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Reducing Damaged and Returned Inventory at MDS Logistics

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Kennesaw State University

2018 Industrial Engineering Design Report



Reducing Damaged and Returned Inventory at MDS Logistics

Final Design Review

TEAM OTP CONSULTING

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ISYE 4900
Dr. Khalid

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EXECUTIVE SUMMARY

MDS Logistics is a middle-man that delivers and installs appliances to multi-family complexes and neighborhoods in Georgia. One of the biggest issues that they face in day-to-day operation is damaged and returned appliances. MDS's longest standing contract is with GE and GE has extensive records of damage that is incurred by using similar companies across the country. We will be consulting with MDS while using the data produced by GE to compare MDS with the similar companies to see where improvement can be made reasonably.

When an appliance is damaged it is brought back to MDS's warehouse where they are stored until GE allows them to return the products to distribution centers, which is about twice per year. With this, MDS is responsible for the product and is liable for the retail cost of the appliances. During the course of the year, there can be up to two thousand units sitting in their warehouse waiting to be returned.

Damages to appliances are incurred in a multitude of ways. These include manufacturer defects, mislabeled packages, concealed damage, botched installation, and mishandled appliances. Those that are completely out of MDS's control are still counted against the company which results in a minimum number of damages.

If appliances are unable to be delivered, that often means that the jobsite is not ready for their installation. This results in the appliances having to be returned to MDS and scheduled for a later date. The increased handling leads to higher chances of damaged inventory.

OTP Consulting identified and evaluated possible changes to each area that MDS had the power to change to improve current processes.

The issues that were evaluated aimed to reduce damages incurred while units were in the warehouse, damages incurred while units were being moved to jobsite, and damages caused by repeatedly moving units to jobsites with unconfirmed point of contacts.

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CHAPTER 1 – PROJECT INITIATION

INTRODUCTION

This project will be focusing on reducing the damaged and returned inventory at MDS Logistics. A study done by Chris Montell – Project Manager, Amir Samadabadi – Project Coordinator, and Darioush Moein – Logistics and Supply Chain Manager.

OVERVIEW

MDS Logistics is a middle-man that delivers and installs appliances to multi-family complexes and neighborhoods in Georgia. One of the biggest issues that they face in day-to-day operation is damaged and returned appliances. MDS's longest standing contract is with GE and GE has extensive records of damage that is incurred by using similar companies across the country. We will be consulting with MDS while using the data produced by GE to compare MDS with the similar companies to see where improvement can be made reasonably.

OBJECTIVE – MINIMUM SUCCESS CRITERIA

Historically MDS is one of the highest volume companies dealing with GE. Their average damage rate is roughly 0.50%, while their competitor maintains at about 0.35%. Further, the failed attempted deliveries are about 0.60% for MDS and about 0.40% for their top competitor. The goal of this project is to reduce the percentage of damages and failed attempted deliveries by at least 0.10%. These changes should decrease the damaged inventory rates for all clients of MDS.

JUSTIFICATION

There are roughly five thousand returns per year at MDS Logistics, but they are only allowed to return the appliances to GE twice per year. This ties up at large amount of the company's capital since they are liable for the costs of the appliances not delivered. Further, they are often responsible for the retail price of the appliances.

PROJECT BACKGROUND

The current General Manager at MDS Logistics is a colleague of the Project Manager for this project. When contacted to see if there were any improvements needed at his facility, the GM was happy to have the team come in and evaluate.

PROBLEM STATEMENT

When an appliance is damaged it is brought back to MDS’s warehouse where they are stored until GE allows them to return the products to distribution centers, which is about twice per year. With this, MDS is responsible for the product and is liable for the retail cost of the appliances. During the course of the year, there can be up to two thousand units sitting in their warehouse waiting to be returned.

To fix the damage it is important to understand what is causing the issue. Damages to appliances is incurred in a multitude of ways. These include manufacturer defects, mislabeled packages, concealed damage, botched installation, and mishandled appliances. Those that are completely out of MDS’s control are still counted against the company which results in a minimum number of damages.

If appliances are unable to be delivered, that often means that the jobsite is not ready for their installation. This results in the appliances having to be returned to MDS and scheduled for a later date. The increased handling leads to higher chances of damaged inventory. See Figure 1 for a visualization:

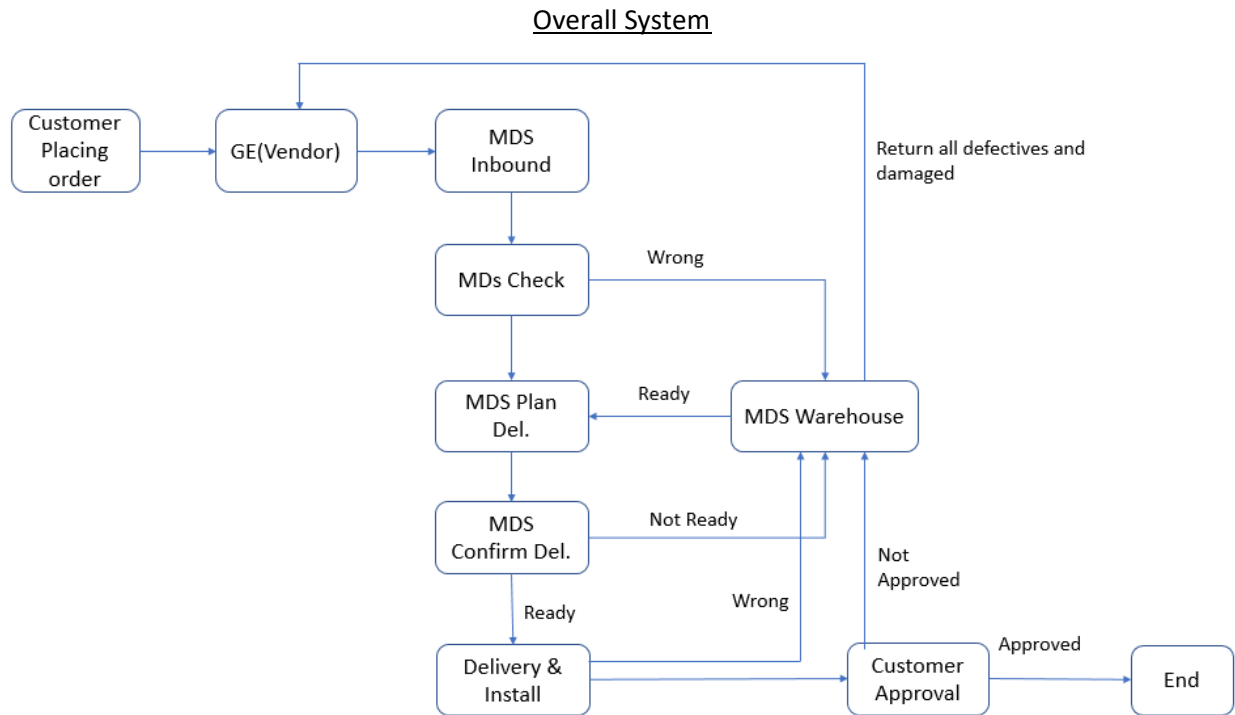


Figure 1 - Flow chart of the overall system of MDS Logistics. Author: Darioush Moein

CHAPTER 2 – PROJECT PREPARATION

LITERATURE REVIEW

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 - “Preparing Measure Process Work Time Study”, valuable article that the team read in preparation for the time study performed. Outlined what should be done prior and during a time study.

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 - “Determine Root Cause 5 Whys” was helpful in identifying the areas of business that MDS had the power to change and the areas that they did not.

CHAPTER 3 – PROJECT PLANNING

PROBLEM SOLVING APPROACH

To achieve the objective of the project, the root cause of the issues was first identified. The issue is failed deliveries. From here, the problem-solving method chosen was to use the “5 Whys” (Unknown n.d.).

To explore and express the cause-and-effect relationship with the problem, the question “Why?” was asked of the root cause. From here, it leads to two categories, Non-Damage Returns and Damaged Returns. Branching from these two categories revealed several causes. In these causes there were issues identified that MDS Logistics has the power to address and does not have the power to address.

The issues that MDS cannot address include site readiness, unresponsive delivery locations, and inbound damage.

The issues that MDS has the power to address are unanswered calls, warehouse damages, and delivery damages. See Figure 2.

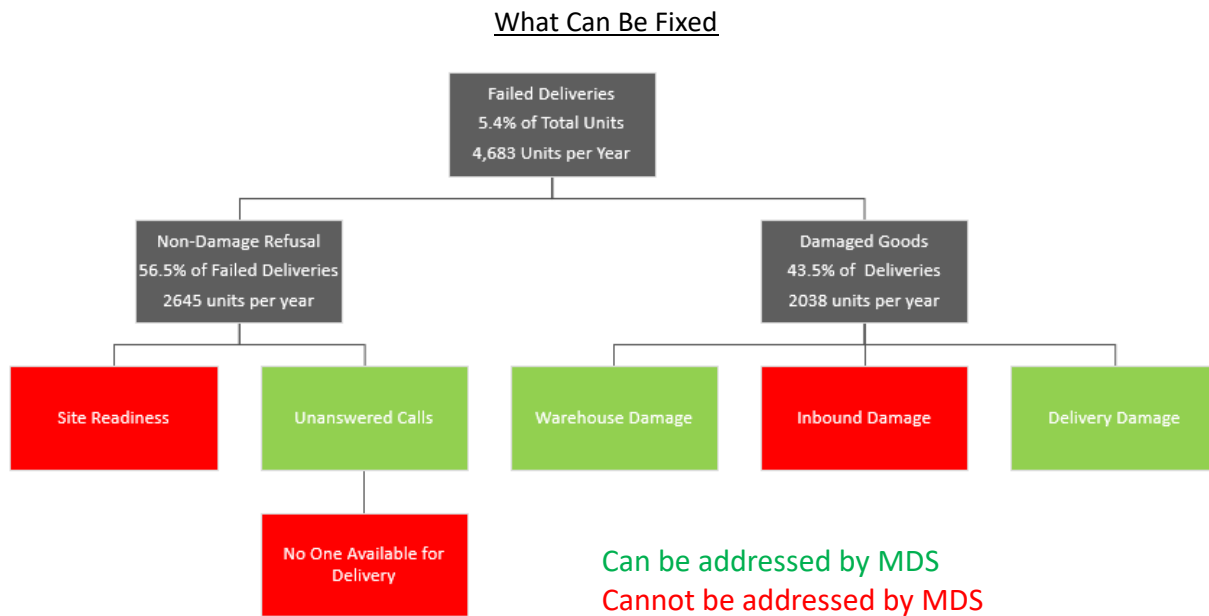


Figure 2 - Flow chart for visualizing what can and cannot be fixed by MDS Logistics. Author: Chris Montell

Unanswered Calls:

In the current system, the inbound appliances from GE are delivered at night, the day before they should be delivered. Before business starts the next day, the customer service representatives for MDS come in and schedule the routes for the day. The CSR then contacts the point of contact for the delivery around 8:00 am. If the point of contact does not answer, the CSR will leave a message, keep the delivery on the route, and move onto the next delivery. When the delivery is attempted without the point of

contact acknowledging the delivery, there is a 60% chance that the delivery will not be completed, as there needs to be someone there. The delivery will be attempted again the next day.

The proposed changes to this system include: (Farber 2017)

- Follow up call if the first fails prior to delivery
- Calling one day prior to delivery, holding material an additional day
- Mandatory contact with point of contact prior to delivery

These possibilities will be evaluated using Arena Simulation.

Warehouse Damages:

In the current system, after an appliance is returned, because it is damaged, it is shrink wrapped by hand per GE's return instructions to be inspected and returned to GE. Doing this process by hand takes up time from the warehouse workers and takes up floor space as they do not like to stop what they are doing to wrap one piece.

The proposed change would be to add a shrink-wrapping machine to reduce worker time spent and clutter in the warehouse. While the reduction of clutter is not quantifiable, the time saved versus the cost of the machine is quantifiable. The simulation that will be done in Arena will evaluate the different models of shrink wrap machines available and recommend the best fit for MDS's needs.

Delivery Damages:

The current system at MDS lacks the inclusion of padding between appliances in the outbound trucks. Considering the often-long routes that the drivers make, this does increase the chances that damage will be incurred. Also, there is no training in place at MDS for best practice, resulting in a lack of consistency in installation quality.

The proposed change would be to evaluate the benefit of making a one-time purchase of wrapping blankets to use between the appliances, taking into consideration the added time required during loading and unloading. Finally, a compilation of the installation manuals for the different makes and models of the appliances that they deal with for installers to reference in the field.

REQUIREMENTS

The design requirements for this project were established to ensure a minimal acceptable outcome if implemented.

1. Reduce the number of units damaged.
2. Reduce the number of attempted deliveries.
3. The cost of any changes should have a return on investment in one year.
4. Maintain the current employees.
5. The implementation shall take no longer than one month.

SCHEDULE

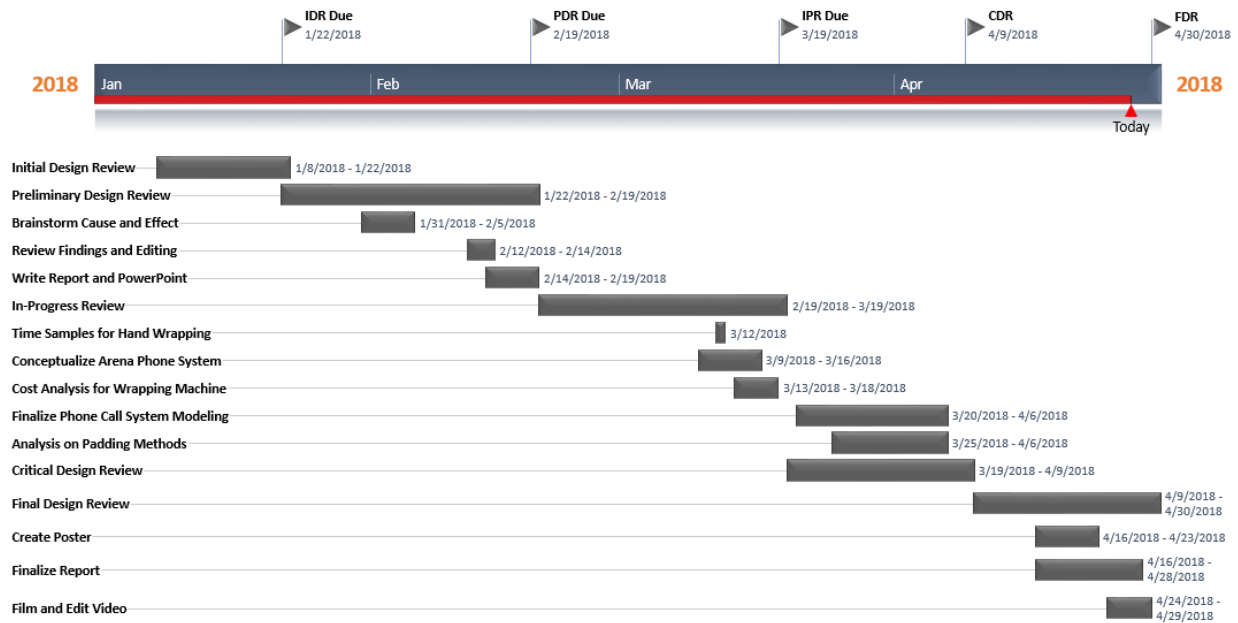


Figure 3 - Gantt chart of project tasks and milestones. Author: Chris Montell

RESPONSIBILITIES

| Darioush | Chris | Amir |
|---|--|---|
| <ul style="list-style-type: none"> • Logistic And Supply Chain Manager ➢ Oversee warehouse ➢ Material handling ➢ Customer service ➢ Deliveries inspection ➢ Efficiency of operation | <ul style="list-style-type: none"> • Project Manger ➢ Analyzing and managing project risk ➢ Monitoring progress ➢ Controlling time management ➢ Cost estimating and developing the budget ➢ Activity and resource planning | <ul style="list-style-type: none"> • Project Coordinator ➢ Determining project changes ➢ Developing project strategies ➢ Ensuring project deadline ➢ Organizing and motivating a project team ➢ Undertaking project tasks |

MAJOR CHAPTER CONTRIBUTORS

Chapter 1: Darioush Moein, Amir Samadabadi

Chapter 2: Chris Montell, Amir Samadabadi

Chapter 3: Chris Montell, Darioush Moein

Chapter 4: Darioush Moein, Amir Samadabadi

Chapter 5: Chris Montell, Amir Samadabadi

Chapter 6: Chris Montell, Darioush Moein

Chapter 7: Darioush Moein, Amir Samadabadi

Chapter 8: Chris Montell, Amir Samadabadi

Video: Amir Samadabadi, Darioush Moein, Chris Montell

BUDGET

There is not a set budget for this project, as long as the proposed changes have a return on investment within one year.

MATERIAL REQUIRED / USED

- Arena Simulation
- Microsoft Office Suite

RESOURCES AVAILABLE

- Professors at KSU
- The GM at MDS Logistics
- KSU Library and Databases
- Previous senior project reports
- Internet

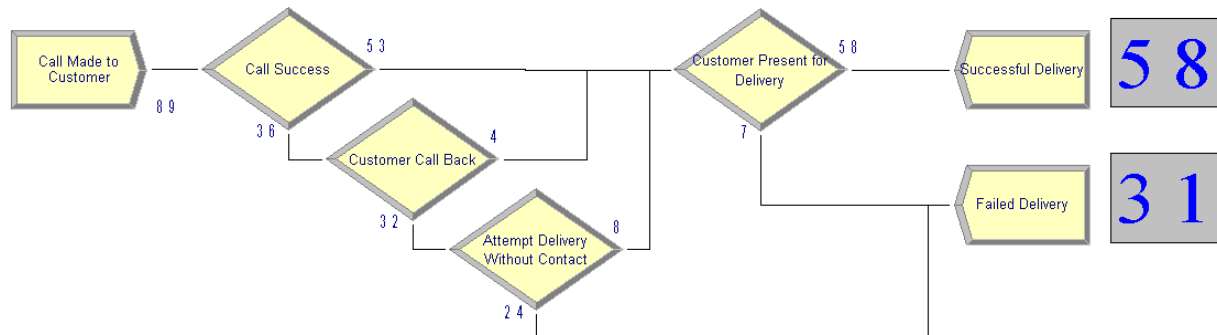
CHAPTER 4 – PROJECT EXECUTION – UNANSWERED CALLS

PHONE CALL SYSTEM

Since there are not accurate percentages of the calls that go out, are successful, and are not successful, the general manager provided the percentages that were used for this portion. Calls go out at a rate of approximately 7.4 calls per hour. This is obtained by dividing the total number of deliveries per day (89) by the twelve-hour working shift that the customer service puts in. All simulations are performed with Arena Simulation. (Kelton 2015) (Sisson 2014)

In the current system, 70% of calls made are successful in reaching the point of contact. Approximately 10% of point of contacts that are not reached initially will return the call prior to delivery. If the point of contact is not contacted at all, the delivery will stay on route and has a 40% chance of being delivered. Of all-of the point of contacts that are contacted, there is still a 10% chance that the delivery will fail due to no one being on site to receive the order. All failed deliveries are brought back to the warehouse. The result of this system run through area is a 65% chance that the order will be delivered and a 35% chance that the order will come back to the warehouse. The daily breakdown using this method has 58 successful deliveries and 31 failed deliveries when simulated. See Figure 4.

Current System



| | Name | Type | Percent True |
|---|----------------------------------|-----------------|--------------|
| 1 | Call Success | 2-way by Chance | 70 |
| 2 | Customer Call Back | 2-way by Chance | 10 |
| 3 | Attempt Delivery Without Contact | 2-way by Chance | 40 |
| 4 | Customer Present for Delivery | 2-way by Chance | 90 |

Figure 4 – Arena Simulation: Current phone call process at MDS Logistics. Authors: Darioush Moein, Chris Montell

The first possible option explored is to include a follow up call prior to releasing the order for delivery. By adding the follow up to the phone call system, the chance of customer response will increase to 80%. Also, even if customers still didn't answer the follow up call since they have received two missed calls from the same number, the chance of them responding back will increase to 50% instead of 10%. By adding the follow up call to the system in Arena will result to reduction in percentage of 16.85% delivery failures. The daily breakdown using this method has 74 successful deliveries and 15 failed deliveries when simulated. See Figure 5.

Follow Up Call

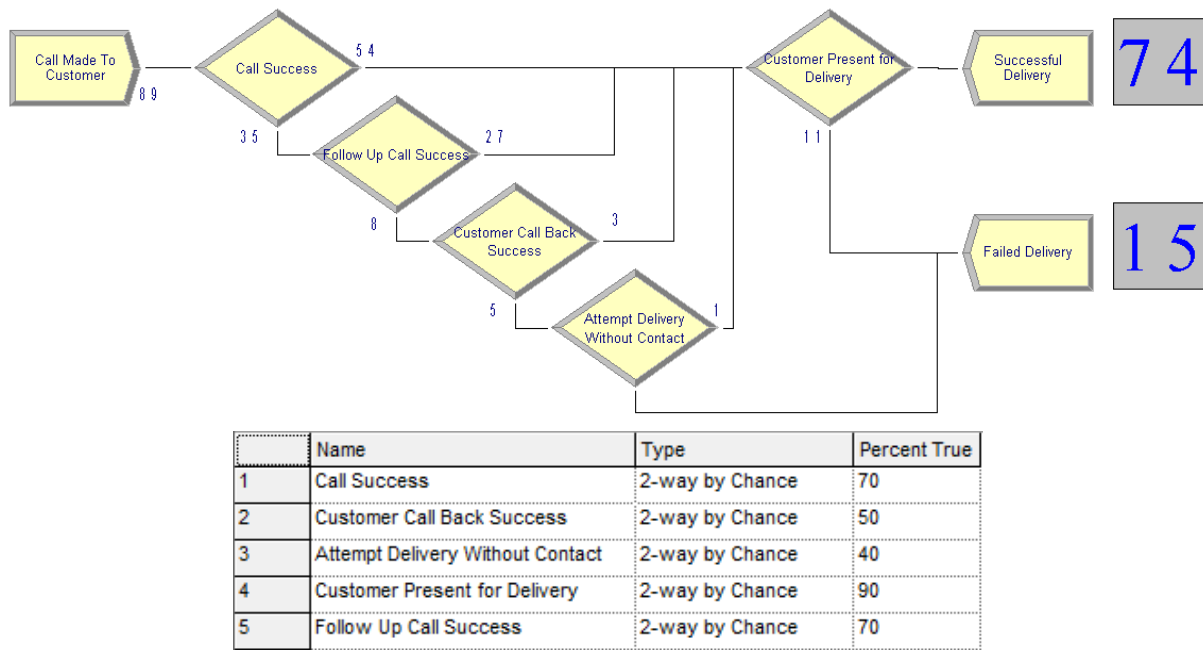
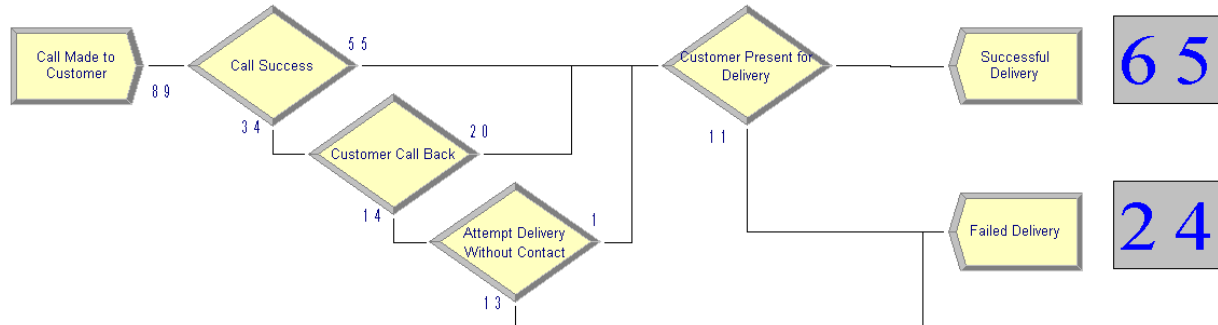


Figure 5 – Arena Simulation: Phone process with follow up call at MDS Logistics. Author: Darioush Moein, Chris Montell

The second option evaluated was to increase the time that MDS held units prior to delivery from same day to one day. Calling the client one day prior to delivery is a solution that gives them more time to respond back to MDS due to the missed call. By adding a one-day lead to the current system in Arena only the percentage of the customer responding back increases from 10% to 50% which reduces the percentage of failure from 35% to 26.97%; however, adding a one-day lead to the system results in having more products to be kept in MDS’s warehouse and since their storage space is limited, this may not be a viable solution. See Figure 6.

Increased success due to one day lead

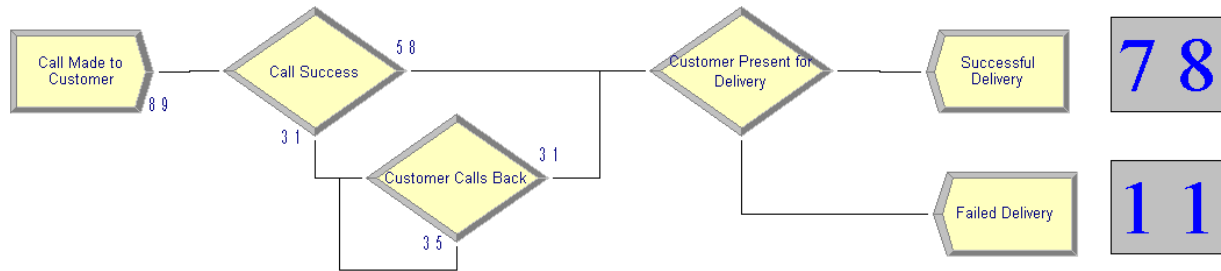


| | Name | Type | Percent True |
|---|-------------------------------|-----------------|--------------|
| 1 | Call Success | 2-way by Chance | 70 |
| 2 | Customer Call Back | 2-way by Chance | 50 |
| 3 | Attempt Delivery Without | 2-way by Chance | 40 |
| 4 | Customer Present for Delivery | 2-way by Chance | 90 |

Figure 6 – Arena Simulation: Phone process with one-day lead at MDS Logistics. Author: Darioush Moein, Chris Montell

The final option simulated was to require the point of contact to be contacted prior to an attempted delivery. By requiring a mandatory contact prior to delivery, the lack of communication between MDS and their clients will reduce. By adding a loop in the customer call back section in Arena, MDS prevents any unconfirmed delivery happen, and the chance of customer contacting MDS back will increase from 10% to 50%. If their delivery date passes, they will contact MDS to make the next delivery appointment. By adding mandatory contact prior to the Arena system and skipping the attempt delivery without confirmation, the percentage of the delivery failure will reduce from 35% to 12.36%. See Figure 7.

Mandatory Contact Prior to Delivery



| | Name | Type | Percent True |
|---|-------------------------------|-----------------|--------------|
| 1 | Call Success | 2-way by Chance | 70 |
| 2 | Customer Calls Back | 2-way by Chance | 50 |
| 3 | Customer Present for Delivery | 2-way by Chance | 90 |

Figure 7 - Arena Simulation: Phone process mandatory contact prior to delivery at MDS Logistics. Author: Darioush Moein, Chris Montell

CHAPTER 5 – PROJECT EXECUTION – WAREHOUSE DAMAGE

WRAPPING MACHINE

The initial plan for comparing the wrapping machines versus hand wrapping was to model the different systems in Arena. By collecting hand wrapping time data, the comparison is best made by simply calculating manhours spent in excel. (Chandoo 2015)

Following up with the proposed solution of the purchase of a wrapping machine, three wrapping machines (made by U-Line) were compared based on their price, speed, and dimensions. All of the data needed was provided on the U-Line website and incorporated into the analysis.

A time study was done to establish an average hand wrapping time on twenty-two items, resulting in a total time of 107.32 minutes measured and an average time of 4.88 minutes per unit. (Appendix D) (Holpp n.d.)

Analysis of the machines and savings:

| Wrapping Method | Man Hour/Unit | Wrap Speed (min) | Hours Wrapping Per Year | Cost Manhours (\$15/hr) | Price to Purchase | Savings Using Machine Per Year | Months Until Payoff | Savings by End of Year 2 |
|---------------------|---------------|------------------|-------------------------|-------------------------|-------------------|--------------------------------|---------------------|--------------------------|
| Hand Wrap | 4.88 | 4.88 | 382.27 | \$ 5,734.00 | \$ - | - | - | - |
| Automatic W.M. | 0.5 | 3 | 39.17 | \$ 587.50 | \$ 9,990.00 | \$ 5,146.50 | 23.29 | \$ 303.00 |
| Semi-Automatic W.M. | 0.6 | 3 | 47.00 | \$ 705.00 | \$ 6,630.00 | \$ 5,029.00 | 15.82 | \$ 3,428.00 |
| Manual W.M. | 5.5 | 5 | 430.83 | \$ 6,462.50 | \$ 4,330.00 | \$ (728.50) | NA | NA |

Table 1– Cost analysis of wrapping machine payoff versus hand wrapping cost in manhours. Author: Chris Montell, Amir Samadabadi

Saving per Pallet per Machine:

| | | Savings Per Pallet |
|---------------------------|---------|--------------------|
| Pallet Count Per Year | 4700 | |
| Current Cost Per Pallet | \$ 1.22 | - |
| Automatic Wrap Per Pallet | \$ 0.13 | \$ 1.10 |
| Semi-Auto Per Pallet | \$ 0.15 | \$ 1.07 |

Table 2 – Cost analysis of wrapping machine payoff versus hand wrapping cost per pallet. Author: Chris Montell, Amir Samadabadi

Times require for each of the different wrapping machine models is shown in the first chart above. Both the automatic wrapping machine and the semi-automatic machine allow the worker to press a button to wrap the unit after loading a unit on the machine. The main difference in the two is that the automatic machine will also cut the shrink wrap after its cycle is complete. The manual wrapping machine is comprised of a rotating base that is operated with a foot pedal. This machine requires a worker to guide the wrapping arm, operate the pedal, and cut the shrink wrap once complete.

While the wrapping time of the automatic and the semi-automatic are three minutes per unit, this analysis is only accounting for thirty seconds of man-hours spent since the worker is only required to load the machine, press a button, and walk away.

The total units returned per year are 4,700 units. This is multiplied by the wrapping speeds of each, then divided by sixty to produce the manhours spent wrapping. From here, it is multiplied by fifteen dollars to approximate the manhour cost per year.

Results show that the manual wrapping machine is not viable for this application. Also, that the automatic and semi-automatic wrapping machines with the semi-automatic having a greater saving by the end of the second year.

Since the semi-automatic machine carries a price difference of \$3,360 when compared to the automatic machine, this is the model that this study recommends. The automatic wrapping machine does cost \$0.03 less per pallet to wrap but would take over ten years to surpass the savings of the semi-automatic machine.

Calculations show that the semi-automatic machine would take roughly sixteen months to have a return on investment, violating one of the original design requirements of a one-year return on investment. Since the expected savings by the end of year two is \$3,428, this machine is still a viable recommendation that will be presented to the general manager.

CHAPTER 6 – PROJECT EXECUTION – DELIVERY DAMAGE

MOVING BLANKETS

There are roughly two-thousand units damaged while in the warehouse and/or being delivered. The application of padding between packages should reduce this number.

MDS Logistics on average has about eight twenty-four-foot box trucks out for delivery each day. The inner dimension of each box truck is twenty-four feet long by ninety-eight inches wide. The average small sized package is stacked on top of another package, resulting in an average package size of twenty-six inches by twenty-six inches by seventy-two inches high. With this, the maximum number of packages that can be fit into the box truck is forty (two packages per footprint) leaving several inches between the packages one wall.

In order to load the packages, the outbound area is staged so the packages can all be lined up and pushed onto the receiving box trucks.

To optimally protect the packages, one moving blanket should be places on every other package prior to them being pushed into the box trucks (see Figure 8 below). This method would result in allocating fifteen, 80" x 144" moving blankets per truckload of the smallest appliances. fifteen blankets for eight trucks would require one-hundred and twenty blankets to be purchased at \$33.27 each for a total of \$4,271.87 with tax included. (Costs taken from homedepot.com)

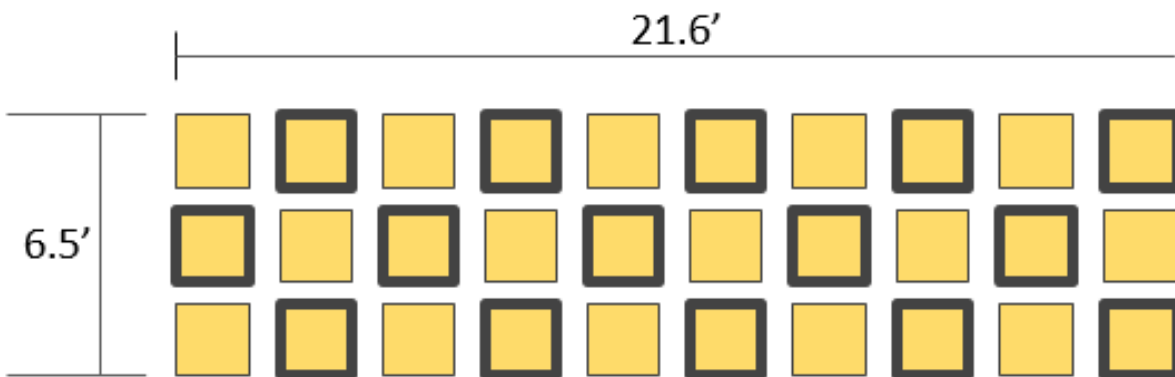


Figure 8 – Padding layout using moving blankets for 24' long box truck. Author: Chris Montell, Amir Samadabadi

****Thick lines represent blanket wrapped****

However, it is hard to justify spending this amount of money is a feasible solution when there is no data on the damage reduction rate improvement achieved through this method.

The solution to justifying the purchase of moving blankets is to make use of material the MDS has at their disposal already, cardboard, as a test.

By implementing a process to place additional cardboard between the packages one can get an idea of the damage reduction rate improvement achieved.

To calculate the cost of using cardboard instead of moving blankets for an initial test, the time that it would take an employee to apply additional padding would roughly be the same for each method. The cardboard method would only cost the manhours required to collect, save, and store cardboard scraps. We can estimate the time that an employee would take to disassemble a refrigerator box into panels and place them aside at about two minutes per box. Disassembling a refrigerator box would yield two seventy-two inches by seventy-two-inch pieces of cardboard.

Looking at the image below (Figure 9) for the padding method when using cardboard:

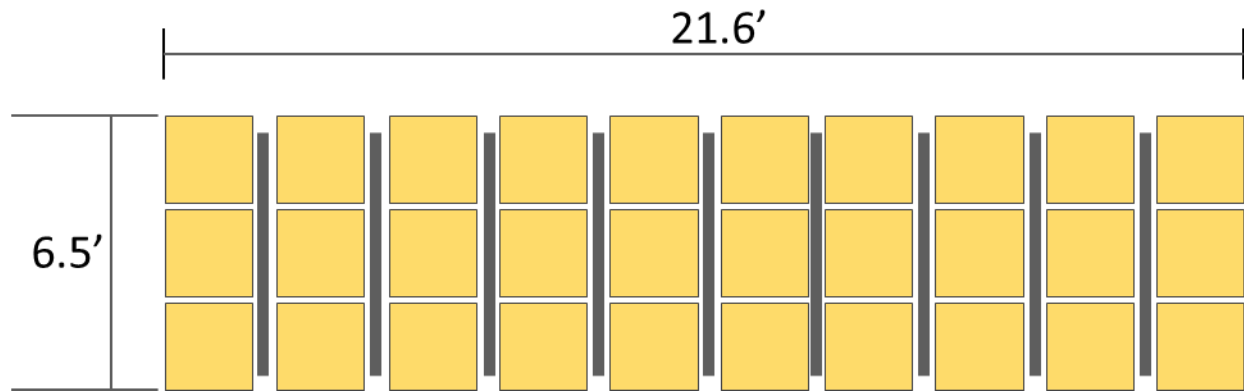


Figure 9 - Padding layout using moving blankets for 24' long box truck. Author: Chris Montell, Amir Samadabadi

****Thick lines represent 72" x 72" cardboard padding****

This would result in MDS needing four and a half-disassembled refrigerator boxes worth of cardboard per truck, so thirty-six boxes for all eight trucks. The thirty-six boxes would require roughly an hour and a half of manhours (two minutes per box), costing \$23 per set of boxes. Boxes should last an estimate of one week before deteriorating, at which point, another set would be needed. Since MDS is relying on the damage metrics by GE that are provided quarterly, cardboard padding would need to be used for twelve weeks. Twelve sets of cardboard padding would cost \$276 in manhours since the material is free. If this method resulted in one package being undamaged the company would save approximately \$1,000, justifying this methods validity.

If the cardboard method of padding results in a reduction of damaged products in the warehouse and delivery, purchasing blankets would be beneficial since they have a much longer lifespan.

CHAPTER 7 – RESULTS AND DISCUSSIONS

Overview:

The changes to the MDS's current phone call process should reduce the number of failed attempted deliveries caused by a lack of communication to the customer by 18%.

The addition of a wrapping machine to the facility will provide an annual savings in manhours of \$5,029 after the second year. While the savings do not reduce damage to product, the implementation of this machine should reduce the queue of boxes waiting to be wrapped on the facility floor, which in turn should reduce damage occurrences in the warehouse.

The new transit padding system will only cost manhours to implement. After a quarter of this process being in place, data can be evaluated on its efficacy in reducing delivery damage and a decision can be made on whether or not it is viable to make an investment in moving blankets.

The original minimum success criteria was to reduce the average damage rate and failed attempted delivery rate (0.5% and 0.6% respectively) by 0.1%, as reported by the GE metrics.

Overall, the proposed changes will result in an 18% reduction in failed attempted deliveries, an annual manhour saving of \$5,029 per year, and potentially a process that will reduce damage incurred during deliveries. The 18% reduction should result in a 0.09% reduction, just under our success criteria goal of 0.1%

Assuming that the proposed method of additional padding is successful in reducing delivery damages, MDS will see a reduction on their GE metric. The manhour cost of roughly \$300 to supply cardboard for padding, for the quarter, would be justified if at least one unit that would have been damaged arrives undamaged. However, since there is not existing data on the efficacy of this method, the usefulness of the proposed changes will be seen in time.

Phone Call System:

In the current phone system, customers only received one call prior to an attempted delivery the same day. The percentage of the calls answered in this current system is only 70%. Simulations show that follow up call is the best solution to increase this percentage and reduce the failure rate.

By adding the follow up to the phone call system, the chance of customer response will increase to 80%. In the event that the customer didn't answer the follow up call, the chance of them returning the call increases to 50% instead of 10%, due to the multiple missed calls from the same number.

Wrapping Method:

There are roughly 4,700 units returned to MDS each year. Each unit needs to be shrink wrapped and stored in MDS's warehouse, where it sits until the manufacturer allows returns (about twice per year). As units are returned to MDS, they are lined up and individually wrapped by hand. This takes up a lot of valuable time and space, hence the evaluation of wrapping machines.

In the cost analysis of the wrapping machines vs hand wrapping, 4,700 is multiplied by the wrapping speeds of each wrapping method, then divided by sixty to produce the manhours spent wrapping. From here, it is multiplied by fifteen dollars to approximate the manhour cost per year.

Results show that the manual wrapping machine is not viable for this application. Also, that the automatic and semi-automatic wrapping machines with the semi-automatic having a greater saving by the end of the second year.

Calculations show that the semi-automatic machine would take roughly sixteen months to have a return on investment, with an expected savings by the end of year two of \$3,428.

Transit Padding:

There are roughly two-thousand units damaged while in the warehouse and/or being delivered. The application of padding between packages during deliveries should reduce this number.

The initial plan was to recommend using moving blankets between every other unit. Since there is not data on the efficacy of this method, OTP recommends using the cardboard boxes that the refrigerators come in to pad between the sets of units.

Cardboard padding would cost approximately \$276 in manhours to produce enough for one quarter since the material is free. If this method resulted in one package being undamaged the company would save approximately \$1,000, justifying this method's validity.

Final Budget:

The final budget would include the cost of a semi-automatic wrapping machine (\$6,630.00) and the additional one-time cost of additional manhours required to produce cardboard padding (\$276), totaling \$6,906.00.

Future Improvements:

OTP Consulting would recommend implementing a customer service phone call monitoring system. This would allow MDS to pinpoint issues and develop their own matrices of the effectiveness of the customer service representatives. Also, in continuing their relationship with GE, they should push for more points of contact for the customer if possible.

Requirements Revisited:

1. Reduce the number of units damaged.
 - a. Proposed changes will reduce the number of damaged units
2. Reduce the number of attempted deliveries.
 - a. Proposed changes to phone process will reduce attempted deliveries.
3. The cost of any changes should have a return on investment in one year.
 - a. Proposed changes will take slightly longer than our original requirement, providing a return on investment after sixteen months
4. Maintain the current employees.
 - a. Proposed changes maintain current employees
5. The implementation shall take no longer than one month.
 - a. Proposed changes will take less than one month to implement.

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APPENDIX A: ACKNOWLEDGEMENTS

Technical Contributions of each Team Member

Amir:

- Video Production, voice-over and editing
- Time Study
- 5 Whys development

Chris:

- Excel Cost analysis
- Arena Simulation, model layout
- Time Study
- Gantt Charts
- Chart Making

Darioush:

- Arena Simulation, model layout
- Overall system flowchart
- Excel Data consolidation

APPENDIX B: CONTACT INFORMATION

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APPENDIX C: REFLECTIONS

Working with MDS logistics was a great experience real world System and Industrial Engineering issues.

Dealing with vendor and clients, developing good customer cares requires both clients and company satisfaction. From the beginning we have create a list of problems found at MDS that need to be fixed, by analyzing the issues we were able to develop multiple some solutions. However, not all solutions are possible for MDS to implement since they are limited by what GE will allow.

For instance, adding text messaging to the phone call system was one of our great option to make the follow up with people who were not able answer the notice- call for the delivery; however, GE won't authorize to add the text messaging to our phone call system

Additionally, the cost analysis that we did for the shrink wrap machine was a great experience that added more value to MDS's wrapping process. Furthermore, MDS often lacks space to hold the failed deliveries and returned units.

However, with all of the limitations, we were able to narrow down all of the possible changes to best fit MDS's needs.

We learnt form the class that concentrating on cost analysis will give us better view to fit our results with MDS requirements. By doing cost analysis MDS managers have a better view of saving and they were satisfied with increasing in their revenue.

APPENDIX D: Tables

Table 1: Cost analysis of wrapping machine payoff versus hand wrapping cost in manhours

| Wrapping Method | Man Hour/Unit | Wrap Speed (min) | Hours Wrapping Per Year | Cost Manhours (\$15/hr) | Price to Purchase | Savings Using Machine Per Year | Months Until Payoff | Savings by End of Year 2 |
|---------------------|---------------|------------------|-------------------------|-------------------------|-------------------|--------------------------------|---------------------|--------------------------|
| Hand Wrap | 4.88 | 4.88 | 382.27 | \$ 5,734.00 | \$ - | - | - | - |
| Automatic W.M. | 0.5 | 3 | 39.17 | \$ 587.50 | \$ 9,990.00 | \$ 5,146.50 | 23.29 | \$ 303.00 |
| Semi-Automatic W.M. | 0.6 | 3 | 47.00 | \$ 705.00 | \$ 6,630.00 | \$ 5,029.00 | 15.82 | \$ 3,428.00 |
| Manual W.M. | 5.5 | 5 | 430.83 | \$ 6,462.50 | \$ 4,330.00 | \$ (728.50) | NA | NA |

Table 2: Cost analysis of wrapping machine payoff versus hand wrapping cost per pallet

| | | Savings Per Pallet |
|---------------------------|---------|--------------------|
| Pallet Count Per Year | 4700 | |
| Current Cost Per Pallet | \$ 1.22 | - |
| Automatic Wrap Per Pallet | \$ 0.13 | \$ 1.10 |
| Semi-Auto Per Pallet | \$ 0.15 | \$ 1.07 |

Hand Wrapping Times: Used for wrapping machine analysis

| | Wrap Time (min) | Total Time | Average Time |
|----|-----------------|------------|--------------|
| 1 | 4.73 | 107.32 | 4.88 |
| 2 | 4.10 | | |
| 3 | 5.60 | | |
| 4 | 4.04 | | |
| 5 | 5.04 | | |
| 6 | 4.74 | | |
| 7 | 4.92 | | |
| 8 | 4.44 | | |
| 9 | 4.76 | | |
| 10 | 5.42 | | |
| 11 | 4.96 | | |
| 12 | 5.44 | | |
| 13 | 4.86 | | |
| 14 | 4.94 | | |
| 15 | 5.24 | | |
| 16 | 5.19 | | |
| 17 | 5.56 | | |
| 18 | 4.13 | | |
| 19 | 4.25 | | |
| 20 | 4.54 | | |
| 21 | 5.46 | | |
| 22 | 4.95 | | |