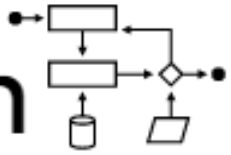
2016-2017 ACRP University Design Competition

Transtag - A Prioritization of Domestic Transfer Baggage

Pro-motion 

Challenge Addressed: Airport Operation and Maintenance

University Attending: Stevens Institute of Technology

Team Pro-motion: Yasha Binyamin, Owen Burke, John Mawad, Evan Sandford

Number of Undergraduates: 4

Number of Graduates: 0

Advisors: Professor Eirik Hole, Alanna Zappariello

1.0 Executive Summary

Title: Transtag - A Prioritization of Domestic Transfer Baggage

Team: Four undergraduates from the Engineering Management Department, School of Systems and Enterprises

University: Stevens Institute of Technology

Baggage handling is an essential part of airport operations. The current system in place for checking luggage negatively affects 8 in every 1000 passengers per year, who arrive at their destinations and discover that their bags have been misplaced. Each missing bag has the potential to cost the airline, or outsourced handling company, a maximum of $3,300 in reimbursement to the customer for the bag's contents. This is a significant amount of money, and does not even include the refunding to the customer of the initially charged suitcase checking fee. Therefore to save money and improve service, airlines are in search of ideas on how to reduce this high number of lost bags. Statistics show that 45-49% of the bags which fail to make it to their correct destinations go missing between transfer flights. Because of this, the team has decided to focus specifically on improving the transfer aspect of the system.

The transfer process as it is now incorporates a significant amount of human interaction, as bags are unloaded from their initial flight and sent to their next. The improvement proposed by the group aims to reduce errors resulting from that human interaction; it is a simple, yet effective change which, according to simulations conducted by the group, has the potential to increase transfer bag handling efficiency by as much as 70%. The solution will also save the airlines millions of dollars annually, and can easily be implemented without investing in any new airport infrastructure.

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2.0 Problem Statement and Background

The team has been tasked to design an improved approach to baggage handling, including solutions to address human factors issues. To understand where an improvement can be made in baggage handling it was absolutely necessary to observe and document any malpractices or inefficiencies in the current process. Baggage handling has remained largely unchanged for the last 40 years. With a steady yearly increase in passengers, current baggage operations are finding it hard to cope with the increasing load that comes with it. One way to alleviate this problem is by updating and automating the entire baggage system from start to finish. This is not realistic, however, as infrastructure changes are not only costly, but will also add significant delay in airport operations.

During the investigation, the team started to see a pattern that the ground crew operating the system lacked not only ambition, but also the tools to do their jobs efficiently. From our visual investigations of current processes and oral communications with expert and workers in the field we learnt that 28 million bags a year get lost,damaged and/or mishandled as a result of this. These bags only account for 8/1000 a year but are responsible for over 70% of airports flight delays. Out of these Bags almost 50% of them, 14 million bags a year, come from transfer flights.

There is an evident need to ameliorate the transfer bag system as it is unproportionally the root cause for the majority of delays and customers dissatisfaction. This is why Promotion started to investigate where possible improvements in human interactions can, and ultimately will, be made in the system as it stands. The team seeked to formulate a human solution for a human problem.

3.0 Summary of Literature Review

In order to decide on a problem to address, the team needed to fully understand how the baggage system currently works. From here the team could pick the from the areas which appear to have the highest amount of flexibility. Ultimately focus would be shifted on the most significant problem determined to be associated specifically with that area chosen.

The majority of the information used by the group while innovating came from sources who work at John F. Kennedy (JFK), Newark (EWR), and Teterboro Airports (TEB). These sources provided documents to answer the majority of the questions asked by the group. The documents included information on the step by step bag checking process from start to finish. They also helped the group discover what problems exist and where in various parts of the system. In addition to this the documents helped the group establish a list of efforts already undertaken by the airlines to reduce the amount of lost bags. This list assisted in regards to specifying solutions for the group to not pursue, because the ideas were not unique enough.

In addition to the documents provided from various airport personnel and the FAA website were deemed useful in providing regulation on airport operations. These regulations were useful to the team because they provided insight in regards to the specific components in the airport operations which are not adjustable, such as the security bag checks, which the team should work around.

The task of conducting literary research from non industry sources proved to be difficult. As it so happens, the baggage handling information from individual airlines and their outsourced

handling companies is generally not released to the public due to concerns about bad publicity and competition with competing airlines. In spite of this fact the group was still able to find certain statistics from various news sources. The statistics that were found also helped the team to narrow down its area of focus, and to ultimately define a project scope. The scope was to focus on only transfer bags flying on domestic US flights.

4.0 Problem Solving Approach

Having established the project parameters and scope, the team was able to start formulating approaches to help solve the problem. The goal was to tackle delays associated specifically with human interactions throughout the operation of transferring baggage between connecting flights. Currently the ground crew tasked with transferring the luggage between flights during the scheduled layovers finds it difficult to conduct their jobs promptly. Based on the information the team was able to collect from the airport contacts, it appears that the biggest current problem with transfer bag process is the lack of time between flights. Bags only travel as fast as the crew can work. The team has concluded that is imperative to provide the ground crew with the tools necessary to better identify the transfer bags within the cargo holds, if there is to be any hope of minimizing their handling time.

As it currently operates, the crew must manually remove each bag from the cargo hold. The bags must be manually scanned for the crew to determine their next destination. These destinations could be either the final carousel to be collected by the passengers, or a connecting flight either of the same or a different airline. Only the bags going to another flight have a time

constraint; the team has determined that to streamline the process, it is necessary to prioritize these bags before the non-transfer bags.

A significant problem is that the crew has no convenient way of knowing which bags are transfer and which are not until they manually scan them. The manual scanning is slow and results in delays, however. The amount of time wasted could easily make the difference between a transfer bag making it to its connecting flight or missing it. Additionally, transfer bags often wind up being reintroduced to the bag system within the airport after being removed from their initial flight. This is the major cause of delay; it takes an average minimum of 45 minutes for a bag to make its way through the bag system, assuming that the system is operating perfectly and that no extra steps are endured.

Many schedule layovers are less than 45 minutes in the first place. However, a significant amount of layovers are scheduled to be more than 45 minutes but wind up being less than that due to arrival delays. This causes a domino effect ending in customers arriving at their final destinations without their bags. This is a bad experience for the customers, and poor customer satisfaction hurts the reputations of the airlines as well as their finances.

5.0 Interaction with Airport Operators and Industry Experts

The Team's first interaction with airport operators came in the form of a discussion that teammate, John Mawad, had with his supervisor, Pablo Navarette, in late September. It was in this discussion that Pablo invited John and the rest of the team to come in and talk to the team about how the baggage process works within the airline industry. Pablo also shared with the team his own experiences working for Aircraft Service International Group (ASIG) for 18 years. ASIG is an independent aviation ground service provider at more than 80 airports worldwide. In this company, Pablo overlooked the sorting, loading, and unloading of baggage at Newark Airport (EWR). He also noted that a lot of the baggage handling systems at Newark Airport were extremely outdated, with some tracks dating back to World War I. When questioned what the most problematic part of the baggage system was, Pablo indicated that it was the transfer handling. This meeting pointed Pro-Motion's scope in the right direction.

The team was also in contact with Ed Grabowski, the Hub Manager at United Airlines. Ed was also able to give the team very valuable insight about how the baggage handling system works at Newark Airport. Ed introduced Pro-Motion to Carlos Marques, the Safety Advocate at United Airlines in EWR. Carlos took the team on a tour of the baggage handling system from the check-in, to the security, automated and manual sorting, and

the loading and unloading of the aircraft. Team members were also able to speak to Jarek Dabrowski, Manager of Facility Maintenance at United, and John Deep, manager at United. This tour gave the team a firsthand experience of where human interaction comes to play in the system and why it might cause issues within the overall system. The team received feedback on various potential solutions that were thought about prior to the visit. However, United's baggage system was recently renovated with new tracks and infrared scanners and they were not looking to change much of the current infrastructure. In fact, the employees mentioned that this was a very successful year for United as far as baggage handling goes.

United employees were not the only employees that were not fond of changes in technologies especially IATA was going to be enforcing resolutions in baggage handling technologies within the next few years. Airlines, such as Delta Airlines, also have been working on incorporating RFID's within the baggage handling systems. Udi Benjamin, Supervisor of technology in the security department based in Geneva for El-Al company, also advised us via video call to steer away from changes in technologies and advised the team to look for human solutions as opposed to automated solutions. Wilson Felder, Director of the FAA's William J. Hughes Technical Center in Atlantic City, NJ, was also able to facilitate an understanding on how current operations take place, especially in regard to the security issues with transfer luggage.

Pro-Motion conducted further research from companies such as IATA, SITA, and the Department of Transportation and concluded that transfer mishandling was consistently the biggest reason for delayed/damaged/lost bags since 2007. With a better understanding of how the baggage handling system works at airports such as EWR, JFK and LGA, the team was better

able to propose a universal solution that can be integrated with almost any system, regardless of infrastructure.

After prototyping and simulating a solution, the team went to JFK to meet with Jonathan Greco, a Senior Process Engineer at Delta Airlines. The team was able to solely focus on the transfer process. Pro-Motion's transfer prioritizing system was presented to Jonathan and he was very impressed with the ease of integration that this system would have with systems currently in place. The positive feedback from Jonathan reinforced our intuition that this type of 'pre-sorting' would quickly move transfer luggage to where they need to go. Jonathan gave us constructive feedback on future plans to add functionality to our proposed solution. The team also brought this proposed solution to the attention of Ulysses Duenas, Baggage Strategy Manager for Delta Airlines at JFK, and he also believed that this solution is a solution that many airlines and hubs can adopt.

6.0 Current Process and Best Practices

Today, many travelers may feel dismayed to pay to check-in their bags especially when taking more than one flight. Travelers would rather have their luggage within their line of sight in order to avoid any unnecessary situations. Sound baggage handling systems would give both the airlines employees and the travelers the ability to ensure that the luggage would travel with the passenger as opposed to having the luggage be delayed or left abandoned at another airport. As stated previously, the main reason for delayed/lost luggage is transfer mishandling. With the system at hand, the containers with the transfer luggage should be loaded onto the plane last in order to be unloaded first. However, this is not the case. At the end of the day, airlines are still running a business. This means that instead of loading transfer luggage last in order to be

unloaded first, baggage handlers will load ‘premier’ or ‘preferred’ customers last in order to be unloaded first. These customers are usually business class passengers that have some sort of ‘higher tier’ of membership with that specific airline. The fact of the matter is that every airport may have their own way of loading/unloading an aircraft, or have a slightly different baggage handling process. Based on literature research and conversations with industry experts, the following is a breakdown of the best practices and techniques of baggage handling systems.

6.1 Check In

The bags are introduced to the system, Most airports provide its customers with two options of checking in bags, one is electronic and the other is by means of personal assistance. No matter the choice all bags are handled the same and are placed in a tray that goes onto the baggage conveyor belt. Each tray is manually and uniformly positioned on the belt with a visual aid of a smiley face.

6.2 Security

The bags go into 9 possible tracks, each track leads to a security “CTX” scanning station. Not all lanes are necessarily active and those that are not in operation can be used to relieve the load if a specific lanes is backtrack or cannot handle the baggage flow. A typical day sees 24k bags, peak periods experience +40k bags.

Before arriving at the CTX machine each bag passes through 4 IR sensors that attempt to read the bag that is on the belt. These sensors are strategically placed so that they cover areas where the bar codes of the bags will be visible. The sensors at this stage have a very high success rate however there are some cases where the tags are unscannable or are not in the IR zones. Once at the CTX machine, If the bag is a security risk a alarm goes off, these alarms are also

scheduled but most of them are due to observed item on the CTX machines. Once an alarm is made the bag is taken of the track and is manually inspected. Once cleared, the bag is then manually moved to a scanning station where it is reintroduced to the system.

In Newark Airport, 24% of bags are dealt with manually after the security check which adds on average 5 min to the duration of the journey per bag. Bags that do not set an alarm pass through the CTX in under 30 seconds. A typical bag will be in the luggage handling system from start to end for about 15 min, if it is a transfer flight to/from an international hub, it will be in the system for 45 minutes if it is from an international flight to domestic and 1 hour and 30 minutes if it is from a domestic flight to international. Most problems in the system occurs due to the transfer flights.

6.3 Sorting the Luggage

Sorting the luggage is for the most part automated, once passed security each bag is scanned again using IR and is placed on a compartmental conveyor belt. Each individual compartment shelf is tracked using IR. The bags have to be perfectly orientated on each shelf. This is done using a well calculated timing mechanism that releases the bag perfectly to each shelf. The shelfs continue in the system until they reach the desired “drop off” zone where they tip the bags into a receiver belt that allow for the workers to place the bags in compartments it to be taken to the aircraft.

6.4 Manual Scanning

Manual scanning takes place for bags that fall off the shelves, bags that were not scanned and transfer flight bags. These bags are transported manually into a room,if they fell of the shelves they are manually dragged into bays that feed the manual scanning room, if they were

not scanned they will be transported to the belt that leads to the room , if they come from transfer flights they go into receiving bays that are either pre-checked which signifies they went through security and can be introduced to the system this way, otherwise they have to be checked-in again. The worker in the room uses a IR reader to scan each tag, however if the tag is not scannable or if the IR reader does not work properly the workers have to manually type the flight code into the systems computer.

6.5 Loading to Aircraft

Loading the aircraft is done by transporting the metal cargo compartments to the aircraft, each cargo compartment is filled with specific bags, one is for transfer, another is for business.. Etc. once transported to the aircraft they are placed on a manually controlled mechanical ramp that correctly orientated and moves the container into the cargo bay.

6.6 Unloading from Aircraft

Unloading from the aircraft can occur in two scenarios, the first would be if the passenger did not board the plane or is taken off of it, the bags need to then be removed and physically IDed with the passenger, this does not occur often and is done as a security protocol.

The second, and most common, is once the plane arrives at its destination the cargo is unloaded. Because the bags are already in grouped compartments it is easier to know where each bag should go. The ground crew unloads the bags and transports them to the baggage hub. There are many different types of cargo, but we will only be focusing on the bags that are part of the baggage system.

Bags that arrive at their final destination will be manually loaded into bag shoots that take the bags into the arriving carousel for pickup; Bags that are in transit to another flight will be taken to sortation.

6.7 Process Flow Diagram

The figure below depicts the current transfer process for baggage in between flights. Human interaction within the system takes place at the start of the process, the manual TSA checkpoint, the manual sortation, and the loading of the aircraft which is right before the finish. Our proposed system, Transtags, would aid at the start of the process when unloading the aircraft. The baggage handlers would be able to prioritize the bags based on the visual aids and would put on emphasis on getting those bags within the system quicker than a terminating bag. The Transtags will allow for workers working within the BHS to keep an eye out for bags with Transtags that may be stuck in the system, especially if they end up in the unscanned baggage area. If the bag ends up in the unscanned baggage area, the bag is in more risk of not making the flight. The Transtags will also serve as a type of "pre-sorting" when unloading the aircraft. Baggage handlers will be able to spot these unique, visual aids and put them in a designated area in order to quickly move the transfer bag along to its proper destination as opposed to scanning

each independent bag to find out what the status of the bag is (terminating or in-transit).

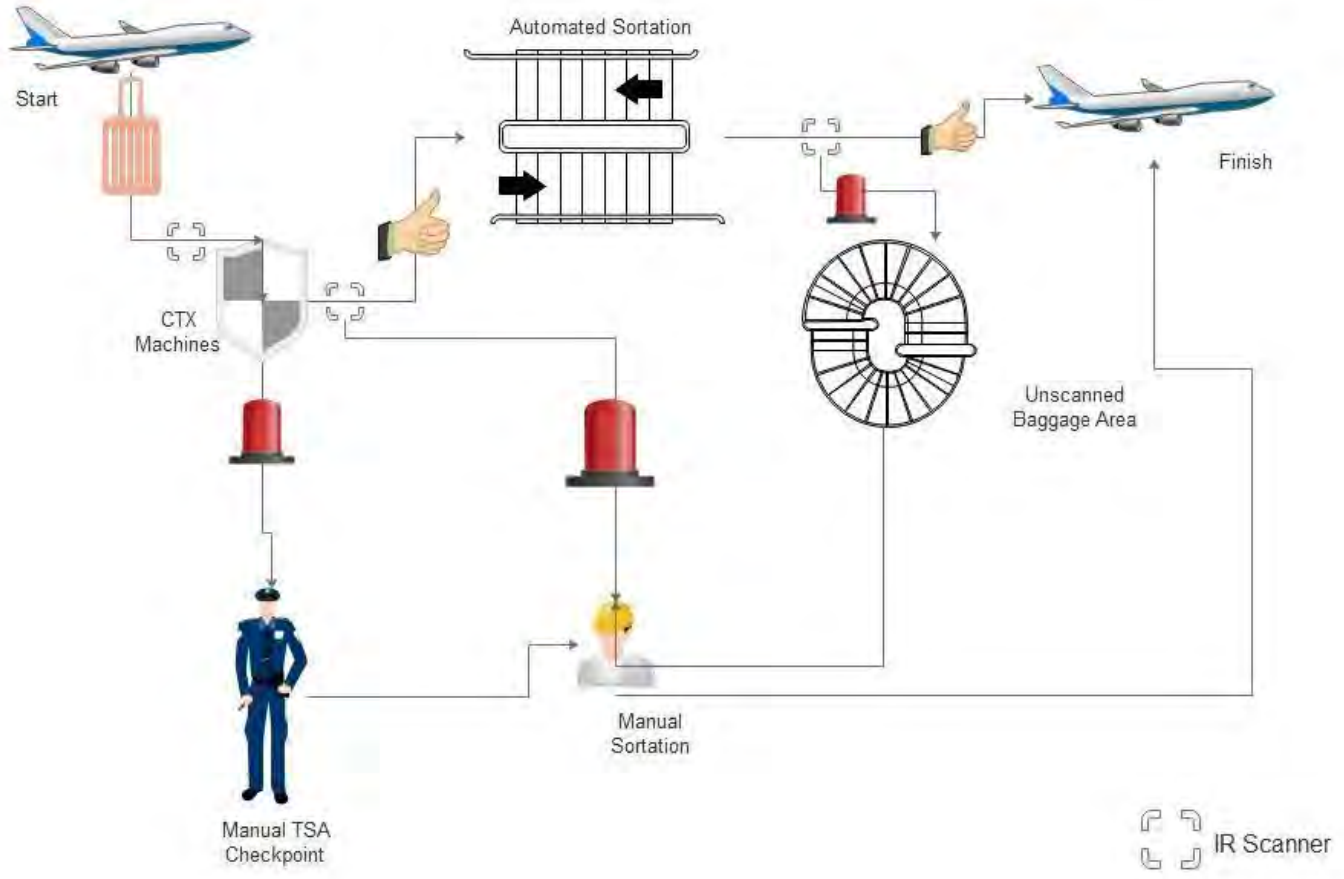


Figure 6.7

7.0 Technical Aspects Addressed

The proposed system consists of slight variations from how the system is currently done. The Transtag will be applied on at the baggage check-in area at the airport of origin, and would continue through the system as it currently would until it was ready to be loaded onto the plane. Here, all the bags without a Transtag would be loaded on first to ensure that the bags that have a connecting flight to get to will be unloaded first at the layover airport. Once at the layover airport and unloaded from the plane first, the bag can complete the journey to the connecting flight as one would normally do now unless some issue prevents it from doing so. Bags may fall out of

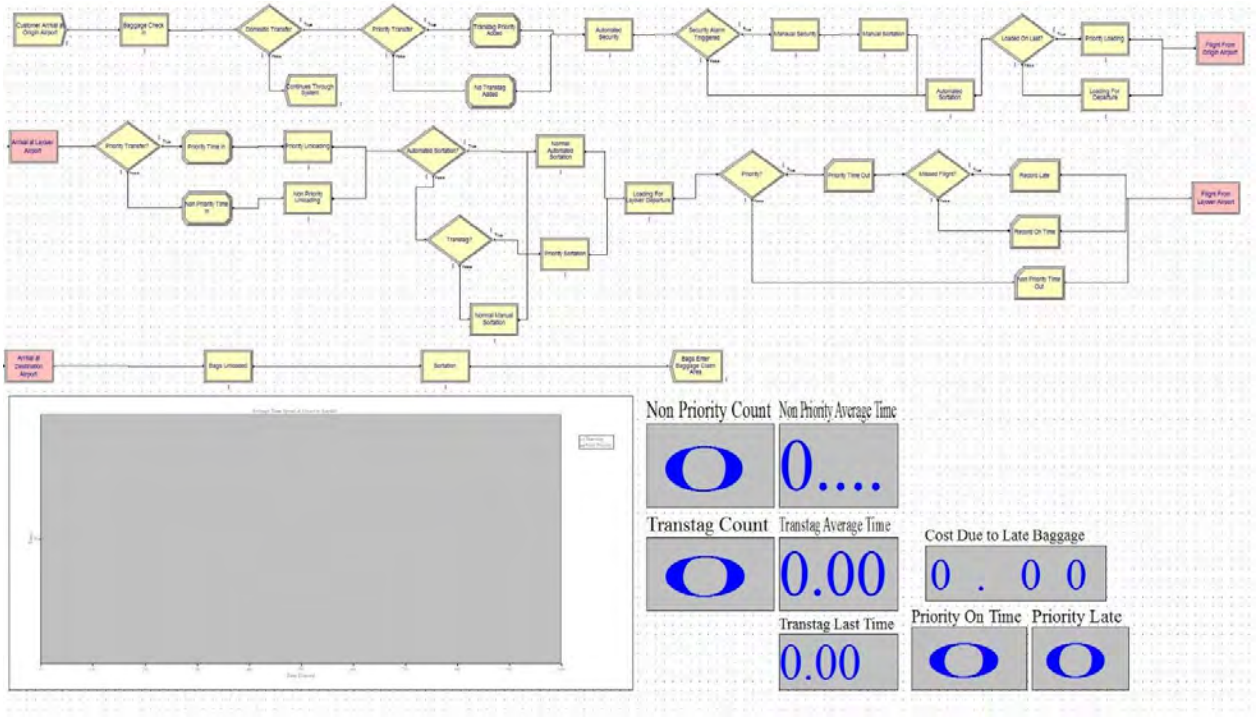
the belt system or there may be a failure of the scanners during the automated sortation process. As it happens now, bags in this predicament would have to be manually place back in the beginning of the automated sortation process. With the Transtag, the bag can be identified by airport employees as a priority and brought to the loading area for departure without having to start over. Once the bag is ready to be loaded on its connecting flight, it can finish the system as it currently happens now.

7.1 Arena Simulation

The team built a simulation to test the proposed design mentioned above in Arena, which is a discrete event simulation and automation software. The team decided to test how the current system compares to our solution. With a side-by-side analysis, the group can see in which areas of the domestic transfer baggage handling system the solution helps or harms. Pro-motion hypothesized the result of less time spent for priority bags in the system with the solution will result in the reduction of loss or damaged luggage during the process and, thus, will save money for the airlines. The simulation includes a process flow diagram for the whole system, but with different time parameters for the priority and non-priority bags in some areas to simulate how our proposed design functions. All of the parameters used in the model are values or intervals explicitly given to us by the industry professionals we have met. For our simulation, a recorded time in the layover airport greater than 30 minutes was considered late and the flight would leave without that bag. Graphics with the counts and average time spent at the layover airport for non-priority and priority, as well as the counts of on time and late priority bags, are used in our model. The potential cost due to late baggage was provided in the model to show how much an airline can save with the Transtag. A line graph is also included to show the average time spent

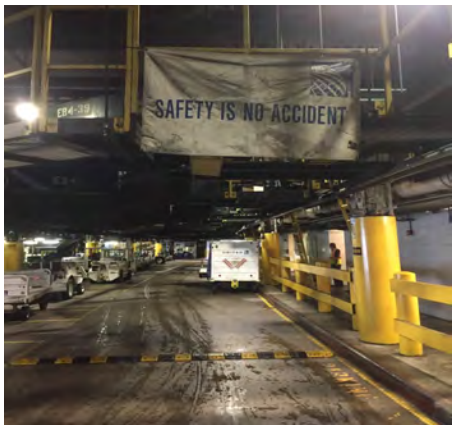
in the layover airport's system in real time. Pro-motion's Arena simulation is shown in Figure 7.1 below.

Figure 7.1



8.0 Safety Risk Assessment

The safety of passengers and employees was a top priority for the team when considering designs for our solution. Early in the concept phase it was determined by the team that the standards and procedures of the Transportation Security Administration (TSA) would be off-limits and not to be disrupted or changed in the proposed design. Pro-motion decided it was essential for this project to fully embody the mission of the Federal Aviation Administration, which is "to provide the safest, most efficient



aerospace system in the world." To fulfill this goal, the team followed the Safety Risk Management (SRM) process as mentioned in FAA Advisory Circular 150/5200-37. The SRM process includes describing the system; identifying the hazards; and analyzing, assessing, and controlling risk. The results of our assessment are provided below.

8.1 Describe the System

The Transtag system is comprised of a bright color tag called Transtags. The tag is introduced by the check-in desk personnel to transfer luggage that has a layover time shorter than 30 minutes. Once the bags with the Transtag arrive at their layover airport, ground workers will be able to identify the priority bags and swiftly move them to their connecting flight location.

8.2 Identify the Hazards

Number	Hazard
1	Transtag is a temporary label
2	Transtag is a sturdy label to endure all environments
3	Baggage handlers experience high volume of bags with time constraint
4	Transtag identifies a bag that is definitely getting on more than one flight
5	Transtag is a new, innovative approach to baggage handling
6	Requires current labeling systems to be fully integrated with function to print Transtags

Figure 8.2

8.3 Determine the Risk

Number	Hazard	Risk
1	Transtag is a temporary label	Transtag fall off during initial flight

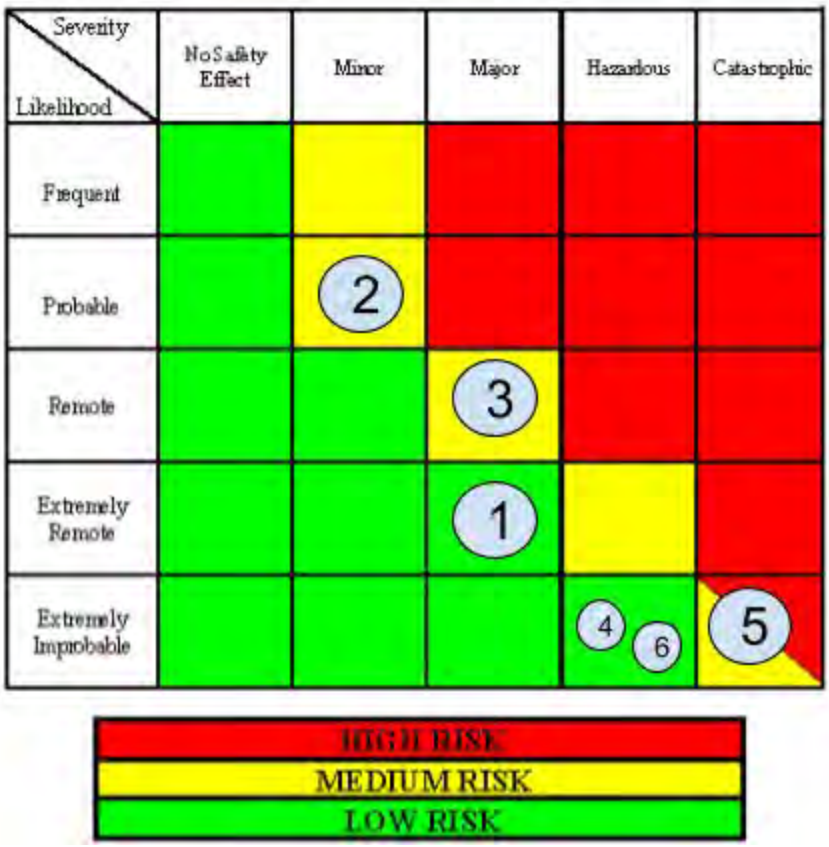
2	Transtag is a sturdy label to endure all environments	Transtag not taken off after reaching final destination
3	Baggage handlers experience high volume of bags with time constraint	Transtag placed on area where it is hard to spot
4	Transtag identifies a bag that is definitely getting on more than one flight	Suitcase makes it on flight without passenger
5	Transtag is a new, innovative approach to baggage handling	Inadequately trained ground crew that does not know about the Transtag
6	Requires current labeling systems to be fully integrated with function to print Transtags	Mechanical error in printing of the tag/not enough blank templates

Figure 8.3

8.4 Assess and Analyze the Risk

Number	Hazard	Risk	Severity	Likelihood
1	Transtag is a temporary label	Transtag fall off during initial flight	Major	Extremely remote
2	Transtag is a sturdy label to endure all environments	Transtag not taken off after reaching final destination	Minor	Probable
3	Baggage handlers experience high volume of bags with time constraint	Transtag placed on area where it is hard to spot	Major	Remote
4	Transtag identifies a bag that is definitely getting on more than one flight	Suitcase makes it on flight without passenger	Hazardous	Extremely improbable
5	Transtag is a new, innovative approach to baggage handling	Inadequately trained ground crew that does not know about the Transtag.	Catastrophic	Extremely improbable
6	Requires current labeling systems to be fully integrated with function to print Transtags	Mechanical error in printing of the tag/not enough blank templates	Hazardous	Extremely Improbable

Figure 8.4



In Figure 8.4 above, Team Pro-motion has determined that the risks and hazards associated with the Transtag are medium to low, the most catastrophic risk would be associated with the ground crew being badly oriented towards the solution.

At a worst case scenario, if the Transtag does not operate to the expectations based on modeling and observation it will not hinder the process and would simply revert it to where it is today.

8.5 Treat the Risk

Risk	Mitigating strategy
Transtag fall off during initial flight	The Transtag will be applied using the same adhesive technology as current regular bag tags, this has a long historical success rate in remain intact during the flight.
Transtag not taken off after reaching final destination	At the check-in desk, the personnel that places the tag should check to make sure there are no previously used tags on the luggage.
Transtag placed on area where it is hard to spot	Multiple transtags can be used on one piece of luggage
Suitcase makes it on flight without passenger	All Transtags on the transfer flight will be easily identified and could be taken off with minimal delay if the passenger list does not match.
Inadequately trained ground crew that does not know about the Transtag.	A trained supervisor should be present at the initial introduction of Transtag to make sure the workforce understands the training.
Mechanical error in printing of the tag/not enough blank templates	Form a ticket inventory, similar to the ones currently in use at airports.

Figure 8.5

9.0 Project Analysis and Impacts

As stated before, the simulation was run to its completion to show the difference between how the process is currently done and with our solution. The time it took each bag to reach its connecting flight from the time it was unloaded from the first flight was recorded because this is the area where our solution will help the system. That value for priority bags was determined late if that time was greater than 30 min. The number of late priority bags was then used to calculate the total potential cost to airlines for late luggage.

After running the simulation with the current system in Figure 9.0.1 below, the team found that all of the priority bags missed their connecting flight averaging a time of about 52 minutes to complete the baggage system at the layover airport. The potential cost to the airlines was about $63,000 for the late priority bags.

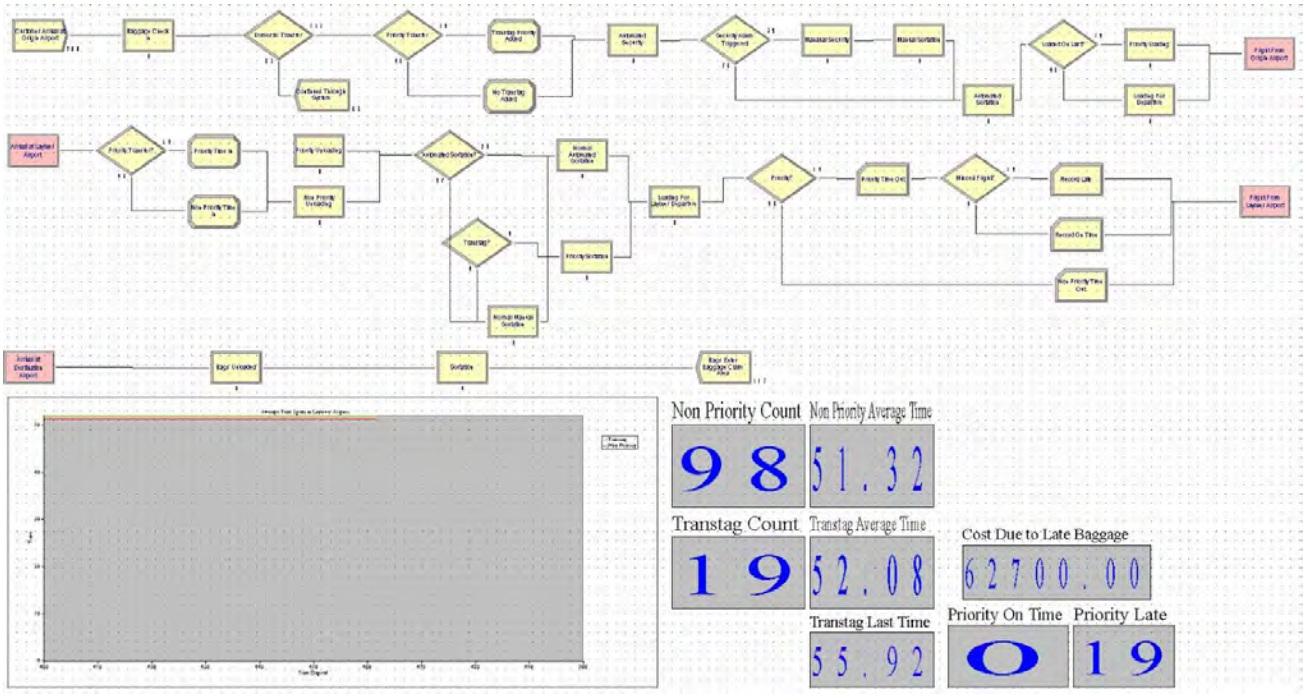


Figure 9.0.1

The results shown below in Figure 9.0.2 were much more optimistic. It revealed that the Transtag can genuinely help the efficiency of baggage handling system and cut costs for airlines. The average time to complete the baggage system at the layover airport is reduced to about 28 minutes from 52 minutes for bags with priority. The Transtag system was able to increase the percentage of on time priority bags by 74% and reduce the potential cost to the airlines by about $43,000. Team Pro-motion was ecstatic to see that the Transtag can cut more than 20 minutes off the time a transfer bag is needed to make it through the layover airport baggage handling system.

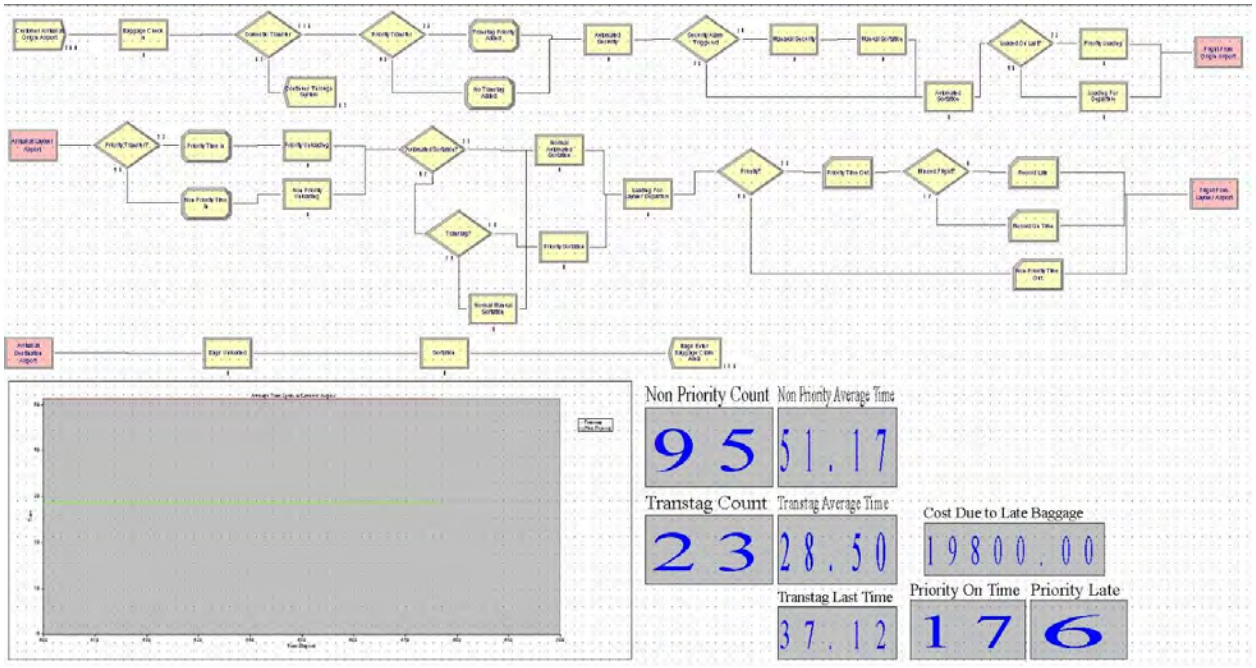


Figure 9.0.2

9.1 Economic Impact

Using the example of New york and New Jersey based airports in 2016, around 50,000 transfer bags were lost, displaced or mishandled causing delay. If Transtag was used on them, the operating cost would be $2,500. With the current model accuracy of around 70%, it can be determined that 35,000 bags would've made it on time using the Transtag. This represents a saving in reimbursement costs to the airlines of $110,000,000. With every $1 spent on Transtag, airlines can save up to $60,000 from not paying reparations to customers. For the price of a plane ticket 35,000 additional customers are satisfied which increases the likelihood that they will return to use the airlines' services again. Transtag provides a fantastic return on investment for airlines.

10.0 Implementation Process

The solution has two parts, the first part being the Transtag and the second being the training manual for the ground crew and check-in personnel. The Transtag is the label itself. It is placed on the transfer bags that need to be given priority, so they can be easily identified by the ground handling crew. The training manual, on the other hand, will be used to educate any workers who are not familiar with the new system changes.

The Transtag:

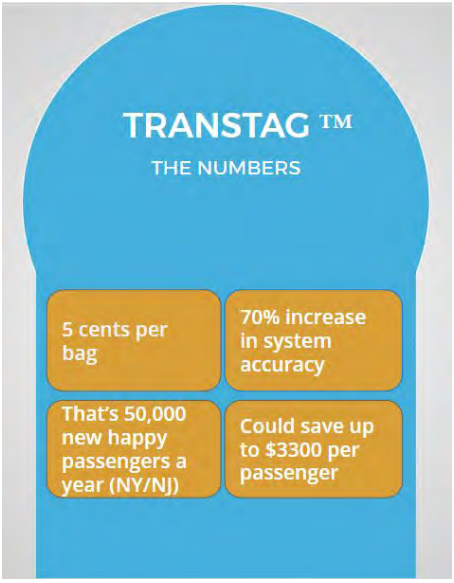


Figure 10.0.1

The Transtag is implemented in three steps:

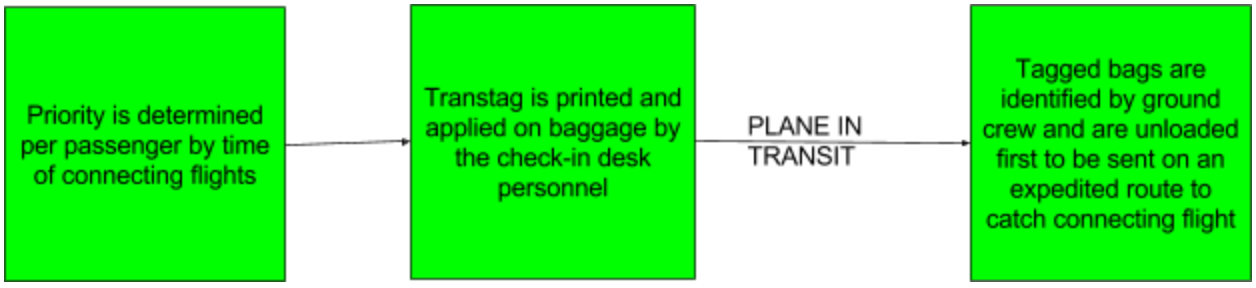


Figure 10.0.2

Layover time will be used to determine which bags require a Transtag. Bags which have scheduled layover times of 30 minutes or less are the urgent bags; these bags are the ones with the greatest need for speed, and shall therefore be given a Transtag in order to increase their chances of arriving at their connecting flight in time. Any greater amount of scheduled layover time however is not considered urgent, so those bags will go as they normally would without a tag.

The passenger flight information is known by the personnel at the initial check-in, so the check-in crew will be the ones to actually apply the tags to the bags. The passengers will not apply the tags, ensuring they don't falsely label their bags as urgent when they realistically are not. Once the tags are placed on the bags, the bags will be sent to their first flights as they normally would be.

At the connecting airport, however, system changes start to occur. The Transtag will be easily noticed in the cargo holds due to their bright color and shape. This will enable the handling crew to easily distinguish them from the regular bags. The bags with a Transtag will be the first ones scanned and removed from the plane and placed in a designated Transtag area. The bags will be picked up and sent on an express route to their connecting flights, rather than go through the normal sorting process with the other bags. This has been modeled by the team and the results show significant improvement.

The Transtag is designed to be printed using the existing technology at the check-in counters. This allows for a smooth transition from current operations. It will cost just 5 cents to produce each tag, and each tag has the capability of saving airlines a maximum of $3300 for each bag that is not lost but otherwise would be. As seen in the model, the Transtag has the potential

to increase system accuracy by 70%. This means that 70% more bags will make it on time to their connecting flights instead of being late and going missing as a result.

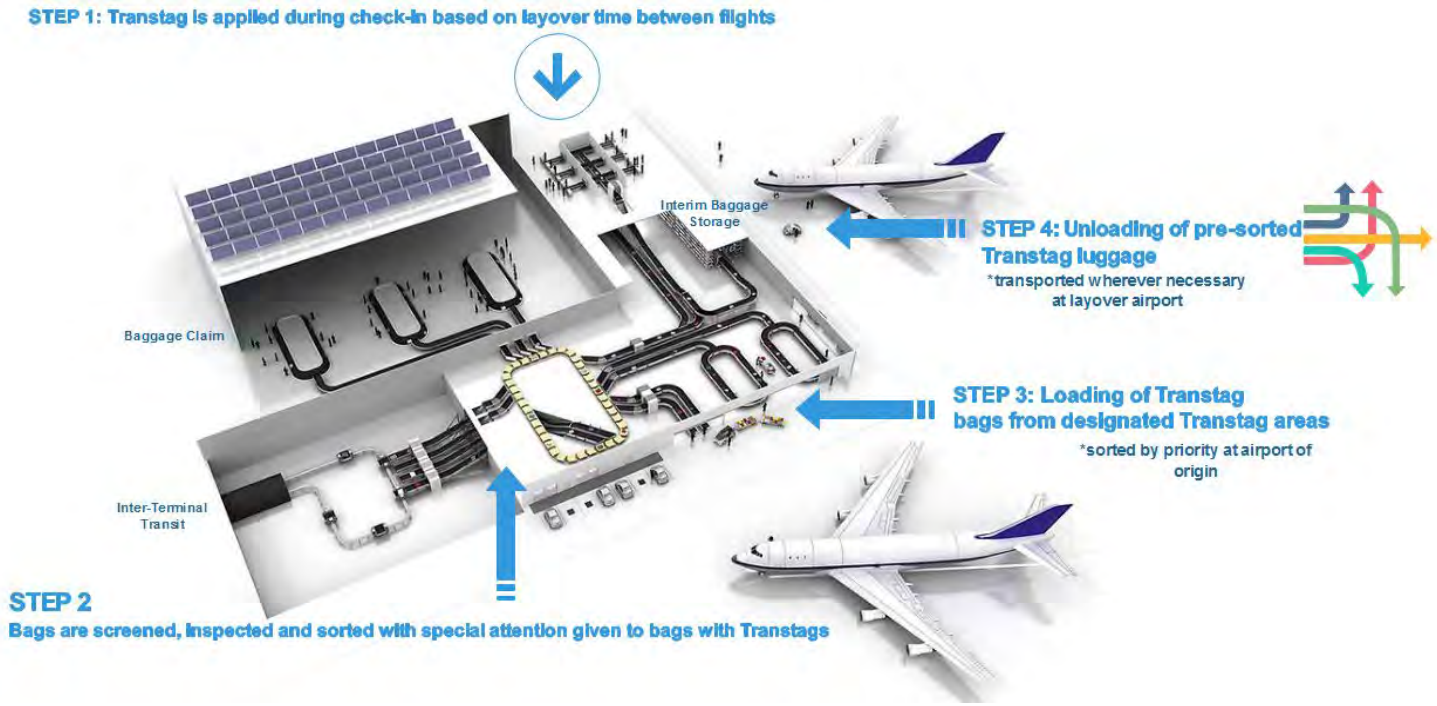
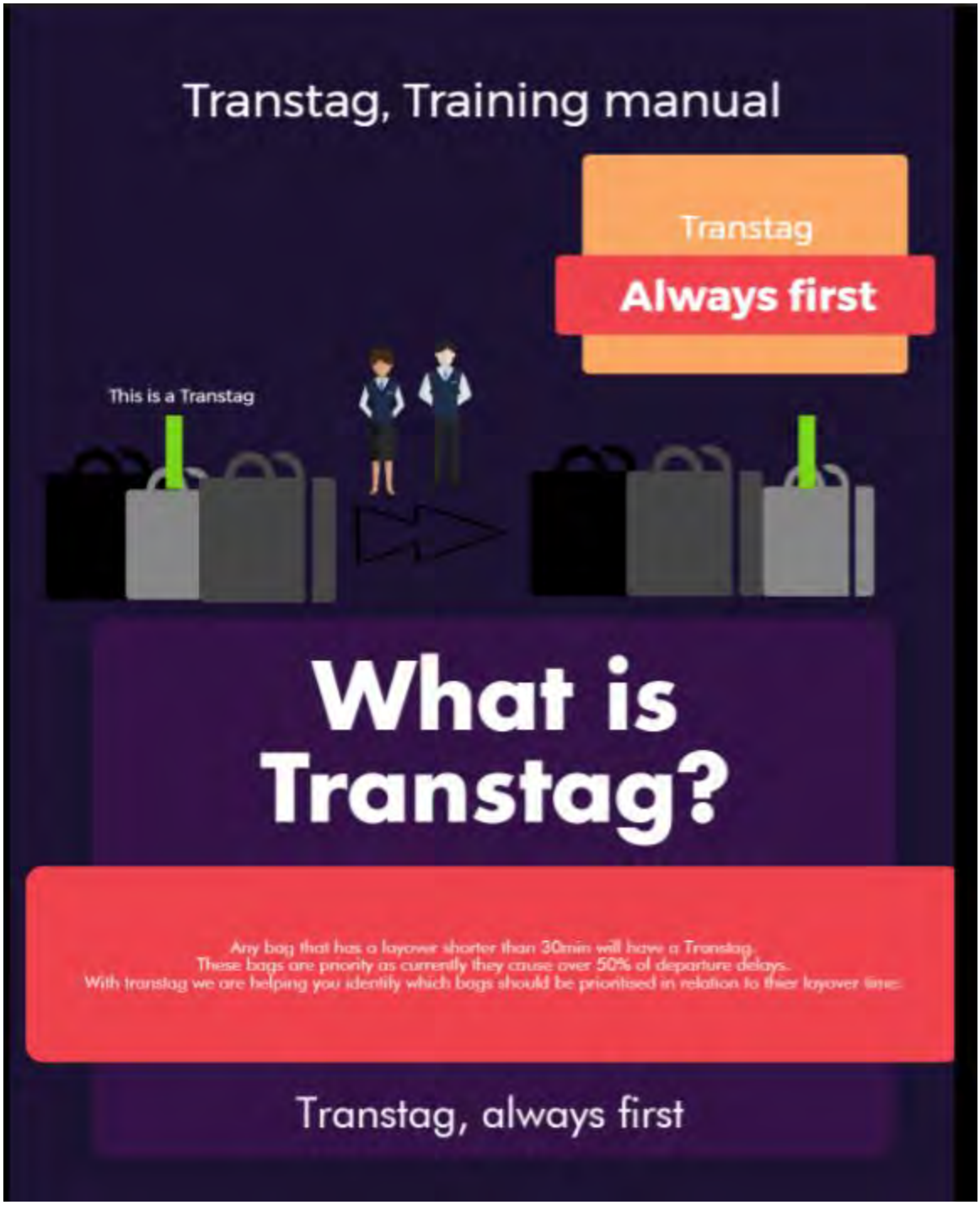


Figure 10.0.3

The manual:

The Transtag manual is a one page educational source for current and new baggage handlers (seen on following pages). It's purpose is to train the workers so that there will be no confusion as to what the Transtag is and how it should be used. It is the hope of team Pro-motion that the manual will serve a secondary purpose in promoting a more streamlined approach to the baggage handling. This approach is to assist the baggage handlers, rather than spend exorbitant amounts of money on complicated technology improvements and new airport infrastructure.

Ground crew manual:


Transtag, Training manual
Transtag
Always first
This is a Transtag
What is Transtag?
Any bag that has a layover shorter than 30min will have a Transtag.
These bags are priority as currently they cause over 50% of departure delays.
With transtag we are helping you identify which bags should be prioritised in relation to their layover time.
Transtag, always first


Its as simple as
1. Spot the Transtag
2. place it on the express route
Bags on time results in Happy customers
Customers are happy because of your work!
70%
By prioritizing Transtags you will work faster with better results! Bags are 70% more likly to make it on thier connection flight with transtag

Figure 10.0.4

Check-in personnel manual:

Figure 10.0.5

11.0 Conclusions

Airlines are always looking for ways to save money and to improve their operations. Money is a scarce resource, however, limiting their desire to spend large amounts on automation and other sophisticated infrastructure upgrades. The Transtag on the other hand is a cheap, simple improvement with the potential to make significant improvement. For every $1 spent, airlines save $60,000 by not having to pay reimbursements to customers. It also has the potential for quick implementation; the crew can learn to understand it in a matter of minutes, and it can be enforced as soon as the airlines make the decision. This is because it does not require a disruptive construction process or the gradual phasing out of any old systems. The training manual is incredibly simple to understand, being only one page in length.

Team Pro-motion truly believes in the Transtag and is confident that it will work as intended. It aims to tackle issues involving the necessary human interactions associated with the baggage system. The simulations performed by the group back this up, showing improvements of up to 70% under the correct circumstances. For airlines it is a win win, as satisfied customers are more likely to return in the future. Transtag, bags on time for half a dime.

Appendix A - Contact Information

Team Member Contact Information

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Appendix B - University Description

Stevens Institute of Technology is a premier, private research university situated in Hoboken, New Jersey. Founded in 1870 by America's First Family of Inventors, technological innovation has remained the hallmark of Stevens' education and research programs ever since. Today, within the university's three schools and one college, 6,600 undergraduate and graduate students collaborate with more than 290 faculty members in an interdisciplinary, student-centric, entrepreneurial environment to advance the frontiers of science and leverage technology to confront global challenges. Stevens' alumni network, more than 40,000 strong, also continues to make national and global impact while contributing energy, ideas and support to the continued growth and momentum of the university. Stevens is home to three National Centers of Excellence, as well as dozens of joint research programs.

The School of Systems and Enterprises (SSE) offers two undergraduate majors, two minors, nine master's programs and four doctoral degrees focusing on three core areas: systems & software engineering, financial engineering, and enterprise science & engineering. Research at SSE is conducted through four state-of-the-art research centers, the Systems Engineering Research Center, a University-Affiliated Research Center of the US Department of Defense, the Center of Complex Systems and Enterprises, the Hanlon Financial Systems Center and the Center for Coastal Resilience and Urban Excellence. In these centers, faculty and students work alongside on crucial research projects and develop solutions to complex socio-technical problems of national and international significance, in domains such as: financial systems, national security, health care delivery and coastal urban resilience.

Appendix C - Partners

The team did not have any non-university partners involved in this project. We relied on the help of our professor, Eirik Hole, and our teaching assistant, Alanna Zappariello, to successfully complete this project.

Appendix E - Educational Experience

Student Evaluation

1. **Did the Airport Cooperative Research Program (ACRP) University Design Competition for Addressing Airports Needs provide a meaningful learning experience for you? Why or why not?**

Yes, because it caused the team to do intense research and innovate. It made the team go beyond simply looking things up online, but instead reach out to actual industry experts.

2. **What challenges did you and/or your team encounter in undertaking the competition? How did you overcome them?**

It was difficult to find needed statistics, because the information the team needed is not released to the public by the airlines. The team got around this by meeting people in the industry and asking them for the information we could not otherwise find.

3. **Describe the process you or your team used for developing your hypothesis.**

The team decided to keep everything as simple as possible. We looked for areas in the current practices which seem to have the most problems, and from here we thought about the cheapest and easiest ideas to correct the problems.

4. **Was participation by industry in the project appropriate, meaningful and useful? Why or why not?**

Yes it was, for reasons stated in question 2. The information needed by the team was not available to the public.

5. **What did you learn? Did this project help you with skills and knowledge you need to be successful for entry in the workforce or to pursue further study? Why or why not?**

The team learned that simple is often best. It helped with skills for entry into the workforce, because companies always want to achieve the best results with the least amount of money and resources as possible.

Faculty Evaluation

1. **Describe the value of the educational experience for your student(s) participating in this Competition submission.**

The opportunity to work on a real-world challenge is very valuable. It requires the students to:

- really engage with the problem from the perspective of the airports, the airlines and other relevant stakeholders and potential vendors
- be exposed to real-world constraints – not only technical and economical, but also finding and accessing the right people, data and so on
- the realization that they are working on something that is of actual interest to several stakeholders
- Reach out and establish relationships with stakeholders and external subject matter experts

2. **Was the learning experience appropriate to the course level or context in which the competition was undertaken?**

Absolutely – the work fits well into the scope and context of a capstone Senior Design project in Engineering Management

3. **What challenges did the students face and overcome?**

- Get access to the right people to be able to observe how baggage is currently handled and get feedback on their ideas.
- Set up simulations that could predict the impact of their design with a reasonable level of accuracy

4. **Would you use this Competition as an educational vehicle in the future? Why or why not?**

Yes, for all the reasons given under #1.

5. **Are there changes to the Competition that you would suggest for future years?**

No

Appendix F - References

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