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Development of Web Application Framework for Lean Assessment Approach

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Abstract— *Lean manufacturing is a process of eliminating non value added activities in an Industry. Non value added activities (NVA) are the activities, which does not add values to the products made in the industry. Industry uses either lean team or external lean consultant to carry out the lean manufacturing process. Lean manufacturing software is a web based application which helps the lean team as well as lean consultant to carry out their process in faster, reliable way of approaching their results. The Database Management System connected to web application stores, calculate and manipulate the data which are collected from data collection process and provide statistical data output which are further carried to decision phase by the lean team. An idea to make the lean implementation process go lean.*

Keywords—Value stream mapping, Process flow Analysis, Value added ratio, Overall Equipment Effectiveness, Database Management System, Asp.Net.

I. INTRODUCTION

Industries have started implementing lean to their activities in order to reduce the Non Value Added Activities which increases the productivity and the reduce the cost of the product. Though implementing process of lean is a tedious process which is to be controlled by separate lean team or lean consultants, the lean manufacturing process takes much time to produce successful results. Non Value Added activities are the activities which does not add values to the product produced in the industry or the activities which the customer not willing to pay for. Lean manufacturing has several lean tools and procedural flow of activities to be carried, in order to find and reduce the NVA in the industry.

Lean manufacturing software is developed in order to decrease the time taken to implement the lean manufacturing process. The raw data needed for several lean tools are collected by the lean team and are uploaded to the web application, which delivers the results of several lean tools in statistical data, which in turn are used by the lean team for decision of type of implementation need to be carried with. The software develops Current state Value Stream Mapping, Process flow analysis, Overall Equipment Efficiency, Value added ratio.

II. LITERATURE SURVEY

"Er.Kirtesh Jailia, Mrs.Sujata, Mrs.ManishaJailia, Mrs.Manisha Agarwal " Lean software Development ("as a survival tool in recession") in International Journal of Software Engineering and Its Applications In this paper the author describes about the Lean software development is a new ray of hope for survival in the phases of recession. The term recession is like a nightmare for software companies. Here in this paper the author discuss how to sustain the business in the recession with the help of lean software development [1]. " J. Pernstal, R. Feldt, T. Gorschek " The lean gap: A review of lean approaches to large-scale software systems development in Elsevier The Journal of Systems and Software ,The objectives of this study are to identify and classify state of the art in large-scale software development influenced by LPD approaches and use this established knowledge to support industrial partners in decisions on a software process improvement (SPI) project, and to reveal research gaps and proposed extensions to LPD in relation to its well-known principles and practices [2]. "EetuKupiainen, Mika V. Mantyla, JuhaItkonen" Using Metrics in Agile and Lean Software Development – A Systematic Literature Review of Industrial Studies in Elsevier - Information and Software Technology The author mentioned about to increase knowledge of the reasons for and effects of using metrics in industrial Agile development. We focus on the metrics that Agile teams use, rather than the ones used from outside by software engineering researchers. In addition, we analyze the influence of the used metrics [4]. "Xiaofeng Wang , Kieran Conboy, OisinCawley" Leagile software development: An experience report analysis of the application of lean approaches in agile software development in Elsevier - The Journal of

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Systems and Software In this paper the author had clearly mentioned The results of our study show that lean can be applied in agile processes in different manners for different purposes. [6].“Aravinth Kumar A , Dr. D. Rajenthirakumar ” Lean Implementation through Enhancing Productivity in a Pump Industry in International Journal of Engineering Research, In this paper Lead time is calculated by adding value added and other Non-value added time. The lean tools that are applied in this project are Kaizen, Layout optimization, setup time reduction and Line Balancing which eliminates inventory which in turn reduces the lead time during manufacturing [7].“A.Aravinthkumar,K.SathishKumar,Dr.D.Rajenthirakumar”Embellishing TPM through facilitating OEE in a sustainable manufacturing concern in International Journal of Emerging Technology and Advanced Engineering In this paper the author had improved OEE (Overall Equipment Effectiveness) by using Kaizen methodology and we use different layout to improve the productivity in the manufacturing industry by embellishing the concepts of TPM. The suitable new plant layout eliminates the transportation waste and improves the material flow, which in turn increases the productivity [8]. “Kai Petersen , Claes Wohlin” Software process improvement through the Lean Measurement (SPI-LEAM) method , the author tells about the change to lean has to be done in a continuous and incremental way. In response to this we propose a novel approach to bring together the quality improvement paradigm and lean software development practices, the approach being called Software Process Improvement through the Lean Measurement (SPI-LEAM) Method. The method allows to assess the performance of the development process and take continuous actions to arrive at a more lean software process over time. [9].“ D. Rajenthirakumar A. Aravinthkumar S. Sivagurunathan A.Balasuadhakar ” Benefits of Implementing Lean Principles to Real Manufacturing Environment in International Journal for Scientific Research & Development , The main purpose of this technical manuscripts to present the benefits of using lean manufacturing tools and principles on dynamic manufacturing environment [10]. “Oleghe Omogbai, Konstantinos Salonitis” A lean assessment tool based on systems dynamics in this paper the author clearly explains about the interactions between lean practices and their improvements are often latent and need to be investigated: a systems approach can be used to disclose these hidden interactions. In this article, system dynamics is used as a lean assessment tool to assess and improve lean performance for a print packaging manufacturing system. [11].“Aravinth Kumar A , Dr. D. Rajenthirakumar” Lean Tools and Techniques Implementation in a Manufacturing Industry in Journal Of Applied Sciences Research , It tells us about the current state or As Is model (where we are) and future state or To Be model (where we want to be) [12].

III. METHODOLOGY

The development work starts with the identification of data that are required to specific lean tools, which are used in the web application. According to the lean tools, all the possible data types are researched, collected and sorted. Application algorithm has been made as whole and as well as for individual lean tools separately. Framework has been made according to the algorithm and software has been developed using Asp.Net. and MS Access. The methodology flow is plotted in figure 1. The below figure clearly shows the methodology which we are followed for the research work .

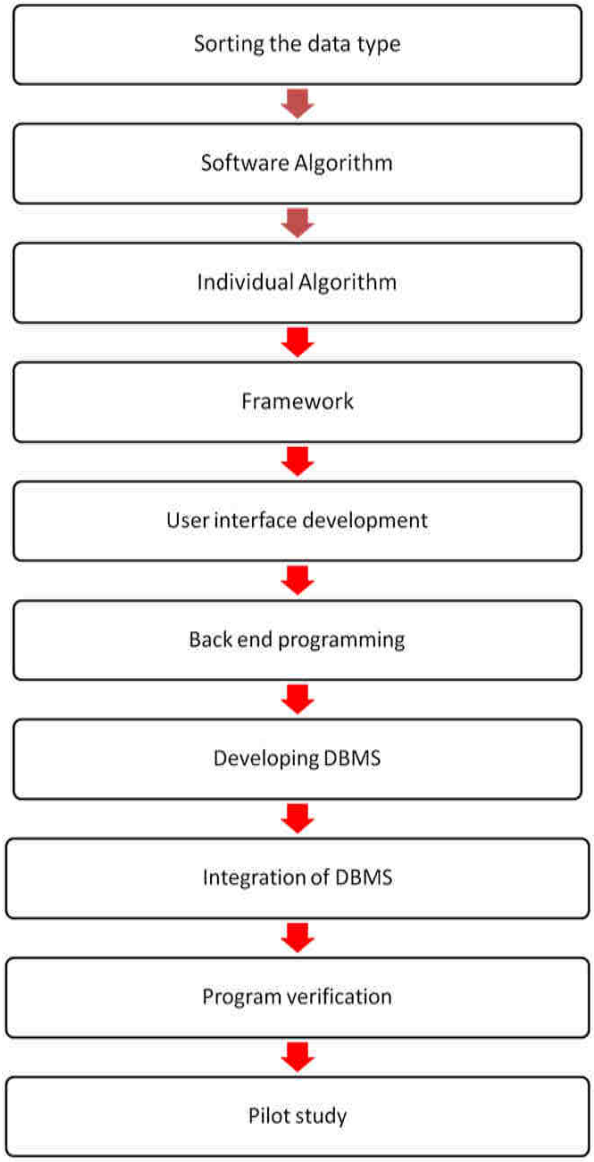

Fig.1: Methodology

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A. Sorting data types

Starting with the research of data needed for specified lean tools, the data types are arranged in order to ease the application end user. Data types are the entity which are relevant to the specific lean tools and data are the attributes to which the entities depend upon.

a) Process flow analysis

For the process flow analysis the data for entities are

i) Operations, Transport, Storage, Delay, Inspections

ii) Meters, Seconds, Parts.

b) Value stream Mapping

All the possible attributes are used as follows Part number, Current Cycle Time, Takt Time, C/O Frequency, C/O Over time, OEE [%], Scrap [%], Rework [%], Direct Labor, Indirect Labor, Actual # of Units/day, Plan # of Units/day, Available Time, Days/week, Shifts/day, Hours/shift.

c) Takt Time and OEE Calculations

Attributes considered for takt time calculation and Overall Equipment Effectiveness are, Operation number, Part name, Part number, Customer demand, Labour and productivity, Variants on line, Number of machines or stations, Changeover frequency, Changeover time, Number of changeover operations, Material process losses, Mean time to repair, Days per week, Mean time between failures, Machine capacity, Shift pattern, Minutes/shift, Total scheduled time per day, Planned downtime per shift, Breaks per shift, Planned downtime per day, Net available time, Current OEE , Process, Period of time to achieve the target OEE , Target OEE , Equipment availability, Unplanned down time. In practice, all operations produce with a slightly higher pace than what the takt time calculation says. If not, they would not have any opportunity to be able to fend for disturbances.

Takt time should therefore not be seen as a tool, but rather a vision. If your production pace were exactly the same as the mean customer demand, it would require perfectly stable processes and completely balanced flows. A long term goal in Lean Manufacturing. Takt time is calculated on virtually every task in a business environment. It is, however, most common in production lines that move a product along a line of stations that each performs a set of predefined tasks.

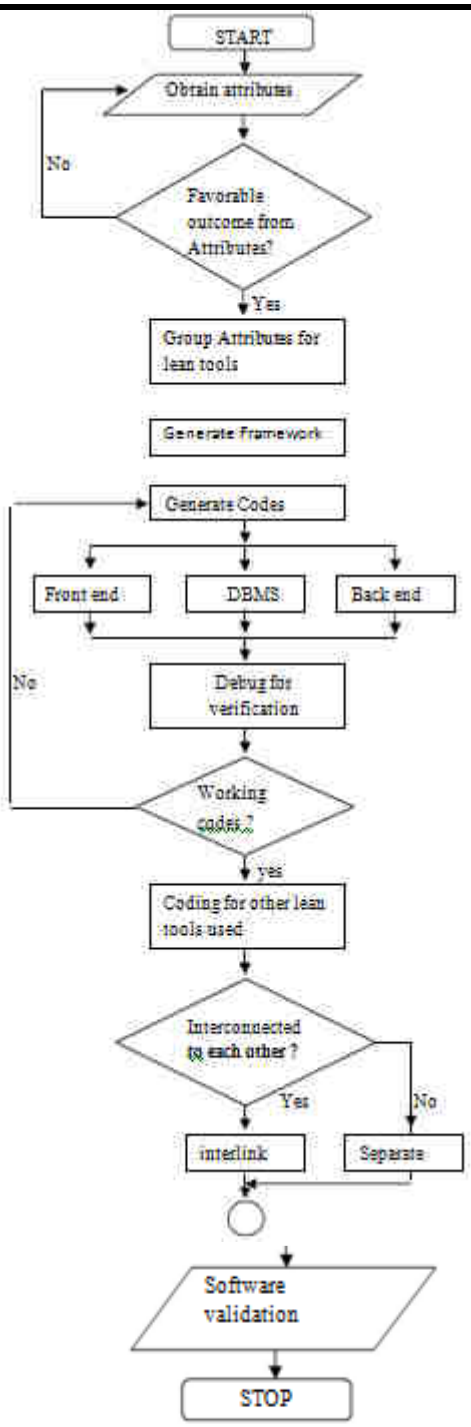

Fig.2: Flow chart for software algorithm

IV. SOFTWARE ALGORITHM

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A) Process Flow Analysis Algorithm

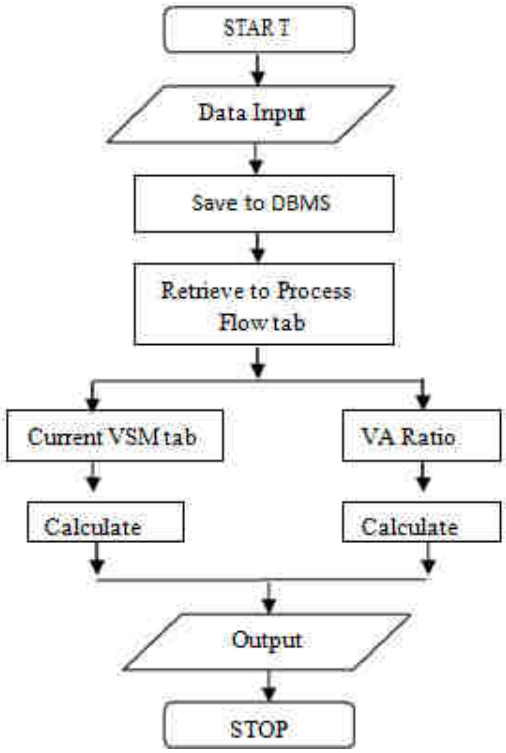

Fig.3: Flow chart for process flow analysis

B) Takt time- OEE Algorithm

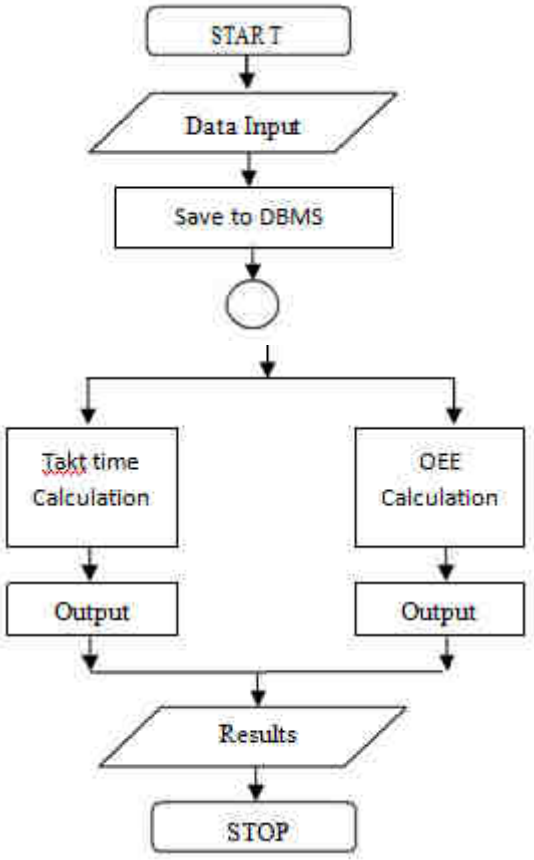

Fig.4:Flow chart for Takt Time and OEE calculations

V. FRAMEWORK

Framework provides the generic functions of the software which are going to be developed. Framework results the overall idea of how, the software will be working after completion. Framework for this web application software has been designed using MS Excel .

A) Process flow framework

The framework work for process flow analysis has been made with three different tabs interconnected to each other, such that data input to the first tab provides the input for the VSM and VA ratio tab automatically.

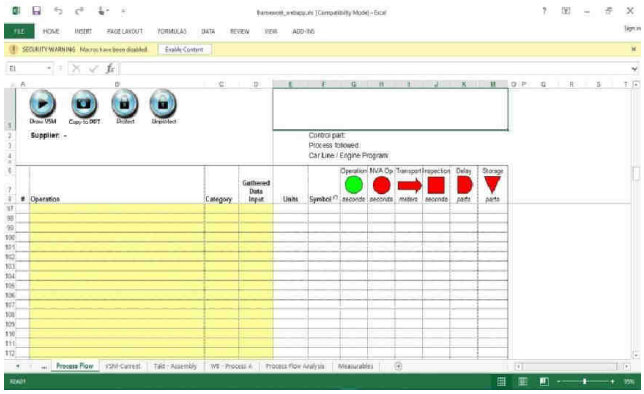

Fig.5: Framework for process flow

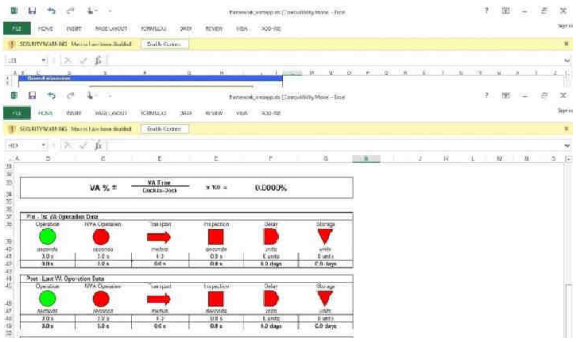

Fig.6: Framework for V.A Ratio

B) Takt time and OEE framework

All the parameters need for the calculation of takt time and OEE are observed and the framework has been created, the framework for the Takt time and OEE are designed using MS.Excel.

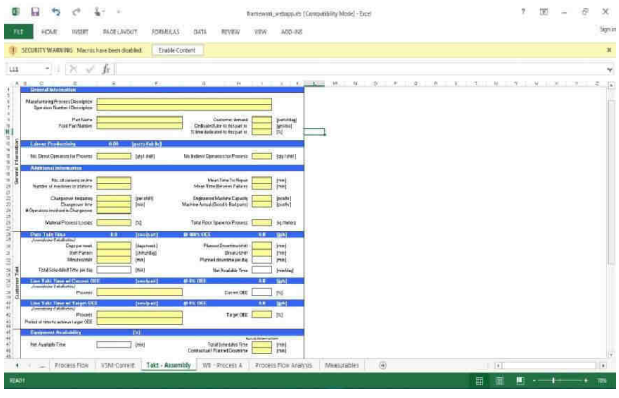

Fig.7: Framework for Takt and OEE

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VI. USER INTERFACE AND BACK ENDPROGRAMMING

The user interface is designed by using Asp.Net C # in Microsoft Visual Studio. The front end has been designed in the way as the framework design so as to calculate the data which are being entered, wherever necessary. Microsoft Visual Studio has the ability to design the user interface by drag and click method rather than programming the interface. The user interface development of takt time calculation, OEE calculation and process flow are show in the below figure.

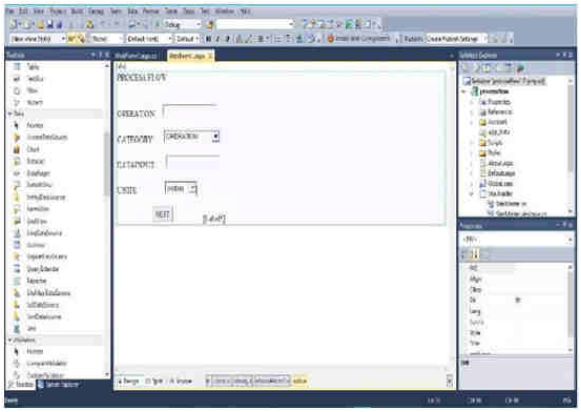

Fig.8: Process flow front end

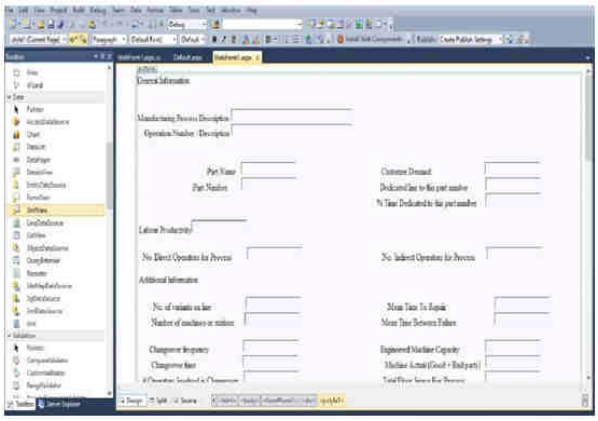

Fig.9: Takt and OEE front end

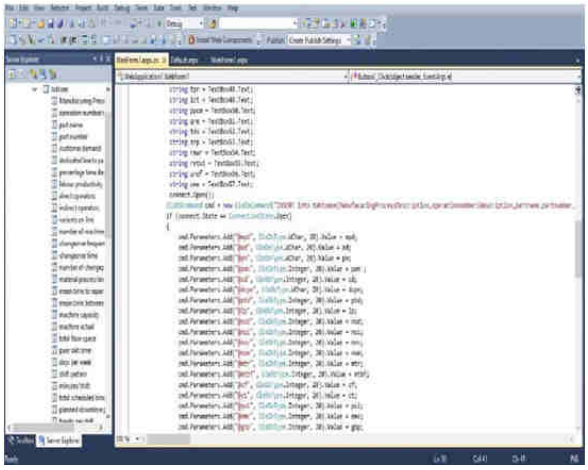

Fig.10: Takt and OEE programming

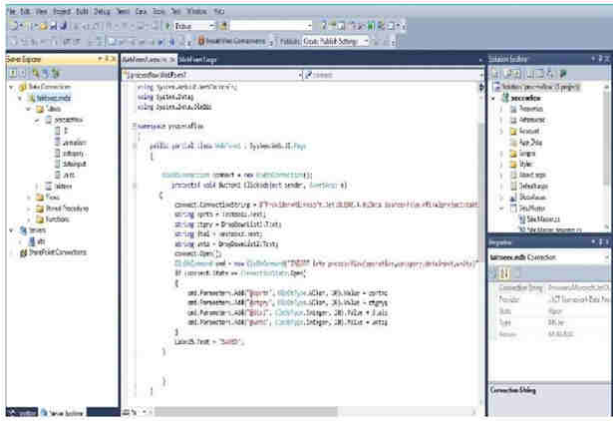

Fig.11: Process flow programming

VII. DATABASE MANAGEMENT SYSTEM

Database Management System (DBMS) used here is M.S. Access, where the back end plays the role. The data which are entered and calculated are stored in this software which are to be controlled by the admin of the lean team or the lean consultant. The designing of the back end are interconnected via primary and foreign keys used in MS Access. The following are the databases of the takt time and process flow back end.

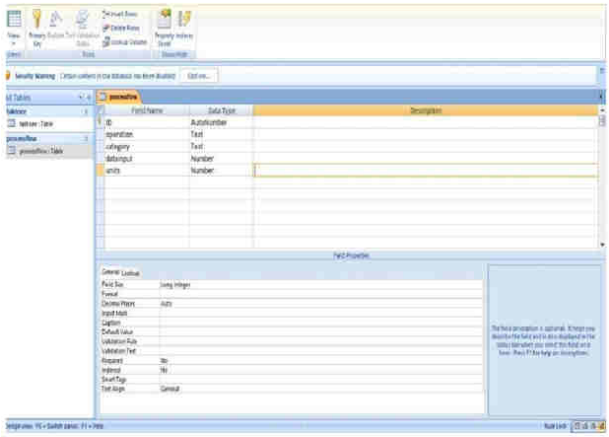

Fig.12: DBMS back end for process flow

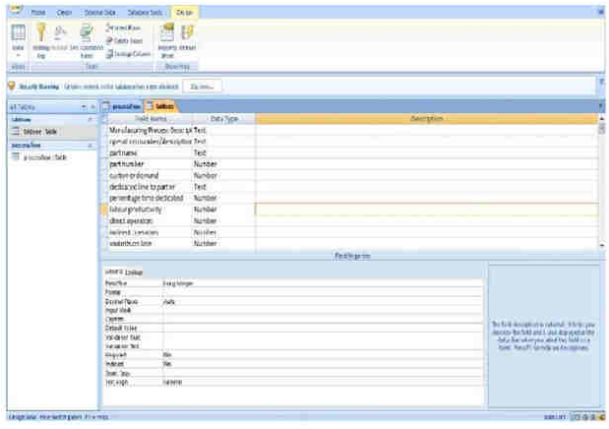

Fig.13: DBMS back end for takt and OEE

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VIII. ADVANTAGE OF WEB APPLICATION

The main advantage of using web application for lean manufacturing process is that it reduces the time taken to find the Non value added activities and reduce the manual work done by the lean team.

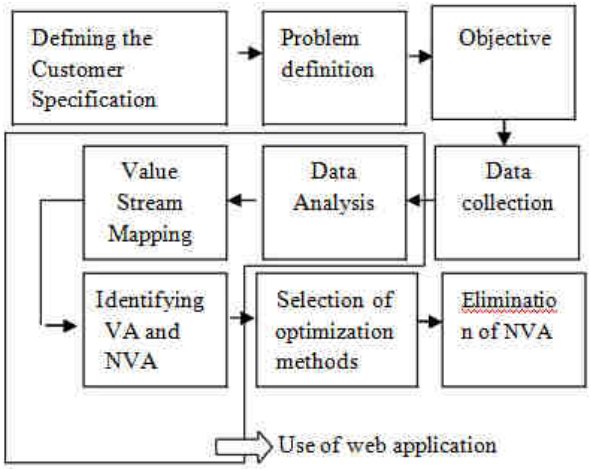
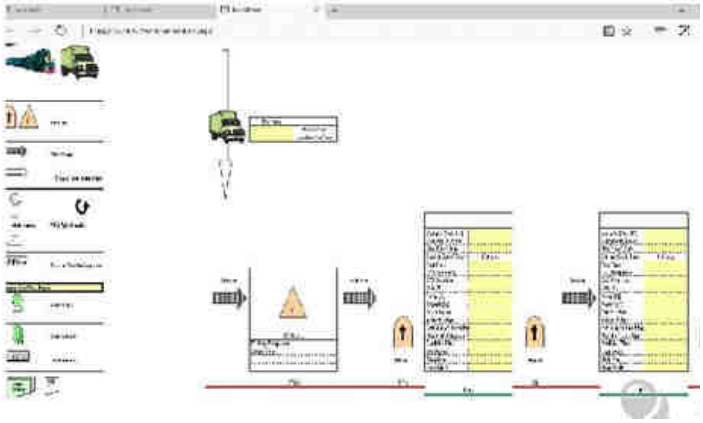


Fig.14: Flow chart of lean implementation process

IX. RESULTS

The web based application has been to developed and are verified for bugs. The results shows the local host of the developed application and the measurable tab shows the details of the statistical values obtained using the web application. The web application ready for pilot study, by applying the data obtained from the industry.



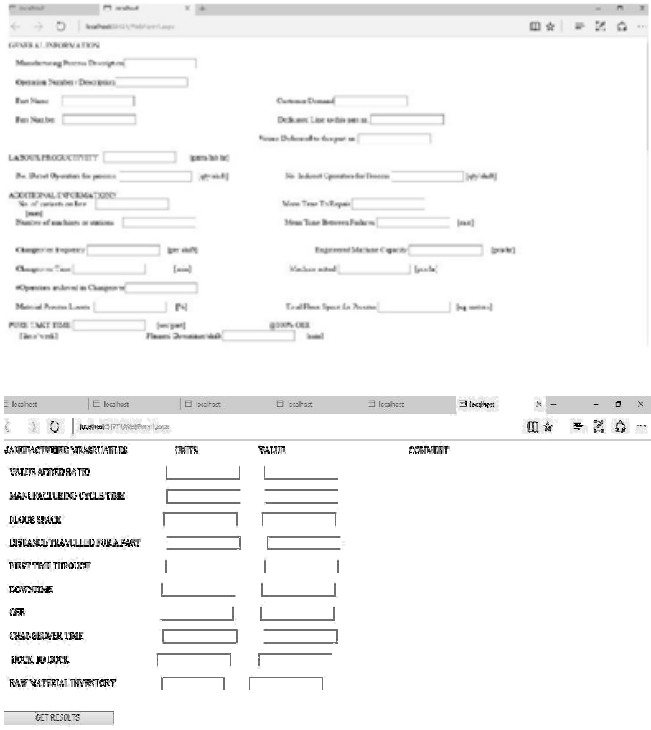


Fig.15: Output of the web application

X. CONCLUSION

The development of web application for lean manufacturing has been developed which provides the statistical data output from the data which are collected for lean manufacturing process.

The result from the web application helps the lean team to obtain the statistical data and to use it for decision making process to implement lean in the industry. Also the web application reduces the time of lean implanting process.

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