Extending the Critical Chain Project Management Body of Knowledge to Research and Development using the Lean Six-Sigma model

or

How Lean Six Sigma can help when applying CCPM to uncertain projects.

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Presentation Overview

Can we associate CCPM with Lean Six-Sigma:

I. in theory?

II. in practice?
I. Operational definition of classic CCPM

1. The optimum allocation of resources and sequencing of activities to minimise the overall duration of a collection of tasks within a given resource constraint.

2. A planning and control mechanism that minimizes the number of projects completed later than plan.
I. Suggested OD of CCPM with uncertain projects

1. The optimum allocation of resources and sequencing of activities to minimise the overall duration of a collection of tasks with a variable resource constraint.

2. A process based planning and control mechanism that maximizes the (successful) project completion rate.

We observe both of these in organisations that excel in uncertain projects.
What is OD?
I. Operational Definitions of Lean Six Sigma: more than minimizing variation.

1. A common global platform and a collection of tools that will empower the company’s employees, improve decision speed and reduce the gap between the company’s production and its client expectations (Al Stroucken, CEO of Owens Illinois).

2. Lean Six Sigma: Combining Six Sigma Quality with Lean Production Speed (Michael George).

3. Cross-functional project teams embedded in operations.

4. A problem resolution method that ensures that the client expectation is defined up front and the problem understood before an improvement is made i.e. “Look before you leap!”

5. Fast DMAIC (Define, Measure, Analyze, Improve, Control): A gated process performance method that is scalable (Kaizen event, Yellow Belt Project, Green Belt Project, Black Belt Project, Master Black Belt Program).

6. A process- and people-orientated approach linking continuous improvement and quality management.

7. A discipline that draws upon best practice in Lean, data collection, benchmarking, statistical analysis, project management and soft skills.
I. Can we associate Lean Six Sigma with CCPM?

No:
LSS uses rigid project networks.

Yes:
LSS’s project networks are guidelines, re-evaluated at each of the toll gates.
One of the key metrics for a LSS deployment is project cycle time (the shorter, the better because the projects run on the same timescale as operations).
There is a focus on not running more projects than you can resource.
There is an in-built escalation mechanism to either accelerate or reinforce the project.

CCPM has been in the American Society of Quality LSS body of knowledge since 2002 (although not updated).

Question:
What would it take for a LSS project network to resemble a CCPM network?
I. Condition for LSS and CCPM networks to be similar.

Classic CCPM task duration probability histogram: not necessarily valid for uncertain projects.

CCPM assumes that C is the likely time duration that will be quoted for a task: i.e. “under-promise and over-deliver”.

For a CCPM project, but also in principle for a LSS project, B will quoted: “Let us give it our best shot”!

The LSS project network looks like a CCPM network without buffer (high level of “pushback”).
I. LSS provides a solution to deal with the system constraint of uncertain projects: will it work?

Key R+D Project Processes: Investigative Processes (Business Case, Project Network), Decision Process, Execution Process

Common Pitfall: low process effectiveness due to glut of active projects

Real Question: How to simultaneously mitigate project risk and to achieve good process effectiveness. Can LSS help?
II. Lean Six Sigma in R+D Projects: process effectiveness and risk mitigation.

1. Constrain project demand:
   a) Choosing the right project.
   b) Correctly defining the project

2. Enhance the probability of success at first attempt:
   a) Defining Client Expectations and the best way to achieve them up front.
   b) External benchmarking provides ideas that drive paradox resolution.
   c) Cell concept: synchronic rather than diachronic i.e. up front cross functional and even cross corporate interaction that shares accountability.
      II. Design for Six-Sigma application to accelerate supplier development.

3. Use Reliability Engineering concepts:
   a) Risk Analysis throughout
   b) Multiple Pathways
   c) Scalability: From incremental to decisive change.
The LSS Project Selector stratifies overall Project Value into contributing factors:

- a consensual approach to prioritization.
- allows the project team to limit work in progress and right-sizes project demand.

<table>
<thead>
<tr>
<th>Project</th>
<th>Project Benefits</th>
<th>Fit with Company</th>
<th>How Easy?</th>
<th>Attractiveness Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Project</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>Maybe Project</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Leave alone Project</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

Notes:
1. Used in “Be Fast or be Gone” to increase project focus by a factor of about ten.
2. Combined benefit of increased completion speed and improved response time to surprises (…).
3. Extra Columns can be added: “enabling impact” allows the table to emulate a goal tree analysis.
II. LSS constrains project demand by correctly defining the project upfront (charter updated at each gate).

What is the compelling business case of the project?
What is the problem to be resolved?
What are the deliverables?
What are the project metrics?
What is in scope? What is out of scope?
What are the expected resource needs?
What are the risks?
What are the expected milestone dates?

Who are the competent team members who can commit themselves to the project?
Who is running the project?
Who has responsibility for the project outcome + minor roadblocks?
Who has taken on the task of eliminating major roadblocks?

An attentive supervision structure that effectively mitigates the resource risk in LSS experienced teams.

Typically the deployment champion manages the jagged interface between operational and project priorities i.e. he can divert extra resources from operations or the combined LSS team to support the project if needed.
II. LSS enhances the probability of success at first attempt by defining client expectations and the best way to achieve them up front.

Example using the quality function deployment tool: Gas Project Acceleration (Twenty times)

In R+D conditions, customer requirement analysis and benchmarking can create an advantage akin to the “Mafia Offer”
II. LSS enhances the probability of success at first attempt: external benchmarking provides ideas that drive paradox resolution.

1. Resolved Conflict Clouds for Gas Project Acceleration project:

   ![Diagram of resolved conflict clouds]

2. TRIZ for Gas Project Acceleration project:
   - Ideal Final Result: eliminating all unnecessary parts.
   - Conflict Resolution between “Ease of Operation” and “Ease of Manufacture”.

   ![Diagram of TRIZ solutions for gas project]

II. LSS enhances the probability of success at first attempt: up front cross functional and even cross corporate interaction shares accountability.

T – reduce transportation of information
I – reduce inventory of semi-finished work
M – reduce motion of people
W- reduce waiting time
O- keep team members focussed on goal
D- increased accountability decreases defects and parasitic competitive (sub-optimisation) processes: squabbling, schedule chicken...

leads to:

A/ Simplification and up to 30° Acceleration of Labyrinthine processes

B/ Mitigation of the risk of late Process Failure

Idea A
Step B
Step C
Step D
Solution E
II. LSS project cell enhances the probability of success at first attempt and adds speed: application in Pharmaceutical Drug Development.

From:

Marketing:
Definition of therapeutic time horizon target of product $T_M$

Supply Chain:
Specification of maximum withholding time in supply chain $T_{SC}$

R+D Development time = $f(T_M, T_{SC})$

With the added risk of R+D being unable to deliver to initial specifications … and being slow to admit it

To:

Marketing Sub-project:
Definition of minimum therapeutic time horizon of product $T_{MM}$

Supply Chain Sub-project:
Specification of BIC withholding time in supply chain $T_{SCBIC}$

R+D Development time = $f(T_{MM}, T_{SCBIC})$
II. LSS project cell enhances the probability of success at first attempt and adds speed: Design for Six-Sigma application to accelerate supplier development.

LSS can:
- follow process effectiveness outside corporate limits: with suppliers or clients.
- eliminate the need for a pilot process by getting it right first time.
- use the existing supplier quality system, industrial benchmarks and process know-how to go direct from concept to industrial scale.

Previous process Flow Diagram (iterations between steps possible): duration 6-9 years

Final process Flow Diagram: duration 3 months

1st time loading of 30,000 tonnes of sand for direct factory use.
II. LSS uses reliability engineering concepts: Risk Analysis throughout.

1/ Regular update of process and stakeholder risk analysis throughout project: formalized at each toll gate with the possibility of project termination if the mitigated risk is evaluated as being excessive.

2/ Possible Monte Carlo Analysis: Discrete modelling to visualize the impact of input variable variation (Quality, Time, Cost) with the possibility of improving the process for it to fit a specification (here marked USL with a red line).
II. LSS uses reliability engineering concepts: Multiple Pathways to improve reliability of uncertain processes.

Example: Extra time up-front helps successfully develop a factory supplier (quarry).

**Site Selection**
- Site A (unsuitable because of underground obstacles)
- Site B (unsuitable because of site refractory pollution)
- Site C (OK)

**Partner Selection**
- Partner A (unsuitable because of final corporate constraints)
- Partner B (lost interest)
- Partner C (OK)

**Partnership style**
- Joint Venture (too complex except for Partner A)
- Controlled by Mine Owner (OK)
- Factory buys mine and employs development partner (too complex)
II. LSS is scalable covering Incremental to Step-Change Improvement.

1. Several size building blocks that we can adapt to a particular size of project (Kaizen event, Yellow Belt Project, Green Belt Project, Black Belt Project, Master Black Belt Program, Lean Six-Sigma Portfolio).
2. Decisive change or incremental change

![Diagram of Successful Process Improvement, Maximize change impact, Decisive change (DFSS, DOE), Minimize Risk to Process, Incremental Change (Kaizen, EVOP)]

Assumptions:
- High cost to current situation
- Subtle impact of decision variable
- Limited time-span for action

Assumptions:
- Sensitive Measures
- Stable Process
- Possibility of decomposing final change into constituent steps
- Flexible Client
Conclusion

1. Why Change?
   Because the initial CCPM approach can meet strong antagonism in a R+D environment.

2. What to Change?
   A focus on number of active projects.

3. What to Change to?
   A focus on process effectiveness and risk mitigation.

4. How to cause the change?
   The use of Lean Six Sigma...as an enabler.

5. How to create POOGI?
   Extending the field of application of CCMP

1. Why Change?
   Because the initial CCPM approach can meet strong antagonism in a R+D environment.
David Brown-Brulant

Australian and French, I received my chemical engineering training with Imperial College London, my process engineering doctorate from Ecole Centrale Paris, my Black Belt training from George Group and my Master Black Belt training from Moresteam/Ohio State University.

I have 20 years of experience with world leaders in petro-chemicals, glass, mines and pharmaceuticals from research through production and projects to supply chain. Grounded in quality systems audit and performance reporting, I have turned my patents into industrial successes, set long lasting world records for production change, achieved high project cost reduction and acceleration, increased service and project throughput and pioneered a successful large scale supply chain re-organisation.