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"Optimization of Instrumental Workflow in CSSD" at Hospital Sector

Poonthamil R, Maheshwar Pratap

Abstract: ***Theobjective of this paper is to analyze the existing instrument workflow of CSSD [Central Sterile Supply Department] and to suggest the optimized workflow solutions for the hospital. We need to study about CSSDand what are the various activities which takes placethere along with the timings they required for each activity. By knowing those, we need to find out the critical and non-critical activities to create a map.The basic outline of the map is that the instruments from OT [Operation Theatre] to TSSD [Theatrical Sterile Supply Department], TSSD to CSSD, then CSSD to TSSD and TSSD to OT store. In detail, we will study about each area how the instruments are moving, and how much time it consumes.For that we need to create an existing workflow with the lean tool called VSM [Value Stream Mapping] and in that pick out the critical and non–critical activities. We can remove the non–critical activities and create a new workflow.With the new workflow we will form the Program Evaluation & Review Technique model which helps to know the percentage of efficiency has been improved in accordance to the existing workflow. With this solution, we can propose a new workflow of Instruments with the minimized critical activity and time period for the activities which takes place in CSSD of the hospital sector.***

Keywords: Value Stream Mapping, Program Evaluation and Review Technique, Optimized Workflow.

I. INTRODUCTION

In the hospital sector, the lean improvement is very much need to have an optimized workflow with high efficiency. The CSSD [Central Sterile Supply Department] is the heart of the hospital sector operations and the major process which takes place over there is the Instruments flow from the OT [Operation Theatre] to CSSD [Central Sterile Supply Department] for the sterilization process and Vice versa. This study helps us to understand the activities in the flow of instrument towards sterilization and the key operations which takes place over there by means of lean improvement tool in the existing workflow, the value which driven the workflow of the instruments and then critical and non-critical activities. Then the process will be mapped and reconstructed in terms of time efficiency.

PLAN

The plan of this paper was to find the workflow of the instruments by studying the current workflow in hospital sector. In order to study the current workflow, we need to know the instrument flow and it goes mainly in two phases (which described below).

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By mapping those existing movement flow of instruments, the flow time has been analyzed and by using PERT the process has been mapped and reconstructed to improve the efficient flow of instruments.

II. LITERATURE REVIEW

The workflow optimization in the hospital sector is the key need for having a smooth and uninterrupted process. This importance of this Optimized operational flow in the hospital sector has been discussed by many authors using different methodologies.

A. Lean Improvement In Hospital

In hospital sector from [1], I came to know that how to implement the lean thinking for the improvement in flow of patients and its support services. They make this optimization into three stages such as gaining knowledge, implementation and sustaining which results on having the safest accessible during their growing demand.

In-home health care real-time scheduling optimization, [2] explains us how to make an effective scheduling the appointment while having constraints like the cancellation of appointment, failures due to improper functioning of devices. To establish such an optimized schedule, they are using empirical analysis to verify the proposed model to know which is better or not. They also mentioned the recommendations for further research purposes such as optimizing the workflow at different departments in hospital region.

Lean improvement in the health sector has been discussed in [3]. In this study, the author is explaining how to increase the throughput time for patients by reducing costs with the principles of lean.

The lean and six sigma methodologies in the operating room to have a high-efficiency improvement described from [4]. It details about the performance, engagement of the staffs and the sustainable growth in financial aspects. This paper [5] proposes how to explore the hidden opportunities that will improve the process by eliminating the waste which helps to increase the efficiency of the process by using this lean tool VSM. On owing to the need of quality management in the hospital sector, [6] explains the transformation of lean to have an improvement in a continuous manner on all aspects with the aim of providing the only efficiency in terms of optimization. The strategy of multiphase optimization in[7] tells us about the MOST (Multiphase Optimization Strategy) and which is used to develop a high efficiency in terms of scale and cost. This gives us the passage to have an understanding on the feasibility and acceptance of the strategy.

The instruments sterilization has been discussed in [8]. This one primarily focusing on the cut down in the sterilization cost by outsourcing it. Then, it will also discusses about the redesigning of the logistics to improve the material availability along with cut down in cost.

B. Usage Of Fuzzy Constraint Theory

The optimization has been done with the different methodology in [9] with the fuzzy magnetic optimization of clustering (Fuzzy – MOC). This helps us to deal with the huge data set to implement the optimized magnetic algorithm in health care.

To have an Integrated system layout planning, [10] explains about the usage of fuzzy constraint theory. It helps us to design the optimize facility layout for the operation theatre. For the day to day activities, the modernized layout is very important and that's what they proposed by using this theory.

C. Value Stream Mapping In Hospital

For having an optimized capacity utilization of operation room (OR), the usage of Value stream mapping (VSM) had done by [11]. In this study, authors are making the use of prospective analysis in VSM on OR capacity utilization. As a result, we are able to have a good throughput time per patient in OR. Adding to the lean manufacturing tool, [12] explains the efficient outcome by using VSM for finding the value-adding activities of the process. This mapping of activities enables them to provide the improvised future state map of the process. A VSM in [13] deals with not only supporting the activities of patient flow. It also proposes the simple adaptations which turn into an implementation of lean healthcare process. In [14], they explained us about what in the US health reform required as a new change over in the monitoring of the health care data of the patients with the technology. They propose a new innovative as well as attribute-based model to get the details of the patient along with the analysis of the health care service for patients. The explanation of development in the simulation model with the regression to know the patient's stay at the Intensive Care Units bed [15]. This helps us to understand how the optimization combines with the simulation to have a desired outcome for the management. Apart from the theories that are proposed by authors in favor to optimization, there is also a case study which describes about the model and data to support the optimization of health system [16]. They have taken the US air force's Wilford hall medical care to explain how they improve the process to reduce the impediments to intensive care units. The discussion is on about the mixed integer programming model and its use of having an optimized network to the needy patients, along with the capturing of utilization as well as the accessibility of the network.[17]

Technology Based Approach

The barcode technology in the sterile area is discussed in [18] which provides us the information on importance of sterile instruments. It clearly depicts the idea of providing the service without compromising on time and cost to meet the surgical outcomes and its difficulties. We have discussed the different concepts of methodology but in this [19], they are explaining about the RFID (Technology of identification by radio frequencies) to have a rapid growth phase in the hospital sector. This results in formation of the smart hospital with high efficiency on the perspective to consumer demands. In extension to the technology-based strategy [20], tells us about EMR (Electronic Medical Record) system implementation in order to have a good information technology skill for the effective outcome. TheUS health care organizations formed a committee to know outcome of the service in hospital at affordable cost. This leads them to have a good protocol on minimizing the variability and inefficiency. It results in good quality practices which have more transparency and effective use of resources [21]. The author[22] explains about informatics which plays a vital role in medical sector on analyzing the large computational data for producing the inferences. It also explains the temporary limitations of using informatics along with the inference framework. And in [23], they are expressing the improvement of quality in patient's data through the digitalization of the process. It creates efficiency in both sides such as the consumer as well as a caretaker.

On continuation, under the section of biomedical informatics, [24] explains us about the requirement of statistics along with the data in order to have an observation in surveillance system. They are using the regression models to have a forecasted range which helps to indicate the preferred method and its adaptability.

D. Effective Supply Chain Management At Hospital

The supply chain management also contributes the optimization to have an increase in efficiency and it was discussed by [25]. They are focusing on the ways for making the process as an innovative approach by not compromising the factor called cost. This case uses Just-In-Time approach in logistics to improve its efficiency.

For the making decisions with efforts of modelling and simulation on supply chain management, [26] explains us that why they are not using the trial and error method and what is the advantage of using simulation and modelling to support the decision making. For the constructive modelling in a supply chain management decision, the study [27] help us to understand how to engage the constructive model in favour to reducing the cost in the supply chain management.

From all this references, I arrived at the conclusion of my objective of implementing a lean tool called Value Stream Mapping in order to get the optimized workflow process in CSSD.

III. METHODOLOGY

Value stream mapping and Program evaluation & review technique (PERT) are the two key methodologies which is used to map the workflow of the instruments. With the value stream mapping the critical activities of the instrument flow in the two phases are determined and with these determination, the key solution to the problem will be identified and then analyzed when the solution is implemented who much the process will become an efficient in terms of all aspects.

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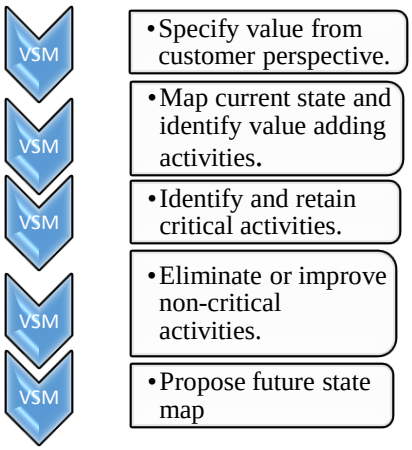


IV. PROCESS OF CSSD: PHASES

In the hospital, they are having the two phases of the process for the flow of instruments, one is in the OT area and another one is in the ground floor. These two are associated with lifts for transporting the instruments starting with one zone then onto the next zone. This will be the key procedure for the instruments after the finishing of their utilization.

A. PHASE 1:

After the usage of Instruments, it all will be checked with the list provided along with the set then it will bring towards the Phase 1 where they are having 3 zones.

Zone - 1:

There the pre washing of Instruments will takes place by manually and it will be trailed by the general pre washing procedure for those instruments. After the pre washing it will be checked once again with the staff from zone 3 who belongs to the phase 2 department.

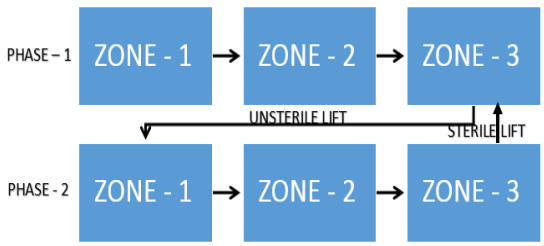
Zone - 2:

The fine and robotic instruments washing will takes place in this zone and here the washing procedure will takes place, generally the washing of such instruments will takes place by the concern department rather than nursing staff in charge at OT.

Zone - 3:

This zone will be used for transporting the Instruments which is needed to be cleaned and sterilized and this zone is having the lift facility for transporting the instruments. For the emergency case and fine Instruments who gone for the zone 2 washing, will all be cleaned, packed and sterilized in this zone itself. Before sending those instruments, it all will be recorded in received and issued notebook which belong to the zone 3.

Physical Outline Of Instrument Flow



B. PHASE 2:

After the completion of pre washing, the instruments will be moved from the phase 1 to phase 2 for the washing, packing and sterilizing. The most important and heart process for the instruments will takes place here. In the phase 2, they are having 3 zones and are as follows:

Zone 1:

The Instruments will be moved from lift towards the zone 1 for washing from the phase 1 where the washing procedures will all takes place and also they will wash according to the instruments type. For example if it is like a tube like instruments it will be washed through with water and then with dry air. Individual instrument will be washed manually and then set instruments will be splashed and kept in ultrasonic machine to wash along with lubricant and RO to avoid the damage of the instruments. In this zone, the first thing which takes place is the recording of the instrument set or individual instruments which are all comes through the lift. Then it is passed through the pass box to zone 2.

Zone 2:

After getting the instruments from the pass box which connecting the zone 1 and zone 2. The instruments will all need to be dried so to that it all will be wiped with the dry linen cloth. After the wiping procedure done, it will be moved to the sorting of the instruments according to the set, after sorting the instruments in order as an set wise it will be moved for packing. There is a packing procedure for each type of instruments, and it all will be done by the ID workers only who will done a course which concern about that department. In the packing they need to pack all instrument as a set wise manner and the labelling follows after the packing. In the labelling they need to label the packed set which consisting of what are the instruments present in the set. If it is a disposable packing, then it will have the seal denoting the expiry date of that instrument. The expiry date will also be mentioned on above each and every instrument. After this, all the packed instruments will be placed in a trolley for sterilization and it also be recorded in separate notebook which is maintained for the autoclave (sterilizing) machine only.

Zone 3:

After the sterilization of machine has been done, it will be moved out from that machine and moved towards to the sterile storage room as a temporary storage of all the instruments. In this zone, they are having the separate racks for all the instruments set and the sets are all placed in their respective places. If the request arises from the phase 1of this process, through the sterile lift they will sent all the instruments towards the phase 1. There the concern nursing staff who are responsible for taking the instruments will check and take out the instruments from the phase 1 of zone 3.In the phase 2 of zone 3, the instruments which are moving out are all noted down in the received and issued notebook which belongs to phase 2. After the phase 1 of zone 3 received the instruments they will also record in their respective notebook regarding the received and issued notebook of the phase 1. After the nursing in charge taking those instruments they will store it in the instrument room which is a common store room for all the instrument and some fine and robotic instruments will have their own store room to store their instrument in order to avoid damage to the instruments.

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These are all the process takes place after the usage of the instruments and from these the flow of instruments will be taken and mapped with the value stream mapping method. In this value stream mapping the key finding is the questionnaire to find out the value of the instruments flow process.

V. ANALYSIS AND INTERPRETATION

A. Program Evaluation And Review Technique (Pert):

a) CURRENT STATE MAP: [FIGURE 1]

- Total time : 259 minutes
- In hours : 4 hours 19 minutes

Green activity: Where implementation of software is applicable.
Blue activity: Critical activity where implementation of software is not applicable.

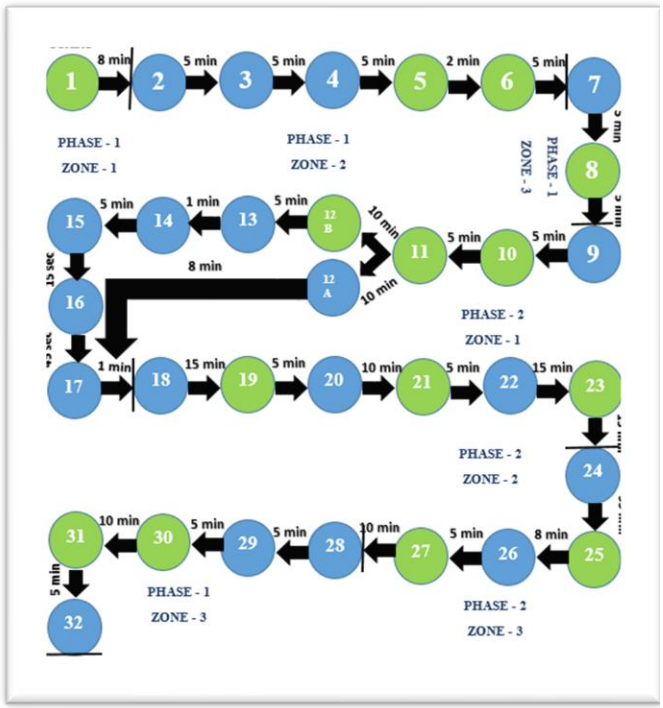

Fig 1

b) FUTURE STATE MAP: [FIGURE 2]

- Totaltime : 189 minutes
- In hours : 3 hours 9 minutes

Green activity: Where implementation of software is applied.
Blue activity: Critical activity where implementation of software is not applicable.

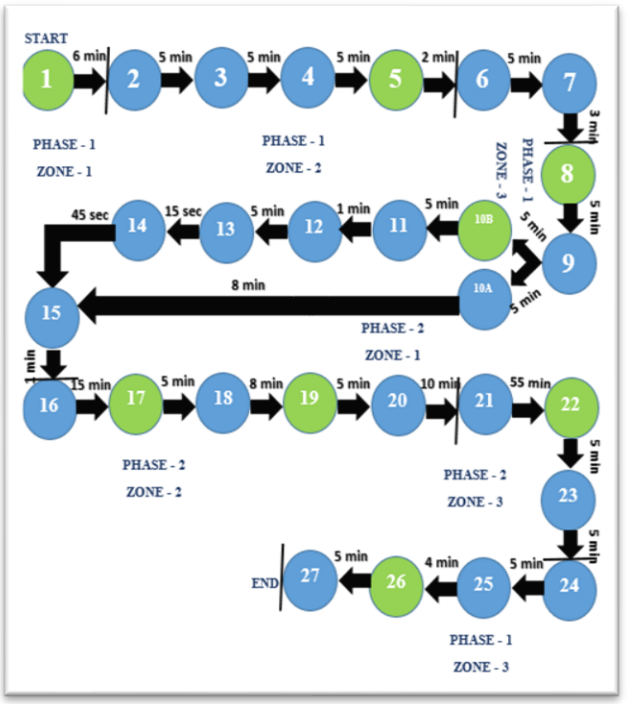

Fig 2

B. COMPARISON CHART:

This comparison chart is showing the corresponding zones and their activities along with respective timings. Before the implementation how much activities takes place and after implementation how much activities will takes place in each zone and its total at last.

TABLE I

PHASES	ZONES	Before		After	
		Activity	Timings (Min)	Activity	Timings (Min)
PHASE -1	ZONE - 1	1	8	1	6
	ZONE - 2	5	22	4	17
	ZONE - 3	2	10	2	8
PHASE - 2	ZONE - 1	9	51	8	36
	ZONE - 2	6	65	5	43
	ZONE - 3	4	78	3	65
PHASE -1	ZONE - 2	5	25	4	14
Total		**32**	**259**	**27**	**189**

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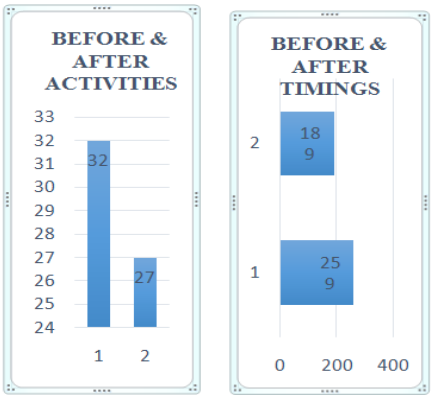
VI. RESULTS

1. The proposed workflow is having more efficiency in terms of time than the existing one. (i.e., 70 minutes more efficient)
2. It is having minimum activity than the existing one (i.e., 5 activity lesser than the existing)
3. It requires lesser man power due to the reduced activities and the implementation of software.
4. Software implementation will drastically decreases the manual errors happening at the time of recording.
5. It can be easily monitored and there will be no lack in tracking of instruments.

VII. CONCLUSION:

The Effective optimization of the CSSD Instrument workflow using lean management tool VSM has eliminated the29% non-value adding time and activitiesfrom earlier system. From the below graph 1 & 2, it is evident that the activities reduced from the earlier system (5 activities) which contributing to the value-based system with high efficiency in the workflow optimization of the Instruments at the hospital sector.



GRAPH 1 & 2

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