A VSM project “Lean manufacturing initiative at M AB”

Overview:

A company we will call “M AB” is a midsize manufacturer of rubber shields for mining industry. The company experiences very high increase in sales of products for mines due to the present fast increase in worldwide demand for raw materials. Although the company is achieving record sales, their profit margin is decreasing and product lead-times are just continuously growing. The increase in customer orders has turned the company into chaos. Production workers are waiting to get material to build the products, and managers are stressed to ship orders on time.

The company produces many different modular rubber panels, many of those being custom. The production process was organized on the basis of a job shop, after the management discovered that most of the products and components can be broken down into just a handful of families.

Most of the panels (even the standard types) are built to customer orders, but there are some that are built to stock. Number of styles and sizes available, is so big, that stocking would not be practical.

Production on the factory floor is run in batches, always comprising the entire order. If the order calls for *20* parts, *20* parts are in a batch; if the order calls for *500* parts, *500* parts are in a batch. High levels of work in process (WIP) are created as pallets of products move from one department to the next. In addition, many processes are only manned on one shift. Piles of product are queued in front of machines when pallets are dropped off from the other two shifts. Products move slowly though the plant as they wait for processing. This creates high levels of work in process (WIP), long lead-times, and a reduction of available floor space. The production scheduling and planning is quite complex, so frequent planning mistakes and miscommunications add to the long lead-times.

Almost all of these modular panels require the same manufacturing steps to produce them. The production quantities are shown in Fig.1.

The first step in the current production method is that customer service releases an order to production. Production control will review the order and check the bill of materials to verify that the correct materials are on hand. Any materials that are not in stock are ordered. Production control then releases the work order to the shop floor.

Scheduling and planning are discussed between the plant supervisor, planner, and production leads. Orders are often scheduled based on ship date and resources available.

The first step in the fabrication of the panel is in the metal fab department. Stocked metal bars are cut and welded to make a frame being the internal support structure for the panel. This operation is currently run in a batch mode were all the frames (of one order) are cut and welded before being transported to the next department. The thinking behind this mode of production is to avoid having to change set ups and produce parts more efficiently (by not losing to much time for changeovers).

Low availability of the equipment contributes to this mode of operations. The reliability was never measured properly but is estimated by the maintenance staff to something between 0.7 and 0.9.

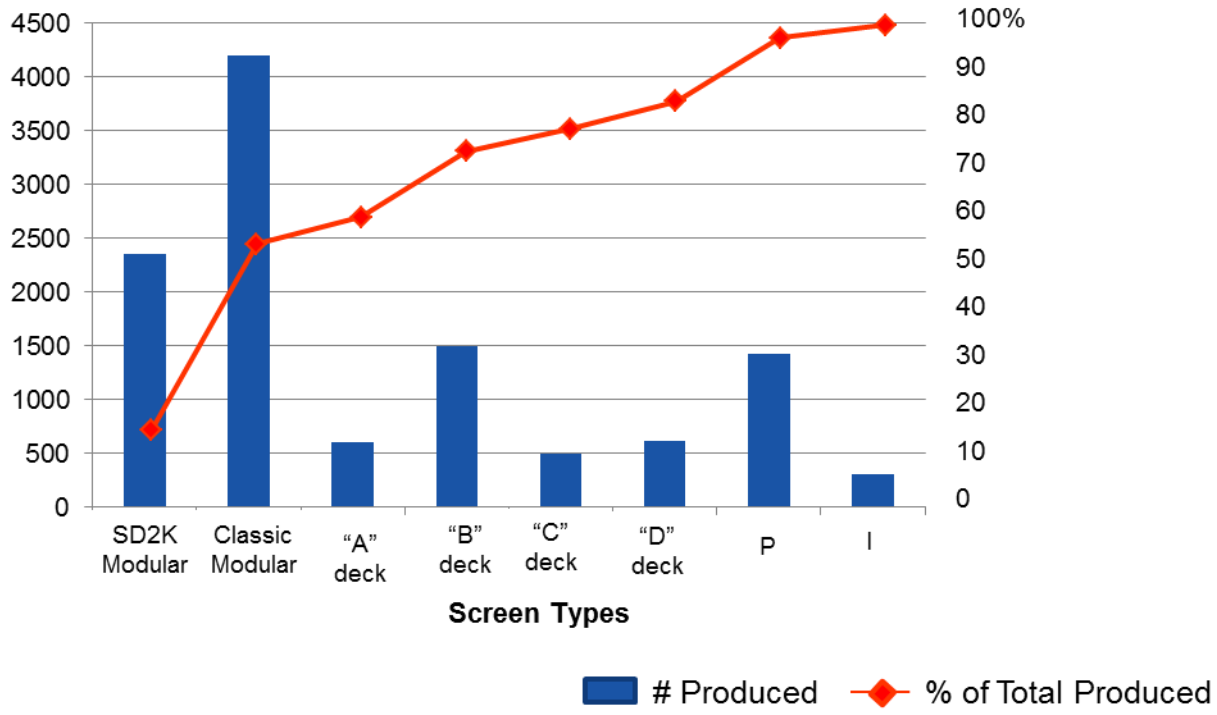

Fig.1. Quantities of the rubber screens produced during last 12 months

(One year of production = 11500pc)

After all the parts for the order are cut and welded they are transported by forklift to the next operation; media blasting. All internal framework needs to be blasted in order to get an adhesive agent to bond properly. Large piles of WIP accumulate in front of the blast machine because the blast machine is only manned full-time on second shift. Also operators from other departments are blasting other components in the same blaster. After blasting is completed, the entire order is placed in queue until just before the frames are ready to be used in the rubber pressing station. The rubber press operation starts with the rubber press operator going and looking for a right blasted frame in the input buffer. Space is limited so finding the right framework can be difficult because the staging area is not organized in a systematic way (explain why the operators have to look after a "right" framework). The frames are then brought to the priming booth where an adhesive agent is applied. The adhesive assures a good bond between the internal metal framework and the rubber that will be pressed around it. The application of adhesive is not done in a batch mode; the adhesive is applied only to the framework that will be used next in the rubber press. This is max only 2 to 4 pieces painted, waiting before the rubber press. The common order or batch sizes can range from 20 pieces to several hundred pieces. At the rubber press, the frames are placed in an open mold. Un-vulcanized rubber is cut and weighed, then placed into the mold. The mold is then positioned into a press where heated platens press the rubber around the frame in the mold. The pressure is

held for several minutes until the rubber is molded and vulcanized. At this point, the mold is removed from the press and de-molded. The de-molded part is then placed on a pallet nearby the rubber press. For now there two molds available for each panel type in the press. The process of applying the adhesive and molding the part is repeated until the entire order is complete. When the entire order is completed and put on pallets, the order is moved from the rubber department to the finishing department. The finishing department consists of three processes. The first process is trimming, where flash resulting from the molding operation is removed. The second operation is a clickering process where a punch removes a film of rubber that is produced over the screen openings. The third operation is sawing where the panels are cut square and to length.

The trimming is also done in a batch mode. All the parts are picked up one by one from the pallet and carried to a trim table. The part is trimmed and then put by hand to another pallet (output buffer from trimming).

The parts are not moved to the next operation until all the panels are trimmed. It should also be noted that there are often large piles of WIP in front of the trimming table because most of the trimming only occurs on the first shift, and the saw is quite often down for blade sharpening.

The next coming two operations – clickering and sawing - are also performed batch-wise, and of the same reason as at trimming a lot of WIP is grouped on the floor around.

After sawing, the panels are then placed on a pallets and will remain on the floor next to the saw until shipping team is ready to pack and ship the product.

Data collection:

The information is gathered from the company's ERP system and by walking and taking notes on observations around the plant floor.

The two most common panels produced are the SD2K and the “Snap deck” Classic screen panel (see fig.1). Their production processes are very similar, so that the two products may be grouped to one family, and might be produced together without change over, except for the tooling used to mold them in the press. These two styles of panels would account for approximately 55% of the produced panels (see fig.1.). It was decided that the VSM analysis should be performed for a group of those two products.

Customer orders are taken daily by customer service and entered into the ERP system. A significant portion of the total lead-times promised to customers is lost in the order entry process. The orders are then sent to production control each morning. Planning and scheduling activities are performed by the plant supervisor, planner, and department leads. Job directions (what products to do) is communicated to each person at every machine/station daily (a work orders are printed and sent to each operation).

The first operation that the work order and traveler is send is the welding operation. When steel is ordered for a job, the material will sit on the floor for an average of 3 days before processing begins. The average set up time in welding for a modular panel is 30 minutes. This must be done before each new product type may be started. After the set up is complete, each frame takes only 4 minutes to weld. The welding operation occupies one operator on each of the two shifts.

After welding, the frames are then sent to media blasting. Large quantities of frames are in queue waiting for blasting. In this case, there are 110 pieces waiting for an average of 5 days. Blasting

has a set up time (change over) of 10 minutes and each part takes on average 5 minutes to blast. The blaster is mainly operated only on the second shift, and its availability is around 80%.

After the frames are blasted, they are placed on pallet and stored in any available floor space near the priming area. Again, large amounts of WIP wait in queue before being primed; in this case, a 107 pieces are waiting to be primed. The parts are left in queue until the rubber press is ready to take in the frames. When frames are needed for molding in the rubber press, the operator goes to the priming area looks up a right frame and applies the adhesive only to the frames that are going to be pressed next. This is a pull system where frames are pulled from priming to the rubber press only when needed. The max no parts in queue between priming and rubber press is 4. The applying of the adhesive in the priming station takes 15 minutes with no set up time. The primed frames are then moved by operator by hand to the rubber press. Here the frame is placed in a mold along with a specified amount of raw natural rubber. The mold is placed in the press and the platens are closed. The throughput time for the whole rubber press operation was measured to 45 minutes. This long time gives the operator time to set up the next mold and prime the next frame. The changeover time for a new panel type (exchanging of molds) is 20 minutes. To avoid making unnecessary changeovers, entire batches are processed through the press before changing to another mold. All the panels produced at the press are set on pallets until the entire order is completed. About 10% of the planned production time is used for maintenance (when the press is closed down).

After the entire order of panels is pressed, they are moved via forklift to the finishing department. The first operation in the finishing department is to remove flash at the trimming table. There are typically long wait times and large amounts of WIP in front of trimming because trimming is primarily performed only on first shift. The operator at the trim table will have the screens produced from both the second and third shift of the previous day to trim before the panels produced that day can be trimmed. Trimming on average takes 7 minutes with a 10 minute changeover time.

The next operation in the finishing department is clickering. Parts are moved from the trim table to the clicker and put into queue. Clickering primarily is performed only on the first and second shifts; therefore, large amounts of WIP are piled around the clicker as panels from multiple shifts are processed. In this case, 40 panels are queued in front of the clicker with an approximate wait in queue of a one-half day.

The last process in finishing is to saw the panels to the correct size. The reason is that the rubber is hard to control dimensionally while processing. Therefore parts are made over-sized and then cut to length. The saw is manned only on second shift. Panels from the first and third shifts are piled around the saw. There are 20 panels in queue with an observed wait time of a one-half day. The time to saw a panel takes on average 6 minutes. The sawed panels are then placed on pallets on the floor around the saw. The panels will wait there until the order is ready to be prepared to ship which on average is three-quarters of a day for each order (=shipment).

When an order is ready to be shipped, a person from shipping will pick up the pallet from the finishing department and take it to the shipping department where the screen panels will be packed and staged available for shipment. Shipments are made daily to the customers after the whole order is produced.

Observe that the plant is operated for 21 hours a day. Only during a few % of the time the value added processing is taking place. This means that during ca. 95% of the time no value added activities take place. Observe also that the company <u>is really delivering</u> all the quantities of products listed in figure 1!

Your task:

The purpose of this project is to suggest a way to improve the current situation at M AB, so the company may adopt their operations to the market requirements.

Do the following:

1. Create a current state map to get understanding of what is happening on the shop floor today.
2. Populate the current state with the data gathered from the text above. The data is not univocal (as in any real project), so assume here values you find reasonable. Motivate your assumptions! Some few pieces of data may be missing – in this case just assume values you find practical. Do not share the data with other groups (the purpose of the "missing" data is to differentiate the projects between the student groups).
3. Analyze the operations and propose changes in the aim to improve
    a. interaction with customers to meet the expected development trends on the market
    b. production flow, so the production volumes increases at least 20%
    c. lead times by shortening them, and make it possible to produce every part every week (EPEW)
    d. Introduce supermarkets and end-item stock if needed
    e. Discuss new investments if needed
    f. Develop planning and control system for the operations
4. Create a future state map and action plan to achieve the proposed changes.
5. Study dynamic behavior of your future state and explain in what way your solution helps to increase production and response to customer.
6. Prepare report
7. You will also conduct a peer review of a project of another group.

Good Luck!