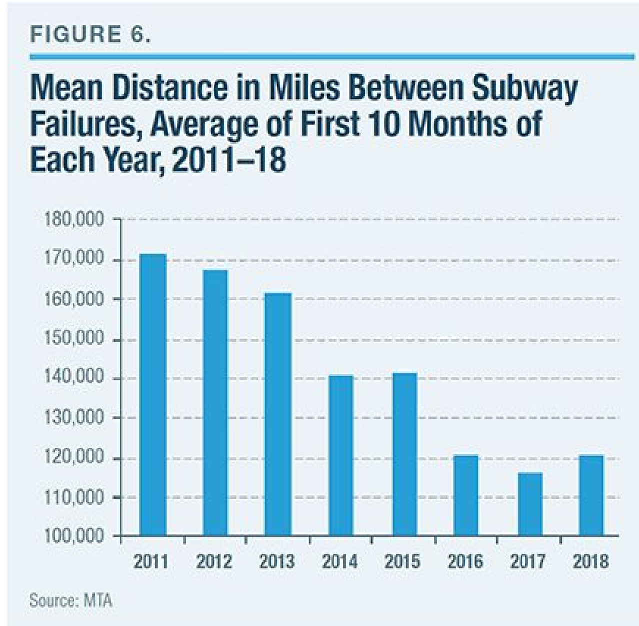


Figure 2: Graph showing train ridership for the years 2012-2017

Source: MTA

Figures 5 and 6 shows mean distance in miles between subway failures from 2011-2018. In 2011, trains could run up to 170,000 miles or more between failures. This has drastically changed. Since 2016, trains are breaking down at a much faster rate. From the graphs it can be seen that trains are breaking down at less than 120,000 miles.





Graph 1 and 2 shows the mean distance in miles between subway system failures.

Source: Manhattan Institute

CONCLUSION:

The MTA still has a long way to go. The MTA nearly year-and-a-half-old “subway action plan” has not yielded productive results. The plan has helped stop the subway system’s precipitous decline of the previous half-decade. Yet the slight improvements that the MTA has eked out over the past year are not enough. The subway system is still not performing close to the levels of more than half a decade ago, when delays, train failures, and major incidents were much rarer than they are today. The MTA has not yet proved that it can keep up with today’s record residential population, record daytime population, and record tourist population.

We have focused on as many feasible and practical solutions possible that can be implemented by the MTA. The implementation of our solutions can be placed on a 90%

confidence interval. In addition, we have looked at major areas of interest that can solve the needs of customers. However, where does the other 10% go. We are still facing some challenge in trying to solve the signaling problem. Questions that arise are: Will Con-edison who is the supplier of power to the MTA agree to have a meeting where we can negotiate more power? And also would it be cost-effective? Apart from these challenges we do believe that our plan will work because of its flexibility and cost -effectiveness.

REFERENCES:

Hasegawa, Mitsugu1, mhasegaw@nd.ed., and Hirotaka1, hsakaue@nd.ed. Sakaue. "Microfiber Coating for Drag Reduction by Flocking Technology." *Coatings (2079-6412)*, vol. 8, no. 12, Dec. 2018, p. 464. *EBSCOhost*, doi:10.3390/coatings8120464.

Feifei Wang1, feifeipass:[_]wang@126.co. "Study on the Application of Carbon Fiber Composite Materials in High-Speed Trains." *Materials Science Forum*, vol. 893, Apr. 2017, pp. 31–34. *EBSCOhost*, doi:10.4028/www.scientific.net/MSF.893.31.

M. (2017). "New York Subway System Ridership Data." Retrieved May 05, 2019, from http://www.manhattan-institute.org/

"Performance of MTA subway system from 2012-2017. (2018)." Retrieved April 27, 2019, from http://www.mta.info/

"NYCT and Bus Committee Materials." (2017). Retrieved May 05, 2019, from http://web.mta.info/mta/news/books/

Appendix