

# **Application of Value Stream Mapping as Lean Tool along with Arena Simulation in Public Health Care Services: A Case of the Radiology Department.**

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## **Abstract**

Value stream mapping (VSM) is an initial and critical tool for deploying lean concepts in manufacturing and service sector including hospitals. Radiology department receives diverse inputs and provides vast range of services which make this system complex and challenging to optimize. In developing countries where hospitals are oppressed by high patient load, crowded receptions and waiting areas due to long patient waiting time create hindrance in other operations as well. Therefore, the aim of this research is to analyze the working environment of a public sector hospitals' radiology department; as a case study, identify the bottleneck and waste in operations by mapping the current patient flow, and propose system improvements with the help of arena simulation. Use of simulation allow experimenting with different scenarios and make predictions about the outcomes, without changing the complex systems in reality. This study is based on the data collected for 15 days, through doctors and staff interviews and direct observation (Gemba walk). Patients requiring radiology services are classified as routine and procedure patient, with later need an appointment for the consultation after procedure. The research work is divided into two distinct phases: during the first phase waste checklist was developed using 5 why approach followed by Ishikawa diagram to identify the potential causes of long waiting time. The VSM tool mapped the current patient flow, with 13min processing time for routine patient and 59min for procedure patient. However, the total non-value adding time is found to be 188min (3hr) for routine and 388min (6hr) for procedure patients. The patients waiting for the scan reports is found to be the major bottle neck. During the second phase of work: to develop arena model initially best fit distribution is done on the obtained data. Arena simulation model is developed for the radiology department to analyze the number of patients out, waiting time per patient and average number of patients in the system. The model is verified by a specialist and validated using t-test, the model is replicated 200 times in arena to give best results with minimum deviation. Total 6 scenarios are analyzed to determine the impact on the above mentioned KPIs. Simulation results of current scenario showed 567 patients out of the system, with a maximum wait time of 31min/patient and average 43 patients in the system. The simulation results of the 5<sup>th</sup> scenario provided the optimum output, with 30% improvement in patient out, 3% reduction in waiting time per patient and only 19 patients in the system on average. Based on it a future VSM is created which provided a 26% and 19% decrease in processing time, while non value added time is reduced by 73% and 61% for routine and procedure patients. This can lead to increase in the number of patients to be entertained by the radiology services without adding any new resource.

## **Key words**

Value stream mapping, arena simulation, lean tool, health care system, radiology department

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