Velocity

- Br Dee Jacob, Suzan Bergland, Jeff Cox–

Book Summary
2011/01/03

Velocity is a business novel that explains how to combine the Theory of Constraints, Lean, and Six Sigma. The story revolves around a young CEO of a recently acquired company by a large group, with the objective of achieving an annual growth rate of over 10%. Together with her team, she seeks to integrate the three methodologies to meet the set objectives. Although these approaches initially appear contradictory, the team gradually realizes that they can be combined and should be used appropriately to significantly accelerate results, even during economic crises.

Using the example of a company, the authors demonstrate that the "Velocity approach" can be applied not only to production but also across all stages of a company's value chain.

1. The context and implementation of Lean Six Sigma

1.1 Context

Following the acquisition of her company, Hi-T, by a large group, the Marketing and Sales Manager is appointed interim President of Hi-T. Her objective is to implement Lean Six Sigma while ensuring a growth rate of over 10%. To assist her in this process, her superiors appoint a Lean Six Sigma "Black Belt" as an operational manager.

Convinced that Lean Six Sigma will significantly reduce stocks, delivery and design lead times, and achieve significant results, particularly in productivity, the two actors decide to quickly implement it in a factory and in Hi-T's Research and Development department, without considering what already works in each entity.

a. Implementation of Lean Six Sigma in the factory:

The chosen factory produces composite parts and is equipped with an autoclave with cycles ranging from 2 to 23 hours. As a result, the production capacity is lower than that of other equipment, causing an imbalance in the production line.

To address this bottleneck phenomenon (in this case, the autoclave) that governs the factory's production and must never be stopped, the Theory of Constraints was implemented to improve throughput.

The factory director tries to explain his chosen mode of operation to the team responsible for implementing Lean Six Sigma, but they do not take his arguments into account and decide not to integrate the Theory of Constraints into their approach.

The implementation of Lean Six Sigma begins with a diagnostic phase to identify all the wastes or Muda in the factory. The team highlights the presence of numerous wastes at every stage of the process, except for the autoclave.

Based on these findings, the team decides to implement actions that affect all the equipment in the factory, except the autoclave:

- Balancing the production line, meaning having production capacity exactly matching customer demand. For each machine, they calculate a takt time (ideal production rate to meet customer demand) and define actions to achieve it.
- Implementing Kanban.
- Reconfiguring a production machine.
- Utilizing Six Sigma for quality issues.
- Training a sufficient number of "Black Belts" and "Green Belts" to support the company's workforce.

The only action taken for the autoclave is reducing staff, a decision that the team thinks is necessary due to excessive workload demands.

1.2 Implementation of Lean Six Sigma in the Research and Development Unit

Lean Six Sigma is met with less enthusiasm in the Research and Development unit, particularly due to the resistance from the unit's manager, who believes that this approach is useful in production but not in Research and Development.

A value stream mapping is conducted to identify wastes, but it is not detailed. Following this step, several minor actions are undertaken, such as:

- Standardizing reports.
- Reducing distances between laboratories.
- ...

However, the Lean Six Sigma team does not have authorization from the Research and Development manager to address the core issue, which is the product design loop.

By portraying this character (the Research and Development manager), the authors demonstrate that implementing a process and changing mindsets can be challenging if the leadership is not involved and fails to see the value of the methodology.

2. Analysis of the Lean Six Sigma implementation results:

2.1 Why are the results not satisfactory?

After one year of implementing Lean Six Sigma, the achieved results are not as expected, especially concerning the investments made.

In the factory, Lean Six Sigma is well-received, and the employees feel involved in the process. The actions taken have improved their working conditions and shown promising results, including:

- Elimination of quality defects.
- Improved machine efficiency.
- Increased machine productivity.
- Training of "Black Belts" and "Green Belts".

However, these actions have only resulted in a growth rate of 3% (compared to the projected 10%). Simultaneously, several indicators have deteriorated:

- Profits are lower than in previous years.
- Work in progress has significantly increased.
- Delivery delays have become more frequent and severe.
- Overtime hours have skyrocketed.

In the Research and Development unit, the results are catastrophic, with the number of new projects dropping, and none being successfully completed.

Under pressure from her superiors, the Hi-T President organizes a "leadership meeting" attended by managers from each department (sales, R&D, production, finance & administration). The objective is to identify the root causes of these issues and define a plan for recovery.

During the meeting, they construct a cause-and-effect diagram, which reveals two critical points:

- **In R&D, engineers' bonuses are tied to the number of billable hours to clients.** Consequently, the mandatory validation of product design files is only done when engineers have time, causing a batch delivery of design files to the factory and sometimes exceeding product delivery deadlines.
- **The group's management principle is to "*maximize the use of all resources for maximum efficiency*."** To improve productivity and eliminate waste, including excess production capacity, Hi-T turned to Lean Six Sigma. However, in these conditions, even minor disruptions can disturb and delay product manufacturing.

They conclude that to stabilize production and ensure timely product delivery, they need to accept and manage imbalanced production lines.

2.2 The dice game

To understand the significance of production imbalance and the functioning of the "Velocity" approach, the authors propose a simple dice game.

The game consists of a jar of pennies and several dice.

"*The idea of the game is to move pennies from one person to the other (..) Whatever number turns up from one to six, determines how many pennies you can move from your position to the person on your right." (Excerpt from the book, p138).*

Each player starts with a stock of 4 pennies, except for the first player who directly draws from the jar.

A game consists of 20 dice rolls, and at the end of each roll and the game, the number of pennies exiting the system is counted.

The dice game simulates a production line in the context of a factory:

- The pennies represent the finished or work-in-progress products.
- The number on the dice corresponds to the quantity produced per day.
- Each player represents a production stage (or workstation); the first player represents the raw material supply, and the last player represents the delivery of finished products.
- Each dice roll symbolizes one day of production, and one game represents one month of production.
- The number of pennies counted at the end of the game represents the number of finished products manufactured and delivered per month.

The team's objective is to achieve 65 pennies per month (for one game).

1st Game: Simulation of a Balanced Line

Results:

After 20 dice rolls:

- The number of pennies that came out is 46.
- The number of work-in-progress pennies doubled.

Interpretations:

The numbers 1 to 6 on the dice represent the uncertainties that exist in production. As a result, even minor problems at a production stage can cause delays, **making the line unbalanced.**

2nd Game: Simulation of an Unbalanced Line

To simulate an unbalanced line, all players take a second dice, except one person who represents the bottleneck. This player will not take a second dice.

Results:

- The number of pennies that came out is 86.
- The overall quantity of work-in-progress and stock remains high.

Interpretations:

Introducing a constraint significantly increases the throughput of the factory, and thus, the sales. This increase compensates for the costs incurred due to excess production capacity in other stages of manufacturing. However, managing bottlenecks does not effectively reduce stocks or work-in-progress.

3rd Game: Simulation of the Drum-Buffer-Rope (DBR) System

In this third game, the bottleneck still exists, but the first player no longer has a dice. Instead, he waits for the bottleneck to roll the number on their unique dice before passing the corresponding number of pennies to their right-hand neighbor. Additionally, the bottleneck player's safety stock (work-in-progress upstream of their workstation) increases from 4 to 12 pennies.

Results:

- The number of pennies that came out is 74.
- The work-in-progress pennies have not varied much: 31 at the end of the game compared to 28 at the beginning.

Interpretations:

This game simulates the Drum-Buffer-Rope or DBR system: ‘’ *The Drum is the system constraint (...). The Buffer is the time required to deposit materials in queue for the constraint to process. And the Rope is the communication connection to the gate that releases those materials for processing.’’ (excerpt from the book, p225).*

4th Part: Continuous Improvement Simulation

In this part, the players aim to demonstrate the results after "elevating the constraint or bottleneck." To do this, they decide to "remove" the low numbers on the constraint's dice. So, values 1 and 2 will be equivalent to 4, values 3 and 4 will be 5, and values 5 and 6 will be 6. It's important not to add a second dice to the bottleneck player, as that would balance the production line again.

The bottleneck retains its safety stock, and the first player still has no dice.

Results:

- The number of pennies exiting the system is 97.
- The work-in-progress and stocks haven't changed significantly compared to the 3rd part.

Interpretations:

This simulation highlights that the Theory of Constraints (TOC) helps identify the "right" areas for improvement, which should then become Lean Six Sigma projects to enhance performance. Instead of targeting all forms of waste with LSS, the team focuses its efforts on what improves the bottleneck's efficiency, meaning the overall factory performance.

As a result of the game, the management team concludes that to accelerate the company's performance, they must align the three methods as follows:

1. **Stabilize and make production robust using the Theory of Constraints.**
2. **Identify improvement points with the Theory of Constraints.**
3. **Improve performance at those points using Lean Six Sigma.**

They call this approach "Velocity" or velocity vector, representing speed with direction.

3. The "Velocity" Approach

3.1 The Team

The implementation of the "Velocity" approach starts with the formation of the team. It consists of a small executive committee comprising the previously mentioned responsible individuals. This team has a comprehensive and interconnected view of the organization, allowing them to understand the interactions between different departments. Their objective is to establish and monitor a turnaround plan for the company.

3.2 Stabilizing the Production across the Company with TOC

The first step of the Theory of Constraints (TOC) is to identify the constraint, which may vary based on the scope of analysis. For instance, the authors clearly demonstrate that the bottleneck in the production factory is the autoclave. However, for the Hi-T company as a whole, the bottleneck lies in the engineers' validation of design documents. Without this validation, the production factory cannot manufacture the required parts.

Based on this information, the team decides to implement several actions:

For the production factory:

- Revert to a non-balanced production line where the autoclave should never stop.
- Adopt the Drum-Buffer-Rope (DBR) system by eliminating the traditional min/max stock levels for raw materials. Instead, they implement a regular time interval for material replenishment, ordering only the amount used during that interval. This action allows them to reduce stock and work-in-progress levels.

For Research and Development (R&D):

- Revise the engineers' bonus system, linking it to overall company performance rather than billed client hours.
- As engineers are the bottleneck and a scarce resource, a priority system called "Relay Runner" is implemented to minimize multitasking and involve them more effectively in document validation.

The "Relay Runner" approach manages priorities (excerpt from the book p263): "*Once you're handed a task, you take it and run with it. And you keep running fast as you can – consistent with requirements for safety and quality – until one of three things happens*:

1. *You finish the task and hand off the assignment to whoever gets it next.*
2. *You're blocked and have to stop because you have to wait for something you can't supply.*
3. *A task with higher priority is given to you- at which point you pause what you were doing and run with the higher priority assignment."*

By implementing these actions, the "Velocity" team reverses the trends and achieves positive outcomes:

- Increased production quantities and deliveries.
- Decreased work-in-progress and stock levels.
- Timely deliveries.
- Reduced overtime and transportation costs.

However, the productivity indicator does not reach its target.

3.3 Targeting Improvement Areas and Implementing Continuous Improvement Actions

To achieve annual growth of at least 10%, the "Velocity" team seeks a way to target improvement areas effectively.

They decide to use the Theory of Constraints (TOC) indicators to determine relevant actions to implement:

1. Throughput: This represents the sales flow and the profit margin of the company.
2. Investments and Stocks: Consider work-in-progress and stock of raw materials or finished products as short-term investments.
3. Operating Costs: Focuses on the expenses required to run the company.

Over the years, the goal is to increase Throughput while proportionally reducing investments and operating costs. Therefore, actions that increase Throughput and decrease operating costs can be considered for implementation. Conversely, proposals that do not significantly impact these three indicators will be dismissed.

When choosing actions, they must avoid those that would increase the capacity of the constraint too much, potentially leading to bottlenecks shifting to another workstation. This could disrupt production stability and robustness around a known and controlled bottleneck. Once the constraint is identified, its production capacity should remain lower than other workstations.

Based on these indicators, the "Velocity" team defines and implements Lean Six Sigma (LSS) actions, such as:

1. Proposing outsourced stock management to clients to enhance customer loyalty and ensure Throughput.

2. Standardizing and redesigning certain products to reduce specifications at the autoclave, leading to increased Throughput.
3. Committing to meet delivery deadlines with penalties for non-compliance to retain existing clients.
4. Reviving relevant and stopped innovation projects to gain new customers.

These actions involve all stages of the value chain and are cross-functional, involving all departments (sales, innovation, R&D, production) in driving the company's performance.

After two years of implementation, this approach has enabled the Hi-T company to achieve a growth rate of over 10%, even during an economic crisis.