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VALUE STREAM MAPPING FOR SOLAR SP PUMPS

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Abstract: Lean manufacturing is a methodology that focuses on minimizing waste within manufacturing systems while simultaneously maximizing productivity. One important tool of lean manufacturing principle is Value stream mapping. Value stream mapping also known as information and material flow mapping helps to reduce/eliminate the time spent on unnecessary nonvalue added activities. This is an important visual tool that maps the entire process in the manufacturing of a product, helping us identify the value addition, up and down time in the production process, etc. Identifying the cause for non-value-added processing time helps reduce the same ensuring better productivity, shorter lead time and higher plant capacity without compromising on the quality, quantity, performance or efficiency of the final product

Keywords: Lean manufacturing,Value stream mapping, information and material flow mapping

1.Introduction:

` Value streams are a component of the business ecosystem that describe how a stakeholder – often a customer – receives value from an organization. The process of classifying and analysing the flow of value in an enterprise is called Value Stream Mapping. Value-stream mapping, also known as "material- and information-flow mapping", is a lean- management method for analysing the current state and designing a future state for the series of events that take a product or service from the beginning of the specific process until it reaches the customer. A value stream map is a visual tool that displays all critical steps in a specific process and quantifies easily the time and volume taken at each stage. Value stream maps show the flow of both materials and information as they progress through the process. Steps involved in Value Stream Mapping take in all the activities of the enterprise into consideration.

Value Stream Mapping is essentially a cycle that begins at the start of the processes, i.e., Customer Order. Once the confirmation for the customer's order is received the order is passed to the planning department. This department is where the order received is processed depending on the deadline, the availability of raw material, manufacturing capacity of the plant, etc. After the order confirmation is received from the customer end there is an order placed to the vendors for the raw materials. The value stream flow starts from this point and ends with the finished goods being delivered to the customer. A value-added activity is any action taken that increases the benefit of a good or service to a customer.

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Activities that contribute to the performance, quality, capacity, longevity, etc of the product are classified as value addition activities. Non-Value-Added Activities involve work that consumes resources, but does not add value to the product or service. Activities that do not contribute to the performance, quality, capacity, longevity, etc of the product are classified as non-value addition activities. Necessary Non-Value- Added activities are a bit trickier to identify. These are activities that do not add value to the product or service but are currently necessary. Activities that focus on reliability, efficiency, performance, brand name, safety, etc are necessary non-value-added activities.

1.2 Cables

A submersible pump cable is a specialized product to be used for a submersible pump in a deep well, or in similarly harsh conditions. The cable needed for this type of application must be durable and reliable as the installation location and environment can be extremely restrictive as well as hostile. As such, submersible pump cable can be used in both fresh and salt water. It is also suitable for direct burial and within well castings. A submersible pump cable's area of installation is physically restrictive. Cable manufacturers must keep these factors in mind to achieve the highest possible degree of reliability.

The size and shape of submersible pump cable can vary depending on the usage and preference and pumping instrument of the installer. Pump cables are made in single and multiple conductor types and may be flat or round in cross section; some types include control wires as well as power conductors for the pump motor. Conductors are often color-coded for identification and an overall cable jacket may also be color-coded.

A high-voltage (3 to 5 kV) alternating-current source at the surface drives the subsurface motor. Until recently, ESPs had been costly to install due to the requirement of an electric cable extending from the source to the motor. This cable had to be wrapped around jointed tubing and connected at each joint. New coiled tubing umbilical's allow for both the piping and electric cable to be deployed with a single conventional coiled tubing unit. Cables for sensor and control data may also be included.

Submersible water pumps come in a few different types based on their method of moving water up the well. There are low-cost "diaphragm" submersibles, intended for pumping lower water volumes from shallow depths with flow rates from 1/2 to 5 gpm from up to 230 ft of TDH lift. These may operate on 12 to 30 volts (V) of DC power from any source and are typically constructed of marine-grade bronze and stainless steel. Designed to be installed below the water level in a pond, river, cistern, or groundwater well, these typically have higher operating efficiencies than centrifugal pumps, but require more periodic maintenance due to their design and have lower tolerances for sand or grit in the water. These limitations mean these pumps are not often recommended. "Helical rotor" is a type of positive displacement submersible pump and is also known as a progressing cavity pump, eccentric screw pump, or cavity pump. This type of pump is gaining popularity in solar pumping and has several positive features. You are encouraged to investigate this type of pump for your applications.

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1.3 Measures Taken to reduce the Cycle Time

Reduction in cycle time leads to an increase in production capacity of the manufacturing facility thus increasing the profitability of the operation. The measures implemented to reduce the cycle time are as follows:

a) Assembly Station Fixture

Assembly stations used to have a single pump assembly fixture which consumed much more time than the newly proposed and implemented three pump assembly fixtures.

b) Pneumatic tools

Using manual spanners and torque wrenches has reduced the cycle time of the entire process.

c) Relay of layout

Motor testing process has been transferred from the sample testing tester to a separate area in order to maintain the 5S at the workplace.

d) Automatic Testing System Update

The Testing Control Pannel's software has been upgraded to capture the inputs from the tester automatically in order to be saving time in recording the data.

e) Quick Release Coupling

The previously used flange connectors consumed time in clamping and unclamping and has been replaced with a Quick Release clamp to save time in the process of sample testing process.

f) Specialised tool for play

check Vernier callipers were used to measure the pump shaft play and the value for shafts at two positions were noted. This time-consuming process was eliminated with the use of a specially made Specialised tool in order to measure the play of the pump shaft.

g) Motor No-load Test Kiosk

No-Load motor testing kiosk has been designed and is in the process of implementation to standardize the no-load testing panel

h) Motor Packing Component DesignChange

Time taken for motor testing is being reduced by close to 2.5 minutes. The testing time is being reduced from 7.6 minutes to ~4 minutes.

i) Improve Motor Processing

Integrated gripper design to ease motor movement inside the plant.

j) Name Plate Engraver Fixture

Time taken for Engraving the nameplate has been reduced by implementing a few changes in the future for the nameplate on the Roland engraver.

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2. TESTING:
2.1 Sample Testing

S.No	ACTIVITY	AVG	Value Addition	Necessity
1	Work station to tester	12.284	NVA	X
2	Coupling the adapter	36.09	NVA	X
3	Coupling the motor	37.518	NVA	X
4	Quick Release clamping	33.418	NVA	X
5	Trolley to the tester	54.636	NVA	X
6	Clamping	31.276	NVA	X
7	Key in	33.254	VA	✓
8	Test	253.914	VA	✓
9	Results noted	31.77	NNVA	✓
10	Unclamping	32.21	NVA	X
11	Onto the trolley	50.466	NVA	X
12	Quick Release unclamping	41.92	NVA	X
13	Uncoupling the motor	30.542	NVA	X
14	Adapter Uncoupling	28.738	NVA	X
15	Pump to the Work station	12.216	NVA	X
	Average in seconds	**720.252**		
	Average in minutes	**12.0042**		

"Centrifugal type" pumps are higher-power submersibles, intended for pumping higher water volumes from greater depths. They can be used to fill an open tank or in a pressurized system and operate up to 2000 watts (W) of DC power at 30 to 180 V from any DC power source. Constructed of corrosion-resistant marine-grade bronze and stainless steel, they are multi-stage centrifugal pumps with submersible motors that incorporate.

NOTE: In the "Typical Solar Water Pumping Layout" example well diagram on the left side of the Total Dynamic Head sheet, there is displayed a calculated "Hydraulic Workload"

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2.2 Pump Packing

S.No	ACTIVITY	AVG	Value Addition	Necessity
1	Insert cushion	4.5	VA	✓
2	Note down the motor's S.no	6.556	NNVA	✓
3	Note pump's S.no	5.838	NNVA	✓
4	Load pump	6.906	VA	✓
5	Insert cushion	11.514	VA	✓
6	Cap the tube	11.448	VA	✓
7	Screw the tube	33.374	VA	✓
8	Replace the packing sticker	20.856	NNVA	✓
	Average time in seconds	100.992		
	Average time in minutes	1.6832		

3. Conclusion:

● No load testing time can be considerably reduced by implementing small changes in the existing design of the motor packing.

● With the suggested change in the motor packing design the effective time reduction in No-load test will be ~ 2.5 minutes/motor.

● The proposed motor packing design will also serve as a solution for the current ergonomic problem of unloading and loading the motor manually.

● The name plate fixture is bound to reduce the fixture time by ~4 seconds/ nameplate.

● The play checking tool is said to reduce the time taken for play check by 1.3 minutes/pump.

● Quick release clamp used in the sample testing procedure reduces the time by 2 minutes/ pump.

● Automation of the tester eliminates chances of errors arising during the process of recording the results from the tester.

● Relay of the workstation has led to the proper implementation and sustenance of 5S in the workplace.

● Using three pump fixture improves the operator's efficiency over a period of time and reduces the assembly time for the pum

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