

Applying Toyota Production System Principles And Tools At The Ghent University Hospital

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Abstract

For the last decades many organizations started using Lean as their major business strategy for organizing and improving their operational activities. Results in manufacturing have been very good, but nowadays also service and office environments start to realize that the Toyota Production System, which is the basis of Lean, is a universal approach. Healthcare institutions in the U.K. and the U.S.A. have already been applying lean principles to some degree. This paper describes the findings of our exploratory research on lean in service and healthcare showing how one department from the Ghent University Hospital in Belgium started to implement lean, resulting in significant performance improvements. After a brief discussion on the different elements of the Toyota Production System, we will show how they were adapted and applied in a service environment.

Keywords

Lean, healthcare, Toyota production system, lean tools

1. Introduction

Lean Thinking is globally probably the most emerging improvement strategy in the last decades. Based on the Toyota Production System (TPS) and its principles, the first applications and successes were shown by Womack and Jones [1]. Since then, many publications have described the Toyota Production System and its tools in great detail ([2,3]). The overall goal is to have the best quality in the shortest lead time at the lowest cost through improving the flow by eliminating non value added activities, also called 'waste'. The TPS is made out of several pillars as depicted in Figure 1.

As with Toyota, the first implementations of Lean Thinking were in manufacturing environments, while later it became clear that also office and service processes could benefit from the lean approach. In that perspective, some important achievements were made by applying lean principles and tools in healthcare, especially in the U.S.A. and the U.K. ([4-11]).

Since a few years some hospitals in Belgium and the Netherlands have also been discovering Lean and the successes that obtained abroad. This has motivated them to make the first steps. In Belgium, the University Hospital in Ghent has been taking a pioneer role. This paper describes the findings of our exploratory research: Can different elements of TPS be adopted for implementation in a service/healthcare environment and in which way? Does this then lead to significant improvements? We will use the "house" of lean as developed by Toyota (Figure 1) as the basic reference framework and will look for evidence in one department of the Ghent University Hospital that acts as a pilot area for their implementation of Lean.

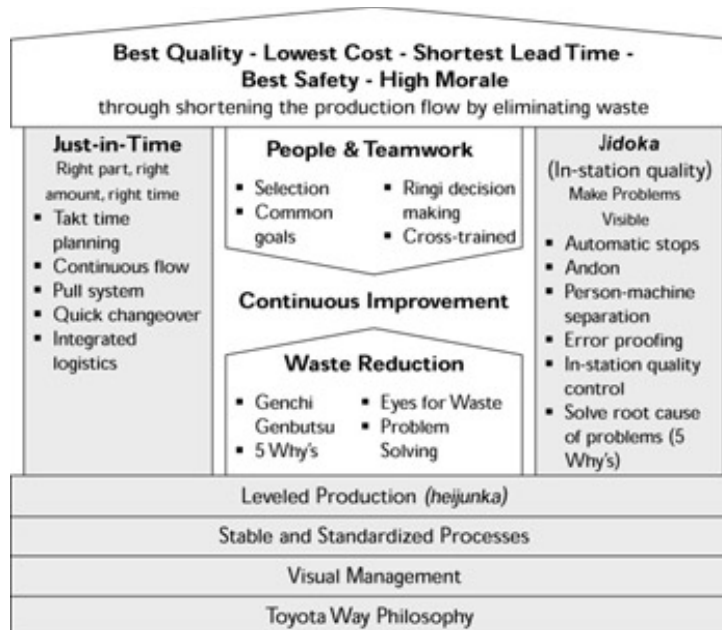


Figure 1: The Toyota production system [3]

2. The Dermatology Department and the Need for Lean

The main focus of this research was in one pilot area: the Dermatology Department. Although the department is already nationally and internationally recognized as a highly regarded academic department with several expert faculty, high impact scientific research projects and publications, it has a vision that all of this can be done in a better, more structured way, with a clear patient focus.

The staff realized that a necessary condition for achieving this vision, was to have clear, standardized and sound operational processes. There was certainly a burning platform for change: patients were experiencing long waiting times for consultations, poor punctuality, lack of communication of relevant information at the appropriate time and many difficulties to reach the department by phone.

Lean was chosen as the main strategy to achieve this vision, given the focus in Lean on customer/patient value, well designed processes and value streams, and last but not least, a paradigm shift and a lasting culture change. As Lean originates from a manufacturing environment, it was not straightforward which lean principles and tools from the different pillars of the Toyota Production System house (Figure 1) could be easily applied or adapted to this specific service environment in order to obtain breakthrough results.

3. Implementation of Lean Tools

3.1 Correctly Specify 'Value' for the Customer – Identify the Value Stream

As Womack and Jones describe in their 5 steps of implementing Lean Thinking: you should start with correctly specifying 'value' for the customer [1]. Although frequently forgotten and not always easy to do, this is a critical step. Too often people jump straight to the reduction or elimination of waste, however this cannot be done in a very effective without this first step. Mathematically speaking we can say that 'Waste= 1 – Value', so the full extent of what waste is, only becomes clear after we define value.

A cross functional team of representatives of the different roles within the department came to this definition of 'value':

- A patient expects top quality medical care, supported by evidence based medicine.

- A patient expects a streamlined process, without waiting times and with punctual appointments.
- A patient expects to be satisfied with the complete value stream.

Based on these expectations concrete objectives were determined (Table 1).

Table 1: Objectives for the lean implementation

	Cancer patients	Regular patients
Reducing waiting times for appointments	< 1 week	< 2 weeks
Improve punctuality on the day of the appointment	80% within 5 minutes	90% within 5 minutes
Increase number of patients per doctor		260 per week
Increase Patient Satisfaction (based on large scale survey)		80%

The value stream depicts how value is currently created throughout the department. Typically it is easy to see that not everything that happens is value. In this case there were numerous examples of the different types of waste. Some are mentioned in Table 2. Immediate countermeasures were identified and implemented by the people on the floor. The current state observations also showed that performance on the KPIs needed a drastic improvement. Current values are shown in Table 3.

Table 2: Examples of some types of waste in the dermatology department

Type of Waste	Observation	Countermeasure
Overprocessing	Results of allergy tests are first written on paper, then typed into a computer and on top of that, copied for the archive.	Only one entry of the data in the electronic filing system, accessible for all authorized personnel
Transport	Beds of patients were transported to the specialist creating congestion and chaos in the hallways.	The specialist will go to the patients. Only patients that are mobile come to the consultation area.
Waiting	Unbalance in Cycle Times as the allergy doctor finishes earlier seeing the patient than the nurse who has to perform the allergy tests. This causes waiting for patients.	The doctor will already start writing the report and completing the patient file. In that case workload is better balanced and waiting times reduced.
Motion	Equipment needed is spread out over different rooms.	Analyze and improve the layout of the lab using spaghetti charts.
Talent	Not enough critical review of which tasks have to be performed by the specialist versus the nurse	An area has been setup in which the nurse can do basic work on wounds, doctors do only the more surgical work.
Etc.		

Table 3: Current state performance

	Cancer patients	Regular patients
Waiting times for appointments	4 months	6 weeks
Punctuality on the day of the appointment	37% within 5 minutes	10% within 5 minutes
Patient Satisfaction (based on large scale survey)		70%

3.2 Implementing One Piece Flow in the Consultation Value Stream

The current state value stream analysis showed that the doctors reserved about 15 minutes of time for each patient and that they were typically writing the reports of their examinations in the late afternoon/evening, after they finish seeing patients. It became clear that all activities were not executed in a one piece flow fashion.

As can be imagined, beside a physical changeover (retrieving and opening each patient file) there was in this case also an important mental changeover.

As a countermeasure the consultation time slots were increased to 20 minutes. Hence, the writing of the report could be done immediately. Although the scheduled times per patient were increased, overall there was a reduction in time

needed per patient, so extra capacity became available and more patients could be seen. This was really counter-intuitive to what people in the department were expecting. Until then, for them an increased output always had to go along with more capacity.

3.3 Implementing Load Leveling (Heijunka) in the Consultation Value Stream

Typically appointments for the 4 available specialists were scheduled at the same time. This created batches of patients arriving at the reception desk (which is, on top of that, also a shared resource – serving multiple value streams). The countermeasure was to better level-load the arrival pattern. Appointments are now scheduled 5 minutes apart as indicated on Figure 2.

Secondly, as there are only two buffers to deal with variations in a service process (capacity or lead time), spare capacity was chosen in order not to jeopardize the lead times (or waiting times of the patients) in case of unforeseen variations (more patients or internal problems). The fourth doctor has some empty slots on his schedule that can be used for urgent last minute patients and for taking over patients when a colleague is running behind (note: some doctors are still in training, so for them it might take longer to see a patient than an experienced specialist).

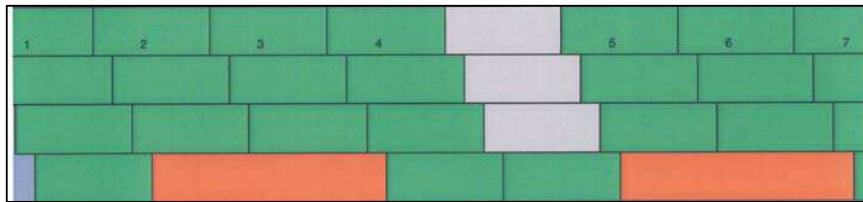


Figure 2: Leveled doctor schedules with free capacity slots

3.4 Reducing Variability by a Better Matching of Capacity and Demand

As mentioned in the previous section, the reception desk of the department is a shared resource. Typically three types of activities can be seen:

- Registering an incoming patient
- Answering phone calls
- Booking follow-up appointments for patients

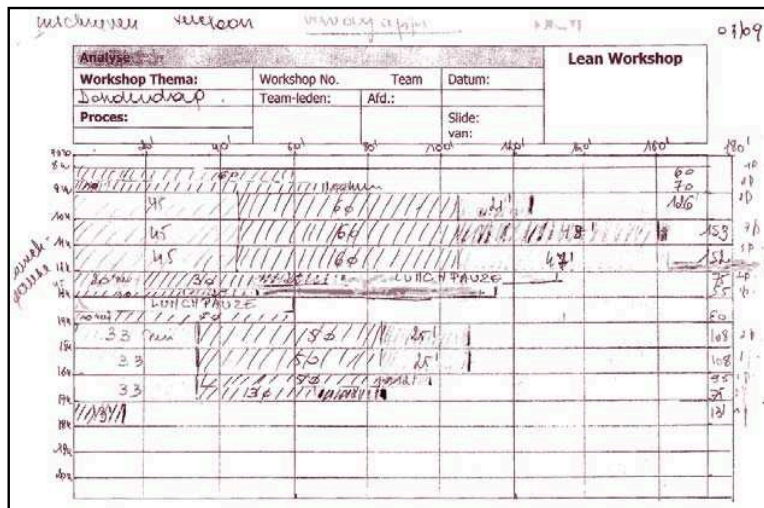


Figure 3: Measuring incoming workload at the reception

In the current state there were always three people present and out of courtesy they would help each other out when there was a peak load. This created quite some chaos and running around.

It was decided to measure the real incoming workload, for each hour of the day. These measurements were executed during a week. An example of the registration sheet is shown in Figure 3.

Based on the results it was clear that the staffing was not aligned with the actual demand, one average takt time per day did not fit all. Influencing the variation of incoming patients is not so easy, therefore it was decided to go for flexible staffing so that a capacity buffer is used to deal with these variations and so that lead time (or waiting time) for the patients is not negatively influenced: just one receptionist starts at 8am, the second one at 8.30am and the third one only starts at 10am. Where in production environments material and lead time buffers are better suitable to deal with variability (and thus one average takt time can be used more easily), in a service/healthcare setting there is a need for calculating takt times over shorter time frames (e.g., hourly) resulting in flexible capacity in order to limit the use of the lead time buffer (as this implies directly longer waiting for customers).

3.5 Eliminate Waste and Increase Capacity by Implementing Standard Work for Specialists

Measurements and observations also showed that the flow at the reception desk was often interrupted by phone calls. On top of that there were quite some patient complaints that the reception desk was hard to reach by phone. The team gathered data on the phone calls and this showed that the second largest category of calls had to do with patients requesting to speak to the doctor for obtaining the results of their consultation. This could not be solved by just increasing the capacity at the reception desk. An Ishikawa analysis showed that patients want to talk to the specialist as he or she promised to communicate the results within a certain time frame. Typically the doctor would not be available or was out when the patient called, resulting in chaos, and more follow-up phone calls

As a countermeasure the standard work for the doctor was changed. Some slots in the schedule of the specialist are now reserved for calling patients. The exact times were agreed upon with the patients during each appointment. The elimination of this variability resulted in an important reduction of the number of (useless) calls at the reception desk and at the same time an increase in patient satisfaction.

3.6 Enabling and Supporting Continuous Improvement with Visual Management, 5S and Performance Boards

Several actions with regard to visual management were taken. A 5S implementation was started, visual standard work and instructions are implemented and A3 sheets were used for strategy deployment. As the main value streams and value stream owners are identified, also specific KPIs and objectives were determined and initiatives are implemented based on PDCA (Plan-Do-Check-Act).

An example is depicted in Figure 4; this graph shows the evolution of the waiting time for an appointment.

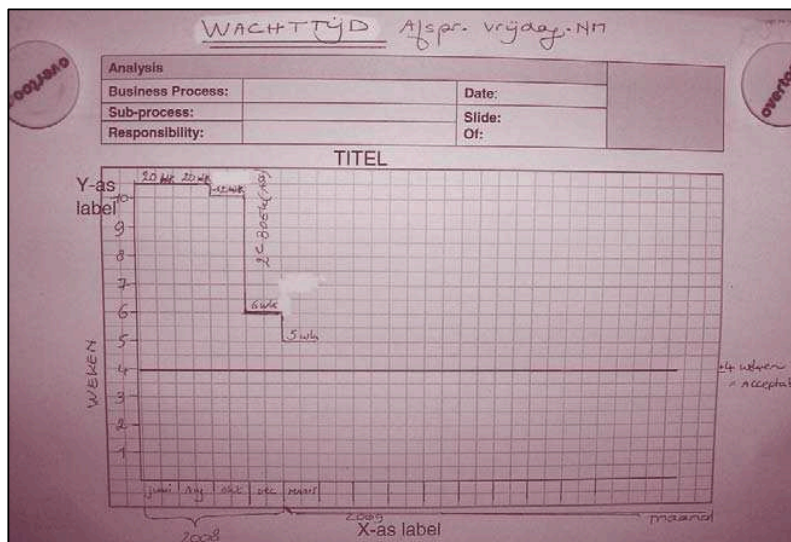


Figure 4: Visualization of the waiting time for an appointment

Weekly the KPIs and the results are discussed during a 15 minute meeting with all concerned associates. Countermeasures and owners are identified whenever performance is below target.

This way of sharing information with everyone about the department's performance increased involvement and ownership of all associates. As a result of these discussions more opportunities for improvement are identified.

The department head is also having weekly meetings with the value stream owners. Hence, initiatives and improvements stay aligned with the departmental objectives.

4. Results So Far and Next Steps

The lean implementation in the Dermatology Department shows after one year already important improvements (Table 4). However, as implementing lean is a journey and not a project, these are of course only intermediate results. The next challenge is now to start improving the value streams that involve multiple departments, but also to hold the gains that were obtained in the pilot value stream.

As a result of the initial successes in the Dermatology Department, the board of the University Hospital chose for a hospital-wide implementation of Lean.

Table 4: Some intermediate results

	Cancer patients	Regular patients
Waiting times for appointments	< 1 week	< 1 week if urgent < 2 weeks for others
Improve punctuality on the day of the appointment		47% within 5 minutes
Increase number of patients	Increase from 21.000 to 23.000 per year	
Increase Patient Satisfaction (based on large scale survey)	80%	

5. Conclusions and Further Research

Our exploratory research has found conclusive evidence that many of the TPS tools can be applied in a healthcare setting with great results. In this study following Lean techniques were proven to be effective:

- One piece flow of value added activities
- Identifying 7 types of waste and implementing countermeasures in order to eliminate or reduce
- Heijunka principles for improving the flow
- Flexible capacity for dealing with varying takt times for improving flow
- Standard Work for eliminating waste resulting in more available capacity
- Visual management as basis for a continuous improvement culture



Figure 5: Lean tools applied in this case study

As can be seen on Figure 5 they cover the JIT and CI pillars, as well as the fundament of the TPS house. In this case limited or no evidence was found of implementation of techniques from the Jidoka pillar or from value stream improvements outside the departmental boundaries, across different hospital entities. This could be subject to further research.

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