Motion and Time Study for Increasing Efficiency, Productivity, and Safety for an Unloading Facility

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Abstract

This project analyzed a proposed installation of a loading dock to increase the efficiency of the unloading facility of a building materials distributor while ensuring the employees' safety. The facility deals with the unloading and organization of doors from the suppliers. This two-man operation begins with unloading the doors onto a rack that is lifted in the air by a forklift operator. After unloading the doors, they are carried into a shed, and the rack is placed where there is free space. If there is none, the doors are unloaded from the rack and placed in a row against the wall. The installation of a loading dock is proposed on the east wall of the shed. With the installation of the loading dock, the supplier will be allowed to back into the loading dock at ground level and provide a safer and more efficient method of unloading doors while keeping them organized afterward. To justify the construction of the loading dock, a time study was conducted over 10 weeks to determine the average standard time it takes to unload one door. Simio software was then used to create what-if scenarios that showed the loading dock would cut unloading time almost in half. By comparing the observed times to simulated times and researching injury costs, the Payback Period, Internal Rate of Return, Benefit-Cost Ratio, and Net Present Value of the loading dock were determined to justify the construction from an economical perspective.

Keywords
Time study, Simio simulation, Payback period, Internal rate of return, Benefit-cost ratio, Net present value, Unloading facility design.

1. Introduction
The project was conducted at a distribution company that supplies building materials including lumber, siding, doors, and windows to customers varying from professional contractors to weekend warriors. The company expanded significantly in the last eight years since its opening, providing its services to a growing number of customers. As it is growing, several issues are emerging within this facility. The problem can be divided into three parts: part one concerns the safety of employees who are loading and unloading the doors, the second part is concerning the time spent unloading the doors from the incoming trucks, and the third part is the arrangement of the incoming doors in the storage facility. The doors are shipped in a semi-truck with an enclosed trailer. This truck will not fit inside the shed designated for the doors, so a 4x8 foot door rack is lifted to the trailer by a forklift to unload them. This poses a safety

hazard and is inefficient because the worker usually must get in the rack while it is off the ground, and if there is only one rack available, the doors must be carried inside the shed to be unloaded so that the rack can be used again. An average of 70 doors are received each week, and this process of unloading is very time-consuming. This leads to disorganization which leads to longer staging times. In return, sales per man hour and profit are decreased.

The arrangement of the doors poses another problem. The doors share a shed with the sheetrock that IBM keeps in stock, so the doors take up one-half while the sheetrock takes up the other half. There is limited space for the large number of doors that are kept, causing bad organization which leads to longer staging times. The process of unloading the doors only worsens this. Workers sometimes rush to unload the doors off the racks which results in disorganization and even damage to the product.

The project design team investigated the possibility of the installation of a loading dock on the east side of the shed to ensure the safety of employees and to increase unloading efficiency in terms of time. No employee would have to be lifted off the ground because of the rack already being ground-level with the trailer. In addition, unloading times would decrease due to the decrease in movements and distance traveled. The time saved is expected to be utilized to rearrange the doors in the storage facility. In Figure 1, the black line indicates the existing route trucks must take to back up to the shed for the loading process to begin. The red line indicates the proposed route that trucks will use once the loading dock is installed. This new route is a key part of cutting down time and increasing the efficiency of unloading the doors safely and effectively.

Figure 1: Overview of Existing and Proposed Delivery Truck Route

1.2 Problem Statement

Currently, two employees oversee the unloading process; one employee is the forklift operator and the other is in the door rack. The forklift operator must first lift a four-by-eight-foot rack into the air [see Figure 2]. Although the rack sits comfortably on the forks of the forklift, it is six feet off the ground. The rack is not constrained to the forklift and can move freely at any given time. The second employee is inside the rack unloading the doors. The potential capacity for a rack is 16-17 doors and each one is loaded into the rack by the second employee without a harness. Although the inside of the truck is blocked in, the rack still has the potential to turn over with too much weight on one side.

Figure 2: Current method for unloading doors.

Figure 3: Current organization of doors

After the doors are unloaded, the rack is carried inside a shed to be unloaded once again. The reason for this is that many doors are brought in each week and many of the remaining racks still have doors occupying them from the week before [see Figure 3]. Unloading the racks for a second time increases the time unloading the truck while also putting a pause on another employee using the forklift for gathering deliveries. The current process of unloading puts the safety of whoever is in the rack at risk while also taking up much time.

1.2 Objectives
Hence, the goal of this project is to increase the efficiency in terms of productive time of the unloading facility while ensuring employees' safety. To achieve this goal, the following objectives had to be met.

a) To study the current safety issues and to ensure a safe work environment for the employees.
b) To perform a motion and time study for the unloading of doors.
c) To increase unloading efficiency in terms of time.
d) To rearrange the doors in the storage facility.
e) To verify the effectiveness and efficiency of installation for a new loading dock.

2. Literature Review
In this section, several literature reviews were chosen and summarized to directly relate to the principles the team is attempting to solve in the industry. As a part of the literature review, the team collected several relevant journal and conference articles. This article illustrates some safety rules and Motion and Time Study Principles.

2.1 Safety rules
Ryan and Ryan (2006) state that the National Institute for Occupational Safety and Health (NIOSH) found that 100 fatalities occurred in 1997 due to forklifts (p. 22). In addition, the number of people seriously injured was 20,000. To provide a broader spectrum, the National Traumatic Occupational Fatalities (NTOF) Surveillance System found that there were 1,021 forklift-related fatalities between 1980 and 1994. These fatalities were further divided by accident type, with the main four being forklift overturn with 22%, pedestrians hit by forklift with 20%, persons crushed by forklift with 16%, and persons who fell from forklift with 9%. Roll-over accidents happen when a lift is unbalanced and is affected by another force such as an impact or a shift in weight (Ryan & Ryan, 2006, p. 22). Falls from a loading dock, turning too sharply, and carrying loads with unevenly distributed weights are other reasons overturns can occur. These roll-over accidents are the leading cause of forklift-related fatalities. This is usually the result of no overhead rollover protection or unused seatbelts. Another prominent cause of forklift-related fatalities is falls from a forklift, which accounted for 9% of fatalities from 1980 to 1994. This means that around 92 deaths resulted from falling. According to Ryan & Ryan (2006), "the forklifts that people fall from often have no sort of personnel platform" (p. 25). There are certain guidelines presented by OSHA for proper platforms and enclosures.

2.2 Motion study principles
Productivity is the ratio of output to input. In addition to this, productivity can be defined in other ways. According to Rajiwate, *et al.* (2020), productivity is the mentality of progress. Engineers, economists, and accountants all may have their definitions and interpretations, but they all boil down to about the same thing. Factors that affect productivity can be divided into two categories: controllable and uncontrollable factors. Controllable factors are what can be influenced to improve productivity. Motion and time studies can be used to determine the proper methods of approach to improve productivity. Motion studies are recordings and analyses of the current ways of doing work. Industrial Engineers use this to develop easier and more effective ways to do the observed work. Motion studies do this by eliminating unnecessary movements. Time studies are used to establish a time to complete a certain job at a specified level of performance. A stopwatch can be used to keep track of time in these studies. Motion studies help with determining the time that each job must be completed.

2.3 Loading dock safety evaluation tool
In 2007, Bourbonniere, *et al.* conducted a study with the main objective to develop and validate a safety evaluation tool regarding loading dock truck restraint measures. "This tool should allow for precise evaluations, offering valid results while using different types of systems in a variety of contexts" Bourbonniere, *et al.* (2007). In the first stages, they had to become familiar with the different measures that were currently in use by industries and gather pertinent information for analysis. They were allowed four exploratory visits which allowed them to complete five analytical charts that were used to collect data. The charts were used to gather information about the sizes, types of activity, etc. that took place in each facility they visited.

The tool was designed to evaluate safety levels at loading docks to suggest new means of improving safety to the evaluator and provided the evaluator with information about the various restraints to draw up the best picture of a given situation from a safety point of view. The tool was tested during the evaluation of 12 installations in the visited establishments. These tests were chosen for their differences in terms of loading and unloading activities to get an idea of how the tool could help in different situations at different facilities. This tool is based on a detailed analysis of the safety awarded by different types of measures.

2.4 Warehouse process optimization

In 2022, Bajor, *et al.* constructed a paper that presents a comparative analysis of warehouse processes on selected case studies of three companies. The purpose of this was to show the differences and similarities in bottlenecks and the processing times between warehouses. "This research has two goals: the identification and optimization of critical factors that affect the execution of quality and speed in the warehouse processes and prove that by combining simple methods and tools without complex algorithms, a significant level of warehouse processes optimization can be achieved, thus increasing efficiency" (Bajor, *et al.*, 2022, p. 217). Each measurable process can be optimized by different approaches and methods. This paper introduces the implementation of optimization methodology on warehouse processes of three companies. They broke the process down into several phases and gathered the data needed from each company. Once the data was collected, they began the process of determining the best methodology for each company and compared how some of the same concepts could be implemented into more than one company. The research was only limited because the test was not conducted in the same periods at each company, and they limited the observation and test to only three companies. They plan to expand the research in the future by adding other types of warehouses, breaking down the main warehouse processes into activities, and introducing augmented reality technologies to improve warehouse processes.

3. Methods

3.1 Time study

A time study is the study of each of the steps in an operational or production procedure and the time consumed by them. After data analysis, strategies can be devised to increase the efficiency and productivity of the system at work. The goal of the time study conducted in this project was to collect data that could be used to help increase efficiency. For this time study, team members observed and recorded data based on the unloading of doors at the company. What time the truck arrived, the number of doors each truck was carrying, and the average time it was to unload a single door that week were the data observed and used in Equations 1 and 2 below to record the data for ten weeks.

This subsection presents the mathematical equations which are used while conducting the time study and evaluating the standard time, the observed time, and the normal time. Here the Observed Time (OT) indicates the recorded average time from the stopwatch for unloading a single door. Normal Time (NT) is the time it takes a well-trained worker working at a normal pace to complete a task without any delays. Standard Time (ST) is the time taken by the worker to complete the work while dealing with unavoidable delays. An unavoidable delay, for example, could be the forklift operator getting called off to help with another project and the doors not being moved after the rack is completely loaded. Rating factors (R) and allowance factors (A) must be taken into consideration when developing a case study. The rating factor is when the analyst compares the data recorded from the operator's speed with the speed of a well-trained operator working at a normal pace. The allowance factor can be described as the extra time figures that are added to the basic time of the operation. Allowance factors can be thought of as temperature, wind speed, forecast for rain, how much sleep the unloader got the night before, soreness, etc. Below are the equations used to find NT and ST.

$$NT = R \times OT \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots . Eq. (1)$$
$$ST = NT \times (1 + A) \dots\dots\dots\dots\dots\dots\dots\dots\dots .. Eq. (2)$$

For the data collection, the team analyzed the time it took to unload the total number of doors each week. While conducting the time study, a timer was used and started as soon as the rack is first pulled up to the truck and stopped when the last door or rack is placed in the shed. The group used this data to find the OT from the unloading system. Time Study principles and methods were then used to calculate the NT and ST from the data obtained through the study. The R-value was obtained using the Westinghouse System, which involved team members rating IBM workers in four categories: skill, effort, system condition, and system consistency. These values were used to find an average that was used in the analysis. Similarly, the recommendation by the International Labor Office (ILO) was used to obtain the value of allowance factor, A.

For this project, the team used the Simio modeling and simulation software to construct an identical simulation model of the proposed loading dock. First, the doors received from the supplier were categorized into four groups consisting of interior singles, interior doubles, exterior singles, and exterior doubles. The team then found how many seconds it took to carry each door 20 feet. This was done to get the speed of a worker while carrying each type of door in feet per second. Three workers were involved in this study. Interior singles and exterior singles were carried by one worker, while interior doubles and exterior doubles were carried by two workers. These times were used in the simulation to get accurate times for unloading and can be found in Table 1. The last item needed for the simulation was a design for the arrangement of doors inside the shed. AutoCAD was used to create a 2D model of the storage facility which was then imported into Simio. This model is shown in Figure 4, with IS representing interior singles, ID representing interior doubles, ES representing exterior singles, and ED representing exterior doubles.

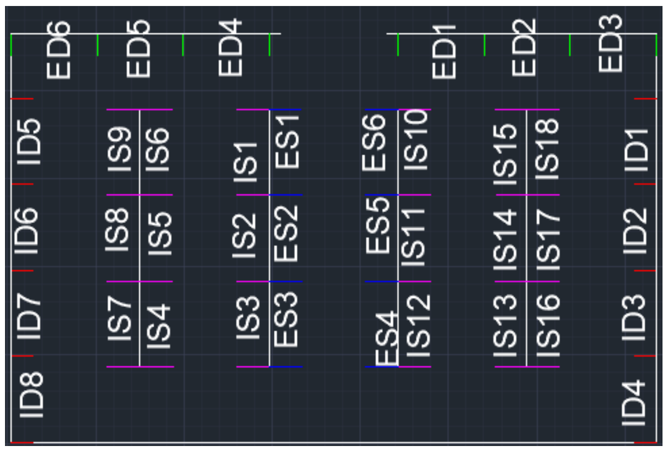

Figure 4: 2D Model of Door Arrangement

The cost for this installment is quoted as $15,638.66 by a construction contractor. Analysis of observed times from the Time Study and simulated times from Simio allowed the team to evaluate the construction of the dock from an economical perspective. Methods from Engineering Economics were used to calculate the Payback Period (PBP) and Internal Rate of Return (IRR) of the proposed loading dock.

The data gathered for this experiment was the total time it took to unload the doors each week and the total number that was received. This data has been broken down further into the average number of doors each week, the average unloading time, and the average time for unloading one door. The data for this experiment was collected every Tuesday at the arrival of the supply truck at 8:00 a.m. The time it takes to unload the truck each week varies based on the number of doors that are on the truck. Unloading takes one person to operate the forklift and another employee inside the truck to place the doors into the rack. The person that operates the forklift uses a stopwatch and starts the time as soon as the rack is pulled up to the truck and stops the timer when the last rack or door is placed in the shed. Following assumptions are made during the data collection.

- The correct resources will be provided.
- Cheap labor will be available during the winter and rainy seasons.
- All team members have the required skills.
- All equipment used will be in good condition.
- The contractor will provide services and equipment promptly.

The physical location of the dock plays an important role in the installation. Since the dock will be installed next to the housing projects, the team will need to make sure no water or electrical lines run underneath the shed where the dock will be placed. Since there are also materials beside the shed, the team will need to find an alternate solution for placing the materials in the yard.

4. Data Collection

In this section, the team gathered data for 10 weeks for unloading the doors. Table 1 includes the number of weeks, the number of doors each week, unloading time in minutes, and the average number of doors unloaded per minute each week. The table also includes the total number of doors received and the total time it took in the 10 weeks the data was collected. The total average number of doors unloaded per minute is located at the bottom of the table.

Table 1. Unloading Time

Weeks	Number of Doors	Unloading Time in Minutes	Time in Minute per door (OT)
Week 1	23	25	1.09
Week 2	32	50	1.56
Week 3	46	63	1.37
Week 4	51	56	1.10
Week 5	22	32	1.50
Week 6	101	94	0.93
Week 7	70	105	1.50
Week 8	26	31	1.19
Week 9	80	115	1.44
Week 10	72	88	1.22
Total	523	659	
Average	52.3/week		**1.26**

Next, the NT and ST were found using the OT from the data set in Table 1. The value of R has been set to 1.03, and the value of A has been set to 0.25. These values were found using the Westinghouse System and the International Labor Office chart of Recommended Allowances. All in all, the average ST was found to be 1.65 minutes. The average number of doors in each shipment is 52.3/week, which translates to 86.3 minutes of standard time required for unloading a track of doors in each shipment.

5. Results and Discussion

The team used Westinghouse System (Freivalds and Niebel, 2014) method to calculate the rating factor (R). Three team members did this subjective evaluation independently and then the average value was considered to get the value of the rating factor. Table 2 shows this evaluation result and in summary, the value of R becomes 1.05.

Table 2: Survey results for calculating rating factor (R) in Westinghouse System

Team member	**Skill**	**Effort**	**System Condition**	**Consistency**	**Total**
1	+0.07	0.02	-0.03	+0.01	+0.05
2	+0.06	0	-0.03	+0.03	+0.06
3	+0.05	0	-0.02	+0.01	+0.04
				Average	**+0.05**

According to the International Labor Office (ILO), the suggested allowance is calculated based on, a constant personal allowance of 5%, a constant basic fatigue allowance of 4%, a variable allowance for standing posture of 2%, for using of force or muscular energy, 11% (assuming estimated weight of a door 45lb), and a rest allowance (RA) factor for atmospheric conditions (heat and humidity) calculated using Eq. 3.

$$RA = e^{(-41.5+0.0161\times W+0.497\times \text{WBGT})} \ldots\ldots \text{ Eq. (3)}$$

where w = working energy expenditure (kcal/h) = 300 kcal/h (estimated), and Wet Bulb Globe Temperature (WBGT) is found from the National Weather Service 76°F, for the Natchitoches, Louisiana region; thus $RA = e^{(-41.5+0.0161\times 300+0.497\times 76)} = 3\%$. Hence the total allowance becomes (5+4+2+11+3) = 25% or A = 0.25.

The team then used Simio simulation software to predict times by building a model of the loading dock. This allowed the team to create what-if scenarios that gave plausible numbers without implementing the dock physically. First, an average walking speed had to be found with each category of doors (Table 3).

Table 3. Average Time to Carry Doors 20 Feet

Category	Time (s)						Average Time (s)
Single Interior	6.7	7.2	6.9	7.2	8.2	7.9	7.3
Double Interior	8.9	9.2	8.1	7.8	9.2	8.1	8.5
Single Exterior	7.5	7.7	8.3	7.4	8.7	8.9	8.1
Double Exterior	9.1	9.2	9.5	8	8.6	9.1	8.9

Next, the percentage of each door category in terms of total doors was found. A sample of purchase orders was analyzed to get the percentages in Table 4. A 2D model, represented by Figure 4, was created showing the proposed arrangement of the doors inside the shed. This was uploaded into Simio to get the 3D model depicted in Figure 5.

Table 4. Percentage of Each Door Category

Category	Quantity	Percentage
Interior Single	211	**63%**
Interior Double	25	**7%**
Exterior Single	69	**20%**
Exterior Double	32	**9%**
Total	**337**	

Figure 5: Simio Model of Proposed Door Layout in Shed

After running 250 simulations, the software predicted an average time of 34.86 minutes, which is approximately 51.44 minutes less than the average time of the current unloading process. The number of doors on the truck was represented with a triangular distribution with 23 as the minimum, 54 as the average, and 107 as the maximum. Currently, the standard time it takes to unload the doors from each truck is 86.3 minutes. Both employees responsible for this task make \$20/hour. If we multiply this rate by the 86.3 minutes ($20 \times \frac{86.3}{60}$), we get \$28.77. This means that those two employees are being paid an average of \$57.53 each week to unload the truck. The simulation showed that approximately 51.44 minutes would be saved during each unloading process. A similar calculation like the one above is used to see how much the employees will get paid with a loading dock installed (predicted average unloading time of 34.86 minutes from the Simio simulation). It goes as this: $20 \times \frac{30.86}{60} = 10.29$. This means that the employees will be paid $20.57 each week to unload the truck. By subtracting this value from the one previously obtained (57.53-20.57), the team learned that the loading dock will save $36.96 each week by cutting off time.

For the current process of unloading doors to work, another employee must give up his forklift to the two employees that are unloading doors. He is sitting idle for the entirety of the unloading process because of this. He makes $15/hour, but the loading dock will not result in him giving up his forklift. This will save another $\frac{\$15 \times 86.3\ min}{60\ min}$ = $21.58 per visit from the door truck. By adding the money saved by reducing the time it takes to unload each truck and the money saved from the employee not giving up a forklift the team concluded that the loading dock will save ($36.96+$21.58) = $58.54 per visit. To get the amount saved annually, this value can be multiplied by 52 weeks to get an annual savings of $3,044.

Table 5. Payback Period (PBP) and Net Present Value with an Interest Rate of 7%

Time (year)	Cashflow/ prospective savings	Present Value (PV)	The cumulative sum of PV
0	-$15,638.66	-$15,638.66	-$15,638.66
1	3,251.38	$3,038.67	-$12,599.99
2	3,251.38	$2,839.88	-$9,760.11
3	3,251.38	$2,654.09	-$7,106.01
4	3,251.38	$2,480.46	-$4,625.55
5	3,251.38	$2,318.19	-$2,307.36
6	**3,251.38**	**$2,166.53**	**-$140.83**
7	3,251.38	$2,024.80	$1,883.97
8	3,251.38	$1,892.33	$3,776.30
9	3,251.38	$1,768.54	$5,544.84
10	3,251.38	$1,652.84	$7,197.67
11	3,251.38	$1,544.71	$8,742.38
12	3,251.38	$1,443.65	$10,186.03
13	3,251.38	$1,349.21	$11,535.24
14	3,251.38	$1,260.94	$12,796.18
15	3,251.38	$1,178.45	$13,974.63
16	3,251.38	$1,101.35	$15,075.98
17	3,251.38	$1,029.30	$16,105.29
18	3,251.38	$961.97	$17,067.25
19	3,251.38	$899.03	$17,966.29
20	3,251.38	$840.22	$18,806.51
21	3,251.38	$785.25	$19,591.76
22	3,251.38	$733.88	$20,325.64
23	3,251.38	$685.87	$21,011.50
24	3,251.38	$641.00	$21,652.50
25	3,251.38	$599.06	$22,251.57
26	3,251.38	$559.87	$22,811.44
27	3,251.38	$523.25	$23,334.69
28	3,251.38	$489.01	$23,823.70
29	3,251.38	$457.02	$24,280.72
30	3,251.38	$427.12	$24,707.85
	Net Present Value	**$24,707.85**	

Additional savings come from the fact that a forklift will not be used in the new process, so the risk of forklift injury dissipates. According to the Bureau of Labor Statistics, U.S. Department of Labor, the most common forklift injuries are fractures, which accounted for 29% of injuries in 2020. The average settlement for a fracture is $59,253 [Reichard, 2023]. One goal for the loading dock is for it to pay itself off within 30 years. About 0.7 injuries occur for every 10,000 workers. There are on average 50 employees in this organization. By dividing 50 by 10,000 and then multiplying by 0.7, the team discovered that .0035 probable injuries. The team then multiplied this by the average settlement amount for a fracture and gets the estimated injury cost $207.38/year. This value is added to the $3,044 found earlier to get a yearly savings rate of $3,251.38. The initial investment of the dock is $15,638.66 (as per the quote from the construction contractor). After analysis, the Pay Back Period (PBP) is found to be between 6 years with a 7% interest rate, as seen in Table 5.

In addition, the Internal Rate of Return (IRR) is found to be 15.97%, which is greater than the average interest rate of 7%. The Net Present Value (NPV) for this 30-yearlong project is found to be $24,707.85 [refer to Table 5], and the Benefit-Cost Ratio (BCR) is calculated as, $\frac{\text{PV of Benefit Expected from the Project}}{\text{PV of the Cost of the Project}} = \frac{\$40,346.51}{\$15,638.66} = 2.56$, which is greater than 1. All of these economic analyses indicate that the installation of a loading dock at the facility will eventually bring financial benefits in the long run.

6. Conclusion

For this project, the team analyzed the system for unloading doors from the supplier. It is clear from touring the yard that the unloading system is a hazard to the safety and has proven to be inefficient in production and organization. The team conducted a time study for 10 weeks that analyzed the unloading times, and the number of doors received each week. The number of doors and time each week varied, but the team broke down the data even further to the average time it takes to unload one door. This data concluded that the unloading system was very inefficient and can be improved. The group proposed the installation of a loading dock to increase the efficiency in terms of productive time of the unloading facility while ensuring employees' safety. A simulation model was created that predicted the loading dock would indeed be more efficient. Lastly, the Payback Period, Benefit-Cost Ratio, Net Present Value, and Internal Rate of Return for the loading dock were estimated which justifies the economic aspect of the investment for a new loading dock. The improvement of safety that the loading dock would bring plus the simulation predicting its increased efficiency justifies its construction.

A loading dock would have a tremendous impact on the facility. Safety would be the first benefit of installing a loading dock. In the current procedure for unloading the doors, safety is a big issue when it comes to this weekly task. Installing a loading dock would increase the safety of the employees. Instead of unloading the doors into a rack, the employee would now be able to come straight off the truck into the shed. This would keep the employee from wearing a harness and the doors being unloaded from the truck in a much safer manner.

Another benefit of installing a loading dock would be more time to organize. Currently, as the doors are unloaded from the truck and into the rack, the rack is either placed in a random location in the shed or the doors are unloaded onto a previous stack of doors. Many of the doors are either spread out from their order or buried from the doors that are being received. Installing a loading dock would allow the employees to find a designated spot for the incoming doors and additional space for the racks to be placed in an organized manner. This would save stagers a great amount of time looking for the doors when gathering a delivery. Organizing the doors would allow stagers to find and gather the doors into a rack in a timely manner to be sent on delivery. The third benefit of installing a loading dock would be allowing another stager to use a forklift. As of now, one forklift is used to unload the doors. This causes one stager to give up his use of a forklift. This results in a delay in gathering loads. It is a stager's job at the facility to gather the materials for deliveries for the next day. Without a forklift, a stager cannot gather materials which could result in a delay in deliveries. Installing this dock would allow the stagers to continue gathering materials, while also allowing one employee to unload the doors.

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Biographies

Matthew Lovelady Matthew Lovelady is an Inventory Manager at Interstate Building Materials in Many, Louisiana. He earned his B.S. in Industrial Engineering Technology from Northwestern State University in Natchitoches, Louisiana. For his outstanding performance in academic results, he is honored with SUMMA CUM LAUDE during the commencement. He plans to obtain his M.S. degree sometime in the years to come. While at Interstate Building Materials, Matthew is solving problems with inventory using updated forecasts and lot sizes. He plans to continue research using his current position as Inventory Manager to develop improved processes of inventory management.

Nickolas Tramel earned his Bachelor of Science degree in Industrial Engineering Technology from Northwestern State University (NSU) in Spring 2023. For his outstanding performance in academic results, he is honored with MAGNA CUM LAUDE during the commencement. He worked part-time at Interstate Building Materials for three years. Interstate Building Materials was the inspiration behind the installation of the loading dock to improve the safety, productivity, and efficiency of the company. Nickolas' career plan includes moving to South Louisiana to pursue a career in construction as a project manager.

Tanner Funderburk earned his Bachelor of Science in Industrial Engineering Technology from Northwestern State University in Spring 2023. He is currently working in an entry-level position for Weyerhaeuser in Zwolle, LA. He strives to grow in his career with experience and knowledge and move into a process control engineer or a supervisor position.

Dr. Md. Shahriar J. Hossain is currently serving as the Interim Department Head and Assistant Professor in the Department of Engineering Technology at the Northwestern State University of Louisiana. He completed my Ph.D., and M.S. in Industrial Engineering from Louisiana State University. He has more than 14 years of academic research/teaching experience including 10 years of active teaching in industrial, and manufacturing engineering. He is a FANUC certified CERT (Level I & II) instructor. He served as a camp director for NSU/LA GEARUP Programs from 2019 to 2021. His research and teaching interests are mostly in the industrial engineering area including manufacturing systems, and supply chain optimization. He published more than 30 journal and conference articles. His research works were recognized by many national and international organizations through awards including IISE, AAER and IEOM.

Dr. Nabin Sapkota is an accomplished academic with expertise in industrial engineering. He earned his M.S. and Ph.D. degrees in industrial engineering from the University of Central Florida, USA, in 2003 and 2006, respectively. Currently serving as an Associate Professor at the Department of Engineering Technology, Northwestern State University of Louisiana. His research interests encompass a wide range of areas, including the application of soft computing and nonlinear dynamics, advanced statistics, optimization problem generation, ergonomics, and digital simulation. With extensive experience in simulating industrial systems, implementing lean systems, and ISO 9000 quality systems, he possesses expertise in areas such as conducting Business Process Reengineering, optimization, and quality engineering. His current research focuses on soft computing, predicting nonlinear dynamical systems, optimization problem generation, and applying statistical techniques.