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Applying Lean Principles to Improvement Project Monitoring in the DOT Department: Creation and Implementation of a New Matrix at FPT Industrial

Tools for Innovation and Continuous Improvement in Manufacturing Enterprises: The FPT Industrial DOT Perspective

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Abstract

This work addresses the creation of a new tool, the need for which arose during an internship at the FPT Industrial plant in Turin, within the continuous improvement team called DOT (Driving Operations Together). One of the main activities of the continuous improvement team at the plant is monitoring efficiency projects, meaning those continuous improvement projects that, once completed, will bring economic benefits over a twelve-month period. Monitoring is carried out through a dedicated tool called the Matrix. During the months of the internship, several critical issues and new scenarios emerged, such as the merging of four different business units into a single plant. These developments triggered the need for a new tool that would account for the new scenarios and address the identified issues. The work is divided into three chapters. The first chapter, titled *Introduction to the Company and DOT Department*, introduces the corporate context in which the internship initially took place, and later where the work described here was carried out. The same chapter also includes a theoretical section dedicated to explaining the principles of Lean Management, which originated in Japan in the 1950s and 1960s within the Toyota group and was later exported worldwide. These principles form the foundation of the continuous improvement team's philosophy at FPT Industrial. The second chapter, *Criticality and the Need for a New Tool*, discusses and analyzes the critical issues that led to the need for creating the tool that is the subject of this work. The third chapter, *The New Matrix*, focuses the reader's attention on the consultation and analysis of the new tool, which is already operational and was created entirely using Microsoft Office Excel. It highlights the most innovative aspects that have proven to be highly useful to the company. Technical elements will be analyzed, such as the use of complex formulas or Visual Basic code to meet specific needs, along with the new management possibilities enabled by this tool. The discussion will be supported by a series of images to simulate navigation within the file, making the reading experience more immersive. In conclusion, there is an additional chapter titled *Conclusion*, which highlights all the innovative improvements and goals achieved, while also pointing out some existing limitations and challenges.

Chapter 1

Introduction to the Company and DOT Department

1.1 Iveco Group

It is important to understand the context of the whole work environment, so let us initiate with the introduction of the Group IVECO. The name “IVECO” is an acronym for Industrial Vehicles Corporation. The product range of the group includes Light, Medium, and Heavy Commercial Vehicles (IVECO), Powertrain (FPT Industrial), Buses (HEULIEZ, IVECO BUS), Financial Services (IVECO CAPITAL), and Specialty Vehicles (IDV, ASTRA, and MAGIRUS). IVECO is a pioneering champion that designs, manufactures, and markets heavy, medium, and light-duty commercial vehicles.
In particular, FPT Industrial is a world leader in industrial powertrains and alternative propulsions for on-and-off-road vehicles, as well as marine and power generation applications. IVECO BUS is one of the major players in the European passenger transport sector and offers a complete range of urban and intercity buses, tourism coaches, and minibuses. HEULIEZ is the market leader in electric city buses in France, driven by creativity, excellence, and commitment. IDV specializes in defense and civil protection equipment. ASTRA is a global expert in large-scale, heavy-duty quarry and construction vehicles. MAGIRUS is a highly reputed firefighting vehicle and equipment manufacturer. IVECO CAPITAL, the financing arm, supports them all, serving as the cornerstone of Iveco Group’s new business models.

1.1.1 FPT Industrial

FPT Industrial (see fig 1.1) is a company part of the IVECO Group, which was established in 2005 as FIAT Powertrain Technologies and became FPT Industrial in 2011. It is composed by eight thousands workers for ten plants and ten R&D center around the world. The wide product range includes six engine families with an output of 42 to over 1,000 horsepower,transmissions with torque up to 500 Nm, front and rear axles from 2.45 to 32 tons.

Figure 1.1: FPT industrial plant in Turin

FPT Industrial also boasts the most complete range of natural gas engines for industrial applications on the market today, with a power ranging from 50 to 520 horsepower. Through its E-Powertrain division dedicated to electric propulsion systems, the company is accelerating towards net-zero carbon mobility, with electric drivetrains, battery packs and battery management systems. This offering, combined with the strong focus on Research & Development, makes FPT Industrial one of the world's leading players in the field of propulsion systems and solutions for industrial use.
FPT Industrial's mission is to become a technology leader in all areas related to industrial propulsion systems through innovation, product excellence and continuous improvement. Customer satisfaction is the driving force. The needs of direct and end customers are what drive the company to offer the absolute best in terms of engines, transmissions and after-treatment solutions for any application. In an effort to achieve this mission, it is important the implementation of a sustainable growth process – based on respect for the environment and a commitment to the social well-being of the employees and the communities in which FPT Industrial operate.

From a business perspective the company is composed by 4 different Business units which are mentioned before(see fig 1.4): Engines, Driveline, I&M and E-Powertrain. Moreover, the organizational structure of the plant is organized as follows (see fig 1.2): The plant manager is the employer followed by the various functions/departments whose heads composed the first manegerial line of the Plant Manager. Each business unit mentioned before is composed by Operational Units: Assembly and Machining (see in fig 1.3) and each of them is composed by:

- **UTE (Elementary Technological Unit)**: composed by the head of the UTE, who coordinates the team which is composed also by the white collars and by Team Expert (TE) who provides technical and qualitative support to team workers. Finally, the head of UTE is enrolled also to ensure production advancement and compliance with safety regulations.
- **DOT & Tech**: enhances the process technically and qualitatively, collaborating with Work Analysis to define new work cycles and are the ones who find, evaluate and insert efficiency projects into the monitoring tool.
- **Maintenance**: they are those who deal with direct intervention in the event of breakdowns on machinery and preventive maintenance on machinery.

In the following pages we get deeper into each of the Business Units.

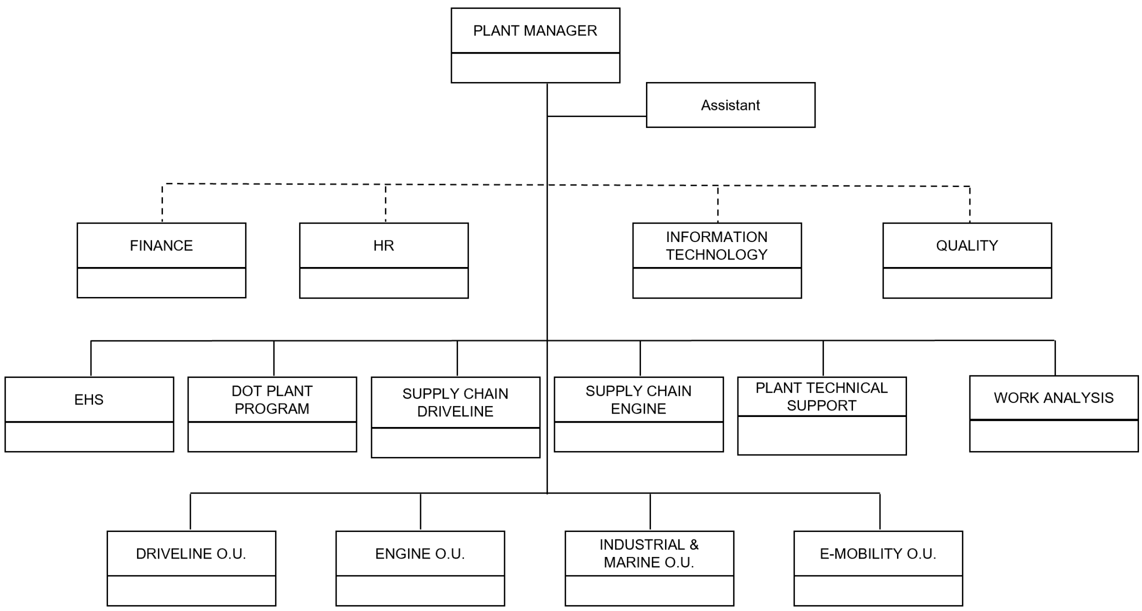


Figure 1.2: Plant organizational chart

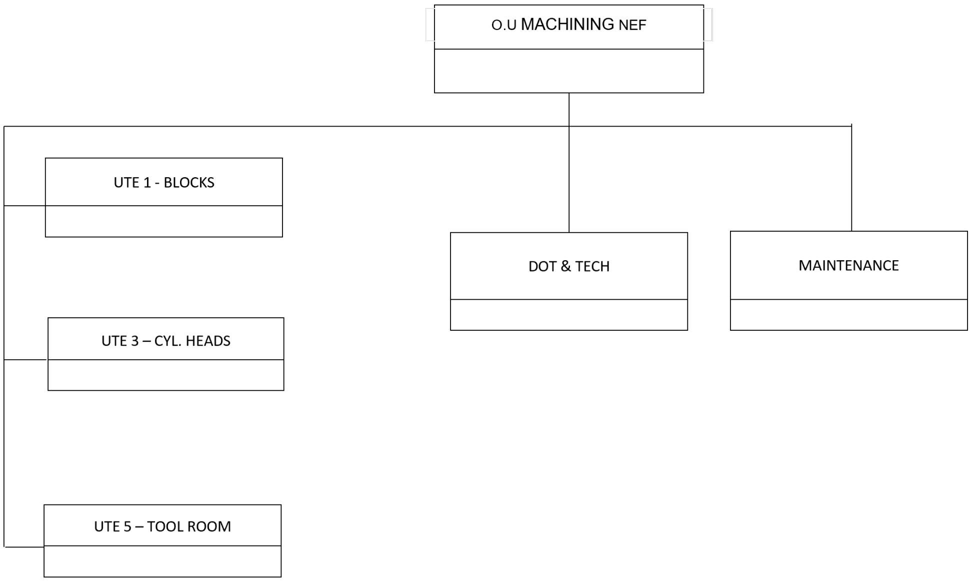


Figure 1.3: Operational Unit organizational chart, here is represented the Machining unit

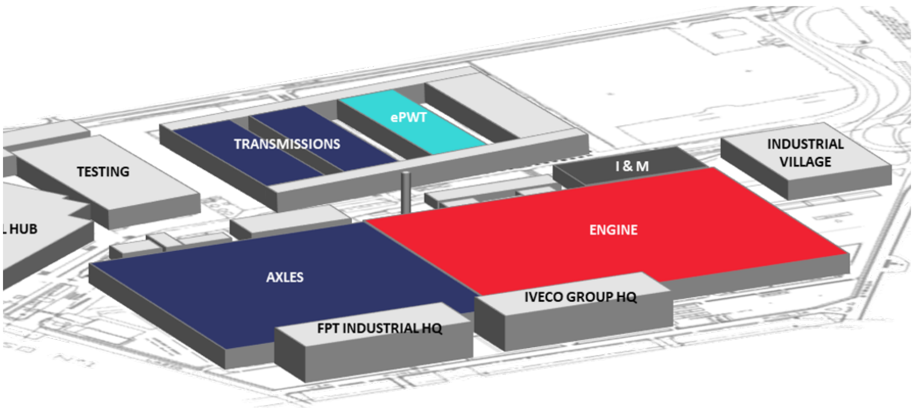


Figure 1.4: The four business units in the plant

1.1.1.1 Engine

This section is responsible for the entire engine manufacturing process, from casting and machining to assembly and testing and is at the heart of the FPT Industrial plant, where various engine families such as F1, NEF (see fig 1.5), VECTOR and CURSOR are produced. Each engine could have multiple variants and the NEF variant is characterized by the most complex production

Figure 1.5: N67 Model NEF engine

process, as it includes both the machining phase, during which the engine head and block are processed, and the assembly phase. The final product could have different uses as for on-road light commercial vehicles, off-road for agriculture, construction, and power units. The area (see fig 1.6) is composed by two macro-areas: Nef Machining and Nef Assembly. The part of the machining includes:

- **NEF Cylinder Head Machining**: in this area, cylinder heads for the NEF engines are machined. The machining process here is crucial for achieving optimal combustion efficiency.
- **NEF Cylinder Block Machining**: dedicated to machining the cylinder blocks, this area focuses on crafting robust and precisely engineered components. The machining process here is crucial for achieving structural integrity, thereby underpinning the superior performance capabilities of NEF engines.

The subsequent part instead, focuses on assembling NEF (New Engine Family) components. It includes the following sub-areas:

- **NEF Short-Long Block, UTE11**: called also "Krause" since the 85% of the machines in this area are Krause Model. This area here assembly of all the components related to the Core Engine, i.e. connecting rods, crankshaft and pistons. Is a crucial stages in the engine assembly process.To be more precise, the Krause consists of three paths: the first (Block) is where all the previously mentioned components are assembled, the second (Head path) is where the head is assembled onto the block, and the last path is where the engine oil pan is assembled.
- **NEF Engine Dressing, UTE 13**: the NEF Engine Dressing, consisting of the Synchronous Line and the Asynchronous Bays, is the section where engines receive their final configurations. Here, skilled technicians meticulously install various components and accessories and assembly activities of the Water, Diesel, Oil sub-groups and electric components are carried out, ensuring that each engine is fully equipped to deliver optimal performance and functionality.
- **Hot-Cold Test, UTE 15**: this area is dedicated to testing the engines under different temperature in appropriate cells conditions to ensure they perform reliably.
- **Painting**: in the Painting area, meticulous attention is given to applying protective coatings to NEF engines and their components. This not only

safeguards against corrosion but also enhances the engines' durability and aesthetic appeal.

- **Shipping**: that's the final part, where all the activities for the shipping of the engine to the client are organized.

The warehouse areas are located adjacent to both the assembly and machining sections. These areas are used for storing raw materials, components, and finished products. The warehouse ensures that the assembly and machining areas have a steady supply of the parts they need. The strategic placement of warehouses ensures that all sections have the necessary materials and components, minimizing downtime and improving overall efficiency.

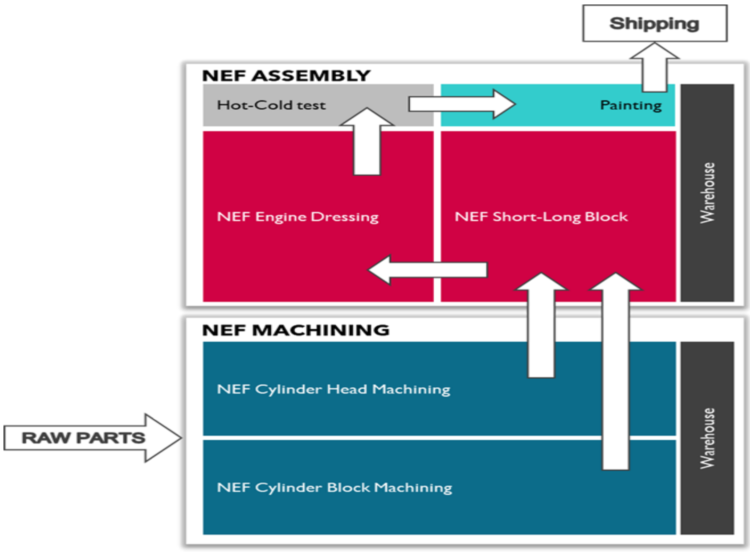


Figure 1.6: Engines plant structure

1.1.1.2 Driveline

In the Driveline area front axles and rear axles (fig 1.7), commonly referred to as bridges, and trasmission (fig 1.8) are produced. Front axles are associated with the front wheels, providing steering capabilities, while rear axles are connected to the rear wheels, which drive the vehicle forward (drive wheels).

Figure 1.7: Light Truck model axle

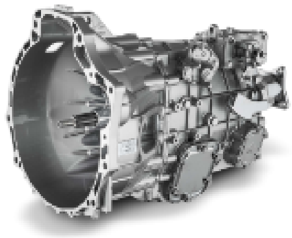


Figure 1.8: FT50.6 Model Trasmission

A special case is the so-called Motor Axles, which are front axles used on heavy-duty vehicles. Unlike standard front axles, these also drive the wheels. The specificity of certain components used for assembling a particular bridge or axle leads to the creation of a wide range of product families. Despite having subtle differences, these families collectively contribute to the production of numerous Iveco-branded transport vehicles. This area (see fig 1.9) is the most complex from a structure point of view since it is the most dated area and there are projects in order to make the production line more efficient and easier. following there will be a briefly outline of the main operations which are carried out in the line and the first one analyzed is the one of Axles.

- **Receiving**: this area is designated for receiving raw materials and components required for the plant's operations. It ensures that all incoming materials meet the quality standards and specifications before being moved to the next stage of production.
- **AXLES Machining**:
  - **UTE 1**: this team focuses on machining semi-axles, transforming raw materials into finished products ready for assembly. They also machine wheel hubs for NDA and HD axles which are 2 specific types of axles.
  - **UTE 2**: near the semi-axle line, this team machines engine gear, central blocks for heavy-duty axles, and differential cases for NDA axles. They also work on various components like levers, covers for heavy-duty axles, Motor Axles parts, and rear axle components.
  - **UTE 3**: UTE 3 handles multiple axle types. One section machines arms for single-wheel NDA axles, while another deals with dual-wheel NDA and

HD axles. They also machine NDA axle boxes, with dedicated machines for HD and SPR axle boxes (SPR is another type of axles). Additionally, there is a specialized area for welding supports onto SPR, NDA, and HD axle arms.

  - **UTE 5**: this team has machines for heavy and medium axle bodies, ensuring efficient and flexible production. They also have separate lines for heavy, medium, and light axle spindles, maintaining precision and quality. Specialized areas within the facility are dedicated to machining wheel hubs for heavy, SPR, optimized, and light axles.
  - **UTE 7**: this area focuses on machining gear pairs and pinions. There is also an autonomous machining island with four new machines for producing spindles for Iveco Stralis axles, ensuring high-demand production without affecting other operations.

- **Painting**: this area is responsible for painting components to protect them against corrosion and provide a finished appearance. The process includes pre-treatment, painting, and curing stages to ensure a high-quality finish.

- **AXLES Assembly**: in this area, axle components are assembled, ensuring they are properly fitted and ready for installation in vehicles. This includes assembling semi-axles, spindles, hubs, and other critical components to form complete axles.

- **Kitting & Sequencing**: this area organizes and sequences components to streamline the assembly process. It ensures that all necessary parts are prepared and delivered in the correct order to the assembly lines, improving efficiency and reducing assembly time. it also ensures right quantities and right typology of components in the line.

- **Inland**: this area is where the final products are stocked in order to be shipped to the final customer.

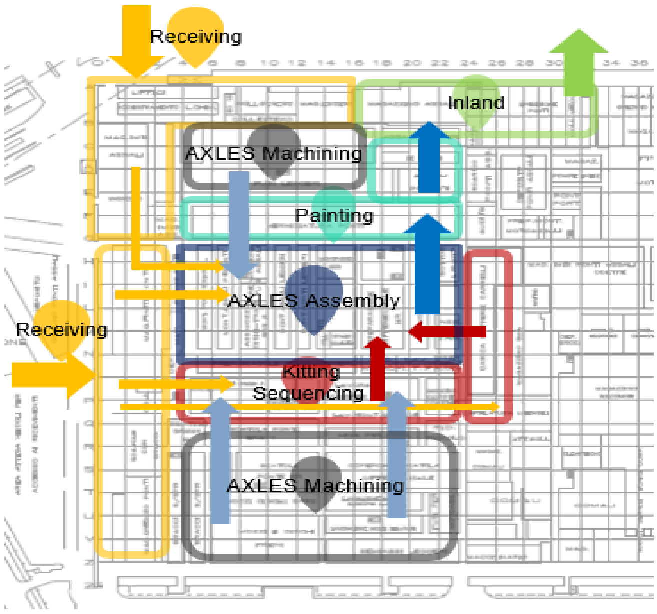


Figure 1.9: Driveline Axles line structure

To complete the business unit of Driveline it is useful to understand the last section which is the Trasmission line (see fig 1.10) where trasmission are made:

- **Receiving and Isothermal Annealing**: raw materials are received from an external supplier. These materials undergo annealing to reduce surface hardness, allowing for easier mechanical processing. Once this process is complete, the parts are ready to be sent to the two machining UTEs.
- **Pre-Heat Treatment Machining**: after undergoing isothermal annealing, the parts are sent to two UTEs:
  - UTE 2 – Gear machining
  - UTE 3 – Shaft machining

  Due to the different configurations of gears and shafts, the parts undergo the same type of transformation process but are machined in two distinct and specially equipped areas. The transformation processes within the UTEs include classic procedures such as turning, hobbing, gear shaping, drilling, and milling. Once these operations are completed, the parts are sent back to UTE 5 for carburizing and, where required, welding.
- **Carburizing and Special Processes**: based on the required metallurgical characteristics, the machined parts undergo carburizing processes. The temperatures and process times are correlated with the specified characteristics.

Some parts, due to their application, also require welding. In these cases, the gear and synchronization ring are joined using laser welding. Within the UTE, there is a metallurgical laboratory where a destructive test is performed on a sample piece from each batch. This ensures the required metallurgical characteristics and serves as a quality control measure. Once the process is certified, the parts are sent to UTE 4 for finishing operations.

- **Post-Heat Treatment Machining**: in UTE 4, the following grinding operations are performed:

  - External diameters for subsequent assembly with supporting components (bearings and roller cages).
  - Holes and thrust faces for gears.
  - Gear teeth for gears and shafts.

  After grinding, the parts are sent to UTE 6 for kitting preparation and then to UTE 7 for final assembly and testing.

- **Assembly**: the assembly line follows a series of predetermined operations for assembling transmission groups and inserting them into the gearbox housing. The internal components of the transmission are produced in-house, while the external parts of the transmission (such as the casing, cover, etc.) are sourced externally. At the end of the line, there is a test bench where the following tests are performed:

  - Engagement
  - Sealing
  - Noise level

  These tests simulate the gearbox's operation within a vehicle. After successful testing, certified gearboxes are shipped to customers for final vehicle assembly.

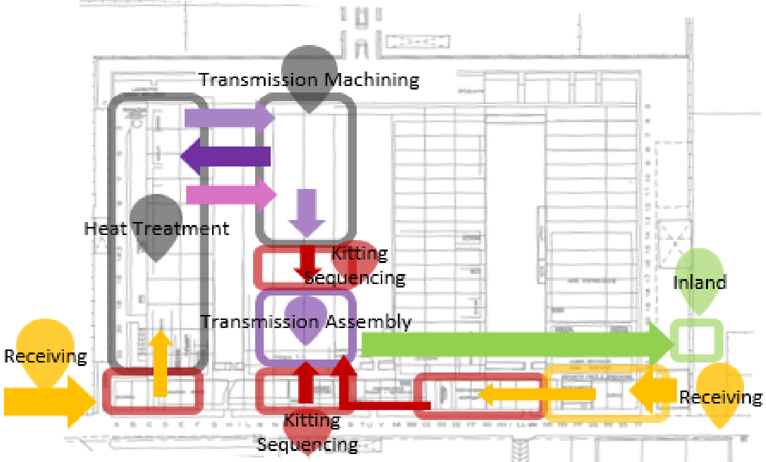


Figure 1.10: Driveline Trasmission line structure

1.1.1.3 Industrial & Marine

I&M produces engines for commercial, pleasure, and G drive marine uses. In this area (fig 1.13), there is no Machining Zone, as it is dedicated solely to customizing five types of engines: NEF, Series 8000, Cursor (see fig 1.11 and fig 1.12), F1, and F5. These engines are customized with components like pulleys, alternators, and starter motors based on customer requests. Additionally, some engines from the Iveco Group are customized here, though they are not produced in Turin. Most engines arrive without customized components, while others come pre-assembled and are then reassembled with client-specific parts.
Areas such as Painting, Testing, and Kitting follow the same principles as those described in the engine section. The main clients for industrial engines are Liebherr and Sumitomo, while for marine engines, the key clients are Caterpillar and Yanmar.

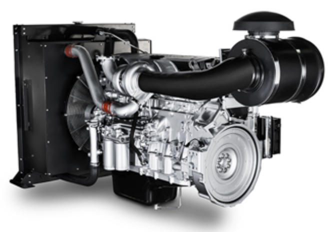


Figure 1.11: Cursor13 330/470 kW model for industrial use

Figure 1.12: Cursor9 600/1000CV for marine use

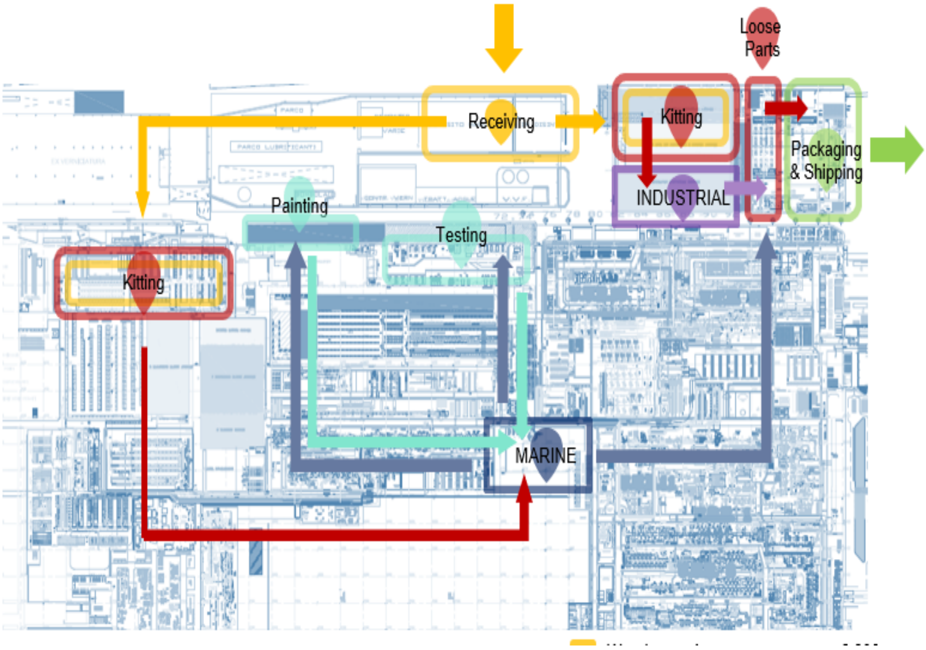


Figure 1.13: Industrial and Marine line structure

1.1.1.4 E-Powertrain

E-Powertrain assembles electric engines for G drive applications and is the smallest of the Business Units, comprising four assembly lines. Unlike other units, except for Industrial & Marine it lacks a machining area (see fig 1.16), with all operations focused solely on assembly.

- **LCV Battery Packs**: this line focuses on assembling the battery for the Daily vehicle. The process starts with securing the battery in a protective cover and then proceeds to the wiring for proper functionality.
- **LCV/Sportscar E-Axles**: this line primarily serves the Maserati client, assembling the rear axle for the Maserati sports car (see fig 1.14). There are two variants: one with two electric engines (one per axle) and another with four electric engines (one per semi-axle).
- **HCV E-Axles**: this line is dedicated to assembling the electric engine for the Nikola vehicle (see fig 1.15).
- **E-Bus Battery**: similar to the Daily vehicle line, but the battery packs here are larger in size and capacity.

For all the lines described above, there is a common area where the lines are supplied, and at the end there is the final testing before shipping the final product to the client.

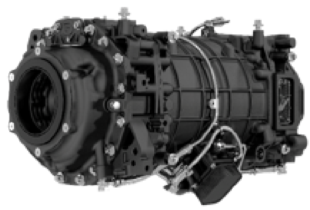


Figure 1.14: Rear Axle Maserati

Figure 1.15: E-Axle for HCV

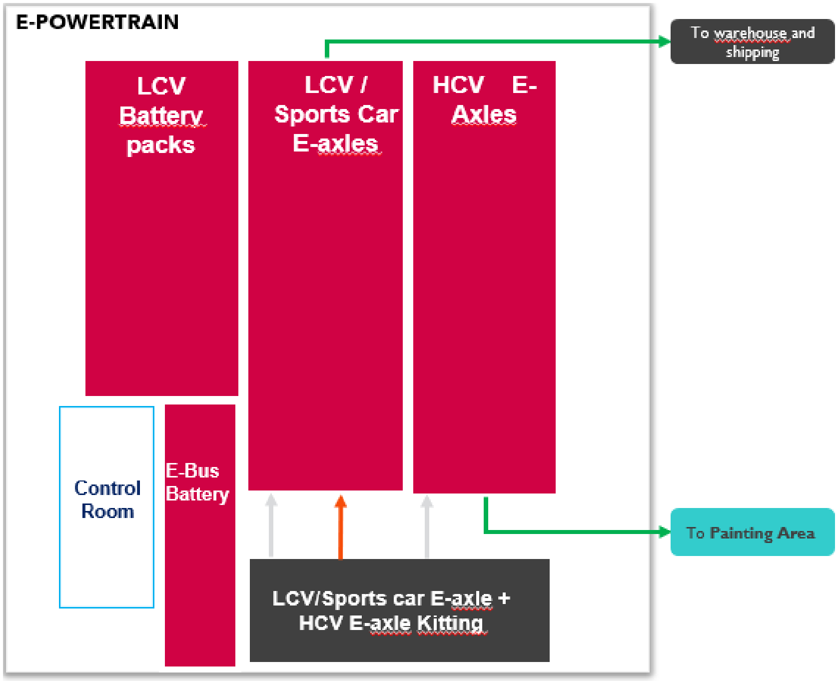


Figure 1.16: E-Powertrain line structure

1.2 DOT & Lean Management

DOT stands for Driving Operations Together (see fig 1.17) and it is an Operational Excellence Holistic Model that supports the "Culture of Excellence" throughout the organisation. It is a philosophy, rather than just a method, derived from lean management and lean thinking, with a foundation in continuous improvement. Before delving into the structure of the DOT system, it's important to explain the basics of the lean management system to better understand the principles that DOT inherits from it.

Figure 1.17: DOT logo

1.2.1 Toyota Production System & Lean Management

When people are asked what the Toyota Production System is, ”80% will likely say it’s a Kanban-based system, another 15% will connect it to a specific production system, while only 5% will understand its core purpose: a system to eliminate waste” (Shingo, 1989). The term ”Lean Production” first appeared in 1988 in John F. Krafcik’s article “Triumph of the Lean Production System,” based on his thesis at MIT Sloan School of Management. Krafcik introduced this term to compare the production systems of Western manufacturers, which he called buffered, with the innovative Toyota Production System (TPS) that emerged in Japan after WWII. Lean Production refers to a system that aims to ”do more with less,” using minimal resources to achieve maximum efficiency and quality. Initially implemented at Toyota Motor Manufacturing, Lean focuses on identifying and eliminating non-value-adding activities (*Muda*) to enhance factory productivity. The Toyota Production System is synonymous with Lean because it uses fewer resources compared to mass production: half the human effort, factory space, tool investment, development time, and far less inventory so it has embedded a sort of lean way of thinking. Unlike mass production, which relies on narrowly skilled designers and semi-skilled production workers, Lean promote teams of multi-skilled workers at all organizational levels. Lean Manufacturing aims to achieve two primary objectives: ensuring customer satisfaction and maximizing profitability. The core principle is that every action should contribute value to the end customer. Lean organizations focus on understanding what the customer values and strive to enhance this by optimizing the value creation process to minimize waste. By cutting waste throughout the value stream, Lean practices reduce the need for human effort, space, capital, and time in production. This approach enables companies to adapt quickly to shifting customer needs while maintaining high standards of variety, quality, cost efficiency, and speed in production. A foundation of Lean thinking, as we said, is the continuous identification and removal of non-value-adding activities, or those for which the customer is unwilling to pay and waste can be eliminated at various stages of manufacturing, from initial product development to ensuring design compliance and operating a completed facility (Melton, 2005). Lean Production identifies seven types of waste: movement of products, inventory, physical motion of people, waiting, over-production, over-processing, and defects (see Table 1.1). Additionally, beyond *Muda*, it is essential to consider *Mura* and *Muri*. *Mura*, the waste of unevenness/irregularity, drives *Muda*, if a company fails to smooth demand, it leads to variation and fluctuation, creating inventories and other wastes. *Muri* results in overload, causing unnecessary stress on employees and processes due to *Mura* (demand fluctuation), lack of training, production system failures, or inadequate tools (Womack, 2007). So, to summarize:

- **Muda**: represents considered work-level waste and should be eliminated.
- **Muri**: represents process and system level waste and requires root cause investigation and planned steps to prevent recurrence and eliminate waste.
- **Mura**: represents the Management Waste, this is waste created by poor leadership, poor decisions, and poor policies. This type of waste requires thorough reflection (carefully and deeply thinking about past actions, decisions, or events to understand them fully and learn from them) and preventive measures to eliminate it.

Through the prevention and reduction of these wastes, Lean techniques offer numerous benefits: improved quality due to fewer defects and rework, fewer process breakdowns, more engaged and satisfied employees, better supplier relationships, lower inventory levels, and higher stock turnover with less space required. However, implementing Lean is not an overnight process. It requires full organizational commitment and involvement. Regardless of the country or industrial context, the success of Lean Thinking and its implementation relies on the engagement of people and a readiness to embrace change at all organizational levels. The less an organization is stuck in inertia (organizational or cultural inertia), the quicker and more effectively it can implement Lean changes.

1.2.2 Lean Thinking

Lean Thinking (refer to fig 1.18), also known as lean management, is an approach focused on waste elimination to develop efficient, standardized processes at minimal cost, involving the active participation of the workforce. It is versatile, applicable across various industries, and relevant to all areas of a company. Originating from the Toyota Production System (TPS), Lean Thinking began in manufacturing but

Types of Wastes	Description
Handling	Movement of products from a location to another or between operations
Inventory	Stock of finished goods and the work in progress (also raw materials)
Motion	Physical movement of a person while he/she is conducting an operation
Waiting	Waiting time for a product or for a machine to finish
Over-production	Producing more than what the customer asks for
Over-processing	Making operations more than what the customer requires
Defects	Reworked or rejected products due to some process errors

Table 1.1: Seven Types of Wastes (Liker, 1996)

has since been successfully implemented in areas such as product design, development, logistics, and administration. Central to Lean Thinking is a strong emphasis on customer focus: it prioritizes meeting customer needs, continuously seeks to eliminate waste (*Muda*), and empowers employees to drive value through ongoing improvement. Lean Thinking involves a collection of practical tools and techniques designed to apply lean principles within a company. However, it should be viewed as more than just an operational strategy; it represents a chance for fundamental change that impacts not only day-to-day processes but also the company's overall values, rules, and culture. In order to understand better what the logic of lean thinking, let's analyze the core principles:

- **Customer Focus**: the centrality of the customer is the starting and ending point of all activities and actions undertaken by the company. Through its products and services, the company aims to deliver the value that the customer expects. This customer-centric approach applies not only to external customers but also to internal customers. Ongoing dialogue with the customer is essential to identify needs and define value.

- **People's Contribution**: the concept of "knowing how to run a business" (or Monozukuri in Japanese) is achievable only by managing people effectively (in Japanese is embedded in the concept of Hitozukuri). Achieving and sustaining business competitiveness, along with significant and lasting results, is possible through the continuous alignment of management and all employees toward a common goal.

- **Eliminating Waste**: *Muda* (the Japanese term for waste) encompasses all activities that consume resources and energy without adding value to the product or service, thus providing no value to the customer. Identifying and eliminating waste is crucial for implementing Lean thinking.

- **Continuous Improvement**: *Kaizen* (meaning continuous improvement in Japanese) signifies that no process is perfect but can always be improved.

Everyone in the company, from top management to operators, must participate in the improvement process by sharing common and clearly defined goals.

These principles, when embraced and practiced consistently, drive the transformation towards a lean enterprise.

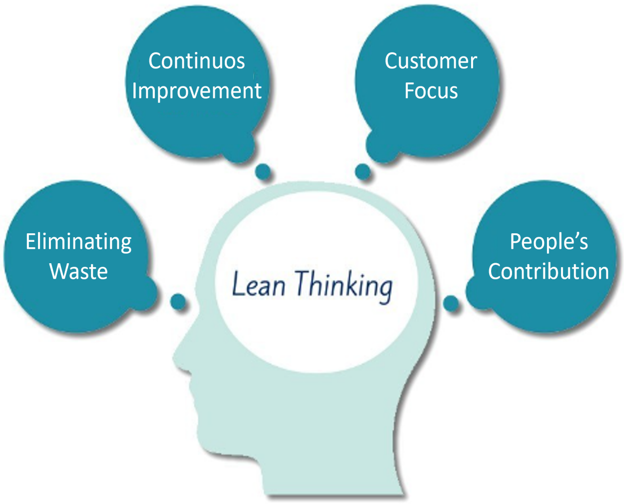


Figure 1.18: Lean thinking approach (considi.it)

1.2.3 Lean Principles

Following Lean methodology, the systematic elimination of these three sources of inefficiencies (Muda, Mura and Muri) is only possible through five actions, called principles (see fig 1.19):

- **Identify Value**: recognizing the value is the first step in eliminating waste. The customer determines this value, which reflects what they are genuinely willing to pay for; it is crucial, therefore, to precisely identify what the customer considers valuable. Organization use some tools like Brainstorming or Quality Function Deployment (QFD), in order to seek out the value-adding steps to make them as efficient and free of wastes as possible. The idea at the basis of the first principle could be summarized in the slogan "customer first" (Walker, 1990). Tools to reach what mentioned before could be Voice Of Custoemr (VOC).

- **Mapping the Value Stream**: the second action consists in mapping the Value Stream: it is constituted by all those interconnected activities necessary to transform the raw materials into finished product, generating value for the customer (Lovelle, 2001). In order to map it, Lean thinking suggests for instance the visual tool of value stream map, which considers the current (probably inefficient) and the future state of the flow (Grewal, 2008). This second step focuses on identifying which aspects of the process truly add value for the customer—what they are willing to pay for—so that the process time can be evaluated, and any activities that do not contribute to value can be eliminated. Tools to reach what mentioned before could be VSM (Value Stream Map), Swim Lane, Spaghetti Chart, Cross Analysis and Service Level, Work Sampling and OEE: for mapping the flow of value and individuate wastes.

- **Continuous Flow**: once non-value-adding activities have been eliminated, the remaining activities need to be organized into a smooth flow where the process operates without obstacles or interruptions. Ideally, this flow is strictly related to the concept of one-piece flow, although practical considerations such as machine setups and the need to handle multiple product streams through individual machines or cells often make this difficult (Krafcik J. F., 1988). Typically, achieving this flow involves exploiting tools from Kanban systems to the design of small machines and cells. Any disruption to this flow is considered waste and should be identified and eliminated promptly, ensuring the process can operate without constraints. Additionally, each production unit must adhere to the takt-time, which indicates the expected production rate necessary to meet customer demand (Myerson P., 2012). This production pace, is calculated by dividing the total available time for delivering a product by the volume of product demanded. Tools to reach what mentioned before could be 5S e SMED: to create a flow and reduces lead time and waitings.

- **Pull Production**: the fourth principle is crucial and directly relates to how production is organized and conducted. Inventory, a significant source of waste, must be eliminated. Ideally, production should be initiated only in response to customer orders, driven by actual market demand. (Spearman et al., 1992). This approach, known as pull production, is facilitated through tools like Kanban and supermarkets. Kanban, a clear and visible system, ensures components are restocked based on external demand. In practice, only minimal stock is kept on hand, and operators use Kanban cards to request just-in-time replenishment before stock is depleted. Just-in-Time production ensures a continuous flow, producing the right products with the right components, in the right place, and at the right time. This approach supports rapid fulfillment of customer orders by producing components from standardized parts or by maintaining a small reserve stock, similar to how supermarket shelves are replenished as items are sold. Effective pull production demands high visibility of the process to swiftly address demand changes, thereby improving the efficiency of just-in-time production. Tools such as Kanban and supermarkets are essential for achieving this (Kumar et al., 2007).

- **Striving for Perfection**: the first four actions construct the way for significant waste reduction within organizational processes. However, the fifth principle is closely tied to the philosophy's ultimate goal and the daily mindset that drives its practical implementation. Lean methodology emphasizes the pursuit of continuous improvement by prioritizing daily operations. Merely outperforming competitors is insufficient, as the primary objective is delivering value to customers through the elimination of waste, striving for perfection. Tools to reach what mentioned before could be Kaizen Events, Skill Matrix and Visual Management.

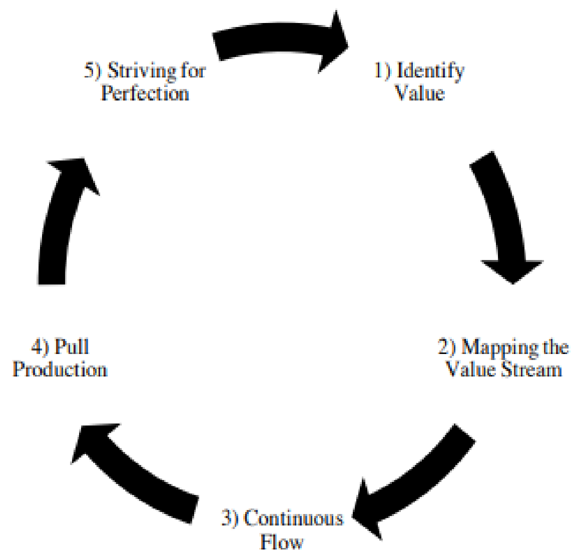


Figure 1.19: Five cycling actions for Lean implementation (Lean Enterprise Institute, 2016)

Therefore, to summarize, the first action is the definition of value as perceived by the customer, the second action aims at identifying the value stream for each product, the third principle states that it is necessary to make a continuous product flow through the remaining value added steps and the fourth action aspires to a flow which is pulled by the customer, where continuous flow is possible. The last

principle aims at striving for perfection and these actions must be performed in a infinite ways, every day, like a cycle for the continous improvement.
The Lean paradigm is more than just five actions and is often shown as the "Lean House," which illustrates its principles and structure of the Lean methodology (fig 1.20). This system can be broken down into 14 management principles. However, Lean is mainly a mindset, not just a list of tasks (Shingo, 1989). An important part of Lean is involving everyone in the organization (Womack, 2007): everyone needs to help implement the philosophy (Juran, 1991; Deming, 2000). Additionally, the Toyota Way includes five key values applied at all levels to consistently satisfy customers: Challenge, Kaizen, Genchi Genbutsu, Respect for people and Teamwork (Toyota Motor Corporation, 2003).

- **Challenge**: means pursuing a long-term vision, by facing all the dares with necessary bravery and creativity.
- **Kaizen**: refers to continuous improvement attitude, a never-ending path towards perfection
- **Genchi Genbutsu**: aims at finding the root cause of a problem in order to take corrective action to pursue the objectives.
- **Respect for people**: means to esteem all the stakeholders, by trying continuously to understand them and establishing a trustful partnership with them.
- **Teamwork**: means to share growing opportunities and to improve individuals together with team performances.

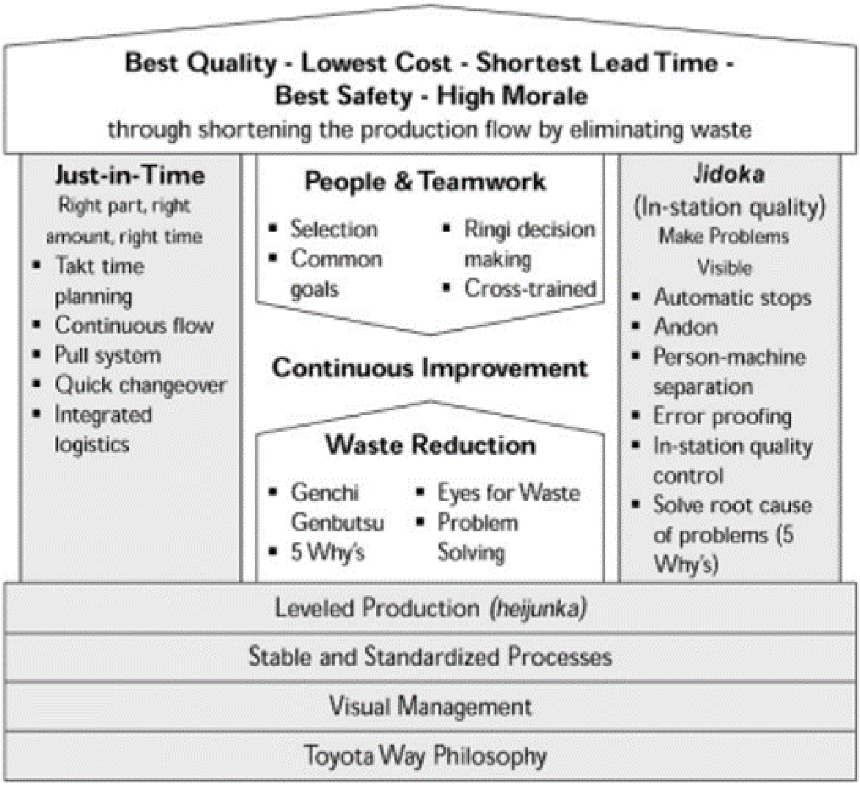


Figure 1.20: House of Lean Production (Liker, 2004)

Standardization is a core principle in Lean methodology (look at the base of the House of Lean). It defines how to execute processes using best practices and forms the foundation for continuous improvement in learning processes (Dolak et al., 2004). Standardized Work involves breaking down tasks into a repeatable sequence of elements. This means the process is divided into specific phases, each performed consistently. Any deviation can increase cycle time and lead to quality issues. Standardization ensures productivity, safety, and quality are maintained at high levels. Standardization is crucial for implementing *Visual Management* effectively. Managing the shop floor visually allows real-time monitoring of process progress using simple tools, enhancing visibility for everyones involved. The goal is to collect tangible information about results and progress to identify and address issues promptly. Visual Management, for instance, is closely tied to the 5S methodology, which optimizes the workplace by eliminating inefficiencies (Michalska et al., 2007). The 5S principles are: *Seiri* (Sort): Separate useful items from unnecessary ones; *Seiton* (Set in Order): Organize useful items for easy access; *Seiso* (Shine): Clean and tidy the workplace; *Seiketsu* (Standardize): Standardize activities and communicate correct methods; *Shitsuke* (Sustain): Maintain and respect workplace standards (Peterson et al., 2001). The 5S methodology supports Visual Management by making system behaviors and deviations from standards visible, promoting continuous improvement, optimal space use, time savings, reduced machinery breakdowns, and a tidier, safer workplace. Another key concept in the House of Lean is *Heijunka*, meaning "production smoothing or leveling." Along with takt-time, it enables flexibility to meet demand while maintaining a smooth, constant, and measurable process. Heijunka facilitates just-in-time production by balancing product inventory with demand variability, eliminating *Mura* (workload variability) and *Muri* (overburden), thereby ensuring components are available in the right sequence and quantity at the right time. The aim is to avoid production schedule peaks and valleys, ensuring a steady workforce and process over time (Coleman et al., 1994). Furthermore, in the house of lean it can be seen another important concept which is *Just In Time*(JIT) (Ohno, 1988) which means producing the right item at the right time in the right quantity, aiming for zero inventory (Monden, 1993). Companies should keep minimal inventory, producing only what is needed based on a pull production system. The cornerstone of Just in Time is the *Kanban System*, represented by a physical card that contains all the necessary details for the current production, its stage, and the subsequent steps to complete the process (kumar et al., 2007). In this system, information about the required units, including quantity and type, is written on a tag or card, which is then sent from one process operator to the workers of preceding processes. This method links multiple processes within the plant, enabling better control over the quantities needed for different production units.

On the opposite side of the House of Lean, there is the concept of *Jidoka*, it focuses on cost reduction by eliminating waste, another pillar of Lean (Liker, 2004). Jidoka gives machines and operators the ability to detect abnormalities and stop work immediately, known as "automation with a human touch" (Liker, 2004). Quality is monitored at each stage, with team members responsible for checks before moving products to the next phase. Upon detecting a defect, production interrupts to address the issue. Jidoka includes *Andon*, a visual board showing production line status, and *Poka-Yoke*, methods to prevent defects by reducing error opportunities (Dudek-Burlikowska et al., 2009). There are two different types of Poke-Yoke systems: warning systems, which alert when there is a deviation from the standard, and control systems, when a machine automatically stops whenever there is a deviation from the standard condition (Shingo, 1989). Typically, there are devices that nearly eliminate the possibility of operators making common mistakes in their workplaces. In connection with the concept of Jidoka and the broader goal of error prevention, it is possible to talk about *Total Productive Maintenance* (TPM), which

aims at eliminating the breakdowns (Willmott, 1994). TPM consists of three key elements:: *Maintenance* which involves preserving the efficiency of equipment over time (such as the machinery at FPT); *Productive* which aims to enhance plant productivity; *Total* which signifies the full and active participation of the entire workforce.The primary Key Performance Indicator for monitoring TPM's effectiveness is OEE (Overall Equipment Effectiveness), which measures the ratio of value-adding operational time (when machines are actively in use) to the total available time. (Ahuja et al., 2008).
To achieve the ultimate goal of Lean, depicted at the top of the Lean House (Liker, 2004), it is essential to support continuous improvement and waste reduction. Eliminating waste, as has been said many times, is crucial for successful for the Lean implementation and closely tied to problem-solving approaches. The Toyota Production System (TPS) isn't just a collection of tools, it embodies in fact a philosophy focused on problem-solving by examining situations from various perspectives. At the basis of this Lean Problem Solving there is an iterative approach called *Deming Cycle (PDCA)* (Moen et al., 2006), comprising four phases: *Plan*, *Do*, *Check*, and *Act*. Initially, in the Plan phase, activities are studied to define objectives. The Do phase involves executing these plans. The Check phase is critical as it gathers and analyzes feedback to identify issues and organize corrective actions. Finally, in the Act phase, these planned activities are implemented, that could be followed by a re-planning and so a re-start of PDCA cycle.. In explaining the Lean House, it's essential to emphasize the importance of *People and Teamwork*. Lean focuses on individuals who add value, moving from functional expertise to team-oriented value streams. The attitude of continuous improvement must be shared by the whole organization, supported by top management. This bottom-up approach encourages collaboration, inviting more team members to participate in decision-making to find optimal solutions. Successful Lean implementation requires overcoming internal resistance (if exists, they could be organizational or cultural inertia), necessitating a cultural shift towards Lean practices where.

At this moment, the philosophy and logic behind the DOT have been explained in detail, allowing for a deeper insight into its core activities. The main activities of the DOT are to disseminate, support, and train on Lean methodology and tools to enhance efficiency and provide better customer service. This is done following the Excellence Board (see fig 1.21) which represents the main tool through which the DOT method is implemented within the plant. Firstly, the board's actions are

KPIs and performance-driven which means ensuring that the efforts align directly with measurable outcomes. The Excellence Board emphasize sustainable depth and expansion of DOT activities, ensuring they are not only impactful but also enduring. The approach is rooted in industrial standards, providing a robust framework for the operations. Moreover, there is a continuously updating of the practices through both external and internal benchmarking. This allows to stay competitive and incorporate the best practices available.
in the horizontal axes there are the *Field* which represents the field of application in order to define the streams of actions.

- *Safety Management* which has the aim of reducing the number of events by developing a culture of prevention.
- *Sustainability Management* has the goal of continuously improving the working conditions in accordance with requirements and standards, and promote a green culture.
- *Quality Management* promote constant engagement to improve process conditions and prevent non-conformities, with the common goal of achieving maximum quality.
- *Asset Management* which focus on maximize the operational autonomy of machines, site performance, and the useful life of components.
- *Workplace Management* improve production efficiency and productivity through enhancements in ergonomics, safety, and quality, and eliminate non-value-added activities.
- *Extended Logistics Management* establish JIT (Just In Time) conditions within the plant and with suppliers to drastically reduce inventory levels, increase line saturation, and limit internal handling.
- *Extended New Product Management* focus on shorten, simplify, and strengthen product definition, reduce time to market, ensure high quality, and maximize process productivity.
- *Extended New Equipement Management* design machines that are easy to use, maintain, and inspect, anticipating potential technical and quality issues from the start, and introducing innovative concepts to improve process productivity.
- *Digitalisation* leverage the latest digital technologies and practices to transform and innovate business processes, creating new value and relationships.

- *Management System* transform continuous improvement activities into plant culture to increase engagement and commitment at all levels.

On the vertical axle there are the *Commitment*, which represents technical engagements, content to support fields achievements, they are related also to the departments in the plant, and so the responsabilities areas, and are represented by: *Safety Care*, *Results Optimization*, *Continuos Improvement*, *People Care*, *Green Care*, *Quality Care, Machine Care, Process Optimization, Logistics Optimization, Product Developement*, *Technologies.* Starting with scorecards and by analyzing the indicators not in line with the targets, the Fields of Action and the Areas of Responsibilities are crossed in the Excellence Board to identify the standards to be applied to improve these indicators. These standards are divided into 3 levels: fundamental, evolved, advanced. Fundamental activities represent the basic tasks that must be followed according to specific standards. Evolved activities are more advanced, involving preventive measures to ensure certain issues do not occur, requiring more sophisticated tools compared to the fundamentals. Advanced activities are proactive tasks that necessitate the use of the most advanced tools. So the focus of each level are respectively on main requirements, on improvements and on excellence. If we focus the Asset Management for example, the vertical reading allows to understand which are the standards that everyone in the plant must apply to manage asset while the horizontal reading (Machine Care) allows you to understand which are the standards to be applied for Assets to improve management throughout the Plant (see table 1.2).

0 - Loss & Waste data collection and Attackable Loss analysis;
1 - Machine Classification (based on production impact, quality,cost, delivery, safety, time to repair) linked to yearly plant strategy (based on bottle neck and strategic machines);
2 - Basic conditions & elimination of deterioration (with Plant team involvement):MTBF (Mean Time Between Failure) & MTTR (Mean Time To Repair) Analysis and countermeasure;
3 - Breakdown maps and countermeasure against sources of contamination and difficult access;
4 - Maintenance calendar (availability): machine ledger (TBM-Time Based Maintenance, HBM-Heat Based Maintenance), component classification, standard autonomous maintenance(CLR), creation of SMP (Standard Maintenance Procedure), maintenance cycle;
5 - Productivity Analysis and countermeasure (availability -performance-quality): OLE/OEE(residual losses, cycle optimization, Man-Machine interactions analysis, SMED...);

Table 1.2: Example of Fundamental actions for the Asset Management field in the commitment Machine Care

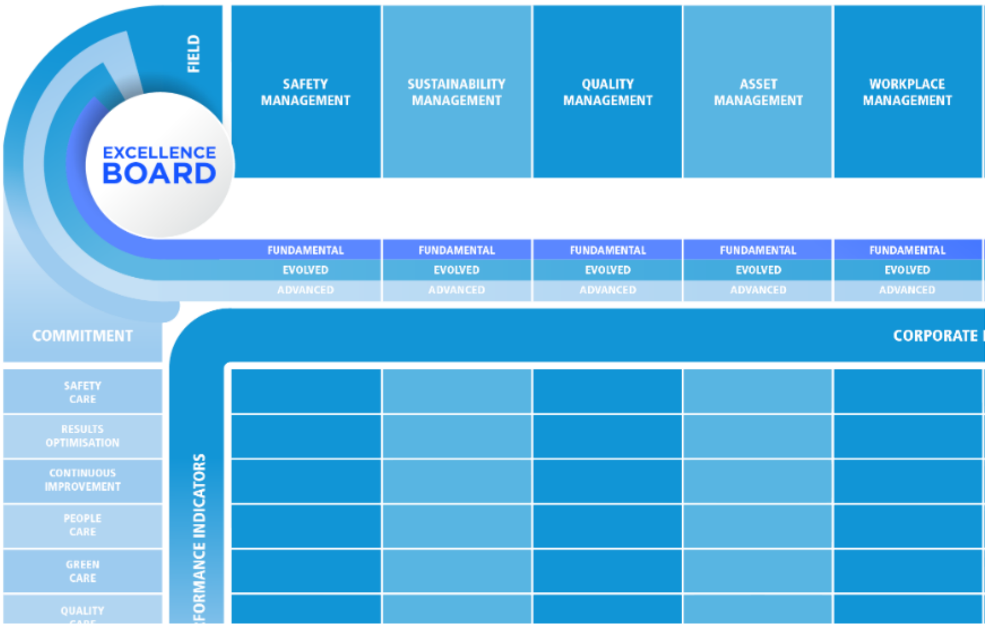


Figure 1.21: Excellence Board

The DOT team consists of four members, led by Marco Virzì, the manager. One member focuses on the *Tips System* which is a tool related to the commitment people which will be explained in the next rows while another, along with the undersigned, works on the Matrix tool (which will be detailed in the following lines) which is related to all the commitment mentioned before since this involves supporting and

monitoring the continuous improvement activities of each individual business units for every department/commitment mentioned in the excellence board. The team's primary responsibility is to provide tools for identifying, creating, and monitoring improvement projects. These projects can include for instance activities related to machinery in a production process in order to reduce defects/non conformities, workforce improvement (work analysis), improving the durability of a instrument and, if necessary, the team has the responsability also to organize events to identify and implement efficiency projects targeting specific cost areas that requires improvement. The events often organized by the DOT include Kaizen Blitz and Kaizen Week. The term "Kaizen" means continuous improvement, while "Blitz" means a rapid, intensive campaign or attack. Kaizen Blitz represents a strong approach to finding new opportunities for projects aimed at improving plant efficiency. These events could last a week, with all activities meticulously planned in advance. During this time, the team focuses its efforts on achieving specific targets. Kaizen Week is a continuous improvement event targeting a specific line or workstation, with a defined goal and team over a set period. The aim is to accelerate the implementation of improvement projects by applying tools and standards based on plant needs and criticalities. The process involves selecting an area with underperforming indicators, assembling a multidisciplinary team, and understanding, planning, and executing actions to improve the results. These actions are based on established standards to ensure effective improvements.
Moreover, interconnected with the philosophy of continuous improvement and the bottom-up approach, the DOT team is responsible for sharing, teaching, and maintaining the Tips System mentioned before. The system allows blue-collar workers to share new ideas and solutions to specific problems they could encounter daily at their workstations. If certain constraints are met, they can earn extra money at the end of the month. This approach helps spread lean thinking across the entire organization and optimizes solutions through collective input and engagement. To get a deeper understanding of this system, if a worker has an improvement idea, there are two ways to proceed. First, the worker proposes the idea to the UTE responsible and fills out the Quick Kaizen form using the PDCA method (see Fig 1.22), in this phase is sufficient that the Plan and Do section are filled.

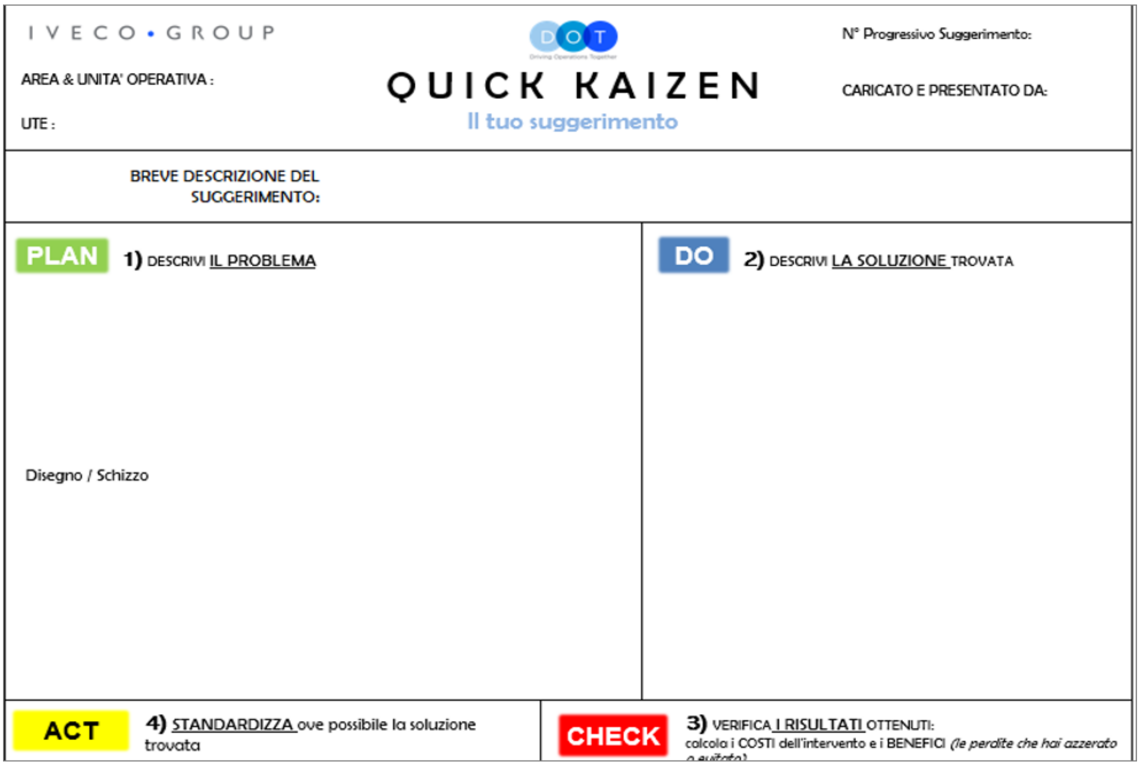

IVECO • GROUP
AREA & UNITA' OPERATIVA :
UTE :
QUICK KAIZEN
Il tuo suggerimento
N° Progressivo Suggerimento:
CARICATO E PRESENTATO DA:
BREVE DESCRIZIONE DEL SUGGERIMENTO:
PLAN 1) DESCRIVI IL PROBLEMA
Disegno / Schizzo
DO 2) DESCRIVI LA SOLUZIONE TROVATA
ACT 4) STANDARDIZZA ove possibile la soluzione trovata
CHECK 3) VERIFICA I RISULTATI OTTENUTI:
calcola i COSTI dell'intervento e i BENEFICI (le perdite che hai azzerato o evitato)

Figure 1.22: Quick Kaizen for improvement projects

After completing the Kaizen form, the UTE Head evaluates its feasibility and provides feedback. If feasible, the competent team implements the idea. Once the activity is done, the UTE Head completes the Quick Kaizen form, especially the Act and Check sections, uploads it to the software, and evaluates it using a points grid. Finally, the Quick Kaizen document is sent to the DOT system, and the payment is processed. The payment or reward is determined, as mentioned before, by the evaluation made by the Head UTE (see Fig 1.23). The maximum score that can be achieved is 180 points, with each point worth €0.50, which will be added to the wages for the following month.

POINTS	ECONOMIC IMPACT	ORDER AND CLEANLINESS OF THE ENVIRONMENT	QUALITY	PROCESS IMPROVEMENT	WORKING CONDITIONS/SAFETY
1	Has noticeable or minor economic effects 15	Improves the order of the workstation 10	Addresses a defect that affects the assembly of the piece and/or impacts the production line/rework inside the plant 5	Improves a production process in a single Work Station/machine operation 5	Eliminates at least one MURI (overload) or eliminates a known UA/UC 15
2	Has noticeable and quantifiable economic effects (medium entity) 30	Improves order and contributes to workstation cleanliness 15	Addresses a defect that affects the piece functionality and/or impacts km0 (vehicle customer defects) 15	Improves a production process for an entire product range 15	Eliminates at least one MURA (irregularity) or identifies and eliminates a new UC/UA 25
3	Has noticeable, quantifiable, and tangible economic effects (medium-high entity) 40	Is extendable to other areas 20	Addresses a defect that affects the piece safety and/or impacts warranty (final customer defects) 20	Improves a production process for the entire UTE and is extendable to other areas 20	Eliminates at least one MUDA (waste) or addresses UC/UA and is extendable to other areas 40

Applicato dai proponenti e certificato da RESP.UTE	40	MAX 180

Figure 1.23: Rewarding Points Grid

Moreover, there is the potential to earn additional bonuses, translating to more money. Specifically, for savings between €5,000 and €15,000, the worker earns an extra 220 points, equivalent to €110. If the savings exceed €15,000, the worker receives 320 extra points, which translates to €160. Additionally, there are bonuses related to safety tips: improving the base condition of the workplace/area earns 220 extra points (€110), while collective proposals that improve workplace conditions earn 320 points (€160). Consequently, a worker can earn up to €250 more on top of their wage.

The other way to proceed is through a smarter and faster process which is *Adesso Proponi Tu* system (see fig 1.24). The employee scans the QR code that he will find printed inside his area and in the relaxation area of the plant and a questionnaire will open on his device to be filled in order to insert the improvement proposal. The data collection will be visible to all UTE supervisors and Head UTE in order to then proceed with the feasibility verification of the

Figure 1.24: Adesso Proponi Tu system

idea and the implementation of the suggestion itself. Then the procedure of the fulfillment of the Kaizen form is the same.

There are efforts to standardize and unify this system across the plant, how it was done for the Matrix system. For instance, in the E-Powertrain section, there is a designated area with a screen where the Head UTE and blue-collar workers can submit ideas while in the other business units there isn't. Furthermore, in the Driveline section, engagement is lower, particularly among older workers who may be unaware of the system. This highlights, for instance, the need for targeted advertising to increase awareness and participation in the *Adesso Proponi Tu* system.

In addition to what is been explained above, there is the *Rewarding System*, strictly interconnected with the tips system, where blue-collar workers are further recognized for their top suggestions in three categories: Savings, Quality, and Safety. For Savings, the first-place suggestion receives €1500 for savings over €45000, or €1000 for savings over €25000. Subsequent rewards are €400 for second place, €300 for third, €200 for fourth, and €100 for fifth. In both the Quality and Safety categories, the top two suggestions each earn €200. This system further incentivezes the engagement of the blue collars in the firm in therms of contributions and sense of belonging. The ceremony takes place in each business unit at the end of every two quarters. The Plant Manager announces the winners and thanks them by delivering a certificate of victory.

The Matrix and the tips system both aim to generate continuous improvement project for the company. The tips system is designed for blue-collar workers to submit ideas/projects, while the Matrix system is for white-collar workers and only includes projects with substantial savings. Sometimes, projects from the tips system's savings section, after review by the DOT team, can be migrated to the Matrix tool. These projects then become efficiency projects contributing to the annual efficiency target set at the beginning of the year.

1.2.4 Matrices

It is useful at this moment to explain the various types of Matrix up to the one we will analyze in the next chapters, which represents the core of this work. In general, matrices serve as a fundamental tool for managing all information related to loss identification and reduction, ultimately leading to the monitoring of new projects that generate savings (see table 1.3).

Matrix Type	Description
Matrix A	Identify losses qualitatively and quantify losses starting from data collection or quantitative measurements
Matrix B	Separate causal losses from resultant losses
Matrix C	Transform identified losses into costs
Matrix D	Identify the methods to eliminate losses
Matrix E-F	Estimate improvement cost and potential savings and monitoring of the projects

Table 1.3: table with the various types of Matrix and its objective

The *A Matrix* provides a global vision of the process, giving evidence of the whole list of identified losses (Equipment, labor, material, energy, environment). As a consequence, the key information that can be read in this matrix are the list of all identified losses, the dollar amount of each loss and the indication if causal or resultant loss. In the rows of the A matrix are all the losses identified and for each one, an indication of whether it is causal or resultant. In the columns is the location of the loss at the minimum possible level of loss identification (machine or operation). Then, each loss has to be indicated as causal or resultant, in particular, a causal loss is a loss caused by a problem of a process or equipment itself while a resultant loss is a loss that results from a loss in another process. There is no direct solution to attack a resultant loss; unless the real cause of it is targeted, it can't be reduced. Work on a resultant loss would be useless because the real problem wouldn't be solved; it would only be a waste of time and resources. It is important to find the root cause of our problem and work on it. Identify a loss as causal or resultant is a fundamental point of the A matrix. The A Matrix is the total waste and loss we see in the Plant separated into Causal and Resultant Losses.

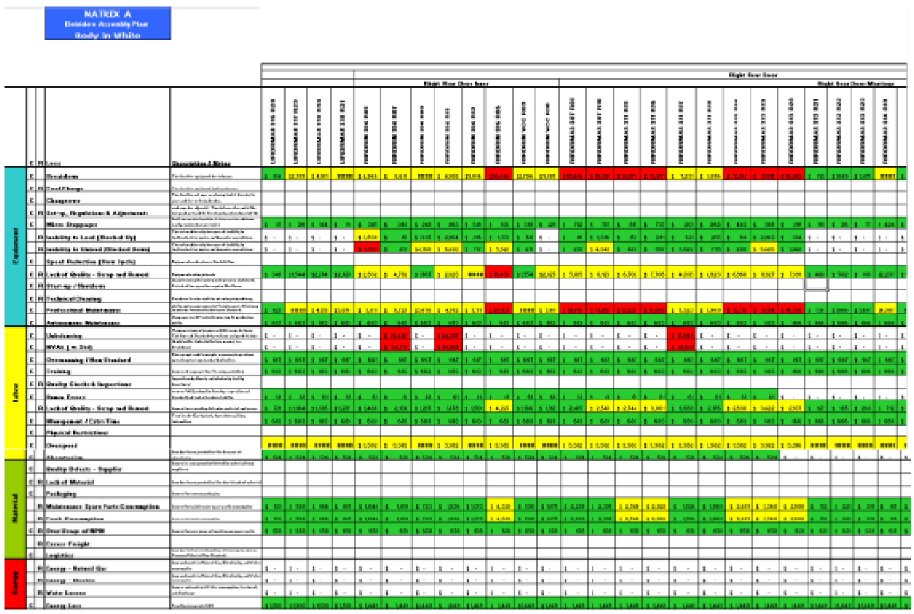


Figure 1.25: A-Matrix

The subsequent matrix is the *B Matrix*, the purpose is to attribute all resultant losses to their causal losses and identify the real sources of losses. The value of a causal loss is given by the sum of the values of all its resultant losses, so it is very important to set relations in a proper way. If the focus of the efforts is on a resultant loss area it will not make an impact. there is the need to eliminate the cause of the loss. To determine if a loss is causal or resultant, it could be useful to make the question: *"in order to reduce this problem, where (and what) I need to change?"*, the answer will be most likely the causal loss. The first step is to create the structure of the B Matrix (see fig 1.26): starting from losses identified in A Matrix, the B matrix is developed with Causal Losses and related locations (area, process, machine, etc.) in the rows and the Resultant Losses and related locations in the columns. Once the B matrix structure is created, the second step is to identify the relations between causal and resultant losses. For each causal loss, the resultant loss is indicated by an "X". Each Resultant loss reported in the columns of the B Matrix, must have at least one "X", meaning at least one relationship with a Causal Loss. If no relationship exists, there is no Causal Loss responsible for this Resultant Loss and the Loss should be considered Causal or Causal & Resultant.

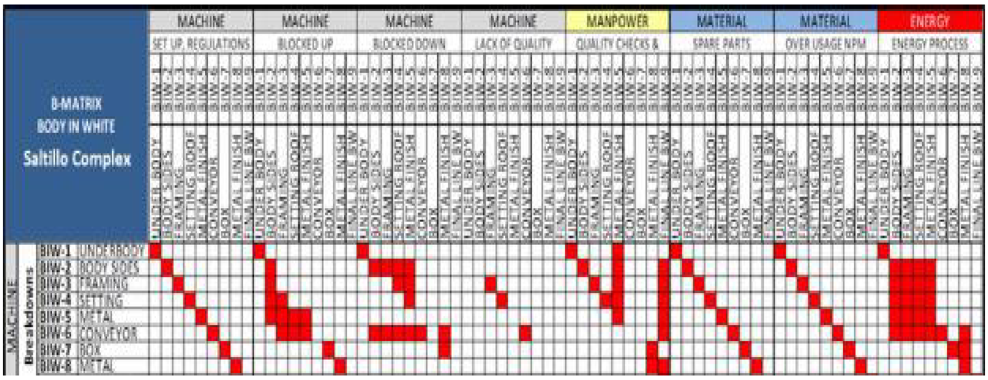


Figure 1.26: B-Matrix

It is important to state that Production employees must be the driving force behind the B Matrix. The ownership of the B Matrix should rest with them (together with the A Matrix). The analysis made in the B Matrix leads to the construction of the *C Matrix* which valorize Causal Losses as the sum of Causal and Resultant losses identified throughout B Matrix and the value of each Causal loss is its individual value plus the sum of the value of its resultant losses, each calculated independently and with reference to financial statement. The structure of the C Matrix is characterized as follows: In the rows are reported all the Causal losses identified in the B matrix with reference to their location (process, area, machine etc.). In the columns are the items of IWB or financial statement. Moreover, data reported in C matrix must represent a 12 month period and if the data in the data set contains less than one full year, it must be annualized the data set to represent losses for one full year. Between the C and the D Matrix there is an intermediate step which is represented by the construction of the C+ Matrix (see fig 1.27), which is the tool that helps to select the most appropriate loss to attack. Listed up all main losses collected in the plant as for C matrix priority, stratify by process till root causes, you can choose the priorities and assess the possibility to have future activities through B/C ratio (Benefit/Cost), ICE analysis, payback ratio etc. The ICE Index, for instance, is a result of three factors each of them has to be evaluated on a scale from 1 to 5, in particular:

- *Impact (I)*: it indicates the loss size where high impact (high loss) corresponds to 5 while low impact corresponds to 1.
- *Cost (C)*: it indicates the cost to bear in order to reduce the loss, where high cost (of loss-reducing activities) corresponds to 1 while low cost (of loss-reducing activities) corresponds to 5.

- *Easiness (E)*: it indicates the easiness of loss reduction where very easy corresponds to 5 while very difficult corresponds to 1.

C+ Matrix										Prioritization				
ID	Loss Name	Operation Unit	Line/G.I/ E.T.U	Workstation/ Machine	Type/ Root Causes	Loss Amount [€/year]	Main Pillar	Other pillars	Approach	Impact (H:5;L:1)	Cost (H:1;L:5)	Easyness (H:5;L:1)	ICE (I*C*E)	Feasibility
1	NVAA	Assembly	L2	25	Difficult Handling	€ 29.000	WO	LCS	Systemic	2	4	5	40	
2	NVAA	Assembly	L1		Difficult Handling	€ 129.000	WO	LCS	Systemic	3	4	4	48	
3	NVAA	Assembly	L3	12	Bad Layout	€ 49.000	LCS	WO	Focalyzed	2	5	2	20	

Figure 1.27: C+ Matrix

The product of the three factors gives a number between 1 and 125 which will indicate the priority of the losses to be attacked, the highest the ICE index the faster the loss are attacked. The following step is that of *D Matrix* (see fig. 1.28). It lists all projects identified through the C Matrix stratification and identifies a proper method, team and technical strategy required to eliminate the causal loss according to identified root cause. At this level, it is required to be able to select a Potential Project Responsible which represents the most appropriate person to lead the project based on main commitment responsible, type of approach and kaizen level, and a Potential Project Team, chosen by the project responsible himself. D Matrix indicate the tool set to solve the problem (Grouped into focalized or systematic tools, the focalized ones are used for short-term effects, while the systematic ones are for long-term effects) so that the responsible can strategically develop a training program for people involved, there are out of 275 tools/skills/method but only around 70 tools are useful to solve/eliminate the specific loss.

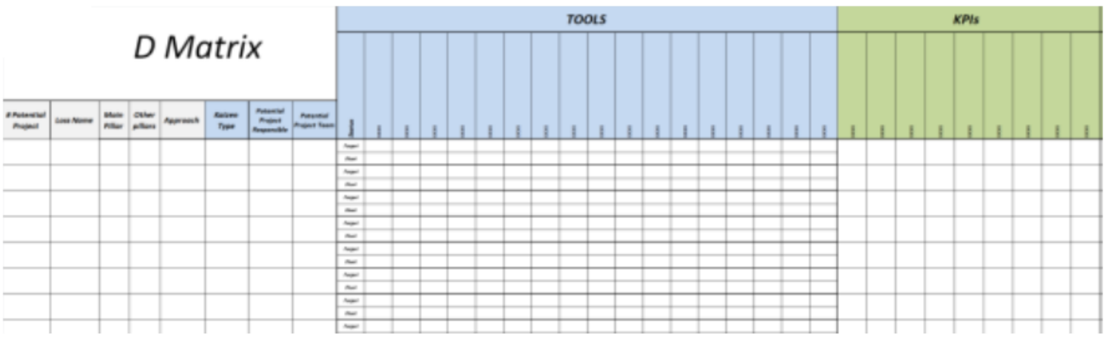


Figure 1.28: D Matrix

The following matrix, the focus of this work, is the *E Matrix* together with the *F Matrix*. According to literature, the E Matrix, or projects matrix, tracks projects that address losses identified in the C Matrix, specifically those with substantial savings. The E Matrix provides all the main information about each project, such as savings, completion dates, project areas, project leads, etc. Closely related to the E Matrix is the F Matrix, which tracks projects from the E Matrix and provides economic data for monitoring all improvement projects. It includes the same projects as the E Matrix plus last year projects that are still giving savings, they are called Carry Over.

Chapter 2

Criticality and the need for a new tool

The objective of this chapter is to underlines the criticality which have triggered the need of creating the tool we will see in the next chapter. The need for a new matrix arose from a shift in vision within the plant. Previously, each business unit managed its matrix and efficiency projects independently, leading to inefficient information collection and a lack of standardization at the site level. This fragmentation caused inaccuracies in the collection of data and evaluations. Over the past year, the plant, consisting of four business units, has adopted a site-level approach for data presentation, so in addition to all the data and reports related to the single business unit, the request is to show the same report but from a plant point of view. Preparing this type of reports required significant time to request and align matrices from all the business units involved, as information quality varied based on each unit's management style (each business unit manager request different type of data for his internal meetings for example). Some units had precise but scarce information, while others had abundant but less useful data. Each business unit also used different types of the same matrix tool, suited for their needs, for project monitoring, leading to data discrepancies when all the data need to be unified. So, the lack of Standardization resulted in wasted time, inaccurate data that needed adjustment to balance accounts at the site level, and discrepancies between reported state and actual/real state. This triggered another critical issue, which is explained below. Before this year and the introduction of the new matrix, there was no intersection with the Finance department to verify if the declared savings from the projects were accurate. It was impossible to track what is called Governance. Understanding governance is crucial: at the beginning of the year, a budget is set, representing how much each business unit can spend. This year, a minus 20% budget cut and the new concept Governance born. For instance, if the business unit Engines manager could spend hundred euro on Consumable Materials (a specific cost item), this year he can only spend eighty euro. This helps identify inefficiencies in previous years' production inputs. Governance involves all this types of managerial actions or tasks. If the need for consumable materials exceeds the defined 80 euro in a given month, the business unit Engine manager must request additional economic intervention from the plant manager. Since production volume, in terms of what it is produced, remains unchanged in the current year, this indicates a potential past waste. These cuts represent financial savings but are not considered efficiency projects, as they follow managerial tasks. For example, reducing personnel in a specific production area cannot be presented as a top project to be shown at the end of each quarter. Thus, tracking this governance became necessary, in order to split the saving coming from real projects and saving coming from these managerial tasks. The top head managers want this type of detail when the trend of savings is shown which was not possible with the tools available before. Even if Governance isn't a yearly standard (its next year presence is not certain), the lack of cross-data with Finance was a critical issue to address. Ensuring consistency between reported savings in the Matrix and actual savings and costs in the plant was vital. The goal was to minimize discrepancies with Finance department data. The data in the matrix has to "speak" the same language as the data in Finance documents.

The need to standardize project management and share it across the plant aligns with a lean thinking principle previously discussed, which has received significant attention this year: visual management. This approach provides tangible information on results and progress, helping identify potential issues. To achieve this, a dedicated room for project monitoring, called the "HUB," was requested. It features walls that visually display projects monthly according to their levels (these levels will be explained later). However, after its creation, a critical issue emerged: the lack of a quick and simple method to print the Kaizen paper from the matrix. Before the new matrix, a lot of time was wasted transferring specific project information from the matrix to the Kaizen paper for printing. There was a need for a simple, shared, and quick method where everyone could print the Kaizen paper directly from the matrix, facilitating easier project monitoring in the HUB and as the project progresses, updates are made in the HUB, advancing through the act and check phases as per literature. When a situation needs assessing, everyone can access the project room for an immediate visual overview. For further detail, if necessary, the matrix and related charts are consulted directly in the room through the use of big screen, the HUB is the temple of the Continuos Improvement phylosophy in FPT. Moreover, every week, a meeting is held for each business unit called the "Analisi Scostamenti" meeting, where cost trends for the week are analyzed alongside various production indices and their performance against targets. Another crucial topic is the progress of projects and their savings relative to the targets (each business units has its own target in terms of efficiency/savings). This has always been a challenge. There was no tool or accurate data to monitor project delays and advances both in terms of timing and consequently in economic terms against the plan. Monitoring delays is essential because, by signaling deviations from the plan, it can suggest how much future advancement or new project insertion is needed to cover that specific delay. Achieving this result previously, as mentioned, was very time-consuming and sometimes, information was entirely lacking, preventing precise and quick monitoring and increasing the risk of not reaching the target (in fact the previous two years the target was not reach). Closely related to the previous topic, it was realized during the meetings that there was a critical issue regarding CAR expenditures. First of all, CAR (Capital Appropriation Request) expenditures within a plant typically refer to funds allocated for acquiring, upgrading, or maintaining physical assets such as property, buildings, technology, or equipment. In particular, these types of expenditures could include construction or major renovations to provide office space, acquisition for future development or expansion of the plant, purchase of new machinery or upgrades to existing equipment, investments in new technologies or IT infrastructure to support operations, procurements of vehicles for the transportation of goods, raw materials, or personnel. There are projects that need this type of expenditure, and the request for these expenditures has a process to be monitored to be ready, when the CAR is approved, to start the implementation of the project itself. The critical issue was the lack of a tool related to the matrix that could monitor the projects needing a CAR and the CAR itself.

Furthermore, during data analysis, it was realized that there was no trace of what is called carryover in the literature, that is, those projects that started in the implementation year but continue to bring savings the following year. The issue is that there was no information related to the previous year's carryovers and no prospectus related to the next year's carryovers. This concept is an information that needs to be monitored frequently and consistently and not just at the end of the year. It seemed that with the advent of the new year, and thus the change of the tool for the current year, the information related to the previous year's matrix was lost. This was a criticality.

It is important to create a tool that addresses these critical issues mentioned so far and provides a clear, consistent, easy-to-use, and accessible for everyone (shared in the cloud Iveco system) overview of the current plant efficiency. Moreover, the ICT department's veto on creating internal solutions via doc software or other means led to the new tool using Microsoft 365's embedded tools to ensure simplicity and a standards knowledge for everyone, resulting in the entire new Matrix being built in Excel.

Chapter 3

The New Matrix

As mentioned in the previous chapter, the ICT department at FPT is very strict when it comes to the freedom of developing new information systems. This is to prevent a lack of standardization within the plant and to avoid a situation where the use and functionality of a specific tool depend on a small group of individuals. If these individuals were no longer available for any reason in the future, it could create issues with using these information systems. Additionally, the lack of specific investments for outsourcing the development of custom software led to the decision to build the new tool using Microsoft Excel, a spreadsheet program, to make it as simple and accessible as possible. The file is named "TO-SITO_MATRICE E-F_OFFICIAL" and is uploaded to the shared folder within Microsoft Teams. Being cloud-based, the file can be easily and readily accessed by everyone who needs to work on it. It is a very large file, consisting of seventeen spreadsheets, some operational and others serving as true support sheets, which are not shown to those responsible for uploading the projects, as they are hidden sheets. The latter are used by the DOT team for continuous improvements and, if necessary, corrections. Some of these sheets contain, for example, a large number of pivot tables that serve as a sort of database for the file itself, from which data is drawn to automatically update charts. The operational sheets and some of the hidden sheets will be analyzed subsequently.

3.1 *Input Scheda Progetto* sheet

The starting point in constructing the matrix was the creation of the Input Project Sheet (see fig. 3.6). This is one of the operational sheet and it can be considered the skeleton of the matrix, where the actual project is entered. Specifically, the structure of the sheet is as follows (what follows is an explanation of the columns that make up the sheet):

- **ID**: the ID serves as the project's unique identifier, represented by a distinct number.
- **BU**: the BU represents the business unit where the project is being conducted. This cell is limited to four options: NEF, Industrial & Marine, Driveline (DL), and E-Powertrain (E-PWT).
- **UO**: the UO represents the operational unit, and like the BU column, the selection is limited to a dropdown menu. Some of the options include: Engine Machining, Engine Assembly, Painting, Transmission Machining, Transmission Assembly, Axle Machining, Axle Assembly, Transmission Heat Treatment, etc.
- **UTE**: UTE refers to the number of the elementary technological unit associated with the UO.
- **Attività**: in this column the project is briefly described; it serves as the identifying description.
- **AS IS**: in the cells of this column, for each project that is entered, there must be a detailed description of the problem, in other words what is the current situation.
- **TO BE**: this column, on the other hand, represents the solution description; it is the proposal for how the problem should be resolved.
- **Project Leader**: the Project Leader is the one responsible for evaluating, implementing, and subsequently monitoring the project.
- **Data di proposta**: it represents the date on which the project is proposed.
- **Costo[k€]**: it represents the cost estimate for implementing the project in question. The decision was made to express the financial units in kilo euros.
- **Saving[k€]**: it represents the assessment of the benefit or savings that the project is expected to bring to the company in one year (12 months) once implemented.
- **Cost Item**: the cost item represents the specific cost category that the project will impact, specifically indicating where the savings will occur.

- **Regular/NONRegular**: within the sheet, this column is automated and, based on the previously selected cost item, will determine whether the project is classified as "Regular" (falling within the DOT domain) or "Non-Regular" (outside the DOT domain). In other words, if a specific project does not attack the listed cost item available in the dropdown menu, the "ALTRO" option will be selected, and the project will be classified as "Non-Regular." Consequently, it will not be considered for analysis, but it will still be retained in the file for record-keeping purposes (see fig. 3.1).

Saving [k€]	Cost item	Regular/NON regular
5,0	MAINTENANCE EXPENSES	REGULAR
5,0	ALTRO	NONRegular
19,7	SCRAP AND LOSSES	REGULAR

Figure 3.1: snapshot of the Input Scheda Progetto sheet showing the Regular-NONRegular control.

The choice to use guided entry through dropdown menus was necessary as it reduces the occurrence of data inconsistencies and ensures better standardization. Regardless of who enters the data or the number of people working on the file, all data must have the same format. The entire file, however, includes controls (see fig 3.4) and suggestions (see fig 3.5) during the data entry process to prevent errors and ensure the highest possible level of standardization. Previously, the uniqueness of each project in terms of its identifier (ID) was discussed. This uniqueness is guaranteed through the use of Excel's data validation tool (see fig 3.2), which, after inserting the correct formula to be followed for data validation, achieves the goal of a unique identifier. Specifically, for example, the formula for validating the ID of each individual project is shown (see fig 3.3).

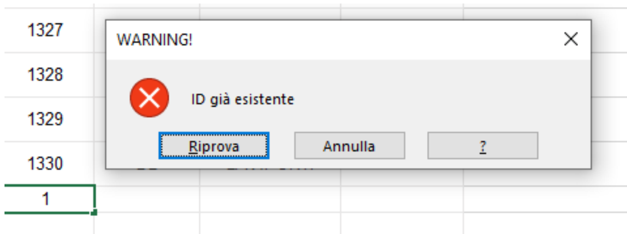


Figure 3.2: warning for the uniqueness of the ID.

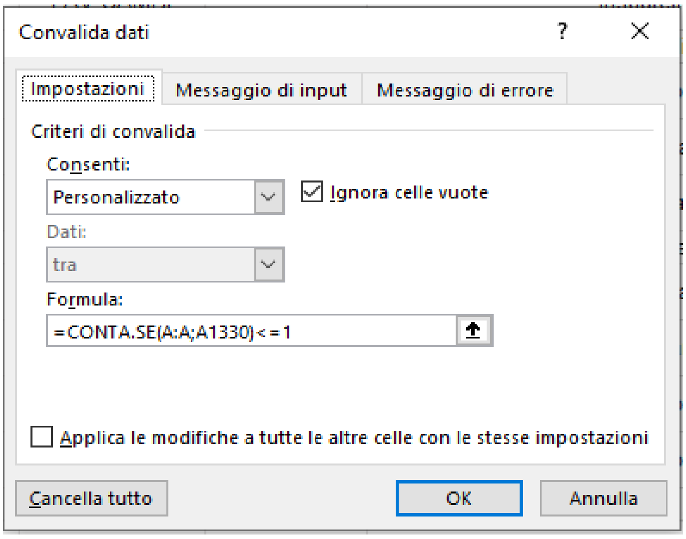


Figure 3.3: validation Data control where the uniqueness of the ID is verified through the use of the COUNTIF formula.

However, each sheet is locked regarding those columns or cells where the data entry is automatic, in order to avoid harmful modifications that could disrupt the functioning of the various automations and connections within the document. There is a significant amount of formulas, links, and VBA controls that are closely dependent on each other. A small change in one formula could cascade and compromise the file's functionality. Locking the cells in the sheet where such errors could occur makes it nearly impossible for the described risk to materialize. Therefore, columns colored blue indicate manual entry, while columns colored green indicate automatic entry.

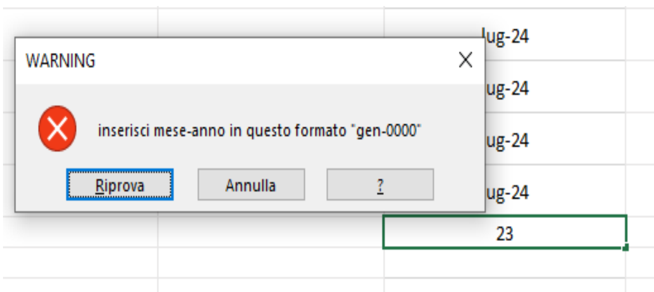


Figure 3.4: warning system about the insertion of the correct data along the process in the sheet *Input Scheda Progetto*.

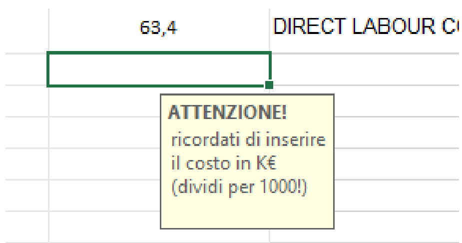
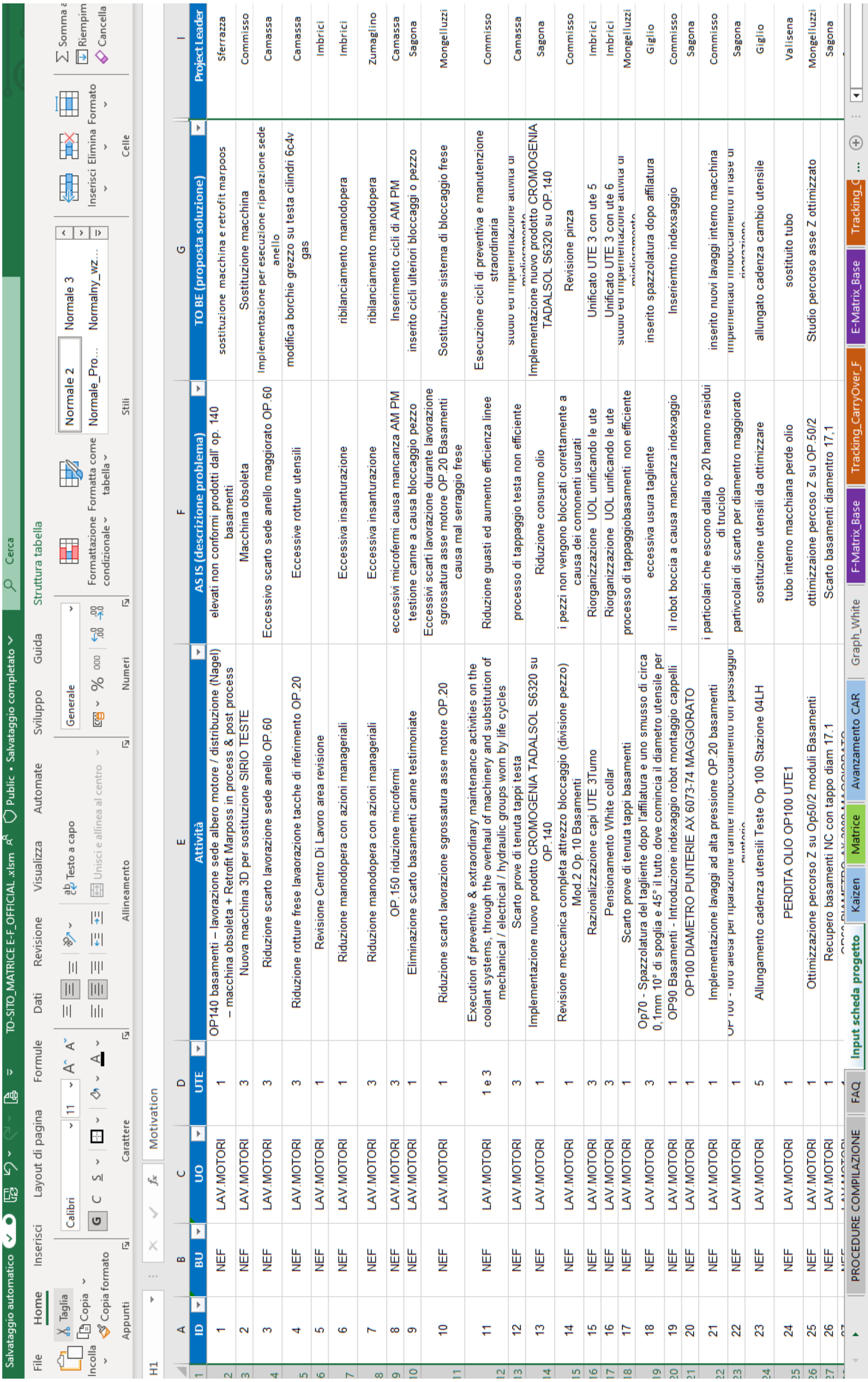


Figure 3.5: tips alert along the process of the insertion of a new project inside the sheet *Input Scheda Progetto*.



ID	BU	UO	UTE	Attività	AS IS (descrizione problema)	TO BE (proposta soluzione)	Project Leader
1	NEF	LAV.MOTORI	1	OP140 basamenti – lavorazione sede albero motore / distribuzione (Nagel) – macchina obsoleta + Retrofit Marposs in process & post process	elevati non conformi prodotti dall' op. 140 basamenti	sostituzione macchina e retrofit marpoos	Sferrazza
2	NEF	LAV.MOTORI	3	Nuova macchina 3D per sostituzione SIRIO TESTE	Macchina obsoleta	Sostituzione macchina	Commisso
3	NEF	LAV.MOTORI	3	Riduzione scarto lavorazione sede anello OP.60	Eccessivo scarto sede anello maggiorato OP.60	Implementazione per esecuzione riparazione sede anello	Camassa
4	NEF	LAV.MOTORI	3	Riduzione rotture frese lavaorazione tacche di riferimento OP.20	Eccessive rotture utensili	modifica borchie grezzo su testa cilindri 6c4v gas	Camassa
5	NEF	LAV.MOTORI	1	Revisione Centro Di Lavoro area revisione			Imbrici
6	NEF	LAV.MOTORI	1	Riduzione manodopera con azioni manageriali	Eccessiva insanturazione	ribilanciamento manodopera	Imbrici
7	NEF	LAV.MOTORI	3	Riduzione manodopera con azioni manageriali	Eccessiva insanturazione	ribilanciamento manodopera	Zumaglino
8	NEF	LAV.MOTORI	3	OP.150 riduzione microfermi	eccessivi microfermi causa mancanza AM PM	Inserimento cicli di AM PM	Camassa
9	NEF	LAV.MOTORI	1	Eliminazione scarto basamenti canne testimoniate	testione canne a causa bloccaggio pezzo	inserito cicli ulteriori bloccaggi o pezzo	Sagona
10	NEF	LAV.MOTORI	1	Riduzione scarto lavorazione sgrossatura asse motore OP.20	Eccessivi scarti lavorazione durante lavorazione sgrossatura asse motore OP.20 Basamenti causa mal serraggio frese	Sostituzione sistema di bloccaggio frese	Mongelluzzi
11	NEF	LAV.MOTORI	1 e 3	Execution of preventive & extraordinary maintenance activities on the coolant systems, through the overhaul of machinery and substitution of mechanical / electrical / hydraulic groups worn by life cycles	Riduzione guasti ed aumento efficienza linee	Esecuzione cicli di preventiva e manutenzione straordinaria	Commisso
12	NEF	LAV.MOTORI	3	Scarto prove di tenuta tappi testa	processo di tappaggio testa non efficiente	studio ed implementazione attività di miglioramento	Camassa
13	NEF	LAV.MOTORI	1	Implementazione nuovo prodotto CROMOGENIA TADALSOL S6320 su OP.140	Riduzione consumo olio	Implementazione nuovo prodotto CROMOGENIA TADALSOL S6320 su OP.140	Sagona
14	NEF	LAV.MOTORI	1	Revisione meccanica completa attrezzo bloccaggio (divisione pezzo) Mod.2 Op.10 Basamenti	i pezzi non vengono bloccati correttamente a causa dei comonenti usurati	Revisione pinza	Commisso
15	NEF	LAV.MOTORI	3	Razionalizzazione capi UTE 3Turno	Riorganizzazione UOL unificando le ute	Unificato UTE 3 con ute 5	Imbrici
16	NEF	LAV.MOTORI	3	Pensionamento White collar	Riorganizzazione UOL unificando le ute	Unificato UTE 3 con ute 6	Imbrici
17	NEF	LAV.MOTORI	1	Scarto prove di tenuta tappi basamenti	processo di tappaggiobasamenti non efficiente	studio ed implementazione attività di miglioramento	Mongelluzzi
18	NEF	LAV.MOTORI	3	Op70 - Spazzolatura del tagliente dopo l'affilatura e uno smusso di circa 0,1mm 10° di spoglia e 45° il tutto dove comincia il diametro utensile per	eccessiva usura tagliente	inserito spazzolatura dopo affilatura	Giglio
19	NEF	LAV.MOTORI	1	OP90 Basamenti - Introduzione indexaggio robot montaggio cappelli	il robot boccia a causa mancanza indexaggio	Inseriemtno indexsaggio	Commisso
20	NEF	LAV.MOTORI	1	OP100 DIAMETRO PUNTERIE AX 6073-74 MAGGIORATO			Sagona
21	NEF	LAV.MOTORI	1	Implementazione lavaggi ad alta pressione OP.20 basamenti	i particolari che escono dalla op.20 hanno residui di truciolo	inserito nuovi lavaggi interno macchina	Commisso
22	NEF	LAV.MOTORI	1	OP100 - foro alesa per riparazione tramite imboccolamento fori passaggio punteria	partivcolari di scarto per diamentro maggiorato	implementato imboccolamento in fase di riparazione	Sagona
23	NEF	LAV.MOTORI	5	Allungamento cadenza utensili Teste Op 100 Stazione 04LH	sostituzione utensili da ottimizzare	allungato cadenza cambio utensile	Giglio
24	NEF	LAV.MOTORI	1	PERDITA OLIO OP100 UTE1	tubo interno macchiana perde olio	sostituito tubo	Valisena
25	NEF	LAV.MOTORI	1	Ottimizzazione percorso Z su Op50/2 moduli Basamenti	ottimizzaione percoso Z su OP.50/2	Studio percorso asse Z ottimizzato	Mongelluzzi
26	NEF	LAV.MOTORI	1	Recupero basamenti NC con tappo diam 17.1	Scarto basamenti diamentro 17,1		Sagona

Figure 3.6: snapshot of the sheet *Input Scheda Progetto*.

3.2 *Kaizen* sheet

The Kaizen sheet (see fig 3.7), one of the operational sheets, represents the first major shift from the old system. The idea behind this sheet was to minimize the time that operational staff would need to spend filling out and printing the Kaizen standard associated with each project. Once the project is correctly entered into the *Input Scheda Progetto* Sheet, it already contains all the necessary information for the Kaizen sheet. The DOT team strongly recommends focusing on accuracy and completeness when filling out the *Input Scheda Progetto* Sheet, especially for the two columns AS IS and TO BE described earlier. These two cells serve as the data source for the Kaizen sheet to automatically fill the PLAN and DO phases. Equally important is the brief description of the activity, which allows the Kaizen sheet to later complete the section dedicated to the activity (see fig 3.7 at the top). Every piece of information in the Kaizen sheet is automatically extracted from the Input Project Sheet, except for the ACT and CHECK phases. These phases are addressed once the project is completed. After the project is finished, the corresponding Kaizen sheet should be printed and placed in the project room (HUB). Once its position is updated, the ACT and CHECK phases are completed, with no need to reprint the sheet. The HUB was created with the idea and philosophy of monitoring projects through the Lean concept of Visual Management. Its goal was to be a room where projects are monitored. Completing the Kaizen sheet with a simple pencil in the project room, once the status changes, fully embraces this philosophy. Using this sheet is quite simple: once the project is entered, navigate to this sheet, and in the upper left section (see fig 3.7), insert the project ID for which you want to print the corresponding Kaizen. The sheet will automatically populate, as previously mentioned, and you can then proceed to print it with a single click and the Kaizen will be ready to be attached in the wall of the project room. This type of automation in this specific sheet is possible thanks to a simple formula found in Excel's library called LOOKUP. The LOOKUP formula in Excel is a search function that allows you to find a specific value within a range of cells and return another associated value. In this case, the formula searches for the ID in the *Input Scheda Project* Sheet and returns the necessary associated information, such as the values of AS IS, TO BE, the B.U., the owner, the proposal date, etc.

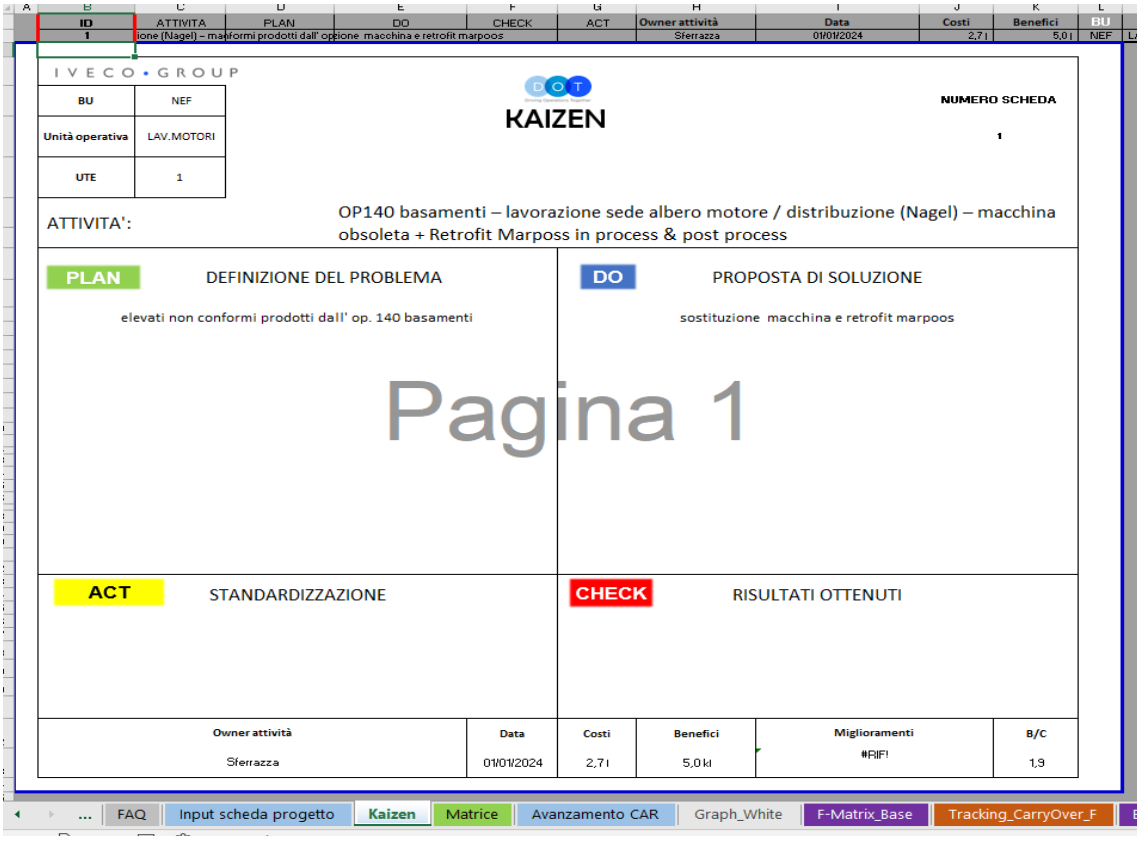


Figure 3.7: the *Kaizen* operational sheet thanks to which it is possible to print the Kaizen sheet.

3.3 *Matrice* sheet

This sheet is the beating heart of the file, where the project, once entered in the *Input Scheda Progetto* sheet, is completed with the missing information for proper monitoring. The blue-colored columns, as previously explained, are the points where manual data input is required. Meanwhile, the green-colored columns are automatic, meaning the data is automatically pulled from other sheets. Starting from the beginning (see fig 3.8), the first cell is automatic, and the *ID* value is obtained from the *Input Scheda Progetto* sheet. Next is the *Level* column, where a dropdown menu allows you to choose between CO,L0, L1, L2, L3, L4 where:

- **CO**: the term CO stands for *Carryover*. The Matrix allows for the inclusion of projects that were completed in the previous year but continue to provide economic benefits this year. By selecting this option in the *Level* column, the matrix will intelligently distribute the savings across the remaining months. Based on the *Actual Finish Date* (a column in this sheet that will be explained in detail later), the Matrix begins to distribute the declared savings monthly (dividing the annual benefit by twelve months) starting from the month in which the project was completed. Thus, a project completed in August of this year for instance, will provide benefits from August until the end of the current year, and the following year, that project still has a residual benefit (*Carryover*) until August, thereby completing the twelve months of benefit.

- **L0**: these are project ideas yet to be evaluated (in terms of cost and savings) and to be planned (in terms of *Planned Starting Date* and *Planned Finish Date*, which will be further explained later).
- **L1**: L1-level projects are those that have been evaluated economically (savings and cost) but have not yet been scheduled in terms of dates (*Planned Starting Date* and *Planned Finish Date*).
- **L2**: L2-level projects are those that have been evaluated economically and have also been scheduled (with *Planned Starting Date* and *Planned Finish Date*).
- **L3**: L3-level projects represent those that have started (they have an *Actual Starting Date*).
- **L4**: L4-level projects are those that have been completed (they thus have an *Actual Finish Date*).

					AUTOMATICO		
					INSERIMENTO MANUALE		
ID	Level	B.U.	UO	UTE	Project Description	Budget(B) Extra (XB)	CAR
1	L2	NEF	LAV.MOTORI	1	OP140 basamenti – lavorazione sede albero motore / distribuzione (Nagel) – macchina obsoleta + Retrofit Marposs in process & post process		SI
2	L3	NEF	LAV.MOTORI	3	Nuova macchina 3D per sostituzione SIRIO TESTE	B	SI

Figure 3.8: starting point in the sheet *Matrice*, this is the fixed section in this sheet.

The next four cells, namely those for *B.U* (Business Unit), *U.O* (Operational Unit), *UTE*, *Project Description*, are green as they are automated cells and the values are taken from the *Input Scheda Progetto* sheet. These first cells represent the information needed to identify the project, and for this reason, this part remains fixed when scrolling horizontally, allowing these details to always be visible while you can scroll horizontally to view other information. The last two columns shown in Fig. 3.8 correspond to *Budget (B)-Extra (XB)* and *CAR*. The first is a column with cells limited to two possible choices: *Budget (B)* and *Extra (XB)*. To fully understand this concept, it's important to note that before the start of a new year, typically around October of the current year, the budget for the upcoming year is defined. The budget represents the amount of money needed to cover all proposed projects. So, after the presentation of projects that are intended to be developed the following year, the budget is established and approved, and it becomes the pool of resources to be used for the realization of all projects in the coming year. When the new year begins, it may happen that new projects are proposed (projects not defined during the previous year's budget planning), and they may be added to the budget if, for example, some of the projects originally budgeted for the previous year cannot be carried out for technical reasons. It can also happen that some newly proposed projects in the new year have a high priority, so it may be decided to execute them with the available budget, sacrificing one or more of the previously proposed projects. Sometimes it can happen that the budget was underestimated, or there is a significant addition of new projects that, due to lack of coverage in terms of money, may end up as XB projects (Extra Budget Projects). The last column in Fig. 3.8 is the CAR column (the concept of CAR was explained in the previous chapter *Criticality and the need of a new tool*). Here, too, the cell is not automated but manual, and the cells in this column are restricted through a dropdown menu where you need to select "yes" or "no." Some projects require the definition of CAR, expenditures within a plant typically referred to funds allocated for acquiring, upgrading, or maintaining physical assets such as property, buildings, technology, or equipment. If a project requires CAR, it will be marked with "SI" and it will automatically be added to the *Avanzamento CAR* sheet (which will be explained later), where its CAR can be monitored. This new way of managing CARs associated with each project is a significant innovation. Previously, the management was done separately from the project monitoring itself, and sometimes there was no record of it at all (let's remember that CARs are handled by the Plant Technical Support department while the project itself is carried out by the DOT & TECH which is related to another department). Having both project monitoring and CAR monitoring in the same file provides quick access to information that wasn't possible before. The collection within the same file of the informational components of a project allows, however, for better monitoring and readiness in managing any issues or delays, without the need to spend additional time searching for the necessary information.

	Totale [k€]	75646,6	144804,1		
Stato	M-Y di inserimento	Saving (CL 100%) [k€]	Cost [k€]	CAP MAINT/ EFF	Project Leader
100%	gen-24	5,0	2,70	CAP MAINT	Sferrazza
100%	gen-24	5,0	350,00	MO_43 - Capacity maintenance (Internal	Commisso

Figure 3.9: part two of the sheet *Matrice*, This is the section that can be scrolled horizontally, allowing you to navigate through the sheet.

Continuing horizontally in analyzing the sheet, we find what is shown in fig. 3.9, and the first column visible is the *Stato* column. It is an automatic cell as we have now learned, being green and the data is automatically pulled from the *Avanzamento CAR* sheet based on its progress level (which will be clearer when the *Avanzamento CAR* sheet is analyzed). The next column, the *M-Y di inserimento*, is an automatic cell where the data is pulled from the *Input Scheda Progetto* sheet when the compiler is asked to enter the date when the project was proposed. Following that, we find the *Saving (CL 100%)*. The "CL" represents the confidence level, i.e., how confident we are that the project will actually achieve the declared saving. The higher the confidence in the declared saving, the higher the confidence level, and vice versa. In this case, the column shows exactly the saving declared in the *Input Scheda Progetto* sheet, as does the next column representing the cost. Next, there is a manually filled column dedicated to categorizing the expense as either *Capital Maintenance* or *Efficiency*. When referring to an expense categorized under *Capital Maintenance* it pertains to investments necessary to keep existing infrastructure in working condition. This can include repairs, replacements, or upgrades essential to ensure that the company's equipment and resources function as intended. The goal of these expenses is to maintain current production capacity (particularly the OEE discussed in the first chapter), prevent breakdowns, and ensure the company continues to operate smoothly. Such expenses, when applied to machinery, can sometimes increase its value, thereby raising working capital. Conversely, an expense categorized under *Efficiency* is aimed at enhancing the operational efficiency of the company. This means investing in projects or equipment that reduce operating costs, increase productivity through improved machine efficiency (like OEE), or optimize existing processes. For instance, it might involve investing in new technologies that enable higher output with fewer resources or refining a production process to lower energy consumption. The goal here is to improve the company's long-term profitability. In summary, while *Capital Maintenance* expenses focus on preserving the current state of the company's resources, *Efficiency* expenses are directed towards performance improvement and future cost reduction. The final column to examine in fig. 3.9 is the *Project Leader*, the individual assigned to execute the project. Here too, the entry is automated. Up to this point, we've seen how manual entry in the file is minimized, with the goal of making the data as uniform and standardized as possible. This approach helps to reduce errors or inconsistencies that can arise from manual input.

Totale (CL > 60%) [k€]	30400,8						
Totale (CL > 80%) [k€]	25829,1						
Sub.Totale [k€]	32086,2						
CL	Saving @CL [k€]	B/C	Planned Starting Date	Planned Finish Date	Actual Starting Date	Actual Finish Date	Status
100%	5,0	1,9	gen-26	gen-26	gen-26		On going

Figure 3.10: part three of the sheet *Matrice*, This is the section that can be scrolled horizontally, allowing you to navigate through the sheet, this is the part in which the worker must complete the project information in order to enable proper monitoring.

We are about halfway through analyzing the *Matrice* sheet, and the starting point for this third stage of horizontal scrolling is the *Confidence Level* previously explained. The column in question requires manual input and serves as a reference for the next column, which is the *Saving CL*. This column adjusts the declared saving according to the estimated confidence level. For example, if a project has a potential saving of 1000 euros but there is not 100% certainty that it will actually achieve that saving, and a confidence level of 70% is applied, the *Saving CL* column will automatically be filled with a value of 700 euro (the result of a simple multiplication). The third column in fig. 3.10 is dedicated to the *B/C* ratio, which is also automated. The *B/C* (Benefit/Cost) is an indicator that provides an idea of how worthwhile it is to put effort into realizing the project. Projects with high *B/C* ratios are those where the benefits far exceed the costs, while projects with low *B/C* ratios need to be carefully evaluated regarding the effort required to carry them out, as these projects do not have benefits that significantly outweigh the costs in economic terms. The next four columns are manually filled and are dedicated to project planning through the entry of dates. To minimize the likelihood of errors, the cells have been formatted as dates, and a validation check has been applied to ensure correct date entry. This will trigger an error if the date entered does not conform to the defined standard format (see fig 3.11).

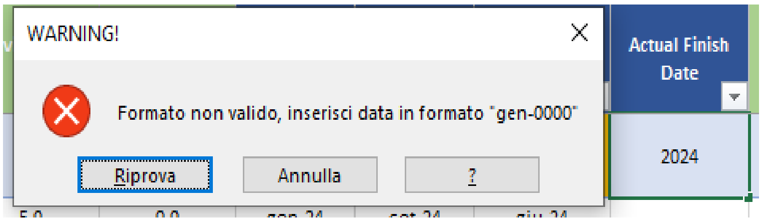


Figure 3.11: warning data insertion alert in the *Matrice*, this is the control system for the corrected insertion of the data.

The first of the four aforementioned columns is the *Planned Starting Date*, which indicates the planned start date of the project (representing the theoretical date), just like the following column, *Planned Finish Date* (theoretical completion date of the project). To conclude the columns dedicated to dates, there are the *Actual Starting Date*, which indicates the date on which the project actually started, and the *Actual Finish Date*, which marks the date on which the project was actually completed. The previously defined rules for assigning project levels require that projects with the *Planned Starting Date* and the *Planned Finish Date* for instance, must correspond to an L2 *Level*, and the opposite is also true—meaning all projects at an L2 *Level* must include these two dates as part of their information. To avoid errors and ensure that these constraints are respected, automatic checks have been implemented using specific formulas linked to conditional formatting embedded in the Excel tools. This latter is a powerful tool that allows you to automatically apply formatting—such as colors, icons, or data bars—to cells based on their values or the result of a formula. When using a specific formula, conditional formatting lets you apply these formats based on more complex or customized conditions. These formulas (see fig 3.12 for one of these formula), in this specific cells in the *Level* column, highlight in red those cells in the level column that do not comply with the rules.

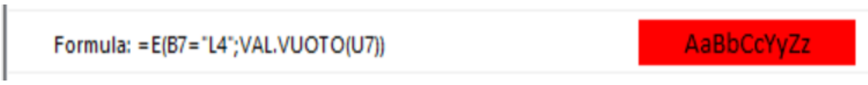


Figure 3.12: formula which checks if the project level in the *Level* column is set to "L4" and simultaneously verifies that the *Actual Finish Date* column does not contain a date. If both conditions are met, this verification is performed using the *AND* function in Excel, the specific cell in the *Level* column is highlighted in red. This red formatting serves as a visual alert, indicating that there's an inconsistency between the project level and the absence of a completion date.

In fig. 3.8, you can see that project with *ID* 1 has an L2 *Level*, and when you look at fig. 3.10, you'll notice that the project has been incorrectly planned.

It not only includes the *Planned Starting Date* and *Planned Finish Date* but also the *Actual Finish Date*. According to standard practice, the project should be classified as L3, or alternatively, if the *Actual Starting Date* is removed (assuming the project hasn't actually started), the L2 level assignment would then be correct. This example highlights another control mechanism, which is aimed at maximizing the accuracy and quality of the information: the cells in the columns for these four dates have color-based checks, through Excel's conditional formatting, related to the correct assignment of the year. Specifically, it is expected that most projects will be executed within the current year; however, it can happen that they are postponed, as was the case for project with *ID* 1. When the year differs from the current one, the cell will turn yellow to signal that the entered year is not the current one. In this case, the date is correct because the project will indeed be executed in 2026, and the coloring will help the project leader keep track of it. The last column to analyze in figure 3.10 is the *Status* column, which indicates the project's status relative to the planned schedule. Specifically, through the use of a formula (see fig. 3.13), various conditions regarding the planned and actual start and end dates of the project are analyzed, and the formula returns a status based on these conditions.

```
=SE(E([@[Project Description]]="";[@[Planned Finish Date]]="");"";SE(E([@[Planned Starting Date]]<>"";[@[Planned Finish Date]]<>"";[@[Planned Starting Date]]>=OGGI();[@[Actual Starting Date]]="");"Planned";SE(E([@[Planned Starting Date]]<>"";[@[Planned Starting Date]]<OGGI();[@[Actual Starting Date]]="");"Delayed";SE(E([@[Planned Finish Date]]<>"";[@[Planned Finish Date]]<OGGI();[@[Actual Finish Date]]="");"Delayed";SE(E([@[Actual Starting Date]]<>"";[@[Actual Finish Date]]="");"On going";SE(E([@[Project Description]]<>"";[@[Planned Finish Date]]="");"Not Planned";SE(E([@[Actual Starting Date]]<>"";[@[Actual Finish Date]]<>"");"Closed";"")))))))
```

Figure 3.13: the figure shows the formula used to determine the status of the projects.

The formula begins by checking if both the *Project Description* and the *Planned Finish Date* are empty. In this case, it returns a blank cell, indicating that there is not enough information to assess the project's status. The various statuses a project can assume are:

- **Planned**: if both the *Planned Starting Date* and *Planned Finish Date* are filled in, and the *Planned Starting Date* is in the future compared to the current date, while the *Actual Starting Date* is still empty, the project is considered *Planned*. In this case, the project is scheduled but has not yet started. This condition reflects a regular plan with no delays, but with the activity still pending to begin.

- **Delayed**: there are two situations where a project is considered *Delayed*. The first occurs when the *Planned Starting Date* has been filled in, but it refers to a past date, and the *Actual Starting Date* has not yet been entered. In this case, the project should have started but didn't within the expected timeline. The second situation happens when the *Planned Finish Date* has passed, and the project is still not completed, indicated by the absence of an *Actual Finish Date*. In both cases, the project is behind schedule.

- **On Going**: if the project already has an *Actual Starting Date* entered but hasn't been completed yet (the *Actual Finish Date* is blank), the formula returns *On going*. This indicates that the project is currently in progress but hasn't reached its completion yet.

- **Closed**: a project is considered *Closed* when both the *Actual Starting Date* and *Actual Finish Date* are filled in. This indicates that the project has been successfully completed: it started and finished, either as planned or possibly with some delay (which will be assessed later), but it has nevertheless reached its conclusion.

- **Not Planned**: finally, the formula returns *Not Planned* if the *Project Description* is provided but the *Planned Finish Date* is missing. This indicates that the project has been outlined, but no completion date has been scheduled yet, signaling a preliminary planning phase without the necessary details for proper scheduling.

This level of detail in project monitoring has been made possible thanks to the creation of these controls, which provide a snapshot of the status of individual projects by assigning them a specific status. Previously, this type of information was not available, and as a result, project tracking had a lower level of detail, making monitoring less effective and increasing the risk of missing potential losses due to delays throughout the year (how this information was obtained will be explained later). This also raised the likelihood of not reaching the efficiency targets set at the beginning of the year. To conclude the analysis of fig. 3.10, let's focus on the upper left corner, where a summary of the adjusted savings based on the confidence level is shown. There is a total for savings with a confidence level greater than 60%, which is the minimum "acceptable" CL for a project, a total for savings with a confidence level over 80%, and a pure total that does not consider the confidence level. This provides an overall picture of the project's benefits.

	Subtotale		Subtotale		
	76,1		13790,0		subtotali
Monthly Delay	Delay Cost [k€]	Year	Planned Yearly Saving [K€]	Regular (R) Non regular (NR)	Cost Items
Missing Actual Finish Date	0,0	2026	5,0	REGULAR	MAINTENANCE EXPENSES

Figure 3.14: part four of the sheet *Matrice*, This is the section that can be scrolled horizontally, allowing you to navigate through the sheet.

As we continue scrolling horizontally through the sheet, we come across what is shown in fig. 3.14, where the first column, *Monthly Delay*, provides more detailed information regarding project delays (previously, the importance of this data was discussed in detail). The formula in the cells of this column, through checks on the dates, is able to quantify any delays in temporal terms. Specifically:

- **Missing both Date**: if both the *Actual Finish Date* and the *Planned Finish Date* are empty, the formula returns this message. It indicates that neither the planned nor the actual completion dates have been provided.

- **Missing Planned Finish Date**: if the *Planned Finish Date* is empty but the *Actual Finish Date* is present, the formula returns this output. This means that the actual date of the completion of the project has been entered, but the planned completion date is missing.

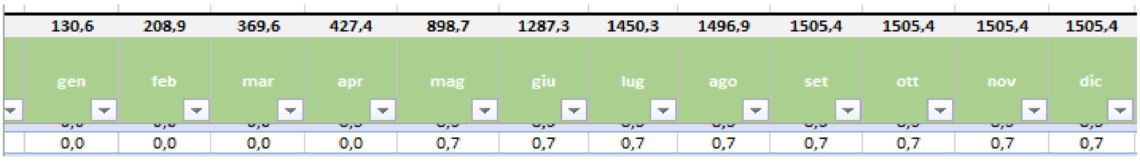
- **Missing Actual Finish Date**: if the *Planned Finish Date* is present but the *Actual Finish Date* is missing, the formula returns this message. It indicates that the actual completion date is missing, while the planned date has been entered.

- **Number of Delays**: if both dates are present, the formula compares the months of each date. If the month of the *Planned Finish Date* is later than the month of the *Actual Finish Date* (meaning that project has a delay), the formula calculates and returns the number of months of delay between the two dates.

- **No Delay**: if there is no delay, meaning the *Actual Finish Date* is the same as or earlier than the *Planned Finish Date*, the formula returns this message. It indicates that the project was completed without delays according to the plan.

This column differs from the one previously explained, *Status*, as it is solely dedicated to the analysis and quantification of delays. The *Status* column, on the other hand, gives an idea of the current real situation of the project but is unable to quantify the delay. With the creation of the *Monthly Delay*, it was possible to obtain a figure indicating how much the project is delayed, allowing delays to be tracked accordingly. Furthermore, as can be seen in fig. 3.14, the cells in the *Monthly Delay* column are conditionally formatted based on a formula, as previously mentioned. This time, the check is performed on the *Planned Finish Date* relative to the current month. Specifically, when the month in which the project was supposed to finish is exceeded, the cell is highlighted in yellow, indicating that the project is a future delayed project. Linked to the output of the monthly delay column is the *Delay Cost* column, where the cost of the delay is quantified. Considering the declared savings for that project, by dividing it by twelve months and multiplying the result by the quantified delay (number of months delayed), the economic impact of the delay is calculated. Specifically, it indicates how much benefit has been lost in the current year. Of course, the lost benefit will be an additional benefit for the next year (the so-called carryover), but for the current year, it is considered a loss. Here too, above the header of this column, there is a space dedicated to calculating the total delays. Being able to conceptualize and quantify the delay associated with a single project, as done here, is of vital importance since by monitoring the potential and current delay of a project, one can also get an idea of the loss related to that delay and subsequently understand if, through advancements (it can obviously also happen that a project finishes early), the loss can be mitigated (in the *Offset_Delay* sheet we will see how this analysis is performed) or if it is necessary to find projects to expedite in order to avoid a negative impact due to that delay. Moreover, it is important to note how much effort was made to minimize worker intervention. All the cells in this section of the *Matrice* are automatic, thus standardizing the quality of the information as much as possible and avoiding inconsistencies. The next column is called *Year*, and it is relatively simple since, based on two other columns, particularly *Actual Finish Date* and *Planned Finish Date*, it indicates the year in which the project should be completed (if only a planned date is available) or finished (if an actual completion date is present). This information may seem trivial, but it is very useful since only projects from the current year need to be considered, whether completed or just planned. It is information used as a parameter in many other parts of the file, such as in the *Graph_White* sheet, which will be analyzed later. We often talk about projects that start during the year, and for these projects, the declared savings will not be fully absorbed by the current year. By spreading the

declared savings over twelve months, only a portion will be attributed to the current year. This is, in fact, what the *Planned Yearly Saving* column represents, the cells related to this column aims to calculate an economic value related to the project, based on specific parameters such as the project level and the planned finish date. In particular, the first parameter to be checked is the value of the *Level* and if the value is L0 it returns zero, because for projects at the *L0* level, no calculation is required. If the level is different, it checks whether the *Planned Finish Date* column is empty; if it is, it returns zero again, since there's no date to base the calculation on. In the case that a *Planned Finish Date* exists, the formula calculates how many months are left until the end of the year. This number of months is then multiplied by the projected economic savings for that project, taken from the *Saving* column, dividing the annual savings by twelve to obtain the monthly savings. If an error occurs during the calculation (for example, an invalid value), the formula returns zero to avoid issues. If everything works correctly, it returns the remaining economic savings of the project for the months left until the end of the year. Above this column, there is a space dedicated to calculating the total, which provides an idea of the actual benefit amount for the current year. Previously, this level of precision in calculating the actual savings for the current year was not done. The project's benefit was not further revised based on the actual months it contributed to the benefit in that specific year. This lack of precision in the data led to an overestimation of the benefit, as the annual benefit was overstated, creating false optimism in achieving the set target (it's worth noting that the target was not met for two consecutive years). The next column is also automatic, and based on the cost category that the project impacts, it determines whether the project is classified as *Regular* (meaning it falls within the DOT perimeter) or *NONRegular* (meaning it does not impact any of the predefined cost categories listed in the *Input Scheda Progetto* sheet). All projects classified as *NONRegular* will not be considered for analyses and reports. Like this column, the following one is also automatic and reflects the cost category declared in the *Input Scheda Progetto* sheet, for which the project is expected to bring a benefit.
The section that will now be analyzed (fig. 3.15) is fully automated and deals with the actual monthly allocation of the project's benefits over the course of the year.



130,6	208,9	369,6	427,4	898,7	1287,3	1450,3	1496,9	1505,4	1505,4	1505,4	1505,4
gen	feb	mar	apr	mag	giu	lug	ago	set	ott	nov	dic
0,0	0,0	0,0	0,0	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7

Figure 3.15: part five of *Matrice* sheet, is where the monthly allocation of the saving takes place.

Specifically, each cell in this section checks whether the project is classified as *NONRegular* in the specific column. If it is, the cell returns an empty string, meaning no calculation is performed, as *NONRegular* projects are not considered. If, instead, the project is classified as *Regular*, the formula proceeds with the calculation. It checks if the year in the *Actual Finish Date* column is the previous year compared to the current one, verifying whether the project is a *carryover*. If it is a carryover, the project's benefits will be spread out over the remaining months based on the declared completion month. If the project is not a *carryover*, after verifying whether the project has an *Actual Finish Date* and declared *Saving*, it checks if the month of the *Actual Finish Date* is less than the current month, meaning the project has not yet yielded its benefit. Otherwise, it calculates the monthly savings by dividing the total savings by twelve. In summary, the formula determines if the project is relevant and, based on the year and month of completion, calculates the monthly savings, returning either 0 or an empty string if the conditions are not met. For each month, as shown in fig. 3.15, there is a cell above it dedicated to the total for that month, which helps provide an overview of the benefit's progress throughout the year. A key effort in implementing this section was the ability to monthly allocate, if present, a *carryover*. Before the introduction of this new matrix, *carryovers* were not managed. By creating a structure that allows for this type of scenario, the matrix becomes flexible in tracking projects that span two years over the coming years. Since this data was missing in previous years, for now, only a projection of the *carryover* for the following year is available (which will be shown later in the sheets dedicated to *carryover*). This represents another feature that has been built into the matrix. There is now the ability to manage the carryover from the previous year, tracking a benefit that has already been realized and continues to have residual value in the current months, while also monitoring the new projects that have begun or are about to begin, to calculate their residual benefits for the next year. The monitoring window has therefore expanded, allowing us to track not just the "today" situation, but also "yesterday" and "tomorrow."
The last section of this sheet is shown in fig. 3.16, where the first column, *Yearly Saving*, represents the project's benefit for the current year. Compared to the *Planned*

Yearly Saving column, it only takes into account projects that are classified as regular. Therefore, the total displayed above this column is what is commonly referred to as the *F-Matrix* (this was explained in the first chapter in the section on matrices). In essence, it shows the benefit for the current year from all projects that have already been completed.

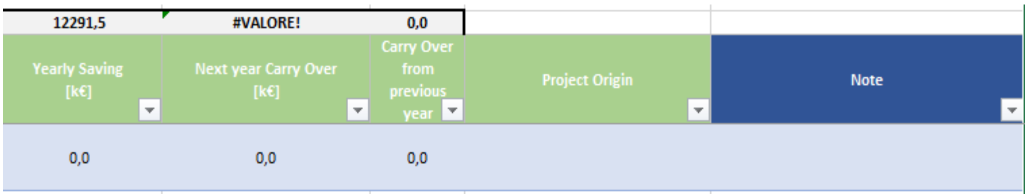


Figure 3.16: part five and last section of the *Matrice* sheet.

The *Next Year CarryOver* column, as previously mentioned, calculates the *carryover* amount for each individual project. It then generates a total at the top, providing an idea of the residual benefit that will serve as the starting point for the next year. The opposite is done for the *Carryover From Previous Year* column, where, for each project, if applicable, the carryover still accruing this year from a project completed in the previous year is tracked. Similarly, there is a section at the top of the column that shows a total of the residual carryover from the previous year for the current year across all projects. To conclude, the last two columns are dedicated to additional information. The *Project Origin* column is automated, with the value taken from the *Input Scheda Progetto* sheet, specifying the project's origin—whether it was initiated by an event such as the *Kaizen Week* (explained in Chapter 1) or a *Kaizen Blitz* (also explained in Chapter 1) for example. The *Notes* column is an extra space for the compiler's comments (as it is a manually filled column). To give an idea of the scope and complexity of the sheet, the matrix currently manages 1,332 projects, tracking delays, benefits, costs, and other relevant metrics.

3.4 *Avanzamento CAR* sheet

The creation of this sheet was another important innovation in the management of continuous improvement projects. Having the ability, within the same file, to manage not only the temporal and financial monitoring of a project but also the section related to CARs (a type of expense that has been frequently discussed) makes project management comprehensive, centralized and reactive. The structure of the sheet is the same as that of the matrix sheet, providing visual and operational continuity. By having standard rules that repeat throughout the file, it becomes easier to learn how to use it and, once again, reduce errors in data entry that could lead to discrepancies in the information.

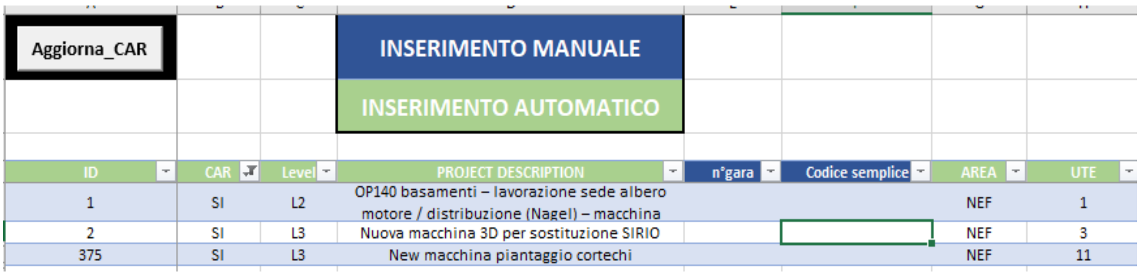
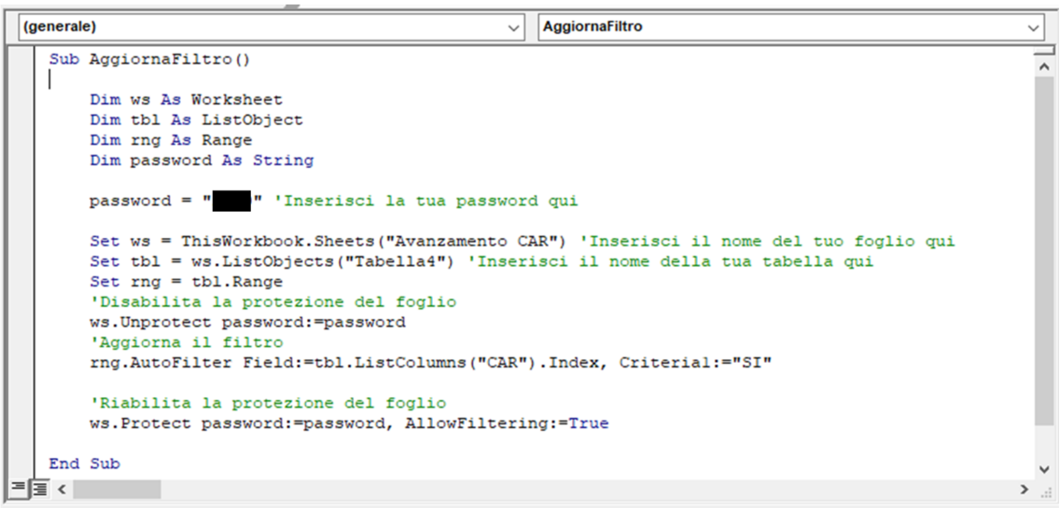


Figure 3.17: part one of the *Avanzamento CAR* sheet, this is the initial screen displayed when the sheet is selected.

The sheet provides a dual-color scheme: as previously noted, blue indicates columns where data needs to be entered manually, while green highlights the automatic columns. The idea behind the functionality of this sheet is to make the process of entering the necessary information as fast as possible. The routine that should be followed when using this sheet is to first press the *aggiorna_CAR* button, which, through a VBA (Visual Basic for Application) code (see fig. 3.18), updates the sheet with the new projects added to the matrix that require CARs. Before delving into the analysis of the code, it's helpful to understand what VBA is and what it allows you to do. Visual Basic (VB) is a programming language developed by Microsoft, designed to be simple and accessible. It allows for the rapid creation of applications based on windows, forms, and graphical controls. VB enables the automation of repetitive tasks and data management, and is widely used for developing desktop applications. Specifically, Visual Basic for Applications (VBA) is an embedded version of Visual Basic used within applications such as, in this case, Excel. In the context of Excel, VBA allows you to write code that automates tasks, performs complex calculations, manipulates data, and interacts with worksheets and charts. Thanks to VBA, it is possible to create macros that execute complex actions with a single command, simplifying operational processes and increasing efficiency. In this context, VBA is used to automate tasks such as updating sheets, filtering data, and managing projects within Excel spreadsheets.



```
(generale)                                   AggiornaFiltro

Sub AggiornaFiltro()

    Dim ws As Worksheet
    Dim tbl As ListObject
    Dim rng As Range
    Dim password As String

    password = "[redacted]" 'Inserisci la tua password qui

    Set ws = ThisWorkbook.Sheets("Avanzamento CAR") 'Inserisci il nome del tuo foglio qui
    Set tbl = ws.ListObjects("Tabella4") 'Inserisci il nome della tua tabella qui
    Set rng = tbl.Range
    'Disabilita la protezione del foglio
    ws.Unprotect password:=password
    'Aggiorna il filtro
    rng.AutoFilter Field:=tbl.ListColumns("CAR").Index, Criteria1:="SI"

    'Riabilita la protezione del foglio
    ws.Protect password:=password, AllowFiltering:=True

End Sub
```

Figure 3.18: this represents the code written in VBA associated with the *aggiorna_CAR* button.

This code is designed to quickly filter the data in this specific sheet. It temporarily unlocks the sheet using a set password (each sheet is locked with a password for the cells that are automated, which are the ones colored green. These cells cannot be selected, thus further minimizing the risk of errors or unintended but highly critical changes), then applies a filter to show only the rows where a certain column in the *Matrice* sheet, related to *CAR*, contains the value *SI*. After updating the filter, it locks the sheet again to protect the data, but still allows the user to apply filters. Essentially, it automates the task of showing only relevant projects by filtering for those marked with *SI* in the *CAR* column, all while ensuring the sheet remains secure. All projects that involve a CAR are listed in this sheet. Specifically, the project *ID* is displayed along with a column indicating whether the *CAR* is marked as "SI", the project *Level*, and the *Project Description*, the *AREA*, the *UTE* and the *Cost_Forecast* which represent the cost estimated for that specific project. As seen in figure 3.17, all of these columns are automatically populated from the *Matrice* sheet. There are three columns, *n° gara*, *Codice semplice*, and *CLUSTER*, which are managed by the *Plant Technical Support* department responsible for overseeing and advancing the CARs. These columns allow for the inclusion of information that aids internal management by the department. However, for the purposes of the DOT team's work, specifically for monitoring efficiency, this information is not processed. There are two additional columns not shown in figure 3.17: the *OWNER* column, which indicates who is responsible for the specific CAR related to the project, and the *STATUS* column, which shows the progress of the CAR. The *STATUS* column is automatically populated based on the information filled in the main section of this sheet, which is displayed below (see fig. 3.19).

5%	30%	45%	50%	65%	90%	95%	100%
CAR Preparation	CAR Approval	Spending	Technical Specification	RDA	Gara	Order	Implementation
feb-24							gen-26

Figure 3.19: this section is the heart of the sheet *Avanzamento CAR*, where the CAR owner manages the completion of the project's progress.

To understand the contents of this sheet, it's important to clarify the various stages of a CAR:

- **CAR Preparation**: this is the initial stage where the request for capital expenditure approval is prepared. It involves gathering all necessary information, such as project details, estimated costs, and expected benefits. A document is created outlining the investment, including reasons, objectives, and a cost-benefit analysis.

- **CAR Approval**: after preparation, the request is submitted for approval. Management or a financial committee reviews the project to decide whether to approve the CAR. They consider factors such as available budget, strategic importance, and return on investment.

- **Spending**: once the CAR is approved, spending phase can begin. The approved budget is allocated, and initial project expenses are allocated. This phase involves detailed planning of resource use and ongoing monitoring to ensure the project stays within budget.

- **Technical Specification**: this phase involves defining the technical specifications for the project or purchase in detail. It includes setting the technical requirements for goods or services to be procured or implemented, ensuring they meet project needs and comply with company or industry standards.

- **RDA (Request for Purchase)**: the Request for Purchase is a formal document that authorizes the start of the purchasing process for the goods or services needed for the project. It represents the formalization of operational and financial needs within the company.

- **Gara**: in this stage, supplier selection begins. A "gara" or request for proposal (RFP) is organized, where various suppliers submit their offers to provide the required goods or services. Offers are evaluated based on price, quality, and compliance with technical specifications.

- **Order**: after selecting a supplier, a purchase order is issued. This formal document confirms the agreement with the chosen supplier and sets the terms of supply, including payment terms, delivery times, and quantities.

- **Implementation**: finally, the project moves to the implementation stage. In this phase, purchased goods or services are delivered and used to complete the project. It involves managing the installation, commissioning, or integration of new resources into business operations, monitoring results to ensure they meet initial expectations.

The owner of the specific CAR, upon accessing this sheet, needs to update the status of the CAR. By entering the start date of each phase, a progress percentage will be assigned to the CAR (as shown at the top of each column in figure 3.19). This percentage will then populate the *Status* column and be reflected in the *Matrix* sheet, as previously discussed. Additionally, this sheet includes alerts that verify the correct entry of dates in the standard format (the same format used in the Matrix sheet) to ensure data consistency throughout the file.

3.5 *F-Matrix_Base* & *E-Matrix_Base* sheets

Continuing to explore the file, within the operational sheets, two relatively simple sheets can be found: the *F-Matrix_Base* sheet (see fig. 3.20) and the *E-Matrix_Base* sheet (see fig. 3.21). These two sheets were created for consultation purposes, specifically for completed projects (*F-Matrix*) and projects yet to start (*E-Matrix*). What is expected over the course of the year is that when consulting these sheets at the beginning of the year, the *F-Matrix* will be almost empty and the *E-Matrix* mostly populated, as there are many projects to complete and few that have been finished. The opposite is true as the year progresses, where one would expect the *E-Matrix* to become less populated and the *F-Matrix* to fill up. In other words, as the year draws to a close, projects should migrate from the *E-Matrix* to the *F-Matrix*, meaning that projects planned for completion should be completed. The creation of these two sheets allows for tracking this dynamic, specifically how quickly the business units are completing their projects. Sometimes, the *E-Matrix_Base* sheet is used to quickly identify delays that may not be as evident in the main *Matrice* sheet (which collects all projects). By filtering the Planned Finish Date column in the *E-Matrix* for projects whose planned completion date has already passed, one can easily identify delayed projects. The content of these two sheets is directly pulled from the main *Matrice* sheet, and what is shown includes the *ID*, *Level*, *BU*, *Cost* (meant as the cost item that the project is targeting), *Saving*, *Planned_Finish_Date*, and, of course, the monthly breakdown of the savings. One additional feature of the *E-Matrix_Base* sheet compared to the *Matrice* is the monthly breakdown of savings for projects that have not yet started (in the *Matrice* sheet, the breakdown of benefits occurs only for completed projects). This extra information allows for the monthly evaluation of each project's benefit, and, if applicable, the impact of any delay for each month.

F-MATRIX

ID	B.U	COST	SAVING	Actual_Finish_Date	GEN	FEB	MAR	APR
				Subtotale	130,63	208,86	369,55	427,44
3	NEF	SCRAP AND LOSSES	19,7	mag-24	0,0	0,0	0,0	0,0
4	NEF	CONSUMABLE MATERIALS	20,0	apr-24	0,0	0,0	0,0	1,7
6	NEF	DIRECT LABOUR COST	450,0	mag-24	0,0	0,0	0,0	0,0
9	NEF	SCRAP AND LOSSES	99,0	apr-24	0,0	0,0	0,0	8,3
10	NEF	SCRAP AND LOSSES	8,2	mag-24	0,0	0,0	0,0	0,0
11	NEF	MAINTENANCE EXPENSES	76,5	giu-24	0,0	0,0	0,0	0,0
12	NEF	SCRAP AND LOSSES	71,1	mag-24	0,0	0,0	0,0	0,0
13	NEF	CONSUMABLE MATERIALS	7,3	mar-24	0,0	0,0	0,6	0,6
14	NEF	SCRAP AND LOSSES	34,0	set-24	0,0	0,0	0,0	0,0
15	NEF	SALARY	50,0	feb-24	0,0	4,2	4,2	4,2
16	NEF	SALARY	50,0	feb-24	0,0	4,2	4,2	4,2
17	NEF	SCRAP AND LOSSES	35,0	giu-24	0,0	0,0	0,0	0,0

Figure 3.20: *F-Matrix_Base* sheet which shows all the projects entered.

18/09/2024 2024

E-MATRIX

REMEMBER: Se il valore in ques
e L3, quindi :

ID	Level	B.U	COST	SAVING	Planned_Finish_Date	GEN	FEB	MAR	APR	MAG
				Subtotale 4903	Subtotale	0,00	0,00	0,00	0,00	0,00
5	L3	NEF	SCRAP AND LOSSES	1,9	dic-24	0,0	0,0	0,0	0,0	0,0
8	L3	NEF	SCRAP AND LOSSES	135,0	ott-24	0,0	0,0	0,0	0,0	0,0
19	L2	NEF	SCRAP AND LOSSES	135,0	dic-24	0,0	0,0	0,0	0,0	0,0
144	L2	NEF	SCRAP AND LOSSES	1,0	set-24	0,0	0,0	0,0	0,0	0,0
154	L2	NEF	SCRAP AND LOSSES	1,0	set-24	0,0	0,0	0,0	0,0	0,0
336	L3	NEF	SCRAP AND LOSSES	24,0	ott-24	0,0	0,0	0,0	0,0	0,0
340	L3	NEF	CONSUMABLE MATERIALS	20,0	set-24	0,0	0,0	0,0	0,0	0,0
342	L2	NEF	SCRAP AND LOSSES	10,5	set-24	0,0	0,0	0,0	0,0	0,0
375	L3	NEF	SCRAP AND LOSSES	392,7	dic-24	0,0	0,0	0,0	0,0	0,0
388	L3	NEF	MAINTENANCE EXPENSES	102,0	dic-24	0,0	0,0	0,0	0,0	0,0
398	L3	NEF	SCRAP AND LOSSES	70,0	ott-24	0,0	0,0	0,0	0,0	0,0
450	L3	NEF	CONSUMABLE MATERIALS	3,1	ott-24	0,0	0,0	0,0	0,0	0,0
487	L3	NEF	SCRAP AND LOSSES	122,9	dic-24	0,0	0,0	0,0	0,0	0,0

Figure 3.21: *E-Matrix_Base* sheet which shows all the projects that are expected to be initiated.

3.6 *Tracking_CarryOver_F* sheet

This sheet represents one of the new features (previously introduced when discussing *carryover* in the *Matrix* section) added with the creation of the new matrix. This type of information is crucial. By having a forecast of projects that will bring benefits in the following year compared to the current one, it extends the monitoring horizon, providing a view into the next year. This allows for tracking the base from which the following year will begin. Moreover, another concept closely related to carryover needs to be explained. *Governance*, as previously discussed (in chapter two), refers to those managerial actions referred to as "hard actions" that bring a benefit through a kind of enforcement by the employer. These benefits are typically seen through actions like reducing the budget allocated, for example, to the replacement of consumable materials. Naturally, consuming less leads to a benefit. However, this benefit is not driven by a continuous improvement project. It is, therefore, important to first quantify *Governance* (as we will see later, this is possible), and then to work on finding projects that can support the benefit derived from *Governance*. To clarify, if there was a *Governance* benefit of 1000 euros in the current year, the goal would be to find projects that could bring a similar benefit for the next year(wich have a residual benefit for the next year of that amount, the *carryover*), because there is no certainty that *Governance* will be present, or if it is, whether it will be of the same amount. Although these are managerial actions, they still serve as a tool to help meet the efficiency targets set. When a particular year benefits significantly from these actions, it's crucial to cover the benefit brought by *Governance* with real projects as much as possible. Otherwise, if the same target is set for the following year and, for whatever reason, *Governance* is no longer available, the organization would find itself at a significant disadvantage. Thus, having an idea of the starting base in terms of benefits (*carryover*) for the next year allows for monitoring how well-prepared the organization is in case *Governance* is lacking. If it is absent, the base should serve as a "cushion," providing support for the new year.

This sheet (see fig. 3.23) aims to provide an overview of the *carryover* for projects that have already been completed (in technical terms, they are associated with the letter F; when an "F" is present, it indicates the final result, meaning the project has already brought benefits). Specifically, the columns displayed include *ID*, *BU* (Business Unit), *Year_Saving*, *Cost_Items*, and the *Actual_Finish_Date*. The most effective way to indirectly filter and isolate completed projects is by displaying only those with an actual completion date. Following this, the savings are distributed monthly based on the *Actual Finish Date*, meaning the savings are projected into the months that do not fall within the current year. The savings are, therefore, broken down monthly as if we were in the following year, reflecting the monthly distribution of future benefits *carryover*. Using a button (visible at the top of the sheet labeled

Update_Carry_Over_F-Matrix) associated with a Visual Basic code (see fig. 3.22), an update of the data is applied. Specifically, before applying the filter, the code ensures that any active filters are removed, allowing the new filter to be correctly applied.

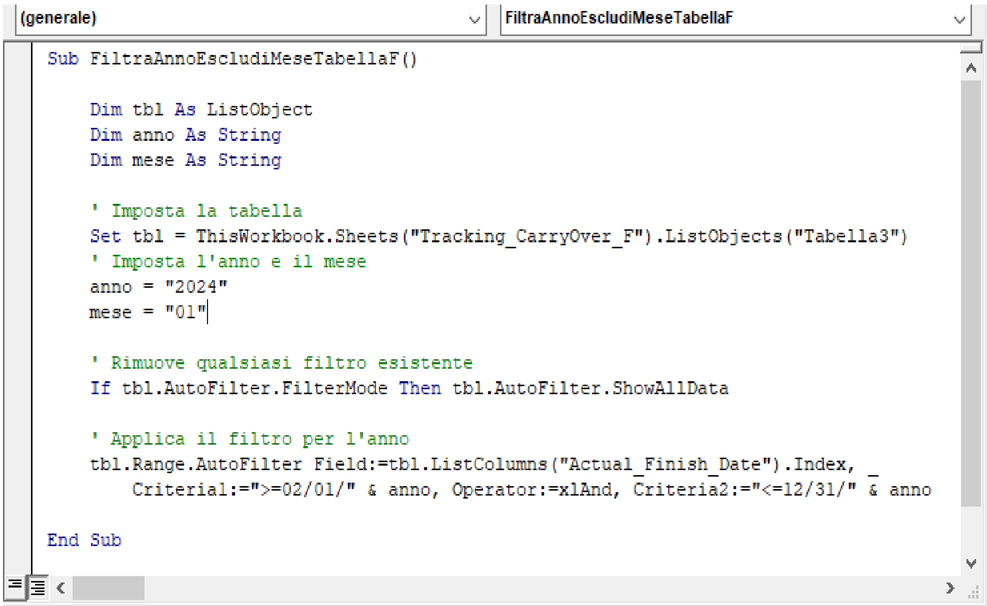
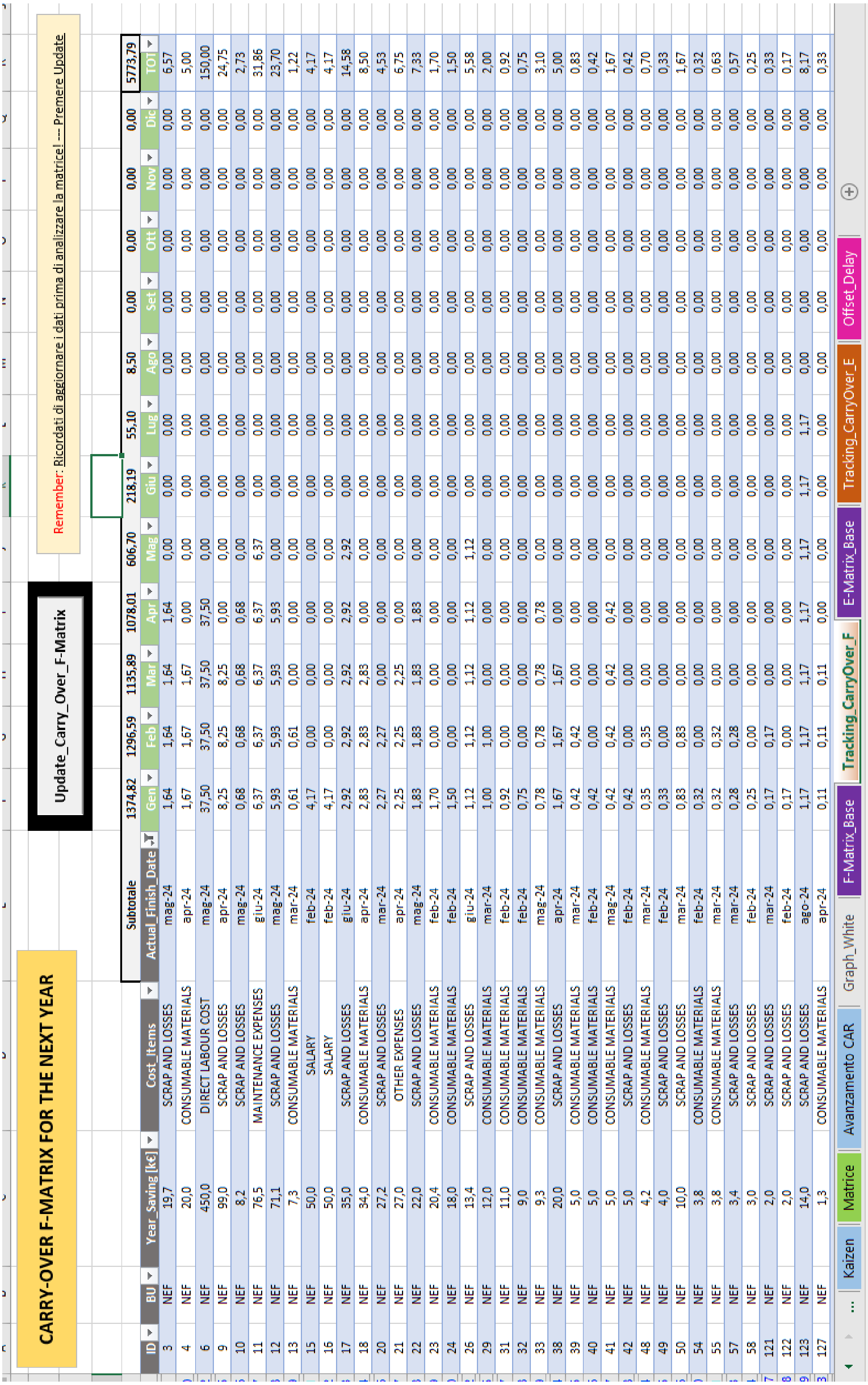


Figure 3.22: Visual Basic Code which allows to isolate *carryover* in the *tracking_CarryOver_F* sheet.

The filter operates on the *Actual_Finish_Date* column and displays only the projects completed between February 2024, and December 2024, excluding those completed in January (if a project finishes in January of the current year, its entire benefit will fall within the current year, meaning it will have zero *carryover* for the following year). In summary, this code isolates projects completed in 2024, starting from February, within the table, providing a filtered and more specific view of the data related to projects that have a *carryover*.

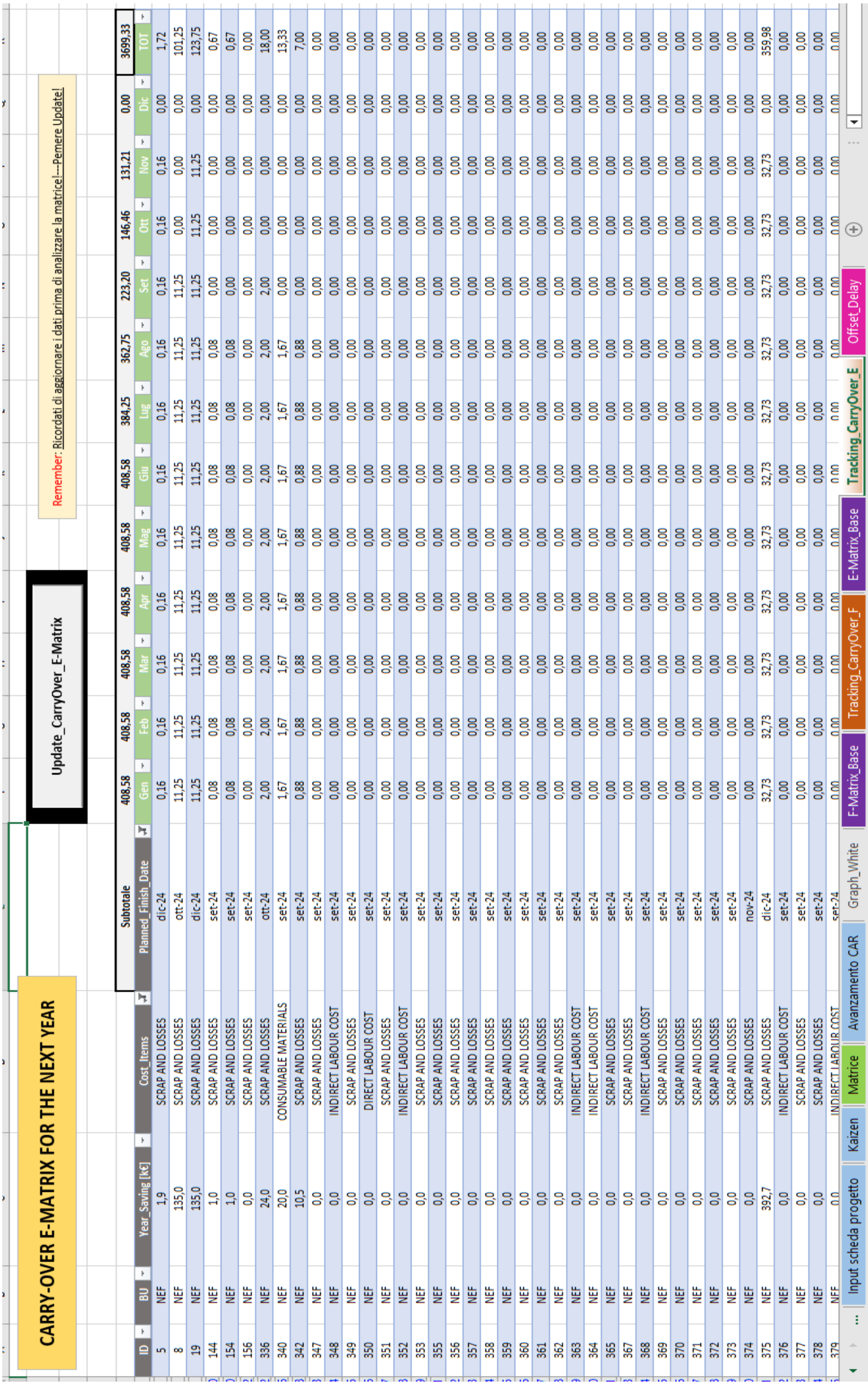


ID	BU	Year_Saving [k€]	Cost_Items	Actual_Finish_Date	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic	TOT
				Subtotale	1374,82	1296,59	1135,89	1078,01	606,70	218,19	55,10	8,50	0,00	0,00	0,00	0,00	5773,79
3	NEF	19,7	SCRAP AND LOSSES	mag-24	1,64	1,64	1,64	1,64	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	6,57
4	NEF	20,0	CONSUMABLE MATERIALS	apr-24	1,67	1,67	1,67	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	5,00
6	NEF	450,0	DIRECT LABOUR COST	mag-24	37,50	37,50	37,50	37,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	150,00
9	NEF	99,0	SCRAP AND LOSSES	apr-24	8,25	8,25	8,25	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	24,75
10	NEF	8,2	SCRAP AND LOSSES	mag-24	0,68	0,68	0,68	0,68	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,73
11	NEF	76,5	MAINTENANCE EXPENSES	giu-24	6,37	6,37	6,37	6,37	6,37	0,00	0,00	0,00	0,00	0,00	0,00	0,00	31,86
12	NEF	71,1	SCRAP AND LOSSES	mag-24	5,93	5,93	5,93	5,93	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	23,70
13	NEF	7,3	CONSUMABLE MATERIALS	mar-24	0,61	0,61	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,22
15	NEF	50,0	SALARY	feb-24	4,17	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	4,17
16	NEF	50,0	SALARY	feb-24	4,17	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	4,17
17	NEF	35,0	SCRAP AND LOSSES	giu-24	2,92	2,92	2,92	2,92	2,92	0,00	0,00	0,00	0,00	0,00	0,00	0,00	14,58
18	NEF	34,0	CONSUMABLE MATERIALS	apr-24	2,83	2,83	2,83	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	8,50
20	NEF	27,2	SCRAP AND LOSSES	mar-24	2,27	2,27	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	4,53
21	NEF	27,0	OTHER EXPENSES	apr-24	2,25	2,25	2,25	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	6,75
22	NEF	22,0	SCRAP AND LOSSES	mag-24	1,83	1,83	1,83	1,83	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	7,33
23	NEF	20,4	CONSUMABLE MATERIALS	feb-24	1,70	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,70
24	NEF	18,0	CONSUMABLE MATERIALS	feb-24	1,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,50
26	NEF	13,4	SCRAP AND LOSSES	giu-24	1,12	1,12	1,12	1,12	1,12	0,00	0,00	0,00	0,00	0,00	0,00	0,00	5,58
29	NEF	12,0	CONSUMABLE MATERIALS	mar-24	1,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,00
31	NEF	11,0	CONSUMABLE MATERIALS	feb-24	0,92	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,92
32	NEF	9,0	CONSUMABLE MATERIALS	feb-24	0,75	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,75
33	NEF	9,3	CONSUMABLE MATERIALS	mag-24	0,78	0,78	0,78	0,78	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	3,10
38	NEF	20,0	SCRAP AND LOSSES	apr-24	1,67	1,67	1,67	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	5,00
39	NEF	5,0	CONSUMABLE MATERIALS	mar-24	0,42	0,42	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,83
40	NEF	5,0	CONSUMABLE MATERIALS	feb-24	0,42	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,42
41	NEF	5,0	CONSUMABLE MATERIALS	mag-24	0,42	0,42	0,42	0,42	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,67
42	NEF	5,0	SCRAP AND LOSSES	feb-24	0,42	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,42
48	NEF	4,2	CONSUMABLE MATERIALS	mar-24	0,35	0,35	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,70
49	NEF	4,0	SCRAP AND LOSSES	feb-24	0,33	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,33
50	NEF	10,0	SCRAP AND LOSSES	mar-24	0,83	0,83	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,67
54	NEF	3,8	CONSUMABLE MATERIALS	feb-24	0,32	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,32
55	NEF	3,8	CONSUMABLE MATERIALS	mar-24	0,32	0,32	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,63
57	NEF	3,4	SCRAP AND LOSSES	mar-24	0,28	0,28	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,57
58	NEF	3,0	SCRAP AND LOSSES	feb-24	0,25	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,25
121	NEF	2,0	SCRAP AND LOSSES	mar-24	0,17	0,17	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,33
122	NEF	2,0	SCRAP AND LOSSES	feb-24	0,17	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,17
123	NEF	14,0	SCRAP AND LOSSES	ago-24	1,17	1,17	1,17	1,17	1,17	1,17	1,17	0,00	0,00	0,00	0,00	0,00	8,17
127	NEF	1,3	CONSUMABLE MATERIALS	apr-24	0,11	0,11	0,11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,33

Figure 3.23: snapshot of the sheet *Tracking_CarryOver_F*.

3.7 *Tracking_CarryOver_E* sheet

The logic of this sheet is the same as that of the *tracking_CarryOver_F* sheet and reflects the reasoning behind the *F-Matrix_Base* and *E-Matrix_Base* sheets. Let's clarify: using the same methodology already outlined in the *tracking_CarryOver_F* sheet, the objective here is to have a projection for the following year concerning those projects that have not yet been completed. This can provide an idea of a good pool of potential projects to draw from if these projects are never completed, allowing for a more timely approach to new initiatives. Some of these projects, for instance, have already been evaluated, have CAR that have already begun, or have simply been postponed to prioritize other projects. What is expected, as we progress through the current year, is a continuous reduction in the *carryover* from the projects in the *E matrix* (which have not yet been completed), in favor of an increase in the *carryover* of the projects in the *F matrix* (which have been completed and are thus generating benefits). In other words, the expectation is to see a transfer of *carryover* from the theoretical (if the project were completed) to the actual. For both sheets, cells have been dedicated above the columns that detail the monthly breakdown of savings (see figures 3.23 and 3.24), which provide an instant visual overview of the current situation or immediately detect any possible anomalies. One such anomaly could be that the total *carryover* in December is expected to always be zero, regardless of whether it is linked to projects in the *F-matrix* or the *E-matrix*. This is because all projects that should finish or have been completed in December of a specific year will have generated a benefit (as previously discussed) that fully applies to the year in which the project was completed. If this is not the case, it would be considered an anomaly, and the structure that has been set up is designed to detect it immediately. This is another aspect that was aimed for with the development of the new matrix: having a structure throughout all operational sheets that allows for the detection of anomalies when present and enables swift and effective intervention by quickly isolating and understanding the cause of the issue. Previously, this was not possible; when a problem arose, the time taken to identify its cause was often quite high, sometimes rendering the intervention less effective, especially when data needs to be available on very short notice. The need for a structure based on these requirements might seem like the bare minimum for ensuring the precision of the required data and for the type of monitoring work to be performed. However, achieving this within this year was not a given.



				Subtotale	408,58	408,58	408,58	408,58	408,58	408,58	384,25	362,75	223,20	146,46	131,21	0,00	3699,33
ID	BU	Year_Saving [k€]	Cost_Items	Planned_Finish_Date	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic	TOT
5	NEF	1,9	SCRAP AND LOSSES	dic-24	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,00	1,72
8	NEF	135,0	SCRAP AND LOSSES	ott-24	11,25	11,25	11,25	11,25	11,25	11,25	11,25	11,25	11,25	0,00	0,00	0,00	101,25
19	NEF	135,0	SCRAP AND LOSSES	dic-24	11,25	11,25	11,25	11,25	11,25	11,25	11,25	11,25	11,25	11,25	11,25	0,00	123,75
144	NEF	1,0	SCRAP AND LOSSES	set-24	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,00	0,00	0,00	0,00	0,67
154	NEF	1,0	SCRAP AND LOSSES	set-24	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,00	0,00	0,00	0,00	0,67
156	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
336	NEF	24,0	SCRAP AND LOSSES	ott-24	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	0,00	0,00	0,00	18,00
340	NEF	20,0	CONSUMABLE MATERIALS	set-24	1,67	1,67	1,67	1,67	1,67	1,67	1,67	1,67	0,00	0,00	0,00	0,00	13,33
342	NEF	10,5	SCRAP AND LOSSES	set-24	0,88	0,88	0,88	0,88	0,88	0,88	0,88	0,88	0,00	0,00	0,00	0,00	7,00
347	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
348	NEF	0,0	INDIRECT LABOUR COST	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
349	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
350	NEF	0,0	DIRECT LABOUR COST	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
351	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
352	NEF	0,0	INDIRECT LABOUR COST	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
353	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
355	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
356	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
357	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
358	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
359	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
360	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
361	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
362	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
363	NEF	0,0	INDIRECT LABOUR COST	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
364	NEF	0,0	INDIRECT LABOUR COST	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
365	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
367	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
368	NEF	0,0	INDIRECT LABOUR COST	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
369	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
370	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
371	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
372	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
373	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
374	NEF	0,0	SCRAP AND LOSSES	nov-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
375	NEF	392,7	SCRAP AND LOSSES	dic-24	32,73	32,73	32,73	32,73	32,73	32,73	32,73	32,73	32,73	32,73	32,73	0,00	359,98
376	NEF	0,0	INDIRECT LABOUR COST	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
377	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
378	NEF	0,0	SCRAP AND LOSSES	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
379	NEF	0,0	INDIRECT LABOUR COST	set-24	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Figure 3.24: snapshot of the sheet *Tracking_CarryOver_E*.

3.8 *Offset_Delay* sheet

This operational sheet (see fig 3.25) represents the final step in the analysis of delays, previously introduced in the section discussing the *Matrice* sheet (when the fourth part of the matrix is introduced, see fig. 3.14). The conceptualization of this approach is a complete innovation compared to previous years, adding an additional layer of management and monitoring for an aspect that can significantly impact the achievement of targets. For each project listed in the matrix, the *ID* and *BU* are displayed, and then, following the methods already introduced in the *Matrice* sheet, the project's status is calculated. Let's quickly recall what can be indicated for each project in the *Monthly Delay* and *Advances* column:

- **Missing Both Dates**: when both the *Actual Finish Date* and *Planned Finish Date* are empty, the formula indicates that no dates for planned or actual completion have been provided.

- **Missing Planned Finish Date**: if only the *Actual Finish Date* is provided and the *Planned Finish Date* is missing, the formula highlights that the actual completion date is available, but the planned date has not been entered.

- **Missing Actual Finish Date**: if only the *Planned Finish Date* is entered and the *Actual Finish Date* is missing, the formula points out that the actual completion date is missing, while the planned date is recorded.

- **Number of Delays or Advances**: when both dates are present, the formula compares the months of the *Planned Finish Date* and the *Actual Finish Date*. If the *Actual Finish Date* is later, the formula calculates the number of months of delay. Otherwise, the number of months by which the project was completed ahead of schedule is calculated.

- **No Delay-No Advances**: if the *Actual Finish Date* is the same as the *Planned Finish Date*, the formula confirms that the project was completed on time without delays and without advances. It is obvious that the presence of a delay will show the lack of an advance in the dedicated column, and the opposite is also true.

Beyond the purely temporal aspect, the impact of a potential delay or advance was also assessed. Specifically, by considering the saving associated with each project and dividing it by the twelve months, you obtain the monthly weight of that project. By multiplying this weight by the number of months of delay or advance, you get the

Delay Cost and *Advances Benefit* columns, respectively. In the upper left corner of the sheet, there is a snapshot of the overall situation regarding delays and advances, providing an evaluation of the net impact on the progress of the projects.

Delay_Impact	Advances_Impact	Net_Impact			
77,6	234,8	157,2			
					Positive_Offset
					Negative_Offset

ID	B.U	Monthly Delay	Delay Cost [k€]	Advances	Advances Benefit
1	NEF	Missing Actual Finish Date	0,0	Missing Actual Finish Date	0,0
2	NEF	Missing Actual Finish Date	0,0	Missing Actual Finish Date	0,0
3	NEF	No Delay	0,0	No Advances	0,0
4	NEF	No Delay	0,0	No Advances	0,0
5	NEF	Missing Actual Finish Date	0,0	Missing Actual Finish Date	0,0
6	NEF	No Delay	0,0	No Advances	0,0
7	NEF	Missing both Date	0,0	Missing both Date	0,0
8	NEF	Missing Actual Finish Date	0,0	Missing Actual Finish Date	0,0
9	NEF	No Delay	0,0	No Advances	0,0
10	NEF	No Delay	0,0	No Advances	0,0
11	NEF	No Delay	0,0	3	19,1
12	NEF	No Delay	0,0	No Advances	0,0
13	NEF	No Delay	0,0	1	0,6
14	NEF	No Delay	0,0	No Advances	0,0
15	NEF	No Delay	0,0	No Advances	0,0
16	NEF	No Delay	0,0	No Advances	0,0
17	NEF	No Delay	0,0	No Advances	0,0
18	NEF	No Delay	0,0	No Advances	0,0
19	NEF	Missing Actual Finish Date	0,0	Missing Actual Finish Date	0,0
20	NEF	No Delay	0,0	No Advances	0,0
21	NEF	3	6,8	No Advances	0,0
22	NEF	No Delay	0,0	6	11,0
23	NEF	1	1,7	No Advances	0,0

Figure 3.25: snapshot of the *Offset_Delay* sheet.

So, operationally speaking, when a delay is detected from the matrix, the economic impact is assessed by consulting this sheet. If the impact is positive, efforts are still made to remedy the delay to maintain a positive net impact. However, if the net impact is negative, immediate action is required to address the delay, such as finding new projects or advancing others to turn the net impact positive again. A negative net impact indicates that we are falling short of the expected benefit delivery. As projects are added to the matrix and planned, a total benefit is projected, which we aim to achieve by the end of the year. If delays accumulate relative to the plan, the total projected benefit automatically decreases, raising the likelihood of missing the target. Conversely, having a positive net impact—through an accumulation of projects completed ahead of schedule—creates a cushion that protects us and ensures that the declared total benefit will be realized. This concept will be further clarified using a graph when discussing the *Graph_White* sheet. This demonstrates the critical importance of monitoring delays and advances to maintain a realistic overview and ensure data accuracy. Prior to the new matrix, such monitoring did not exist, and the lack of data oversight likely contributed to not meeting efficiency targets. This new tool has effectively bridged that gap. In the current situation, we see that the net impact to date is positive, which indicates that we are ahead of schedule compared to the planned projects. This suggests a good 'speed' in the onboarding of projects.

3.9 *Graph_White* sheet

We have reached the final operational sheet. This sheet can be considered as the visual output of all the analysis and discussions we have had up to this point in the various sections of this chapter. It contains all the graphs used in official presentations, which are employed for various meetings to understand the current situation at both the site level and within the various business units. The sheet includes 85 graphs (see fig. 3.27) and is divided into general graphs that we will analyze later at the top, site-specific graphs, and graphs for each business unit. The logic behind the layout of the sheet is to analyze a specific situation at the site level using one graph and then examine the same situation at the level of each Business Unit. In this context, we will analyze the graphs that comprise the overall situation regarding the site, and only for one graph will we analyze the situation for the various business units for the sake of convenience (it will be analyzed one of the most used and important graph). In the following charts, there will be sensitive company data that will therefore be covered. The logic of analysis for the sheet will follow that applied to the *Matrice* sheet, starting from the top left and moving horizontally across the sheet. What we find is shown in fig. 3.26.

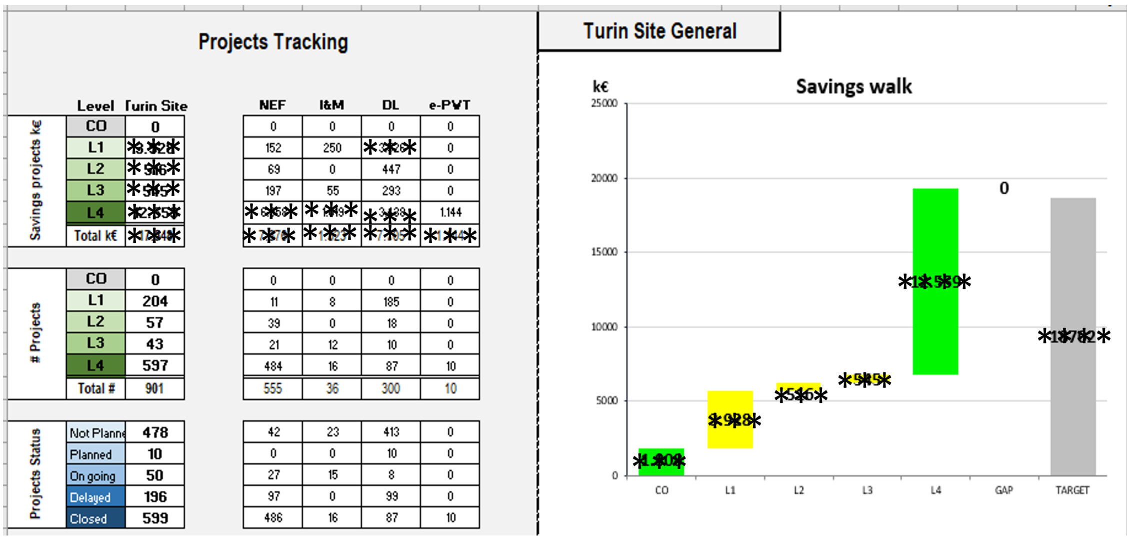


Figure 3.26: snapshot of the first part of the *Graph_White* sheet.

As can be seen, in the top left corner there is a table that lists, in order, the projects in terms of savings for each business unit and for each *Level*. Following this, the projects are indicated in terms of the actual number of projects for each business unit and for each *Level*, and finally, the number of projects is indicated in terms of status (*Not Planned*, *Planned*, *Ongoing*, *Delayed*, *Closed*) for each Business Unit.

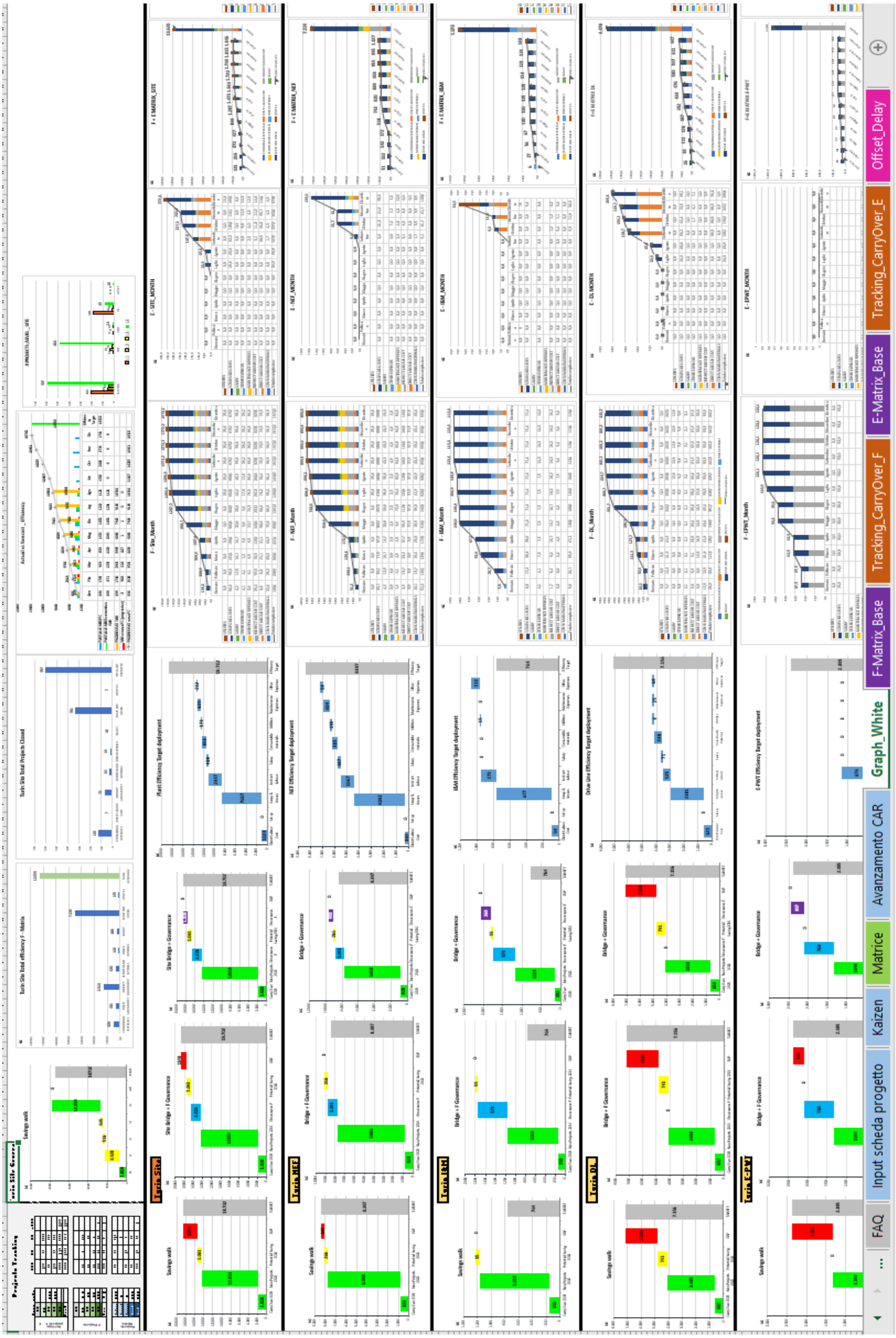


Figure 3.27: snapshot of the sheet *Graph_White* to give an idea of how large the sheet in question is, due to space constraints, what is shown here is only a part of the 85 graphs it contains.

Following this, we can observe the first chart titled *Saving Walk*. Here, in particular, we can see the data reported in the previously mentioned table. In order, there is a green coloration for *Carryover* (projects from the previous year that continue to bring benefits in the current year) and yellow for the saving value brought by the projects at levels *L1*, *L2*, *L3*, and *L4* (in green). Finally, the last column, in grey, indicates the target value to be reached. Here, we can see that overall, the sum of the benefits brought by all projects, regardless of their level, exceeds the target value. This indicates that there is potentially enough strength to reach the target; however, it should be noted that not all projects in *L1*, *L2*, and *L3* are guaranteed to enter, hence there is a potential risk. Continuing to scroll the sheet horizontally to the right, we find two more charts (see fig 3.28), namely the *Turin Site Total Efficiency F-Matrix* and the *Turin Site Total Projects Closed*.

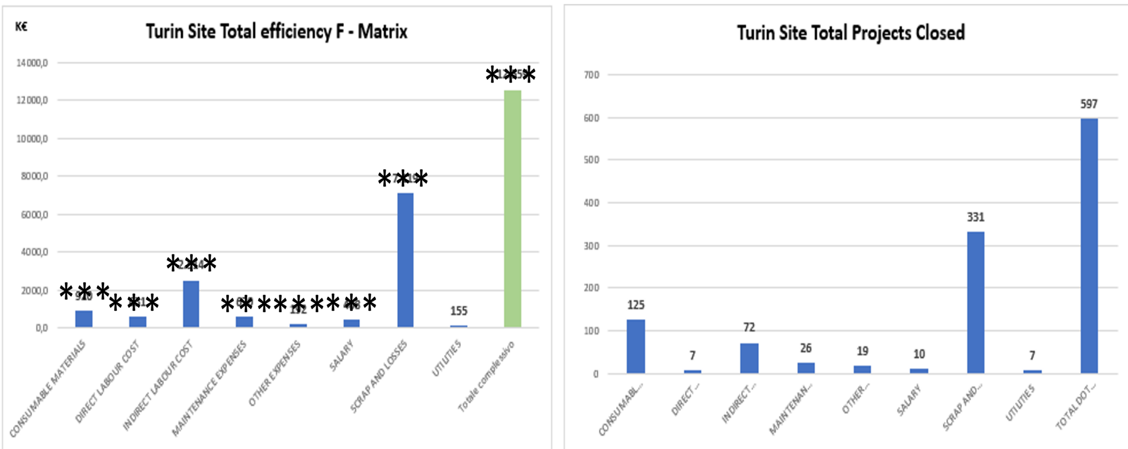


Figure 3.28: snapshot of the second part of the *Graph_White* sheet.

The first chart indicates the value of the benefit brought by all projects in the *F-Matrix* (level *L4*, i.e., those projects that have been completed and are currently generating benefits) divided by cost category, specifically the cost category in which they are delivering the declared benefit. The second, following the same logic, shows the number of projects in status *L4*, therefore completed, divided by cost item. The next chart we find on the sheet is shown in fig. 3.29, called *Actual vs. Forecast Efficiency*. It is one of the fundamental charts where an innovative approach has been adopted to monitor the performance of the plant's overall benefits compared to what is known as the *Forecast*. Before diving into the chart's details, it is essential to clarify what is meant by *Forecast*. Starting from a cost base, which includes all the costs incurred in the previous year, the expected trend of the benefits for the following year is established to achieve the efficiency target. Usually, the benefit is calculated as a specific percentage of the total costs incurred in a given month; this calculation is iterated and adjusted with the correct percentage month by month, ultimately reaching the target. For example, this year the efficiency target represents 10.1% of the cost base from the previous year.

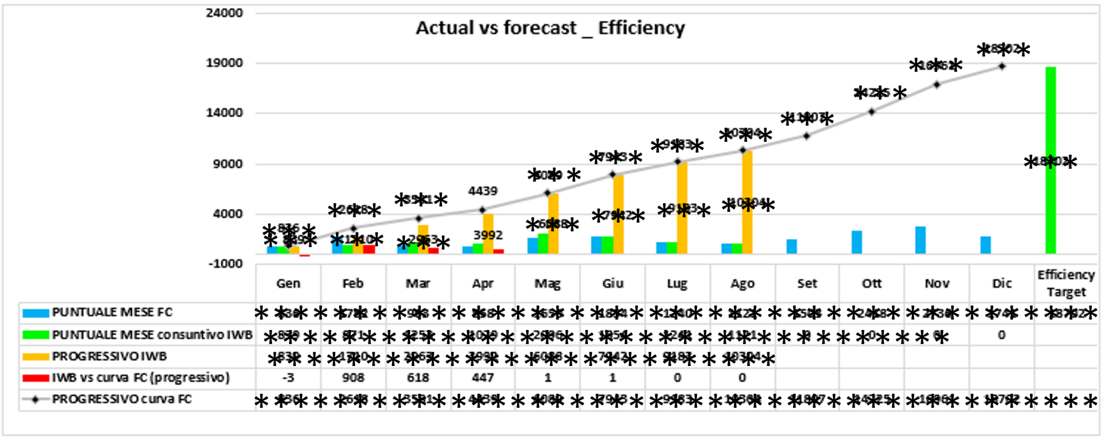


Figure 3.29: snapshot of the third part of the *Graph_White* sheet, this is one of the most important graph in the sheet.

To complete the concept, the previous paragraphs discussed defining a budget for the following year, a budget that would cover the costs of the projects declared and intended to be completed during the upcoming year. This budget is defined based on the declared projects, which should help achieve the target. Therefore, the project selection during the budget phase is made to achieve the target as a benefit. This chart aims to create a current view of how the benefits are trending compared to what was forecasted the previous year, called the *Forecast*. The Finance department drafts this *Forecast*, and the innovative contribution of the DOT team was to build a synergy over several months with the Finance department, sharing data such as this forecast and the actual monthly benefits (the chart resulting from this will be explained in detail when analyzing the site-level charts). This collaboration allowed for a true comparison of the benefit trend, providing a realistic idea of performance. The accuracy and reliability of the data are linked to what is actually recorded and measured by the Finance department through the transcription of what is known as the *IWB* (Industrial Workbook). The "Industrial Workbook" (IWB) in a financial context refers to a document or tool used for planning, analyzing, and monitoring an organization's industrial performance. It is often used in manufacturing or industrial companies to consolidate key information on budgeting and forecasting, including budget planning and forecasting of costs and revenues for production units; cost analysis, including detailed analysis of operational costs such as direct costs (materials and labor) and indirect costs (general and administrative expenses); and performance tracking, monitoring operational performance, such as production efficiency, quality, and resource utilization. Each month, as a result of the synergy created with the Finance department, the *IWB* is delivered to the DOT team. By entering the data into specific tables on particular sheets (these are the previously mentioned sheets that are not operational but are "maneuver" sheets, designed to create and make dynamic the charts we see and will continue to see; they are hidden sheets, visible and accessible exclusively to the DOT team), the chart is updated monthly. This chart shows the *IWB* trend (the actual benefit accrued by the plant) which is the orange column compared to the theoretical trend it should have followed according to the *Forecast* which is the grey line. From chart 3.29, we can see that the Turin plant experienced losses compared to the forecast in February, March, and April, but continuously improved, eventually meeting the target (matching the forecast) for the following months up to the present day. Going into further detail for a single month, in April, the overall *Forecast* (benefits from the beginning of the year up to April) was 4.439 million euros (represented by the grey-curve). The plant had reached, up to April, benefits of 3.992 million euros (the accuracy of the data is 100% reliable as it is compiled by Finance, in the graph it is represented by the yellow column), thus recording a loss of 447 thousand euros compared to the Forecast. We have simulated the reading of the chart, which is done during every meeting. This type of analysis can be done on a monthly basis since the data is available for each month, and the chart provides this capability. The last chart in this first set of graphs (corresponding to the first row at the top of image 3.27) is shown in fig. 3.30 called *#PROJECTS/LEVEL_SITE*.

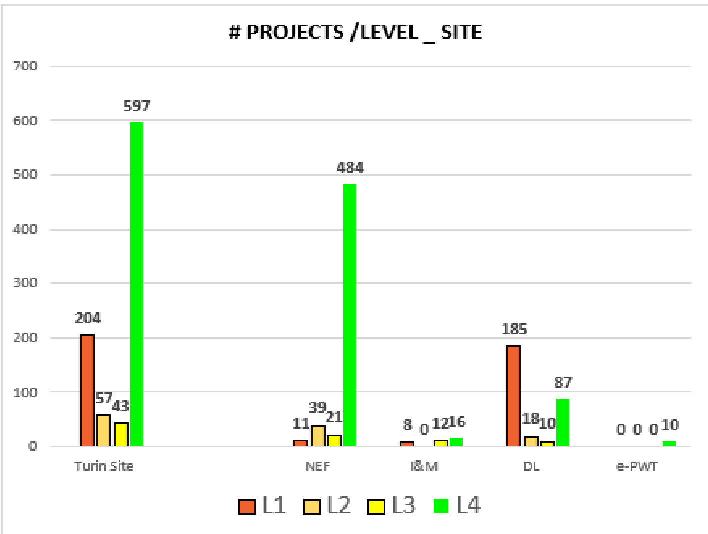


Figure 3.30: snapshot of the fourth part of the *Graph_White* sheet.

This chart displays the number of projects per business unit and per *Level*, providing an overview of how each business unit is performing and, consequently, how the entire site is doing. For instance, analyzing Driveline, we can see that they have 87 closed projects, 185 projects at level *L1*, and 18 and 10 projects at levels *L2* and *L3*, respectively. This situation suggests a bit of a bottleneck, as there seems to be difficulty moving projects from *L1* to the subsequent levels.
At this point, having completed the first set of charts, we can move on to analyze some more operational charts. We will start by analyzing the charts at the site level, and as a demonstration, we will examine the situation for a single BU for one of them, before continuing the analysis exclusively at the site level. The first charts we can observe are those in fig. 3.31, titled *Saving Walk* and *Site Bridge + F Governance*.

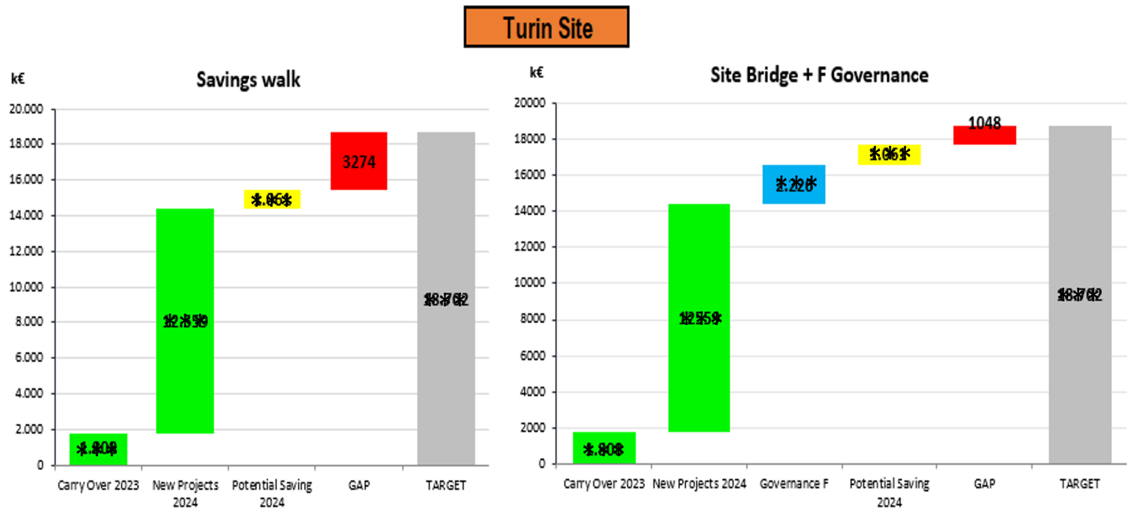


Figure 3.31: snapshot of the fifth part of the *Graph_White* sheet, this is the starting point for the site-level graphs.

The first chart shows the walk, which represents the progress of the various benefits (depicted as columns) that should collectively lead to the achievement of the target. The first green column represents the *Carryover* amount (the residual benefit from projects completed the previous year). The second green column, labeled "New Project 2024," refers to the *F-Matrix*, which is the total benefit from projects that have already been completed. The next yellow column, labeled "Potential Saving 2024," represents the *E-Matrix*, indicating the amount from projects that still need to be completed. The red column represents the GAP, which is the shortfall needed to reach the efficiency target, shown as the final grey column. Currently, we see that the Turin plant has a gap of 3.274 million euros to fill to meet the target. However, this chart deliberately excludes a piece of information, the so-called *Governance*, which has been frequently mentioned. The "Site Bridge + F Governance" chart takes this aspect into account. In particular, keeping everything else the same, the blue column named *Governance* is introduced here. Thanks to the synergy established with Finance department and the creation of this new matrix, at the beginning of each month, the Finance team provides the DOT team with the Industrial WorkBook (IWB), which records all the benefits accrued by the plant for the analyzed month. By entering the recorded benefit for each cost item that falls within the scope of continuous improvement into one of the 'maneuver' sheets (one of these will be shown later for demonstration), the Governance is calculated:

$$IWB = Carryover + F\_Matrix + Governance$$

$$Governance = IWB - Carryover - F\_Matrix$$

Generally, everything that the plant identifies as a benefit is recorded in the IWB document prepared by Finance office, which explains the structure of the formula written above. The carryover, a leftover benefit from the previous year, must be recorded as a benefit, the new projects in the same way, and if there is any Governance, it must also be registered as a benefit by the Finance department. This is why the overall benefit is considered as a sum of three components (Carryover, F-Matrix, and Governance). Therefore, whenever the IWB is greater than the sum of the *Carryover* and the new projects (*F-Matrix*), the difference will quantify what is called *Governance*. This approach represents a significant innovation as it brings a double benefit: first, it allows quantifying and tracking this undeclared benefit, which could otherwise remain hidden if not properly quantified and formalized (*Governance*); second, it verifies the validity of the projects and the declared savings by comparing them with what is actually recorded by the Finance department, reflecting the reality (later, we will see how this concept is represented in a graph and used in meetings). And so, by adding the *Governance* recorded up to today and returning to the graph, a new scenario emerges where the GAP persists but is reduced to 1.048 million euros compared to the target. For this graph, the situations for each business unit will be analyzed to simulate the assessment conducted according to the previously mentioned vertical scrolling logic, which is how this sheet should be consulted. By scrolling vertically through the sheet, we find, as shown in figure 3.32, the status of NEF, followed by Industrial & Marine, then Driveline, and finally E-Powertrain.

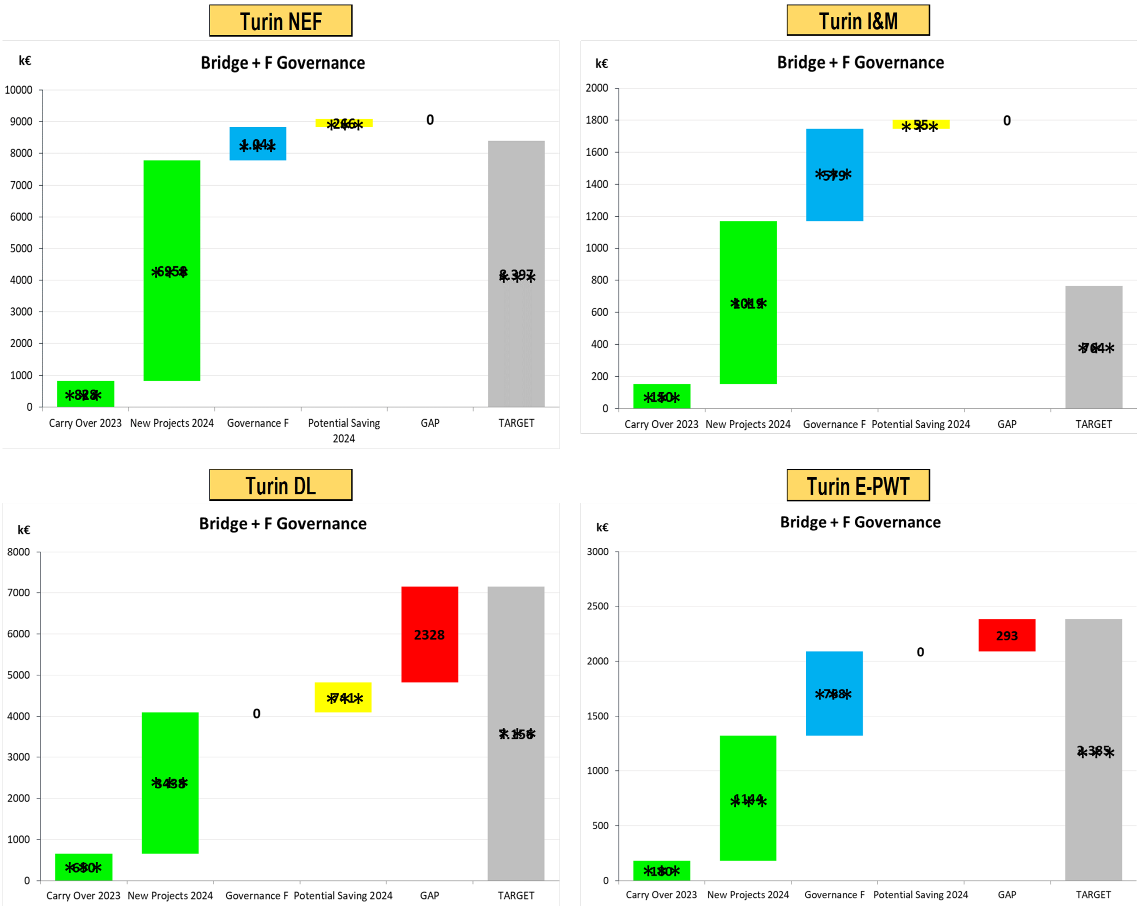


Figure 3.32: this is the set of the same graph in *Graph_White* sheet divided for business unit. The logic for consulting the sheet involves scrolling vertically to view the same chart for each business unit and horizontally to see different charts depending on the location, whether at the site level or the Business Unit level.

The NEF business unit, as shown in the first graph, does not have a GAP. The contribution of the various benefits leads to the achievement of the target. The efficiency target can be broken down by individual Business Unit, and the sum of the targets for each unit will, of course, result in the overall efficiency target for the entire site. It's important to note that the targets defined for each business unit are not the same. Each unit differs in terms of process complexity, size in terms of workforce, and volume, so it's understandable that their efficiency targets must also vary. The situation of Industrial & Marine, like NEF, does not show any GAP. It is likely the best-performing business unit; however, it should be noted that its target is relatively smaller compared to that of NEF, for instance, and its area is significantly less complex. Nonetheless, it still shows an over-achievement compared to its target. The current situation of Driveline is probably the most critical, as seen in the graph. It shows a GAP about 2.328 million euro and it does not show any *Governance*, likely because the managerial actions within this business unit fail to deliver the expected benefit, or because the emerging losses far exceed the benefits of these actions. It should be noted that, if the document drafted by Finance subdivision, the IWB, reports benefits lower than those declared, for instance, if IWB states 1,000 euro and the data in the Driveline *F-Matrix* shows €2,000, this represents an initial actual loss of 1,000 euro. There cannot be a declared project value that exceeds what Finance department has recorded as a benefit. It's evident, given how Governance has been formalized (as previously explained), that in such a scenario, not only will no *Governance* be generated, but losses will also be present (the difference between the IWB and the *F-Matrix* will be negative, representing a loss). The final situation to analyze is that of E-Powertrain, which, like Driveline, is quite critical. Despite having a *Governance*, it shows a GAP of 293 thousand euros. The most concerning aspect, however, is that this business unit has no new ideas. This is due to the fact that the number of projects in the *E-Matrix* (projects yet to be completed) is zero; there are no new projects to finish before the end of the year. Consequently, there will be no new benefits added to the F-Matrix until year-end, as the *F-Matrix* is frozen at its current value. This ultimately means that this GAP will persist until the year's end unless new ideas are found, evaluated, and executed. Returning to the site-level charts and continuing to scroll the sheet horizontally, we find the chart in fig. 3.33 titled *Site Bridge + F Governance + E Governance*.

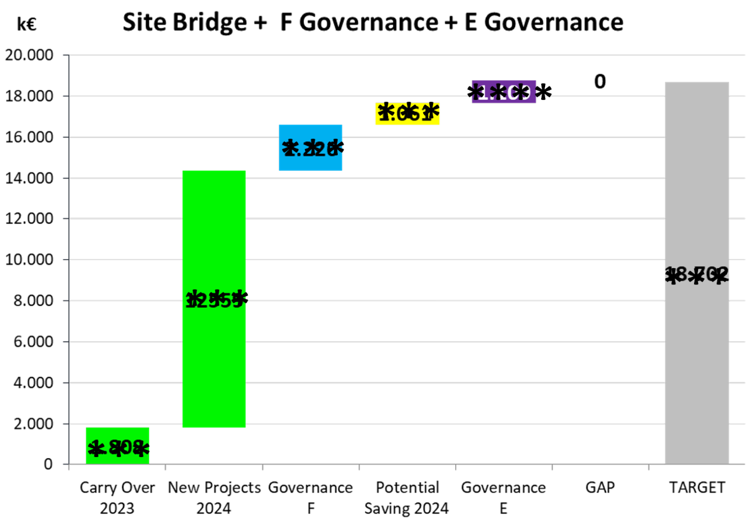


Figure 3.33: snapshot of the part seven of the *Graph_White* sheet, this is the last graph belonged to the *Site Bridges* types.

This chart is the last of those named *Site Bridge*. It introduces an additional innovative element by creating a forecast of *Governance*. The *F Governance* is called this way, following the project nomenclature, because it is already mature. The *E Governance*, on the other hand, is a projection for the remaining months. It has been mathematically modeled as the average of the already matured *Governance* from previous months, and it simply projects for the remaining months, excluding August (which barely has one working week) and considering only one week in December. The scenario created is shown in the figure, where at the site level, the GAP is no longer present. This chart was used and presented as the scenario that best represents the reality of efficiency in terms of continuous improvement until June. During this period, the months from January to June are when *Governance* should be most present since the most substantial projects, in terms of benefits, are completed later. The experience of those who have been part of FPT Industrial for many years suggests a greater presence of substantial projects from May-June to October (some of these larger projects, in fact, require machine downtime to be completed). *Governance*, therefore, is expected to be recorded in the first part of the year, if it ever occurs (this will be shown as true in subsequent charts). In the months following June, the scenario that is shown to be most representative of reality is the one depicted in fig. 3.31, containing the *F Governance* and a GAP of 1.048 million euros. It is not expected that *Governance* will be present in the remaining months, and strategically, it is better to show that there is a GAP in the plant and that efforts are underway to bring projects forward to reduce the GAP, rather than showing a scenario where there is no GAP, and it appears that the plant is generating more benefits than expected. It should also be noted that in recent months no *Governance* has been recorded (this will be shown in the following charts). Therefore, the decision not to show the *Governance* forecast seems to be the right direction. Continuing to scroll horizontally, we find the chart in fig. 3.34 titled *Plant Efficiency Target Deployment*.

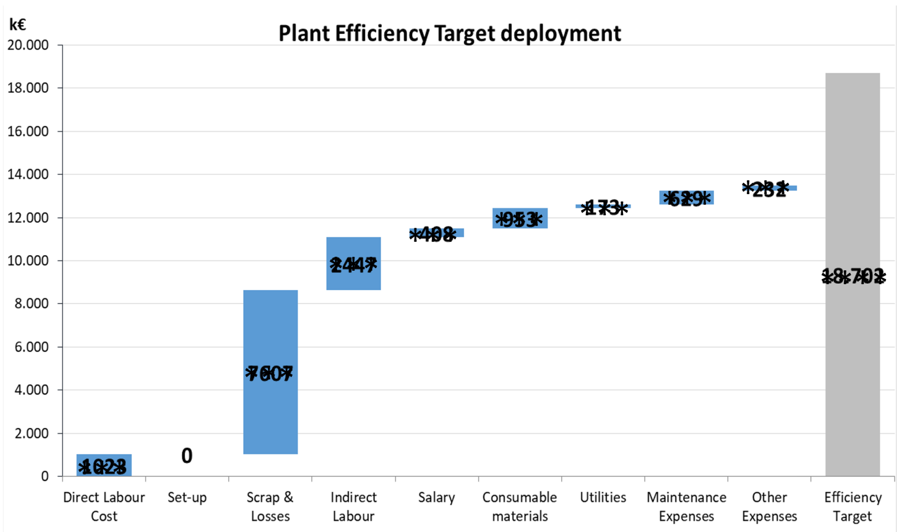


Figure 3.34: snapshot of the part eight of the *Graph_White* sheet.

This chart shows the benefits of completed projects (*F-Matrix*) broken down by cost item. For each cost item, the total contribution in terms of benefits from the various projects is represented using columns. The chart shows a substantial benefit derived from projects related to the cost item *Scrap and Losses*; most projects this year are thus generating greater benefits for that specific cost item. It can be observed that the projects in the *F-Matrix* alone are not sufficient to reach the efficiency target (grey column), but this type of chart was designed only to reflect the completed projects by cost item.
Continuing to scroll horizontally through the sheet, we can find the charts in fig. 3.35 titled *F-Site_Month* and *E-Site_Month*.

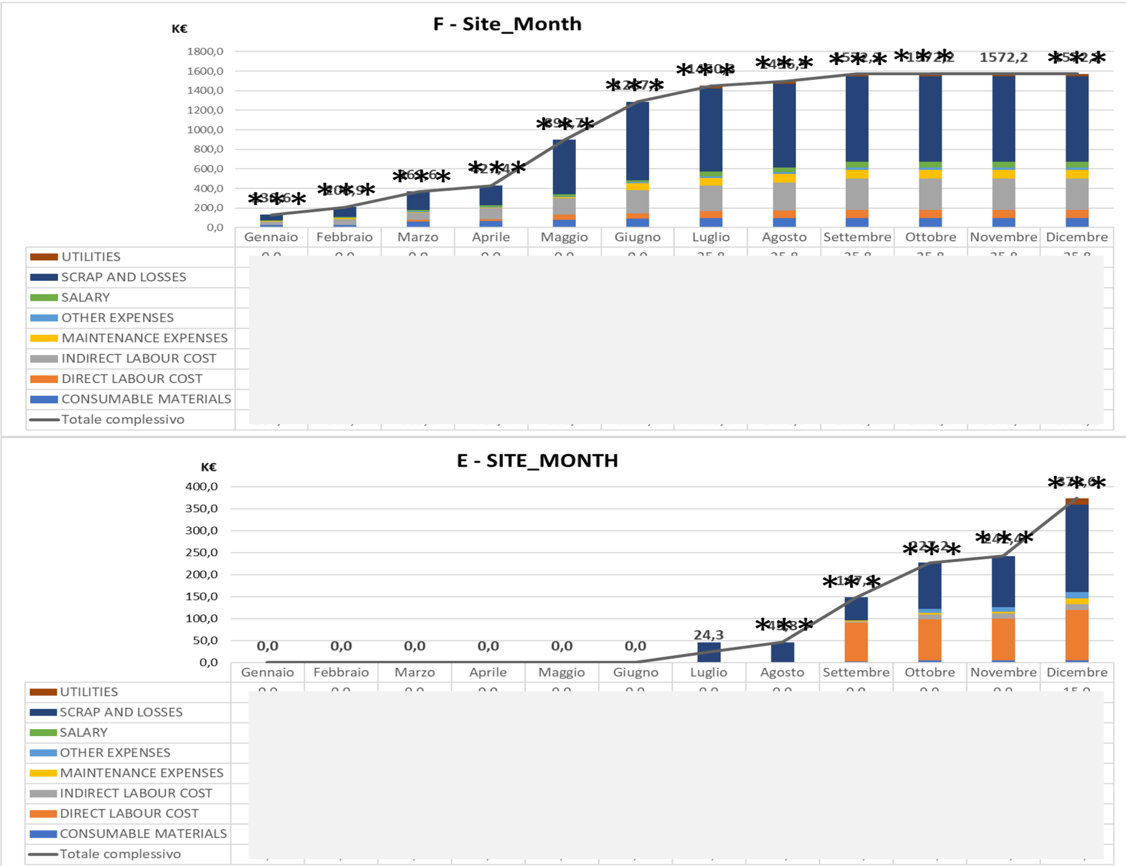


Figure 3.35: snapshot of the part nine of the *Graph_White* sheet, the monthly *E-Matrix* and *F-Matrix* are shown.

These two charts provide an overview of the monthly breakdown of benefits for both completed projects (*F-Matrix*) and projects yet to be completed (*E-Matrix*). However, it is not a given to have a monthly breakdown for the *E-Matrix*. Before the advent of this new matrix, there was no forecast of the benefits in the months for those projects still to be completed. All the focus was on completed projects, losing sight of the more critical months, where substantial projects were planned to be completed, and where more attention might have been needed for monitoring. Thus, with the creation of a monthly breakdown for the *E-Matrix* through the development of the *E-Matrix_Base* sheet, and subsequently with the creation of this chart, precise and up-to-date monitoring of upcoming projects is now possible. Another important aspect, made possible by the creation of the monthly breakdown and the chart related to the *E-Matrix*, is having a visual representation of potential delays. As we have seen many times by now, the *E-Matrix* represents the planned projects that are supposed to be completed in a specific month. What is expected is to see a gradually flattening curve over the months in the *E_Site_Month* chart. This is because past months that still show an *E-Matrix* value (see July and August, for example) represent delayed projects that should have been completed in that month but are still ongoing. By consulting this chart and based on what we have observed, one can immediately refer to the *Matrice* sheet, look into the details of individual projects, and understand how to resolve the issue. This includes identifying the cause of the delay by contacting the team leader and estimating, using the methods previously discussed, the potential delay and its impact on the net effect of various delays and advances. This allows for a proactive approach. Before the introduction of the new matrix, this was not possible. We were reactive when it came to delays, unable to detect them before they happened, and sometimes even unable to detect them after they occurred. The occurrence of a compromising event was neither monitored nor observed once it happened. Now, this is possible. Moreover, it is important to clarify that each month's value does not indicate the new benefit generated in that specific month, but rather a cumulative total, including completed projects from previous months that continue to yield savings in the current month. Therefore, it represents the total benefit expected to be present in that month. The actual benefit that will mature for the first time (in other words, the new benefit that will be generated in that month) in a specific month will be analyzed in a dedicated chart later. Both charts include a data table associated with the graph, using a feature provided by Excel during the chart construction phase, which provides a numerical as well as a visual representation of the composition of each individual column. For each month, it is possible to evaluate the composition of the benefit, based on the contribution of the benefits from each individual cost item (represented by the colors that make up the columns). Closely related to what we have just seen, we can observe fig. 3.36.

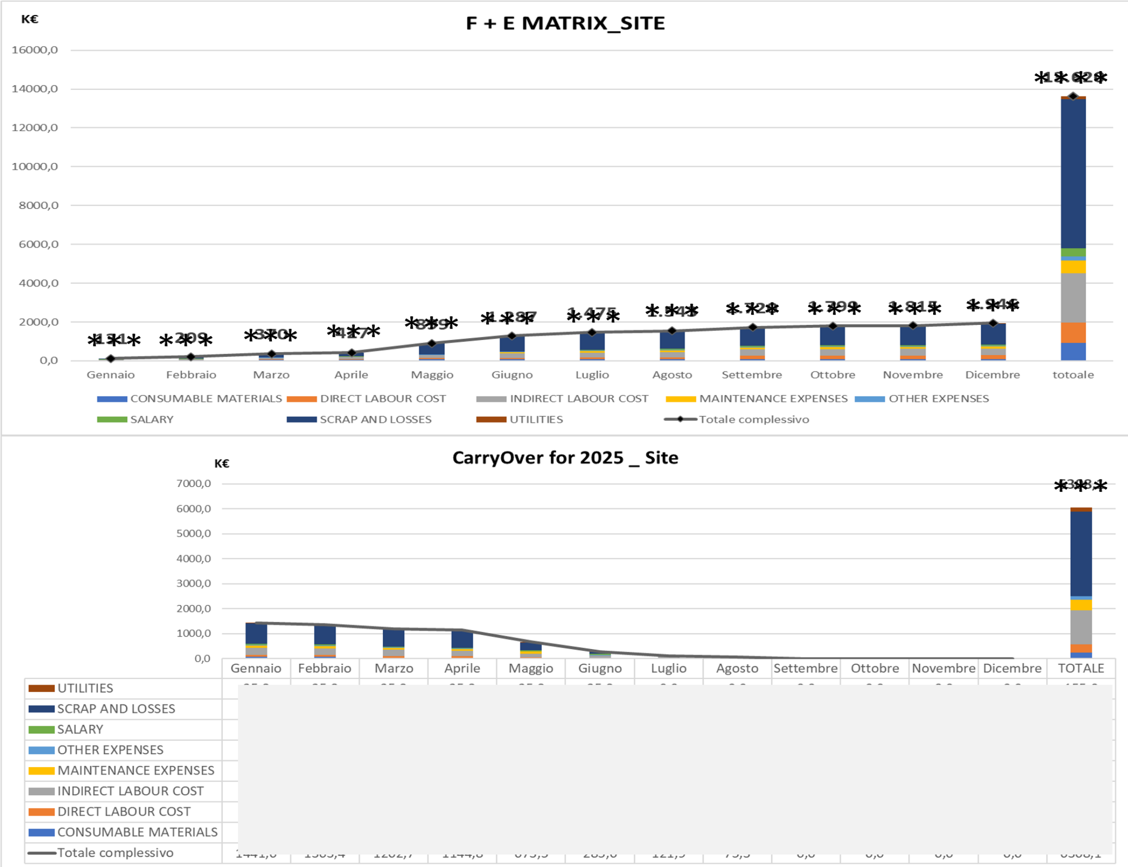


Figure 3.36: snapshot of the part ten of the *Graph_White* sheet.

The first chart, *F+E Matrix_Site*, is simply a sum of the two previously seen charts and gives an idea of both the monthly trend of all projects and (thanks to the last column representing a total) the level of total benefit generated exclusively by continuous improvement projects. It represents the specific weight of the benefit brought solely by projects, regardless of whether they have been completed or not. The second chart, named *CarryOver for 2025_Site*, provides a visual representation of an innovative aspect previously discussed, namely the management and monitoring of *carryover*. This chart gives a visual idea of the monthly breakdown of the residual benefit that will be carried over to the following year, along with a tabulation of monthly values by cost category. As can be seen from the chart, the residual benefit will support the plant in reaching the target for the next year until about July. This means that significant projects will need to be completed for the remaining months. This is the essence of *carryover*, a sort of buffer that helps sustain the plant's efficiency in the early months of each year whether in the presence of *Governance* or not. Thus, this chart visually represents the concept described. As the year progresses, the *carryover* will gradually be exhausted, making way for new projects that, in turn, will generate new *carryover*, and so on.

Continuing with the analysis of the charts, what we find is shown in fig. 3.37, respectively the *F Matrix + E Matrix + F_Gov + E_Gov - Site_Month* chart and the *F Matrix + E Matrix + F_Gov - Site_Month*

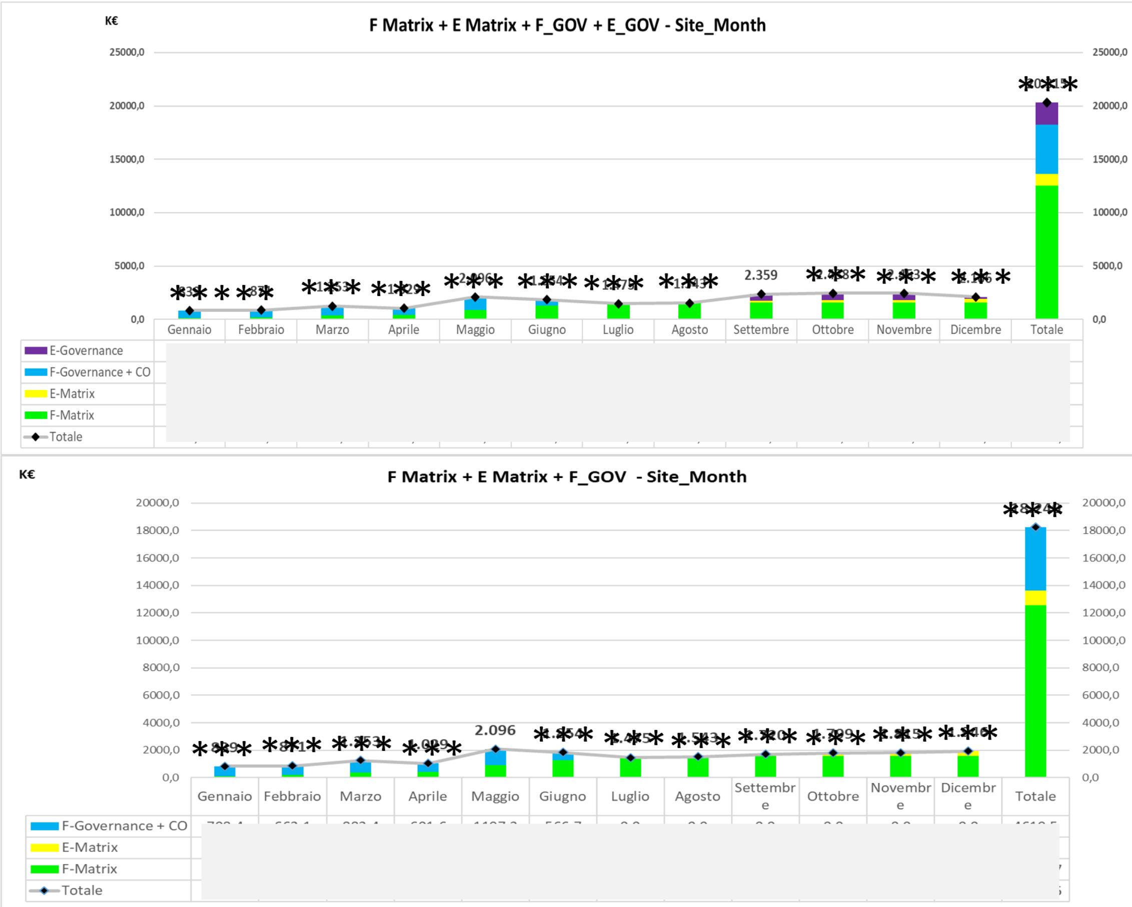


Figure 3.37: snapshot of the part eleven of the *Graph_White* sheet.

The first chart, following the logic of those seen so far, provides a view of the monthly breakdown of *Governance*, both the already matured and the forecasted, as well as the *F Matrix* and *E Matrix*. To provide more detailed information, a table has been created here to support the chart. The *F Governance* (already matured *Governance*) is represented here net of losses (as we saw previously with the formula), but these losses are not included in this chart and will be addressed later. The creation of this chart allows for an instant reading of the *Governance* trend. We can see how it was highly present in the first part of the year (blue column), contributing, along with the carryover, to meeting the monthly targets (the so-called forecast previously analyzed). However, it ceases to be present from July onwards, when most of the completed projects (*F Matrix*, green column) contribute their benefits and it also shows the contribution of predictive *Governance* in the months following the current one. The second chart represents the exact same

concept but is used when, at a strategic level, it is decided not to show a forecast for *Governance* anymore. At this point in the year, as we have seen from the chart, the contribution of *F Governance* starts to diminish, and in some months, it doesn't appear at all. Therefore, showing a forecast doesn't make sense if the trend is in full decline. Today, this is the chart that is consulted. Through the total column, we get a more detailed understanding of the situation, evaluating the contribution of the *F Matrix* (green column), the *E Matrix* (yellow column), and the *F Governance* (blue column).
The next two charts are shown in fig. 3.38, named respectively *F Matrix + E Matrix + F Gov- Site_Saving/Month* and *Tracking Site _ F-Governance & Losses/Month*.

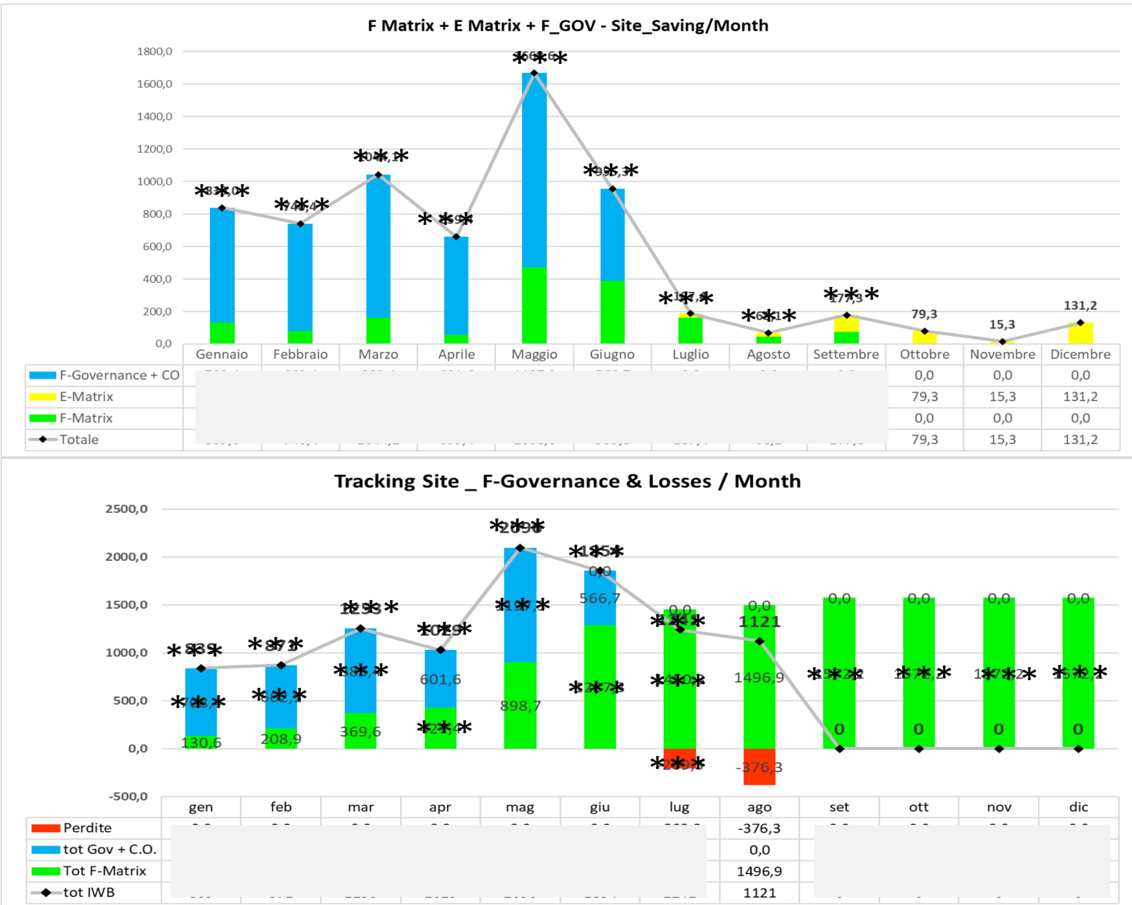


Figure 3.38: snapshot of the part twelve of the *Graph_White* sheet.

The first chart is highly useful and one of the latest created. It provides a different view on the monthly breakdown of the three categories: *Governance*, *F Matrix*, and *E Matrix*. As for *Governance*, it is already calculated monthly, and its value represents the actual monthly benefit. The novelty here lies in how the data for the *F Matrix* (green column) and *E Matrix* (yellow column) is calculated. They represent the 'new' benefit that accrues in that month. Since (as previously mentioned) the benefit is spread over twelve months, each month also includes benefits from earlier months. By calculating the difference between the current month and the previous month, we can isolate the new benefit starting from the current month. This provides a clear idea, especially towards the end of the year, of where the highest benefits are concentrated in terms of months. One of the inputs received this year asks us to try to advance projects scheduled for completion in November and December. This is to safeguard the benefits from potential delays that could prevent target achievement. By isolating the benefit that accrues in the current month and 'cleaning' it from residual benefits, we gain a better understanding of the impact of projects set to complete at the end of the year. From the chart (look at the *E Matrix*, yellow column), we can deduce that the situation is under control, as most projects still pending should be completed in September and October, followed by a decline in November. The rise in December is due to projects (already analyzed by team DOT) that cannot be brought forward, as they require machine downtime to be completed for technical reasons. This scenario aligns with the request we received. Without this chart, the evaluation would have been more time-consuming and less accurate in terms of data quality, and it would not have aligned with one of the objectives of Lean Thinking mentioned in the first chapter, which is *Visual Management*. By consulting this chart, one can quickly and clearly understand the current scenario. The second chart is equally important and innovative because it manages to handle and track losses (represented by the red columns). Earlier, we saw how *Governance* began to decline starting in July. Here, we can see that indeed, losses were recorded in July as well as in August. To clarify, the absence of *Governance*, as seen from the previously discussed formula, may arise from the fact that the IWB confirms exactly the same value as reported in the matrix for the completed projects (*F Matrix*), or due to the occurrence of losses. In August's case, we can observe from the table supporting the chart that the IWB (the document prepared by the Finance department) reports a recorded benefit of 1.121 million euros for the plant, while the matrix reports a benefit of 1.496 million euros. This results in a loss of approximately 296 thousand euros, leading to the absence of *Governance*. This can occur due to an overestimation by the project leaders regarding what the benefit should have been over twelve months, for example. It is important to remember that one of the conditions for *Governance* to manifest is that the IWB must declare a higher benefit than that reported in the Matrix (*F Matrix*). The structure of the *Graph_White* sheet allows, by scrolling vertically, to consult the details of each Business Unit, providing a more concrete assessment of where the loss occurred. The next chart (see fig 3.39) is the most frequently used during meetings and is perhaps the most innovative and useful result of the creation of regular communication/synergy with the Finance department, it is called *Tracking Governance Site - Cost Item(Actual).*

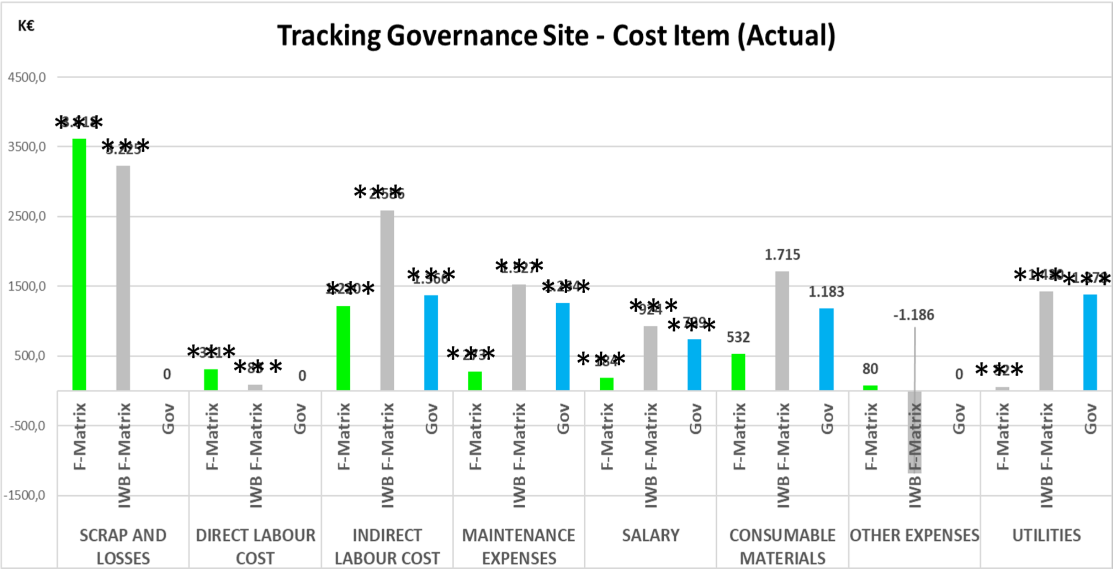


Figure 3.39: snapshot of the part thirteen of the *Graph_White* sheet, this is the most used chart.

Like all the charts we've seen so far, this one updates in real time. The only manual input required is the document provided by Finance team, which needs to be entered and updated at the start of each month (later on, we will show the management sheet dedicated to tracking this data and everything that comes from it). In the chart, for each cost item, the *F-Matrix*, IWB, and *Governance* are represented. The choice of this specific type of chart gives a clear visual sense of the weight of each element mentioned and effectively encapsulates the reasoning we've discussed so far. For example, when analyzing the cost item Scrap and Losses, an anomaly is immediately noticeable: the *F-Matrix* (the benefit contribution declared in the matrix for this cost item) accumulated to date. It's important to note that all the data shown in this chart is up-to-date, unlike earlier charts like the *Saving Walk* and *Site Bridge + F Governance*, which displayed full-year benefits (i.e., the benefit for the current year of all completed projects). In this case, since the IWB is updated monthly, we have chosen to display the *F-Matrix* with benefits accumulated month by month. However, this amount exceeds what has been officially recorded by Finance office for that specific cost item. Consequently, as we've discussed, there will be zero *Governance* for this particular cost item (as well as it being considered a loss due to overestimation). It's important to emphasize that considering an *F-Matrix* greater than IWB as a loss is a significant concept because, in the initial charts we analyzed, since the *F-Matrix* represents the total contribution of declared and completed projects (remember the green column in the fig 3.31 and 3.32 for example), any overestimated figures must be tracked to rebalance the benefit and make it as accurate as possible—hence, the importance of showing losses and consequently this chart. By presenting this in meetings, the goal is to make various DOT&Tech teams aware of the need for extreme precision when estimating actual benefits. In fact, we see that anomalies are rare, and even when they occur, as in this case, they are not critical. A similar case can be observed with the cost item Other Expenses, where we see an *F-Matrix* level of 80 thousand euros, but IWB records a loss for that cost item of 1.186 million euros. Based on the formula discussed earlier, we will therefore record a loss of 1.266 million euros, which is the difference between IWB and *F-Matrix*. Additionally, we can observe a case with the cost item Utilities, where a benefit of 1.430 million euros is reported, but there are very few projects, resulting in most of the benefit coming from *Governance*. This indicates limited activity in seeking projects within the Utilities cost item, with most of the benefit coming from managerial actions, i.e., directives. This chart has been the most appreciated and widely used one, and it's perhaps one of the most innovative aspects of the creation of the new matrix. It provides, moreover, a different perspective on *Governance*, as it is presented here by cost category. Month by month, it gives the operational teams (DOT&Tech) a clear idea of how much they are deviating from what Finance department has reported, both negatively,by trying to offset overestimated declared benefits, and positively. For example, for the cost category Utilities, we initially said that most of it is likely due to managerial actions. This is true, but it doesn't mean there aren't projects; sometimes activities have been carried out that could be considered continuous improvement projects if they were formalized and included in the matrix. This wasn't possible before, as there wasn't such a detailed view, especially one verified by Finance team for each cost category. In fact, sometimes this chart leads to the discovery of new projects that had been overlooked, or to rebalancing declared savings that were overly optimistic (overestimated). In addition, a control mechanism has been created for the declared savings. By including the benefit identified by Finance division, it is now possible to have oversight of the savings entered in the matrix. This kind of control didn't exist before; it was as if people 'trusted' what was entered into the matrix. Since the work on the new tool began, there has been a strong belief that the key to reaching the target, beyond simply carrying out the projects, was to create a synergy with Finance office at the data-sharing level and to ensure that the realized benefits were as close as possible to those declared in the matrix. As we already mentioned in chapter two, it was important that what was written in the matrix and what Finance

department recognized spoke the same language—and now, that's possible.
We have reached the end of the consultation of the *Graph_White* sheet, and the last two charts to be analyzed are shown in figure 3.40.

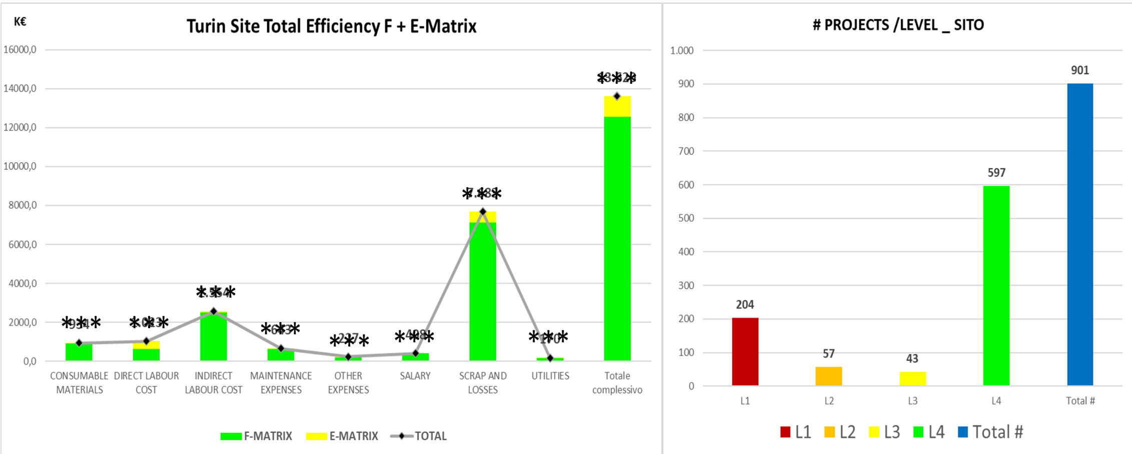


Figure 3.40: snapshot of the part fourteen of the *Graph_White* sheet.

They are called *Turin Site Total Efficiency F + E - Matrix* and *#PROJECTS/ LEVEL_SITE*. The first chart shows the total benefit (full year) of projects that have already been completed (*F-Matrix*) and projects still to be completed (*E-Matrix*), broken down by individual cost category. This gives an idea of where the most effort is being made, and it can be observed that in the cost categories of Indirect Labor Cost and Scrap and Losses, there is a higher contribution of benefit, meaning that most activities are focused on these two cost categories. To conclude, the last chart created shows the number of projects per *Level*, along with a total (blue column). Since it is almost the end of the year, most of the projects are completed (green column), which aligns with expectations. There is a small number of projects nearing completion (yellow column, *L3 Level*, representing ongoing projects), and a not-too-large number of projects planned to start but not guaranteed to do so (*L2 Level*, orange column). There is a substantial number of projects stalled at *L1 Level*, only evaluated, which at this point in the year is expected to remain unchanged. However, it still represents a good pool to draw from in case any critical issues arise that require new projects to be planned and executed. These can, however, be reintroduced during the budgeting phase for planning and completion the following year.
Everything discussed so far, every single sheet and number, is what is shown and what is consulted and used daily. However, there are hidden sheets, accessible to the DOT team, known as the "control sheets", which represent the more process-driven part of data collection and calculations that enable the creation of all the charts

considered so far, thus making the output possible. This will be the subject of the next paragraph.

3.10 The Control Sheets

One of the most populated sheets is the *Base_Pivot* sheet (see fig. 3.41). The figure shows only a portion of the entire sheet to give an idea of its vastness. The lack of dedicated software with a proper database necessitated creating one using Microsoft Excel's tools. The solution was to generate a series of pivot tables, a powerful data analysis tool that allows users to summarize, analyze, explore, and present large datasets flexibly and interactively. It facilitates the quick summarization of large data sets, helping users spot trends, patterns, and comparisons. A key feature is its dynamic organization: users can easily rearrange, group, and filter data by dragging and dropping fields into areas for rows, columns, values, and filters. Additionally, pivot tables create interactive reports, enabling real-time data analysis without altering the original data. It is the most effective tool for reflecting any small changes in the matrix through charts. Pivot tables are indispensable for handling large datasets, as they streamline the summarization and analysis process. This sheet essentially functions as the actual database for the file. This sheet essentially represents the actual database of the file. Depending on the type of chart and data to be represented, there is a dedicated pivot table for it. This makes the data representation highly manipulable and customizable. Many times during the course of the work, new scenarios or needs have arisen, and having a significant number of pivot tables meant that there was already a data structure ready to be represented according to various requirements. If the need for a new chart arises, it is expected that this sheet will contain one or more pivot tables presenting the correct data, allowing for easy translation into a chart without having to create a new database from scratch. This greatly reduces the time spent on representing the values and concepts expressed in this document. For data integrity reasons, this sheet is hidden from the users who consult the file daily. The DOT team has complete control over this sheet, as it represents sensitive data that must be protected. The management of the data contained in the file and its manipulation into structures that allow the creation of various charts is a fundamental aspect. Previously, this was not possible, when there was a need to create a chart or represent data, a vast amount of time was consumed trying to create a database that provided the correct information. With this worksheet, which collects and manipulates data in different ways, there is now a solid structure that serves as a database, so that when needed, it can be "queried" to extract the right information. By "querying," we mean gathering the necessary data to be represented from various points in the sheet, without needing to figure out how to extract them from the matrix, as they are already prepared and ready for use.

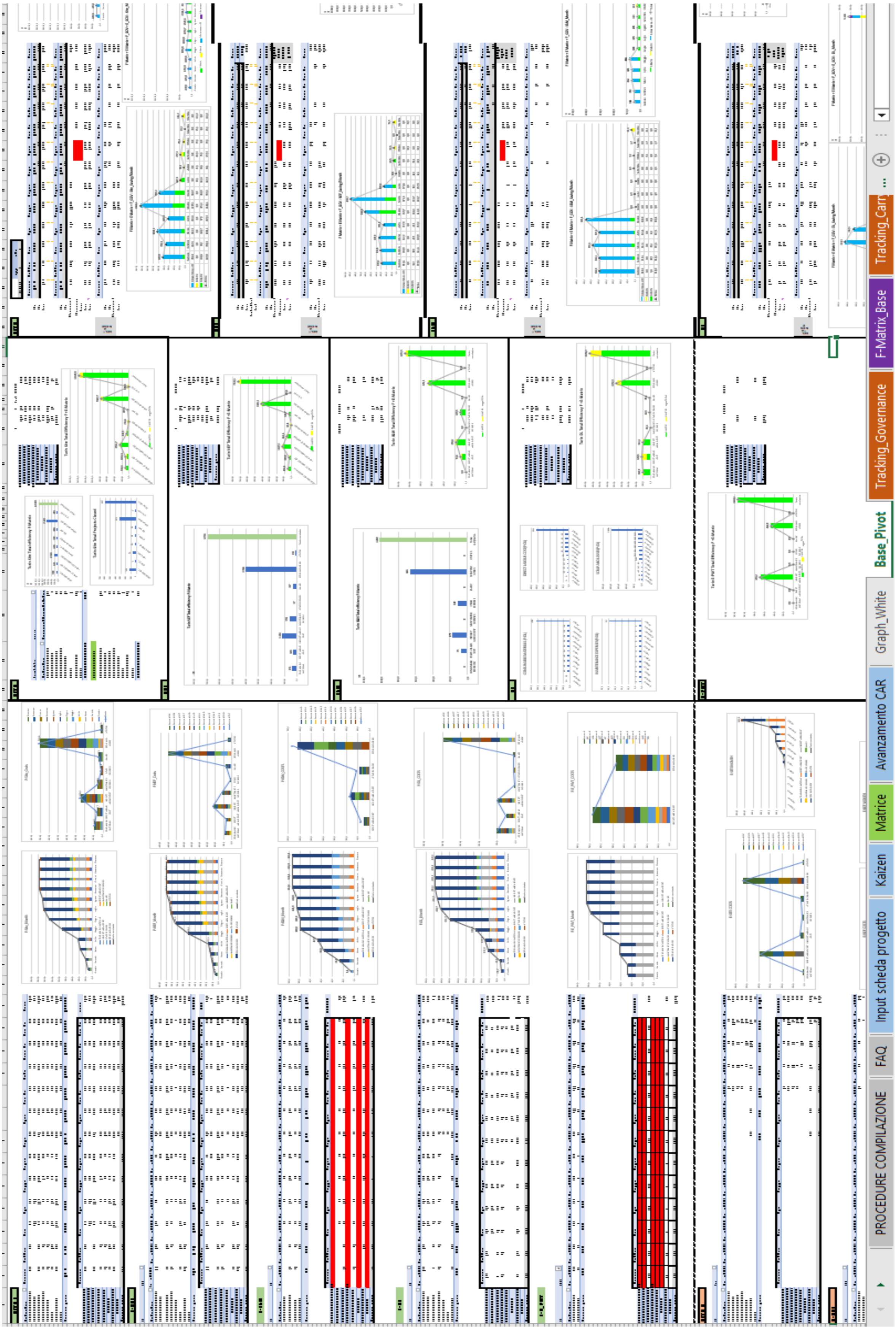


Figure 3.41: this is a snapshot of the *Base_Pivot* sheet.

The second operational sheet to be shown is called *Tracking_Governance* (see fig. 3.42), and it is the core of monitoring *Governance* and losses. It is a very large sheet, but for demonstration purposes, only the table for site-level *Governance* monitoring is shown. The same logic and table are repeated for each business unit, and in the sheet, there are other tables specifically designed for certain types of charts in the *Graph_White* sheet. Looking closely at the figure, the *F-Matrix* is broken down for each cost item and is shown month by month. Below that, there is a section dedicated to the IWB (yellow section), where each month is updated for the DOT team using the document provided by the Finance department. You can see that the current month of September (circled in black) still needs to be updated because the data is delivered at the beginning of October (for the data of a specific month to be collected and recorded, that month must end). At this point, the focus is on the summary table located at the top (circled in red). The first row shows the total *F-Matrix* for the month in question, the second row shows the total IWB for that month, and the two rows below are used to calculate *Governance* and *Carryover* when the difference between IWB and *F-Matrix* is positive, and losses (named in the fig. 3.42 as "Perdite") when the difference between IWB and *F-Matrix* is negative. It is important to note that this year we did not have a projection of what the monthly *Carryover* would be. We received a figure from Finance team that amounted to 1.8 million, but without any further details. This complicated the work somewhat, as without knowing the monthly breakdown of the *Carryover*, it was impossible to fully isolate the *Governance* on a monthly basis, since we didn't know how much of the declared *Carryover* was present in any given month. As a result, it was decided to represent the data as a single figure in some charts (thus showing *Governance* + *Carryover*), and around April, we started subtracting the *Carryover* from the *Governance* to have a pure *Governance* total at the site level. Starting next year, since the structure of the new matrix allows for an accurate and timely monthly *Carryover*, this adjustment work will no longer be necessary. However, the work behind this sheet, specifically the monthly input of data provided by Finance department, is one of the few "manual" actions that need to be done periodically in the file. As mentioned several times, the goal has been to make the file as automated and user-friendly as possible for the DOT team, to minimize human errors.

HISTOGRAM_GRAPHS_PAPER		gen	feb	mar	apr	mag	giu	lug	ago	set	ott	nov	dic		
	Tot F-Matrix	130,6	208,9	369,6	427,4	898,7	1287,3	1450,3	1496,9	1572,2	1572,2	1572,2	1572,2		
	tot IWB	839	871	1253	1029	2096	1854	1241	1121	0	0	0	0	TOT. IWB PROGR.	10303,6
	tot Gov + C.O.	708,4	662,1	883,4	601,6	1197,3	566,7	0,0	0,0	0,0	0,0	0,0	0,0		
	Perdite	0,0	0,0	0,0	0,0	0,0	0,0	-209,3	-376,3	0,0	0,0	0,0	0,0		
TRACK_SITO		gen	feb	mar	apr	mag	giu	lug	ago	set	ott	nov	dic	TOT	TOT
F-MATRIX	SCRAP AND LOSSES	56,78	98,49	187,43	198,39	560,63	802,95	854,53	858,58	875,22	875,22	875,22	875,22	7118,6	7118,6
F-MATRIX	DIRECT LABOUR COST	0,00	0,00	21,08	21,08	58,58	58,58	73,17	78,45	79,95	79,95	79,95	79,95	630,7	630,7
F-MATRIX	INDIRECT LABOUR COST	39,40	59,49	70,26	110,33	162,58	232,66	261,00	284,75	323,50	323,50	323,50	323,50	2514,5	2514,5
F-MATRIX	MAINTENANCE EXPENSES	3,61	6,11	6,53	6,53	10,70	74,32	78,48	86,82	86,82	86,82	86,82	86,82	620,4	620,4
F-MATRIX	SALARY	4,17	12,50	16,67	16,67	20,83	20,83	44,17	48,33	55,83	55,83	55,83	55,83	407,5	407,5
F-MATRIX	CONSUMABLE MATERIALS	22,59	28,19	60,25	64,86	75,84	88,34	95,42	96,44	96,94	96,94	96,94	96,94	919,7	919,7
F-MATRIX	OTHER EXPENSES	4,08	4,08	7,33	9,58	9,58	9,58	17,75	17,75	28,15	28,15	28,15	28,15	192,4	192,4
F-MATRIX	UTILITIES	0,00	0,00	0,00	0,00	0,00	0,00	25,83	25,83	25,83	25,83	25,83	25,83	155,0	155,0
IWB consunt. F-Matrix	SCRAP AND LOSSES	260,00	329,00	524,00	398,00	758,00	643,00	169,00	144,00	0,00	0,00	0,00	0,00	3225,0	3225,0
IWB consunt. F-Matrix	DIRECT LABOUR COST	12,00	13,00	17,00	20,00	20,00	6,00	2,00	-7,00	0,00	0,00	0,00	0,00	83,0	83,0
IWB consunt. F-Matrix	INDIRECT LABOUR COST	138,00	154,00	204,00	177,00	561,00	370,00	465,00	517,00	0,00	0,00	0,00	0,00	2586,0	2586,0
IWB consunt. F-Matrix	MAINTENANCE EXPENSES	111,00	123,00	188,00	177,00	256,00	354,00	233,00	85,00	0,00	0,00	0,00	0,00	1527,0	1527,0
IWB consunt. F-Matrix	SALARY	89,00	96,00	98,00	98,00	160,00	111,00	107,00	164,60	0,00	0,00	0,00	0,00	923,6	923,6
IWB consunt. F-Matrix	CONSUMABLE MATERIALS	272,00	286,00	276,00	291,00	425,00	144,00	13,00	8,00	0,00	0,00	0,00	0,00	1715,0	1715,0
IWB consunt. F-Matrix	OTHER EXPENSES	-165,00	-287,00	-174,00	-254,00	-344,00	-13,00	94,00	-43,00	0,00	0,00	0,00	0,00	-1186,0	-1186,0
IWB consunt. F-Matrix	UTILITIES	122,00	157,00	120,00	122,00	260,00	239,00	158,00	252,00	0,00	0,00	0,00	0,00	1430,0	1430,0
Delta IWB vs. F-Matrix	SCRAP AND LOSSES	203,22	230,51	336,57	199,61	197,37	-159,95	-685,53	-714,58	-875,22	-875,22	-875,22	-875,22	1167,3	-3893,6
Delta IWB vs. F-Matrix	DIRECT LABOUR COST	12,00	13,00	-4,08	-1,08	-38,58	-52,58	-71,17	-85,45	-79,95	-79,95	-79,95	-79,95	25,0	-547,7
Delta IWB vs. F-Matrix	INDIRECT LABOUR COST	98,60	94,51	133,74	66,67	398,42	137,34	204,00	232,25	-323,50	-323,50	-323,50	-323,50	1365,5	71,5
Delta IWB vs. F-Matrix	MAINTENANCE EXPENSES	107,39	116,89	181,47	170,47	245,30	279,68	154,52	-1,82	-86,82	-86,82	-86,82	-86,82	1255,7	906,6
Delta IWB vs. F-Matrix	SALARY	84,83	83,50	81,33	81,33	139,17	90,17	62,83	116,27	-55,83	-55,83	-55,83	-55,83	739,4	516,1
Delta IWB vs. F-Matrix	CONSUMABLE MATERIALS	249,41	257,81	215,75	226,14	349,16	55,66	-82,42	-88,44	-96,94	-96,94	-96,94	-96,94	1353,9	795,3
Delta IWB vs. F-Matrix	OTHER EXPENSES	-169,08	-291,08	-181,33	-263,58	-353,58	-22,58	76,25	-60,75	-28,15	-28,15	-28,15	-28,15	76,3	-1378,4
Delta IWB vs. F-Matrix	UTILITIES	122,00	157,00	120,00	122,00	260,00	239,00	132,17	226,17	-25,83	-25,83	-25,83	-25,83	1378,3	1275,0
Governance E-Matrix	SCRAP AND LOSSES													0,0	0,0
Governance E-Matrix	DIRECT LABOUR COST													0,0	0,0
Governance E-Matrix	INDIRECT LABOUR COST													0,0	0,0
Governance E-Matrix	MAINTENANCE EXPENSES													0,0	0,0
Governance E-Matrix	SALARY													0,0	0,0
Governance E-Matrix	CONSUMABLE MATERIALS													0,0	0,0
Governance E-Matrix	OTHER EXPENSES													0,0	0,0
Governance E-Matrix	UTILITIES													0,0	0,0

Figure 3.42: snapshot of the part fourteen of the *Graph_White* sheet.

Now that part of the extensive control sheets has been shown, we can move on to the final section, which was also the last part created: the compilation procedures and the FAQs (Frequently Asked Questions). In addition to a long training period on how the file works, how it should be filled out, and the explanation of the output (*Graph_White* sheet), it was decided to create a sort of guide for the compilation procedures. This guide helps the user in case of doubts when entering and completing a new project through the creation of the *PROCEDURE COMPILAZIONE* sheet (see fig. 3.43). During the training period, which was conducted with each DOT & Tech present at the facility, we tried to gather all the most frequently asked questions and compiled them into the *FAQ* sheet (see fig 3.44). Any doubts should be addressed either by the previously explained sheet or by this one. The purpose of creating these two sheets is to minimize errors caused by misunderstandings or lack of knowledge. Everything presented so far is the result of months of work, and it is still undergoing continuous improvement as new scenarios constantly arise. However, as of today, the benefit brought to the plant by this new matrix is significant. The management, to whom this data is presented, is satisfied with the work done, and those who use the matrix to complete and monitor projects are working more efficiently and are able to track projects in greater detail.

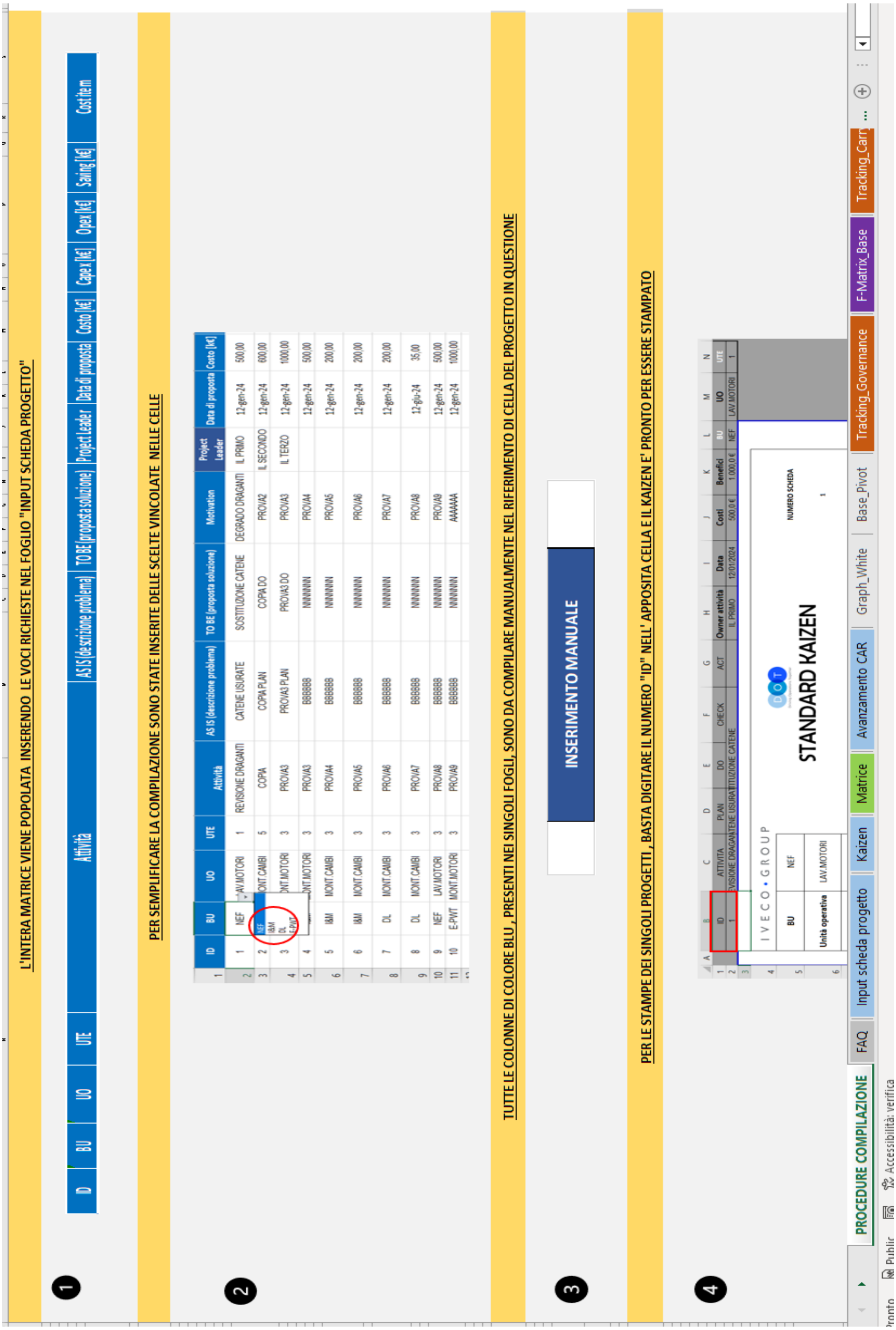


Figure 3.43: this is a part of the *PROCEDURE COMPILAZIONE* sheet, where four out of seven points are shown.

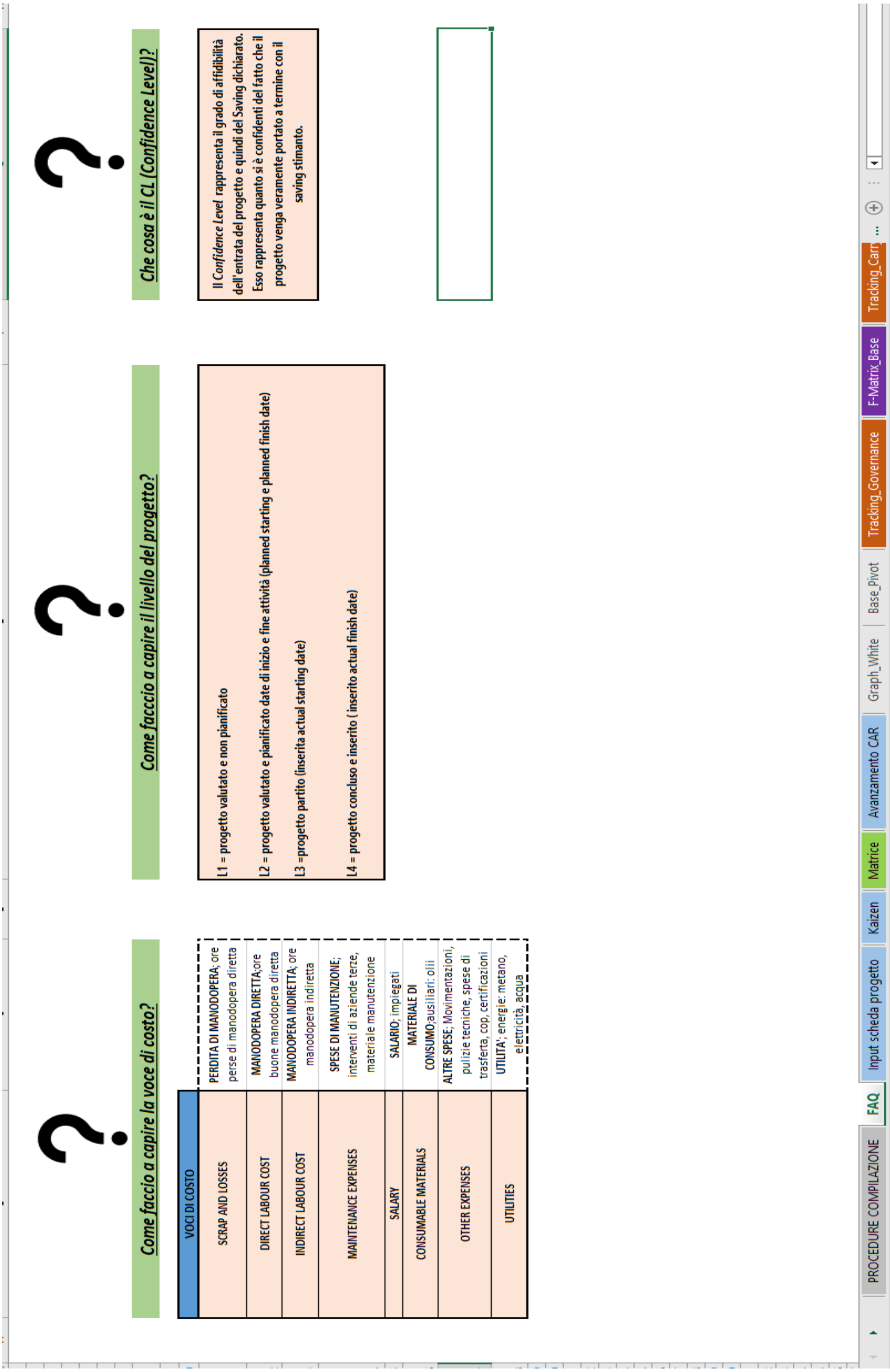


Figure 3.44: this the *FAQ* sheet, where all the frequently asked questions have been gathered.

Chapter 4

Conclusion

The work carried out emphasizes the importance of proper management and monitoring of continuous improvement projects at FPT Industrial. During the internship period, after an initial training phase, it was necessary to integrate into the work processes and begin monitoring and managing the plant's efficiency in terms of continuous improvement projects. This led to the identification of several issues and criticalities, which are thoroughly presented in Chapter 2 of this work. The tool previously in use at the plant had become outdated and completely ineffective. What was happening within the plant in terms of efficiency/continuous improvement projects was not properly formalized and monitored; the tool did not meet the technical and conceptual requirements for effective work. The failure to meet targets in the previous two years was attributed to insufficient focus on continuous improvement (efficiency projects) and the absence of an adequate tool that could collect the sensitive project data, better represent the actual situation, and enable the creation of a true monitoring system. The main goal assigned to the team was to standardize the tool as much as possible, since the company's strategy for the current year was to unify the four different business units, previously mentioned multiple times, into a single plant. This new scenario primarily triggered the need for a single tool structured for project monitoring. Without the creation of this tool, there would have been four different matrices, one for each business unit, leading to structural and informational differences. The lack of standardization, both at the tool and data level, inevitably causes discrepancies, which in turn create inconsistencies in the data and difficulties in representing them. By eliminating the four old matrices and creating this tool, which became the only official one in the plant and was shared on the IVECO cloud through the Microsoft Teams service, it became possible to achieve a situation where the file is always updated in real time, efficient, standardized, and consistent. Today, the matrix manages 1,341 projects in detail

(as discussed in the previous chapter) with a level of data accuracy never before reached. It is worth noting that the decision to establish an organizational routine with the Finance team, where the IWB (Industrial Workbook) document is shared every month and cross-referenced with the matrix, represents a highly innovative aspect, not so much technological as managerial. This innovation allows for the verification of what is declared in the matrix, ensuring accuracy in data representation and enabling precise monitoring. This way, the team can react promptly if anomalies arise that might steer the plant off course from reaching its targets. It is nearly impossible to achieve a goal without proper performance monitoring and if not impossible, it is at least very difficult. As supporting evidence, we have seen in the charts that there is much confidence in hitting the target this year, unlike in previous years, with the forecast curve being respected. To date, this represents a truly significant achievement for the company.
Additionally, there was the objective of creating a tool that was easy to use for those (DOT & Tech) who were searching for and physically executing the projects, one that would facilitate their monitoring work. Specifically, they are required to print the quick kaizen associated with each project and place it in the correct position on the dedicated wall in the project room. (During the internship, part of the time, when not working on the creation of the tool, was dedicated to setting up the project room, which represents the temple of continuous improvement in FPT Industrial and of DOT). As the project progresses over time, DOT & Tech should have a dedicated room where all the projects are stored, and by going there, they can update or correct the project's status. With a tool that now ensures standardized and accurate data quality, this process is possible, and it has become common practice to visit the HUB to monitor project statuses (creating new organizational routines). This has also allowed the team to achieve another crucial objective: to implement a true *Visual Management* system and bridge the gap that existed in this area at the plant, a fundamental aspect of Lean Thinking. Moreover, one of the most practical advantages achieved through the creation of this new tool is an organizational approach focused on responsiveness. To explain further, the new matrix, with all the technical features thoroughly analyzed in the previous chapter, has a fundamental characteristic for effective monitoring: responsiveness. The new matrix is highly responsive to delays, a key aspect to keep under control in order to meet targets. With this new tool, it is now possible to hold dedicated meetings every Tuesday and Thursday to review projects scheduled for the current month, assess their status, and, in case of delays, determine how to address them and understand their impact. The establishment of a meeting solely focused on the matrix

and project review is made possible only through the use of a tool that allows for the immediate identification of anomalies, enabling proactive solutions. The response time to issues must be swift. Now, all of this is achievable. It is a new approach to the concept of efficiency, which is highly valued by FPT Industrial. Connected to the previously explained aspect is also the ability, during meetings, to manage a longer-term vision thanks to the overview and management associated with *carry-over*, which is another of the most innovative and appreciated features of the new matrix. Having a longer-term perspective now allows us to work in the present to achieve specific future benefits and to track them effectively.
However, since the matrix was created entirely in Excel, it has certain limitations. One of these is the inability to create a database that collects all the projects and generates a consistent, easily accessible record of historical data. Each year, the matrix file needs to be replicated, cleared of all projects, and set up for the new year. Developing a dedicated software for monitoring continuous improvement projects could overcome this limitation and allow for a database, potentially cloud-based. Currently, the data history is maintained through a folder containing the matrix files for each year, which makes the data history both insecure and inefficient. Another issue tied to the lack of custom-made software for this purpose is that, since everything in Excel is automated through formulas and links between different parts of the sheet, this inevitably brings potential risks. If a formula, a cell reference, or a link were accidentally modified, errors could arise that might compromise the entire file. As mentioned several times before, the file has been completely locked and protected, but the potential risk still exists. Using software with a backend, meaning a code that runs the software and is not accessible to the users, would safeguard the document and data from these potential risks. The tool is continuously improving, and a similar approach is starting to take hold regarding the suggestion system mentioned in Chapter 1. Using the same logic as the matrix, the aim is to create a monitoring system for suggestions coming from the workforce. Additionally, there are ongoing discussions about adding more buttons with associated VBA code to further automate the entire file and minimize manual interactions by workers. This would help reduce the likelihood of the previously mentioned issues occurring.

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