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Abstract

For the last 20 years, the manufacturing industry company has been revolutionized with process improvements, many methodologies like continuous manufacturing, and among many others, the revolution of the automatization. This research project pursues to analyze, design and recommend an automated option for a palletization manufacturing process. The manufacturing process to be discussed is one where an associate performs the task stand and repeat the process in many instances, for the long of a shift. Repetitive and stand tasks are ones ideal to automatize. The process under evaluation in X Manufacturing Company consist of placing a predetermined quantity of tubs inside a box, record the quantity in each tub and consequently the quantity in the box and pallet in the manufacturing execution system. The methodology used in the research project is the six-sigma methodology Define, Measure, Analyze, Design and Verify (DMADV) and will be conducted till Design/Recommendation phase.

Introduction

The project pursues to redesign and automate a palletization process at X Manufacturing Company. It is important to X Manufacturing Company to constantly seek to improve the process and move toward our already automated era. Therefore, with this initiative, the company will remain competitive, with the best technology and looking to automate manual process.

Problem Objective

The objective is to automate a manual manufacturing process with a pick and place robot arm the process of fill the boxes at X Manufacturing Company.

Methodology

The methodology that is going to be follow will be the Design for Six Sigma (DfSS). Six Sigma is a highly disciplined process that helps focus on developing and delivering near-perfect products. DMADV which stands for Define, Measure, Analyze, Design and Verify/Validate, Figure 4, is a well-known tool system used to develop new processes or products and, that will guide the researcher through the main project phases by Sokovic [5].

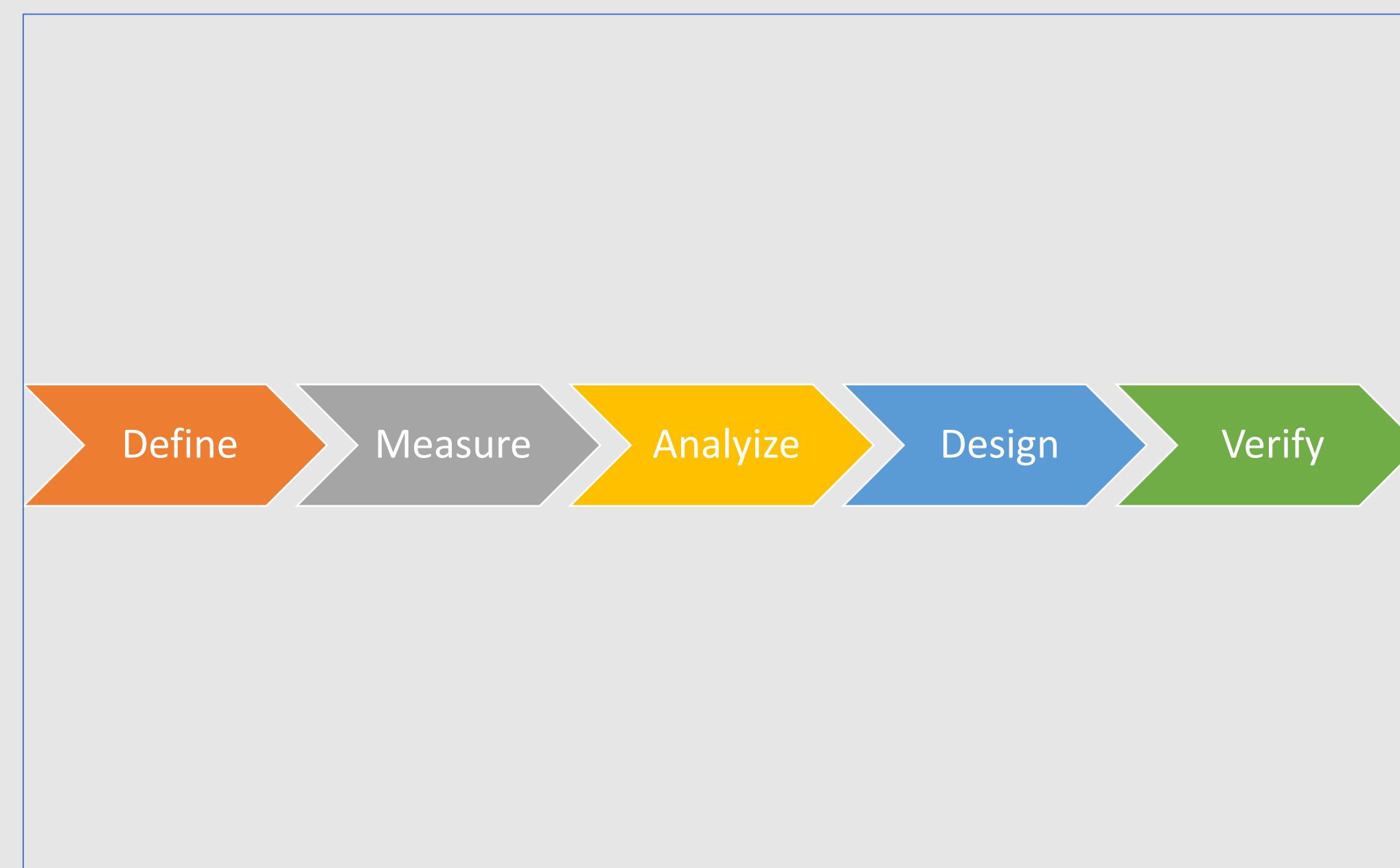


Figure 1: DMADV

Results and Discussion

Define Phase

The process to be redesigned is the shipper assembly process. The shipper assembly process take place at Room 3, the process consists of placing the containers, with the filled syringes in the plastic boxes. They are placed manually, one by one by two stand operators in a 2 x 2 x 4 array for a maximum of 16 containers. Figure 5 is a representation of the array inside the shipper.

Table 1: Project Chart

Problem Statement	During the last 8 years an increase of 50% in ergonomic claims has been reported in Room 3 due to repetitive task when the shipper is built.
Goal	<ul style="list-style-type: none"> Decrease to zero the ergonomic incidents. Implement an automated solution.

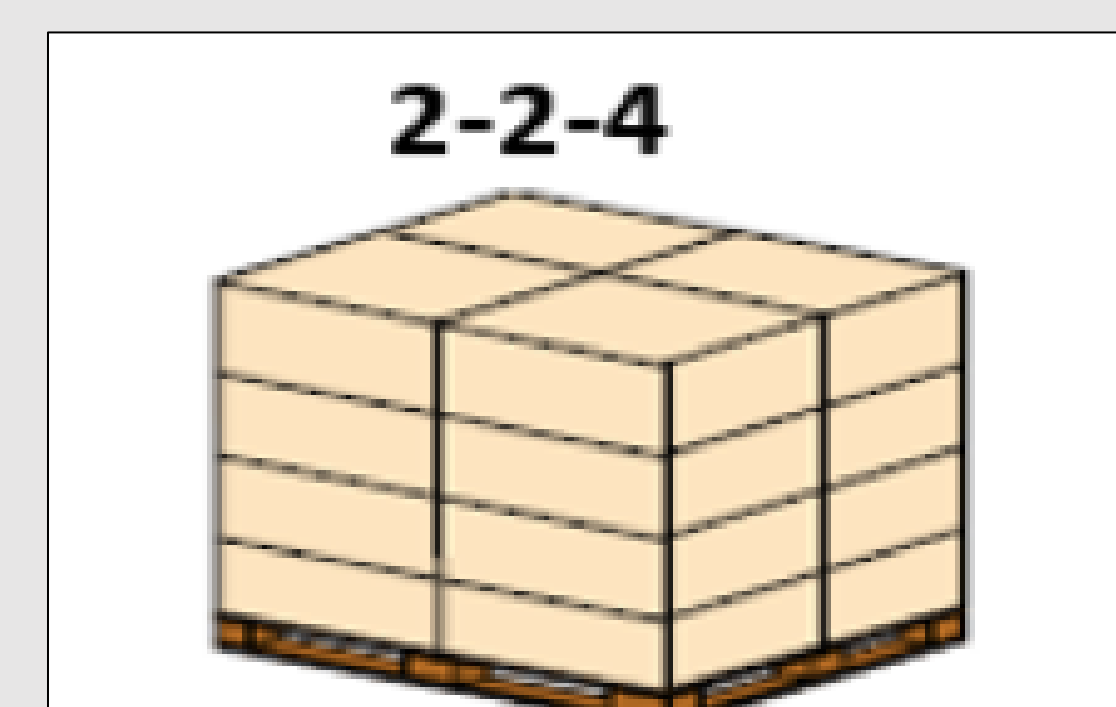


Figure 2

Results and Discussion

Measure Phase

The safety and ergonomic in X Manufacturing are the metrics most important along with productivity indicators. The evaluation made for the past 8 years, Table 2, shows an increase of 56% in the Ergonomic Safety Incidents (2012 and 2019).

Table 2: Ergonomic Events

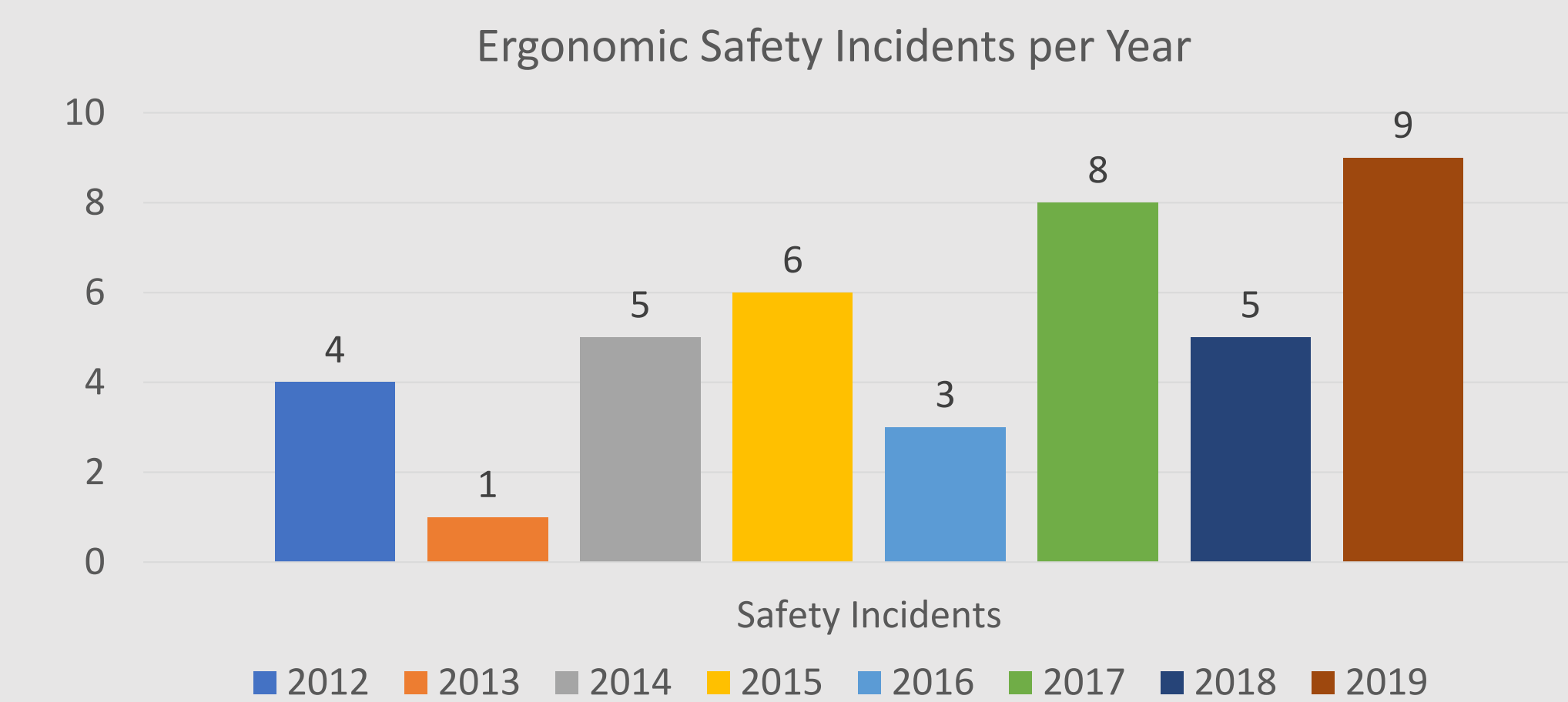


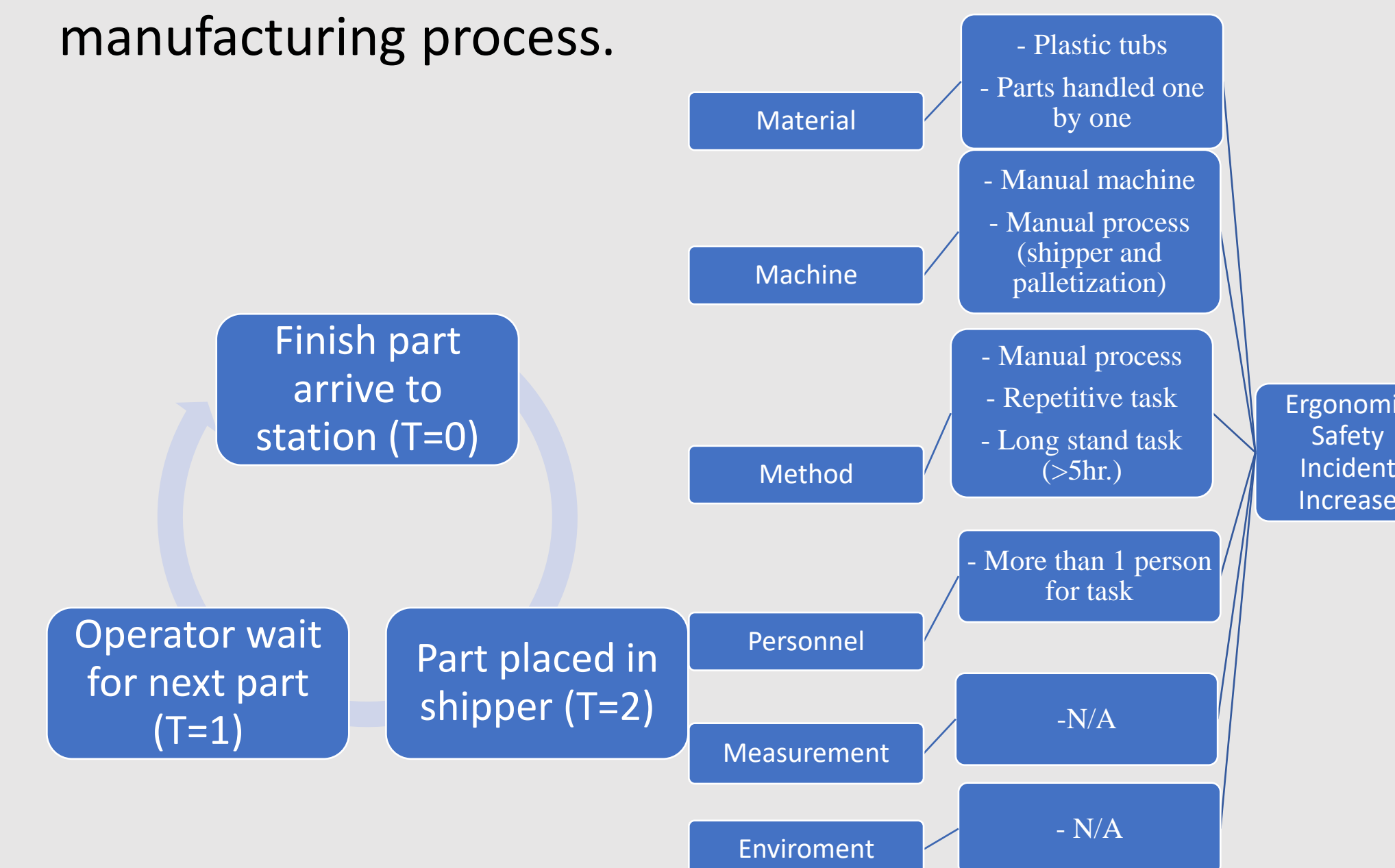
Table 3: Two Operators Spend

Rate/Hour	Rate x 2	Spend/Year
\$ 16.00	\$ 32.00	\$ 61,440

The second metric to be evaluated is the cycle time of building the plastic shipper with the sixteen (16) filled containers. Since the process is simple and it contains only one step. The cycle time of build this shipper is approximately 30 minutes, since the first filled container is received and placed into the shipper till the last filled container (16) is placed and the shipper is closed and sent to the palletization process.

Analyze

A Cause-and-Effect analysis was developed to understand and explore the ergonomic safety incident increase over the last years. As the measurement phase data shows, it was confirmed in the major offender for the increase in safety incidents are related to the current manual manufacturing process.



Results and Discussion

Design Phase

The payback period for this project is estimated in 1.5 year. The NPV is \$156,000. As established in the problem statement, this project pursues the reduction in a hundred percent the ergonomics claims.

Category	Cost
Robot Arm	25,000
Arm Integration and Testing	\$25,000
Arm Validation	\$38,400
Total	\$88,400



Conclusions

Pick and Place robots are wide used in material handling applications. This project demonstrated how an automaton project could benefit from the ergonomic, cost, and cycle time. The DMADV methodology used in this project allow the team to design and propose the project in an easy and structured manner. First, the ergonomic incidents could be reduced in a 100% implementing this robot in the manufacturing task discussed. The robot will perform the repetitive task allowing the operators to be relocated in other tasks or jobs. The economic evaluation shows that the project is attractive with a payback of 1.5 years and NPV of \$156k. Finally, it was demonstrated that the cycle time could be reduced in a 50%.

Future Work

The last section of the DMADV methodology is out of the scope of this project since the scope of the project was to design and propose a solution for the problem statement in this project. Once the design is accepted and implemented the verify phase will be developed.

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