Focus and Leverage
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The Critical Methodology for Theory of Constraints, Lean and Six Sigma (TLS)

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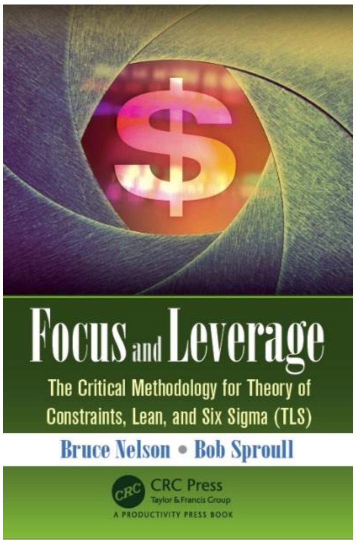

I. Introduction

"*Focus and Leverage - The Critical Methodology for Theory of Constraints, Lean and Six Sigma (TLSis a business novel co-written by Bob Sproull and Bruce Nelson. This new book on the Theory of Constraints follows the format of their previous novel "Epiphanized - a Novel on unifying Theory of Constraints, Lean and Six Sigma*" and serves as its sequel.
n this new installment, Connor Jackson, Joe Pecci, Sam Henderson, and the other heroes from "Epiphanized" agree to help two different organizations: a company and a hospital. The choice of these two application fields for the "TLS" (TOC + Lean + Six Sigma) is significant, as it demonstrates the universality of a methodology that has proven successful in various sectors and undoubtedly deserves attention.
In this book, readers will discover how to align strategy and tactics to improve the functioning of an organization in a structured and coherent manner. The authors illustrate the use of numerous

tools, making this book a reference for anyone looking to embark on a TLS (Theory of Constraints, Lean, and Six Sigma) journey.

II. Aviation Dynamics – Helicopter Maintenance

1 Introduction

The heroes of Focus and Leverage come to the aid of Aviation Dynamics, an MRO (Maintenance, Repair and Overhaul) company that repairs helicopters, with its main clients being companies in the oil industry. AD's activities are organized into two branches with different priorities: planned maintenance and unplanned maintenance.
The customers find the lead times for planned maintenance (TAT or Turn-Over Time) too long, as they exceed 9 weeks, while their repair costs are increasing. However, the company has focused on cost reduction in its operations and has also implemented Lean and 6 Sigma initiatives, unfortunately without achieving any improvement in lead times or OTD.
That is why the leaders of AD have chosen to try a new approach, the combination of TOC, Lean, and 6 Sigma, also known as TLS.

2 Definition of Strategy and Tactics

Before implementing any changes, the heroes and management of Aviation Dynamics start by defining their strategy.

Le TLS

The preliminary strategy of the team consists of adopting two parallel and complementary approaches:

- Resolving the performance and planning issues of Aviation Dynamics.
- Making the company capable of winning any new contract while renewing the ones it already has.

To meet these strategic objectives, the heroes decide to use the combined approaches of Theory of Constraints, Lean, and Six Sigma, which they present to the Aviation Dynamics Executive Committee as "TLS.":
Theory of Constraints asserts that every system has a limiting element or constraint. Therefore, improvements should focus on this element first. To improve the system, the method proposes an iterative improvement process called the 5 Focusing Steps.

- Step 1 - Identify the system's constraint,
- Step 2 Decide how to exploit the constraint,
- Step 3 - Subordinate everything else to the previous decision,
- Step 4 - Elevate the constraint,
- Step 5 - Attention! If in the previous steps a constraint has been eliminated, go back to Step 1 and prevent inertia from constraining the system.

Lean is highly popular and it is also a comprehensive approach that distinguishes between value-added and non-value-added tasks, with the latter being sought out and eliminated. Waste must be eliminated or significantly reduced to facilitate the flow of value through the system. According to the authors of "Focus and Leverage," Lean also advocates for saving money as soon as possible and wherever possible.

Six Sigma focuses on reducing defects and aims to minimize process variability. This method relies on the use of statistical tools and follows an iterative improvement process known as DMAIC:

- Define the Voice of Customer and customer requirements,
- Measure key aspects of the system under study and collect relevant data,
- Analyze the data to investigate and verify cause-and-effect relationships,
- Improve and optimize the current system based on data analysis,
- Control the new system to ensure that potential deviations are corrected before they result in defects.

The TLS approach advocates focusing improvements on constraints and using Lean and Six Sigma principles as improvement tools..

The Objectives and Action Plan

The goal defined by the management of Aviation Dynamics is : **"To achieve a 98% On-Time Delivery (OTD) for the planned maintenance activity"**. With this objective defined, one of the heroes proposes building an *Interference Diagram* to list the obstacles preventing its realization. The obstacles identified are typical probems such as inadequate procedures, parts unavailability, unrealistic scheduling, etc. For example, these obstacles hinder its achievement :

- Tool transfer procedure: Teams are required to retrieve and return their toolboxes to inventory daily as a policy to prevent material loss.
- Parts availability issue: Supply budgets have been reduced, leading to regular unavailability of parts.
- Absence of Master Scheduling: Schedules are not synchronized, resources are not considered, and priorities are not clearly defined.
- Rework and rework inspections: The technical inspector is not always available on time, resulting in the need to redo certain tasks.
- Document search: Maintenance tracking documents are often in the wrong place and need to be searched for.
- Availability of consumables: Items such as nuts, bolts, and other consumables are regularly missing at assembly stations.

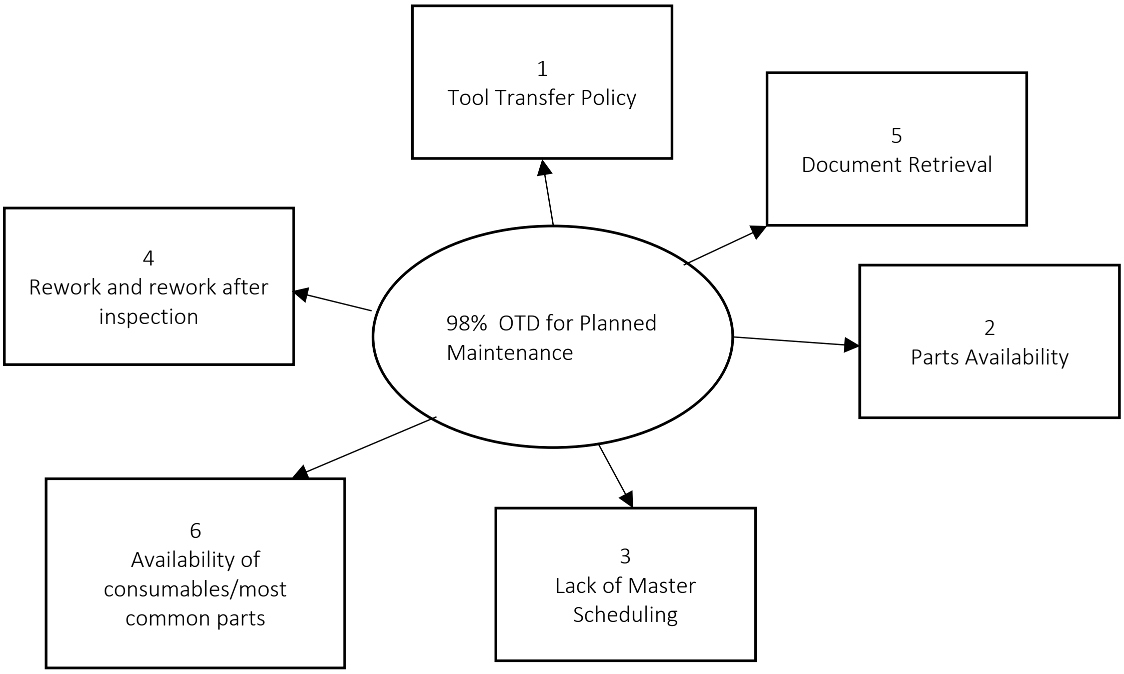

Figure 1 - Interference Diagram

Once the obstacles are identified, Joe proposes to move on to defining the Intermediate Objectives. These IOs are the goals to be achieved in order to eliminate the obstacles identified in the "Interference Diagram", and they help determine where to start.

Here is a table summarizing the obstacles and intermediate objectives:

Obstacle	**Intermediate Objectives**
1. Tool Transfer Policy	1. Update the tool transfer policy
2. Parts Availability	2. Provide complete kits at each workstation
3. Lack of Master Scheduling	3. Iplement a robust scheduling system
4. Rework and rework after inspection	4. Iprove inspection management process during shift changes
5. Document Retrieval	5. Maintain an updated and accurate registry
6. Availability of consumables/most common parts	6. Move consumables to workshop level

Tableau 1 - Obstacles and Itermediate Objectives

Once the IO's have been defined, the next step is to construct a logical tree known as the IO Map or Goal Tree. This tree connects the Intermediate Objectives together and highlights the order in which they need to be achieved to reach the ultimate goal. The IO Map also identifies the necessary conditions that must be met along the way. It serves as a roadmap for ensuring that all the required conditions are fulfilled, as failure to meet any of these conditions would prevent the final objective from being achieved..

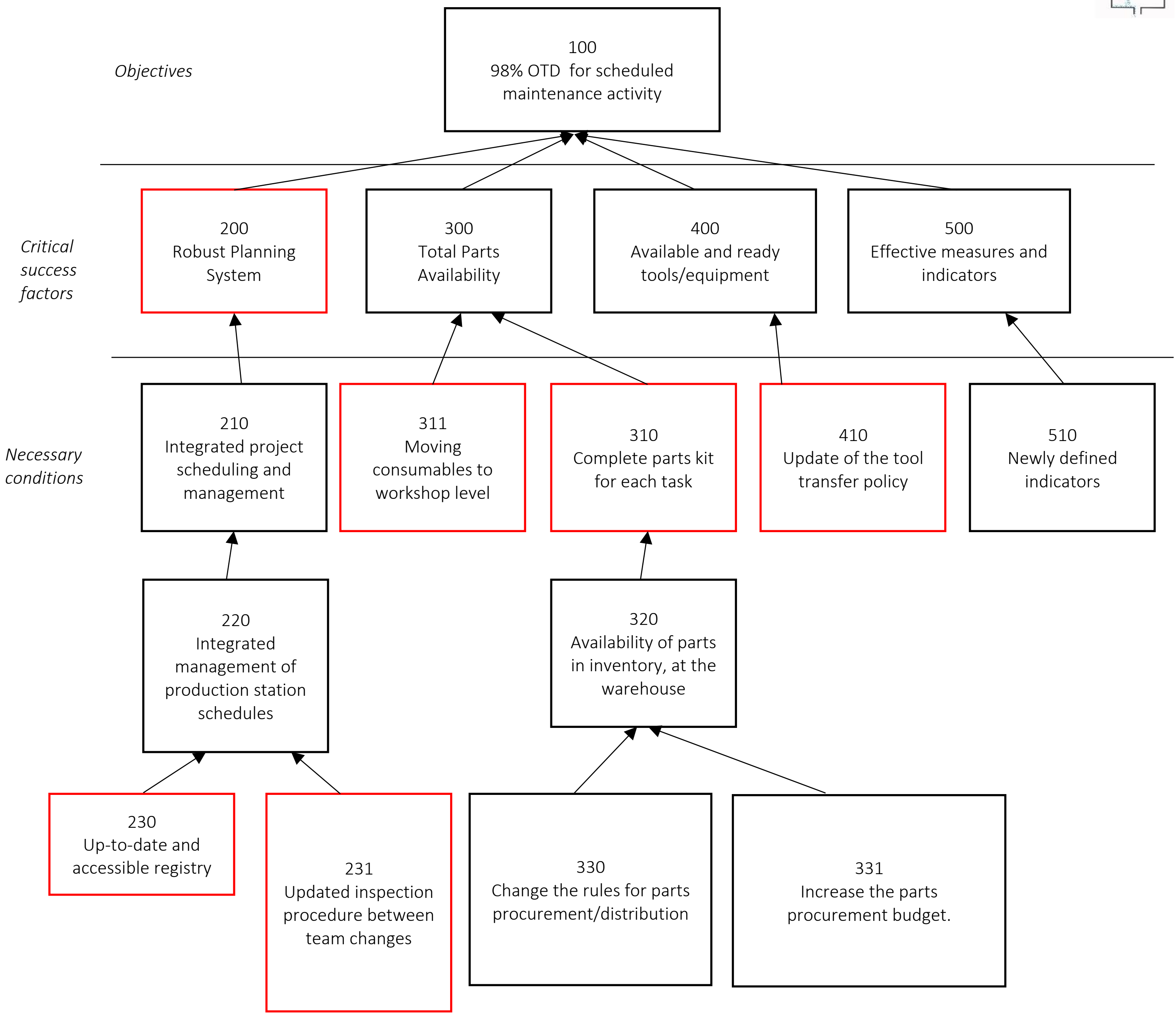

Figure 2 - Goal Tree

3 Solutions and Implementations

After defining the objectives to be achieved, the teams focus on finding solutions and implementing them. The following table summarizes some of the solutions found to meet the necessary conditions and critical success factors listed in the Goal Tree.
To ensure visual tracking of the project progress, the boxes in the Goal Tree are colored green if they correspond to completed tasks, yellow if they correspond to ongoing tasks, and left blank if no action has been taken..

Intermediate Objectives	**Solutions**
230 – Update and accessible register	The team leader is responsible for the register, which contains all the signed documents. These documents follow the product as work is carried out.
231 – Revised procedure for inspection between team changes	Inspectors start 30 minutes before the end of the team rotation to overlap with the previous team.
311 – Consumable stock placed in workshop	Storage bins are installed in the workshop and regularly restocked.
330 – Change rules for parts procurement / distribution	The parts requirements for planned maintenance are predictable, unlike those for unplanned maintenance. Therefore, the needs for unplanned maintenance are protected by a buffer or safety stock.
331 – Increase procurement budgets	Explain to headquarters the impact of stockouts on Lead Times and revenue in order to obtain a higher budget.
410 – Reviewed/ updated tool management procedure	Team leaders are now responsible for tools, instead of the mechanics. They pass the tools from one team to another and ensure that none are missing.

The teams then identify two new problems. They need an integrated scheduling system and a reserve of spare parts (RTV - Return To Vendor).

Utilization of the Critical Chain

In order to speed up helicopter maintenance, the AD teams have decided to schedule their activities based on the principles of Critical Chain Project Management (CCPM).
Indeed, traditional project management involves the following challenges:

- Resources waste a lot of time due to **multitasking**.
- Tasks are often completed as late as possible, and imposed deadlines are frequently missed (**student syndrome**).
- The allocated duration for a task is fully consumed, even if it could have been completed earlier (**Parkinson's Law**). Similar to the student syndrome, this phenomenon arises from fixed start and end dates for tasks, which are perceived as commitments.

The Critical Chain method helps address these issues. To do so, it is necessary to consider resource capacity, eliminate task buffers, and transfer these buffers to a final buffer whose consumption is analyzed.
Moreover, to avoid resource conflicts between projects, Critical Chain proposes sequencing the projects, which means shifting them in time based on the most constrained resource.

The Fever Chart is used to display the consumption of the buffer as the project progresses. It also provides an overall view of the portfolio by plotting the data points of each project on the same Fever Chart.
Project Management using Critical Chain thus resolves the issue of conflicts between schedules. With the Fever Chart, making decisions between projects becomes easier, and priorities can be established more effectively.

Comparaison entre CCPM et la Méthode du Chemin Critique

Critical Pat	Critical Chain	Advantages Critical Chain
Fcused on task completition	Focused on project completion	Track the project, not the tasks
Tass have a start and end date	Tasks start as soon as possible and necessary	Manage the project based on what is accomplished, not what is planned
Tasks have buffers	The project is protected by buffer time and a project buffer	Buffers are used to protect the entire project as a whole, not individually for each task
Resource conflicts are common	Resource availability issues are taken into account	Resources are leveled, and constrained resources are identified.

Different factory configurations

There are 4 types of configurations: A, V, I, or T..

- A configuration: The flows converge towards a common point, e.g., an assembly plant where multiple starting components are assembled into a single final product.
- V configuration: The flows diverge from a common starting point, e.g., a sawmill where a log is cut into multiple boards of different sizes.
- I configuration: The flow is linear, where a single starting product is transformed into a single final product.
- T configuration: Similar to the I configuration but with a final differentiation, such as a change in color, which allows for multiple versions of the same final product..

Le démontage des hélicoptères constitue un V, les activités de maintenance des différents composants constituent des I et leur réassemblage constitue un A.
Chaque configuration a ses particularités, ainsi dans la partie en V, il faut faire attention aux changements de priorité dans le démontage qui favorisent le multitâche et ralentissent l'activité. Dans la partie en I, il faut veiller à ce que les flux soient synchronisés, pour que toutes les pièces soient disponibles au moment du réassemblage.

4 Using the Multple Drum-Buffer-Rope

The Multiple Drum-Buffer-Rope (M-DBR) is used to manage unplanned maintenance of aircraft. This system is a variation of the traditional DBR, with the difference being that multiple drums share the same buffer. The M-DBR is recommended when the pace of the constraint is chaotic and unpredictable, which is the case for unplanned aircraft maintenance.

Here, each maintenance workshop in the unplanned maintenance hangar serves as a drum, as each workshop operates at a different pace based on the repairs required. The buffer, on the other hand, consists of the queue of aircraft awaiting attention.
During this waiting time in the buffer, triage is conducted to differentiate aircraft requiring minimal work from those that will take longer. This allows for "express" workshops to be dedicated to aircraft needing less work, preventing them from waiting unnecessarily in the system. This waiting time should also be utilized to prepare parts kits and notify the teams responsible for handling the aircraft. The goal is to synchronize activities as effectively as possible to repair the aircraft as quickly as possible.

III. The Hospital

1 Definition of the Project Plot Strategy

Connor decides to help the hospital initially reduce the "D2B" ("Door-to-Balloon") time, which corresponds to the duration between the registration at the Emergency Department and the inflation of the balloon in the artery of a heart attack patient. As the time of care is directly linked to the patient's life expectancy, its reduction is crucial.
After 1.5 hours of Gemba and careful note-taking, Connor summarizes the patient care process into three major steps:

- Heart attack victims are registered at the Emergency Department and undergo an electrocardiogram.
- After the electrocardiogram, the patient goes to the operating room,
- Finally, the balloon is inserted.

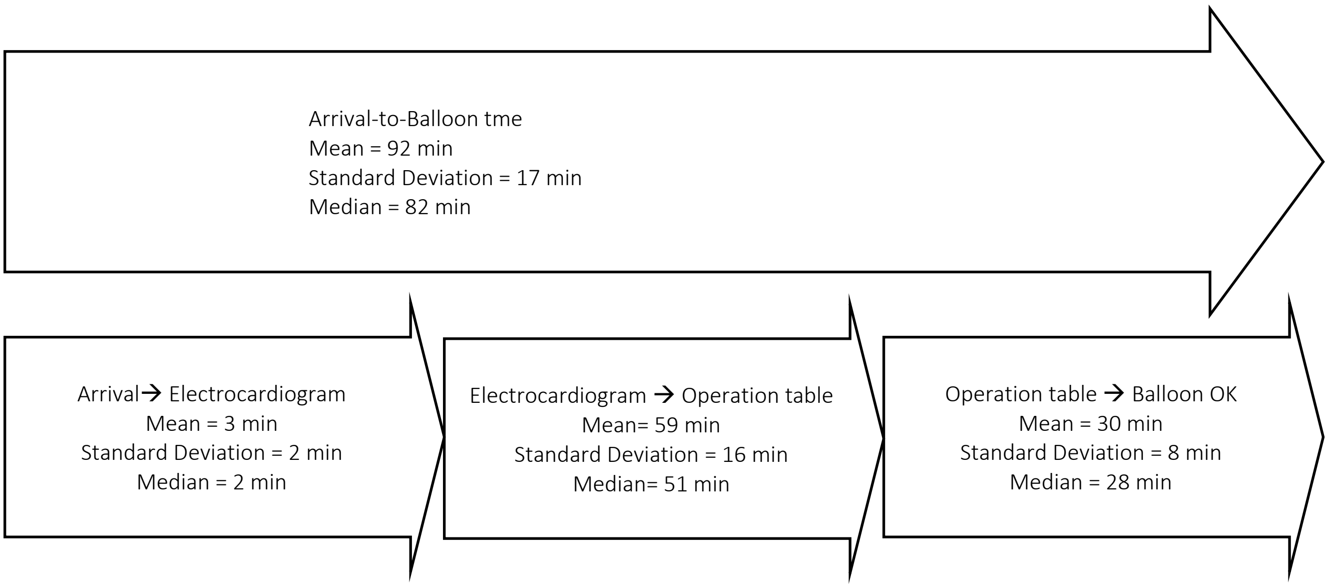

Figure 3 – Process of managing a heart attack

Enlightened by this initial analysis, the teams understand that they need to first focus on the most time-consuming step, which is between the electrocardiogram and the transition to the operating room. This step is the constraint.
After conducting a Value Stream Analysis (VSA), the team constructs an Interference Diagram to identify the main areas for improvement.

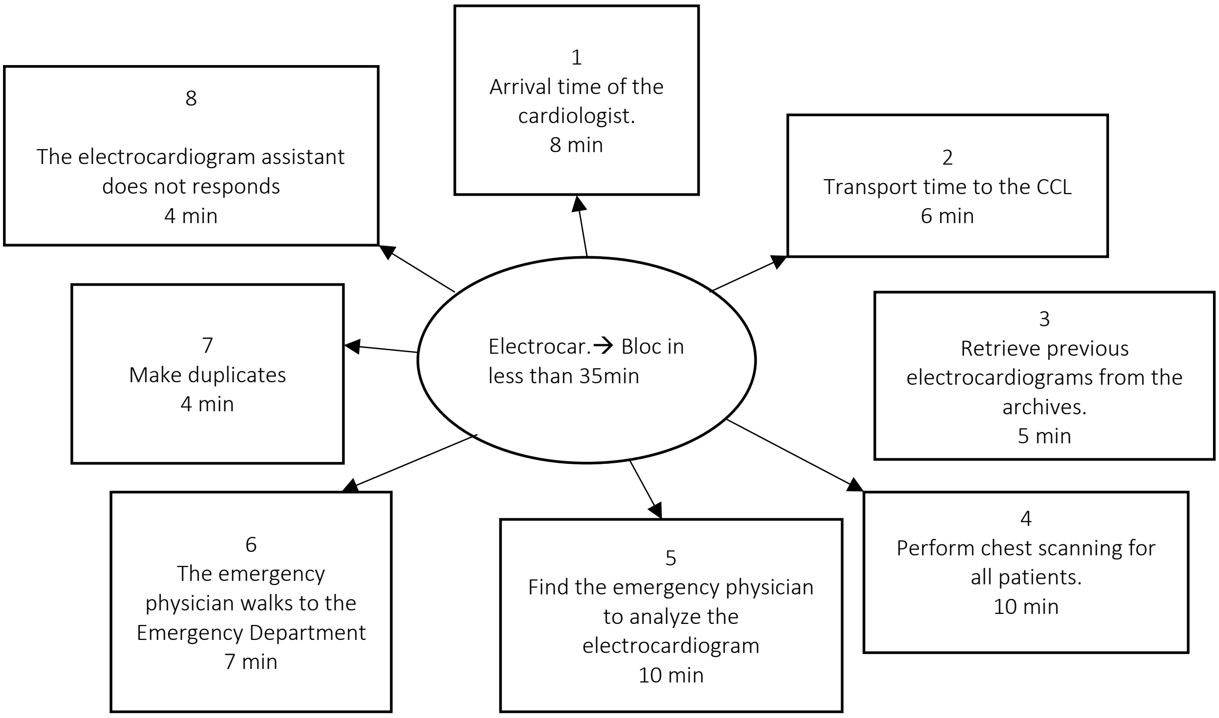

Figure 4 - Interference Diagram D2B

These obstacles correspond to Non-Value Added tasks. Since the teams cannot solve all these problems simultaneously, Connor suggests defining priorities to focus on the most effective improvement levers. To do this, he introduces the improvement team to the Prioritization Matrix :

Benefits of improvement ↑

	1	2	3	4	5
1					1, 2, 5
2					
3			3	4	
4		7			
5	8				

Ease of implementation →

Figure 5 - Prioritization Matrix

The tasks that are easiest to implement and most cost-effective are those that will contribute to reducing the arrival time of cardiologists, reducing the transport time to the CCL, and finding an emergency physician to analyze the electrocardiogram.

To reduce these times and improve practices, new patient care procedures are written and implemented. Thanks to these changes, the D2B time decreases from 91 to 53 minutes on average, resulting in a 42% reduction.

2 Definition of the Comprehensive Strategy

After the successful implementation of the pilot project, the hospital management decides to adopt a Continuous Improvement approach for the entire hospital. To achieve this, they decide to utilize the tools of the TLS.
To begin with, the teams construct a new IO Map or "Goal Tree" to establish an action plan.

3 Reducing Patient Waiting Time in the Emergency Department

After significantly reducing the D2B time, the team decides to reduce waiting times in the emergency department. The main cause of waiting in the emergency department is the unavailability of rooms. This lack of availability is identified as the primary constraint and has two reasons:

- A rule mandates that patient discharge forms must be signed before noon, which means rooms cannot be released after that time.
- The cleaning staff responsible for the rooms has been reduced due to cost-saving measures, leading to increased cleaning time and slower room turnover.

To address these issues, the decision is made to revise the discharge management by removing the rule that imposes a noon deadline. As a result, the signing of discharge forms will be more evenly distributed throughout the day based on the actual condition of the patients.
Additionally, the organization of room cleaning is redesigned to make it more efficient. Cleaning staff from other areas of the hospital will provide reinforcement when necessary, forming teams of three individuals, each assigned specific tasks such as changing sheets, cleaning the bathroom, and mopping the floor. This reorganization reduces the room cleaning time from one hour to 12 minutes.

4 The Multiple Drum-Buffer-Rope at the Hospital

The next constraint is also identified, which is the availability of doctors responsible for treating patients. To improve patient care and speed up the process, Connor advises implementing a Multiple Drum-Buffer-Rope system, similar to Aviation Dynamics.
This system involves prioritizing patient care based on the availability of doctors, as they represent the constraint. Each doctor aims to provide maximum service, and therefore, they are referred to as a 'Drum' or 'Constraint.' The patients waiting for treatment form a common 'Buffer' or 'Queue' for all the doctors. These waiting patients are sorted based on the severity of their condition and are notified as soon as a doctor becomes available. To avoid congesting the flow with patients with less severe conditions, an 'express' queue is created for them, similar to express lanes in supermarkets. As a result, these patients with milder conditions move through the system much faster and no longer have to wait with the critically ill patients. In such conditions, the goal of M-DBR is not to build and manage a buffer of patients but to consume this buffer as quickly as possible. This requires good synchronization, so that as soon as a doctor becomes available, patients can be smoothly taken care of.

IV. Conclusion

The described results are impressive: the planned maintenance of aircraft now only takes 40 days instead of the initial 9 weeks, and the D2B time has been reduced from 90 minutes to 30 minutes. These results are not extravagant and are confirmed by our experiences of implementing the TLS.

