Lean six sigma Model

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Abstract— Lean is an approach that seeks to improve flow in the value stream and eliminate waste. It's about doing things quickly. Six Sigma uses a powerful framework (DMAIC) and statistical tools to uncover root causes to understand and reduce variation. It's about doing things right (defect free).A combination of both provides an over-arching improvement philosophy that incorporates powerful data-driven tools to solve problems and create rapid transformational improvement at lower cost.

Index Terms— lean, six sigma, lean six sigma, TQM, JIT, DMAIC, PDCA, PDSA, VVFPP ,VSM,7 wastes,5S,SMED ,SPC

1 LEAN SIX SIGMA ROADMAP

The researcher explained the lean six sigma roadmap in the next points and shows the flow char of roadmap.

1.1 Phase zero: selection phase

The researcher put the selection phase to overcome the problems in the traditional roadmap DMAIC such as the criteria to selecting the project, the researcher concludes the tools which is used in the selection phase in the next points.

Project selection team : the researcher using this tool to select the projects through cross function team

Project selection mind map : in this step the researcher drawing the project and determine the add value from the project and the researcher used mind man program to achieve this step

Project selection matrix : from this matrix the researcher can determine the importance of the problem or project and the matrix depend on some criteria such as manpower ,complexity, resistance and risk all this criteria against customer satisfaction , cost reduction , supply chain , efficiency , quality and replication (note that all this explained in the next chapter , chapter 5 project selection.

Situational assessment and problem statement: in this step the researcher determine the company pain, Symptoms/consequences (current pains for company and customer) and what should be improved?

Situational assessment : (Financial assessment): this researcher in this step determine the business case or the financial impact from the project

Stakeholder assessment -Identify current levels of resistance: in this step the researcher determine the level of resistance from the stakeholder of the project.

Stakeholder assessment- Identify required levels of support: the researcher in this step put the level of support from the stakeholder, the example of level of support moderately against or just ignores it, Passively Lets it happen, Facilitates to help it happen and Proactively Makes it happen.

Stakeholders assessment - strategies to gain support : the researcher in this step put the strategies to gain the support from the stakeholder , the example of strategies of support discuss, deep meeting , motivation , clear coaching and clear action plan and target

Project Communication Plan: the researcher in this step put the method of communication between the stakeholder and the project team to simplify the communication and gain the support from all.

Business Case - Product/ Service Matrix. The researcher determines in this step the family or the product which the researcher will conduct the project on it and after that the researcher can replicate the project on another family or product.

Business Case -Executive Summary (sales, Quantity and profit Pareto): the researcher in this step will determine the product by using pareto for three direction products sales , the product quantity and the products profit.

Business Case- Risks – Impact- reason to change. The researcher in this step determine the risks if we don't conduct the project

1.2 Phase one: Define phase

The researcher determine some question we can answering it in define phase,

Define who customers are, what their requirements are for products and services, and what their expectations are?

Define project boundaries (the stop and start of the process)?

Define the process to be improved by mapping the process flow?

Who is my customer, and what is the current cost of poor quality?

Defect definition?

Description of Y?

The researcher determine the Checkpoints for Completion to determine the project progress

1- Team Readiness

1.1- Team is sponsored by a champion or business leader.

1.2- Team formed and team leaders assigned.

1.3- Improvement team members fully trained on lean Six Sigma and DMAIC.(small knowledge).

1.4- Full participation by members in regularly held team meetings.

1.5- Team members perform project work when assigned and in a timely fashion.

1.6- Team members regularly document their project work.

1.7- Team is equipped with available and reliable resources.

2- Customers (and CTQs)

2.1- Customers identified and segmented according to their

different needs and requirements.

2.2- Data collected and displayed to better understand customer(s) critical needs and requirements.

3-Team Charter

3.1- Project management charter, including business case, problem and goal statements, project scope, milestones, roles and responsibilities, communication plan.

4- Business Process Mapping

4.1- Completed, verified, and validated high-level 'as is' (not 'should be' or 'could be') business process map.

4.2- Completed SIPOC representation, describing the Suppliers, Inputs, Process, Outputs, and Customers

(In some time we don't need to SIPOC technique).

1.3 Phase Two: Measure phase

The researcher put some questions to answer it during the measure phase and by answering it we can cover this phase and gain the phase requirements. The Project team begins process characterization by measuring baseline performance (and problems) and documenting the process the performance of the Core Business Process involved.

Which inputs(X's) affect outputs(Y)

What is my current process performance (sigma level)?

Are defects contained?

Also the researcher determines the steps of measure phase to conducting it and put some check point to monitor the project during measure phase and monitor the results

Gauge R&R, baseline capability Graphical analysis and Containment plan?

Develop a data collection plan for the process.

Collect data from many sources to determine types of defects and metrics.

Compare to customer survey or Kano model for voice of the customers results to determine shortfall.

The researcher determines the step and the Checkpoints for Completion the measure phase:

1- Key Measures Identified

1.1- Key measures identified and agreed upon.

1.2- High impact defects defined and identified in the business process.

2- Data Collection Planned and Executed

2.1- Solid data collection plan established that includes measurement systems analysis.

2.2- Data collected on key measures that were identified.

3- Process Variation Displayed/Communicated

3.1- Process variation components displayed/communicated using suitable charts, graphs, plots.

3.2- Long term and short term variability accounted for.

4-Performance Baseline/Sigma Calculation

4.1- Measure baseline process performance (capability, yield, sigma level).

1.4 Phase Three: Value Stream Mapping Phase

The researcher put the third phase is value stream map and the value stream drawing as the next figure

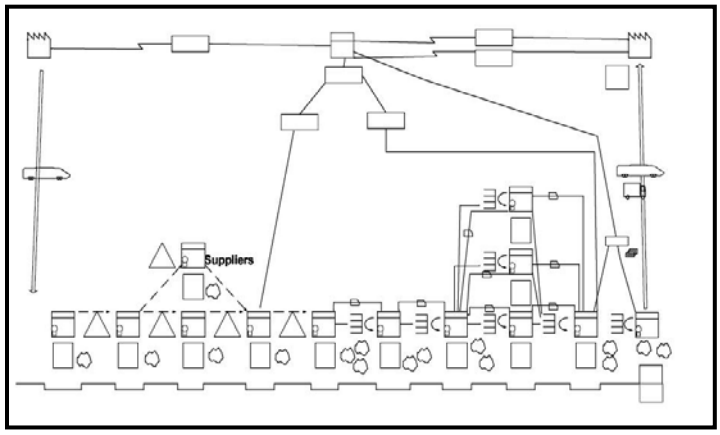

Fig.1value stream map

The researcher conclude the definition of value stream is all the actions, (Value added and non value added), currently required to bring a product through the main flows from raw material into the arms of the customer, Value stream mapping is a paper and pencil tool that helps us to see and understand the flow of material and information as a product makes its way through the value stream.

Also the researcher put some questions in value stream phase to answer it during the project.

Do determine the product family?

Do determine source of variations (X's) which impact directly on the problem (Y)?

Do determine the future value stream and put the hot spots?

The researcher determines the steps of value stream phase to conducting it and put some check point to monitor the project during value stream phase and monitor the results.

Define the value stream of products in current and future state

Determine inputs (x's) and outputs Y as a current value

Understand cause & effect of waste and variability (Y) in a process

Measure key business process capability

Analyze Y and X's to understand the relationship to value added and non value added

1- Drawing the detailed process map

1.1- determines the processes from the start to end.

1.2- determines inputs (X's) and outputs (Y).

2- Drawing the actual value stream mapping

2.1- determine the cycle time of each process

2.2- determine the total lead time

2.3- value add time and non value add time for all processes.

3- Three level information, material and administration direction

3.1- hot spots, quick wins

3.2- WIP, work in process in all processes.

4-TAKT Calculation

4.1- Determine the TAKT time according to customer de-

mand and available time.

4.2- work balance, process fluctuation, over burden

1.5 Phase Four: Analysis phase

The researcher determine in the analyze phase, the project team (researcher) will analyzes past and current performance data. Key information questions formulated in the previous phase are answered through this analysis, the data collected and process map to determine root causes of defects and opportunities for improvement.

Identify gaps between current performance and goal performance.

Prioritize opportunities to improve.

Identify sources of variation.

The researcher determines the steps of analysis phase to conducting it and put some check point to monitor the project during analysis phase and monitor the results.

How much do X's affect Y?

How analyze to identify optimum Y and X's to maximize value added or minimize non value added?

How consistent X's thus Y should create flow?

How analyze the value stream to identify maximum value added?

The researcher concludes the checkpoints for completion the analysis phase:

1- Data and Process Analysis

1.1- Identify gaps between current performance and the goal performance.

2- Root Cause Analysis

2.1- Generate list of possible causes (sources of variation).

2.2- Segment and stratify possible causes (sources of variation).

2.3- Prioritize list of 'vital few' causes (key sources of variation).

2.4- Verify and quantify the root causes of variation.

3- Quantifying the Gap/Opportunity

3.1- Determine the performance gap.

3.2- Display and communicate the gap/opportunity in financial terms.

1.6 Phase Five: Improve phase

The researcher concludes the improve phase, the project team seeks to determine the cause – effect relationship (mathematical relationship between input variables and the response variable of interest) so that process performance can be predicated, improved, and optimized , The target process by designing creative solutions to fix and prevent problems.

The researcher determines the steps of improve phase to conducting it and put some check point to monitor the project during Improve phase and monitor the results.

Create innovate solutions using technology and discipline

Develop and deploy implementation plan .

Improve X's to reach optimum and consistent Y

1- Improve Y to create pull , flow, reduced variation , based of what Y affect total product value

2- Improve X's and Y should reflect the improved value stream in terms of Y

The researcher concludes the checkpoints for completion the Improve phase:

1- Generating (and Testing) Possible Solutions

1.1- Possible solutions generated and tested.

2- Selecting the Best Solutions or the potentials X's

2.1- Optimal solution selected based on testing and analysis.

2.2- New and improved process ('should be') maps developed.

2.3- Cost/benefit analysis of optimal solution(s).

2.4- Small-scale pilot for proposed improvement(s).

2.5- Pilot data collected and analyzed.

2.6- Improved process ('should be') maps modified based on pilot data and analysis.

2.7- Project impact on utilizing the best solution(s).

3- Designing Implementation Plan

3.1- Solution implementation plan established, including schedule/work breakdown structure, resources, risk management plan, cost/budget, and control plan.

3.2- Contingency plan established.

1.7 Phase Six: Control phase

The researcher concludes the control phase in the next statements.

The Project team designs and documents the necessary controls to ensure that gains from the six sigma improvement effort can be held once the changes are implemented.

The improvements to keep the process on the new course.

Prevent reverting back to the "old way".

Require the development, documentation and implementation of an ongoing monitoring plan.

Institutionalize the improvements through the modification of systems and structures (staffing, training, incentives).

Control the improvement to sustain value stream a achieved

Document improvements, milestones and results, control the total product value achieved in terms of non value added and value added

The researcher concludes the checkpoints for completion the control phase:

1- Monitoring Plan

1.1- Control plan in place for sustaining improvements (short and long-term).

2- Process Standardization

2.1- New process steps, standards, and documentation are ingrained into normal operations.

3- Documented Procedures

3.1- Operating procedures are consistent

3.2- Knowledge gained on process is shared and institutionalized.

4- Response Plan

4.1- Response plans established, understood, and deployed.

5- Transfer of Ownership (Project Closure)

5.1- Transfer ownership and knowledge to process owner

and process team tasked with the responsibilities.

1.8 Phase Seven: Replication phase

The researcher conclude the questions and benefits from the replication phase in the next point

- ✓ Who else can benefit?
- ✓ Update corporate knowledge?
- ✓ Is the gain be sustained?

After the researcher shows the questions to conduct the replication phase, the researcher will present the benefits from the replication phase and assuring to conduct this phase which is the weak point in the traditional roadmap for lean six sigma.

1- I prefer not to learn from my mistakes.. I prefer to learn from someone else's mistakes"

2- Replication prevents duplication of effort, different solution to similar issues, and increased time to sole similar issues

3- No project should ever be closed before the black belt performs a search of where their solution or approach may be used to good effect elsewhere in the organization.

4- It is important an electronic record of the project is required.

5- This record should include (a comprehensive record of the project with links or references to attachments such as Minitab files, clear evidence of the completion of each of the SDMVAICR phases).

The researcher concludes the checkpoints for completion the replication phase:

1- after two months

1.1- statistical tool such as control chart to sustain the solution

2- Replication form

2.1- basics information

2.2- VSM, 5S, control plan to another products

2 SDMVAICR MODEL FLOW CHART

The researcher concludes the lean six sigma Model SDMVAICR in the next flow chart and researcher put the progress of each phases.

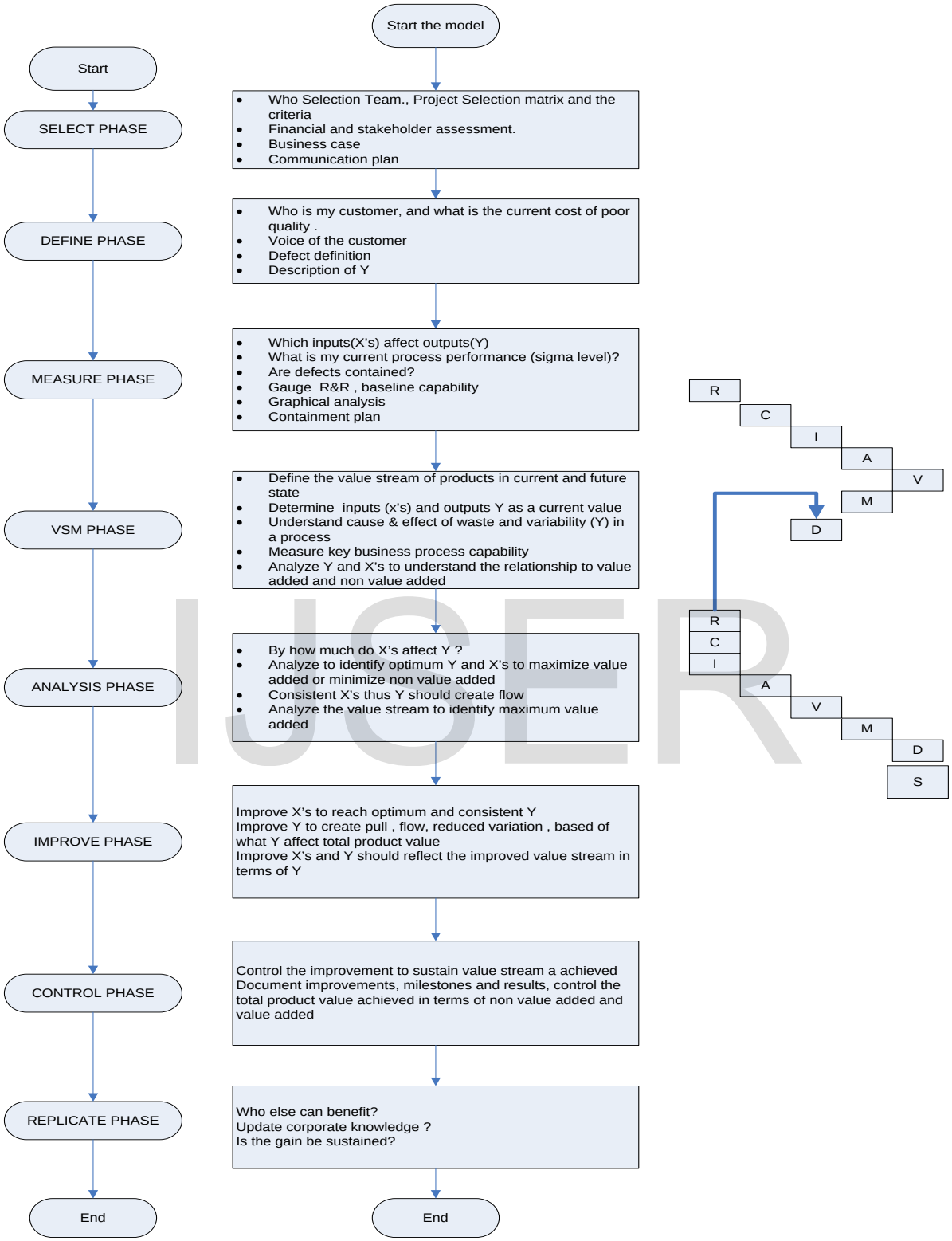

Fig.2 Lean six sigma model (DMVAICR)

3 MODEL TOOL BOX

The researcher concludes the tools in the next table to simplify the phases to saving the time during the implementation.

Tab.4 Illustrated tool box for DMVAICR Model

Selection	Define	Measure	Value stream	Analysis	Improve	Control	Replication
S	D	M	V	A	I	C	R
Project Selection Team.	Project selection team	Seven wastes and process matrix	(VSM) Value stream Mapping	Fish-bone diagram	Future Stream Mapping (FSM)	Control Plan	Replication form
Project Selection Mind Map.	Project selection mind map	Detailed process flow chart	Takt Calculation	Determine Potential X's	Control Chart		
Projects Selection Matrix.	Project selection matrix	Data collection form	Work Balancing		5S technique		
Situational assessment and problem statement.	Situation assessment and problem statement	Data collection plan			Sigma Calculation		
Situational assessment: (Financial assessment).	Financial Assessment	Fishbone diagram			Hypothesis test (2 sample-T test)		
Stakeholder assessment: Identify current levels of resistance.	Stakeholders Assessment	MSA(Measurement system analysis			Process activity mapping (time study)		
Stakeholder's assessment: Identify required levels of support.	Strategies to gain support	Individual Value plot			Spaghetti Diagram		
Stakeholders assessment: strategies to gain support	Project communication plan	Pareto chart			Error proof		
Project Communication Plan.	Products matrix(profit, sales and quantity)	Control chart (before)			Binomial Process Capability		
Business Case - Product/ Service Matrix.	Project impact statement				Work Balancing		
Business Case - I. Executive Summary (sales, Quantity and profit pareto).	Risks(Associated with change and with not to change)				Brainstorming		
Business Case- Risks – Impact- reason to change.	VOC				Data collection form		
Charter	High level process map						

The researcher concludes the tools in the next table to simplify the phases to saving the time during the implementation.

5 COMPARISONS BETWEEN DMAIC AND SDMVAICR

The researcher concludes the differences between the traditional lean six sigma roadmap (DMAIC) and the new model SDMVAICR as the next table

Tab.5 the comparison between DMAIC and SDMVAICR

Number of phases	5	8
complexity	Less	more
Clearness	Less clearness , where lean tools don't appear very well	more clearness , where lean tools appear very well
Project selection	Don't appear any criteria to determine the project selection by clear way also any person can using any project selection tools	There are criteria to selection the project and the problem content 12 steps
financial	Business unit put in chart after we start the project	There are finance assessment in selection phase in phase zero meaning before we start the project so this is saving time and effort
sustain	Sustain the solution but there are problem in replicate the data to other side and other product family	Replication form help them to communicate the solutions and results documented
Lean tool	Appear in different phases but not formal or obligatory	Appear in certain phases in values stream and in improve phase
Results	The results combined between lean and six sigma	The results should be cover the lean tools and six sigma tools
preparation	No any project preparation period	The preparation phase is covered in selection phase only make to more one project and problem

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