

# IMPROVEMENT OF CHOCOLATE PACKAGING LINE



**Industrial Engineering Department**  
**IE 5905 – Capstone Design Course Extension – SP 14**  
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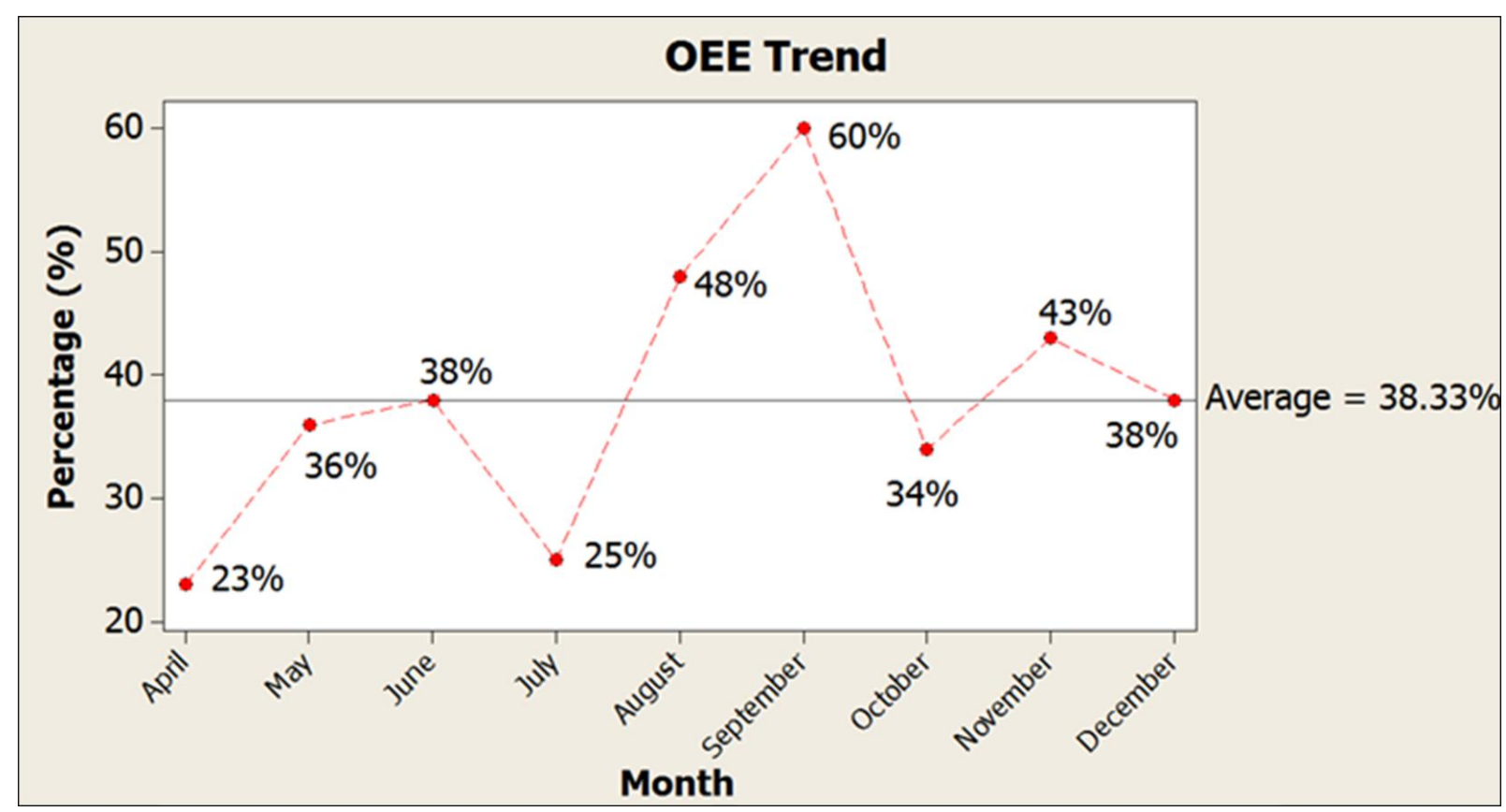
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## DEFINE

### Business Case

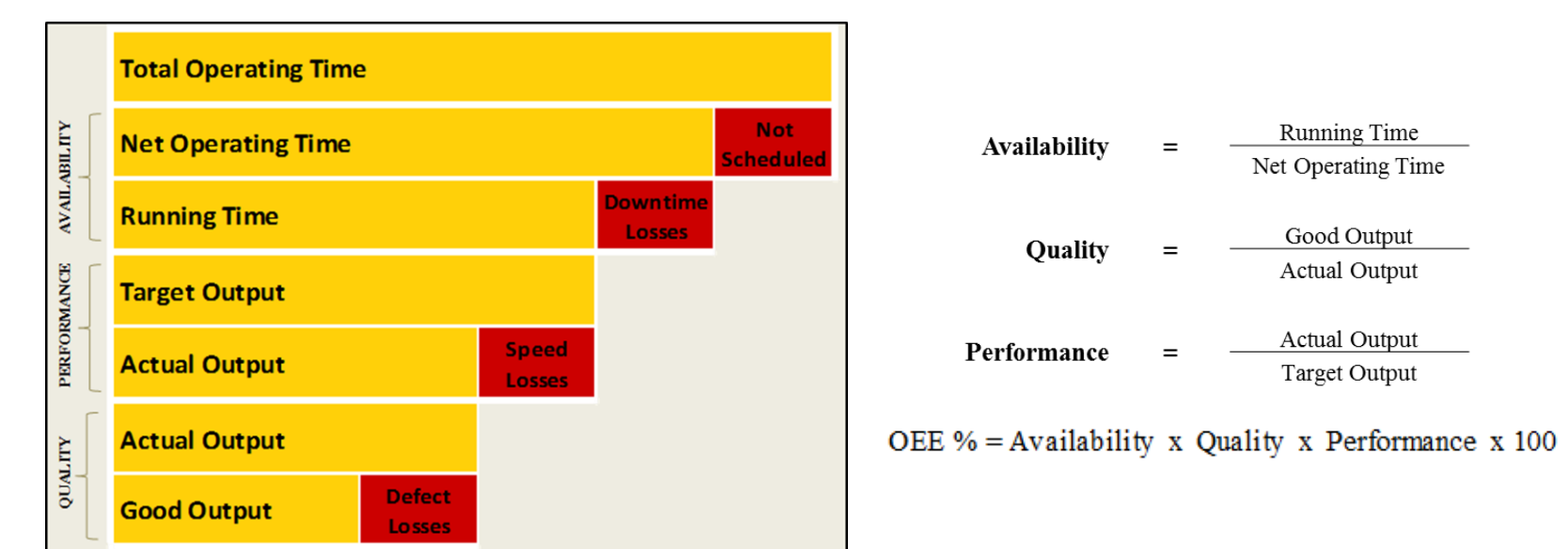
The company's chocolate packaging line is composed of primary packaging with two foil wrapper machines and secondary packaging with four or six different machines, depending on the line setup for the product that is being packed. The company has stated its concern about the chocolate packaging line not meeting the goal of achieving an Overall Equipment Effectiveness of 60%.



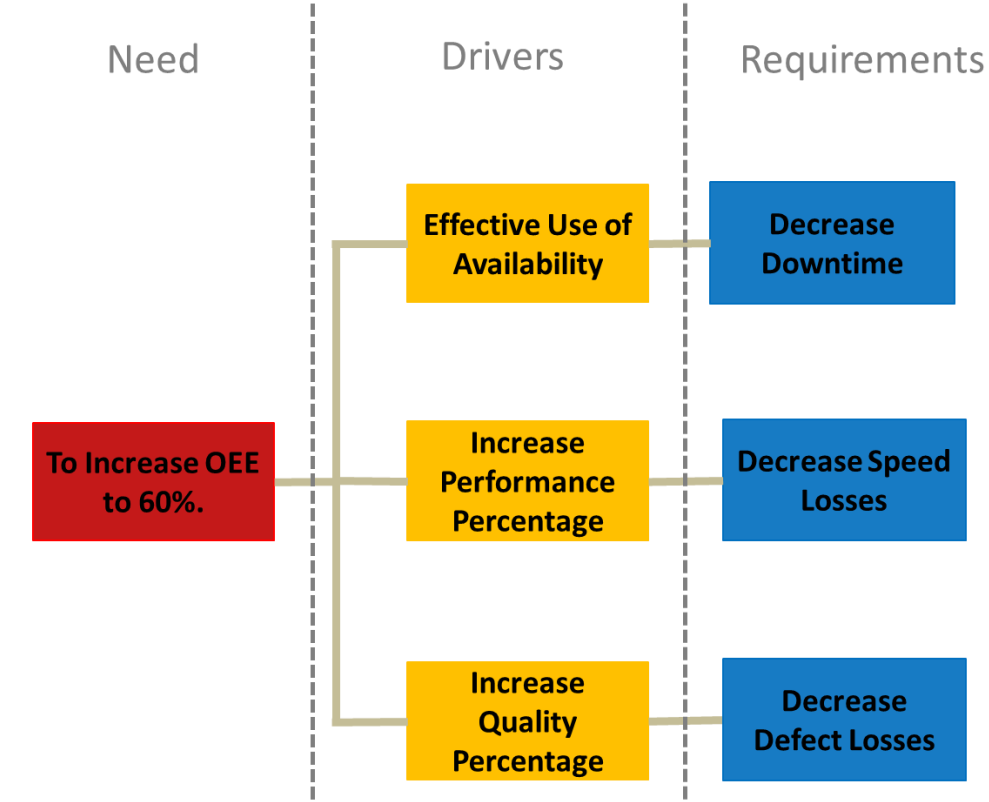
Actual Chocolate Packaging Line OEE Percentage

### Understanding OEE

OEE is a "best practices" metric that allows the identification of the planned production time percentage that is truly productive. This metric can be used to "compare the performance of a given production asset to industry standards, to similar in-house assets, or to results for different shifts working on the same asset and to track progress over time in eliminating waste from a given production asset." (Lean Production, 2013)



### CTQ Tree



### SIPOC

S	I	P	O	C
SUPPLIER	INPUT	PROCESS	OUTPUT	CUSTOMER
<ul style="list-style-type: none"> <li>Planning Dept</li> <li>Manufacturing Dept</li> <li>Warehouse</li> <li>External Suppliers</li> </ul>	<ul style="list-style-type: none"> <li>Packaging Order</li> <li>Chocolate Pieces</li> <li>Operating Personnel</li> <li>Tray</li> <li>Container Box</li> <li>Tray</li> <li>Labels</li> <li>Overwrap</li> <li>Shaper</li> <li>Choc</li> <li>Tray</li> <li>Plastic Wrap for Pallet</li> <li>Machine</li> <li>Printer</li> <li>Carriage</li> <li>Cleaning Material</li> <li>Utilities</li> </ul>	<ul style="list-style-type: none"> <li>Receiving at Chocolate Packaging Area</li> <li>Mechanic Setup (All Machines)</li> <li>Primary Packaging</li> <li>Secondary Packaging</li> <li>QA Release</li> <li>Fill Lines Daily Shift Report Sheet</li> </ul>	<ul style="list-style-type: none"> <li>Line Release</li> <li>Product Release</li> <li>Filed Consumer Box</li> <li>Daily Shift Report Sheet</li> <li>Downstream per Shift</li> <li>Scrap per Shift</li> <li>Re-work per Shift</li> <li>OEE per Shift</li> </ul>	<ul style="list-style-type: none"> <li>Quality Representative</li> <li>Analytical Laboratory</li> <li>Shipping Warehouse</li> <li>Accs</li> <li>Production Dept</li> <li>Managers</li> </ul>

## MEASURE

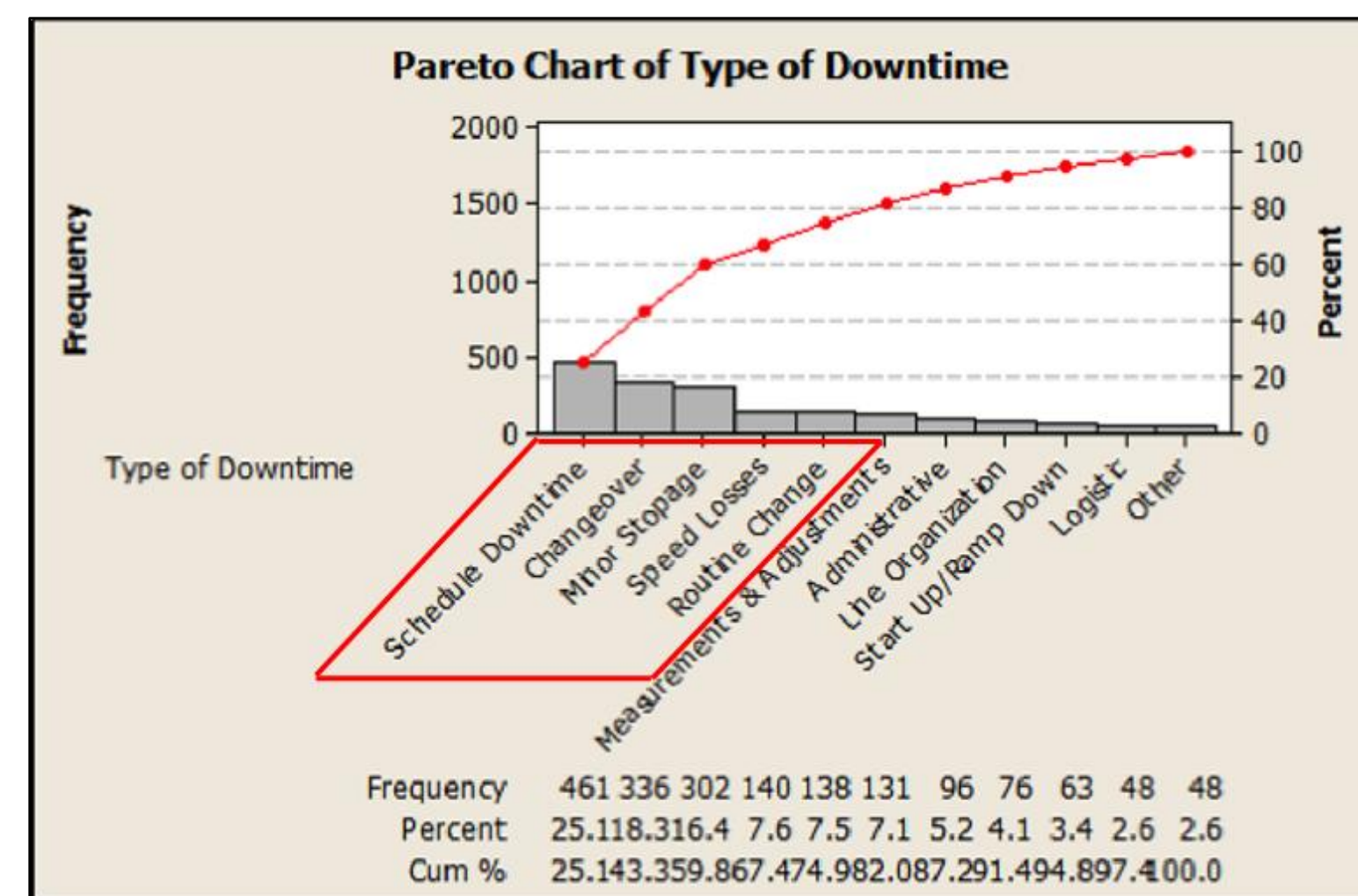
### Data Collection Plan

What	Measure type	How measured	Related conditions to record	Sampling Notes	How/where recorded
Chocolate packaging line measuring and control system	Qualitative Data	Determining if the system is a software or if the data is obtained manually and studying and understanding how the system works, also by determining if the system's users are having problems extracting information, with what frequency these problems (if any) occur, and how reliable is the information given by the system.	If the system is a software, then inputs and outputs	Data will be collected through process observation on the first observed line run, through interaction with users and/or administrators, and with data collection	A data collection sheet will be created to obtain data on how the data is being measured in the chocolate packaging line.
Triggers affecting the packaging line's current state	Major Offenders Discrete Data	Studying and analyzing the line's historical data.	<ul style="list-style-type: none"> <li>Setup Times</li> <li>Process Disturbance Times</li> <li>Breaks</li> <li>Not Scheduled Times</li> </ul>	Time it takes to collect data.	The historical data will be obtained from the company.
Actual percentages of the elements that determine the chocolate packaging line's effectiveness	Availability, Performance, and Quality Percentages - Continuous Variables	The actual percentages of the elements that determine the chocolate packaging line's effectiveness will be measured by studying and understanding the line's total operating times.	<ul style="list-style-type: none"> <li>Running Times</li> <li>Not Operating Times</li> <li>Actual Outputs</li> <li>Target Outputs</li> <li>Good Outputs</li> <li>Down-time</li> </ul>	Data will be collected from the line's historical data.	A sheet will be created to organize and analyze the line's effectiveness per shift.

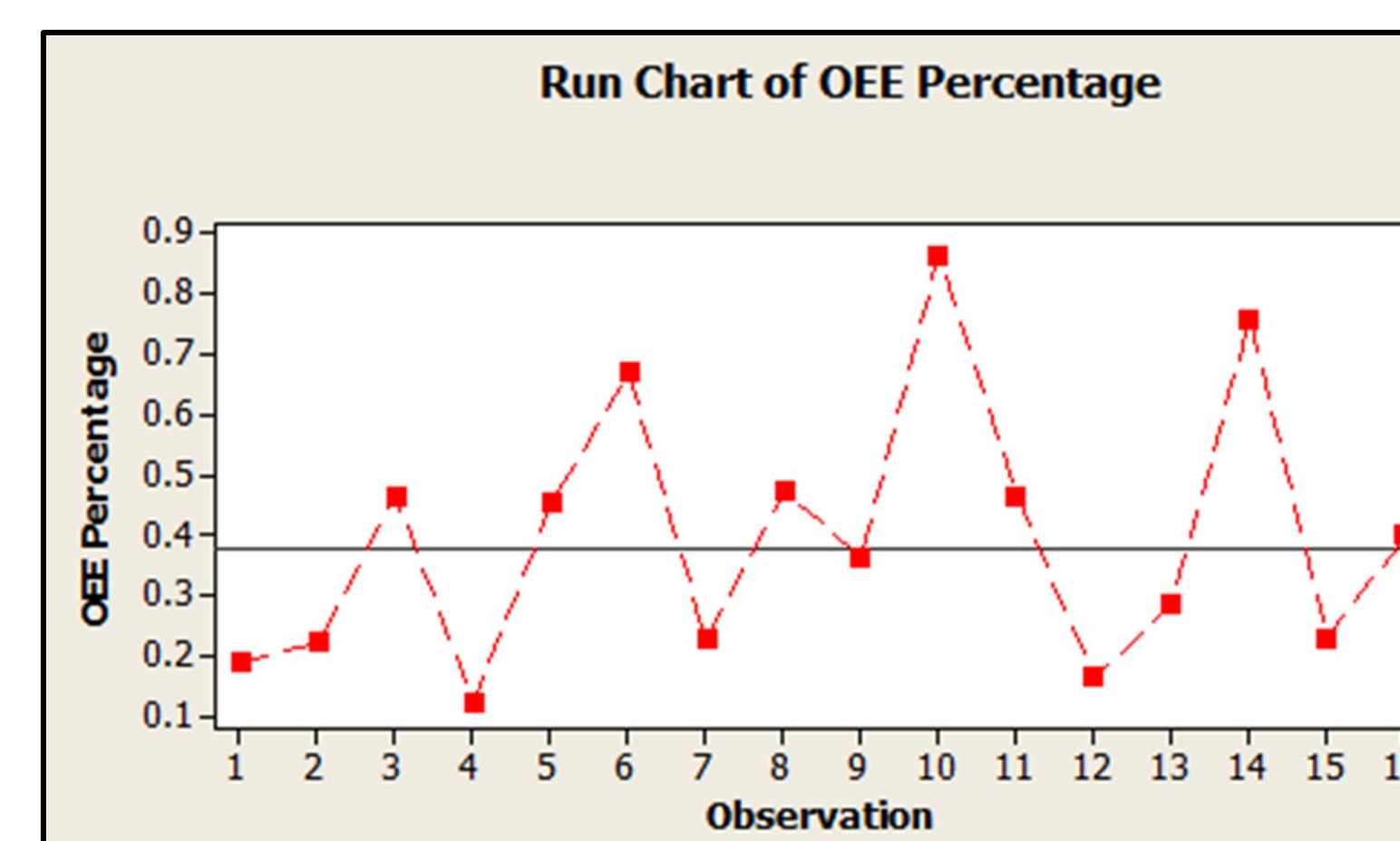
### Measuring System

- Manually collected by operator each working shift.
- Reports are passed to MS Excel for analysis
- During the data measuring process the human factor is involved in all three stages
- OEE only considers Performance Percentage

### Major Offenders

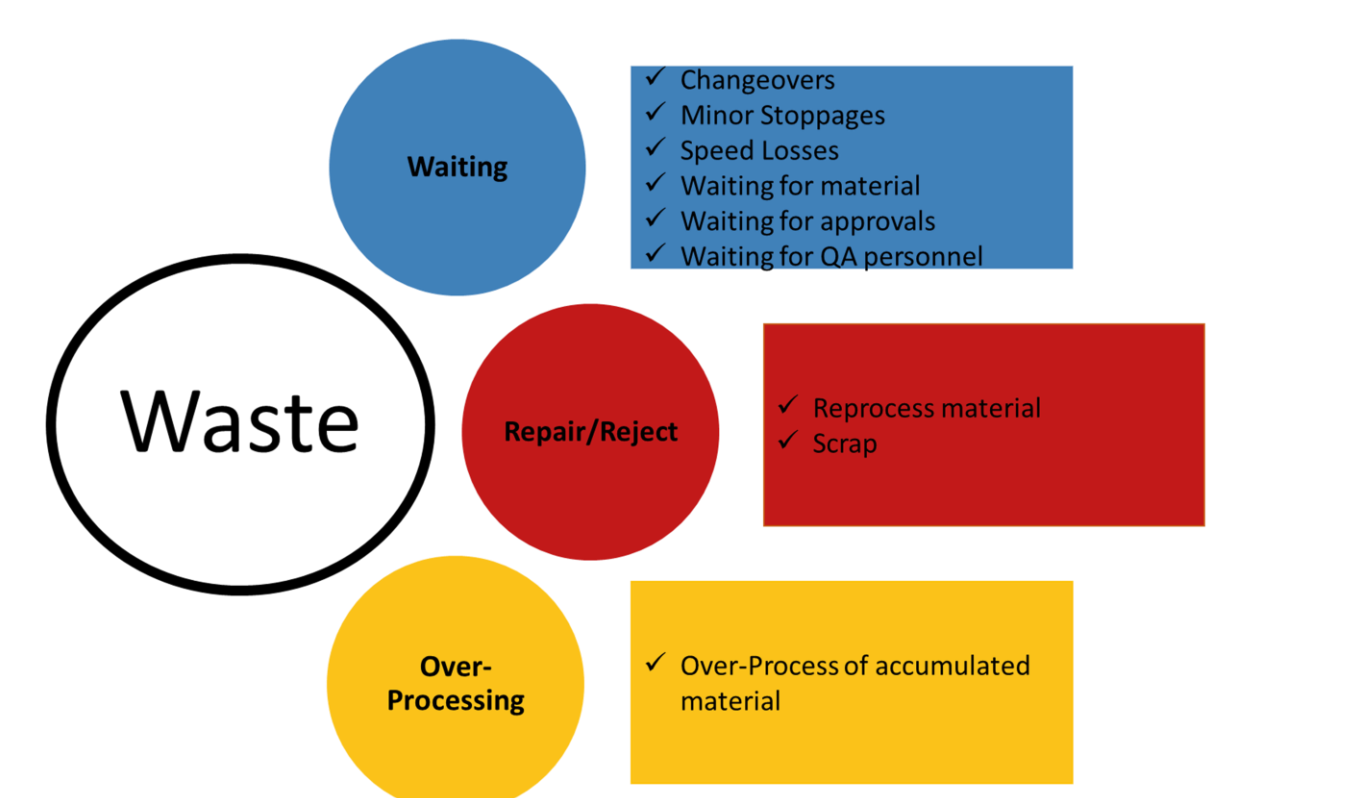


### Quick Improvement considering Availability, Quality & Performance in OEE Percentage Calculation

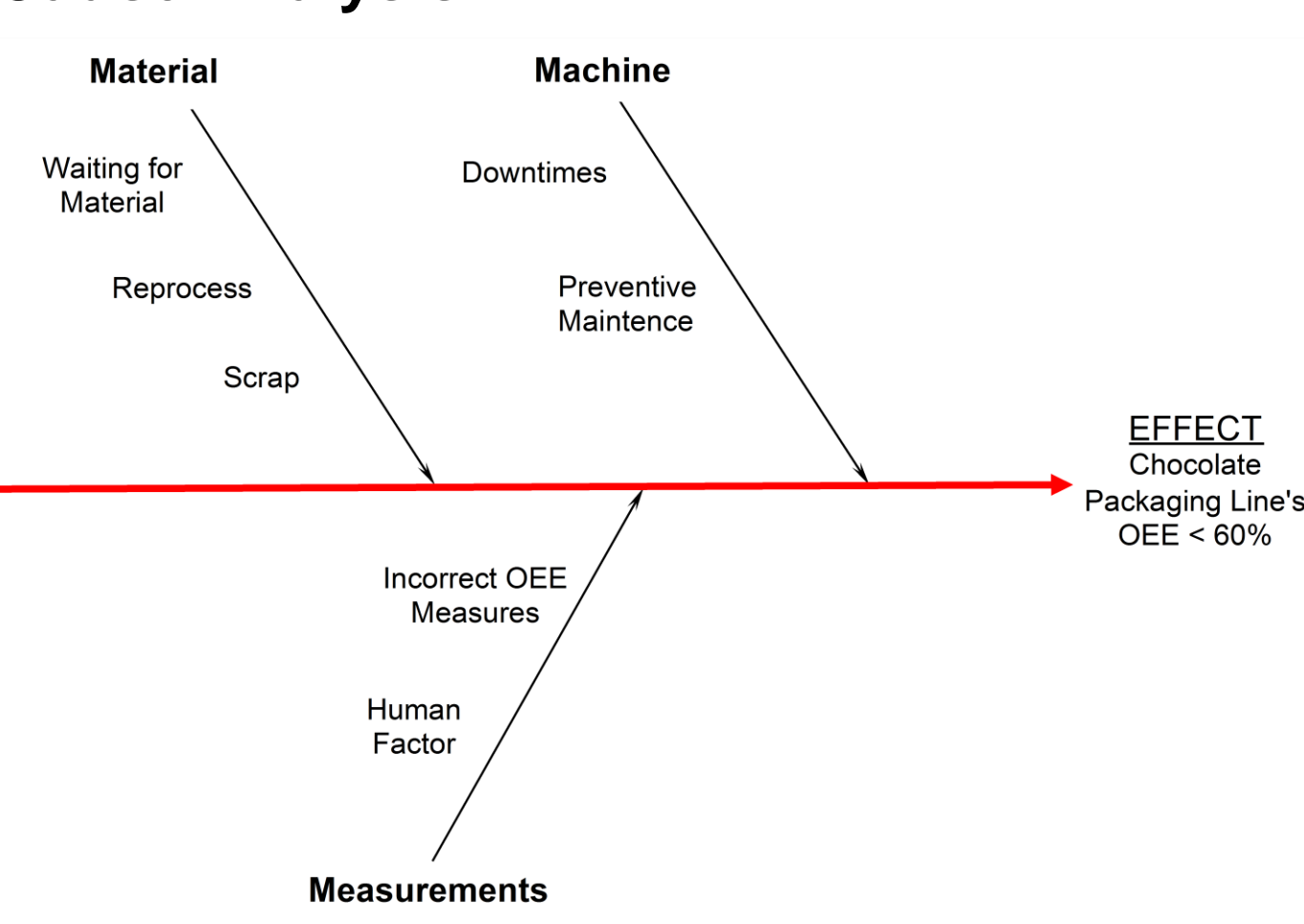


## ANALYZE

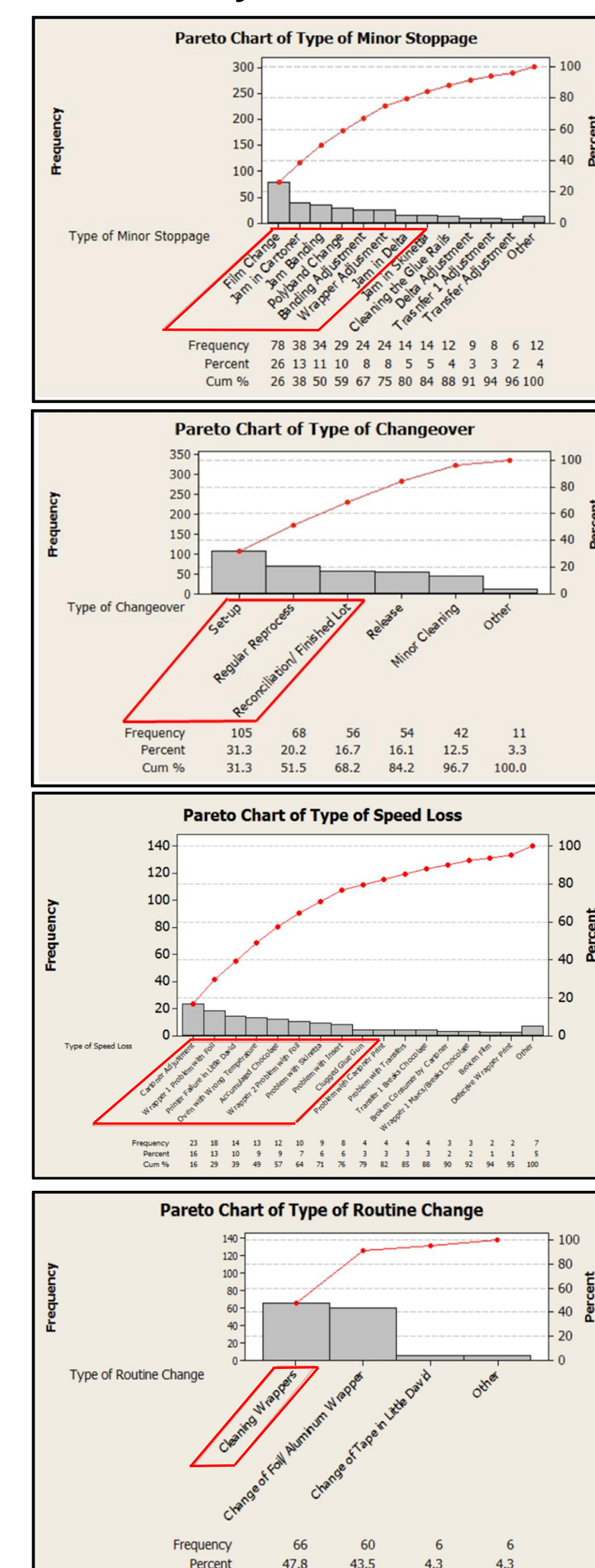
### Waste Identification



### Root Cause Analysis



### Potential Cause Analysis



## IMPROVE

### Solutions

#### Measuring System Standardization for OEE Calculation

- The system will automatically display in real time actual running time, downtime, target output, actual output, and scrap output.
- The system will calculate and display the availability, performance, and quality, along with the OEE percentage.

Category	Current (Manual OEE Measuring System)	After (Automated OEE Measuring System)	Comments
Time to Register Events per Shift	20 minutes	0 minutes	The trend in this category is positive.
Time for Developing Report per Shift	30 minutes	0 minutes	The trend in this category is positive.
Time for Analyzing Data per Shift	30 minutes	0 minutes	The trend in this category is positive.
<b>Total Worked Time per Shift</b>	<b>80 minutes</b>	<b>0 minutes</b>	<b>The trend in this category is positive.</b>
Number of Employees Required for Registering Events per Shift	1 employee	0 employees	The trend in this category is positive.
Number of Employees Required for Developing Report per Shift	1 employee	0 employees	The trend in this category is positive.
Number of Employees Required for Analyzing Data per Shift	1 employee	0 employees	The trend in this category is positive.
<b>Total Worked Time by All Employees per Day</b>	<b>3 employees</b>	<b>0 employees</b>	<b>The trend in this category is positive.</b>
<b>Total Worked Time by All Employees per Day</b>	<b>80 minutes</b>	<b>0 minutes</b>	<b>The trend in this category is positive.</b>
Number of Shifts per Day	2 shifts	2 shifts	There is no trend change.
<b>Total Worked Time by All Employees per Day</b>	<b>160 minutes (2.67 hours)</b>	<b>0 minutes</b>	<b>The trend in this category is positive.</b>
Paid Salary per Hour	\$15.00	\$15.00	There is no trend change.
Paid Salary per Day	\$40.05	\$0.00	The trend in this category is positive.
Total Work Days per Year	354 days	354 days	There is no trend change.
<b>Total Paid Salaries per Year</b>	<b>\$54,177.78</b>	<b>\$0.00</b>	<b>The trend in this category is positive.</b>

Before and After Financial Analysis

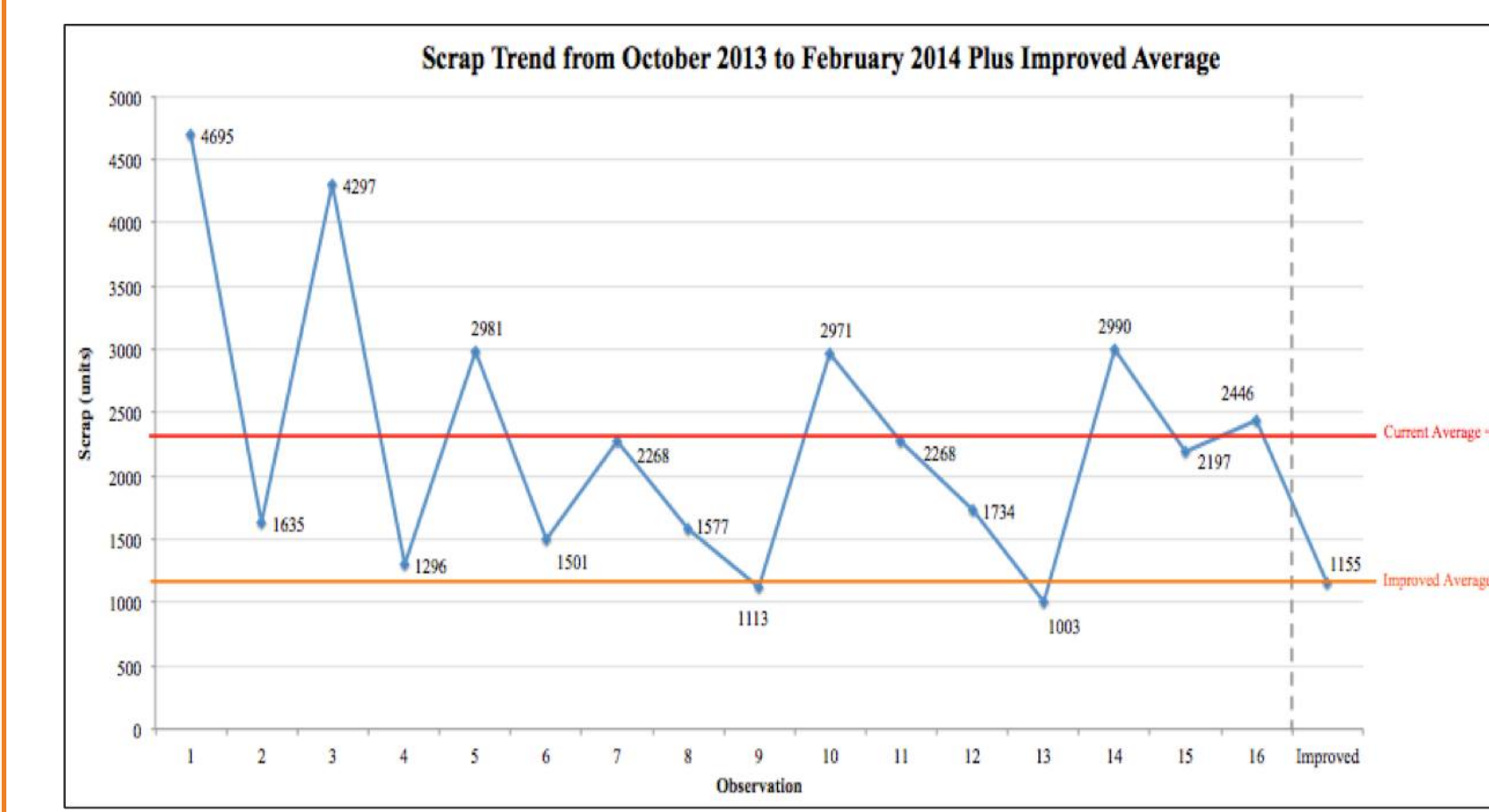
### Zero Quality Control System – Poka-Yoke Mechanism

- Sensors will detect nonstandard conditions before the products turn into defects.
- Sensors be implemented in the Film Wrapping Delta, Lantech Heat Tunnel, and Skinetta machines.

#### Chocolate Packaging Line: Zero Quality Control (ZQC) System

Before (No ZQC System)	Total Scrap	Cost per Unit	Total Cost
Date Range: October 2013 - February 2014	36,972 units	\$1.20 per unit	\$44,366.40
Average per Month	7,394.4 units	\$1.20 per unit	\$8,873.28
<b>After (50% Assumed Improvement)</b>	<b>Total Scrap</b>	<b>Cost per Unit</b>	<b>Total Cost</b>
Average per Month	3,697.2 units	\$1.20 per unit	\$4,436.64
<b>Average Savings per year (assuming a 50% improvement) – \$55,234.40</b>			

Before and After Financial Analysis



Before and After Scrap Trend

### Autonomous Maintenance

- Cleaning and lubricating the Wrapper machines
- Ink and glue maintenance in the Wrapper, Jones, and Little David machines
- Include any other areas in the chocolate packaging line in these types of maintenance.

#### Autonomous Maintenance Benefits:

- Maintain actual operational conditions by detecting irregularities, flaws, defects, and/or anomalies before they turn into losses
- Allows an operator to clean and maintain and even assist a mechanic in the repairing of machinery.

## CONTROL

### Control Phase Steps

- Revise the Standard Operating Procedures (SOPs).
- Launch implementation starting with Pilot Testing.
- Monitor implementation to make additional improvements if necessary.
- Develop a Control Plan.
- Audit the results in order to confirm the improvements.
- Communicate project's methods and results to others in the organization.
- Several months later, validate the performance and financial results.

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