



# MOTION AND TIME STUDY FOR INCREASING TIME EFFICIENCY, PRODUCTIVITY, AND SAFETY FOR THE UNLOADING FACILITY

Matthew Lovelady, Nickolas Tramel, Tanner Funderburk

Department of Engineering Technology, Northwestern State University, 175 Sam Sibley Dr, Natchitoches LA 71497

Faculty Advisor: Dr. Shahriar Hossain

## Company Background

Interstate Building Materials (IBM) of Many, LA, is an independent distribution company that supplies building materials throughout Louisiana. It was founded by the owner, Kyle Martinez, in September 2014.

## Abstract

For this project, the team analyzed IBM's system for unloading doors from Louisiana Millwork. The objectives of this were to enhance the safety of the workers and eliminate the inefficiency of dealing with production and organization.

## Problem Statement

The current process for unloading doors can be improved in terms of safety and efficiency.

## Goals and Objectives

The goals of this project are to increase the efficiency in terms of productive time of the unloading facility while ensuring employees' safety.

- 1) To study the current safety issues and to ensure a safe work environment for the employees.
- 2) To perform a motion and time study for the unloading of doors.
- 3) To increase unloading efficiency in terms of time.
- 4) To rearrange the doors in the storage facility.
- 5) To verify the effectiveness and efficiency of installation for a new loading dock.

## Methodology

- A time study has been used to determine how many minutes it will take to unload one door.
- SIMIO software has been used to predict times by building a model with the loading dock.

## Time Study

- The average ST was found to be **1.66 minutes**.
- Rating (R) has been set to **1.03**
- Allowance (A) has been set to **.25**.

OT	NT	ST
1.09	1.1227	1.40
1.56	1.6068	2.01
1.37	1.4111	1.76
1.1	1.133	1.42
1.5	1.545	1.93
0.93	0.9579	1.20
1.5	1.545	1.93
1.19	1.2257	1.53
1.44	1.4832	1.85
1.22	1.2566	1.57

Weeks	Number of Doors	Unloading Time in Minutes	Minute Per Door Observed Time (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
<b>Total</b>	<b>523</b>	<b>659</b>	<b>1.26</b>

## Westinghouse System

Table 10-2   Westinghouse System Skill Ratings			Table 10-3   Westinghouse System Effort Ratings		
+0.15	A1	Superskill	+0.13	A1	Excessive
+0.13	A2	Superskill	+0.12	A2	Excessive
+0.11	B1	Excellent	+0.10	B1	Excellent
+0.08	B2	Excellent	+0.08	B2	Excellent
+0.06	C1	Good	+0.05	C1	Good
+0.03	C2	Good	+0.02	C2	Good
0.00	D	Average	0.00	D	Average
-0.05	E1	Fair	-0.04	E1	Fair
-0.10	E2	Fair	-0.08	E2	Fair
-0.16	F1	Poor	-0.12	F1	Poor
-0.22	F2	Poor	-0.17	F2	Poor

Table 10-4   Westinghouse System Condition Ratings			Table 10-5   Westinghouse System Consistency Ratings		
+0.06	A	Ideal	+0.04	A	Perfect
+0.04	B	Excellent	+0.03	B	Excellent
+0.02	C	Good	+0.01	C	Good
0.00	D	Average	0.00	D	Average
-0.03	E	Fair	-0.02	E	Fair
-0.07	F	Poor	-0.04	F	Poor

## ILO Recommended Allowances

ILO = International Labor Office

- A. Constant allowances:
1. Personal allowance ..... 5
  2. Basic fatigue allowance ..... 4
- B. Variable allowances:
1. Standing allowance ..... 2
  3. Use of force, or muscular energy (lifting, pulling, or pushing):  
Weight lifted, lb: .....
  5. Atmospheric conditions (heat and humidity)—variable .....

## Current Unloading and Organization



## Engineering Economics

- Time savings equaled \$1,508 per year.
- Safety savings equaled \$210 per year.
- Total annual savings add up to \$21,718.
- The Payback Period (PBP) is approximately 11 years and 6 months.
- The Internal Rate of Return (IRR) is 10%.

Time/year (n)	Cash flow (FV)	PV	Cumulative sum
0	-15,638.66	-\$15,638.66	-\$15,638.66
1	1,718.00	\$1,651.92	-\$13,986.74
2	1,718.00	\$1,588.39	-\$12,398.35
3	1,718.00	\$1,527.30	-\$10,871.05
4	1,718.00	\$1,468.55	-\$9,402.50
5	1,718.00	\$1,412.07	-\$7,990.43
6	1,718.00	\$1,357.76	-\$6,632.67
7	1,718.00	\$1,305.54	-\$5,327.13
8	1,718.00	\$1,255.33	-\$4,071.80
9	1,718.00	\$1,207.04	-\$2,864.76
10	1,718.00	\$1,160.62	-\$1,704.14
11	1,718.00	\$1,115.98	-\$588.16
12	1,718.00	\$1,073.06	\$484.90

## Observations and Results



- 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 max.
- The predicted time was 34.86 minutes per truck with 95 % confidence.
- This was approximately 30 minutes less than the observed average and was used to calculate the time savings.

## Conclusion

- A time study was conducted to determine the average time it took to unload one door.
- A simulation was created to predict the time of unloading the doors if a dock was installed.
- By comparing actual times to simulated times and researching injury cost, the payback period and internal rate of return of the loading dock was determined to justify construction from an economical perspective.

## References

- Niebel, Andris Freivalds Benjamin. Niebel's Methods, Standards and Work Design. McGraw Hill, 2014.
- Rajiwate, A., Mirza, H., Kazi, S., & Momin, M. M. (2020). Productivity improvement by time study and motion study. *International Research Journal of Engineering and Technology*, 07(03), 5308-5311.
- "Work Safety: Forklifts." Injury Facts, 12 Jan. 2023, <https://injuryfacts.nsc.org/work/safety-topics/forklifts/>.