# Value Stream Mapping (VSM) – A Case Study in Orthopedic Hospital

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**Abstract -** *The complete elimination waste is the target of any qualified system. This concept is vitally important today since in today's highly competitive world there is nothing we can waste. This paper attempts to apply the principles of lean manufacturing in the Healthcare sector with the purpose of eliminating wastes and increasing capacity. Value Stream Mapping tool was used to expose the waste and identify a proposed plan for improvement. The results achieved in the proposed plan showed significant improvements in the overall performance of the system, which allowed to be more productive, flexible, smooth and with high quality service*

*Key Words: Lean Methodology, VSM, Current State, Future State etc..*

## 1. INTRODUCTION

The Lean methodology implementation started with the creation of a VSM of the existing situation. VSM is a process analysis tool to identify the key process characteristics such as the sequence of activities in the process, their speed or cycle time. VSM helps establishing a judgement as to whether or not the activities add value for the patients.  "Current state" maps are used to capture the existing process and these are adapted to "future state" maps that suggest how the process may be changed to become lean. The mapping phase is crucial to understand the process and to study the delays, from the decision of the treatment to the first treatment session. By focusing efforts on reducing wasteful activities, healthcare organizations can more efficiently attain organizational objectives.  The general wastes occur during the process are.

## 1.1 Over Production

Entering repetitive information on multiple documents or forms.

## 1.2 Waiting Time

Primary team waiting for patient service.
Patient waiting for appointment.

## 1.3 Transportation

Waiting for transportation to arrive, take patient to testing, surgery, discharge.

## 1.4 Excess processing

Ordering more diagnostic tests than the diagnosis, Retesting.

## 1.5 Inventory

Unnecessary instrument in operating room kits.

## 1.6 Waste of Movement

Nurses leaving room for common supplies.
Searching for charts, patients, medication.

## 1.7 waste of producing defects

Iatrogenic illness.
Medication error.

## 2. CASE STUDY

Case study performed in an Orthopedic Hospital at Nagpur.

General information about the hospital is an Orthopedic Hospital having Radiology, pathology, physiotherapy departments and operation hall having 10 bed capacities. Working shifts are three, 6 hrs, 6hrs and 12 hrs. First shifts and second shifts have 4 staff members each and last shift have 2 nurses. Along with this there are one main doctor and an assistant doctor.

The weekly process and cycle time required for each process is given in Table -1.

**Table -1:** Hospital Daily Statistics

| Processes | Cycle Time (min) |
|---|---|
| 1. Registration. | 5 |
| 2. Evaluation | 15 |
| 3. X-Ray & Evaluation | 15 |
| 4. Plaster | 30 |
| 5. Physiotherapy. | 20 |

### 2.1 Takt Time Analysis

Takt time is the important tool needed for the assessment of current system. It is a tool used to eliminate over servicing. The hospital as explained above works in three shifts. The lunch breaks as well as other necessary breaks for the working staff are covered by another staff. So the total available time is 24 hrs a day which equals to 1440 min.

In average, the daily hospital visits is 45 and available time is 1440 min. so the Takt Time for the process of service is calculated below.

- Takt Time = $\dfrac{Available\ Time}{Capacity}$

$$= \frac{1440}{45} = 32\,min$$

After collecting the information needed with the regard to the patient flow, it is easy now to draw the value stream map for the current state. A value stream is defined as all the actions both value added and non- value added required to bring a specific product, service to a customer or patient.

The VSM of the ED is created by using a predefined set of icons shown in Fig 1 These icons include the process icon, the data box, the outside source, patient serve icon, and information flow icon.
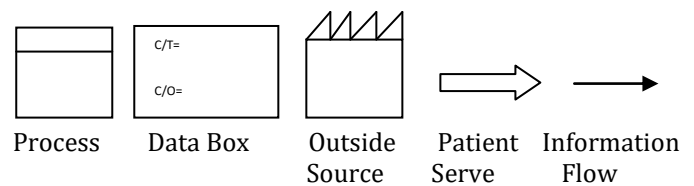


**Fig -1**: Value Stream Mapping Icons.

On the basis of weekly data available we can draw VSM for the current state to analyze the current process which shows in Fig 2 below.

After drawing the VSM for current state we can identified the wastes which exists in the current process
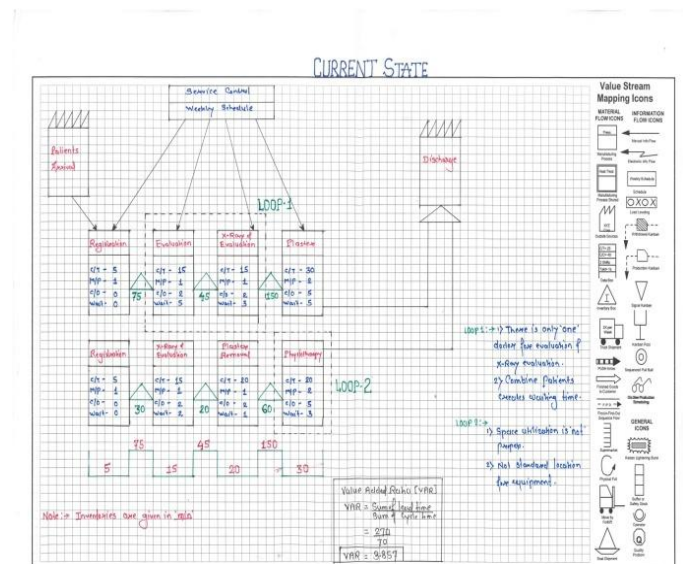


**Fig -2:** VSM for Current State

The Process start with arrival of the patient in the hospital. Before check up, patient has to enter his name and address in the register record. After registration patient wait for the evaluation by the doctor. After evaluated by the doctor or if required or to confirm

whether bone is facture or patient send to radiology department for X-Ray.

After X-ray process patient advice for further treatment if facture occur, if not then patient get discharge. The treatment include plastering of fractured bone or last stage is will be surgery. As in this case, we specially focus up to the plaster process and avoid surgical operation for fine result. As mentioned above the current map focus on existing process and identified the muda's i.e. wastes which can be eliminated.

After study the current process and map we identified some of the problems which occur during the process. The problems are shown on the map by looping which focuses the waste occur during the process. The map shows two loops indicating problem identified during the process.

## 2.2 Problem Identification

### 2.2.1. Loop 1 (Patient & X- ray Evaluation)

- Only one doctor is in operation for patient and X-ray evaluation.
- Bottleneck occurs between the two processes i.e. patient evaluation and X-ray evaluation which increases waiting time.
- Combine patients creates waiting time for further process.

### 2.2.2. Loop 2 (Physiotherapy)

- Space utilization is not proper in physiotherapy department which leads to less patients get served weekly.
- Not standard location for equipments.

## 2.3 Proposed Plan

In the proposed plan, for loop 1 we can appoint a new doctor in radiology or X-ray department who can read the X-ray report which before get read and evaluated by the main doctor or utilized the doctor doing plaster and look after the surgical patient in the X-ray department for X-ray reading and evaluation. For loop 2 proper space utilization can be carry out and this can be happen by using the "5S" tool for proper space utilization and placing of equipments which are used on regular basis.

These improvements mentioned above led to increasing the patients served i.e. capacity from 45 to 62,

reduce inventory by 2 in X-ray section, waiting time of patient can be reduced by 5 min and patient intake per shift can be increased.

These improvements are shown on the future map which shows the process changed and can be leaned.
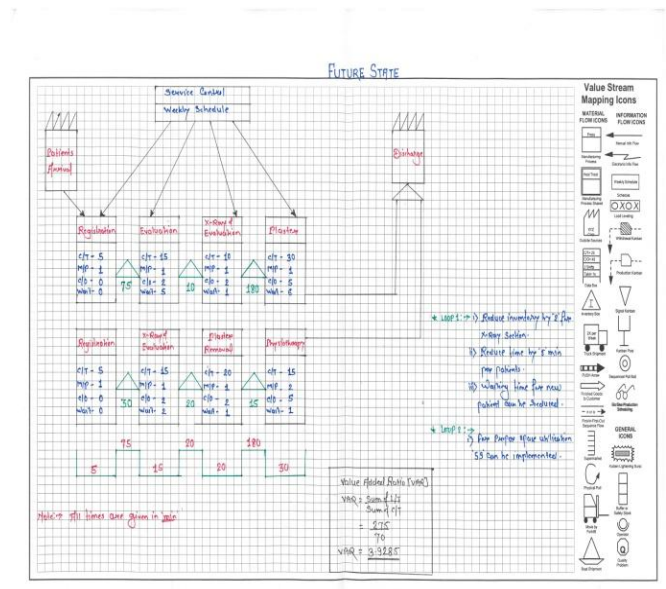


**Fig -3:** VSM for Future State

The detailed result showing the difference between current and future state given below the Table -2

**Table -2:** Comparison of results between Current State & Future State

| Item | Current State | Future State |
|---|---|---|
| Capacity | 45 | 62 |
| Takt Time (min) | 32 | 23.22 |
| Value Added Ratio (VAR) | 3.857 | 3.9285 |

**Table-3**: Result for Loop 1(Patient & X-ray)

| | | Before | After | Percentage |
|---|---|---|---|---|
| X-ray & Evaluation (Loop 1) | Time Reduction (min) | 15 | 10 | 67% |
| | Inventory Reduction (nos) | 45 | 10 | 22% |

**Table- 4:** Result for Loop 2 (Physiotherapy)

| | | Before | After | Percentage |
|---|---|---|---|---|
| Physiotherapy (Loop 2) | Time Reduction (min) | 20 | 15 | 75% |
| | Inventory Reduction (nos) | 60 | 15 | 25% |

## 3. CONCLUSIONS

In general, it was shown that the Value Stream Mapping is an ideal tool to expose the waste in a value stream and to identify tools for improvement. The development of future state map is not the end of a set of value steam activities. It should be stressed that the value steam should be revisited until the future becomes the present.

The idea to keep the cycle going because if sources of waste are reduced during cycle, other wastes are uncovered in the next cycle. The results achieved in the proposed plan showed significant improvements in the overall performance of hospital, which allowed it to be more productive, flexible, smooth and with high quality service.

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