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Optimizing Production in an Electronics Manufacturing Industry Using Six Sigma: A DMAIC Approach to Process Enhancement

By

Shubham Parekh

A Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

In

Manufacturing Engineering Technology

Minnesota State University, Mankato

Mankato, Minnesota

July 2024

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Optimizing Production in an Electronics Manufacturing Industry Using Six Sigma: A DMAIC Approach to Process Enhancement

Shubham Parekh

This thesis has been examined and approved by the following members of the student's committee.

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Table of Contents

Abstract	iii
Introduction	1
Literature Review	2
Methodology	9
Experimentation	10
Define	11
Measure	12
Analyze	14
Improve	33
Control	44
Results	46
Conclusion	48
Bibliography	49
Appendix	50

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ABSTRACT

This paper focuses on the application of DMAIC (Define, Measure, Analyze, Improve and Control) process of Six Sigma methodology for increasing the production numbers in an electronics manufacturing industry. The overall production numbers are improved by identifying the root causes and improving the process efficiency. Detailed analysis of the process cycle time for all stations is conducted and key areas for improvement are identified. Proper implementation of the suggested changes is conducted, and the results are verified. Further recommendations are provided for addressing the key improvement areas for reducing the cycle time of the bottleneck process. The findings highlight the benefits of implementing six sigma processes in an electronic manufacturing industry and provide a roadmap for other organizations seeking similar improvements by using data driven decision-making.

Introduction:

Considering current worldwide trends and improvements, it is evident that the electronic manufacturing business has significant importance in today's world. With the world transitioning into the digital era, there is a growing need for electronic components and chips. Electronic manufacturing includes the processes of designing, fabricating, testing, assembling, and distributing goods, which are like conventional manufacturing methods. Electronic components have a wide variety of applications, including cell phones, military equipment, automotive systems, medical devices, financial services, and several other areas. To meet the growing demand, organizations are using several strategies to enhance their production and product quality while minimizing expenses. Continuous Improvement tools and methods like Lean, Six Sigma etc are highly used by industry to effectively address this difficulty.

These tools promote the use of data driven decision-making practices by using various processes like time study, statistical process control, control charts, pareto charts, etc. While six sigma is a methodology and DMAIC approach is used in this to address the challenges in most of the industries. Data driven tools and methods are used while following this approach. After the collection of the data, they are analysed with the help of a software like Minitab where the required numerical tests can be conducted including hypothesis testing, ANOVA, Control Charts, graphical representation etc.

Therefore, for our experimentation we will be following the DMAIC approach of six sigma which will include all the phases of the approach. Data collection will be done with the help of a stopwatch for time studies while the production numbers will be collected from the ERP system of the company. The challenge will be to increase the production number of the gas meter production line.

Literature Review:

As mentioned by Bhuiyan and Baghel, continuous improvement is an ongoing process which focuses on improving processes, products, services, etc in any industry. Regardless of the of the industry into consideration, the ideology is that there will always be room for improvement in efficiency, quality, reducing waste, etc. While focusing on these aspects, not only the company gets benefited by reducing the cost, but it also improves the customer satisfaction by increasing the value of product or service for the customer (Bhuiyan and Baghel 2005). Key pillars of continuous improvement are mentioned below:

- Employee Empowerment
- Voice of Customer/Customer Focus
- Kaizen (Small incremental changes)
- Standardization

Lean manufacturing divides wastes into eight distinct classifications. Therefore, waste identification and categorization constitute the initial phase of lean manufacturing within an organization or manufacturing sector. After the classification of all wastes is complete, industries can then work to reduce or eliminate the waste. Enhancing production efficiency is the primary objective of waste elimination (Womack and Jones 1996). The Toyota Production system was the first to use Lean principles, which can also be described as a sequence of ideas that are used to improve or develop customer value inside a manufacturing unit while simultaneously minimizing the number of operations that do not contribute value. Not only does lean manufacturing provide value for consumers, but it also emphasizes the significance of employee happiness and personal growth, with a particular focus on continuous improvement (DUTTA and BANERJEE 2014).

Waste is broken down into eight separate categories, as was mentioned before in the Lean methodology. Overproduction, which happens when companies generate higher quantities of things that are in demand by customers, is one of the key causes of waste buildup. Overproduction is a contributor to increased waste. The accumulation of an excessive quantity of inventory not only increases the related risk but also the associated costs. In the process of transportation, companies divide their manufacturing operations over numerous locations, which results in higher costs and product downtime that does not add any value to the manufacturing process. Motion, in which an employee is required to carry out a few unnecessary motions to perform his work tasks, is an inefficient use of time in the same way. It is generally accepted that the smooth running of every process on the factory floor is essential to the overall success of the business. During the period when a product needs to wait in line or be inactive before moving on to the following step, the unoccupied time for that product is extended. During this time, no real work is being carried out. Along the same lines, this is waste. For a product to reach the operational condition that was intended for it, it must go through a considerable number of processes and stages (Jayanath, et al. 2020). On the other hand, it is important to avoid doing an excessive amount of processing on a product for which the processing provides no additional value. Under-utilization of talents is a phenomenon that occurs when businesses engage workers without properly using their abilities or failing to acknowledge their employees' creativity and expertise. This phenomenon is referred to as "under-utilization of talents." According to the lean concept, this is also considered to be a waste since it relates to the innovation and continual advancement of the organization, and it also hinders such processes. Deficiencies are the last category of waste that may be categorized. When it comes to the number of defective devices that are produced, this is relevant. Each of the categories of waste that were discussed earlier adds to an increase in the total production duration, as well as an increase in production expenditures and dangers. As a result, it is of the utmost importance for companies to make the reduction or elimination of waste their top priority, since doing so will reduce the negative effects connected with waste and improve the efficiency of their operations accordingly (Womack and Jones 1996).

The preceding section depicts several types of waste, and we can see the advantages of using Lean manufacturing principles here. Lean manufacturing focuses on optimizing the workflow process, which improves production efficiency. Streamlining processes not only helps with that, but it also helps to reduce operating or manufacturing expenses, resulting in higher profit margins per product for the business. As previously said, one of the key features of lean is continuous improvement and defect reduction, which implies that the product's quality will ultimately increase. Furthermore, because of the changes, items will have shorter lead times or throughput times, allowing them to be supplied to customers more rapidly. This will minimize the total delivery time to the consumer. Reduced shipping, delivery, and lead times, as well as enhanced product quality, will result in increased customer satisfaction. While lean standardizes the work structure at each station on the assembly line, it also helps staff get used to shifting product cycles across production lines. This implies that if the product changes, the people, as well as the necessary procedures, equipment, and software, are adjusted quickly. This implies that the production line's flexibility will rise (Mayatra, Chauhan and Trivedi n.d.). It also empowers the employees to make certain decisions in case of a defect on the line or product. This improved employee involvement in the production line provides them an opportunity for personal growth because it involves quick problem-solving techniques and as a result job satisfaction is also improved. Value Stream Mapping is the systematic process of visually representing and analysing the flow of materials and information needed to coordinate the operations of manufacturers, suppliers, and distributors to efficiently deliver goods to consumers. It aids in pinpointing the origin of waste and identifying opportunities for applying diverse lean strategies (Sundara, Balajib and SatheeshKumar 2014).

Six Sigma is one of the methods which is used for improving various processes used in industries. This focuses on minimizing the defects and the variation between two similar products which results in increased quality of the product and the efficiency of the overall process. This concept originated from Motorola around 1980 and later it was adapted by General Electric. The widespread use of Six Sigma is seen in various industries such as finance, healthcare, manufacturing, etc. Six Sigma is a statistical concept that basically focuses on how much the mean of the process is deviating from perfection which means that how far is the actual process mean is deviating from the observed mean. Six Sigma terms specify all the data under the Six Sigma limit switch says that the total number of defects would be no more than 3.4 defects per million. If a process can achieve the Six Sigma limits it means that the process is very efficient with very minute errors. As it is specified by the name Six Sigma is a statistical process control tool which means that this process depends very heavily on the use of different statistical tools to analyse the data and make decisions based on that (Yang and El-Haik n.d.).

For our experimentation we will be conducting a time study on all the stations on the production line. The basic definition of a time study is that to determine the cycle time of a process. There are various ways by which we can determine the cycle time of a process. Some of the methods are mentioned below (Duran, Cetindere and Aksu 2015):

- Time logs
- Occurrence sampling
- Engineered Method

It is to be noted that in most of the time studies, allowances need to be added but since we are focusing on the cycle time for the individual operators and the machine, we will be ignoring the allowances.

One of the most common methods of time study is MTM-1 method. It is known as Methods-Time Measurement which uses predetermined motion times for various tasks and then uses it to measure and analyze the cycle time. The unit of measurement for time is known as TMU (Time Measurement Units), where 1 TMU is equal to 0.036 seconds. The entire task is divided into various individual motions and then compared with the standard times (Freivalds and Niebel 2014). The various recognized motions according to MTM-1 is mentioned below:

- Reach (R)
- Move (M)
- Turn (T)
- Grasp (G)
- Position (P)
- Release (RL)
- Disengage (D)
- Apply Pressure (AP)
- Eye Action (EA)
- Body, Leg, and Foot Motions (B, L, F)
- Simultaneous Motions (SM)

Bures and Pivodova mentioned that this time study is widely used in manufacturing and industrial engineering applications. The basics process includes breakdown of the entire process into various individual tasks. After that the individual tasks are identified and assigned to the specific motions, each motion is assigned a specific TMU value based on the standard times mentioned in the MTM-1 tables. Then, all the individual TMU values are added to get the overall TMU for the task and then it can be converted into seconds by using the value mentioned above (Bures and Pivodova 2013). While talking about the advantages of MTM-1, Almeida and Ferreira mentioned that this method is used for precise measurements in time study while also providing a standardized method to ensure consistency for all the processes. Although, it is to be noted that proper training is required before conducting experimentation which signifies its complex nature. Apart from that, one of the major disadvantages is that this method can only be used for static tasks and processes which makes it very difficult to implement in a continuous motion manufacturing industry (Almeida and Ferreira 2009).

Another method used for the measurement of time is MTM-2 which simplifies the steps and reduces the amount of motion classification. The classification of the motion is in this method is mentioned below:

- Get (G)
    - Reach, Grasp and Release
- Put (P)
    - Move and Position
- Get Weight (GW)
- Put Weight (PW)
- Regrasp (R)
- Apply Pressure (A)
- Eye Action (E)
- Foot Action (F)
- Step (S)
- Bend & Arise (B)
- Crank (C)

MTM-2 method also uses TMU as a unit of measurement for the cycle time and in this method as well the TMU for the individual motions are added and then the overall TMU can be converted to seconds by using the same conversion factor.

Methodology

Six Sigma focuses on the use of statistical tools in a structured approach and one of the major approaches used by the 6 Sigma is called the DMAIC approach. This constitutes of 5 steps which are Define, Measure, Analyse, Improve and Control. There are some key elements which needs to be considered before applying the DMAIC process. One of them is to address the potential opportunity of improvement and defining the value of the project (Montgomery 2013).

The objectives of each phase of DMAIC process are mentioned below:

1. Design: This includes the identification of the problem, defining objectives and scope of the project. For our project, the key objective is to increase the production numbers to keep up with the over-production schedule. Further information is mentioned below.
2. Measure: This phase includes the collection of data. Time study for each station of the assembly line was conducted for our project and variation in data was present for most of the stations.
3. Analyse: The collected data is than analysed and root causes are identified. Based on the result of the analysis, improvements are suggested.
4. Improve: Suggested improvements are implemented and then data is collected again to analyse the improvements.
5. Control: Mistake proofing methods are implemented where the process is checked and addressed in case the process moves away from the desired limits.

Experimentation

This project was conducted in an electronic manufacturing firm with the aim of enhancing the company's output numbers. The products being considered are gas meter integration products. These items include cellular connection, enabling them to connect to the network and deliver real-time data to the customer.

Itron manufactures the circuit boards in-house and then transfers them to the assembly line where they are integrated with the housing assembly to complete production. The process flow for the production on assembly line is mentioned below:

1. Board Testing: Circuit boards are tested for any functional imperfections including the functionality of the electronic chips and the firmware.
2. Solder: In this process Batteries are attached to the circuit boards which allows them to operate without the need of external power source.
3. Housing Assembly: Soldered units are placed into the housing assemblies which protect them from the external environment.
4. Heat stake: This is one the most critical process as the connecting wires between the battery and circuit board are fixed at the proper position in the housing assembly with the help of thermoplastic stacking by heating the plastic cutouts in the housing assembly to reform and fix the position of loose wires.
5. Potter: After the heat stake, all the units are potted with a mix of epoxy and then allowed to cure for 45 minutes. This is an automated process because of which there is little to no variation in the cycle time.

6. Final Test: The units are tested for one last time before they can be shipped to the customer.
7. Pack Station: The units are packed and moved to the shipping warehouse.

The Process Flow Chart of the production line can be seen from the below mentioned figure.

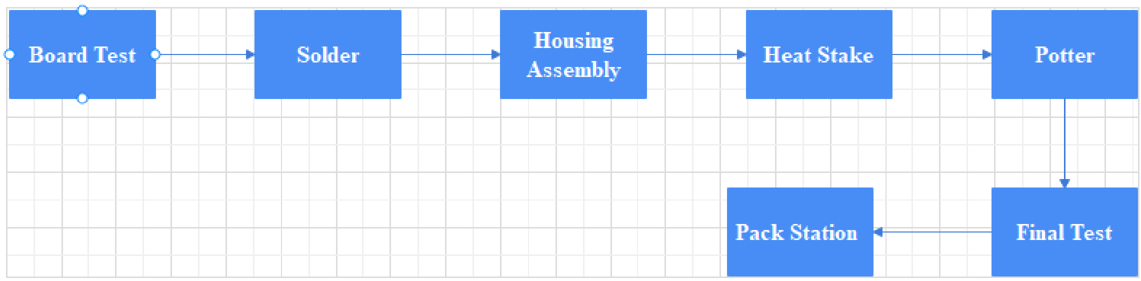


Figure 1: Assembly Line Process Flow Chart

The methodology opted to overcome the challenge of increasing production numbers is the DMAIC approach. A better understanding of Project along with the outcomes and deliverables is mentioned below.

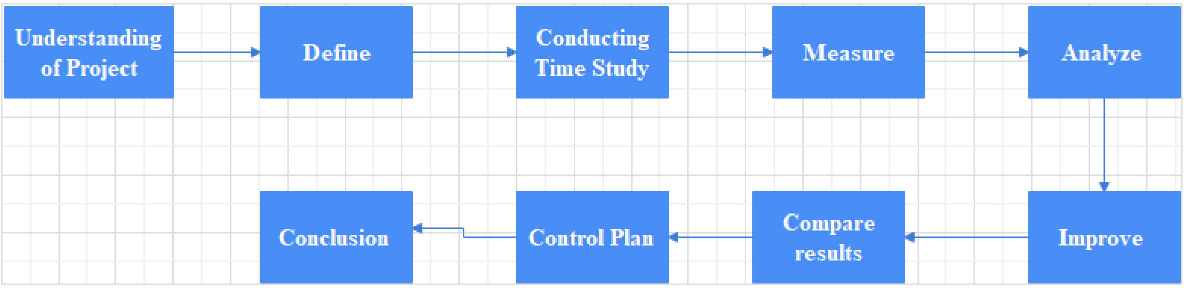


Figure 2: Project Flow Chart

1. Define Phase

The production line currently manufactures about 402 units per shift. While the company has an upcoming scheduled shutdown, they want to ensure that the customer demands, and the delivery of the products is not affected during that period. Production numbers need to be improved if customer satisfaction is not affected.

Problem Statement: To keep up with the customer demand, production numbers of the assembly line need to be increased from 402 units per shift to around 770 units per shift.

Project Scope: Find the bottleneck station on the production line by conducting a time study for every station on the production line while also comparing the performance of the operators for each station.

Milestones:

- Successful completion of time study
- Identification of the bottleneck station
- Implementation of change
- Improvement analysis and summary of the project

2. Measure

Before conducting the time study, it is important to verify the current production numbers to verify the problem statement. Production numbers for a few observed shifts are mentioned in the table below. It is to be noted that all the observations are taken for “A” shift to minimize the variation and get a better understanding of the situation.

Shift	Product	Units
A	Gas Meter	382
A	Gas Meter	396
A	Gas Meter	399
A	Gas Meter	415
A	Gas Meter	362
A	Gas Meter	450
A	Gas Meter	411
A	Gas Meter	431
A	Gas Meter	443
A	Gas Meter	429
A	Gas Meter	447

Actual production numbers can be different from the theoretical number because of human errors or environmental factors. After looking at the production numbers, a time study for each station on the production line was conducted while focusing on the operator performance. The results of each individual station are mentioned below.

Also, to compare the performance of operators based on time taken by them to complete the task at each station, 10 readings are taken for each operator. The six operators on the production line are classified by six alphabetical orders from "A" to "F". The average cycle time for each station can be found below while the detailed time studies can be found in the Appendix section.

- Board Test = 28.8 Seconds
- Solder Station = 47.18 Seconds

- Assembly Station = 38 Seconds
- Heat Stake Station = 46.8 Seconds
- Potter = 40 Seconds
- Final Test = 16.5 Seconds
- Pack = 16.5 Seconds

3. Analyze

In this phase, analysis of the data collected in the measure phase is addressed.

Board Test

We can see from the overall statistics of the station across all the operators that the average time taken to complete the operation is 29.3 seconds with a standard deviation of 3.045 seconds.

Statistics

Variable	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
Time (Seconds)	29.310	0.393	3.045	9.270	22.008	27.567	29.834	31.773	33.994

Variable	Range
Time (Seconds)	11.986

Figure 3: Board Test: Statistics

To compare the performance of operators, mean time taken by each operator is calculated. While comparing the results, we can observe that the mean time taken by each operator is very close to each other with a small variation.

Statistics

Variable	Operator	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3
Time (Seconds)	A	29.03	1.04	3.29	10.82	23.40	26.88	29.53	31.43
	B	29.265	0.656	2.074	4.302	26.936	27.434	29.053	31.112
	C	28.40	1.20	3.79	14.34	23.38	24.62	28.06	32.06
	D	28.607	0.954	3.015	9.093	22.008	27.230	28.717	30.623
	E	30.59	1.06	3.34	11.16	23.99	29.11	31.69	33.19
	F	29.966	0.848	2.682	7.193	23.929	28.657	30.236	32.075

Variable	Operator	Maximum	Range
Time (Seconds)	A	33.48	10.08
	B	32.756	5.820
	C	33.99	10.61
	D	32.414	10.406
	E	33.47	9.48
	F	33.725	9.796

Figure 4: Board Test: Operator Performance Evaluation

From the figure below, we can have a better understanding of the individual performance while also confirming that the data is distributed normally.

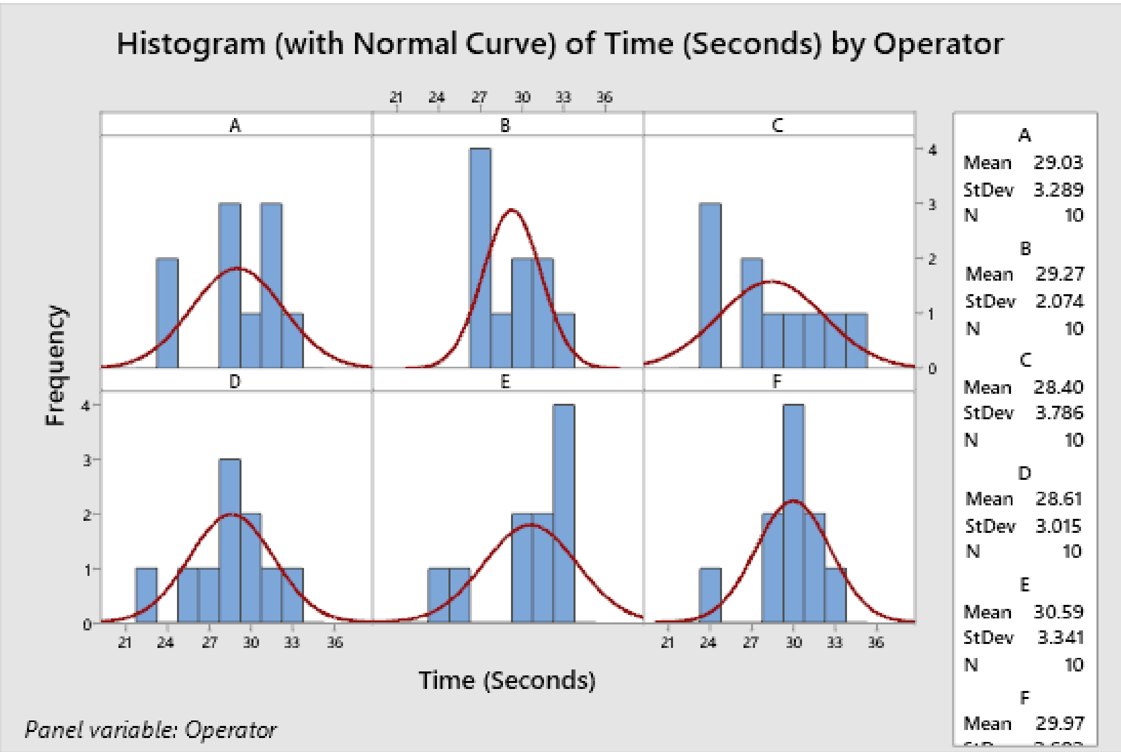


Figure 5: Board Test: Histogram

To check the highest mean time across all the operators, a box plot was generated. We can see that operator "E" has the highest mean time at 30.59 seconds for conducting the board test.

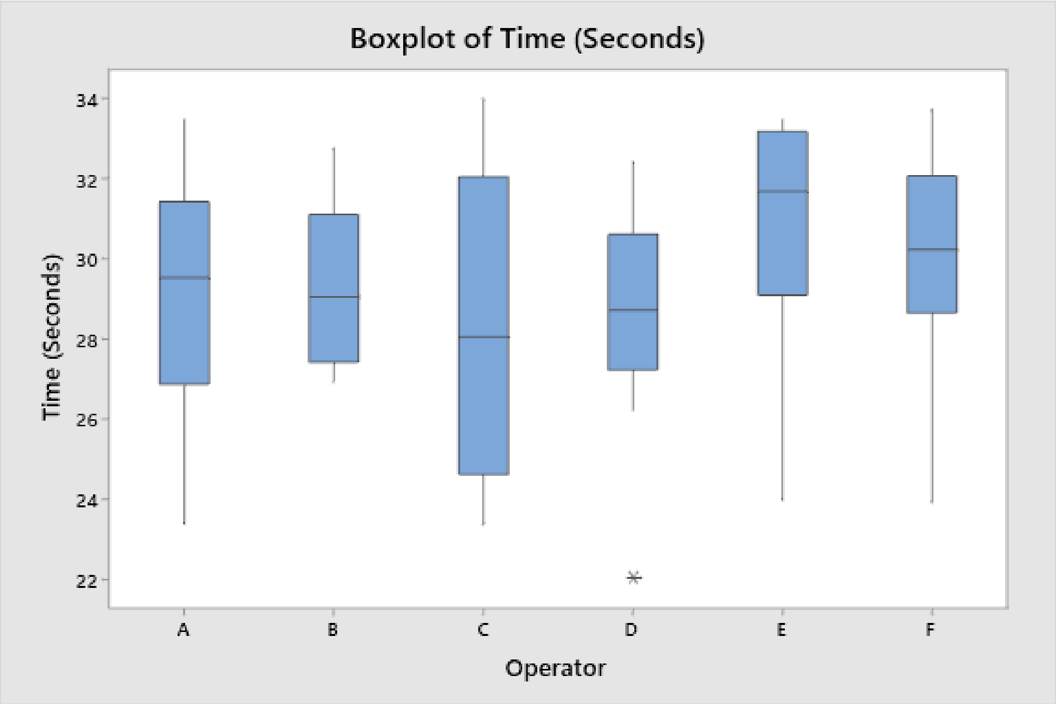


Figure 6: Board Test: Box Plot

Solder Station

We can see from the overall statistics of the station across all the operators that the average time taken to complete the operation is 94.35 seconds with a standard deviation of 28.67 seconds. Although there are two solder stations present on the production line, which means that the overall cycle time for the station is 47.18 seconds.

$$\text{Overall Cycle time} = \frac{94.35}{2}$$

$$= 47.18 \text{ Seconds}$$

This makes it that bottleneck station for the line as this station has the highest mean cycle time. Improvements will be discussed in the improve phase below.

Statistics

Variable	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
Time (Seconds)	94.35	3.70	28.67	821.98	76.23	79.80	82.25	85.73	168.55

Variable	Range
Time (Seconds)	92.32

Figure 7: Solder Station: Statistics

After getting a better understanding of the individual cycle times, we can clearly see that operator "F" has nearly double the mean cycle time when compared to the rest of the operators. While other operators are taking around 80 seconds to complete the task, operator "F" is taking nearly 157.21 seconds to complete which makes this station the top priority for improvements.

Statistics

Variable	Operator	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3
Time (Seconds)	A	80.942	0.840	2.658	7.063	76.230	78.953	81.215	82.651
	B	81.950	0.995	3.145	9.892	77.050	79.248	82.195	84.004
	C	81.180	0.899	2.844	8.086	76.442	78.898	81.320	83.938
	D	80.504	0.705	2.229	4.967	77.165	78.602	80.040	82.332
	E	84.32	1.38	4.35	18.92	79.06	80.09	83.40	88.92
	F	157.21	2.48	7.84	61.53	142.99	151.28	158.69	163.35

Variable	Operator	Maximum	Range
Time (Seconds)	A	85.779	9.549
	B	87.847	10.797
	C	85.600	9.158
	D	83.971	6.806
	E	91.40	12.34
	F	168.55	25.56

Figure 8: Solder Station: Operator Performance Evaluation

The box plot and histogram below give a better visual representation of the difference in mean time between the operators while also confirming the normal distribution of the data.

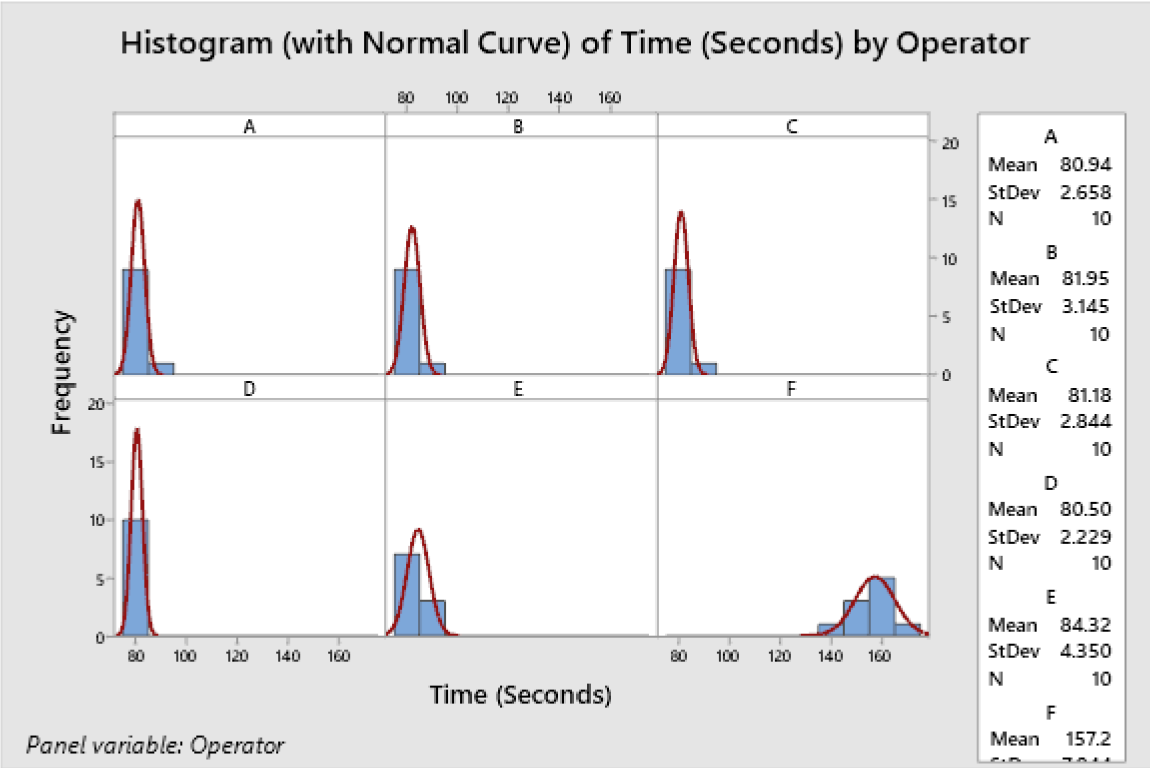


Figure 9: Solder Station: Histogram

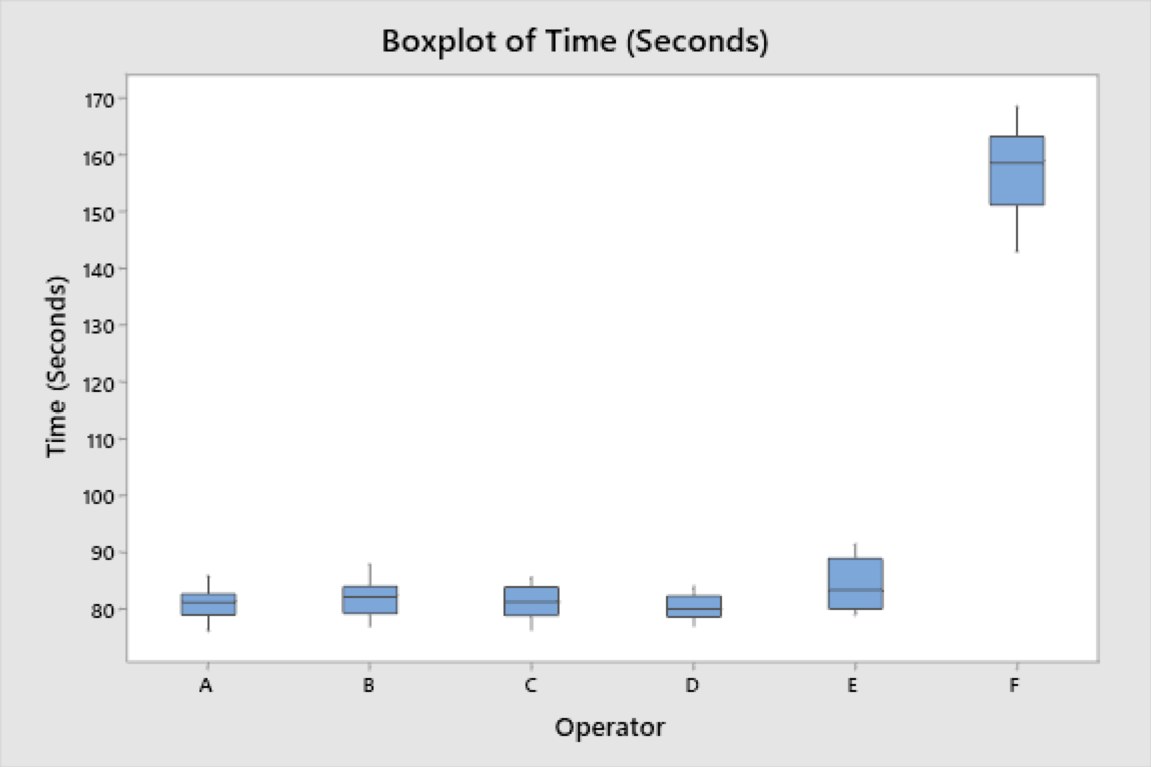


Figure 10: Solder Station: Box Plot

Housing Assembly

We can see from the overall statistics of the station across all the operators that the average time taken to complete the operation is 43.10 seconds with a standard deviation of 9.51 seconds. This will not be under the priority list because of the presence of idle time between housing and heat stake station as heat stake station has higher cycle time.

Statistics

Variable	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
Time (Seconds)	43.10	1.23	9.51	90.47	25.07	37.06	41.49	49.09	69.33

Variable	Range
Time (Seconds)	44.26

Figure 11: Housing: Statistics

To compare the performance of operators, mean time taken by each operator is calculated. While comparing the results, we can observe that operator “D” has the least mean cycle time for the task, while operator “F” has the highest cycle times at 36.56 seconds and 50.02 seconds.

Statistics

Variable	Operator	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3
Time (Seconds)	A	43.66	2.87	9.07	82.32	30.43	37.40	40.80	51.48
	B	42.56	2.41	7.61	57.94	29.23	37.15	42.07	48.34
	C	44.61	3.45	10.90	118.86	28.03	38.34	43.26	50.15
	D	36.56	2.61	8.26	68.21	25.07	27.54	35.91	45.42
	E	41.18	2.64	8.35	69.77	29.95	34.06	40.00	47.01
	F	50.02	2.96	9.37	87.88	38.00	40.35	51.79	59.67

Variable	Operator	Maximum	Range
Time (Seconds)	A	60.37	29.93
	B	54.32	25.09
	C	69.33	41.31
	D	47.84	22.77
	E	57.77	27.82
	F	61.50	23.50

Figure 12: Housing: Operator Performance Evaluation

From the figure below, we can have a better understanding of the individual performance and see the variation between individual data points while also confirming that the data is distributed normally.

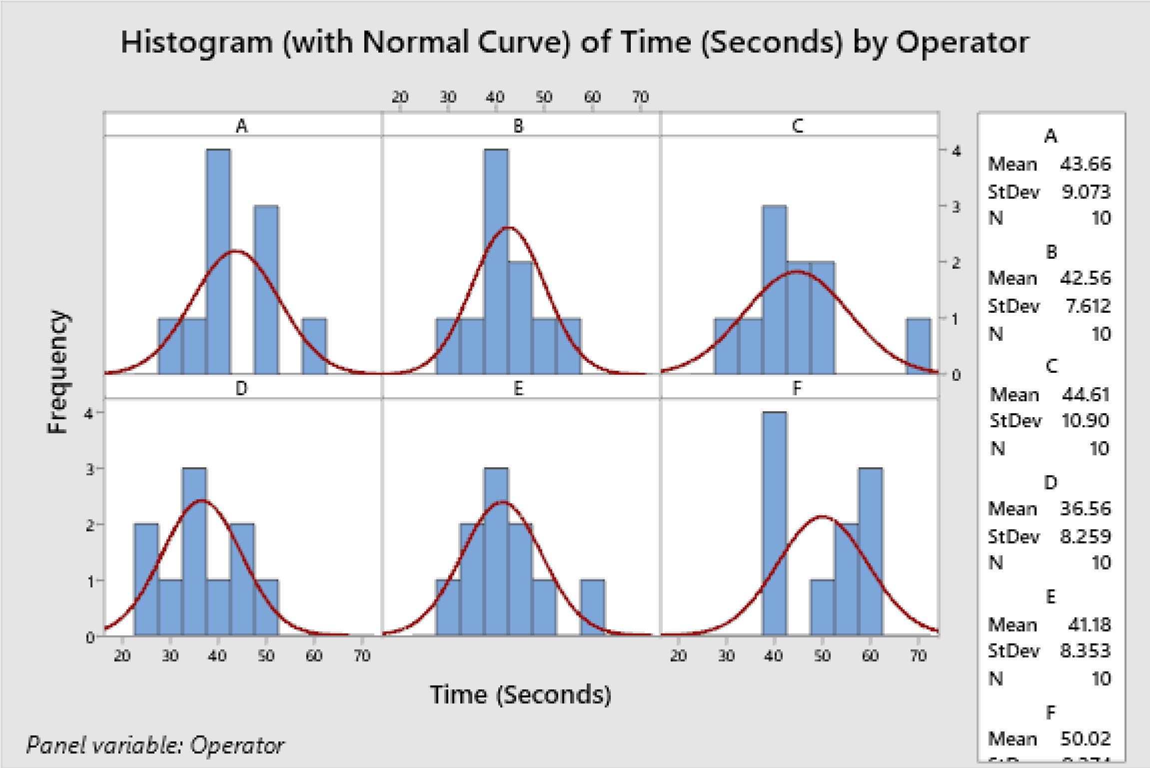


Figure 13: Housing: Histogram

To check the highest mean time across all the operators, a box plot was generated. We can see that operator "F" has the highest mean time at 50.02 seconds for the assembly operation.

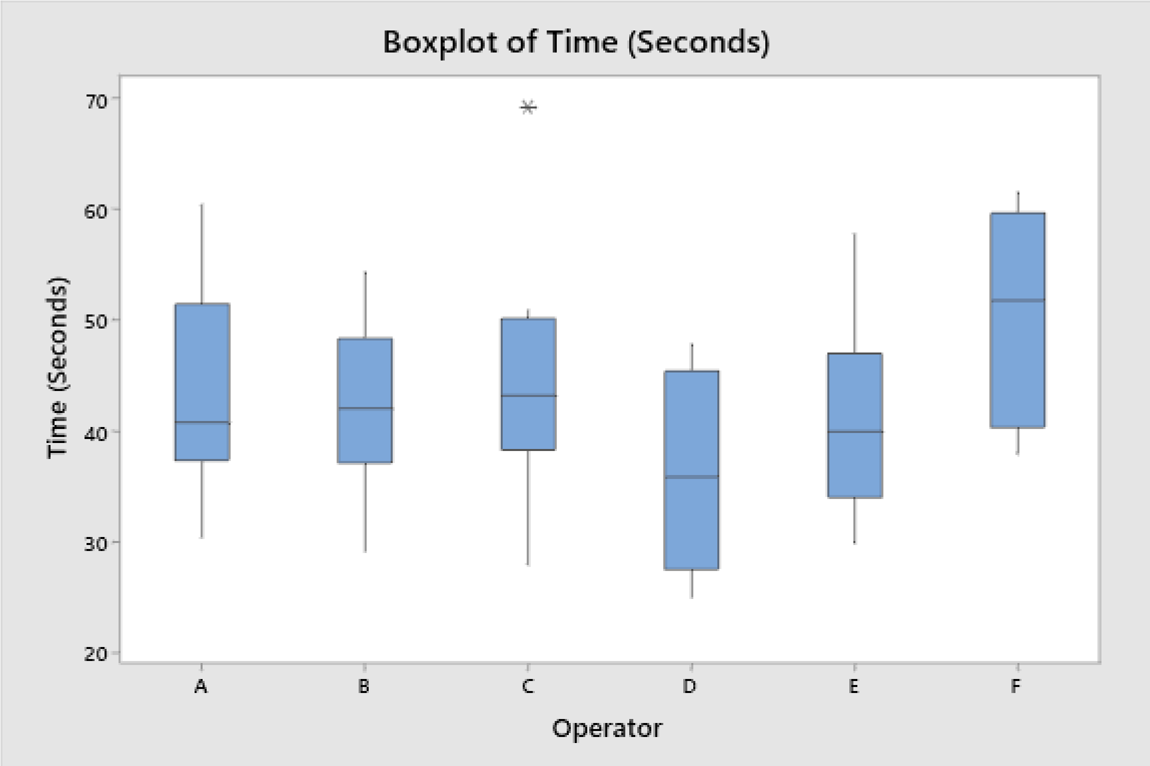


Figure 14: Housing: Box Plot

Heat Stake

We can see from the overall statistics of the station across all the operators that the average time taken to complete the operation is 46.84 seconds with a standard deviation of 7.57 seconds. This station also needs to be on the priority list as the cycle time for this station is also very similar to the bottleneck station.

Statistics

Variable	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
Time (Seconds)	46.840	0.978	7.577	57.404	30.724	42.324	47.243	53.035	62.198

Variable	Range
Time (Seconds)	31.474

Figure 15: Heat Stake: Statistics

To compare the performance of operators, mean time taken by each operator is calculated. While comparing the results, we can observe that operator "F" has the highest cycle times at 54.02 seconds while Operator "E" takes the lest time to complete the task at 42.44 seconds.

Statistics

Variable	Operator	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3
Time (Seconds)	A	47.66	1.47	4.65	21.58	39.05	45.86	47.75	50.24
	B	43.57	2.31	7.31	53.43	30.72	36.90	46.18	47.37
	C	44.62	2.75	8.71	75.80	33.64	36.95	44.77	53.83
	D	48.72	2.62	8.30	68.83	34.12	43.83	47.98	55.10
	E	42.44	2.15	6.79	46.11	33.22	35.54	43.85	46.50
	F	54.029	0.983	3.108	9.661	47.814	52.056	54.336	56.300

Variable	Operator	Maximum	Range
Time (Seconds)	A	55.93	16.88
	B	54.15	23.42
	C	57.12	23.48
	D	62.20	28.08
	E	52.74	19.52
	F	58.400	10.586

Figure 16: Heat Stake: Operator Performance Evaluation

From the figure below, we can have a better understanding of the individual performance and see the variation between individual data points while also confirming that the data is distributed normally.

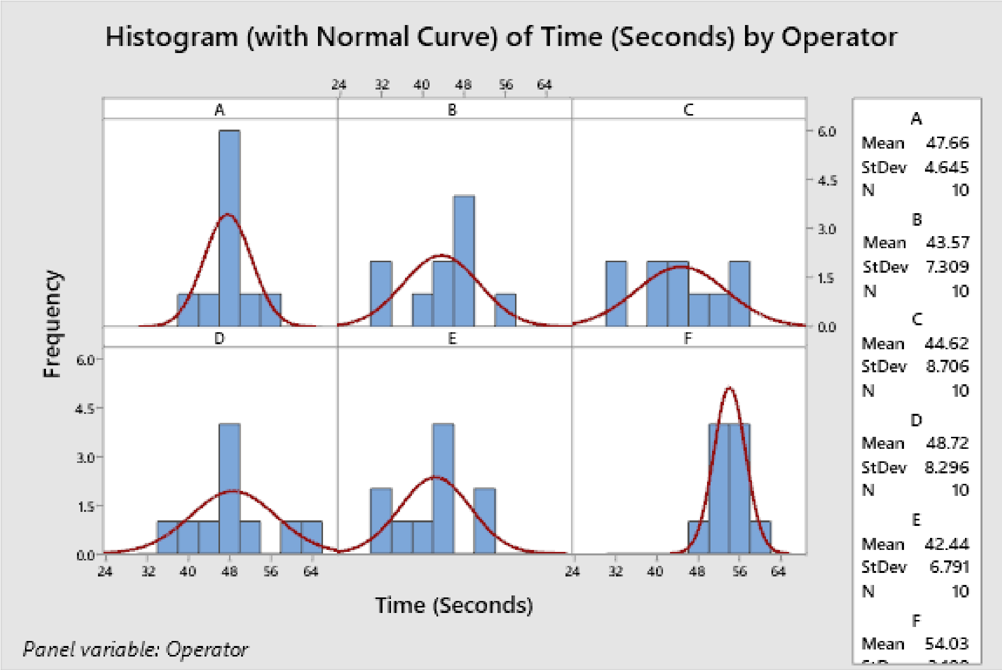


Figure 17: Heat Stake: Histogram

To check the highest mean time across all the operators, a box plot was generated. We can see that operator "F" has the highest mean time at 54.03 seconds for the heat stake operation.

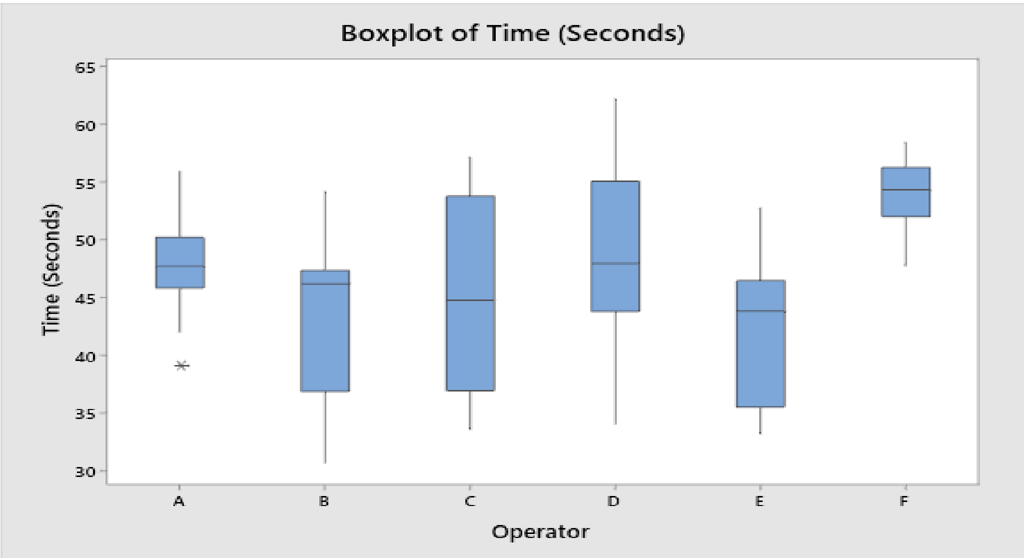


Figure 18: Heat Stake: Box plot

Potter

We can see from the overall statistics of the station across all the operators that the average time taken to complete the operation is 40.21 seconds with a standard deviation of 7.04 seconds.

Statistics

Variable	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
Time (Seconds)	40.208	0.909	7.038	49.532	16.769	35.610	40.349	44.297	58.400

Variable	Range
Time (Seconds)	41.631

Figure 19: Potter: Statistics

To compare the performance of operators, mean time taken by each operator is calculated. While comparing the results, we can observe that operator "C" has the highest cycle times at 44.45 seconds while Operator "E" takes the least time to complete the task at 37.93 seconds.

Statistics

Variable	Operator	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3
Time (Seconds)	A	38.38	1.75	5.52	30.45	29.60	35.38	36.55	44.27
	B	38.44	1.85	5.85	34.19	29.00	33.89	38.13	41.73
	C	44.45	2.08	6.59	43.46	34.13	40.09	44.01	48.45
	D	41.56	1.62	5.11	26.16	35.21	35.54	42.18	45.33
	E	37.93	2.75	8.69	75.59	16.77	33.49	41.43	43.86
	F	40.48	2.82	8.93	79.80	30.31	33.00	38.74	45.57

Variable	Operator	Maximum	Range
Time (Seconds)	A	47.58	17.98
	B	48.90	19.90
	C	58.10	23.97
	D	50.26	15.05
	E	46.19	29.42
	F	58.40	28.09

Figure 20: Potter: Operator Performance Evaluation

From the figure below, we can have a better understanding of the individual performance and see the variation between individual data points while also confirming that the data is distributed normally.

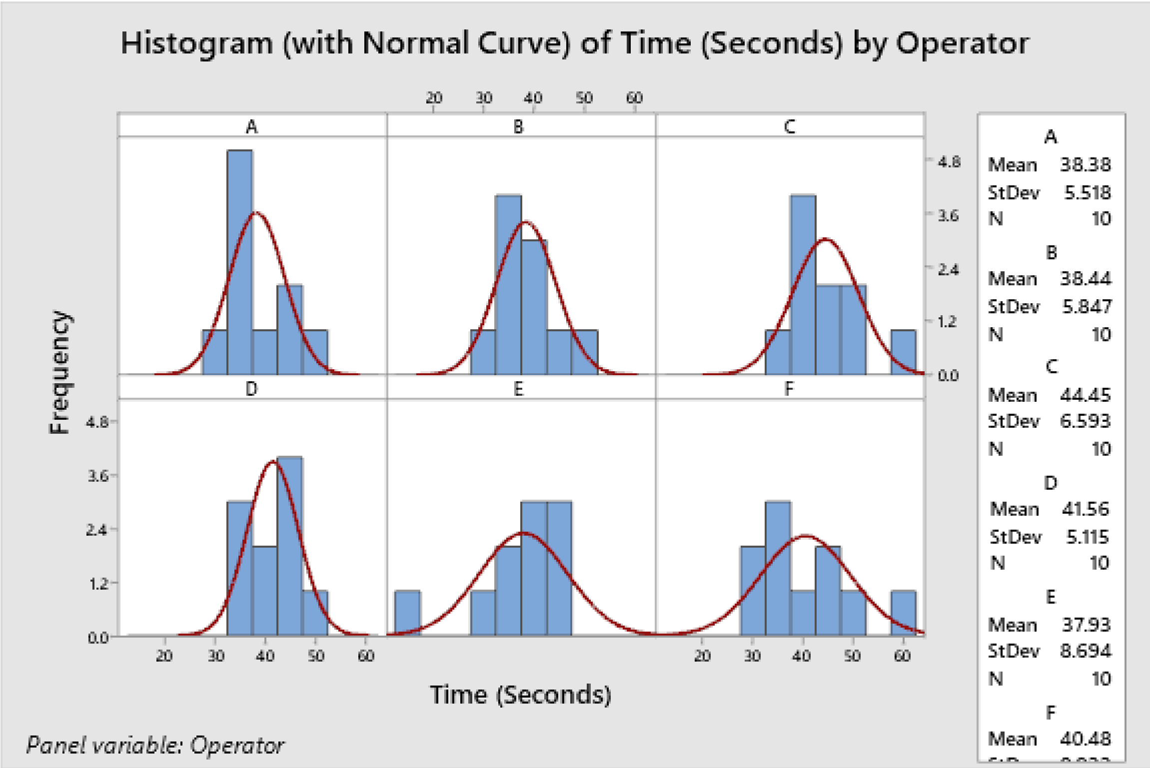


Figure 21: Potter: Histogram

To check the highest mean time across all the operators, a box plot was generated. We can see that operator "C" has the highest mean time at 44.45 seconds for the potting operation.

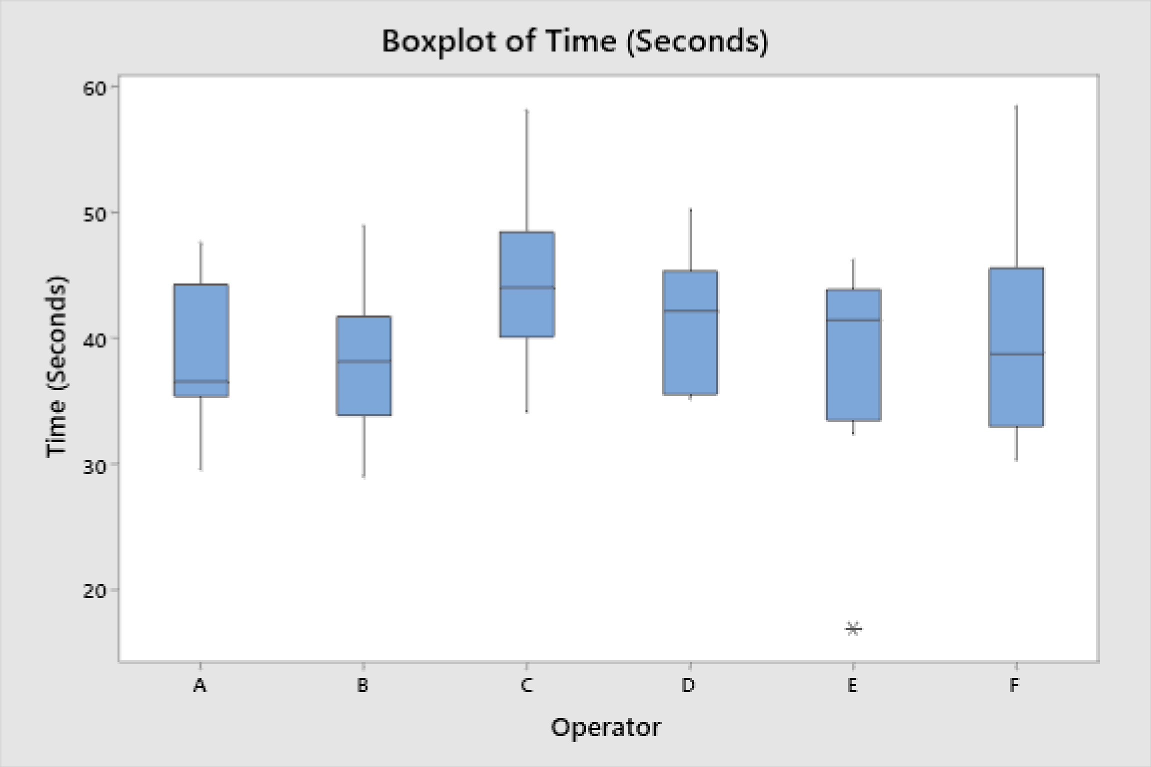


Figure 22: Potter: Box Plot

Final Test

We can see from the overall statistics of the station across all the operators that the average time taken to complete the operation is 32.74 seconds with a standard deviation of 3.5 seconds. Although there are two Final test stations present on the production line, which means that the overall cycle time for the station is 16.37 seconds.

$$\text{Overall Cycle time} = \frac{32.74}{2}$$

$$= 16.37 \text{ Seconds}$$

This makes it the station with the least cycle time for the line.

Statistics

Variable	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
Time (Seconds)	32.744	0.462	3.578	12.805	24.248	30.441	32.862	35.279	41.021

Variable	Range
Time (Seconds)	16.773

Figure 23: Final Test: Statistics

To compare the performance of operators, mean time taken by each operator is calculated. While comparing the results, we can observe that operator "E" has the highest cycle times at 35.23 seconds while Operator "B" takes the least time to complete the task at 31.02 seconds.

Statistics

Variable	Operator	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3
Time (Seconds)	A	34.61	1.06	3.37	11.34	28.32	32.90	34.72	37.63
	B	31.02	1.20	3.79	14.39	24.25	28.71	31.26	33.80
	C	31.935	0.864	2.731	7.459	26.286	30.681	31.272	34.360
	D	31.66	1.17	3.71	13.75	24.77	29.77	32.09	32.93
	E	35.234	0.937	2.964	8.783	31.145	33.034	35.084	37.337
	F	32.00	1.07	3.40	11.53	28.54	29.16	30.80	35.56

Variable	Operator	Maximum	Range
Time (Seconds)	A	39.25	10.93
	B	36.60	12.35
	C	35.604	9.318
	D	39.10	14.33
	E	41.021	9.877
	F	37.78	9.25

Figure 24: Final Test: Operator Performance Evaluation

From the figure below, we can have a better understanding of the individual performance and see the variation between individual data points while also confirming that the data is distributed normally.

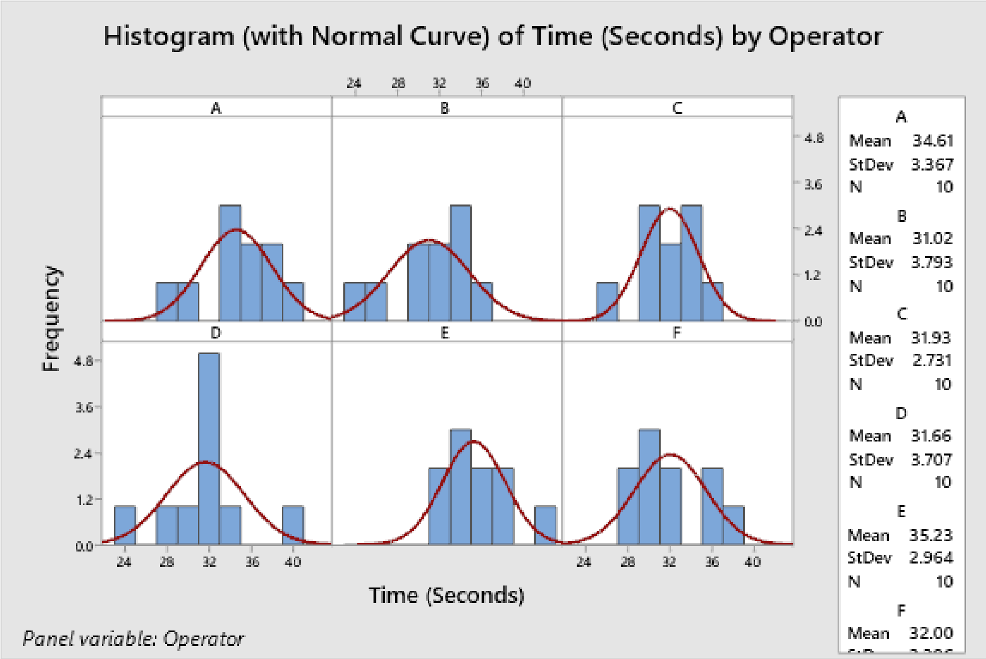


Figure 25: Final Test: Histogram

To check the highest mean time across all the operators, a box plot was generated. We can see that operator "E" has the highest mean time at 35.23 seconds for the potting operation.

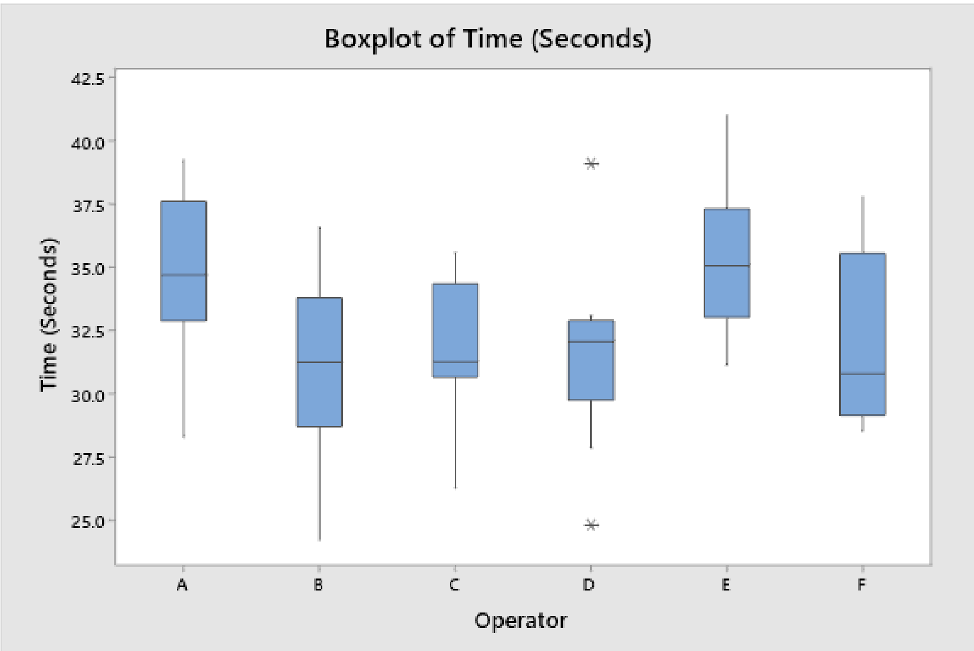


Figure 26: Final Test: Box Plot

Pack Station

We can see from the overall statistics of the station across all the operators that the average time taken to complete the operation is 17.23 seconds with a standard deviation of 2.8 seconds.

Statistics

Variable	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
Time (Seconds)	17.231	0.367	2.839	8.061	9.916	15.123	17.116	19.153	25.600

Variable	Range
Time (Seconds)	15.684

Figure 27: Pack Station: Statistics

To compare the performance of operators, mean time taken by each operator is calculated. While comparing the results, we can observe that operator "F" has the highest cycle times at 19.96 seconds while Operator "B" takes the least time to complete the task at 15.73 seconds.

Statistics

Variable	Operator	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3
Time (Seconds)	A	16.801	0.517	1.636	2.677	14.151	15.665	17.012	17.400
	B	15.73	1.08	3.42	11.68	9.92	13.59	15.52	17.81
	C	16.382	0.723	2.286	5.224	11.644	14.758	17.039	18.046
	D	16.814	0.856	2.706	7.324	12.085	14.517	17.243	19.167
	E	17.694	0.899	2.843	8.085	14.082	14.920	17.457	20.146
	F	19.960	0.752	2.377	5.650	17.834	18.388	19.200	21.200

Variable	Operator	Maximum	Range
Time (Seconds)	A	20.037	5.885
	B	21.02	11.10
	C	19.164	7.521
	D	20.950	8.866
	E	22.015	7.933
	F	25.600	7.766

Figure 28: Pack Station: Operator Performance Evaluation

From the figure below, we can have a better understanding of the individual performance and see the variation between individual data points while also confirming that the data is distributed normally.

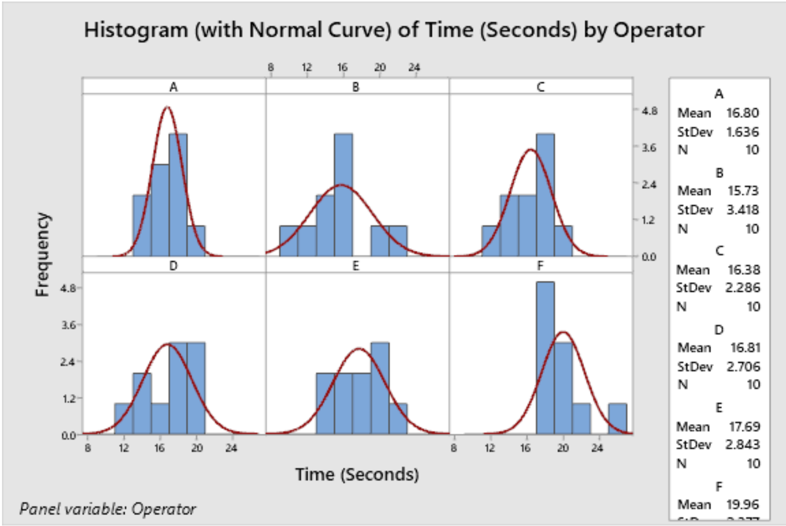


Figure 29: Pack Station: Histogram

To check the highest mean time across all the operators, a box plot was generated. We can see that operator "F" has the highest mean time at 19.96 seconds for the potting operation.

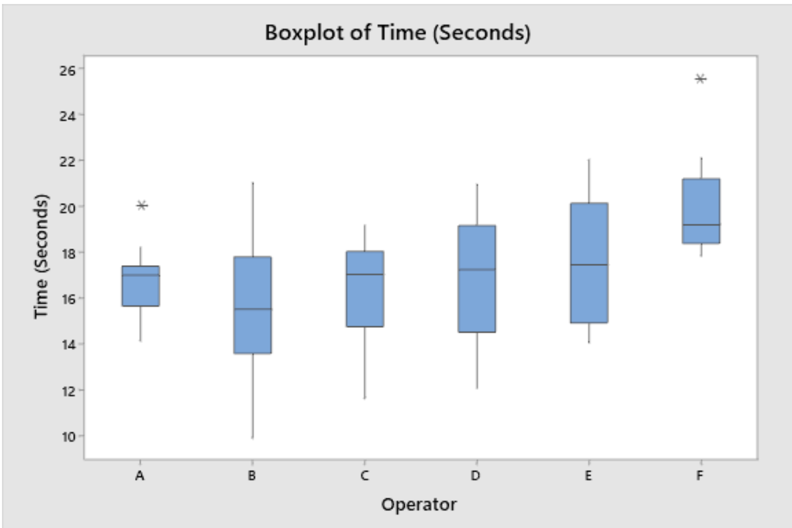
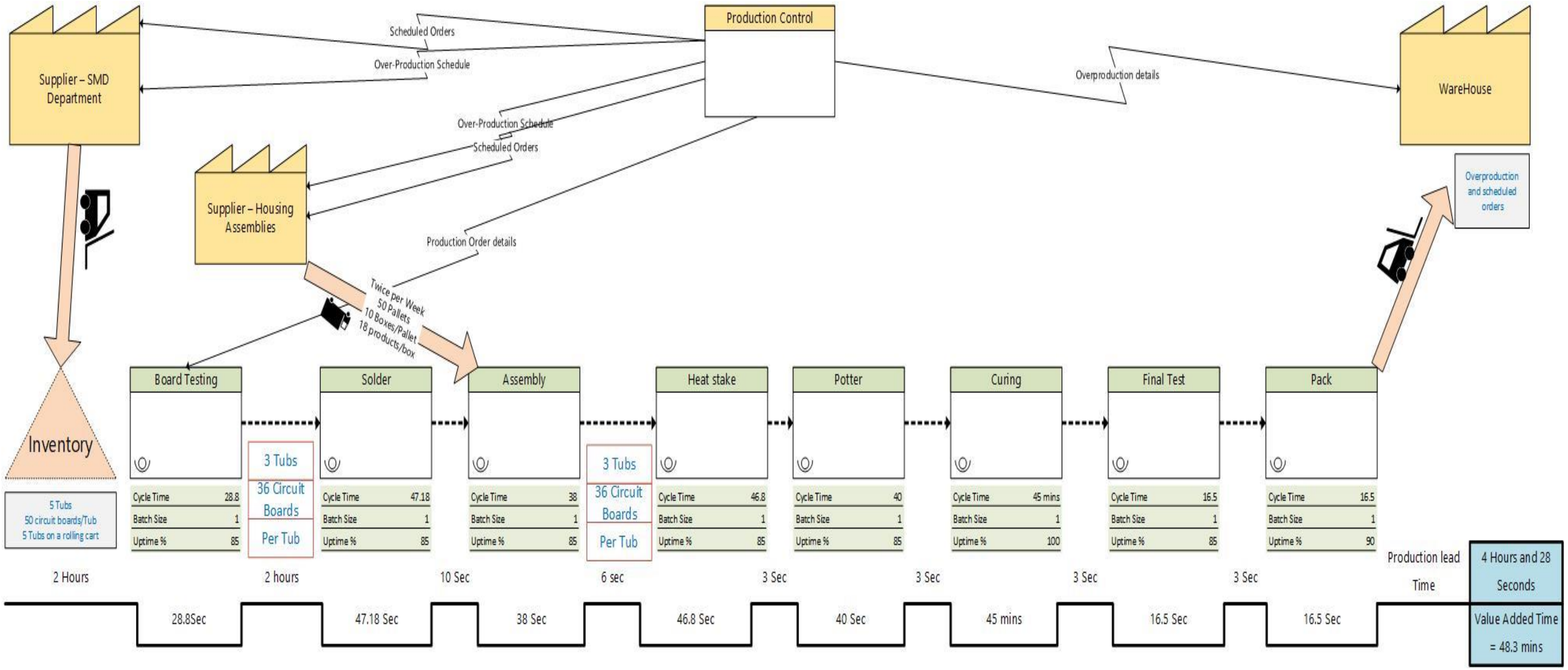


Figure 30: Pack Station: Box Plot


Supplier – SMD Department
Supplier – Housing Assemblies
Production Control
WareHouse
Scheduled Orders
Over-Production Schedule
Over-Production Schedule
Scheduled Orders
Production Order details
Overproduction details
Twice per Week
50 Pallets
10 Boxes/Pallet
18 products/box
Overproduction and scheduled orders
Inventory
5 Tubs
50 circuit boards/Tub
5 Tubs on a rolling cart
Board Testing
Cycle Time 28.8
Batch Size 1
Uptime % 85
3 Tubs
36 Circuit Boards
Per Tub
Solder
Cycle Time 47.18
Batch Size 1
Uptime % 85
Assembly
Cycle Time 38
Batch Size 1
Uptime % 85
3 Tubs
36 Circuit Boards
Per Tub
Heat stake
Cycle Time 46.8
Batch Size 1
Uptime % 85
Potter
Cycle Time 40
Batch Size 1
Uptime % 85
Curing
Cycle Time 45 mins
Batch Size 1
Uptime % 100
Final Test
Cycle Time 16.5
Batch Size 1
Uptime % 85
Pack
Cycle Time 16.5
Batch Size 1
Uptime % 90
2 Hours
28.8Sec
2 hours
47.18 Sec
10 Sec
38 Sec
6 sec
46.8 Sec
3 Sec
40 Sec
3 Sec
45 mins
3 Sec
16.5 Sec
3 Sec
16.5 Sec
Production lead Time
4 Hours and 28 Seconds
Value Added Time = 48.3 mins

After the analysis it can be observed that operator "F" is having a below satisfactory performance which is negatively affecting the overall output of the line.

Also, based on the data collected, a value stream map has been designed to get a better understanding of the entire assembly line.

Based on the bottleneck, we can theoretically calculate the production numbers per shift. Currently, the cycle time of our bottleneck station is 47.18 seconds, which means that there should be

$$\text{UPH (units per hour)} = \frac{3600}{Cycle\ time\ (Bottleneck)}$$

$$= \frac{3600}{47.18} = 76.3$$

Total units produced in one shift = 76.3 * 10

= 763 units

$$\text{Efficiency} = \frac{Observed\ number\ of\ units\ produced}{Expected\ number\ of\ units\ produced}$$

$$= \frac{402}{763} = 0.53$$

This means that our current production efficiency is at 53 percent.

4. Improve

Based on the analyze phase, a few improvements were made. As witnessed, the performance of the operator "F" was negatively affecting the production line. One of the methods which could be opted for is to retrain the operator on the processes.

Although, due to the shortage of time this method could not be opted. So, operator "F" was replaced by another trained operator "X". Performance of operator "X" was also measured, and the time taken by Operator "X" to complete the solder operation is mentioned below. It is to be noted that the measurement was only needed for the solder station as it was facing the most amount of increased cycle time.

Date	**Day**	**Operator**	**Process**	**Change**	**Time (Seconds)**
02/19/2024	A	X	Solder	After Change	109.4
02/19/2024	A	X	Solder	After Change	129.6
02/19/2024	A	X	Solder	After Change	72.2
02/19/2024	A	X	Solder	After Change	123.7
02/19/2024	A	X	Solder	After Change	107.9
02/19/2024	A	X	Solder	After Change	74.1
02/19/2024	A	X	Solder	After Change	119.1
02/19/2024	A	X	Solder	After Change	108.7
02/19/2024	A	X	Solder	After Change	86.6
02/19/2024	A	X	Solder	After Change	79.6

After this change, the solder station needs to be re-evaluated to confirm the results of the change. From the statistics of the updated time study, we can see that the mean cycle time of the process is reduced to 85 seconds.

Statistics

Variable	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3	Maximum
Time (Seconds)	85.00	1.47	11.42	130.53	72.22	79.55	81.85	84.13	129.60

Variable	Range
Time (Seconds)	57.38

Figure 31: Solder Station: Statistics (After Change)

Since there are two solder stations present on the production line, this means that the overall cycle time for the station is 42.5 seconds.

$$\text{Overall Cycle time} = \frac{85}{2}$$

$$= 42.5 \text{ Seconds}$$

This now makes the heat stake station the bottleneck station for the line as that station has the highest mean cycle time at 46.8 seconds. While comparing the performance of operator “X” with other operators, the following results were observed.

According to this, expected number of units produced per shift should be 840 units.

$$\text{UPH (units per hour)} = \frac{3600}{Cycle\ time\ (Bottleneck)}$$

$$= \frac{3600}{42.5} = 84.7$$

$$\text{Total units produced in one shift} = 84.7 * 10$$

$$= 840 \text{ units}$$

The performance of operator "X” is still below other operators as they have the highest amount of cycle time at 101.10 seconds which is nearly 20 seconds more than other operators with a standard deviation of 21.24 seconds. But, even after this we were able to reduce the overall cycle time of the process from 47.18 seconds to 42.5 seconds. The Histogram plot along with the box plot also confirms the results.

Statistics

Variable	Operator	Mean	SE Mean	StDev	Variance	Minimum	Q1	Median	Q3
Time (Seconds)	A	80.942	0.840	2.658	7.063	76.230	78.953	81.215	82.651
	B	81.950	0.995	3.145	9.892	77.050	79.248	82.195	84.004
	C	81.180	0.899	2.844	8.086	76.442	78.898	81.320	83.938
	D	80.504	0.705	2.229	4.967	77.165	78.602	80.040	82.332
	E	84.32	1.38	4.35	18.92	79.06	80.09	83.40	88.92
	X	101.10	6.72	21.24	451.07	72.22	78.22	108.31	120.25

Variable	Operator	Maximum	Range
Time (Seconds)	A	85.779	9.549
	B	87.847	10.797
	C	85.600	9.158
	D	83.971	6.806
	E	91.40	12.34
	X	129.60	57.38

Figure 32: Solder Station: Operator Performance Evaluation (After Change)

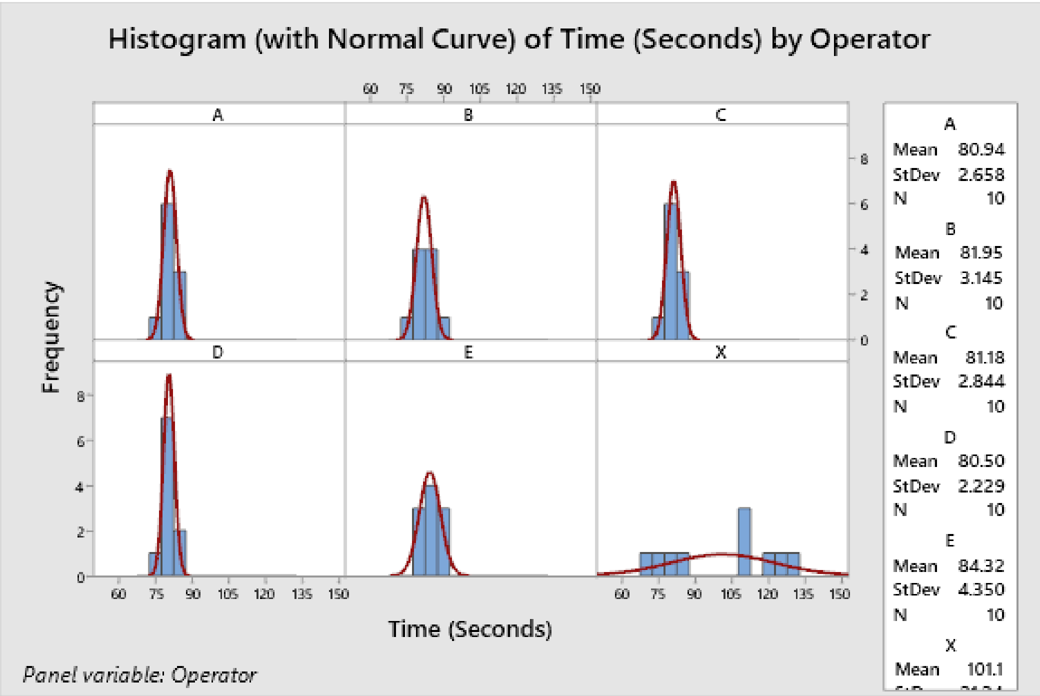


Figure 33: Solder Station: Histogram (After Change)

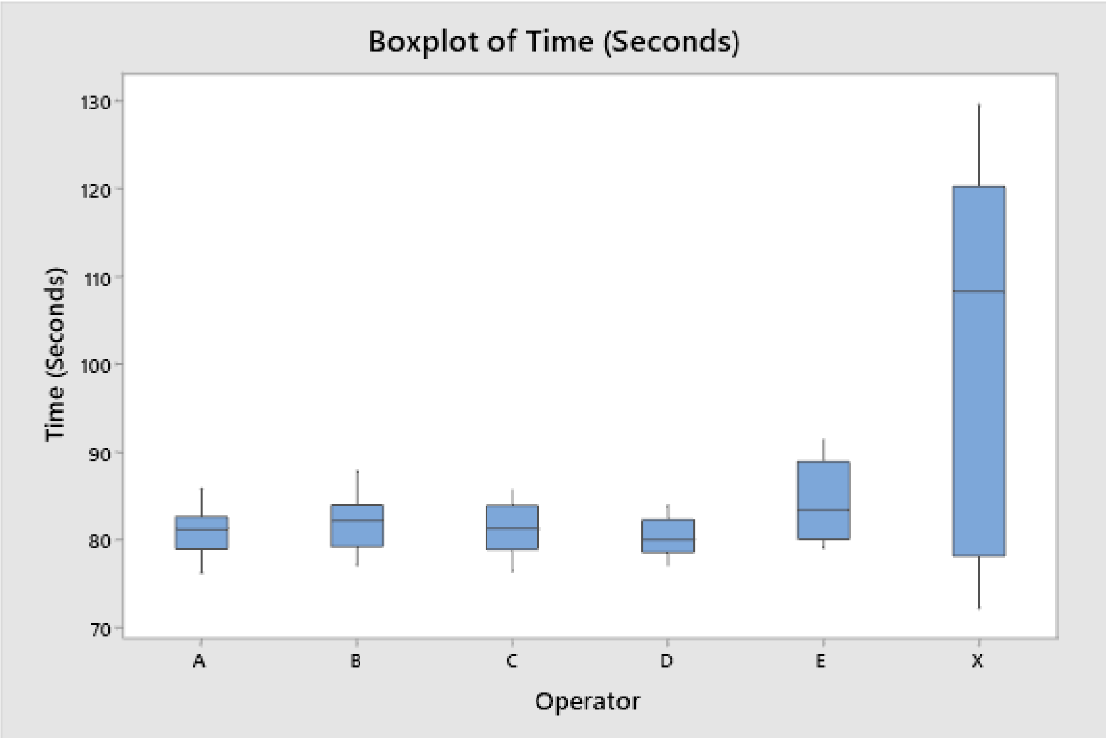
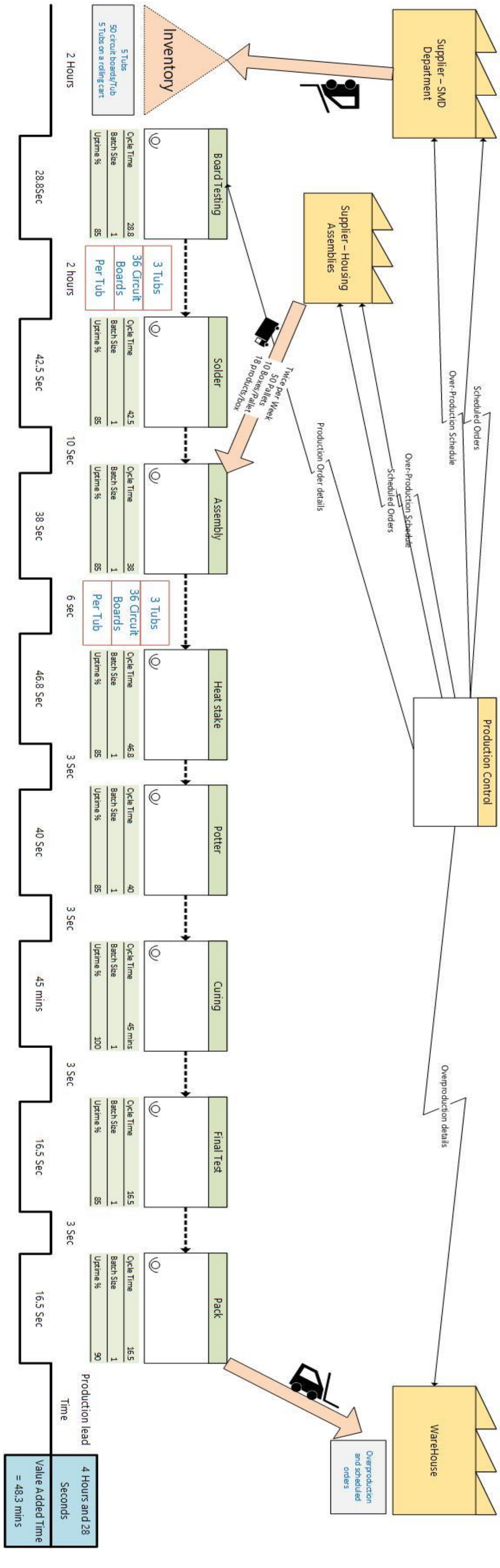


Figure 34: Solder Station: Box Plot (After Change)

Also, the value stream map has been updated after the implementation of the suggested change. The below figure shows the updated value stream map.



Supplier – SMD Department
Inventory
5 Tubs
50 circuit boards/Tub
5 Tubs on a rolling cart
Supplier – Housing Assemblies
Production Control
Scheduled Orders
Over-Production Schedule
Over-Production Schedule
Scheduled Orders
Production Order details
Twice per Week
10 Boxes/Pallet
50 Pallets
18 products/box
Board Testing
Cycle Time 28.8
Batch Size 1
Uptime % 85
3 Tubs
36 Circuit Boards
Per Tub
Solder
Cycle Time 42.5
Batch Size 1
Uptime % 85
Assembly
Cycle Time 38
Batch Size 1
Uptime % 85
3 Tubs
36 Circuit Boards
Per Tub
Heat stake
Cycle Time 46.8
Batch Size 1
Uptime % 85
Potter
Cycle Time 40
Batch Size 1
Uptime % 85
Curing
Cycle Time 45 mins
Batch Size 1
Uptime % 100
Final Test
Cycle Time 16.5
Batch Size 1
Uptime % 85
Pack
Cycle Time 16.5
Batch Size 1
Uptime % 90
Overproduction details
WareHouse
Overproduction and scheduled orders
2 Hours
28.8Sec
2 hours
42.5 Sec
10 Sec
38 Sec
6 sec
46.8 Sec
3 Sec
40 Sec
3 Sec
45 mins
3 Sec
16.5 Sec
3 Sec
16.5 Sec
Production lead Time
4 Hours and 28 Seconds
Value Added Time = 48.3 mins

From the below mentioned table we can see that the average number of units produced per shift is 585 units.

Shift	Product	Units
A	Gas Meter	610
A	Gas Meter	581
A	Gas Meter	592
A	Gas Meter	628
A	Gas Meter	524
A	Gas Meter	586
A	Gas Meter	571
A	Gas Meter	617
A	Gas Meter	569
A	Gas Meter	575
A	Gas Meter	589

To calculate the efficiency of the production line, the expected number of units produced should be based on the updated bottleneck which is the heat stake station.

$$\text{UPH (units per hour)} = \frac{3600}{Cycle\ time\ (Bottleneck)}$$

$$= \frac{3600}{46.8} = 76.9$$

Total units produced in one shift = 76.9 * 10

= 769 units

$$\text{Efficiency} = \frac{Observed\ number\ of\ units\ produced}{Expected\ number\ of\ units\ produced}$$

$$= \frac{585}{769} = 0.76$$

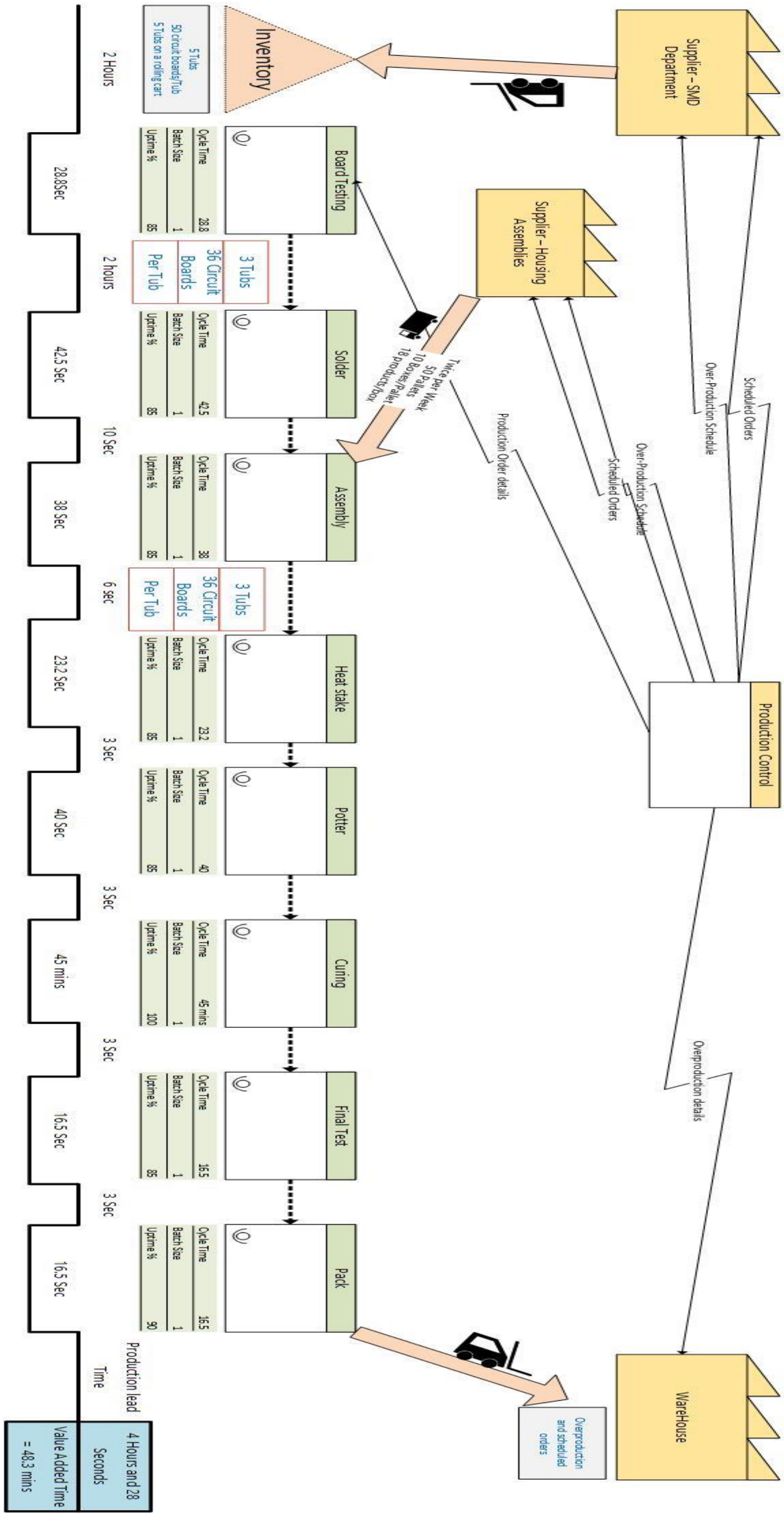
After the improvement, production efficiency of the line has increased from 53 percent to 76 percent.

Apart from this there are a few more recommendations which can be made to improve the production efficiency and increase the production numbers of the line. These recommendations are on the heat stake station as this is the bottleneck station. Currently these changes cannot be implemented on the production line as production will need to be halted to implement these changes. Since the company is focusing on over-producing now to cope with the customer demands during the plant shut down, production lines cannot be stopped. The first recommendation is to add another heat stake machine on the line, which will reduce the cycle time of the station to half since the other machine is the identical machine. This means that the updated cycle time would be 23.2 seconds for the station which will again make the solder station as the bottleneck. In that situation the expected production number would be the same as mentioned above at 840 units per shift.

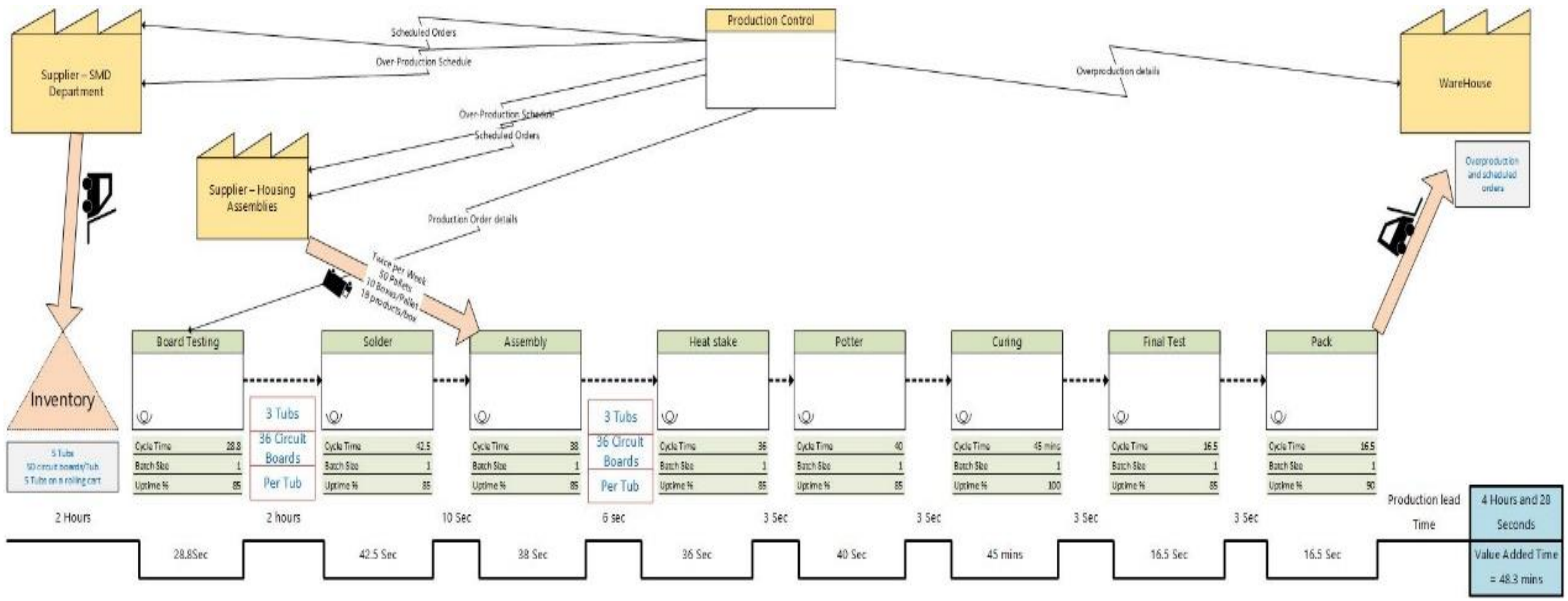
Another recommendation is to replace the heat stake machine with another heat stake machine which has the known cycle time of 36 seconds. In this case as well, the updated bottle neck station would be the solder station and the expected production numbers would remain same at 840 units per shift. In both the situations the overall production numbers are expected to improve.

Factor	Before Change	After Change	Proposed Change 1	Proposed Change 2
Bottleneck Station	Solder Station	Heat Stake	Solder Station	Solder Station
Bottleneck Cycle Time	47.18 Seconds	46.8 Seconds	42.5 Seconds	42.5 Seconds
Production Numbers	402 units/shift	585 units/shift	620 units/shift (Expected)	620 units/shift (Expected)
Production Efficiency	53 %	76 %	73% (Expected)	73% (Expected)

Value stream maps have also been updated according to the proposed changes in the heat stake station. The updated value stream maps can be found below.



Supplier – SMD Department
Supplier – Housing Assemblies
Production Control
WareHouse
Scheduled Orders
Over-Production Schedule
Scheduled Orders
Over-Production Schedule
Production Order details
Overproduction details
Twice per Week
50 Pallets
10 Boxes/Pallet
18 products/box
Inventory
5 Tubs
50 circuit boards/Tub
5 Tubs on a rolling cart
Board Testing
Cycle Time 28.8
Batch Size 1
Uptime % 85
3 Tubs
36 Circuit Boards
Per Tub
Solder
Cycle Time 42.5
Batch Size 1
Uptime % 85
Assembly
Cycle Time 38
Batch Size 1
Uptime % 85
3 Tubs
36 Circuit Boards
Per Tub
Heat stake
Cycle Time 23.2
Batch Size 1
Uptime % 85
Potter
Cycle Time 40
Batch Size 1
Uptime % 85
Curing
Cycle Time 45 mins
Batch Size 1
Uptime % 100
Final Test
Cycle Time 16.5
Batch Size 1
Uptime % 85
Pack
Cycle Time 16.5
Batch Size 1
Uptime % 90
Overproduction and scheduled orders
2 Hours
28.8Sec
2 hours
42.5 Sec
10 Sec
38 Sec
6 sec
23.2 Sec
3 Sec
40 Sec
3 Sec
45 mins
3 Sec
16.5 Sec
3 Sec
16.5 Sec
Production lead Time
4 Hours and 28 Seconds
Value Added Time = 48.3 mins


Supplier – SMD Department
Scheduled Orders
Over-Production Schedule
Production Control
Overproduction details
WareHouse
Supplier – Housing Assemblies
Over-Production Schedule
Scheduled Orders
Production Order details
Overproduction and scheduled orders
Twice per Week
50 Pallets
10 Boxes/Pallet
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Inventory
5 Tubs
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Board Testing
Cycle Time 28.8
Batch Size 1
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36 Circuit Boards
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Solder
Cycle Time 42.5
Batch Size 1
Uptime % 85
Assembly
Cycle Time 38
Batch Size 1
Uptime % 85
3 Tubs
36 Circuit Boards
Per Tub
Heat stake
Cycle Time 36
Batch Size 1
Uptime % 85
Potter
Cycle Time 40
Batch Size 1
Uptime % 85
Curing
Cycle Time 45 mins
Batch Size 1
Uptime % 100
Final Test
Cycle Time 16.5
Batch Size 1
Uptime % 85
Pack
Cycle Time 16.5
Batch Size 1
Uptime % 90
2 Hours
28.8Sec
2 hours
42.5 Sec
10 Sec
38 Sec
6 sec
36 Sec
3 Sec
40 Sec
3 Sec
45 mins
3 Sec
16.5 Sec
3 Sec
16.5 Sec
Production lead Time
4 Hours and 28 Seconds
Value Added Time = 48.3 mins

5. Control

The Control Phase includes the necessary measures to manage the achieved improvements and guarantee the development of a culture of continuous improvement. One of one such measures taken is the creation and maintenance of control charts which include the upper and lower control limits. As seen from the chart below, one of the points is out of the control limit which means that the situation needs to be addressed. Some other things that are included in the control phase are mentioned below:

Apart from that a Communication Plan was also created where in team lead/members can contact the designated engineers as per the requirements.

1. Technicians were required to follow maintenance procedures and safety checks before each shift. Team lead can contact the technicians if further assistance is needed.
2. In case of an operator unavailability, team lead has been directed to contact the human resource department.
3. In-case of receiving defective housings from the suppliers, team lead is directed to contact quality engineer or operations manager.
4. Similarly, for epoxy spillage near potter station, team lead has been directed to contact the Janitors as soon as possible.

Issue/Description	**Communication Method**	**Frequency**	**Responsibility**	**Owner**
Machine/Equipment	Walkie-Talkie	Daily	Technicians	Team Lead

Status				
Operator Unavailability	Email	Daily	Human Resource	Team Lead / Team
Defective Parts	Email	As Needed	Quality Engineer / Operations Manager	Team Lead
Epoxy Spillage	Walkie-Talkie	As Needed	Janitors	Team Lead

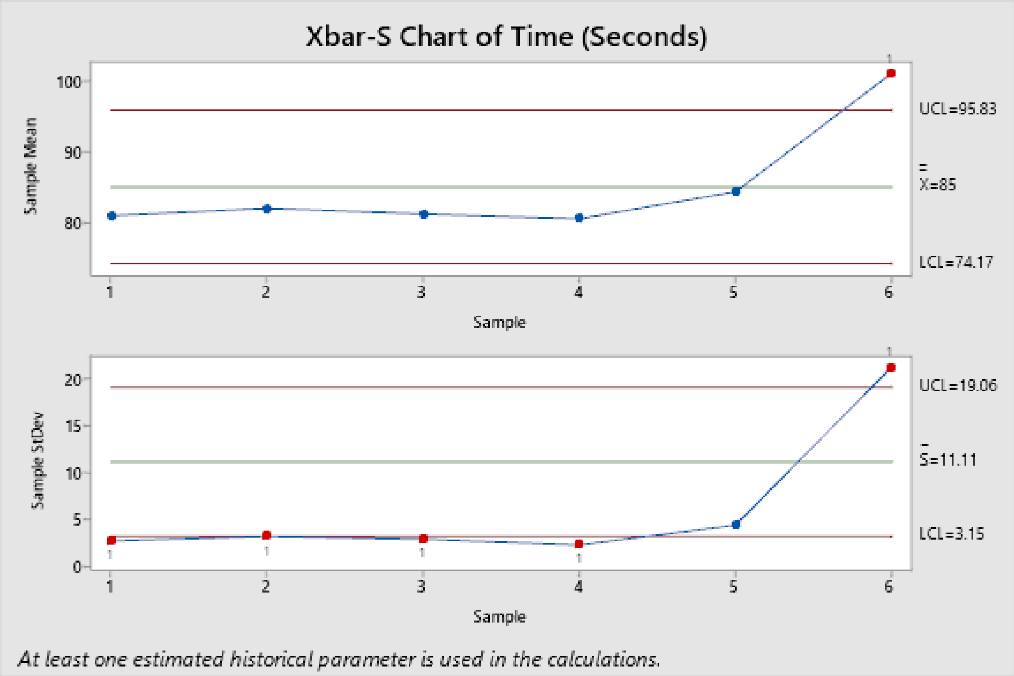

Figure 35: Solder Station: X-Bar S Chart

Results

The outcomes for each phase of the DMAIC process are mentioned below.

1. Define: The outline of the project was defined by identifying our goal to increase the production numbers from 402 units per shift to 770 units per shift. It was required to conduct the time study on every station of the line while also documenting the performance of the operators.
2. Measure: Time study on each line was conducted and the data was measured as per the requirements. The average cycle time for each station is mentioned below.

Station	**Cycle Time (Seconds)**
Board Test	28.8
Solder	47.18
Assembly	38
Heat Stake	46.8
Potter	40
Final Test	16.5
Pack	16.5

3. Analyze: In the Analyze phase, the solder station was identified as the bottleneck station with an average cycle time of 47.18 seconds. Upon further

consideration, it was witnessed that the average cycle time for Operator F was 157.21 seconds. The overall production efficiency was found to be 53%.

4. Improve: Operator F was replaced with Operator X, and it was found out that Operator X is 56 seconds quicker than Operator F. The overall cycle time of solder station reduced to 42.5 seconds and the production numbers increased to 585 units per shift.
5. Control: Use of X-bar S chart has been made mandatory for every station to see any outliers from the control limits. A communication matrix was also developed to keep the team and the management in better contact with each other.

Factor	**Before Change**	**After Change**	**Proposed Change 1**	**Proposed Change 2**
Bottleneck Station	Solder Station	Heat Stake	Solder Station	Solder Station
Bottleneck Cycle Time	47.18 Seconds	46.8 Seconds	42.5 Seconds	42.5 Seconds
Updated Station	N/A	Solder Station	Heat Stake	Heat Stake
Updated Cycle Time	N/A	42.5 Seconds	23.2 Seconds	36 Seconds
Production Numbers	402 units/shift	585 units/shift	620 units/shift (Expected)	620 units/shift (Expected)
Production Efficiency	53 %	76 %	73% (Expected)	73% (Expected)

Conclusion

DMAIC process was used to overcome the challenge of increasing production numbers. Successful results were observed after the successful implementation of the suggested improvisations.

- To find the bottleneck station, a time study was conducted for each station on the assembly line while also documenting the performance of the operators.
- Solder station was the bottleneck station in the current phase where most of the negative impact was due the inefficiency of operator “F”.
- Operator “F” was replaced with operator “X” and the overall cycle time of the process was reduced to 42.5 seconds which meant that the updated bottleneck station was heat stake station. The production efficiency was increased to 76 %.
- To reduce the cycle time on heat stake station, one of the suggested changes was to replace the heat stake machine with the updated machine which will reduce the cycle time of the station to 36 seconds.
- Another suggested change was to include another heat stake machine in the line which will reduce the cycle time of the station to 23.2 seconds and the updated bottleneck station will be the solder station with a cycle time of 42.5 seconds.

The successful implementation of the DMAIC process has increased the production numbers by nearly 200 units per shift, which could be improved if the suggested improvements are implemented.

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Appendix

Here are the time studies used in the experimentation.

1. Time Study for Board Test Station

Date	Shift	Operator	Process	Status	Time (Seconds)
02-12-2024	A	A	Board Test	Current Status (Before Change)	27.8
02-12-2024	A	A	Board Test	Current Status (Before Change)	24.2
02-12-2024	A	A	Board Test	Current Status (Before Change)	33.5
02-12-2024	A	A	Board Test	Current Status (Before Change)	31.8
02-12-2024	A	A	Board Test	Current Status (Before Change)	23.4
02-12-2024	A	A	Board Test	Current Status (Before Change)	28.0
02-12-2024	A	A	Board Test	Current Status (Before Change)	31.3
02-12-2024	A	A	Board Test	Current Status (Before Change)	31.3
02-12-2024	A	A	Board Test	Current Status (Before Change)	28.6
02-12-2024	A	A	Board Test	Current Status (Before Change)	30.4
02-12-2024	A	B	Board Test	Current Status (Before Change)	32.1
02-12-2024	A	B	Board Test	Current Status (Before Change)	29.6
02-12-2024	A	B	Board Test	Current Status (Before Change)	26.9
02-12-2024	A	B	Board Test	Current Status (Before Change)	29.3
02-12-2024	A	B	Board Test	Current Status (Before Change)	27.0
02-12-2024	A	B	Board Test	Current Status (Before Change)	27.7
02-12-2024	A	B	Board Test	Current Status (Before Change)	27.6
02-12-2024	A	B	Board Test	Current Status (Before Change)	32.8
02-12-2024	A	B	Board Test	Current Status (Before Change)	30.8
02-12-2024	A	B	Board Test	Current Status (Before Change)	28.8
02-12-2024	A	C	Board Test	Current Status (Before Change)	23.4
02-12-2024	A	C	Board Test	Current Status (Before Change)	26.4
02-12-2024	A	C	Board Test	Current Status (Before Change)	31.7
02-12-2024	A	C	Board Test	Current Status (Before Change)	33.1
02-12-2024	A	C	Board Test	Current Status (Before Change)	24.7
02-12-2024	A	C	Board Test	Current Status (Before Change)	28.9
02-12-2024	A	C	Board Test	Current Status (Before Change)	27.3
02-12-2024	A	C	Board Test	Current Status (Before Change)	30.3
02-12-2024	A	C	Board Test	Current Status (Before Change)	34.0
02-12-2024	A	C	Board Test	Current Status (Before Change)	24.3
02-12-2024	A	D	Board Test	Current Status (Before Change)	32.4
02-12-2024	A	D	Board Test	Current Status (Before Change)	27.6
02-12-2024	A	D	Board Test	Current Status (Before Change)	29.0
02-12-2024	A	D	Board Test	Current Status (Before Change)	30.0
02-12-2024	A	D	Board Test	Current Status (Before Change)	28.5
02-12-2024	A	D	Board Test	Current Status (Before Change)	22.0

02-12-2024	A	D	Board Test	Current Status (Before Change)	32.1
02-12-2024	A	D	Board Test	Current Status (Before Change)	28.1
02-12-2024	A	D	Board Test	Current Status (Before Change)	26.2
02-12-2024	A	D	Board Test	Current Status (Before Change)	30.1
02-12-2024	A	E	Board Test	Current Status (Before Change)	25.2
02-12-2024	A	E	Board Test	Current Status (Before Change)	33.3
02-12-2024	A	E	Board Test	Current Status (Before Change)	32.4
02-12-2024	A	E	Board Test	Current Status (Before Change)	33.5
02-12-2024	A	E	Board Test	Current Status (Before Change)	24.0
02-12-2024	A	E	Board Test	Current Status (Before Change)	30.4
02-12-2024	A	E	Board Test	Current Status (Before Change)	33.2
02-12-2024	A	E	Board Test	Current Status (Before Change)	31.8
02-12-2024	A	E	Board Test	Current Status (Before Change)	30.7
02-12-2024	A	E	Board Test	Current Status (Before Change)	31.6
02-12-2024	A	F	Board Test	Current Status (Before Change)	28.4
02-12-2024	A	F	Board Test	Current Status (Before Change)	29.4
02-12-2024	A	F	Board Test	Current Status (Before Change)	32.2
02-12-2024	A	F	Board Test	Current Status (Before Change)	30.3
02-12-2024	A	F	Board Test	Current Status (Before Change)	30.7
02-12-2024	A	F	Board Test	Current Status (Before Change)	33.7
02-12-2024	A	F	Board Test	Current Status (Before Change)	32.0
02-12-2024	A	F	Board Test	Current Status (Before Change)	28.7
02-12-2024	A	F	Board Test	Current Status (Before Change)	23.9
02-12-2024	A	F	Board Test	Current Status (Before Change)	30.1

2. Time Study for Solder Station

Date	Shift	Operator	Process	Status	Time (Seconds)
02-12-2024	A	A	Solder	Current Status (Before Change)	82.5
02-12-2024	A	A	Solder	Current Status (Before Change)	79.0
02-12-2024	A	A	Solder	Current Status (Before Change)	79.7
02-12-2024	A	A	Solder	Current Status (Before Change)	76.2
02-12-2024	A	A	Solder	Current Status (Before Change)	81.7
02-12-2024	A	A	Solder	Current Status (Before Change)	83.0
02-12-2024	A	A	Solder	Current Status (Before Change)	78.9
02-12-2024	A	A	Solder	Current Status (Before Change)	80.7
02-12-2024	A	A	Solder	Current Status (Before Change)	85.8
02-12-2024	A	A	Solder	Current Status (Before Change)	81.8
02-12-2024	A	B	Solder	Current Status (Before Change)	84.0
02-12-2024	A	B	Solder	Current Status (Before Change)	82.5
02-12-2024	A	B	Solder	Current Status (Before Change)	84.2
02-12-2024	A	B	Solder	Current Status (Before Change)	81.0
02-12-2024	A	B	Solder	Current Status (Before Change)	79.5
02-12-2024	A	B	Solder	Current Status (Before Change)	87.8

02-12-2024	A	B	Solder	Current Status (Before Change)	81.9
02-12-2024	A	B	Solder	Current Status (Before Change)	77.1
02-12-2024	A	B	Solder	Current Status (Before Change)	83.2
02-12-2024	A	B	Solder	Current Status (Before Change)	78.4
02-12-2024	A	C	Solder	Current Status (Before Change)	79.1
02-12-2024	A	C	Solder	Current Status (Before Change)	79.8
02-12-2024	A	C	Solder	Current Status (Before Change)	78.2
02-12-2024	A	C	Solder	Current Status (Before Change)	77.8
02-12-2024	A	C	Solder	Current Status (Before Change)	84.1
02-12-2024	A	C	Solder	Current Status (Before Change)	81.7
02-12-2024	A	C	Solder	Current Status (Before Change)	78.4
02-12-2024	A	C	Solder	Current Status (Before Change)	81.9
02-12-2024	A	C	Solder	Current Status (Before Change)	81.0
02-12-2024	A	C	Solder	Current Status (Before Change)	76.4
02-12-2024	A	D	Solder	Current Status (Before Change)	80.2
02-12-2024	A	D	Solder	Current Status (Before Change)	79.8
02-12-2024	A	D	Solder	Current Status (Before Change)	79.8
02-12-2024	A	D	Solder	Current Status (Before Change)	81.8
02-12-2024	A	D	Solder	Current Status (Before Change)	82.0
02-12-2024	A	D	Solder	Current Status (Before Change)	77.2
02-12-2024	A	D	Solder	Current Status (Before Change)	78.8
02-12-2024	A	D	Solder	Current Status (Before Change)	84.0
02-12-2024	A	D	Solder	Current Status (Before Change)	83.3
02-12-2024	A	D	Solder	Current Status (Before Change)	78.1
02-12-2024	A	E	Solder	Current Status (Before Change)	77.8
02-12-2024	A	E	Solder	Current Status (Before Change)	80.1
02-12-2024	A	E	Solder	Current Status (Before Change)	78.5
02-12-2024	A	E	Solder	Current Status (Before Change)	83.7
02-12-2024	A	E	Solder	Current Status (Before Change)	79.9
02-12-2024	A	E	Solder	Current Status (Before Change)	79.1
02-12-2024	A	E	Solder	Current Status (Before Change)	83.0
02-12-2024	A	E	Solder	Current Status (Before Change)	84.2
02-12-2024	A	E	Solder	Current Status (Before Change)	80.2
02-12-2024	A	E	Solder	Current Status (Before Change)	83.1
02-12-2024	A	F	Solder	Current Status (Before Change)	152.0
02-12-2024	A	F	Solder	Current Status (Before Change)	168.6
02-12-2024	A	F	Solder	Current Status (Before Change)	163.2
02-12-2024	A	F	Solder	Current Status (Before Change)	164.0
02-12-2024	A	F	Solder	Current Status (Before Change)	156.4
02-12-2024	A	F	Solder	Current Status (Before Change)	161.0
02-12-2024	A	F	Solder	Current Status (Before Change)	161.6
02-12-2024	A	F	Solder	Current Status (Before Change)	153.3
02-12-2024	A	F	Solder	Current Status (Before Change)	149.2
02-12-2024	A	F	Solder	Current Status (Before Change)	143.0

3. Time Study for Assembly Station

Date	Shift	Operator	Process	Status	Time (Seconds)
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	60.4
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	40.0
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	41.6
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	36.9
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	30.4
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	37.9
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	37.6
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	51.2
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	48.3
02-12-2024	A	A	Housing Assembly	Current Status (Before Change)	52.3
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	47.3
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	29.2
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	54.3
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	38.2
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	34.0
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	51.3
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	45.9
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	41.2
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	42.3
02-12-2024	A	B	Housing Assembly	Current Status (Before Change)	41.8
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	44.6
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	50.9
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	41.1
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	38.9
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	28.0
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	44.8
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	36.6
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	69.3
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	41.9
02-12-2024	A	C	Housing Assembly	Current Status (Before Change)	49.9
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	36.6
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	27.7
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	25.1
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	46.6
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	35.2
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	35.2
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	26.9
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	47.8

02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	39.3
02-12-2024	A	D	Housing Assembly	Current Status (Before Change)	45.0
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	32.9
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	46.3
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	40.1
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	49.2
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	37.5
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	57.8
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	43.8
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	30.0
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	34.4
02-12-2024	A	E	Housing Assembly	Current Status (Before Change)	39.9
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	38.0
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	40.2
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	40.4
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	55.1
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	61.5
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	48.9
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	59.3
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	60.8
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	41.4
02-12-2024	A	F	Housing Assembly	Current Status (Before Change)	54.7

4. Time Study for Heat Stake Station

Date	**Shift**	**Operator**	**Process**	**Status**	**Time (Seconds)**
02/13/2024	A	A	Heatstake	Current Status (Before Change)	47.9
02/13/2024	A	A	Heatstake	Current Status (Before Change)	39.0
02/13/2024	A	A	Heatstake	Current Status (Before Change)	47.1
02/13/2024	A	A	Heatstake	Current Status (Before Change)	47.5
02/13/2024	A	A	Heatstake	Current Status (Before Change)	55.9
02/13/2024	A	A	Heatstake	Current Status (Before Change)	47.4
02/13/2024	A	A	Heatstake	Current Status (Before Change)	48.3
02/13/2024	A	A	Heatstake	Current Status (Before Change)	42.0
02/13/2024	A	A	Heatstake	Current Status (Before Change)	49.8
02/13/2024	A	A	Heatstake	Current Status (Before Change)	51.5
02/13/2024	A	B	Heatstake	Current Status (Before Change)	45.9
02/13/2024	A	B	Heatstake	Current Status (Before Change)	47.0
02/13/2024	A	B	Heatstake	Current Status (Before Change)	38.2

02/13/2024	A	B	Heatstake	Current Status (Before Change)	46.8
02/13/2024	A	B	Heatstake	Current Status (Before Change)	48.6
02/13/2024	A	B	Heatstake	Current Status (Before Change)	30.7
02/13/2024	A	B	Heatstake	Current Status (Before Change)	46.4
02/13/2024	A	B	Heatstake	Current Status (Before Change)	54.1
02/13/2024	A	B	Heatstake	Current Status (Before Change)	33.0
02/13/2024	A	B	Heatstake	Current Status (Before Change)	44.9
02/13/2024	A	C	Heatstake	Current Status (Before Change)	57.1
02/13/2024	A	C	Heatstake	Current Status (Before Change)	45.3
02/13/2024	A	C	Heatstake	Current Status (Before Change)	33.6
02/13/2024	A	C	Heatstake	Current Status (Before Change)	53.1
02/13/2024	A	C	Heatstake	Current Status (Before Change)	38.0
02/13/2024	A	C	Heatstake	Current Status (Before Change)	33.7
02/13/2024	A	C	Heatstake	Current Status (Before Change)	44.2
02/13/2024	A	C	Heatstake	Current Status (Before Change)	38.4
02/13/2024	A	C	Heatstake	Current Status (Before Change)	55.9
02/13/2024	A	C	Heatstake	Current Status (Before Change)	46.7
02/13/2024	A	D	Heatstake	Current Status (Before Change)	49.7
02/13/2024	A	D	Heatstake	Current Status (Before Change)	53.7
02/13/2024	A	D	Heatstake	Current Status (Before Change)	34.1
02/13/2024	A	D	Heatstake	Current Status (Before Change)	47.9
02/13/2024	A	D	Heatstake	Current Status (Before Change)	40.2
02/13/2024	A	D	Heatstake	Current Status (Before Change)	45.0
02/13/2024	A	D	Heatstake	Current Status (Before Change)	48.0
02/13/2024	A	D	Heatstake	Current Status (Before Change)	59.2
02/13/2024	A	D	Heatstake	Current Status (Before Change)	62.2
02/13/2024	A	D	Heatstake	Current Status (Before Change)	47.1
02/13/2024	A	E	Heatstake	Current Status (Before Change)	33.5
02/13/2024	A	E	Heatstake	Current Status (Before Change)	44.8
02/13/2024	A	E	Heatstake	Current Status (Before Change)	43.2
02/13/2024	A	E	Heatstake	Current Status (Before Change)	51.6
02/13/2024	A	E	Heatstake	Current Status (Before Change)	52.7
02/13/2024	A	E	Heatstake	Current Status (Before Change)	33.2
02/13/2024	A	E	Heatstake	Current Status (Before Change)	36.2
02/13/2024	A	E	Heatstake	Current Status (Before Change)	44.5
02/13/2024	A	E	Heatstake	Current Status (Before Change)	40.1
02/13/2024	A	E	Heatstake	Current Status (Before Change)	44.6
02/13/2024	A	F	Heatstake	Current Status (Before Change)	53.6
02/13/2024	A	F	Heatstake	Current Status (Before Change)	53.2
02/13/2024	A	F	Heatstake	Current Status (Before Change)	52.3
02/13/2024	A	F	Heatstake	Current Status (Before Change)	51.3
02/13/2024	A	F	Heatstake	Current Status (Before Change)	58.4

02/13/2024	A	F	Heatstake	Current Status (Before Change)	57.5
02/13/2024	A	F	Heatstake	Current Status (Before Change)	55.1
02/13/2024	A	F	Heatstake	Current Status (Before Change)	55.9
02/13/2024	A	F	Heatstake	Current Status (Before Change)	47.8
02/13/2024	A	F	Heatstake	Current Status (Before Change)	55.2

5. Time Study for Potter Station

Date	Shift	Operator	Process	Status	Time (Seconds)
02-12-2024	A	A	Potter	Current Status (Before Change)	36.7
02-12-2024	A	A	Potter	Current Status (Before Change)	39.3
02-12-2024	A	A	Potter	Current Status (Before Change)	29.6
02-12-2024	A	A	Potter	Current Status (Before Change)	36.2
02-12-2024	A	A	Potter	Current Status (Before Change)	47.6
02-12-2024	A	A	Potter	Current Status (Before Change)	44.3
02-12-2024	A	A	Potter	Current Status (Before Change)	44.3
02-12-2024	A	A	Potter	Current Status (Before Change)	36.4
02-12-2024	A	A	Potter	Current Status (Before Change)	36.0
02-12-2024	A	A	Potter	Current Status (Before Change)	33.4
02-12-2024	A	B	Potter	Current Status (Before Change)	29.0
02-12-2024	A	B	Potter	Current Status (Before Change)	40.3
02-12-2024	A	B	Potter	Current Status (Before Change)	39.7
02-12-2024	A	B	Potter	Current Status (Before Change)	48.9
02-12-2024	A	B	Potter	Current Status (Before Change)	36.6
02-12-2024	A	B	Potter	Current Status (Before Change)	37.3
02-12-2024	A	B	Potter	Current Status (Before Change)	33.9
02-12-2024	A	B	Potter	Current Status (Before Change)	46.0
02-12-2024	A	B	Potter	Current Status (Before Change)	33.8
02-12-2024	A	B	Potter	Current Status (Before Change)	38.9
02-12-2024	A	C	Potter	Current Status (Before Change)	40.4
02-12-2024	A	C	Potter	Current Status (Before Change)	34.1
02-12-2024	A	C	Potter	Current Status (Before Change)	46.2
02-12-2024	A	C	Potter	Current Status (Before Change)	42.2
02-12-2024	A	C	Potter	Current Status (Before Change)	45.8
02-12-2024	A	C	Potter	Current Status (Before Change)	39.2
02-12-2024	A	C	Potter	Current Status (Before Change)	41.3
02-12-2024	A	C	Potter	Current Status (Before Change)	48.9
02-12-2024	A	C	Potter	Current Status (Before Change)	58.1
02-12-2024	A	C	Potter	Current Status (Before Change)	48.3

02-12-2024	A	D	Potter	Current Status (Before Change)	41.5
02-12-2024	A	D	Potter	Current Status (Before Change)	46.4
02-12-2024	A	D	Potter	Current Status (Before Change)	42.9
02-12-2024	A	D	Potter	Current Status (Before Change)	35.2
02-12-2024	A	D	Potter	Current Status (Before Change)	50.3
02-12-2024	A	D	Potter	Current Status (Before Change)	43.9
02-12-2024	A	D	Potter	Current Status (Before Change)	35.4
02-12-2024	A	D	Potter	Current Status (Before Change)	35.6
02-12-2024	A	D	Potter	Current Status (Before Change)	39.6
02-12-2024	A	D	Potter	Current Status (Before Change)	45.0
02-12-2024	A	E	Potter	Current Status (Before Change)	37.1
02-12-2024	A	E	Potter	Current Status (Before Change)	40.6
02-12-2024	A	E	Potter	Current Status (Before Change)	33.8
02-12-2024	A	E	Potter	Current Status (Before Change)	42.4
02-12-2024	A	E	Potter	Current Status (Before Change)	43.8
02-12-2024	A	E	Potter	Current Status (Before Change)	16.8
02-12-2024	A	E	Potter	Current Status (Before Change)	42.2
02-12-2024	A	E	Potter	Current Status (Before Change)	44.0
02-12-2024	A	E	Potter	Current Status (Before Change)	32.4
02-12-2024	A	E	Potter	Current Status (Before Change)	46.2
02-12-2024	A	F	Potter	Current Status (Before Change)	33.4
02-12-2024	A	F	Potter	Current Status (Before Change)	58.4
02-12-2024	A	F	Potter	Current Status (Before Change)	41.4
02-12-2024	A	F	Potter	Current Status (Before Change)	43.0
02-12-2024	A	F	Potter	Current Status (Before Change)	43.8
02-12-2024	A	F	Potter	Current Status (Before Change)	36.1
02-12-2024	A	F	Potter	Current Status (Before Change)	31.8
02-12-2024	A	F	Potter	Current Status (Before Change)	35.7
02-12-2024	A	F	Potter	Current Status (Before Change)	30.3
02-12-2024	A	F	Potter	Current Status (Before Change)	50.9

6. Time Study for Final Test Station

Date	**Shift**	**Operator**	**Process**	**Status**	**Time (Seconds)**
02-12-2024	A	A	Final Test	Current Status (Before Change)	33.8
02-12-2024	A	A	Final Test	Current Status (Before Change)	34.1
02-12-2024	A	A	Final Test	Current Status (Before Change)	37.9
02-12-2024	A	A	Final Test	Current Status (Before Change)	35.2
02-12-2024	A	A	Final Test	Current Status (Before Change)	39.2
02-12-2024	A	A	Final Test	Current Status (Before Change)	37.5

02-12-2024	A	A	Final Test	Current Status (Before Change)	28.3
02-12-2024	A	A	Final Test	Current Status (Before Change)	35.5
02-12-2024	A	A	Final Test	Current Status (Before Change)	34.2
02-12-2024	A	A	Final Test	Current Status (Before Change)	30.2
02-12-2024	A	B	Final Test	Current Status (Before Change)	24.2
02-12-2024	A	B	Final Test	Current Status (Before Change)	31.4
02-12-2024	A	B	Final Test	Current Status (Before Change)	36.6
02-12-2024	A	B	Final Test	Current Status (Before Change)	34.3
02-12-2024	A	B	Final Test	Current Status (Before Change)	33.6
02-12-2024	A	B	Final Test	Current Status (Before Change)	33.3
02-12-2024	A	B	Final Test	Current Status (Before Change)	29.7
02-12-2024	A	B	Final Test	Current Status (Before Change)	25.9
02-12-2024	A	B	Final Test	Current Status (Before Change)	31.2
02-12-2024	A	B	Final Test	Current Status (Before Change)	30.1
02-12-2024	A	C	Final Test	Current Status (Before Change)	34.3
02-12-2024	A	C	Final Test	Current Status (Before Change)	34.0
02-12-2024	A	C	Final Test	Current Status (Before Change)	30.6
02-12-2024	A	C	Final Test	Current Status (Before Change)	26.3
02-12-2024	A	C	Final Test	Current Status (Before Change)	34.5
02-12-2024	A	C	Final Test	Current Status (Before Change)	30.7
02-12-2024	A	C	Final Test	Current Status (Before Change)	31.3
02-12-2024	A	C	Final Test	Current Status (Before Change)	31.2
02-12-2024	A	C	Final Test	Current Status (Before Change)	30.9
02-12-2024	A	C	Final Test	Current Status (Before Change)	35.6
02-12-2024	A	D	Final Test	Current Status (Before Change)	27.9
02-12-2024	A	D	Final Test	Current Status (Before Change)	24.8
02-12-2024	A	D	Final Test	Current Status (Before Change)	31.6
02-12-2024	A	D	Final Test	Current Status (Before Change)	32.1
02-12-2024	A	D	Final Test	Current Status (Before Change)	39.1
02-12-2024	A	D	Final Test	Current Status (Before Change)	32.9
02-12-2024	A	D	Final Test	Current Status (Before Change)	32.1
02-12-2024	A	D	Final Test	Current Status (Before Change)	30.4
02-12-2024	A	D	Final Test	Current Status (Before Change)	33.1
02-12-2024	A	D	Final Test	Current Status (Before Change)	32.7
02-12-2024	A	E	Final Test	Current Status (Before Change)	32.3
02-12-2024	A	E	Final Test	Current Status (Before Change)	33.3
02-12-2024	A	E	Final Test	Current Status (Before Change)	37.1
02-12-2024	A	E	Final Test	Current Status (Before Change)	35.9
02-12-2024	A	E	Final Test	Current Status (Before Change)	35.5
02-12-2024	A	E	Final Test	Current Status (Before Change)	31.1
02-12-2024	A	E	Final Test	Current Status (Before Change)	34.6
02-12-2024	A	E	Final Test	Current Status (Before Change)	33.3

02-12-2024	A	E	Final Test	Current Status (Before Change)	38.1
02-12-2024	A	E	Final Test	Current Status (Before Change)	41.0
02-12-2024	A	F	Final Test	Current Status (Before Change)	37.8
02-12-2024	A	F	Final Test	Current Status (Before Change)	29.5
02-12-2024	A	F	Final Test	Current Status (Before Change)	36.4
02-12-2024	A	F	Final Test	Current Status (Before Change)	30.2
02-12-2024	A	F	Final Test	Current Status (Before Change)	35.3
02-12-2024	A	F	Final Test	Current Status (Before Change)	32.9
02-12-2024	A	F	Final Test	Current Status (Before Change)	29.3
02-12-2024	A	F	Final Test	Current Status (Before Change)	28.5
02-12-2024	A	F	Final Test	Current Status (Before Change)	31.4
02-12-2024	A	F	Final Test	Current Status (Before Change)	28.7

7. Time Study for Pack Station

Date	Shift	Operator	Process	Status	Time (Seconds)
02-14-2024	A	A	Pack Station	Current Status (Before Change)	17.1
02-14-2024	A	A	Pack Station	Current Status (Before Change)	18.2
02-14-2024	A	A	Pack Station	Current Status (Before Change)	17.1
02-14-2024	A	A	Pack Station	Current Status (Before Change)	15.9
02-14-2024	A	A	Pack Station	Current Status (Before Change)	14.2
02-14-2024	A	A	Pack Station	Current Status (Before Change)	16.9
02-14-2024	A	A	Pack Station	Current Status (Before Change)	17.1
02-14-2024	A	A	Pack Station	Current Status (Before Change)	16.5
02-14-2024	A	A	Pack Station	Current Status (Before Change)	20.0
02-14-2024	A	A	Pack Station	Current Status (Before Change)	14.9
02-14-2024	A	B	Pack Station	Current Status (Before Change)	15.4
02-14-2024	A	B	Pack Station	Current Status (Before Change)	21.0
02-14-2024	A	B	Pack Station	Current Status (Before Change)	21.0
02-14-2024	A	B	Pack Station	Current Status (Before Change)	16.3
02-14-2024	A	B	Pack Station	Current Status (Before Change)	14.0
02-14-2024	A	B	Pack Station	Current Status (Before Change)	16.8
02-14-2024	A	B	Pack Station	Current Status (Before Change)	14.9
02-14-2024	A	B	Pack Station	Current Status (Before Change)	15.7
02-14-2024	A	B	Pack Station	Current Status (Before Change)	9.9
02-14-2024	A	B	Pack Station	Current Status (Before Change)	12.4
02-14-2024	A	C	Pack Station	Current Status (Before Change)	14.6
02-14-2024	A	C	Pack Station	Current Status (Before Change)	11.6
02-14-2024	A	C	Pack Station	Current Status (Before Change)	15.5
02-14-2024	A	C	Pack Station	Current Status (Before Change)	17.8
02-14-2024	A	C	Pack Station	Current Status (Before Change)	17.6
02-14-2024	A	C	Pack Station	Current Status (Before Change)	17.6

02-14-2024	A	C	Pack Station	Current Status (Before Change)	16.5
02-14-2024	A	C	Pack Station	Current Status (Before Change)	19.2
02-14-2024	A	C	Pack Station	Current Status (Before Change)	18.6
02-14-2024	A	C	Pack Station	Current Status (Before Change)	14.8
02-14-2024	A	D	Pack Station	Current Status (Before Change)	17.1
02-14-2024	A	D	Pack Station	Current Status (Before Change)	13.9
02-14-2024	A	D	Pack Station	Current Status (Before Change)	19.1
02-14-2024	A	D	Pack Station	Current Status (Before Change)	14.7
02-14-2024	A	D	Pack Station	Current Status (Before Change)	15.9
02-14-2024	A	D	Pack Station	Current Status (Before Change)	21.0
02-14-2024	A	D	Pack Station	Current Status (Before Change)	12.1
02-14-2024	A	D	Pack Station	Current Status (Before Change)	19.3
02-14-2024	A	D	Pack Station	Current Status (Before Change)	17.7
02-14-2024	A	D	Pack Station	Current Status (Before Change)	17.4
02-14-2024	A	E	Pack Station	Current Status (Before Change)	17.0
02-14-2024	A	E	Pack Station	Current Status (Before Change)	19.9
02-14-2024	A	E	Pack Station	Current Status (Before Change)	22.0
02-14-2024	A	E	Pack Station	Current Status (Before Change)	14.6
02-14-2024	A	E	Pack Station	Current Status (Before Change)	17.9
02-14-2024	A	E	Pack Station	Current Status (Before Change)	15.7
02-14-2024	A	E	Pack Station	Current Status (Before Change)	14.1
02-14-2024	A	E	Pack Station	Current Status (Before Change)	20.9
02-14-2024	A	E	Pack Station	Current Status (Before Change)	15.0
02-14-2024	A	E	Pack Station	Current Status (Before Change)	19.9
02-14-2024	A	F	Pack Station	Current Status (Before Change)	22.1
02-14-2024	A	F	Pack Station	Current Status (Before Change)	18.9
02-14-2024	A	F	Pack Station	Current Status (Before Change)	20.9
02-14-2024	A	F	Pack Station	Current Status (Before Change)	19.5
02-14-2024	A	F	Pack Station	Current Status (Before Change)	18.6
02-14-2024	A	F	Pack Station	Current Status (Before Change)	19.6
02-14-2024	A	F	Pack Station	Current Status (Before Change)	17.8
02-14-2024	A	F	Pack Station	Current Status (Before Change)	18.1
02-14-2024	A	F	Pack Station	Current Status (Before Change)	18.5
02-14-2024	A	F	Pack Station	Current Status (Before Change)	25.6