APPLICATION OF VALUE STREAM MAPPING IN IMPROVING THE SERVICE PROCESSES OF A DENTAL CLINIC


Shamsodin Nazemi
Ferdowsi University of Mashhad, IRAN
and
Mehryar Nooriafshar
University of Southern Queensland, Toowoomba, AUSTRALIA
and
Zahra Ghabool
Mazandaran University of Science and Technology, IRAN

Abstract

The main purpose of this paper is to demonstrate how the time constraint can be successfully managed by eliminating, or at least reducing, the non value adding activities in a service process. For this purpose, the dental treatment section of a large dental clinic in a provincial city of Iran was selected. This research project focused on the use of the concepts of Lean Thinking by adapting them to suit a service type organization.

The results indicated that the Lean Thinking approaches can be also, successfully, applied to service type industries. Recommendations to reduce the identified non value adding activities were made to the management. Finally, suggestions for further research in this area were also made.

Keywords: waste, value stream mapping, lean manufacturing

Introduction

Regardless of the type (manufacturing or service) and size of organisations, meeting the customers' needs and gaining their satisfaction is significantly important for their success or even survival. Competitions from other organisations and availability of different options for the customers have certainly added another dimension to this need. It is extremely important to ensure that required product or service with the desired price and quality reaches the customers on time. Hence, businesses should be mindful of meeting the quality, price and time requirements at all times. An approach which has proven to be quite effective is Lean Production (Manufacturing).

It is noteworthy to mention that the concept of Lean Production (Manufacturing or more generally Thinking) was explored and presented in a book titled "The Machine that Changed the World" (Womack et al, 1990). This book which is based on five years of research presents a careful explanation of the logic and techniques of Lean Production (Manufacturing). The term lean highlights the role of reduction in costs as a means of achieving increased production. In other words, produce more by using fewer resources in terms of manpower, materials and time.

Pioneering and related work however, in the area of Lean Manufacturing was carried out at Ford Industries in the early part of the previous century (Abbett, 1999). The use of excessive amounts of materials and resources was regarded as waste by Ford. It is interesting to note the close

relationship between this concept and the Just in Time (JIT) philosophy which was developed back in the eighties in Japan.

The lean way of manufacturing is regarded as an approach or philosophy in which all concerned seeks to find ways of improving the processes. The main objective is to eliminate the non value adding activities from the processes. In order to achieve this objective, various methods may be adopted. One of these techniques includes the use of Value Stream Mapping (VSM). VSM was presented by Rother and Shook (1998) as a means of visualising the processes, the flow of materials and information. The main purpose of VSM techniques is to construct a pictorial representation of all activities which includes value adding and non value adding activities. Based on the observation by (Schultz et al, 2005) these tools and techniques create a suitable environment for achieving the ultimate objective of Lean Manufacturing. They assist with identification of the sources of value adding and non value adding activities by providing a comprehensive pictorial representation of the processes.

It should be noted that the majority of publications in this area have focused on goods producing rather than service providing industries. One of the main contributions of the research project, on which this paper is based, is a demonstration of how the concepts and techniques of VSM can be applied to a service type industry. For the purpose of the investigation, a dental clinic in a provincial city of Iran was selected. This paper demonstrates how the tools of Value Stream Mapping (VSM) can be adapted and applied to identify non value adding activities with a view to eliminate them from the processes.

Lean Manufacturing

One of the main characteristics of Lean Manufacturing is the idea of responding to customer demands. Therefore, each product is produced according to the customers' requirements and the demanded time (Kalsaas BT, 2002).

The ultimate objective is the elimination of waste. It is only logical to assume that elimination or even reduction of waste in processes can ultimately contribute to reductions in costs and time (Mehrban R, 2005). Generally speaking, Lean Manufacturing has three main objectives:

Achieve the highest levels of customer satisfaction.
Aim for complete elimination of waste.
Take into consideration the human factors in all processes.

According to Womack et al (1998), Lean Production (Manufacturing) includes: Description of value from the customer' viewpoint, determination of value stream, flow, pull and perfection.

They also note that waste includes all processes that use up resources and increase costs but do not generate any benefits for the customer. Seven categories of waste within a production unit have been identified which include; overproduction, unnecessary storage, scrap/faulty parts, unnecessary movement and transportation of materials and products, unnecessary processes, and delays.

Value Stream Mapping

Rother and Shook (1998) regard Value Stream as a collection of both value adding and non value adding activities in every stage of production. In other words, according to Tapping et al (2002) Value Stream covers stages from procuring raw materials and parts from the suppliers up to delivery of the product to the customer.

It should be mentioned that Value Stream Mapping (VMS) is, ideally, the very first step in evaluating the production processes (Rizzardo D. and Brooks R, 2003). As suggested by Shakeri Roshan (2005), Value Stream Mapping tools aim to map, analyse and document all the necessary processes and information flow in the production. This is achieved by accurately creating a graphical representation of all the necessary processes and information flow for the existing situation. In order to make improvements, a series of key questions relevant to the application are developed. In other words, by systematically and critically applying a questioning technique, improved methods and processes can be proposed. One can easily link these techniques with the traditional approaches of Methods Study which were widely used earlier in the previous century. As a result, non value adding activities can be identified and then eliminated. Again one can draw parallels with the Just in Time (JIT) philosophy which targets the elimination of whatever is regarded as waste.

Like JIT, Lean Thinking is also based on the pull rather push philosophy. Hence, instead of producing for *just in case*, one aims for *just in time*. Being mindful of this philosophy, one can chart and map all the processes from downstream (customers) all the way up to upstream (raw materials). The output will then reveal the productive times associated with value adding activities as well as the wasted times caused by the non value adding processes.

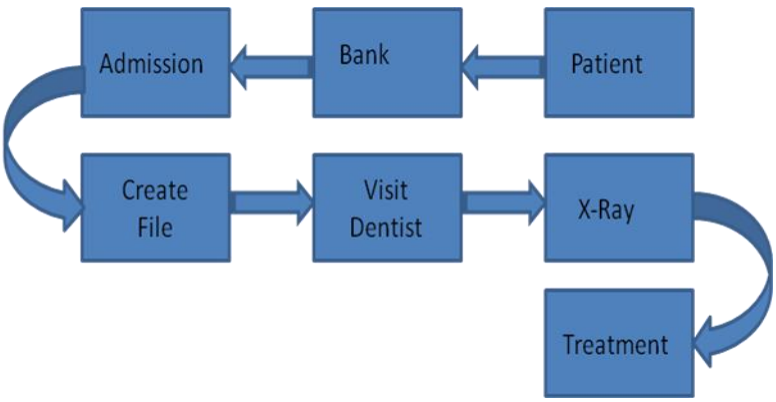
In summary, Value Stream Mapping consists of mapping and charting an existing situation in a given process and critically analysing it so that appropriate improvements can be suggested and implemented (Salzman RA, 2002). The next section presents a case study based on a real application in a typical service sector. Hence, it is demonstrated how the concepts of VMS can be adopted and then adapted to suit a non manufacturing application.

The Methodology Applied in Applying Value Stream Mapping

In order to test the applicability of VMS to service type industries, a dental clinic in a provincial city of Iran was selected. This particular clinic is known as having reasonable fees and above standard treatment quality. On average per day, around 90 clients visit the clinic. 36 patients (39.5%) of the patients are referred to the dental treatment department. A number of these patients require multiple treatments. Hence, the average demand for the Dental Treatment department is around 50 patients per day.

It should be noted that the chosen processes in this case relate to the dental treatment and the patients constitute both customers and the materials. The patients and their flow through the system are also very closely associated with information and its flow. Figure 1 is a diagrammatical representation of the processes under investigation.

Figure 1 – Activities Included in the Dental Treatment process



It was agreed that the most effective way of mapping the current situation was to, physically, be present at the clinic and conduct the data collection by observation. In order to ensure that the collected data for our sample did not exhibit any biases, a complete week was chosen as the period of observation. The methodology adopted for this study consists of: 1- General observation; 2- Calculation of the number of patients; 3- Data (types, durations and sequences of various activities) collection; 4- Value Stream identification and mapping the current situation; and 5- Value Stream analysis of the current situation; and 6- Developing and mapping the Value Stream for the future (improved) situation. Before proceeding any further, it would be appropriate to elaborate on the key phases above.

The method of observation and data collection was thoroughly explained to the staff of the clinic prior to the study. The general observation and data collection were carried out by three observers who were present at the clinic for a period of one week during the working hours. The team members were equipped with digital stopwatches similar to those used in Motion and Time Study. After their allocation, the observers conducted the study according to a pre determined schedule. To keep a record of the number of patients entering the system, a spreadsheet was used.

Table 1 presents a summary of the key information related to Phase 3 for various sections of the chosen department.

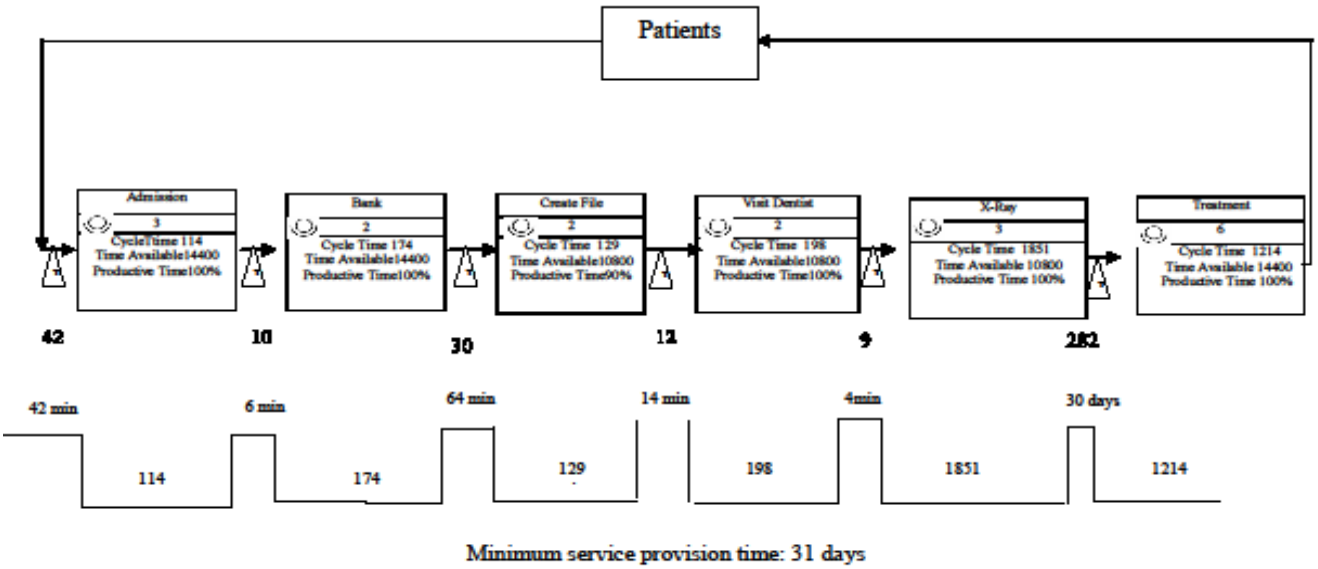
Table 1.

Table1 – Times Associated with the Activities of the Existing Situation

Stage	Total Time per Patient (Sec)	Productive Time (%)	Queue Length	Number of Staff
Admission	114	100	42	2
Bank	174	100	10	2
Create File	129	90	30	2
Visit Dentist	198	100	12	2
X-Ray	1851	100	9	3
Treatment	1214	100	282	6

This tabular representation can also be illustrated graphically using an approach and symbols similar to those adopted in a typical Method Study or Organization and Methods (O&M) exercises. For instance, the above sequence of the stages (1 to 6) can be depicted along a time axis as shown in Figure 2.

Figure 2 – The Graphical Representation of the Existing Situation for a Day shift



The number below the Stage title inside the box represents the number of staff at that Stage. The number at the bottom between each box (Stage) shows the average queue length (Work in Progress). The top number along the staggered timeline below the Figure represents the average waiting time before entering the Stage. And finally, the lower number along the timeline is average cycle time for the activity. Please note that the cycle time (average) is also shown inside each activity box.

As a first step in analyzing the activities, it was necessary to determine the nature of the activities in terms of being value adding or non value adding. It should be noted that non value adding activities, in some cases, are unavoidable. Therefore, the study focused on identification of the avoidable non value adding activities with a view to either their elimination or replacement.

The following Tables (2 to 6) tabulate the problems and waste type identified in each stage of the activities presented in Table 1.

Tables 2 to 6.

Table 2 – The 'Admission' Phase

Identified Problems	Waste Type
Entering the System at the Opening Hour by the Majority of the Patients	Unnecessary Storage (Waiting/Queuing) times Due to a Very Large Demand
Large Number of General Enquiries with regard to	Delays

Various Issues	
Lack of Information Signs to Assist Visitors in Finding their Way to the Right Place	Unnecessary Movements by Patients

Table 3– The 'Create File' Phase

Identified Problems	Waste Type
Early and Premature Arrivals at the Desk	Unnecessary Storage (Waiting/Queuing) times
Lack of sufficient Information Signs	Unnecessary Movements by Patients

Table 4 – The Visit Dentist' Phase

Identified Problems	Waste Type
Recommendations for Additional or Unwanted Treatment from the Patients' Viewpoint	Overproduction (Unnecessary Activities) in the Case of Patients' Acceptance of the Recommendations
Early and Premature Arrivals in the Room	Unnecessary Storage (Waiting/Queuing) times
Incorrect Diagnosis	Unnecessary processes

Table 5 – The 'X-ray' Phase

Identified Problems	Waste Type
Unnecessarily High Quality of the Materials and products	Overproduction (Unnecessary Activities)
Long Waiting Times Considering the Overstaffing Situation	Delays

Table 6 – The 'Treatment' Phase

Identified Problems	Waste Type
Relatively Long Durations	Delays
Unsatisfactory Outcome in Some Cases	Faulty/Scrap parts

The findings provided in the above Tables (2 to 6), were then used to deal with the identified causes of non value adding activities with a view to their elimination from the processes. It was necessary to calculate the average available time per patient for each phase. This calculation was carried out as follows:

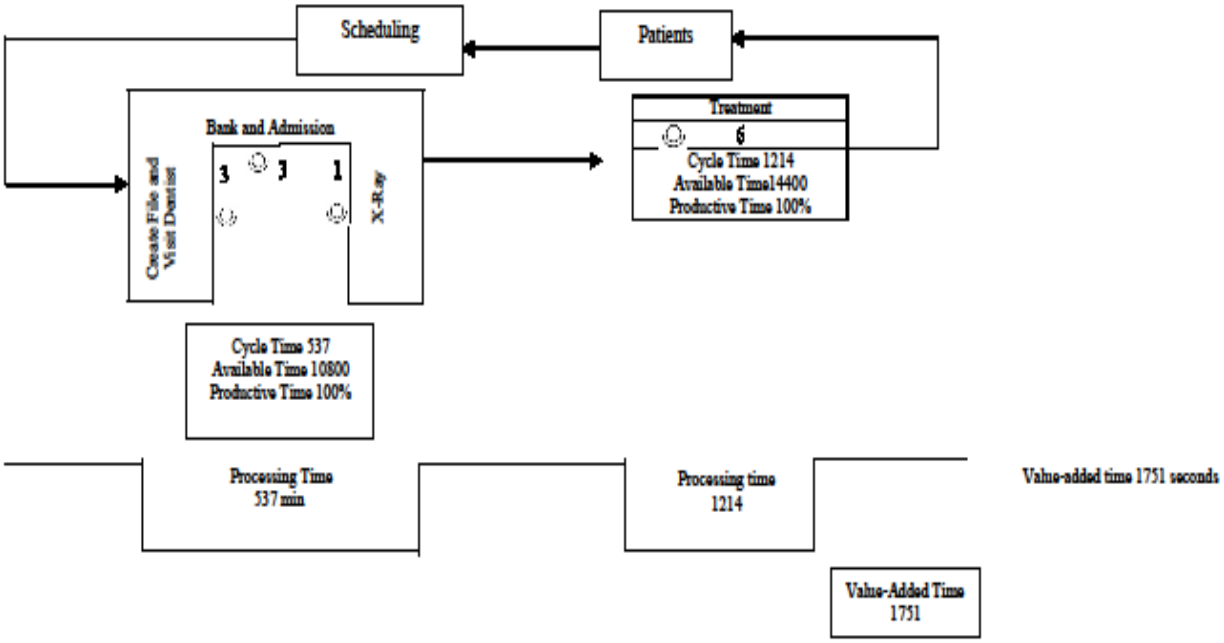
Average Available Time per Patient (AATP) =

Total Daily Available Time / Average Daily Demand

According to the findings of the existing situation, both visits to the dentists (phases 4 and 6), have fluctuating times for different patients. These fluctuations are the deviations from Average Available Time per Patient. For instance, the deviations from the AATP for these phases are 120 and 288 seconds per patient respectively. There are also waiting lines in these phases. These queues are predominantly caused by uneven distribution of the patient arrivals at the dentists' rooms. These queues can be eliminated or at least minimised by a more even distribution of the patients throughout the day. As a result, a continuous flow with relatively smaller fluctuations can be created. Improvements in the facilities and equipment can also contribute to achieving this goal. For instance, the X-Ray section can benefit from updating their equipment and methods of processing films. Considering the daily demand of 50 cases and an average treatment time of 1214 seconds per patient, an average of 16 hours, 52 minutes and 40 seconds would be required. By dividing this figure by the number of dentists available per day, two hours, 48 minutes and 37 seconds of productive work by each dentist would be a requirement.

Figure 3 illustrates a graphical representation of the improved situation. As it is shown, the total time has been considerably reduced. This reduction in total time is achieved by improving incorporating a new activity titled Scheduling which can allocate patients to various stages at more appropriate times. The layout of the facilities should also be improved by combining activities such as Admission and Bank services. Such a combination would contribute to a smoother flow of materials, information and products (service).

Figure 3 – The Graphical Representation of the Improved (Value Added) Situation for a Day Shift



Conclusions, Recommendations and Suggestions for Further Research

The findings have revealed that the investigated clinic is certainly not a lean organization. This is partly caused by a gradual increase in the demand over the years but with practically no changes or improvements in the processes. It was demonstrated that Value Stream Mapping could be a suitable tool in identifying the nature and exact location of the waste.

In particular, the 'dentists' visits' and 'treatment' phases would certainly benefit from avoiding unnecessary and unwanted procedures. Hence, an attempt to create an even flow of patients rather than fluctuating arrivals can be achieved. The dentists could also ensure that they would receive the necessary information with regard to an anticipated demand so that they could be present and ready. The X-Ray section should investigate the possibilities of changing to automated film processing from the current manual methods.

As it was discovered in the current situation's analysis, a lack of communicating the necessary information and instructions by appropriate displays around the clinic also plays a role in generating waste.

It is also recommended that a further comparative study of a number of similar organizations to be carried out to identify the nature and effect of factors contributing to non value adding activities. Such an investigation would rank the strength of contributory factors which are commonly identified.

References

Abbett D & V. Payne (1999) *Gulf Stream Value Stream Tour*.

Djumin SC, Wibowo Y & Irani S(2000) *Value Stream Mapping from an Industrial Engineering Viewpoint*, The Ohio State University.

Kalsaas BT (2002) *Value Stream Mapping. An Adequate Method for Going Lean?* NOFOMA, The 14th International Conference, Trondheim.

Khaswala ZN & Irani SA(2001) *Value Network Mapping(VNM): Visualization and Analysis of Multiple Flows in Value Stream Maps,* The Ohio State University

Mehrban R(2005) *Lean Manufacturing,* Jahaneh Farda Publications, Tehran, Iran.

Rizzardo D & Brooks R (2003) *Understanding Lean Manufacturing,* Maryland Technology Enterprise Institute.

Rother M & ShookkJ (1998) *Learning to See: Value Stream Mapping to Add Value and Eliminate Muda,* Brookline Lean Enterprise Institute.

Shakeri Roshan M (2005) *A Review and improvement of processes using VSM, with a Focus on Lean Thinking,* University of Science and Technology, Tehran, Iran.

Salzman RA (2002) *Manufacturing System Design: Flexible Manufacturing System and Value Stream Mapping*, M.S. Thesis, Massachusetts Institute of Technology.

Schultz KM, Paruchuri MR & Patel JB (2005) *Applying Lean Principles in a Test Laboratory Environment,* SAE World Congress, Detroit, Michigan, April 2005

Tapping D et al (2002) *Value Stream Management*, Productivity Press.

Womack J, Jones D & Roos D (1990) *The Machine that Changed the World*, Macmillan Publishing Company, New York.