**3. LEAN SIX SIGMA:**

In recent years, some practitioners have combined Six Sigma ideas with [lean manufacturing](https://en.wikipedia.org/wiki/Lean_manufacturing) to create a methodology named [Lean Six Sigma](https://en.wikipedia.org/wiki/Lean_Six_Sigma).[[7]](https://en.wikipedia.org/wiki/Six_Sigma#cite_note-WalsheHarvey2010-7) The Lean Six Sigma methodology views lean manufacturing, which addresses process flow and waste issues, and Six Sigma, with its focus on variation and design, as complementary disciplines aimed at promoting "business and operational excellence".[[7]](https://en.wikipedia.org/wiki/Six_Sigma#cite_note-WalsheHarvey2010-7)

**3.1 Lean management:**

Lean management is a way of management for the companies that helps on a process of continuous improvement, it’s a long-term methodology that aims to achieve small and incremental improvements in the process, particularly on the efficiency and quality.

The main objective of Lean Management is to create value for the final costumer through the optimization of the resources and elaborate a stable workflow respecting the costumers’ requirements, it do it eliminating all the wastes and the unecessary efforts of the process by an identification of each step of the business process and reviewing and eliminating the steps that do not add a value.

It focusses on defining the value from the starting point to the final costumer; limiting the waste; continuously improve of the process.

Lean Management enables a shared leadership and responsibilities. Through the continuous improvement they can ensure that each single employee contributes to the improvement process. Lean Management acts as a guide to build a successful and strong organization that continuous progressing, recognizing the real issues and fixing them.

The roots of Lean Management are in the Toyota production system stablished in the late 40’s. By applying the 5’s principles of Lean Management, Toyota decreased the amount of non-valued processes, being known as the “Toyota Way”.

### 5 principles of lean management:

### The 5 principles of Lean Management that are applied by managers are:

* **Identifying value**: the initial step in Lean Management, it means finding the problem that the costumer is facing and trying to resolve. The offer product must be part of the solution that the costumers need. Any not value-added activity must be removed.
* **Value stream mapping:** in this step, we proceed by doing a map of the company’s workflow, including all people and actions who makes part of the process of creating and delivering the final product to the costumer. It’s a tool for managers to visualize the processes and identifying the people responsible for measuring, evaluating and improvement of the process. This step helps managers to define which parts of the system are not adding value to the workflow.
* **Creating a continuous workflow:** it consists of ensuring that each team’s workflow progress in the most efficient way and avoid any interruptions that may occur with the cross-functional teamwork. Between the techniques we can find the Kanban, it utilizes a visual track to trigger actions, it enables the easiest communication between teams, helping them to identify what needs to be done and when it must be done. The Kanban works by breaking the total process into a smalless sets and visualizing the workflow facilitating a feasible remotion of process interruptions and barriers.
* **Developing a pull system:** this step consists of ensuring that the continuous workflow keep being stable and the teams can deliver the work faster and with less effort; it is a specific technique that reduce the waste of any production process by ensuring that new work is started only if there’s a demand for it, minimizing the overhead and optimizing the storage costs.
* **Facilitating continuous improvement:** represent a variety of techniques that are used to identify what an organization has done, what it needs to do, any possible obstacles that can be found in the process and evaluating how all the members of the organization can improve their process. Since the Lean Management is a cyclical process, the problems could occur in any of the 4 steps. This is the last but most important step of the process.

**3.2 Six Sigma Methodology:**

Six Sigma (**6σ**) is a set of techniques and tools for the process improvement. It was presented by the Bill Smith, an American engineer.

Six Sigma aim to improve manufacturing quality by identifying and removing the causes of defects and reducing the variability in the process. This is done by applying empirical and statistical method and by working with Six Sigma experts. Each Six Sigma project follows a defined methodology and has specific value targets.

International Organization for Standardization (ISO) published in 2011 the first standard definition of Six Sigma “ISO13053:2011. Other standards have been made by universities and companies.

Six Sigma origins are from Statics, from the field of Statistical Quality Control. It refers to the ability of the processes to produce a high proportion of output. The process that operates with “Six Sigma Quality” in a short term are assumed to produce long-term defects levels under the 3.4 defects per 1.000.000 opportunities (DPMO). The 3.4 DPMO is based on a shift of ± 1.5 sigma explained by Mikel Harry.

Specifically, say that there are six [standard deviations](https://en.wikipedia.org/wiki/Standard_deviation)—represented by the [Greek letter](https://en.wikipedia.org/wiki/Greek_alphabet) σ ([sigma](https://en.wikipedia.org/wiki/Sigma))—between the [mean](https://en.wikipedia.org/wiki/Mean)—represented by μ ([mu](https://en.wikipedia.org/wiki/Mu_(letter)))—and the nearest specification limit. As process standard deviation goes up, or the mean of the process moves away from the center of the tolerance, fewer standard deviations will fit between the mean and the nearest specification limit, decreasing the sigma number, and increasing the likelihood of items outside specification. According to a calculation method employed in process capability studies, this means that practically no items will fail to meet specifications. [[1]](#footnote-1)

Six Sigma emphasises that [[2]](#footnote-2):

* It’s necessary to make continuous efforts to achieve a stable and predictable process results.
* Manufacturing and business processes have characteristics that can be defined, measured, analysed, improved, and controlled.
* Achieving sustained quality improvement requires commitment from the entire organization, particularly from top-level management.

Features that set Six Sigma apart from previous quality-improvement initiatives include [[3]](#footnote-3):

* Focus on achieving measurable and quantifiable financial returns
* Emphasis on management leadership and support
* Commitment to making decisions based on verifiable data and statistical methods rather than assumptions and guesswork

Lean Management and Six sigma shared some methodologies and tools. The difference is on the focus of the approach, Lean Management aims to eliminate waste through tools that aim organizational efficiencies by the integration of a performance improvements system and Six Sigma by eliminating the variation. Both are led by data, but Six Sigma depends on more accurate data.

The main and most evident goal on Six Sigma is to improve the process but not necessarily to 3.4 DPMO level. The organization must select a proper sigma level depending on the importance of the processes.

### Methodologies of Six Sigma:

Six Sigma projects follow two project methodologies, inspired by W. Edwards Deming's Plan–Do–Study–Act Cycle, each with five phases.[[4]](#footnote-4)

* **DMAIC**: is used for projects aimed at improving an existing business process
* **DMADV**: is used for projects aimed at creating new product or process designs.

**Six Sigma in practice:**

Six Sigma is normally applied on large organizations, according to Thomas Pyzdek and J. Kullmann, Industry consultants, the companies that will find Six Sigma more suitable for it processes are the companies with more than 500 employees, but it also has tools that could fit on smallest organizations. E.g., the difficult to afford a Black Belt specialist (higher level on the Six Sigma pyramid, does not mean that they cannot apply the other tools of Six Sigma.

### In the financial field, Six Sigma has shown an important role by improving the accuracy of the allocation of cash, automatic payments, more accurate reports, and documents, among others.

### On the Bank of America, Six Sigma helped to increase the customer satisfaction by 10.4% and reduce the costumer issues of 24%. Between the big financial companies that have applied Six Sigma on their processes there are American Express, GE Capital and JPMorgan.

**3.3 LEAN SIX SIGMA:**

Lean Six Sigma is a methodology that apply a collaborative team effort to improve the performance by limiting the waste and variation. It’s a combination of Lean Management and Six Sigma to eliminate the wastes, called *muda*.

Lean Six Sigma uses the DMAIC phases as in Six Sigma. There are 5 phases used on Lean Six Sigma to identify the root of the inefficiencies and work with any process and services that have a big amount of data.

Fujio Cho defined the waste (muda) as “anything other than the minimum amount of equipment, materials, parts, space, and workers time, which are absolutely essential to add value to the product".

Different types of waste have been defined in the form of a [mnemonic](https://en.wikipedia.org/wiki/Mnemonic) of "downtime":

* **D**efects: is a product that is not able to be used, requires the interventions or to be discarded. This creates a cost to the company on time and money.
* **O**ver-production: excessive quantity of production or in produced at the wrong moment.
* **W**aiting: refers to the delays in the process and there are 2 kinds, waiting for material or weak equipment.
* **N**on-Used Talent: refers to the waste of human resources and skills. The main problem is when the employees does not have the opportunity to give a feedback and assessments to managers to improve the process.
* **T**ransportation: not proper movements of materials, products, people, equipment, and tools. It represents a value-add to the products and processes.
* **I**nventory: represent an excessive quantity of products and materials that are unprocessed. It is a problem since the product may become useless to the costumer, creating a useless cost of storage.
* **M**otion: unnecessary movement of people.
* **E**xtra-processing: is doing more steps than necessaries to finalize the product.

**Lean Six Sigma Belt Levels.**

Lean Six Sigma’s levels of certification are structured in belt colours. Being the highest level the Master Black Belt, after this there are the Black Belt, Green Belt, Yellow Belt, and White Belt. To be part of the different levels, is necessary to success on an exam about Lean Six Sigma and applications.

White Belt: employee understands the meaning and goals of Lean Six Sigma. They know the terms associated with the methodology and report any process problems to colleagues with either Green or Black Belts.

Yellow Belt: an employee understands essential Lean Six Sigma concepts, tools, and techniques. They report process problems to colleagues with either Green or Black Belts.

Green Belt: employee has some expertise in Lean Six Sigma strategy and can launch and manage Lean Six Sigma projects. They focus on the use of tools and the application of DMAIC and Lean principles.

Black Belt: employee with advanced Lean Six Sigma expertise who reports to Master Black Belts. They can be full-time, cross-functional project team leaders, as well as a coach or mentor to Green Belts. They are responsible for putting Lean Six Sigma changes into place.

Master Black Belt: employee with a Master Black Belt has extensive Lean Six Sigma expertise is typically responsible for the Lean Six Sigma initiative. They can act as coach or mentor and monitor projects. They work with company leaders to identify efficiency gaps and training needs. They report to C-Suite executives.

**PROCESS:**

In Lean Six Sigma the process is defined by a DMAIC, that is a data-driven quality strategy that aim to improve the processes. DMAIC stands for Define, Measure, Analyse, Improve, Control. That represent the 5 parts of the process.

**Define**: this step aims to clarify the business problem, goal, resources, scope, and timeline. This phase is normally used on the project chapter creation, that consist of an explanation of the current situation of the process. It aims to clarify, define objectives, and develop the project team. It defines the following:

* Problem
* Costumer, using a SIPOC.
* Voice of the customer (VOC) and Critical to Quality (CTQs)

### Measure: this step represents the measurement of the specification of the problem and goal. Here the data is collected. The performance metric for this phase will be compared to the final metric of the project to analyse if the improvement were achieved. The team decides about what should be measured and how, normally here the teams spend big quantity of time to assess the appropriateness of the proposed measurement system. Good data is the heart of the DMAIC.

### Analyse: the aim of this step is identified, validate, and select the root cause of the elimination. Most of the potential root causes are identified through a root cause analysis (e.g., Fishbone diagram). The roots are choose using a multi-voting consensus for other validations. A data collection plan is created, and data are collected to establish the relative contribution of each root causes to the project metric. This process is repeated until valid root causes can be identified.

### Improve: the aim of this step is to identify, test and apply a solution to the issues, partial or full depending on the situation. To fix or prevent the issues is necessary to identify creative solutions, e.g., apply tools like Six Thinking Hats and Random Word. The aim of the improve step could be also find the solution without implementing it. The idea is to:

* Create
* Focus on simple solutions.
* Test solutions using plan-do-check-act cycle
* Depending on PDCA results, try to anticipate any preventable risks related to the improvement using Failure mode and effects analysis (FMEA)
* Stablish a detailed implementation plan
* Organize improvements

### Control: the aim of this step is to insert the changes and guarantee sustainability, it’s the final step if the DMAIC method. In this step, the following processes are undertaken amend ways of working, quantify and sign-off benefits, track improvement, officially close the project, and gain approval to release resources.[[5]](#footnote-5)

* A control chart can be useful during the Control stage to assess the stability of the improvements over time by serving as a guide to continue monitoring the process and providing a response plan for each of the measures being monitored in case the process becomes unstable.
* Standard operating procedures (SOP's) and Standard work
* Process confirmation
* Development plans
* Transition plans
* Control plan
* Benefit delivery

3.4 TOYOTA:

**Toyota Motor Corporation** is a Japanese multinational automotive manufacturer headquartered in Toyota City, Aichi, Japan. It was founded by Kiichiro Toyoda and incorporated on August 28, 1937. Toyota is one of the largest automobile manufacturers in the world, producing about 10 million vehicles per year.The company was originally founded as a spinoff of Toyota Industries, a machine maker started by Sakichi Toyoda, Kiichiro's father. Both companies are now part of the Toyota Group, one of the largest conglomerates in the world. While still a department of Toyota Industries, the company developed its first product, the Type A engine in 1934 and its first passenger car in 1936, the Toyota AA[[6]](#footnote-6).

**Implementation of Six-Sigma in Toyota[[7]](#footnote-7):**

Toyota applied the phases of the Six Sigma Methodology to start the project, then improved the processes. The DMAIC was applied in the following way:

**Define:** since the automobile industry was facing numerous changes, Toyota was not able to ensure their leadership’s position on the market for the future. The managers defined the current situation and understood the conflicts and problems.

After the understanding of the problem the company created a project plan including the Costumer to Quality.

**Measure:** Toyota managers found a processed the information available to find new solutions through Value Stream Mapping*,* Data Gathering, Data measurement validation.

**Analyse:** At this stage, the management had reliable information about the problem or areas of potential problem the information was be analysed to get the root cause of the problems. Cause and Effect Analysis, FMAE (Failure modes and effects), Correlation and regression studies and DOE (design of experiments).

**Implement**: the management/implementation team understood the problem at hand, had a well-defined picture of what is going on in an organization, understood departments with inefficiencies and the financial implications of the gaps (Wheelen and Hunger, 1998). The next step is to devise several possible solutions to be implemented. Here staffs should be fully included.

**Control:** Toyota Management at different regional offices developed a control and monitoring team. When controlling there is an already set path, through which processes had to be followed. They had to start from somewhere heading to another area.

**3.5 Royal Bank of Canada IT&S Luxembourg and Lean Six Sigma:**

For more than 120 years, RBC Investor & Treasury Services (RBC I&TS) has provided asset and payment services to corporate investors and financial institutions globally.

Are a financially strong partnertrusted with CAD 4.1 trillion in assets under administration2 with offices in 13 countries.

With clients at the heart of their service offering, safeguard assets and leverage data and technology solutions to:

* Deliver meaningful insights
* Simplify our clients’ operations
* Support their growth[[8]](#footnote-8)

**Application of Lean Six Sigma on RBC IT&S in Luxembourg:**

RBC IT&S, after the capacitation of the relevant employees for the project and acquired the certifications and necessary belt, is applying the Lean Six Sigma philosophy to upgrade the processes to achieve a lean organization and reducing all the wastes on the process.

The initial process of RBC IT&S Luxembourg is done by creating a Short-Range-Outlook. Objective of this Short-Range-Outlook report is to produce a P&L view with actual, budget and forecast to our CFO:

* This is an Excel report including several tabs with EPM tool data (Actual Budget, Forecast and Manual adjustments).
* The report is produced twice a month: after month end closing and one week before month end closing.
* Only the forecast figures are supposed to change considering the business input i.e., exceptional events.
* Adjustments are done at the reporting level i.e., not granular and are only available in the document.
* Business partners must be involved in the forecasting process to obtain realistic values.
* The excel report is used to produce a PowerPoint slide.

During it application they identified some issues on the processes that are creating a more exhaustive and expensive workflow. Between the issues we have:

* The SRO report was built incrementally by adding the sponsor’s (Chief Financial Officer, CFO) requirements.
* It is necessary to add comments to be able to monitor the adjustments
* We depend on the business partners collaboration to be able to create a forecast of the SRO figures thar are accurate.

**A graphic representation of the initial process of RBC.**

The goal that RBC IT&S Luxembourg wants to achieve through Lean Six Sigma application is to:

* Clean-up the report (clean any data/files/links not used at this level of granularity and reformat/rebuilt).
* Potentially the tracking of the change can be lost when explaining the variances: therefore, create a tracker to discuss the variances (through comments of others).
* Partnership with business stakeholders must continue to be enhanced to get the right support at the right time: explain the objective of the exercise and implement SLA or clear instructions.

These improvements will result on a decrease of the time spent month by month and increase the efficiency, enhance clarity on the figures and provide a bigger accuracy on the results.

The Lean Six Sigma tools that have being applied inside of the bank’s management and analysis is the DMAIC process to stablish the interventions and identify the issues, Fishbone scheme to have a complete view of the process and applying the Kanban strategy to organize the daily task between the team members.

The future process will be achieved by reducing some of the process and interventions necessary to achieve the SRO in the best way possible.

Final ppt.

**How Lean Six Sigma will help RBC IT&S Luxembourg to reduce operational risk:**

On the 2 schemes showed below, we can see the changes in the process of RBC IT&S Luxembourg, there we can find 3 main changes:

* Addition of the phase called “ONE OFF”, that represent an additional analysis on the events that affect the bank having a monetary value of over 1.000.000€.
* The further development of the adjustments, to understand properly the reason of the necessary adjustment from the plan.
* The autonomation, that reduce the intervention of the employees on the process, creating a more autonomous and developed system.

All of the changes have a positive impact when it comes to operational risk management, since they will reduces the possibility of human errors that is the main loss on the operational risk and analyse the other motivations of the losses through the “ONE OFF” analysis and the further development of the adjustments; applying this new process RBC IT&S Luxembourg will be able to reduce the losses and identify and measure more accurately the issues and will be able to intervening at a good moment before that the losses are of big impact.

1. Tennant, Geoff (2001). [SIX SIGMA: SPC and TQM in Manufacturing and Services](https://books.google.com/books?id=O6276jidG3IC). Gower Publishing, Ltd. p. 25. [↑](#footnote-ref-1)
2. Tennant, Geoff (2001). [SIX SIGMA: SPC and TQM in Manufacturing and Services](https://books.google.com/books?id=O6276jidG3IC). Gower Publishing, Ltd. p. 25. [↑](#footnote-ref-2)
3. Tennant, Geoff (2001). [SIX SIGMA: SPC and TQM in Manufacturing and Services](https://books.google.com/books?id=O6276jidG3IC). Gower Publishing, Ltd. p. 25. [↑](#footnote-ref-3)
4. De Feo, Joseph A.; Barnard, William (2005). JURAN Institute's Six Sigma Breakthrough and Beyond – Quality Performance Breakthrough Methods. Tata McGraw-Hill Publishing Company Limited. [↑](#footnote-ref-4)
5. ["DMAIC | Control Stage - InvisibileConsultant.co.uk"](https://invisibleconsultant.co.uk/dmaic-control-stage/). *InvisibileConsultant.co.uk*.  [↑](#footnote-ref-5)
6. Wikipedia Contributors. (2019, February 26). Toyota. Retrieved from Wikipedia website: https://en.wikipedia.org/wiki/Toyota [↑](#footnote-ref-6)
7. Six-sigma in Toyota Motor Corporation| Retrieved from Free Essays website: https://ivypanda.com/essays/six-sigma-in-toyota-motor-corporation-report/

   ‌ [↑](#footnote-ref-7)
8. RBC Investor & Treasury Services | Who We Are. Retrieved from www.rbcits.com website: https://www.rbcits.com/en/who-we-are.page

   ‌ [↑](#footnote-ref-8)