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Optimizing Project Management Methodologies to Enhance Efficiency and Success in New Product Development

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ABSTRACT

The thesis titled "Optimizing Project Management Methodologies for Enhancing Efficiency and Success in New Product Development" narrows its focus to the critical role of quality management within project management frameworks in the automotive industry. This research specifically investigates how integrating comprehensive quality assurance processes can streamline production and enhance the efficiency of new product development at German Truck & Bus company, with a case study on the Flywheel Housing project at 2a S.p.A, an OEM in the automotive and truck sectors.

The study proposes a refined project management framework that emphasizes the importance of quality management throughout the project lifecycle, from initiation to completion. It meticulously examines how robust quality assurance methods can be integrated with traditional project management tools to ensure that products not only meet but exceed both internal and external standards and expectations. The framework focuses particularly on how these quality management practices can enhance operational efficiency, mitigate risks, and ensure the timely delivery of innovative automotive components.

By conducting a detailed analysis and evaluation of the Flywheel Housing project, the thesis demonstrates how a targeted approach to quality management within project management can lead to significant improvements in process efficiency and product quality, ultimately supporting the broader goal of achieving excellence in new product development.

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1. INTRODUCTION

The automotive industry is highly competitive and constantly demands innovation, particularly in the development of new parts. This thesis aims to enhance the project management processes at 2a S.p.A., a company that excels in producing high-pressure die-cast aluminum components and serves as a Tier 1 supplier in the automotive sector. Known for its commitment to pushing the boundaries of aluminum use for efficiency and sustainability, 2a S.p.A. supports projects from conception through to execution, ensuring both cost-effectiveness and robust component design.

The primary focus of this research narrows down to the vital role of quality assurance processes in meeting stringent internal and external standards throughout the product development lifecycle. By examining the production of the Flywheel Housing for a prominent German Truck & Bus company, this study dives deep into how effectively embedding process quality management (PQM) can enhance operational efficiency, mitigate risks, and guarantee the timely delivery of products.

The goal here is to craft a detailed framework for quality management within product development, aligning closely with the Project Management Institute's (PMI) Quality Management principles. This framework will incorporate essential methodologies like Process Failure Mode and Effects Analysis (PFMEA), detailed control plans, and rigorous performance indicators to systematically elevate quality from the start to the end of the project.

This thesis also identifies a subtle yet impactful gap in current practices, showcasing the potential for significant enhancements through a structured approach to quality management. Focusing specifically on PFMEA and broader quality management aspects, the research connects these areas to the established PMI project management practices. This connection lays the groundwork for a comprehensive analysis that highlights the benefits of integrating established PQM theories, methods, and techniques.

The findings aim to offer valuable insights into integrating quality management seamlessly into project management practices, setting a standard protocol for future automotive projects. By not only outlining the successes but also deriving lessons from the challenges faced, this research will provide a robust benchmark for future projects aiming to refine product development processes through focused and effective quality management.

2. LITERATURE REVIEW

A project management methodology is a carefully formulated blend of logical practices, methods, and processes that guide the effective planning, development, and oversight of a project throughout its lifecycle, ensuring its successful completion. This approach is underpinned by scientific principles and is both systematic and disciplined, focusing on the implementation and finalization of a project. The primary goal of employing a project management methodology is to oversee the entire management process through informed decision-making and effective problem-solving, thereby guaranteeing the success of various processes, approaches, techniques, methods, and technologies. Typically, a methodology outlines a detailed framework that guides project managers on the necessary steps to align project activities with the project's timeline, budget, and requirements. [1]

Choosing the right project management methodology facilitates several key benefits:

- It clearly defines the needs of all stakeholders involved.
- Establishes a unified language for clear and precise team communication.
- Ensures that cost estimates are comprehensive, accurate, and dependable.
- Promotes a standardized approach to executing each task.
- Helps in identifying and resolving potential conflicts at an early stage.
- Guarantees that the anticipated outcomes are achieved and delivered.
- Enables the swift application of learned lessons and solutions.

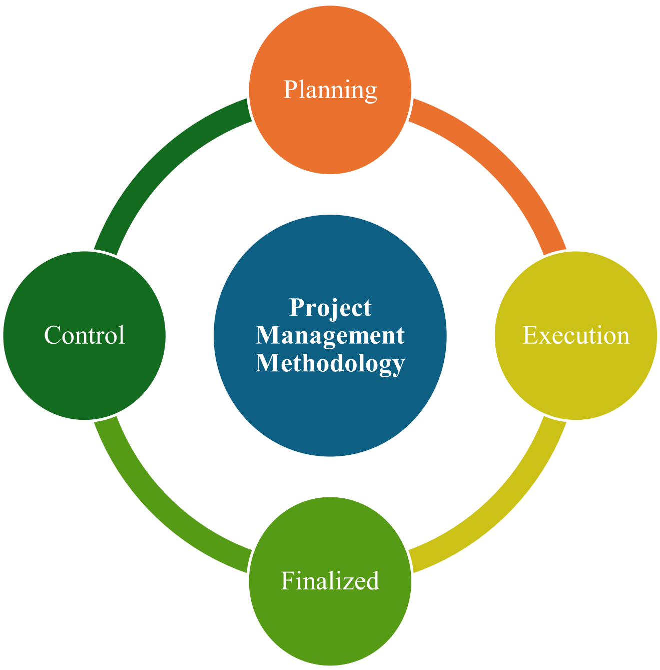


Figure 1: Project Management Methodology

Program management involves utilizing specific knowledge, skills, and techniques to oversee a program and achieve its objectives, providing benefits and efficiencies that cannot be realized by managing individual components in isolation. The primary aim of program management is to efficiently coordinate a collection of related projects and initiatives to deliver overarching benefits. The program manager plays a crucial role in realizing these goals and objectives. On the other hand, project management focuses on successfully delivering project outcomes within the agreed-upon constraints of time, cost, and specifications, ensuring that business needs are effectively met.[2]

Project management establishes a planning framework, facilitating the realization and execution of projects of any kind, size, nature, and type. This framework focuses on driving desired changes in line with a selected methodological approach. Essentially, managing change is at the core of this process. It involves identifying and outlining the best ways to manage these changes, with the methodology acting as a systematic path to effect changes concerning time, cost, and quality.

Project management entails detailing and performing necessary activities aimed at achieving specific goals that result in changes. Take, for example, the project of writing a book. The objective here is to complete the book, which is accomplished through a series of steps: defining the topic, gathering supporting materials, drafting, typing, proofreading, and more. From a project management perspective, the author needs to define and then execute all necessary actions to achieve the goal of writing the book, thereby effecting a change.

Framework-project management can be viewed as a structured compendium of all pertinent knowledge on effecting change through methodological approaches. It doesn't provide a precise algorithm for managing a particular project but rather offers a comprehensive overview of various methods, rules, processes, and standards. Thus, the methodology of project management can be seen as a specific tier within the broader concept of framework-project management. [4]

An illustrative example of how project methodology fits within a hierarchical management structure is depicted below:

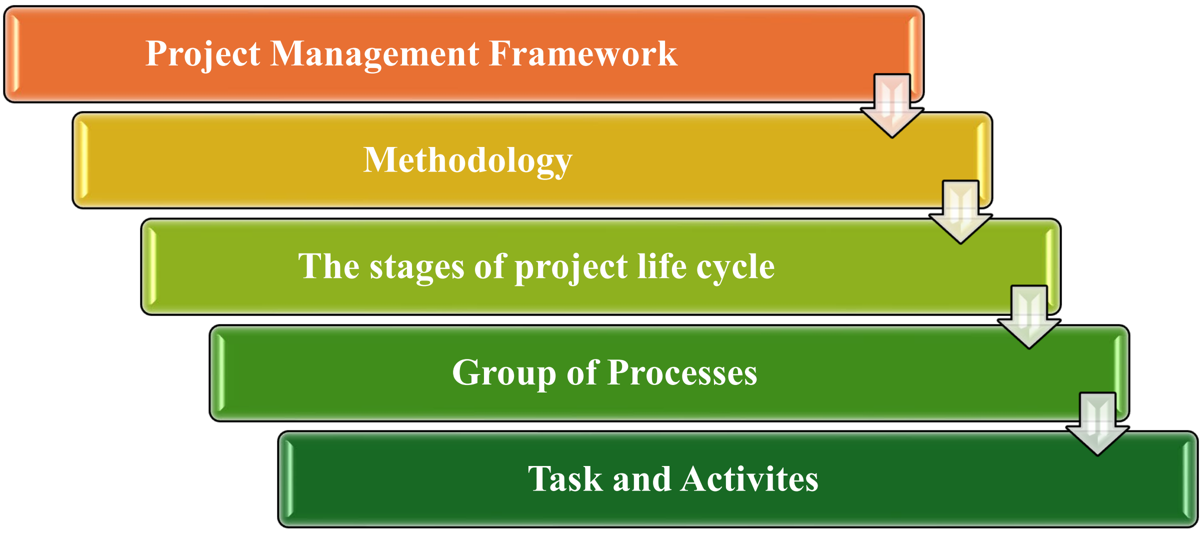


Figure 2:Project Management Framework

2.1. Project Management Methodologies

Traditional project management adheres to a structured, sequential approach, which organizes the development and delivery of a product or service into distinct steps. This methodology, known in the IT and software development realm as the "Waterfall" method, follows a linear progression where each stage directly follows the previous one. The key phases of traditional project management include:

- Initiation: Setting out project specifications and requirements.
- Planning and Design: Outlining how the project will be executed.
- Implementation: Actual construction or coding of the project components.
- Control and Integration: Ensuring all elements of the project work together smoothly.
- Validation: Conducting tests and debugging any issues.
- Closing: Final installation and ongoing maintenance.
- Modern Project Management Approaches

In contrast to traditional methods, modern project management techniques embrace a more dynamic and flexible approach [5]. These methods are particularly beneficial in fields like IT and software development, as well as other industries looking to streamline their operations. Some of the most recognized modern project management methodologies include:

PMBOK Guide: While primarily a comprehensive compendium of project management best practices rather than a methodology per se, the PMBOK Guide is widely used for planning, executing, and overseeing projects. It organizes project management into 47 processes spread across five groups and ten knowledge areas, and is recognized internationally as a standard by institutions like ANSI and IEEE

PRINCE2: Standing for Projects IN Controlled Environments, this methodology offers a process-driven framework that is applicable across various project types. Originating in the UK and used globally, PRINCE2 outlines a methodical approach to project management that has been refined since its inception in 1989. It emphasizes controlled and efficient project planning and execution.

CPM (Critical Path Method): This technique focuses on identifying the most crucial tasks of a project, mapping out potential activity sequences and estimating the longest span of time these sequences might take, thus helping in precise project timing and task prioritization.

Lean: Lean project management seeks to maximize customer value while minimizing waste. By optimizing process flows and eliminating unnecessary resources, this methodology enhances efficiency and customer satisfaction.

Six Sigma: Developed by Motorola, Six Sigma aims to enhance production processes by minimizing or eliminating defects. This approach has become a staple in project management, known for its rigorous focus on quality and efficiency.

CCPM (Critical Chain Project Management): An application of the Theory of Constraints (TOC), this method prioritizes resource management and task scheduling by utilizing buffers and addressing the critical chain of project tasks

SCRUM: Part of the Agile methodology suite, SCRUM organizes project management into 30-day sprints with periodic reviews, ideal for collaborative and flexible project teams focusing on rapid development cycles.

2.2. Project Management Evolution in Automotive Industry

2.2.1. Initial Hierarchical Structure

Historically, automotive companies were organized in a hierarchical manner with clear divisions between departments such as design, engineering, and manufacturing. Each department operated independently with specific roles, and communication across departments was limited and formal. This structure was conducive to straightforward, repetitive tasks but lacked the flexibility needed for innovation and quick adaptation to market changes.

2.2.2. Shift Towards Integrated Project Management Structures

The integration of project management brought about a significant restructuring within these companies. Instead of rigid departmental lines, the industry moved towards a more matrix-like structure where cross-functional teams could collaborate more effectively. Project managers began to play a central role, tasked with the coordination of activities across different departments, aligning them towards common project goals.

These project managers were given the authority to oversee all aspects of vehicle development projects, from initial concept through to production and market launch. This role included budget management, timeline scheduling, and quality control, requiring a comprehensive understanding of every part of the vehicle production process.

2.2.3. Evolution of Professional Practices in Technical Areas

2.2.3.1. Standardized Production Practices

In the early days, automotive manufacturing focused heavily on standardized production practices, inspired by models like Fordism, which emphasized mass production of a limited range of models. This approach prioritized efficiency and cost reduction but was inflexible and slow to incorporate innovations or respond to changing consumer demands.

2.2.4. Introduction of Advanced Management Techniques

With the introduction of project management, there was a shift towards more advanced manufacturing and quality techniques like Total Quality Management (TQM) and Just-In-Time (JIT) manufacturing. TQM introduced a continuous feedback loop for quality improvement, involving workers at all levels, while JIT minimized inventory costs and reduced waste by coordinating production closely with demand and supply logistics.

These methodologies required a more nuanced approach to project management, incorporating risk management, stakeholder analysis, and advanced planning techniques. Automotive companies began investing in training programs to enhance the skills of their project managers, equipping them with the tools needed to handle increasingly complex projects.

2.2.5. Transformation in Subcontractor Relationships

Initially, relationships with subcontractors were predominantly transactional, with car manufacturers setting the specifications and subcontractors delivering exactly to those requirements. This model limited the potential for innovation from suppliers and was strictly governed by cost considerations.

2.2.5.1. Strategic Partnerships and Collaboration

As project management philosophies took root, automotive companies began viewing their subcontractors as strategic partners. This new model fostered a collaborative approach, involving suppliers early in the design process and integrating them into the project management framework. Such integration allowed for innovations in design and manufacturing processes to be shared, leading to better outcomes in terms of product functionality, cost efficiency, and speed to market.

This collaborative approach often involved co-locating supplier teams with the company's project management teams to facilitate seamless communication and immediate problem solving. Contracts with suppliers evolved to focus on shared outcomes and incentives aligned with project success, rather than merely adhering to cost and delivery schedules.

2.2.5.2. Phases of Project Management Evolution in the Auto Industry

First Phase (1945-1970)

During this initial phase, project management was nearly non-existent in the automotive sector. Companies followed a linear, functional approach to product development, with little strategic emphasis on managing projects as integrated efforts.[8]

Second Phase (1970-1985)

During this era, markets gradually became saturated, leading Japanese automakers to penetrate the American market with innovative marketing and management strategies. This shift necessitated the management of numerous projects, highlighting the strategic importance of project management. Companies recognized the need to enhance their project management capabilities to improve efficiency.[21]

In the late 1960s, both in Europe and the United States, automakers adopted new strategies to develop modern, diverse multi-product vehicle ranges. This diversification and international expansion introduced complexities that previous practices could not manage effectively. The solution lay in professionalizing project management:

- In the 1970s, dedicated project functions were established for the first time, accompanied by regular reviews.
- Systems for guiding and controlling project execution were implemented, complete with schedules and financial reporting tools.
- This era marked the emergence of the "lightweight project manager," a term coined to describe the role during this period.[9]

This revamped project organization led to improvements in vehicle project outcomes. However, it often suffered from a lack of coordination, a frequent cause of project failures.

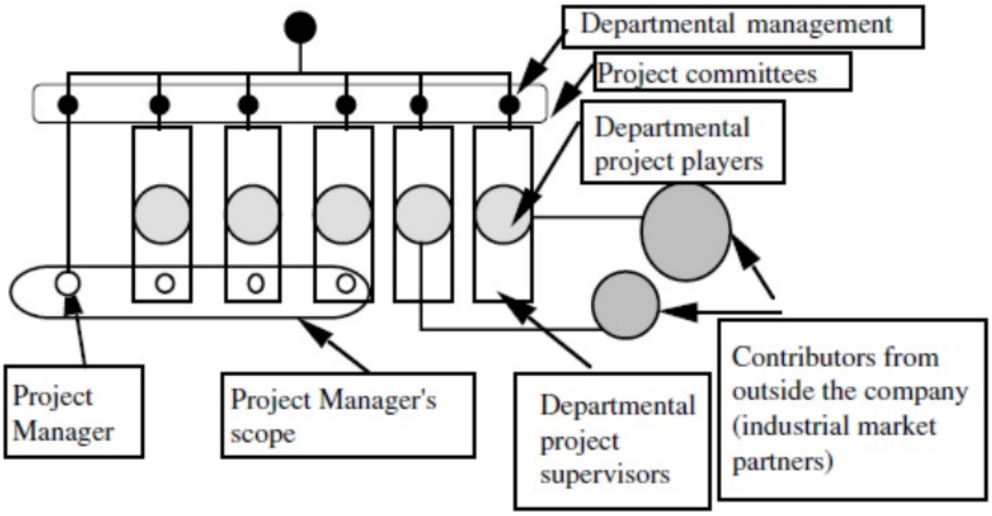


Figure 3: Project Organizational Structure

Third Phase (1985-1995)

The introduction of the heavyweight project manager or project director role marked this phase. These individuals had significant authority and responsibility, bridging multiple functions and overseeing projects from inception to completion. The role of the project director was crucial in implementing concurrent engineering practices, drastically reducing development times and improving the integration of various project aspects. [9]

Fourth Phase (1995-present)

The most recent phase is characterized by rapid innovation and the need for highly sophisticated project management techniques. Project management now needs to handle multiple, overlapping projects with varying scopes, often on a global scale. The focus has shifted towards managing portfolios of projects and aligning them closely with corporate strategic objectives. [22]

2.3. PMI METHODOLOGY

The PMI methodology, developed by the Project Management Institute (PMI) in the United States, is detailed in the Project Management Body of Knowledge. This methodology advocates for managing projects across ten key knowledge areas:

Project Integration Management: This area involves the processes and activities needed to identify, consolidate, unify, and coordinate the various processes and activities within the project management groups.

Project Scope Management: This includes all processes necessary to ensure that the project encompasses all the work required for its successful completion.

Time Management: Focuses on the processes that define the project's timelines and manage its timely execution.

Cost Management: Encompasses the processes involved in planning, budgeting, funding, and controlling costs to complete the project within the approved budget.

Quality Management: Includes all processes that ensure the project is completed to the required quality standards and meets the needs for which it was initiated.

Human Resource Management: Involves the processes that organize, manage, and guide the project team.

Communication Management: Pertains to the processes of gathering, storing, and disseminating project information.

Procurement Management with a Focus on Negotiation: Deals with the processes related to the procurement and acquisition of materials and services necessary for the project.

Risk Management: Involves the processes of planning, identifying, analyzing, responding to, and controlling project risks.

Project Stakeholder Management: Includes the processes necessary to identify stakeholders and analyze their expectations and influences, and to develop strategies to effectively engage them in project decisions and execution.

Each of these areas is critical to the effective management of projects and ensures that all aspects of project execution are considered and appropriately managed.

2.4. Project Governing Bodies and Rules

2.4.1. Steering Committee

The Chief Technology Officer (CTO) or Program Director is responsible for overseeing the performance of a collection of projects, with specific duties that include:

- **Portfolio Management:** Maintaining a list of projects, along with overseeing budget and resource allocation.
- **Launch Oversight:** Guaranteeing flawless project launches by validating and managing project risks.
- **Issue Escalation:** Bringing critical project issues to the attention of the business management committee.

- **Financial Goals:** Achieving key financial targets such as Gross Margin, Development Costs, and Investments.
- **Leadership and Standards:** Serving as a role model in project management by promoting and enforcing standardized methodologies, tools, organizational practices, indicators, conducting audits, and leading project efficiency initiatives.
- **Development of Project Management Capabilities:** Enhancing project management functions through defining competencies, career paths, and providing training.

The Project Manager is responsible for the overall performance of his project, specifically focusing on:

- **Meeting Project Objectives:** Achieving Quality, Cost, and Delivery (QCD) objectives as outlined in the project's budget.
- **Team and Process Management:** Overseeing the project team and ensuring processes adhere to corporate standards, including project risk management, scheduling, deliverables, product gross margin, and budget management.
- **Performance Reviews:** Conducting project team appraisals and presenting the project at Quality Management and Business Management reviews to ensure alignment with safety and compliance standards.[19]

Figure 4: Project Governing Body

The Function Manager is tasked with the delivery of outputs for the project, specifically:

- **Resource Assignment:** Allocating appropriate project members and contributors to meet project deliverables and milestones.
- **Execution Oversight:** Monitoring the progress of activities and organizing regular formal reviews.
- **Action Plan Validation:** Approving action plans to address critical project issues.
- **Function Excellence:** Ensuring the quality of functional deliverables.

- **Budget Management:** Managing and adhering to budgets allocated to their function for all projects within their scope.
- **Support Provision:** Offering additional support, when necessary, which may include leveraging internal or pooled resources.
- **Competence Assurance:** Making sure that project members and contributors possess the required competencies.
- **Team Management:** Acting as the hierarchical manager of the Project Team Members and Contributors. [19]

Each role is critical in ensuring that the projects are executed efficiently, meet their objectives, and align with the strategic goals of the organization.

Historically, many organizations utilized a functional organizational structure for product delivery. This approach eventually proved ineffective for long-term project management due to its complexity and the prioritization of functional over project-specific activities. Such prioritization often resulted in delayed project timelines and slowed product market entry. [10]

To address these challenges, a shift has occurred in recent times within many automotive companies. These organizations have transitioned from a functional to a pure project management organizational structure. This change was implemented to better meet the demands of timely product delivery.

In this pure project management setup, project team members are granted authority by their respective functions to oversee their assigned contributors, who are selected by department managers. Team members are tasked with the meticulous planning and budgeting of their activities. Additionally, they are expected to execute these tasks in accordance with the established procedures and efficiency plans of their function.

Project goals related to Quality, Cost, and Time-to-Market are becoming more demanding and require a comprehensive technical analysis and decision-making framework. [20] This framework includes:

2.4.2. Two Dedicated Committees

- Project Management Committee: Responsible for making technical decisions.
- Business Development Committee/KAM: Focuses on decisions related to business and sales.

2.4.3. Execution of Design Reviews Team

These reviews are essential for confirming the practicality of design implementations, including both product and process aspects, involving suppliers. They are typically orchestrated by a member of the Purchasing team and led by a member of the R&D team, with contributions from Quality and SQA members, among other pertinent participants.

2.4.4. Project Quality Committee

Chaired by the company's president of quality, this committee provides the Business Management Committee with critical technical decisions that:

- Guarantee the quality of technical deliverables.
- Address significant impacts on customer milestones and budget considerations.
- Evaluate and manage project risks and the readiness of contingency plans.

2.4.5. Business Management Committee

Led by the company's managing director, this committee focuses on business-oriented decisions to:

- Enhance customer satisfaction.
- Ensure a seamless product launch.
- Maximize project profitability.

2.5. Introduction To New Product Development

In the realms of business and engineering, the process of new product development (NPD) encompasses the entirety of bringing a new product to the marketplace. A product, whether tangible, like a physical item, or intangible, such as a service, experience, or belief, represents a set of benefits offered in exchange. The NPD process splits into two concurrent paths: one focuses on idea generation, product design, and detailed engineering; the other centers on market research and marketing analysis. For companies, new product development is considered the initial phase in the broader strategy of product life cycle management, which is critical for sustaining or enhancing market share.[7]

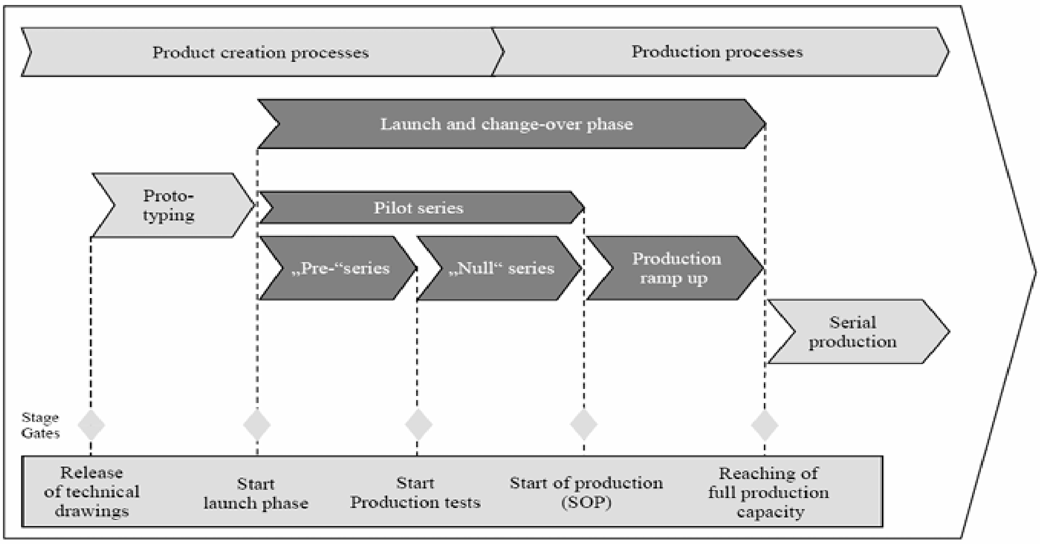


Figure 5: Product Lifecycle Management in Automotive Industry

The conventional strategy for new product development in the automotive industry evolves various team members, including a project manager, process planner, designer, quality planner, and cost evaluator. The project manager acts as the liaison between the client and the design department, ensuring timely delivery of the finished product. The process planner bridges the design team and production, overseeing technical project execution. The designer focuses on aligning product development with customer specifications. [12]

A critical initial phase is the quotation phase, crucial for securing new projects and the future of series production. Traditionally, some companies may rely on their established brand reputation and longstanding customer relationships during this phase. However, this strategy is becoming less effective as new competitors, particularly from Asia, enter the market. In response, our revised approach incorporates the design team early in the quotation phase to emphasize the competitive landscape and inspire cost-effective product development.

Following a successful quotation phase, the concept phase begins, where the product starts to materialize. During this phase, 'A' samples are created and sent to the customer for concept verification and validation. Unlike traditional methods, the process planner starts defining the production process flow early, collaborating with the designer to refine the product concept and mitigate potential extra costs at the production stage. Concurrently, the Quality Planner initiates Design - Failure Mode and Effects Analysis (D-FMEA) to develop a reliable design and minimize functional risks. [12]

After the customer reviews and approves the concept and 'A' samples, the project moves into the final design phase. This phase solidifies the design, finalizes the materials list, and forms an implementation team led by the process planner. The team, representing various departments, starts defining the inquiry sheets for materials, fixtures, and equipment, essential for the purchasing department to identify potential suppliers. Process planners also begin the Process Failure Mode and Effects Analysis (PFMEA), with a team that includes representatives from production, engineering, and quality departments.

Once the design is completed, 'B' samples are constructed and evaluated. If these samples fail to meet all customer requirements, a design review is necessary. Subsequent 'C' samples, along with the final design, are then sent to the client for final validation.

Upon customer approval, the testing and qualification phase starts, marked by significant involvement from the implementation team. The project buyer places orders for new materials, equipment, and devices, while logistics representatives manage stock levels to support new and ongoing production needs. The process planner collaborates closely with suppliers to ensure the accurate construction of devices and equipment.

The project then progresses to practical training and mass production, segmented into three stages: final acceptance of equipment and devices, a full test run or pre-production, and the official production start. The project concludes with a 6-month ramp-up period where the project manager and process planner oversee optimal production processes and product quality before transferring full responsibility to the production department. [12]

2.6. Project Management Process in Automotive Industry

2.6.1. Project Initiation

Determining the exact start of a project can be ambiguous. Typically, the initiation phase is intended to launch the project, yet it also forms part of the initiation it aims to establish. For instance, in the business case, a critical document created to outline the project's cost-benefit analysis and necessary investment, does not involve starting the actual project work. Instead, the initiation is centered on defining the project's goals and the requirements to achieve them.

The Initiating Process Group involves processes that help to start a new project or a new phase of an existing project by securing the necessary authorization. The primary goal of project initiation is to set the project's initial financial resources, identify key internal and external stakeholders who will influence the project's outcome, and appoint a project manager if one has not yet been assigned. [13]

The first phase of project management, once a promising project idea has been identified, is crucial for laying a strong foundation for the subsequent project activities. The Initiating Process Group aims to align stakeholder expectations with the project's purpose, provide clarity on the project scope and objectives, and engage stakeholders to meet their expectations.

Initiation processes may occur at the organizational, program, or portfolio level, which could be beyond the project's direct influence. With a solid business case and an understanding of organizational constraints, the project initiation can proceed. This step includes the development of a project charter, a project scope statement, and the identification of project stakeholders.

2.6.1.1. Developing a Project Charter

The process of developing a project charter involves creating a document that formally authorizes the project or a phase, documenting the initial requirements that address stakeholders' needs and expectations. This document establishes a formal agreement between the performing and requesting entities (or customer, in external projects).

The project charter is a vital element of the project initiation phase. It is a formal, concise document that outlines the entirety of the project including its objectives, execution plan, and stakeholder list. It plays a pivotal role throughout the project lifecycle, offering a clear definition of the project's goals which informs the project's organization, schedule, staffing, and tasks.

The charter must be authorized by a sponsor who possesses the appropriate level of authority to fund the project. This sponsor may either draft the charter themselves or delegate it to the project manager. The signature of the initiator on the charter formally authorizes the project, which is typically motivated by internal business needs or external pressures. This step links the project to the organization's strategic objectives.

2.6.1.2. Inputs to Developing a Project Charter

This stage begins by identifying a business issue or opportunity, leading to the formulation of a business case which presents various solution options. A feasibility study assesses the potential success of each solution in addressing the business problem, culminating in a preferred solution. Following approval, a project charter is drafted to define the project's goals, scope, and structure, and a project manager is appointed. The project manager then begins to form a project team and establish a project office. Upon obtaining approval, the project moves into the detailed planning phase.

The initiation process concludes with a Project Kick-off Meeting, where the Project Manager presents the Project Charter to the stakeholders.

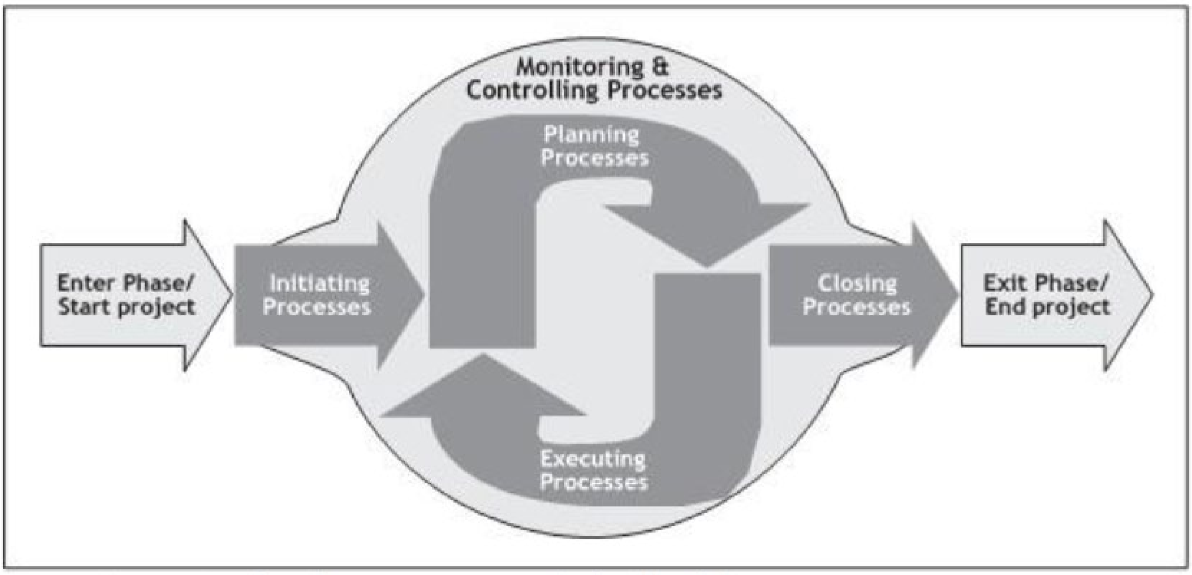


Figure 6: Project Management Process

2.6.2. Project Planning

Planning is fundamentally about defining the necessary actions, tasks, and resources required to meet specific objectives. Tucker describes planning as a process for monitoring, steering, communicating, and facilitating collaboration among stakeholders. Specifically, project planning involves setting goals and objectives that detail the necessary work, timeline, and resources needed to fulfill the project's aims. Projects usually stem from strategic goals set by senior management, with project planning focusing on establishing the methods, policies, and plans needed to achieve these objectives. This includes preparing a predetermined action course suited to the expected circumstances. [15]

The Project Management Institute emphasizes that the planning process involves defining and refining project objectives and choosing the most effective options for achieving these goals. In Europe, Project Cycle Management (PCM) is a prevalent tool used to allocate and oversee financial funds and is crucial for organizations that require a comprehensive system to plan and manage projects. A key component of PCM is the Logical Framework Approach (LFA), which aids project managers in identifying the main elements of a project, including resources, activities, products, outcomes, and goals. [14]

The primary aim of project planning is to create a detailed guide for the project that informs the team about necessary work packages, scheduling, and overall progress tracking, while also serving as a historical record for future reference. It ensures that all stakeholders are well-informed of every project facet, including constraints related to time, quality, and cost. Additionally, project planning checks the feasibility of plans, ensuring they can realistically be transformed into actionable tasks.

In the literature, there is discussion about the essential considerations during the planning phase, such as technical skills, project management expertise, and the organizational strategy. This stage involves crafting preliminary designs, evaluating project risks, defining the execution strategy, and making crucial decisions. Key areas addressed during this phase include clarifying expected outputs, identifying stakeholders, defining the project's scope, setting schedules, costs, quality benchmarks, and outlining communication pathways and potential risks.[15]

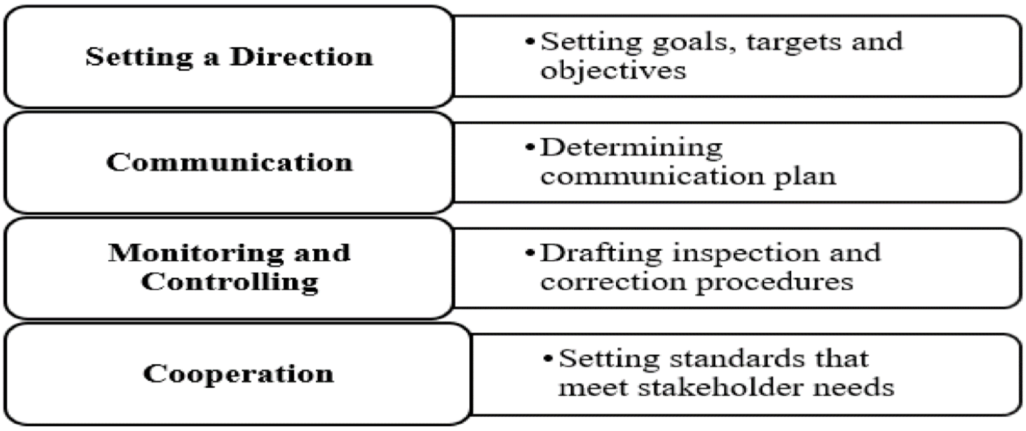


Figure 7: Conventional Planning

The Project Management Institute also proposes a similar structure for project planning, highlighting the need for detailed process descriptions within project activities. Figures 7 and 8 illustrating the distinctions between traditional and project planning show that project planning involves a more thorough breakdown of involved processes.

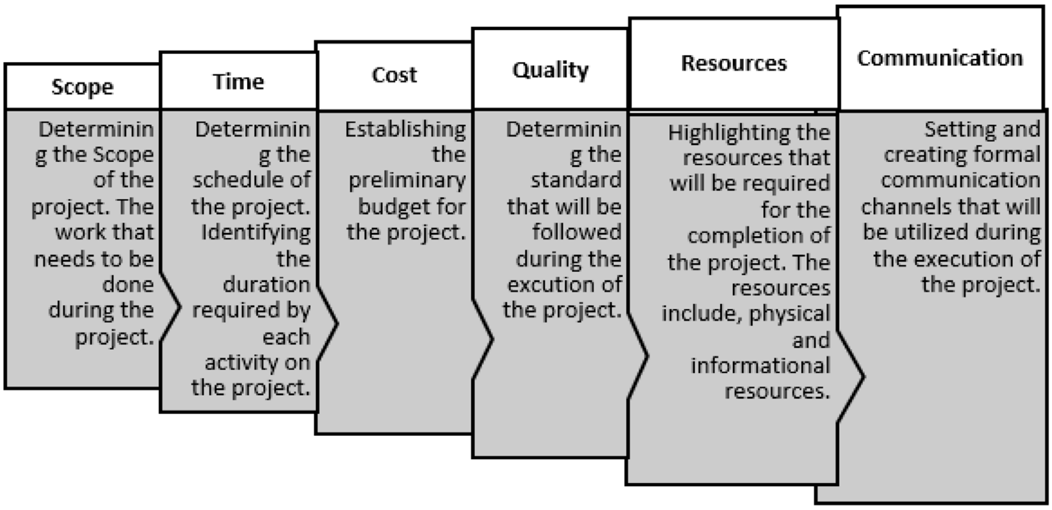


Figure 8: Project Planning

2.6.3. Stakeholder Management

Stakeholder management involves managing expectations and communications while assessing and addressing stakeholder needs to garner their support. This domain encompasses several critical processes:

2.6.3.1. Stakeholder Identification

Stakeholders are individuals, groups, or organizations that might influence, be influenced by, or believe they are influenced by decisions within a project, program, or portfolio. They may be either internal or external to the organization. The process of stakeholder identification involves documenting all key stakeholders in a stakeholder register. This register categorizes each stakeholder based on their relationship to the program, their level of influence, their support, and other characteristics that may affect their perception of the program and its outcomes. As the program evolves, this register should be updated to reflect new stakeholders or changing interests among existing ones. [16]

Name	Organizational Position	Program Role	Support Level	Influence	Communication	Other Characteristics
Stakeholder 1	Director	Supplier	Neutral	Low	Email monthly	Interests
Stakeholder 2	Customer	Recipient	Supportive	Medium	Conference weekly	Needs
Stakeholder 3	Sr. Vice President	Sponsor	Leading	High	Status report quarterly	Status—engaged

Figure 9: Project Stakeholder Identification

2.6.3.2. Stakeholder Analysis

After stakeholders are identified and documented in the stakeholder register, the next step is stakeholder analysis. This process involves categorizing stakeholders based on their influence and needs or expectations. This analysis is essential for understanding stakeholders' perspectives and objectives, enabling effective communication and engagement throughout the program's duration. By understanding stakeholders' needs and expectations, program managers can identify potential risks and opportunities and develop strategies to manage stakeholder interactions effectively.

2.6.3.3. Stakeholder Engagement

Engaging stakeholders is a continuous activity within the program. As the program progresses and outcomes materialize, both the list of stakeholders and their perceptions may change. It is the responsibility of the program manager to ensure that all stakeholders are actively and effectively engaged throughout the program. This is facilitated by ongoing stakeholder identification, interest mapping, and interaction planning. Regular reviews and updates of the stakeholder register, and maps are necessary to keep engagement strategies relevant and effective. [16]

2.6.3.4. Stakeholder Communications

Effective stakeholder engagement is fundamentally centered on robust communication strategies. Communication is vital for executing program initiatives and ultimately delivering benefits to the organization. It provides a framework for information sharing, negotiation, and collaboration among program team members, driving the program's activities forward. Program managers must maintain active and strategic communication with stakeholders, tailored according to their influence and needs as identified in the stakeholder register and maps. Continuous feedback through these communications is crucial for adjusting strategies and enhancing the program's overall success.

2.6.4. Risk Management

Risk management involves identifying, assessing, and prioritizing risks that may impact the successful execution of a program, along with implementing preventive actions to mitigate these risks. A well-defined program risk management strategy is crucial for ensuring the program's roadmap aligns with the organizational strategy and accounts for external environmental factors identified through assessments.

The risk management strategy includes several key steps:

- Risk Identification: Pinpointing potential risks that could affect the program.
- Risk Assessment: Evaluating the risks to understand their potential impact and likelihood.
- Risk Prioritization: Ranking these risks based on their severity and probability of occurrence.
- Developing Mitigation Measures: Creating strategies to reduce or eliminate the risks.
- Implementation and Review: Executing these mitigation measures and regularly reviewing their effectiveness to make necessary adjustments.

This comprehensive approach ensures that risks are managed proactively throughout the lifecycle of the program.

2.6.5. Quality Assurance in Project Management

Quality assurance is critical in ensuring high standards of engineering projects and systems. It is a specialized field dedicated to providing confidence and ensuring that all quality standards and requirements are met for a project. Quality assurance aims to satisfy both internal and external quality expectations. Internally, it ensures projects align with organizational needs, and externally, it ensures projects meet the quality expectations of stakeholders such as regulators, government agencies, customers, and others.

While closely linked to quality control, quality assurance serves as the broader discipline. Quality control specifically involves operational techniques and activities to fulfill quality requirements. Quality assurance, on the other hand, employs various methods like inspection and auditing to meet these needs. Inspection in quality assurance involves examining, measuring, and testing different project elements against design specifications to ensure conformity and adherence to the highest quality standards. Auditing in quality assurance focuses on evaluating a project's quality conditions, comparing them against expectations, and documenting the findings in detailed reports.[17]

With the increasing complexity and market pressures in engineering projects, implementing quality assurance throughout the project lifecycle has become essential to maintaining high standards. Starting quality assurance from the project's initial stages, such as during requirements gathering, is crucial. It helps identify potential quality issues early in the development phase, preventing substantial rework if initial designs are flawed. Implementing quality assurance early also minimizes the errors and defects that might be discovered during the testing phase of project implementation. [18]

Quality is a multifaceted aspect of project management that depends on organizational goals and stakeholder perspectives. Several views on quality need to be considered in quality assurance efforts. These include the transcendental view, which sees quality as an unattainable ideal; the user view, which bases quality on the ability to meet user expectations; the manufacturing view, focusing on quality during and after development; the product view, which examines the internal and external aspects of a project; and the value-based view, which relates quality to cost, assessing quality in terms of its practical benefits.

Quality assurance must also address several key attributes, including correctness—ensuring specifications meet user and customer needs—and unambiguity, which emphasizes the clarity and preciseness of requirements and specifications so that they are open to only one interpretation. Adhering to these principles and views helps ensure a comprehensive approach to quality assurance, contributing to the successful outcome of projects.

2.7. PFMEA in Automotive Industry

The "5 step method" of creating FMEAs is a widely recognized practice in the automotive industry, established under the VDA standard. This method systematically begins by forming hierarchical groups of system element networks. Each system element is then linked with its respective functions, followed by defining the potential effects of failures and evaluating the associated risks. The process culminates in the ranking and mitigation of these risks. Despite its prevalence, this method is resource-intensive due to the extensive number of reviews required for each newly developed product. Consequently, many companies have adopted "best practices" and leveraged internal know-how to expedite the FMEA process through templated approaches. However, even with these efficiencies, certain redundant steps remain challenging to eliminate. [23]

In environments with multiple independent departments or competence centers, diverse strategies for system modeling are employed, focusing on different analytical points. This variability can lead to latent quality gaps and risks, particularly when different products or components are integrated into a single system, necessitating interconnected FMEAs. A consensus on quality processes is achievable, while engineering aspects are supported by P-diagrams and boundary diagrams from the QS 9000 standard. Initial failures are often identified using Fault Tree Analysis (FTA) or Functional Hazard Analysis (FHA).

The analysis of hardware and mechanical elements is generally more straightforward than that of software elements due to the physical boundaries and the extensive support from existing standards. Software components, often modeled in Unified Modeling Language (UML) or through flowcharts, present challenges in identifying safety gaps and risks, especially in safety-critical modules. Interface inconsistencies, parameter errors, and data layer functions can lead to exceptions if incorrectly programmed or tampered with. While customers demand visibility of identified risks, analyzing and presenting numerous potential combinations of issues remains a complex task.

To optimize software module analyses, a functional or logical grouping of interface evaluations is recommended. These are difficult to detect through testing alone, but FMEA processes are crucial in pinpointing essential requirements and functions for further examination.

A comprehensive automotive system analysis should segregate hardware, software, and mechanical components, as these cannot be concurrently analyzed due to differing development schedules. At the highest common level, typically used for effect or system FMEA, discussions with customers regarding each severity number can facilitate the guidance of failures through the system, from top-level requirements down to specific elements like screws or software modules.

At the first point of analysis in system FMEA, a full risk evaluation is conducted, with potential for multiple system FMEAs running concurrently. This stage lists system functions linked to a higher level to determine the severity ranking for each potential failure. Below this, design FMEAs analyze mechanical, electrical, and software components within their logical connections to system-level FMEAs, creating a network that illustrates which components are involved in specific functions.

The final stages include process FMEAs, focusing on the risks associated with component production, and potentially a cause level, which, though not regularly utilized, offers significant benefits by cataloging design or process failure causes commonly across the system. This structured approach ensures a thorough and systematic evaluation of potential failures and their impacts across all levels of automotive part production.

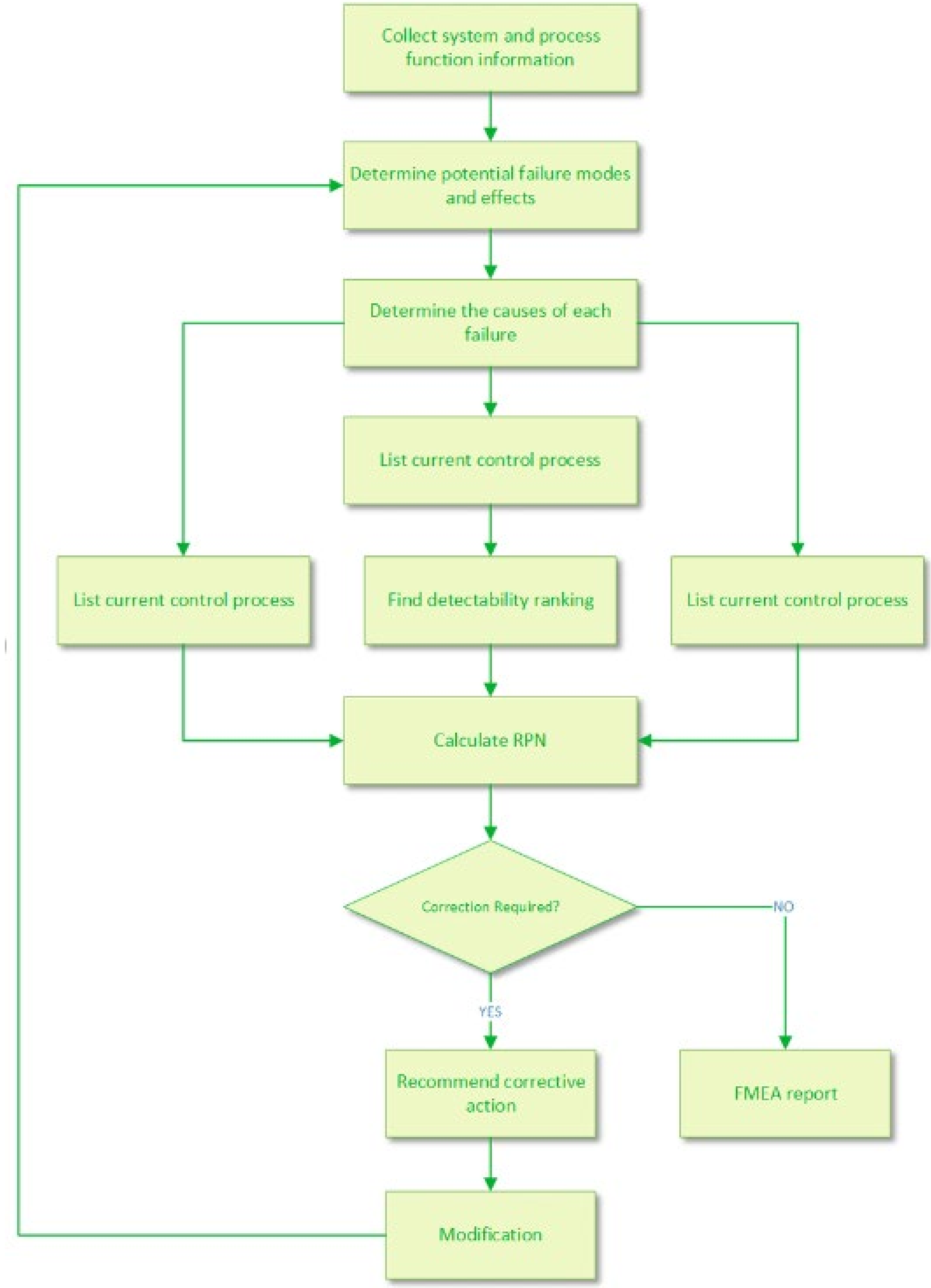


Figure 10: PFMEA Flow Chart

3. Identified Gaps in Project Management at 2A S.pA.

In conducting a detailed analysis through interviews with nine project managers, divided into four teams, significant inefficiencies in the current project management practices at the automotive company were identified. These inefficiencies stem primarily from non-standardized procedures employed throughout the project lifecycle, extending from project initiation to the Production Part Approval Process (PPAP). The discussions held with both technical leads and project managers further highlighted these fundamental gaps, underscoring additional areas where these inefficiencies compromise the effectiveness of project management in new product development. This comprehensive examination not only identifies these gaps but also emphasizes the need for strategic interventions to enhance overall project execution and success.

3.1. Extended Analysis of Existing Gaps and Related Issues

3.1.1. Lack of Standardization Across Project Teams

Primary Gap: Different project teams operate without a unified methodology, leading to inconsistent approaches in project initiation, execution, and closure.

Related Gap: This inconsistency often results in duplication of efforts and conflicting project outputs, as teams may inadvertently work on similar tasks without synergy or shared objectives. The resulting redundancies not only waste resources but also delay the integration of various project components, further slowing project momentum.

3.1.2. Inconsistent Application of PFMEA and Control Plans

Primary Gap: Variations in how PFMEA is conducted and control plans are executed lead to inconsistent quality control measures.

Related Gap: The variability in quality assurance practices can result in non-compliance with industry regulations and standards, which may not only lead to product recalls but also harm the company's reputation. Additionally, inadequate risk assessments contribute to unforeseen vulnerabilities, affecting product reliability and safety.

3.1.3. Inefficient Resource Management

Primary Gap: Unclear project roles and responsibilities complicate the efficient allocation and management of project resources.

Related Gap: This lack of clarity can lead to poor team dynamics and low morale, as team members may feel undervalued or unclear about their contributions to the project. Furthermore, inefficient resource management often leads to over or underutilization of personnel and materials, increasing project costs and affecting timelines.

3.1.4. Time Delays and Cost Overruns

Primary Gap: Non-standardized processes and quality variances inevitably lead to project delays and budget overruns.

Related Gap: The ripple effect of these delays and cost issues can disrupt the broader product launch schedules and marketing strategies, affecting the company's market positioning and competitive advantage. Additionally, continual budget overruns strain financial resources, potentially impacting funding for future projects.

3.2. Proposed Enhancements and Framework Adjustments

Building on the identification of these gaps, the thesis proposes a comprehensive enhancement of the project management framework to include:

3.2.1. Integration of Advanced Project Management Tools

Implementing project management software and tools significantly enhances planning, tracking, and collaboration, thereby standardizing workflows across teams within an organization. These tools are crucial for providing real-time updates and dashboards, helping maintain alignment among team members with overarching project goals. However, despite these advancements, a notable gap remains in the existence of a clearly defined, standardized workflow that can be universally applied across all projects and teams.

By introducing this standardized workflow into the methodology, organizations can ensure that all projects are managed consistently, leading to predictable outcomes and enhanced success in project execution. This structured approach not only fills the current workflow gap but also leverages advanced project management tools to enhance overall efficiency and effectiveness.

3.2.2. Robust Quality Management Systems

Strengthening the implementation of PFMEA and control plans with periodic audits and reviews to ensure compliance with the latest industry standards and practices. Introducing training programs to enhance the skills of team members in applying these tools effectively can also help mitigate quality-related risks.

3.2.3. Dynamic Resource Allocation Model

Developing flexible resource allocation models (Project Organization Chart) that can adapt to project needs in real-time. This involves setting up an internal resource pool that can be dynamically assigned to projects based on current requirements, optimizing resource use and reducing idle time.

3.2.4. Proactive Risk Management Framework

Establishing a proactive risk management framework that not only identifies potential risks early but also integrates mitigation strategies directly into the project plan. This approach should include regular risk review meetings and the development of contingency plans to handle potential issues swiftly.

These enhancements aim to fill the identified gaps, ensuring that project management practices not only meet but exceed the standards required for successful product development in the automotive industry. This structured approach promises to improve operational efficiencies, enhance product quality, and ensure timely project completions, aligning with strategic business objectives and market demands.

4. PROPOSED PROJECT METHODLYGY

4.1. Waterfall Project Management

The Waterfall project management methodology is a sequential, linear process model that is one of the oldest and most traditional forms of project management. It is characterized by a clearly defined series of stages that flow downwards like a waterfall through the phases of conception, initiation, analysis, design, construction, testing, deployment, and maintenance. This approach is well-suited for projects with well-defined requirements that are unlikely to change during the development process. Each phase must be completed fully before the next begins, allowing for systematic, orderly progression. This clear structure makes it easy to understand and manage, but it can be inflexible, as it typically does not allow for going back to modify the project scope once a phase has been completed.

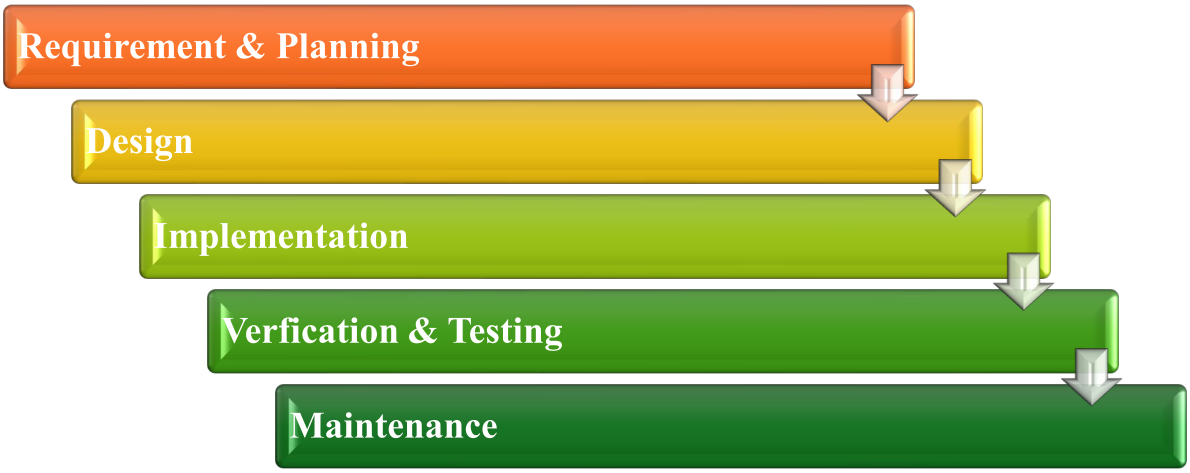


Figure 11: Waterfall Project Management

For this specific project, we will employ the traditional Waterfall project management methodology to meet its requirements. This approach adheres to a structured project management lifecycle, ensuring that the project progresses through a series of sequential phases. This format facilitates effective and orderly completion of the project, with each phase logically flowing into the next, ensuring thorough development and implementation.

4.2. Project Lifecycle Management (PLM)

Project Lifecycle Management (PLM) refers to the systematic approach to managing the various stages of a project from its inception to its conclusion. It involves planning, organizing, and controlling a project to ensure successful delivery within the specified time frame and budget, while meeting the defined objectives and requirements. PLM is critical in providing a structured process that helps project managers and teams anticipate, manage, and mitigate risks throughout the duration of a project. Here’s a detailed look at the different phases and key aspects of project lifecycle management:

4.2.1. Project Initiation

This initial phase of the PLM involves defining the project at a broad level. This step is crucial as it sets the foundation for the entire project. Key activities include:

Project Charter Development: Creating a document that formally authorizes the start of the project and includes a clear statement of objectives, scope, and participants.

Feasibility Study: Assessing the project's viability, risks, and potential benefits to determine if it should proceed.

Stakeholder Identification: Identifying all parties interested in or affected by the project and understanding their influences and requirements.

4.2.2. Project Planning

This phase is where the project solution is further developed in as much detail as possible, and plans are made for the next phases. It typically involves:

Scope Management: Defining and managing what is included and excluded in the project.

Resource Planning: Determining what resources (people, equipment, materials) and what quantities of each should be used to perform project activities.

Schedule Management: Developing a timeline for the completion of the project, including setting milestones and deadlines.

Cost Estimation and Budgeting: Estimating the costs of the resources needed and developing a budget that meets financial constraints.

Risk Management Planning: Identifying potential risks and devising strategies to mitigate them.

4.2.3. Project Execution

During this phase, the plans created during the previous phase are put into action. It is typically the longest phase of the project lifecycle and involves significant effort and coordination. Key components include:

Task Execution and Management: Directing and managing project work to produce the project deliverables within the planned scope, time, and cost parameters.

Quality Assurance: Implementing quality management processes to ensure that deliverables meet the required standards.

Communication: Ensuring effective internal and external communication flows according to the communication plan developed in the planning phase.

4.2.4. Project Monitoring and Control

This phase occurs concurrently with the execution phase and involves tracking, reviewing, and regulating the progress and performance of the project. This ensures that project management standards are being followed, and project objectives are being met. Key activities include:

Performance Measurement: Monitoring project milestones against the project plan.

Scope Verification and Change Control: Managing changes to the project scope, schedule, and costs.

Project Reporting: Providing detailed progress and performance reports to stakeholders.

4.2.5. Project Closure

This final phase ensures that all aspects of the project are completed and accepted by the stakeholders. Closure activities might include:

Final Deliverables: Handing over project deliverables to the client and ensuring their acceptance.

Documentation: Gathering and cataloging project documentation to ensure that all project work is documented and archived.

Post-Implementation Review: Evaluating what went well and what didn’t, to capture lessons learned.

Project Release: Releasing project resources and formally closing out contracts.

4.2.6. Importance of PLM

Project Lifecycle Management is essential for several reasons:

Efficiency: Improves project efficiency through structured planning and control methods.

Visibility: Provides all stakeholders with better visibility into the project’s progress and potential issues.

Risk Management: Helps in identifying and managing risks before they become more significant problems.

Cost Control: Aids in keeping the project within the approved budget by monitoring and controlling expenditures.

PLM frameworks vary by industry, company size, and project complexity, but the fundamental principles of structured project management remain the same. Effective PLM ensures that projects meet their objectives, deliver benefits, and are completed on time and within budget.

4.3. New Product Development Methodology for 2a S.p.A

A comprehensive workflow tailored for new product development (NPD) projects. It includes a step-by-step breakdown of the entire process, from the initial project kick-off, through various stages such as engineering, development, procurement, industrialization, product/process qualification, Production Part Approval Process (PPAP) submission, to the start of full-scale production. The Project Manager is designated as the primary responsible party for overseeing these activities.

4.3.1. Goals and Objectives

The purpose of this section is to provide a clear and methodical guide for the effective implementation of the NPD process for new projects. The objectives outlined aim to:

- **Streamline the NPD Process:** Define a clear and structured workflow from the inception of the project through to full-scale production, ensuring all phases are executed with efficiency and clarity.
- **Ensure Quality Compliance:** Highlight the importance of adhering to established quality standards and meeting customer requirements throughout the development and approval processes, leading to successful PPAP submission and approval.
- **Facilitate Team Coordination:** Enhance collaboration and communication among cross-functional teams and external partners to ensure all efforts are synergistically aligned with the project's milestones and goals.
- **Optimize Resource Use:** Provide guidance on the efficient allocation and utilization of resources, ensuring that project deliverables are met within the stipulated timelines and budget constraints.

These sections serve as a foundational framework for discussing the structured approach to NPD within a dissertation, maintaining the specific terminologies and themes pertinent to project management and product development.

4.3.2. Project Team

A dedicated project teams bring a prominent level of commitment, expertise, and continuity to their projects, making them indispensable for complex and strategic initiatives that require focused attention and specialized skills.

- **Focused Expertise and Effort:** A resolute team brings specialized knowledge and skills to a project, allowing for a focused approach to tackling specific challenges and tasks. This concentration of expertise ensures that team members are not distracted by responsibilities unrelated to the project.
- **Improved Coordination and Communication:** With a dedicated team, members work closely together, which enhances coordination and communication. Regular interactions help to build a deeper understanding among team members about the project's goals and the strategies for achieving them.

- **Faster Decision-Making:** A dedicated team can make decisions more quickly. Familiarity with the project's details and direct communication channels allow for swift resolution of issues and faster progression through project phases.
- **Greater Accountability:** When a team is dedicated to a project, each member's roles and responsibilities are clear, and this clarity increases accountability. Team members are more likely to take ownership of their tasks and outcomes.
- **Enhanced Project Monitoring and Control:** Continuous involvement with the project allows the team to monitor progress effectively and make necessary adjustments in real-time. This initiative-taking management helps in maintaining project schedule and budget.
- **Better Risk Management:** Being fully immersed in the project allows the team to better anticipate, identify, and mitigate risks, as they are more familiar with the potential pitfalls and complexities of the project.

For the **Flywheel Housing**, these roles collectively contribute to the streamlined and efficient development of new products.

Figure 12: Project Organization Chart

KAM (Key Account Manager): This individual is responsible for managing customer sales and handling negotiations for customer RFQs (Request for Quotations).

STABILIZZATORE (Project Manager): The leader of the project team, this person works closely with the KAM and reports directly to the Project Director.

PD (Product Development): This development team analyzes the RFQs and, based on requirements, conducts preliminary and detailed analyses, creates CAD designs of molds and tools, and performs simulations to analyze results.

QP (Product & Tool Qualification): This team is responsible for the testing and verification of the product and works closely with suppliers and project managers to ensure the product meets quality standards.

Purchasing: Divided into two sections: In-house tool purchase, which includes tools used internally like Casting Tools, Trimming Tools, and occasionally machining fixtures and tools; and outsourced activities purchase, which involves subcontractor activities such as Heat Treatment, Polishing, etc.

Quality: Quality assurance is divided into Customer Care and Supplier Quality. Customer Care handles customer inquiries and complaints, while the Supplier Quality team manages and ensures the quality of supplies.

Logistics: This team manages the complete logistics of parts and functions as the Material Planner, like its traditional role.

4.3.3. Project Process Flow

The process flow of New Product Development is presented as follows:

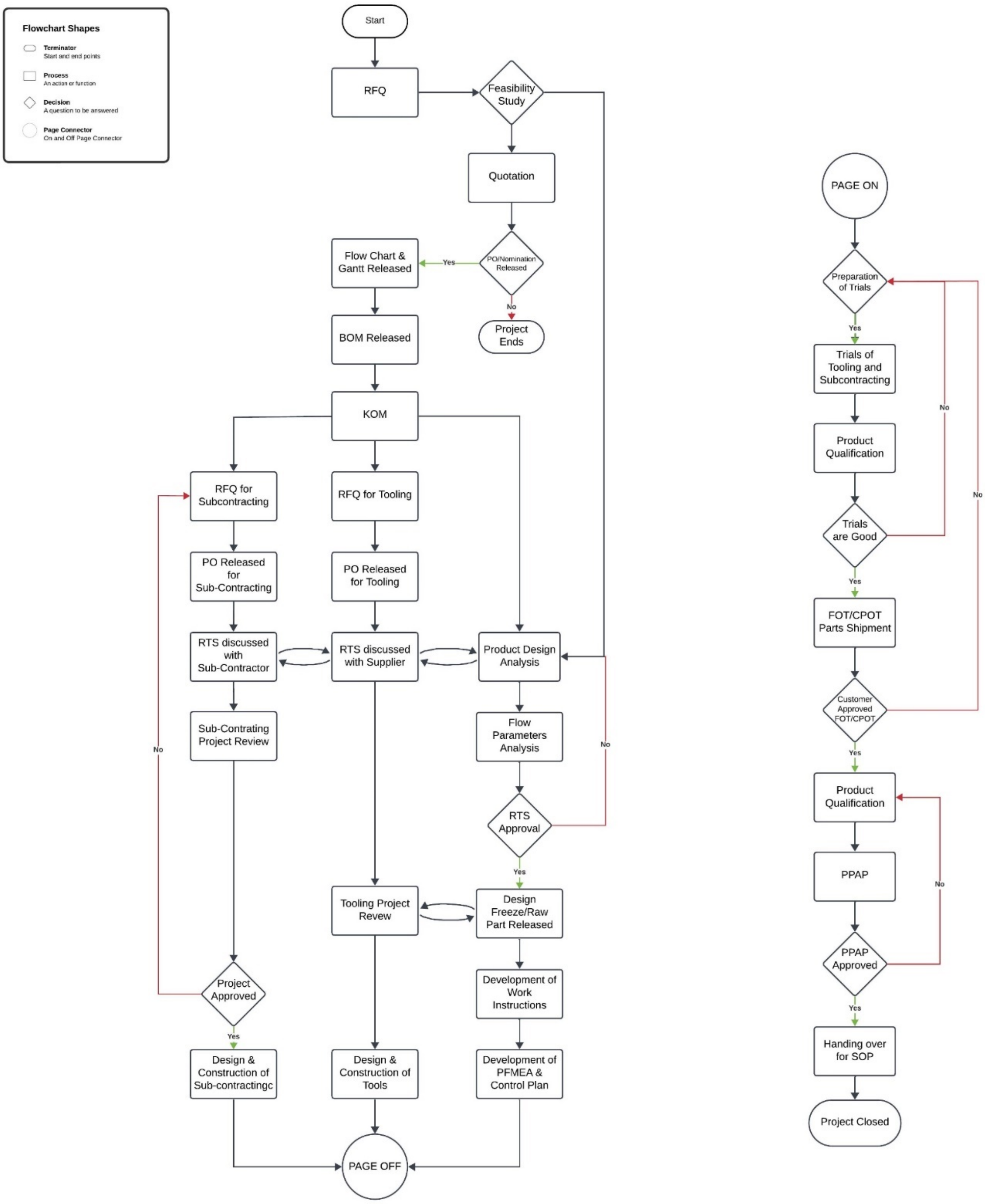


Figure 13: Proposed Project Management Framework for 2a S.p.A

4.3.3.1. Workflow from KOM To PPAP Approval

This workflow outlines a structured process for moving from the initial Kick-Off Meeting (KOM) to the final Production Part Approval Process (PPAP) approval, ensuring precision and clarity at each step.

Preparation Phase

1. Kick-off Meeting: Conduct the foundational meeting to establish the project's scope, objectives, timelines, and responsibilities, aligning all stakeholders. (KAM)
2. Data Collection for KOM: Gather all necessary data to facilitate informed discussions and decision-making during the KOM. (KAM)
3. Flow Chart Development: Develop and finalize a flow chart that outlines the entire project lifecycle, ensuring a clear roadmap for execution. (KAM)
4. Flow Chart & GANTT Chart Released: Produce detailed Gantt charts for both internal use and customer review, mapping out project milestones, and secure necessary approvals for these charts. (STAB)
5. Material Codification and Management: Codify the Bill of Materials and semi-finished products, (STAB)
6. Release of BOM: Integrate above data into the internal ERP system for efficient tracking and management. (Logistics)

Design and Specification Review

1. Product Design Analysis: Conduct a detailed 3D analysis of the product design, focusing on dimensions, materials, and functionality. (PD
2. Flow-Parameter Design: Design optimal ingate systems and casting flow parameters for superior material flow. (PD)
3. Ongoing RTS Reviews: Engage in continuous reviews of the RTS with the customer, adjusting project specifications based on feedback until all specifications are agreed upon and finalized. (PD)

Note: The RTS approval week is considered as W0.

Engineering and Development Phase

1. Tooling Specifications Discussion: Discuss specifications and timelines for tooling during the Request for Quotation (RFQ) phase. (PD)
2. Order Submission for Tooling: Submit orders for the required tooling and materials post-RFQ phase to ensure availability and readiness. (PD and purchasing)
3. Technical Specifications Review: Initiate the Review of Technical Specifications (RTS) with the project team and the customer to fine-tune technical details. (PD)

Tooling and Production Preparation

1. Development of Work Instructions: Establish comprehensive work instructions for both external suppliers and internal production teams, ensuring consistency and clarity in production processes. (PD)

2. Risk and Quality Management Implementation: Release the initial Process Failure Mode and Effects Analysis (PFMEA) and control plan, which outlines potential risks and quality control measures. (STAB)
3. Packaging Proposals: Define specific packaging requirements for each production step. (STAB)

Tool and Equipment Verification

Conduct thorough reviews for all major tool projects—die casting, trimming, and machining to ensure each tool is ready for production and meets required specifications. (PD)

Tool design and construction at supplier:

Align the Gantt chart with the tooling and subcontracting supplier and take weekly follow-ups to stay updated with the unforeseen risk and mitigate the risks if there will be any by conducting the meetings or taking necessary actions. (STAB)

Final Trials and Qualification

1. Equipment/Tooling Trials: Conduct extensive trials (firstly T1 and then plan T2 after fine tuning the results of T1) to validate all tools and processes, ensuring compliance with quality and performance standards. (QP)
2. Product qualification process: Once the trials has been finished, the QP team start working on final qualification and release some documents like Run Rate report, capability report and perform the internal audit of complete process and release the report as well. (QP)
3. FOT Parts Shipment date: The date on which the internally approved parts are ready for shipment to the customer for the customer analysis and approval.

PPAP Submission and Approval

1. Documentation Compilation: Compile all necessary documentation for the PPAP, ensuring comprehensive coverage of quality records, certifications, and process details. (QP)
2. Sample Preparation and Submission: Prepare high-quality sample parts and submit the complete PPAP pack for customer review. This date is also important in terms of customer milestones. (QP)
3. Final Customer Approval: Secure formal customer approval, confirming that all aspects of production meet or exceed the specified standards. (QP)

This detailed process ensures a meticulous and structured approach to each phase of the project, from planning and design through tooling, trials, and final approval. The focus on comprehensive planning, consistent communication, and stringent quality controls is crucial for the successful development and launch of new products. A detailed BPMN by using the Signavio software is attached in Annexure No 01, which describes the complete project management framework with the responsible persons.

5. ANALYSIS OF PROJECT METHODLYGY

Flywheel Housing, a new requirement has been initiated from MAN Trucks, the project was launched by creating a turtle diagram for the Kickoff Meeting (KOM) to analyze the requirements and needs of the stakeholders.

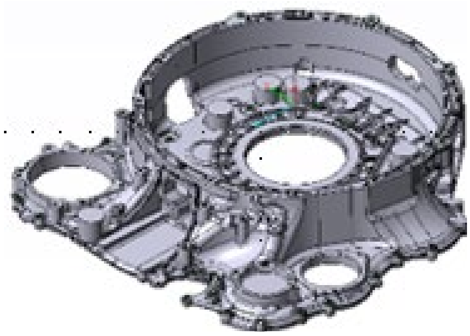


Figure 14: Flywheel Housing, Component of a German Truck & Bus company

5.1. KOM – Turtle Diagram

A turtle diagram is a visual tool used in process management and quality assurance to map out the key elements of a process in a clear and concise manner. This diagram gets its name from its shape, resembling a turtle, with different sections or 'shells' that detail various components of the process. The typical turtle diagram includes inputs and outputs of the process, the resources needed, and the responsibilities assigned. Here's what each part generally represents:

- **Inputs:** What materials, information, or other resources are required to start the process?
- **Outputs:** What are the final products or results of the process?
- **Process:** What are the key steps or activities involved in transforming the inputs into outputs?
- **Criteria:** What standards or requirements must the process meet to be considered successful?
- **Resources:** What tools, equipment, technologies, and other resources are necessary to carry out the process?
- **Responsibilities:** Who is responsible for each part of the process? This might include specific roles or departments within an organization.

Turtle diagrams are highly valued for their simplicity and effectiveness in providing a comprehensive overview of a process briefly. They are particularly useful in quality management systems for auditing and continuous improvement, helping teams understand processes thoroughly and identify areas of potential improvement.

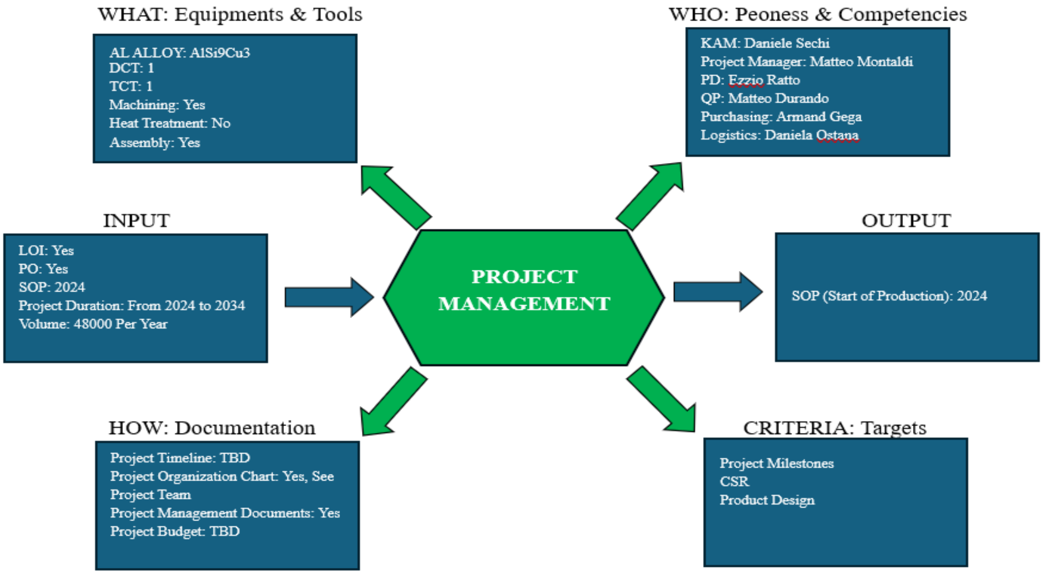


Figure 15: Turtle Diagram for Flywheel Housing

5.2. Project Plan – Gantt Chart

A Gantt chart is a type of bar chart that represents a project schedule over time. It is an essential tool in project management that helps to visualize the timeline of all the tasks that make up a project, their start and end dates, and the dependencies between these tasks. Here's an outline of how a Gantt chart functions and its importance in managing projects:

5.2.1. Process Description of Gantt Chart:

Task Listing: The first step in creating a Gantt chart is to list all tasks or activities involved in a project. Each task is represented by a horizontal bar whose length represents the duration of the task.

Setting Timelines: The chart is laid out with a timescale that spans the entire length of the project, from start to finish. The timeline can be divided into weeks, months, or quarters, depending on the total duration of the project.

Assigning Dates: Each task is assigned a start date and an end date. These dates are used to place the bars on the chart in a way that reflects when the task will begin and when it is expected to be completed.

Dependencies: Connections or arrows between bars show the dependencies among the tasks. This means that the start or completion of one task is dependent on the start or completion of another.

Progress Tracking: As the project progresses, the Gantt chart can be updated to reflect what tasks have been completed and which ones are still in progress. This provides a visual representation of the project's progress against the planned schedule.

We have developed the Gantt chart by following the process flow steps for this project. The Gantt chart has been attached in Annexure No 02.

5.3. Process Flow Chart

The flow chart is essential for documenting the manufacturing processes of automotive and truck components. The flowchart is an indispensable tool in manufacturing, helping to visualize each step of the process from start to finish, ensuring that every component is created under standardized and controlled conditions.

5.3.1. Importance of the Flow Chart

A well-maintained flowchart serves several critical functions in the manufacturing process:

Clarity and Consistency: It provides a clear and consistent visual representation of the entire manufacturing process, allowing stakeholders from various departments such as engineering, manufacturing, and quality assurance to have a common understanding of process steps and requirements.

Effective Communication: The flowchart facilitates effective communication across teams, ensuring that all members understand the process flow, dependencies, and their individual roles within the project. This understanding is crucial for coordinating efforts and aligning activities toward a common goal.

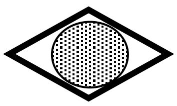
Process Improvement: Regularly updated flowcharts help identify bottlenecks, redundancies, or inefficiencies within the manufacturing process. This visibility allows for continuous improvement and optimization of workflow, contributing to better quality control and efficiency.

Training and Onboarding: For new employees, the flowchart serves as an educational tool that offers a quick overview of how processes are intended to flow and how various tasks interconnect. This aids in faster onboarding and training, helping new team members to understand their roles within the larger context of production quickly.

Compliance and Documentation: In industries where compliance with safety and quality standards is mandatory, having detailed flowcharts is essential. They serve as proof of adherence to prescribed manufacturing standards and practices, assisting in audits and quality checks.

5.3.2. Symbols of Flow Chart

Below symbols has been used to represent different process,

OPERATIONS NAME	**Operations/Process/Storage/Shipment**
	**Inspection/Final Inspection**
A	**Applicable**
NA	**Not Applicable**

5.3.3. Key Processes used in the part production

Primary Material Preparation: The chosen aluminum alloy is prepared by melting it in a furnace to the required casting temperature. There is a separate sheet for the different chemical composition of Aluminum in the form of ingots. The alloy has been finalized by the customer and should be added to the Flow chart. The incoming material should be inspected as per the control plan.

Casting

Pouring: The molten metal is poured into the mold, filling the cavity of the desired shape.

Cooling and Solidification: The metal is allowed to cool and solidify within the mold, forming the raw shape. Once the metal has solidified, the cast product is removed from the mold.

Trimming

Excess material and ingates (the channels through which the molten metal was poured) are trimmed from the cast part. This step is usually performed using trimming/cutting tools or by snapping off the excess in a controlled manner by don't deforming the cast part.

Sand Blasting

After trimming, the bracket undergoes sand blasting. This process involves blasting the surface of the bracket with fine grains of sand propelled by compressed air. This smooths the surface, removes residual mold material, and prepares it for further finishing processes.

Heat Treatment

To improve the mechanical properties and relieve stresses built up during casting and trimming, the bracket may undergo heat treatment processes such as annealing or tempering. This process is applicable only as per customer demand.

Finishing Processes

The bracket is machined to achieve the precise dimensions, additional features i.e. threading, holes, chamfers, and surface finish specified in the 3D design.

Surface Treatment:

Additional surface treatments, such as painting, powder coating, or galvanizing, are applied to enhance corrosion resistance and aesthetic appeal. This process is applicable only as per customer demand.

Assembly:

If there are some sub-components, they should be assembled after machining/finishing process, the subcomponents should be firstly inspected as per the control plan and then assembled accordingly. The subcomponents might be Rivets, Screws, O-Rings etc.

Washing Process:

After machinery the part might be sent for washing to clean the aluminum chips from everywhere. This process is applicable only as per need/customer demand.

Quality Control

Inspection and Testing: Each batch/lot as per the control plan undergoes rigorous quality control testing. This includes material composition analysis for raw material, dimensional checks and casting defects for cast parts, and mechanical property testing.

Leakage Testing

The assembled part may be subjected to leakage testing as per the customer requirements, The leakage testing would be done by pressurizing the assembled component and monitoring for pressure drops which indicate leaks.

Final Inspection:

A final inspection ensures all specifications are met before the bracket is approved for shipment.

Packaging/Storage:

Finished products are packaged securely as per the packaging plan to prevent damage during transportation.

Shipping:

Packaged products during process cycle and after final inspection are shipped to the to the next stage of production chain or to customer respectively.

5.3.4. Formation Procedure

The formation of flow chart starts from the material in-housed and ends when the finished product dispatched to the customer. It will progress in terms of tens in the “STEP No” like 10, 20, 30 etc. The processes mentioned in this document are commonly used (See Annexure No 03). The flow chart formation should be performed with the assistance of process specialist, who can assist in analyzing the process need to be done on the part in the right sequence which not only minimizes the uncertainties of flow and defects probabilities as well. The right sequence which not only minimize the uncertainties and the process waste.

The naming of the operations should be noticeably clear, for example, if there is a second external operation then, it should be written as “2^{nd} External Operation”, so that it will be clear for the reader. For each step, a succinct description should be added, the related control plan document number for the reference purpose only if applicable, and any additional comments/notes for the stakeholders.

The flow chart is the first document to formalize the project management documentation, it would be the base of Bill of Material (BOM) and then for the control plan (CP) and Process failure mode and effect analysis (PFMEA).

After constructing the flow chart, the flow chart must send to the Technical Manager for the review purpose and once it has been reviewed it should send to the Quality Manager for the final approval.

The Flow Chart for Flywheel Housing is attached in the Annexure No 03.

5.4. Bill of Material (BOM)

The Bill of Materials (BOM) is a comprehensive list that outlines all materials, components, and assemblies required to construct a product. It plays a pivotal role across various departments including Product Design, Production, Procurement, and Inventory Management. By detailing each item's quantity and providing essential information, the BOM aids in production planning and control. The creation of a BOM begins post the issuance of an ST-Number.

5.4.1. Significance of a Bill of Materials

The primary aim of a Bill of Materials is to foster standardization in the creation and management of material lists within an organization. Key benefits include:

- Ensuring accurate and current documentation of all materials and components needed for manufacturing.
- Enhancing communication and collaboration across various departments.
- Facilitating precise inventory management and procurement planning, crucial for timely production schedules.
- Supporting quality control measures and compliance with specifications and customer requirements, ensuring product consistency and reliability.

5.4.2. Methodology for Completing the BOM Template

5.4.2.1. Project Details

Project Identification: Record the name or ID of the project, linking the BOM to specific product initiatives.

Customer Information: Note down the customer's name or ID, aligning the BOM with customer specifications.

Prototype or Series: Indicate whether the BOM pertains to a prototype or series production, clarifying the production scope.

ST Number: Enter the unique internal part number for traceability and reference.

5.4.2.2. Revisions and Modifications

Revision Tracking: Initiate with a revision number of zero and increment for each update, capturing the evolution of the BOM.

Revision Date: Document the date on which any revision was finalized.

Change Description: Provide a succinct explanation of modifications to understand the evolution of the process.

Compiler Information: Identify the individual responsible for compiling the BOM, ensuring accountability.

5.4.2.3. BOM Entries

Part Numbers: Enter both customer and internal part numbers to ensure accuracy in procurement and inventory tracking.

Detailed Descriptions: Offer comprehensive descriptions of each item, detailing critical specifications to eliminate ambiguities.

Process Codes: Utilize codes to categorize internal processing, material purchasing, and external processing activities.

Target Prices and Cycle Times: Set realistic cost goals for components and estimate cycle times to optimize production efficiency.

Quantitative Requirements: Specify the required quantities for each item, considering operational needs and potential inefficiencies.

5.4.2.4. Finalization and Approval

Upon completion, the BOM must undergo a review and approval process by both technical and commercial directorates to confirm adherence to technical specifications and commercial viability. This dual approval ensures that the BOM is both accurate and economically feasible.

5.4.2.5. Implementation

Once approved, the BOM is forwarded to logistics for integration into the ERP system, enabling the generation of detailed production and procurement schedules. This step is critical for transitioning from planning to operational phases, ensuring that all team members are aligned and informed.

This structured approach to managing a Bill of Materials not only standardizes production activities but also enhances operational efficiencies, making it an indispensable tool in manufacturing management.

The Bill of Material for Flywheel Housing is attached in the Annexure No 04.

5.5. Product Development Design & Tooling

After initial assessment of RFQ, the product development team initiate a detailed analysis of requirements and CAD Model provided by the customer, the perform the analysis which provides a comprehensive overview of the results from the filling simulations conducted for the component. Product development and Project Management scheduled several meetings with customer, the intention is to review critical aspects of the manufacturing process, emphasizing quality control and process optimization.

5.5.1. Key Points Covered by Product Development during the assessment and CAD Modelling Phase

5.5.1.1. Filling Simulation Outcomes

The presentation meticulously outlines the outcomes of filling simulations across multiple runs (RUN-00 and RUN-01). These runs were evaluated to ensure that the casting processes, including the configurations of runners, ingates, and overflows, are optimal for achieving high-quality casting results.

5.5.1.2. Quality Analysis

Detailed analysis of various quality parameters like temperature control during filling, fraction solid, and air entrainment is provided. These parameters are crucial for understanding the material behaviour during the die-casting process and for predicting the occurrence of defects.

5.5.1.3. Defect Identification

The presentation identifies specific zones within the flywheel housing where potential defects such as shrinkage porosity and air entrainment might occur. Each zone is analysed to determine the risk levels and necessary adjustments in the production process to mitigate these risks.

5.5.1.4. Geometric Modifications

Adjustments made to the geometry of the cast shot model are discussed. These modifications are crucial for reducing defects and enhancing the overall quality of the final product.

5.5.1.5. Critical Issue Mapping

A zone-wise breakdown is provided, detailing issues related to machined surfaces, threaded, and machined holes, inner defects, and overall tightness. Each aspect is classified according to its defect level, and necessary actions are suggested to address identified issues.

5.5.1.6. Technical Specifications and Standards

The presentation includes details about the technical standards adhered to during the simulation processes, ensuring that all operations align with industry benchmarks for quality and safety.

5.5.1.7. Visual and Interactive Elements

The presentation is enhanced with clickable images and videos that demonstrate the simulation results, offering a dynamic way to visualize how the filling process affects the component's quality.

5.5.1.8. Future Actions

The need for further simulations is highlighted, especially in zones where the risk of porosity and other defects are not satisfactorily mitigated. These ongoing assessments are crucial for continuous improvement and maintaining the integrity of the manufacturing process.

These analysis serves as a crucial element for stakeholders involved in the manufacturing of the component, providing them with detailed insights into the filling process, identifying potential quality issues, and outlining necessary corrective actions. It emphasizes the company's commitment to innovation and quality in die-casting, ensuring that each component meets stringent safety and performance criteria. The detailed analysis and strategic overview aim to foster better understanding, facilitate informed decision-making, and drive improvements in future production cycles.

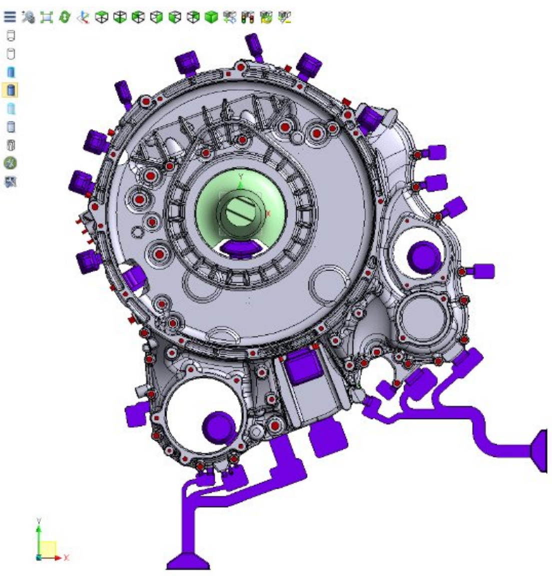


Figure 16: Flywheel Housing 3D Raw Part Released

5.6. Purchasing of Tools and Subcontracting services

For the project in question, the procurement of tools and the subcontracting of specific services are critical components of the production process. These elements are integral to ensuring that the project is executed efficiently and meets the required quality standards. The following details outline the strategy and considerations involved in the purchasing of tools and the subcontracting of services for this project.

5.6.1. Purchasing of Tools

The project requires specific tools that are crucial for the production process, namely casting tools or Molds, and trimming tools. These tools will be procured internally to maintain control over quality and facilitate rapid commencement of production activities.

5.6.1.1. Casting Tool or Mold

Purpose: The casting tool or Mold is essential for shaping the parts as per the project specifications. It is the first step in the manufacturing process, where the raw materials are transformed into the basic form of the final product.

Selection Criteria: The selection of the casting tool will be based on the complexity of the part design, the material specifications, and the expected production volume. Durability and precision are key factors in choosing the right tool to ensure it can withstand the production demands and maintain dimensional accuracy.

Supplier Engagement: Suppliers will be shortlisted based on their capability to produce high-quality Molds within the required timelines. Competitive bidding will be used to select the supplier offering the best value, considering cost, quality, and delivery time.

5.6.1.2. Trimming Tool

Purpose: After casting, excess material needs to be removed, which is done using a trimming tool. This tool ensures the parts meet the precise size and weight specifications.

Customization: Each trimming tool must be custom designed to align with the specific contours and edges of the cast parts. The design process will involve close collaboration with the tool supplier to ensure accuracy.

Procurement Process: Like casting tools, the procurement of trimming tools will involve evaluating suppliers based on precision, reliability, and cost. Only suppliers with a proven history will be considered to minimize the risk of production delays.

5.6.2. Subcontracting Services

Certain processes in the manufacturing sequence, such as machining and assembly, will be subcontracted. This approach leverages specialized expertise to enhance product quality and efficiency.

5.6.2.1. Sandblasting:

Purpose: Sandblasting is employed to clean the surface of cast parts or to create a surface texture that meets specific technical or aesthetic requirements.

Subcontractor Selection: Sandblasting requires precise control and expertise to ensure the finish meets the project's specifications. The subcontractor will be chosen based on their ability to deliver consistent quality and their experience with similar materials and products.

Process Integration: Sandblasting will be scheduled in the workflow before final inspections to ensure any residues or imperfections are removed, enhancing the final appearance and quality of the components.

5.6.2.2. Machining:

Scope: Machining involves the detailed refinement of the cast parts to achieve the final dimensions and surface quality required. It may include drilling, milling, turning, and other processes.

Subcontractor Selection: The choice of a machining subcontractor will be based on technological capability, adherence to quality standards, and the ability to meet tight schedules. Quality audits and past performance reviews will be integral to the selection process.

Quality Control: Despite subcontracting, quality control will remain a core focus. The project team will regularly inspect the subcontractor's facility and conduct random quality checks to ensure compliance with the project specifications.

5.6.2.3. Assembly:

Integration: In cases where multiple components need to be assembled to form a finished product, specialized assembly services may be required.

Expertise: Subcontractors with specific expertise in assembling complex products will be preferred to maximize the integrity and functionality of the final product.

Monitoring and Evaluation: Continuous monitoring of the assembly process will be enforced through scheduled visits and quality testing of assembled units to ensure that the final products are functional and meet all required standards.

5.7. Integrating Process Quality Management with PMI

Integrating Process Quality Management (PQM) theories, methods, and techniques into the Quality Management area of the PMI (Project Management Institute) Project Management discipline enhances both the strategic and operational aspects of project execution. This synthesis ensures that projects not only meet but exceed the quality standards expected by stakeholders, thereby increasing the overall project success rates.

5.7.1. Theoretical Alignment

Process Quality Management theory revolves around the continuous improvement of processes through systematic control and feedback loops. Key components of this theory include defining quality standards, measuring performance against these standards, and implementing improvements based on the results. Similarly, PMI's Quality Management discipline emphasizes the importance of "Plan Quality Management," "Manage Quality," and "Control Quality" processes as part of its methodology. By aligning PQM theory with PMI's framework, project managers can create a more robust approach to quality that is proactive rather than reactive, focusing on preventing quality issues before they arise.

5.7.2. Methodological Integration

- PQM methods such as Six Sigma, Total Quality Management (TQM), and Lean focus on reducing waste, improving process efficiency, and maximizing stakeholder satisfaction. These methodologies align closely with PMI's quality management processes:
- Plan Quality Management in PMI can be enhanced by incorporating Six Sigma's DMAIC (Define, Measure, Analyze, Improve, Control) methodology to set quality objectives and identify key deliverables.
- Manage Quality involves the integration of TQM principles, where continuous stakeholder feedback and team involvement are crucial in maintaining high-quality standards throughout the project lifecycle.
- Control Quality can utilize Lean techniques to monitor and optimize processes, ensuring they remain efficient and aligned with the project's quality standards.

5.7.3. Technique Application

Specific PQM techniques like statistical process control (SPC), Pareto analysis, and root cause analysis can be directly applied to PMI's quality management practices:

- Statistical Process Control (SPC): This technique can be used during the PMI's Control Quality process to monitor variations in project processes. By applying SPC, project managers can detect and address variations from the project's quality baseline early, preventing them from becoming more significant issues.
- Pareto Analysis: During the Manage Quality process, Pareto analysis helps in identifying the major causes of quality issues within a project, allowing teams to focus their efforts on correcting the most significant problems first.
- Root Cause Analysis (RCA): RCA is critical in both Plan Quality Management and Control Quality processes. It helps in determining the underlying causes of any discrepancies noted in quality audits or reviews, ensuring that solutions are effective and prevent recurrence of the same issues.

5.7.4. Implementing Quality Assurance Framework

By integrating PQM techniques into the PMI framework, a comprehensive quality assurance framework can be developed. This framework not only supports the delivery of high-quality project outputs but also ensures that processes are continuously reviewed and improved, leading to higher efficiency and effectiveness in project management.

Connecting PQM theories, methods, and techniques to the PMI's Quality Management discipline provides a structured yet flexible approach to quality. This integration helps projects meet rigorous standards, adapt to changes smoothly, and achieve both short-term and long-term objectives effectively, fulfilling the needs and expectations of all project stakeholders.

5.8. PFMEA

Process Failure Mode and Effects Analysis (PFMEA) is an indispensable risk assessment tool in the automotive industry, employed to predict and mitigate potential failures in manufacturing and assembly processes. By systematically evaluating the possible modes of failure within a process, automotive manufacturers can identify critical risks and implement measures to enhance the safety, quality, and reliability of automotive components and systems. The approach not only adheres to industry standards, such as those outlined by the Automotive Industry Action Group (AIAG), but also aligns with stringent regulatory requirements.

5.8.1. Risk Assessment Using RPN:

Assess each potential failure mode using three criteria:

- **Severity (G)**: Evaluate the seriousness of the impact on vehicle safety and performance.
- **Occurrence (O)**: Estimate the likelihood of the failure occurring during the life of the vehicle.

- **Detection (R)**: Assess the probability that the failure will be detected before it reaches the customer.

Calculate the Risk Priority Number (RPN) for each failure mode:

$$\mathbf{RPN = Severity \times Occurrence \times Detection\ (OR)\ RPN = G \times O \times R}$$

Equation 1: RPN Number Calculation

5.8.2. Objectives of PFMEA in the Automotive Industry

PFMEA aims to:

- Identify Potential Failure Modes: Evaluate each step in the automotive manufacturing or assembly process to determine where and how failures might occur.
- Assess Risks Associated with Failure Modes: Examine the potential impact, frequency, and detectability of each failure mode.
- Prioritize the Failures: Use a scoring system to prioritize failures based on their severity, occurrence, and detectability.
- Develop and Implement Corrective Actions: Formulate strategies to reduce or eliminate high-risk failure modes, improving process robustness and product quality.

5.8.3. Benefits of PFMEA in the Automotive Industry

- Enhanced Vehicle Safety and Reliability: By proactively addressing potential failures, manufacturers can significantly improve the safety and reliability of their vehicles.
- Compliance with Safety Regulations: PFMEA helps ensure that automotive products meet or exceed international safety standards and regulations.
- Cost Efficiency: Preventing failures before they occur reduces costly recalls and enhances customer trust and satisfaction.
- Streamlined Production: Identifying and mitigating process inefficiencies lead to smoother operations and higher-quality outputs.

5.8.4. PFMEA Working Procedure

The PFMEA begins with a precise definition of its scope, which involves specifying the process or product part under scrutiny. This clarity is crucial as it ensures all participants understand what aspect of production is being evaluated and the goals they are aiming to achieve through this analysis. A diverse team should be assembled, pulling expertise from various departments such as engineering, manufacturing, and quality assurance. This multidisciplinary approach ensures comprehensive identification and analysis of potential failure modes by incorporating diverse knowledge and experiences.

Next, the team should map out the process meticulously. Each process step is defined and documented, often visualized through a flowchart to provide a clear, sequential understanding of operations. This visual representation aids in systematically analyzing each part of the process for potential failure modes the ways in which each process step could fail to perform as intended or meet quality standards. The analysis then extends to examining the consequences of each failure mode. It is vital to consider how these failures affect the subsequent processes, the product, or the end-user's experience. Each potential effect is assigned a severity (G) rating on a scale (1 to 10) Table No 02, helping prioritize the failures that pose the greatest risk to safety or quality.

Table 1: Occurrence Table for PFMEA

OCCURRENCE (P)			
PROBABILITY	**Ppk**	**Likely Failure Rates**	**Ranking**
Very High: Persistent Failures	< 0,55	≥ 100 per 1000 pieces	10
	≥ 0,55	50 per 1000 pieces	9
High: Frequent Failures	≥ 0,78	20 per 1000 pieces	8
	≥ 0,86	10 per 1000 pieces	7
Moderate: Occasional Failures	≥ 0,94	5 per 1000 pieces	6
	≥ 1,00	2 per 1000 pieces	5
	≥ 1,10	1 per 1000 pieces	4
Low: Relatively Few Failures	≥ 1,20	0,5 per 1000 pieces	3
	≥ 1,30	0,1 per 1000 pieces	2
Remote: Failure is Unlikely	≥ 1,67	≤ 0,01 per 1000 pieces	1

The process continues with a thorough investigation into the causes of each identified failure mode. The team estimates the likelihood (Table No 1) of each cause occurring, utilizing historical data or predictive analysis where possible. This step is complemented by assessing the existing controls currently in place to prevent or detect these failures. The effectiveness of these controls is critical in understanding the existing safeguards and their limitations.

Table 2: Severity Table for PFMEA

SEVERITY (G)			
Effect	**Criteria: Severity of Effect This ranking result when a potential failure mode result when a potential failure mode results in a final customer and/or a manufacturing/assembly plant defect. The final customer should always be considered first. If both occur, use the higher of the two severities. (Customer Effect)**	**Criteria: Severity of Effect This ranking result when a potential failure mode result when a potential failure mode results in a final customer and/or a manufacturing/assembly plant defect. The final customer should always be considered first. If both occur, use the higher of the two severities. (Manufacturing / Assembly Effect)**	**Ranking**
Hazardous without warning	Very high severity ranking when a potential failure mode affects safe vehicle operation and/or involves non compliance with governement regulation with warning.	Or may endanger operator (machine or assembly) without warning.	10
Hazardous with warning	Very high severity ranking when a potential failure mode affects safe vehicle operation and/or involves non compliance with governement regulation with warning.	Or may endanger operator (machine or assembly) with warning.	9
Very High	Vehicle/Item inoperable (loss of primary function)	Or 100% of product may have to be scrapped, or vehicle/item repaired in repair department with a repair time greater than one hour.	8
High	Vehicle/Item operable but at a reduced level of performance. Customer very dissatisfied.	Or product may have to be sorted and a portion (less than 100%) scrapped, or vehicle/item repaired in repair department with a repair time between a half-hour and an hour.	7
Moderate	Vehicle/Item operable but Comfort/Convenience item(s) inoperable. Customer dissatisfied.	Or a portion (less than 100%) of the product may have to scraped with no sorting, or vehicle/item repaired in repair department with a repair time less than a half-hour.	6
Low	Vehicle/Item operable but Comfort/Convenience item(s) operable at a reduced level of performance	Or 100% of product may have to be reworked, or vehicle/item repaired offline but does not go to repair department.	5
Very Low	Fit and Finish/Squeak and Rattle item does not conform. Detect noticed by most customers (greater than 75%).	Or the product may have to be sorted, with no scrap, and a portion (less than 100%) reworked.	4
Minor	Fit and Finish/Squeak and Rattle item does not conform. Detect noticed by 50% of customers.	Or a portion (less than 100%) of the product may have be reworked, with no scrap, on-line but out-of-station.	3
Very Minor	Fit and Finish/Squeak and Rattle item does not conform. Detect noticed by discriminating customers (less than 25%).	Or a portion (less than 100%) of the product may have to be reworked, with no scrap, on.line but in station	2
None	No discernible effect.	Or slight inconvenience to operatio or operator, or no effect.	1

The process continues with a thorough investigation into the causes of each identified failure mode. The team estimates the likelihood (Table No 2) of each cause occurring, utilizing historical data or predictive analysis where possible. This step is complemented by assessing the existing controls currently in place to prevent or detect these failures. The effectiveness of these controls is critical in understanding the existing safeguards and their limitations.

The Risk Priority Number (RPN) is then calculated for each failure mode by multiplying the severity, occurrence, and detection ratings. This metric helps in quantifying risk and serves as a basis for prioritization. Failure modes with high RPNs are flagged for immediate attention. The team formulates action plans aimed at reducing the RPN, which involves detailing corrective measures that can mitigate the severity, reduce the occurrence, or improve the detection of risks. Responsibilities for implementing these actions are assigned to specific team members with clear deadlines to ensure accountability and timely execution.

Table 3: Detection Table for PFMEA

DETECTION (R)						
Detection	Criteria	Inspection A Error proofed	 B Gauging	 C Manual Inspection	Suggested Range of Detection Methods	Ranking
Almost Impossible	Absolute certainty of non-detection.			X	Cannot detect or is not checked.	10
Very Remote	Controls will probably not detect.			X	Control is achieved with indirect or random checks only.	9
Remote	Controls have poor chance of detection.			X	Control is achieved with visual inspection only.	8
Very Low	Controls have poor chance of detection.			X	Control is achieved with double visual inspection only.	7
Low	Controls may detect.		X	X	Control is achieved with charting methods, such as SPC {Statistical Process Control}.	6
Moderate	Controls may detect.		X		Control is based on variable gauging after parts have left the station, or Go/No Go gauging performed on 100% of the parts after parts have left the station.	5
Moderately High	Controls have a good chance to detect.	X	X		Error detection in subsequent oparation, OR gauging performed on setup and first-piece check (for set-up causes only).	4
High	Controls have a good chance to detect.	X	X		Error detection in-station, or error detection in subsequence operation by multiple layers of acceptance: supply, select, install, verify. Cannot accept discrepant part.	3
Very High	Controls almost certain to detect.	X	X		Error detection in-station (automatic gauging with automatic stop feature). Cannot accept discrepant part.	2
Very High	Controls certain to detect.	X			Discrepant parts cannot be made because item has been error-proofed by process/product design.	1

After the implementation of these measures, it is essential to monitor their effectiveness and adjust, as necessary. The PFMEA document should be a living document, revisited and updated regularly to reflect any changes in the process, new equipment, or other factors that might introduce new risks or alter existing ones. It is also important that the results, including the action plans and any process changes, are clearly documented, and communicated across the organization. This transparency ensures that all stakeholders are informed and can contribute to ongoing process improvement.

The PFMEA for this product is attached in Annexures No 05.

5.9. Control Plan

In the automotive industry, a Control Plan is a vital document used extensively in the manufacturing process to ensure that product quality and process efficiency are maintained at the highest levels. It forms a part of the core quality management tools under Advanced Product Quality Planning (APQP) guidelines and is closely related to other processes like Process Failure Mode and Effects Analysis (PFMEA).

5.9.1. Purpose of a Control Plan in the Automotive Industry

The primary purpose of the Control Plan in the automotive sector is to systematically monitor and control product and process characteristics that are critical to quality (CTQ). By doing so, it helps prevent defects and ensures that the production process remains in control and predictable.

5.9.2. Components of a Control Plan in the Automotive Industry

A typical automotive Control Plan includes detailed information about the process steps, control methods to be employed, measurement systems, and required corrective actions. Here is what it usually encompasses:

- Part Information: Includes details such as part number, part name, and part description, which help in identifying the specific component the Control Plan addresses.
- Process Information: Details about the process steps involved in manufacturing the part, including equipment and technology used. Each process step is usually linked to a corresponding PFMEA to ensure that all potential failure modes have been considered.
- Product and Process Characteristics: Lists all critical characteristics that need monitoring, which could include dimensions, material properties, or visual defects. These characteristics often stem from the DFMEA (Design Failure Mode and Effects Analysis), linking design to manufacturing.
- Control Methods: For each characteristic, the plan will specify how it will be controlled. This could include statistical process control (SPC), visual inspections, automated checks, or specific testing procedures.
- Sample Size and Frequency: Specifies how frequently each characteristic should be checked and the number of samples to be assessed during each inspection interval. This ensures a balance between control and efficiency.
- Control Limits: Defines acceptable limits for process variation. These are usually based on the design specifications and the inherent variability of the production process.
- Reaction Plan: Outlines the steps to be followed when a process or product characteristic goes out of control. This includes troubleshooting methods, who needs to be notified, and how to contain the problem.
- Document Control: Information on the version of the Control Plan, author, approval signatures, and date of last revision. This ensures that the manufacturing process uses the most current and approved method.

5.9.3. Control Plan Working Procedure

The process of publishing a Control Plan (CP) involves a series of detailed steps designed to ensure that the document meets all specified standards and accurately reflects the product requirements. The publication process is critical in maintaining the integrity and effectiveness of the CP and involves multiple review and approval stages. Here is a detailed overview of each phase:

5.9.3.1. Phase 1: Initial Draft

Responsibility: Assistant Project Manager

Process: The stabilizer edits the CP to ensure it adheres to the specific standards and specifications outlined by the company. During this initial phase, the CP must be written according to the organization's quality standards, often under the guidance of a Stabilizing Tutor. In this instance, the tutor is identified as Rinaldi.

Phase 1.1: Provisional Review

Context: This is a provisional step until the stabilizer is fully prepared to perform the activity independently.

Process: The Senior Project Manager/Project Manager checks that the CP has been drafted in compliance with the relevant specifications and standards.

5.9.3.2. Phase 2: Verification

This phase is split into two distinct parts to ensure comprehensive validation of the CP content:

Phase 2.1: Product Development Verification

Responsibility: Product Development

Process: The SP reviews the CP to confirm that all product requirements have been considered. They must ensure that the CP includes all necessary content and that the standards or specifications used for assessing the acceptability of these requirements align with those defined in the RTS with the customer.

Phase 2.3: Quality and Product Qualification Verification

Responsibility: Customer Care Quality and Product Qualification teams

Process: This team verifies that the CP correctly identifies appropriate control methods and frequencies for assessing product requirements. They must also confirm that the CP includes all process requirements necessary to ensure outgoing quality verification of the component.

5.9.3.3. Phase 3: Validation

Responsibility: Technical Manager

Process: The Technical Manager provides formal validation of the CP once the first two phases are satisfactorily completed. Validation is evidenced by a hand-signed PDF of the CP, confirming that all prior verifications have been executed as required.

5.9.3.4. Phase 4: Approval

Responsibility: Quality Manager

Process: With the CP now having the signatures of the Editor and the Validator, the Quality Manager conducts a final review to ensure there are no omissions. Upon satisfactory review, the Quality Manager signs off on the CP, formally approving it for publication.

5.9.3.5. Phase 5: Publication

Process: The approved CP, now a signed PDF document, is uploaded to a designated folder on SharePoint. The team is then notified about the publication, ensuring that all relevant stakeholders have access to the finalized document.

This structured approach to editing, reviewing, validating, and approving the Control Plan ensures that the document is thorough, accurate, and effective in guiding the manufacturing process according to stringent quality standards. Each step is designed to build upon the previous one, providing multiple layers of oversight to capture and correct any potential errors or omissions before the CP is officially published and implemented.

The Control Plan for this product is attached in Annexures No 06.

5.10. Control and Monitoring Procedure

The primary goal of this control and monitoring is to foster transparency and ensure alignment among all stakeholders regarding the progress and status of ongoing projects. The objective is to deliver concise updates on project milestones, identify challenges, and outline forthcoming actions. Additionally, the report will highlight any project delays to prompt immediate action from management and stakeholders to mitigate these issues.

5.10.1. Control and Monitoring Procedure

The monitoring document is organized into four main sections, each featuring two types of status indicators: ongoing project activities with their progress, and a tabular status box that includes four distinct phases for each section. These sections are Milestones, Review of Technical Specifications (RTS), Purchasing, and Process Industrializations, with designated stakeholders for each part.

The tabular status box within each section provides a visual representation of progress, with parameters fixed to indicate completion (Green), in-progress (Yellow), or not started (colorless) for each phase. This allows stakeholders to quickly assess the status of ongoing activities and make informed decisions to keep the project on track. In some cases, the activity may have a risk of delay so we write it in (Orange), risk to delay, apparently if the current phase is delayed so, it should be written in (Red).

5.10.1.1. Milestones

Customer Milestones

Project Initiation: The issuance of the Purchase Order (PO) marks the formal commencement of the project.

Early-Stage Testing (FOT/CPOT): This phase evaluates the initial tooling and production processes to ensure feasibility and functionality, providing essential insights into the viability of proposed solutions.

Quality Validation (PPAP): A critical phase that involves detailed testing and validation to ensure production processes and product quality meet stringent standards.

Production Commencement (SOP): Signifies the start of mass production, indicating the successful achievement of preparatory milestones.

Ongoing Tracking: Continual monitoring of milestone completion percentages is crucial for adjusting strategies and resource allocation to address any project deviations promptly.

2A Internal Milestones

Supportive Scheduling: These milestones are strategically designed to align with customer milestones, incorporating buffer times to facilitate adjustments and meet project goals effectively.

Dynamic Oversight: Real-time tracking of milestone completion provides insights into project progress, enabling proactive management of resources and timelines.

5.10.1.2. Review of Technical Specifications (RTS)

Initial Feasibility Analysis: Conducted upon receipt of customer designs and requirements, this analysis ensures proposed designs align with technical capabilities and market expectations.

Specification Refinement: Involves collaborative sessions with the customer to meticulously refine technical specifications.

Design Implementation Milestones: Critical phases such as the 2D-3D release and design freeze transition conceptual designs into fully detailed technical specifications.

5.10.1.3. Purchasing

Equipment Acquisition Strategy: Encompasses everything from equipment design to procurement, ensuring all equipment adheres to project specifications and quality expectations.

Management of Subcontracting Services: Oversees the procurement of essential services like machining and heat treatment, ensuring all subcontracted services meet project requirements.

5.10.1.4. Process Industrialization

Operational Preparation: Covers activities from developing Flow Charts and Bills of Materials to implementing PFMEA and Control Plans, optimizing all processes for efficiency and quality.

Documentation and Compliance: Focuses on generating detailed work instructions and managing document reviews to ensure all operations comply with project specifications.

The following template has been used for reporting the weekly status of all activities of project.

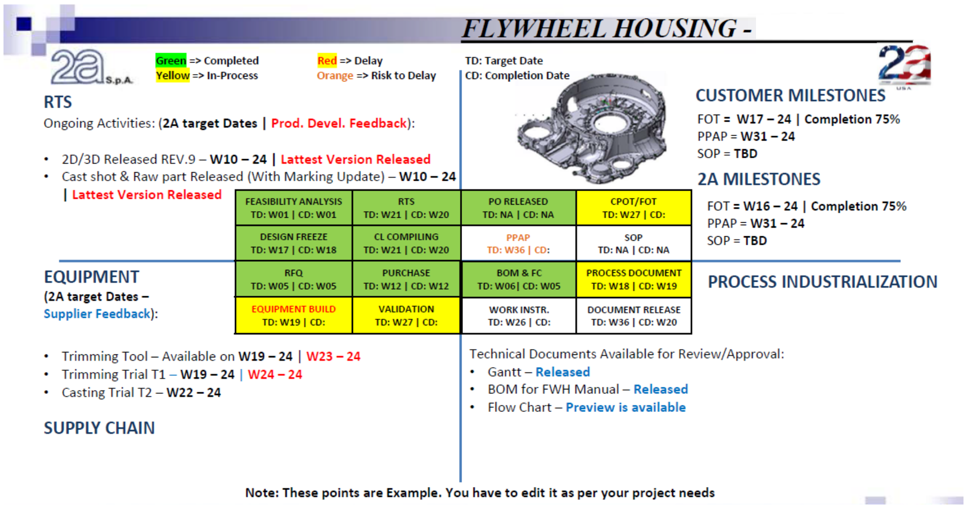


Figure 17: Control and Monitoring Document Template

5.11. PPAP DOCUMENTATION

The Production Part Approval Process (PPAP) is a critical component in the automotive industry's quality assurance practices, ensuring that engineering design records and specification requirements are consistently met during production. While PPAP is extensively recognized in the industry standards set forth by the Automotive Industry Action Group (AIAG), it is also adapted and used in conjunction with the German Association of the Automotive Industry (VDA) standards, particularly in Europe. The VDA version includes specific adjustments and additions to align with European automotive requirements and methodologies.

5.11.1. Overview of PPAP in the VDA Model

The VDA model for PPAP is part of the overall quality management in the automotive sector, ensuring that all components and assemblies meet or exceed the stringent quality standards of the automotive industry before full-scale production begins. The PPAP documentation under the VDA model is crucial for demonstrating the supplier's ability to meet the manufacturers' requirements consistently and at the intended production rate.

5.11.1.1. Key Elements of PPAP Documentation According to VDA

The PPAP documentation in the VDA model typically includes several key elements that suppliers must submit to their customers for approval. These elements are designed to verify that the production process reliably produces parts that meet all specifications at the agreed-upon production rate, Design Records: A copy of the drawing. If the customer is responsible for the design, this is a release drawing in the customer's system. If the supplier is responsible for the design, this is a drawing in the supplier's system.

Engineering Change Documentation: A record of approved changes from the customer. This documentation must include a description and approval of the changes by the customer.

Material Certifications: Certifications that all materials meet the agreed-upon specifications.

Process Flow Diagrams: Detailed process flow charts identifying all steps of the manufacturing process from raw materials through to the final product.

Process Failure Mode and Effects Analysis (PFMEA): Analysis of potential failure modes within the manufacturing process including their effect on the product and measures for their control.

Dimensional Results: A list of every measured dimension annotated on components or assemblies compared with specified dimensions.

Initial Process Studies: Usually Statistical Process Control (SPC) charts showing that critical processes are stable and capable.

Measurement System Analysis (MSA): Evidence that measurement systems used to control critical processes are capable.

Qualification Test Results: Copies of qualification tests performed according to customer-specific standards, demonstrating compliance with design specifications.

Control Plan: A comprehensive control plan that lists all control points in the process, including measurement and monitoring mechanisms geared at preventing defects.

Appearance Approval Report: For components affecting appearance, a report showing that parts meet aesthetic requirements and are acceptable.

Sample Production Parts: A sample from the actual production run to provide a physical example of parts produced using the specified process.

Master Sample: A sample signed off by the customer and supplier that serves as a standard for comparison for future production.

Checking Aids: Details and calibration records of checking jigs and fixtures.

Customer Specific Requirements: Documentation that all customer-specific requirements have been met as per the contract.

Part Submission Warrant (PSW): This document summarizes the whole PPAP package and declares that the supplier has met all PPAP requirements and that all details are available for review.

5.11.1.2. Importance of PPAP in the VDA Model

The implementation of PPAP according to the VDA model is essential for:

- Ensuring a prominent level of trust between automotive manufacturers and suppliers.
- Reducing the risk of product failures in the field.
- Facilitating the identification of issues early in the production process, which can save costs and prevent delays.
- Meeting regulatory and safety requirements that are critical in the automotive industry.

5.11.1.3. Submission Levels and Approval

The VDA model specifies various levels of submission for PPAP files, like the AIAG standards. These levels dictate the amount and detail of documentation that must be submitted to the customer for review. The level required will depend on the agreement between the supplier and the customer, often influenced by the part's criticality and past performance.

Requirement	Level 1	Level 2	Level 3	Level 4	Level 5
1. Design Records - For proprietary components/details - For all other components/details	R R R	S R S	S R S	* * *	R R R
2. Engineering Change Documents, if any	R	S	S	*	R
3. Customer Engineering Approval, if required	R	R	S	*	R
4. Design FMEA	R	R	S	*	R
5. Process Flow Diagrams	R	R	S	*	R
6. Process FMEA	R	R	S	*	R
7. Control Plan	R	R	S	*	R
8. Measurement Systems Analysis Studies	R	R	S	*	R
9. Dimensional Results	R	S	S	*	R
10. Material, Performance, Test Results	R	S	S	*	R
11. Initial Process Studies	R	R	S	*	R
12. Qualified Laboratory Documentation	R	S	S	*	R
13. Appearance Approval Report (AAR), if applicable	S	S	S	*	R
14. Sample Product	R	S	S	*	R
15. Master Sample	R	R	R	*	R
16. Checking Aids	R	R	R	*	R
17. Records of Compliance with Customer Specific Requirements	R	R	S	*	R
18. Part Submission Warrant (PSW) Bulk Material Checklist	S S	S S	S S	S S	S S

S - Submit to the customer
R - Retain at manufacturing location and make available to the customer if requested
* - Retain at manufacturing location and submit to the customer if requested

Figure 18: PPAP Documentation Levels by VDA

6. Discussion of Results

The deployment of a comprehensive project management framework within 2a S.p.A has significantly enhanced the new product developments, like the Flywheel Housing project, are handled. This section explores how the introduction of well-defined processes and meticulous documentation has not only streamlined operations but also fostered a culture of consistency and efficiency across teams.

6.1. Process Flow and Stakeholder Management

The first significant step in the implementation was the establishment of a standardized process flow using Signavio BPMN modeling. This advanced tool enabled the creation of a clear, detailed visualization of each project stage, from kick-off to production. By defining precise roles and responsibilities through this model, the framework ensures that all stakeholders are well-informed of their duties, fostering a cooperative and coordinated effort throughout the project lifecycle.

6.2. Embracing Standardized Project Documentation and Tools

To navigate the complexities of new product development and ensure uniformity across different project teams, several key documents and management tools were standardized and integrated into the project lifecycle:

Project Organization Chart: This chart clarified the structure of the team, detailing who does what and showing how each role contributes to the project, ensuring everyone understands their responsibilities and how they fit into the bigger picture.

Bill of Materials (BOM): Serving as a critical reference, this document lists all necessary materials, components, and assemblies, which has been invaluable for precise procurement and effective inventory management.

Process Flow Chart: Providing a roadmap of the project from start to finish, this chart ensures all processes are well understood and properly followed by everyone involved.

Gantt Chart: Developed using Microsoft Project, these charts helped in planning out detailed schedules, allocating resources effectively, and keeping the project on track by providing a visual representation of the timeline and progress.

Control Plan and PFMEA: Central to quality assurance, these documents help in maintaining control over each production phase and managing potential risks effectively. The Control Plan outlines specific methods for overseeing product and process quality, while PFMEA focuses on identifying potential failures and their impact on the project.

Review of Technical Specifications (RTS) Approval: This crucial step confirms that all technical specifications meet customer expectations and industry standards, ensuring that the project only moves forward once these criteria are satisfied.

PPAP Documentation: Essential for quality management, this documentation proves that all client specifications are met, and that the production process is capable of consistently producing outcomes that meet these specifications.

6.3. Monitoring and Controlling Mechanisms

Robust monitoring and control mechanisms are vital in maintaining the project's alignment with its goals:

Regular Performance Reviews: These reviews are crucial for assessing how well the project is meeting its objectives, allowing for quick identification and correction of any deviations or issues.

Risk Management Framework: The inclusion of regular risk assessments and contingency planning ensures proactive management of potential challenges, keeping the project resilient and adaptable.

6.4. Impact and Outcomes

By adopting these refined project management practices, 2a S.p.A has not only optimized its operations but also enhanced product quality and shortened project timelines. Standardizing critical documents and integrating advanced management tools have revolutionized project management within the company, setting a new benchmark for future projects. The success seen in the Flywheel Housing project is a testament to the effectiveness of this comprehensive approach, demonstrating significant benefits in terms of stakeholder satisfaction, cost efficiency, and competitive market positioning. The heartfelt commitment of the team to embrace these changes has been instrumental in realizing these improvements, showcasing a promising path forward for the company in the competitive automotive industry.

The comprehensive overhaul of project management practices at 2a S.p.A has not only streamlined operations but has also translated into significant monetary gains, particularly through reductions in time and cost expenditures. These improvements have brought measurable and impactful benefits to the Flywheel Housing project, demonstrating the tangible value of strategic project management enhancements.

6.4.1. Time Saving

The introduction of a standardized Gantt chart, facilitated by Microsoft Project, allowed for meticulous tracking and timely adjustments. This precise management of project timelines cut down the product development cycle by about 15%, enabling the team to bring products to market more quickly. Additionally, the dynamic allocation of resources meant that the team could adapt to project needs in real-time, eliminating bottlenecks and utilizing both human and material resources more effectively. This not only ensured a smoother workflow but also minimized idle time, substantially boosting overall project efficiency.

6.4.2. Cost Reduction Enhances Bottom Line

The proactive approach of using PFMEA and a detailed Control Plan significantly curtailed the incidence of costly errors and subsequent reworks. By focusing on preventing quality issues rather than correcting them post-production, the project saw a 20% reduction in rework and scrap rates. This proactive quality control not only saved on direct costs like materials and labor but also preempted potential project delays, contributing to overall cost efficiency. Moreover, improved quality control processes reduced the dependency on extensive end-product testing, saving roughly 10% in related costs.

In essence, the enhancements made to the project management processes at 2a S.p.A have proven their worth by not just achieving operational success but also by delivering substantial financial benefits. These gains reflect the profound impact of well-structured project management on a company's bottom line and competitive standing in the industry.

7. Conclusion

The thesis "Optimizing Project Management Methodologies to Enhance Efficiency and Success in New Product Development" presents a compelling narrative on the transformative impact of integrating quality management within project management frameworks. This synthesis not only targets operational excellence but profoundly enriches the product development lifecycle, especially within the automotive industry.

At the heart of this study is the Flywheel Housing project at 2a S.p.A, serving as a practical case study to illustrate the inefficiencies previously marring the new product development process. The research methodically outlines the introduction of standardized process flow, advanced project management tools, stringent quality control systems like PFMEA, and dynamic resource allocation models, each contributing to significant enhancements in process efficiency, quality assurance, and project timeline adherence.

Moreover, the thesis effectively bridges the theoretical and applied aspects of project management. By weaving Process Quality Management theories into the Project Management Institute's Quality Management area, it sets a precedent for future projects, advocating for a proactive quality management approach that aligns with strategic business objectives and market demands.

In conclusion, this research provides a robust framework for industry application, ensuring that project management not only meets but exceeds the rigorous standards required for success in the highly competitive and innovation-driven automotive sector. The outcomes of this study are poised to guide future projects, ensuring they capitalize on the lessons learned and contribute to the ongoing evolution of project management practices.

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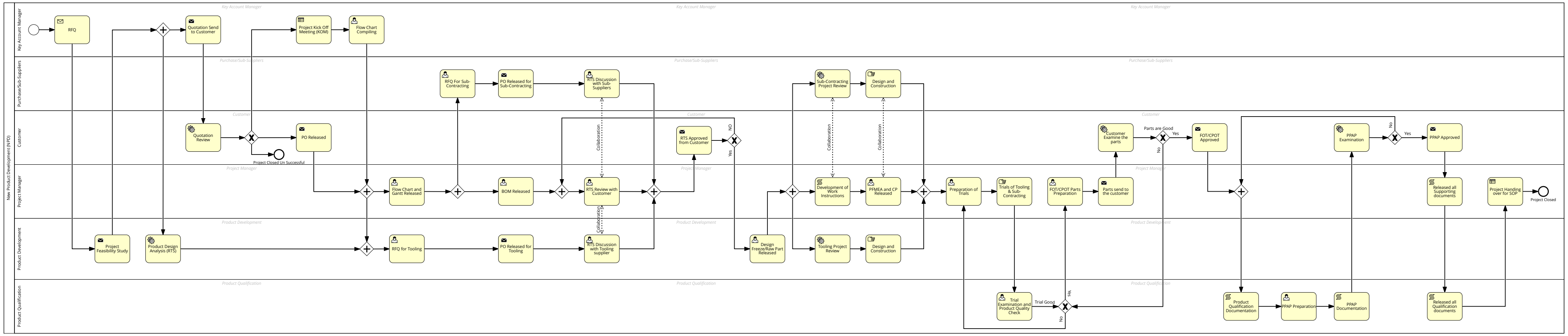
Annexure No 01

NPD (NEW PRODUCT DEVELOPMENT)



Annexure No 02

GANTT CHART

2a S.p.A.

GANTT_2754824-2754836_Rev7

ID	Nome attività	Durata	Inizio	Fine
1	**Flywheel Housing 2754824_2754836 - Rev007**	**407 g?**	**lun 12/12/22**	**ven 13/09/24**
2	**Project Milestones**	**0 g**	**lun 12/12/22**	**lun 12/12/22**
3	Kick-off Meeting	0 g	lun 12/12/22	lun 12/12/22
4	PPAP [according Mr. Leickt mail 06/12/2022]	0 g	mar 06/02/24	mar 06/02/24
5	SOP [according RFQ documentation]	0 g	mer 01/05/24	mer 01/05/24
6	MAN PPAP Deadline	0 g	lun 03/06/24	lun 03/06/24
7	**0 - KOM**	**92 g**	**lun 12/12/22**	**mar 02/05/23**
8	Data collecting and processing for KOM	3 g	lun 12/12/22	gio 15/12/22
9	Flow Chart Release	1 g	gio 15/12/22	ven 16/12/22
10	GANTT Customer + 2A Development	1 g	ven 16/12/22	lun 19/12/22
11	GANTT Approval + Release	0 g	lun 19/12/22	lun 19/12/22
12	Tooling RFQ phase discussion	18 s	mar 13/12/22	ven 28/04/23
13	MAN Order submission	1 g	mar 02/05/23	mar 02/05/23
14	**1 - ENGINEERING - DEVELOPMENT**	**231 g**	**ven 16/12/22**	**mer 13/12/23**
15	Kick-off RTS	2 g	ven 16/12/22	lun 19/12/22
16	3D + 2D Analysis and check	2 s	mar 20/12/22	mar 10/01/23
17	Ingate and Casting Flow-Parameters design	3 s	mar 03/01/23	mar 24/01/23
18	ReENG waiting for MAN Order submission	70 g	mer 25/01/23	lun 08/05/23
19	RTS Review with Customer [ONGOING]	7 s	mer 10/05/23	mer 28/06/23
20	**Commercial discussion for 100% Impregnation implementation**	18 g	gio 29/06/23	lun 24/07/23
21	WEEK 0 [RTS Closure + Approval]	0 g	lun 24/07/23	lun 24/07/23
22	Working Flow + Instruction for external Suppliers	3 s	mer 22/11/23	mer 13/12/23
23	Working Instruction for internal operations	1 s	mer 22/11/23	mar 28/11/23
24	PFMEA First emission	10 s	mar 12/09/23	mar 21/11/23
25	Control Plan First emission	10 s	mar 12/09/23	mar 21/11/23
26	Die Casting Tool Project Check	8 g	mar 25/07/23	gio 03/08/23
27	Trimming Tool Project Check	8 g	mar 25/07/23	gio 03/08/23
28	Machining Equipment Project Check	1 s	mar 25/07/23	lun 31/07/23
29	Leakage Test Equipment Project Check	8 g	mar 25/07/23	gio 03/08/23
30	Assy Equipment Project Check	8 g	mar 25/07/23	gio 03/08/23
31	BOM & Semi-finished product codification	4 g	mar 12/09/23	ven 15/09/23
32	BOM release on internal ERP	4 g	lun 18/09/23	gio 21/09/23
33	**2 - PURCHASING**	**7 g**	**mar 01/08/23**	**mer 30/08/23**
34	Die Casting Tool Purchasing	1 g	mer 02/08/23	mer 02/08/23
35	Trimming Tool Purchasing	3 g	ven 04/08/23	mar 29/08/23
36	~~Dedicated Gauge Purchasing (TBC)~~	~~1 g~~	~~ven 04/08/23~~	~~ven 04/08/23~~
37	Machining Fixture Purchasing	3 g	mar 01/08/23	gio 03/08/23
38	Project Dedicated Tooling Purchasing	4 g	ven 04/08/23	mer 30/08/23
39	Deburring/Shotblasting Purchasing	3 g	ven 04/08/23	mar 29/08/23
40	External Machining Purchasing	3 g	mar 01/08/23	gio 03/08/23
41	External Laboratory Test Purchasing (Cleanliness, etc.)	3 g	mar 01/08/23	gio 03/08/23
42	**3 - INDUSTRIALIZATION**	**151 g?**	**mer 02/08/23**	**mar 02/04/24**
43	Packaging definition for each process step	9 s	mar 12/09/23	mer 15/11/23
44	**Equipments construction**	**151 g?**	**mer 02/08/23**	**mar 02/04/24**
45	**Casting Tool**	**151 g**	**mer 02/08/23**	**mar 02/04/24**
46	Design	6 s	mer 02/08/23	mer 04/10/23
47	Tool Project Rewiew (Tool Check List)	1 s	lun 11/09/23	ven 15/09/23
48	Construction Launch Release	1 g	mer 04/10/23	gio 05/10/23
49	Construction time	24 s	gio 05/10/23	mar 02/04/24
50	Delivery for 1st trial	0 g	mar 02/04/24	mar 02/04/24
51	**Trimming tool**	**139 g?**	**ven 04/08/23**	**lun 18/03/24**
52	Design	6 s	mer 30/08/23	mar 10/10/23
53	Tool Project Review (Tool Check List)	1 s	mer 04/10/23	mar 10/10/23
54	Construction Launch Release	1 g	mer 11/10/23	mer 11/10/23
55	Construction time	21 s	gio 12/10/23	lun 18/03/24
56	Delivery for 1st trial	0 g	lun 18/03/24	lun 18/03/24
57	**Dedicated Gauges [ON HOLD]**	**5 g?**	**ven 04/08/23**	**gio 31/08/23**
63	**Machining fixture**	**116 g**	**ven 04/08/23**	**mer 14/02/24**
64	Design	4 s	ven 04/08/23	gio 21/09/23
65	Tool Project Rewiew (Tool Check List)	1 s	ven 15/09/23	gio 21/09/23
66	Construction Launch Release	1 g	ven 22/09/23	ven 22/09/23
67	Construction time	19 s	lun 25/09/23	mer 14/02/24
68	Delivery for 1st trial	0 g	mer 14/02/24	mer 14/02/24
69	**Project Dedicated tooling**	**114 g**	**mar 29/08/23**	**mer 14/02/24**
70	Design	4 s	gio 31/08/23	mer 27/09/23
71	Tool Project Rewiew (Tool Check List)	1 s	mer 27/09/23	mar 03/10/23
72	Construction Launch Release	1 g	mer 04/10/23	mer 04/10/23
73	Construction time	17 s	gio 05/10/23	lun 12/02/24
74	Delivery for 1st trial	0 g	mer 14/02/24	mer 14/02/24
75	**PRODUCT/PROCESS QUALIFICATION**	**58 g**	**lun 08/04/24**	**mar 02/07/24**
76	**CASTING TRIAL**	**34 g**	**lun 15/04/24**	**mar 04/06/24**
77	1st trial (FOT)	2 s	lun 15/04/24	mar 30/04/24
78	RdB 1st trial	2 g	gio 02/05/24	ven 03/05/24
79	Fine Tuning	3 s	lun 06/05/24	ven 24/05/24
80	Delivery for 2nd trial	0 g	ven 24/05/24	ven 24/05/24
81	2nd trial	1 s	lun 27/05/24	ven 31/05/24
82	RdB 2nd trial	2 g	lun 03/06/24	mar 04/06/24
83	**TRIMMING TRIAL**	**29 g**	**gio 02/05/24**	**mar 11/06/24**
84	1st trial (FOT)	1 s	gio 02/05/24	mer 08/05/24
85	RdB 1st trial	2 g	gio 09/05/24	ven 10/05/24
86	Fine Tuning	3 s	lun 13/05/24	ven 31/05/24
87	Delivery for 2nd trial	0 g	ven 31/05/24	ven 31/05/24
88	2nd trial	1 s	lun 03/06/24	ven 07/06/24
89	RdB 2nd trial	2 g	lun 10/06/24	mar 11/06/24
90	**MACHINING TRIAL**	**29 g**	**gio 09/05/24**	**mar 18/06/24**
91	1st trial (FOT)	3 s	gio 09/05/24	mer 29/05/24
92	RdB 1st trial	2 g	gio 30/05/24	ven 31/05/24
93	Fine Tuning	1 s	lun 03/06/24	ven 07/06/24
94	Delivery for 2nd trial	0 g	ven 07/06/24	ven 07/06/24
95	2nd trial	1 s	lun 10/06/24	ven 14/06/24
96	RdB 2nd trial	2 g	lun 17/06/24	mar 18/06/24
97	~~GAUGES TRIAL [ON HOLD]~~	~~6 g?~~	~~lun 08/04/24~~	~~mar 16/04/24~~
104	**PROJECT DEDICATED TOOLING TRIAL**	**24 g**	**gio 30/05/24**	**mar 02/07/24**
105	1st trial (FOT)	2 s	gio 30/05/24	mer 12/06/24
106	RdB 1st trial	2 g	gio 13/06/24	ven 14/06/24
107	Fine Tuning	1 s	lun 17/06/24	ven 21/06/24
108	Delivery for 2nd trial	0 g	ven 21/06/24	ven 21/06/24
109	2nd trial	1 s	lun 24/06/24	ven 28/06/24
110	RdB 2nd trial	2 g	lun 01/07/24	mar 02/07/24
111	**Qualification test for Die Casting/Trimming process**	**6 g**	**mer 05/06/24**	**mer 12/06/24**
112	Run & Rate	2 g	mer 05/06/24	gio 06/06/24
113	Capability	2 g	ven 07/06/24	lun 10/06/24
114	Internal Audit	2 g	mar 11/06/24	mer 12/06/24
115	**Qualification for Deburring/Shotblasting process**	**6 g**	**gio 13/06/24**	**gio 20/06/24**
116	Run & Rate	2 g	gio 13/06/24	ven 14/06/24
117	Capability	2 g	lun 17/06/24	mar 18/06/24
118	Internal Audit	2 g	mer 19/06/24	gio 20/06/24
119	**Qualification for Machining process**	**14 g**	**mer 19/06/24**	**lun 08/07/24**
120	Run & Rate	2 g	mer 19/06/24	gio 20/06/24
121	Capability	2 s	ven 21/06/24	gio 04/07/24
122	Internal Audit	2 g	ven 05/07/24	lun 08/07/24
123	**5 - PPAP \ ISIR**	**31 g**	**lun 01/07/24**	**lun 02/09/24**
124	Collection and editing PPAP reduced (10 samples)	1 s	lun 01/07/24	ven 05/07/24
125	10 samples submission to SCANIA (each PN)	0 g	lun 08/07/24	lun 08/07/24
126	Collection and editing PPAP documentation (50 samples)	9 g	mar 09/07/24	ven 19/07/24
127	Samples preparation	5 g	lun 22/07/24	ven 26/07/24
128	PPAP-ISIR submission on Customer Portal - Parts shipment	0 g	lun 29/07/24	lun 29/07/24
129	Customer evaluation	2 s	mar 30/07/24	lun 02/09/24
130	Customer Approval	0 g	lun 02/09/24	lun 02/09/24
131	~~Gestione Preserie [ON HOLD]~~	~~2 g?~~	~~mar 06/12/22~~	~~mer 07/12/22~~
136	~~Preparazione SOP [ON HOLD]~~	~~1 g?~~	~~mar 06/12/22~~	~~mar 06/12/22~~

Progetto: PlanningProgettoMil
Data: gio 15/02/24

Attività | Divisione | Cardine | Riepilogo | Riepilogo progetto | Attività inattiva | Cardine inattivo | Riepilogo inattivo | Attività manuale | Solo durata | Riporto riepilogo manuale | Riepilogo manuale | Solo inizio | Solo fine | Attività esterne | Cardine esterno | Scadenza | Avanzamento | Avanzamento manuale

Annexure No 3 Flow Chart

2a S.p.A. FLOW CHART	NOME PARTICOLARE FLYWHEEL HOUSING	DATA DI REVISIONE FLOWCHART	02/02/2024		PARTICOLARE DI SICUREZZA	
		Rev.	0		SÌ	~~NO~~
		Descrizione del processo di revisione	Prima emissione del documento			

Data prima pubblicazione		02/02/2024	
Compilato da (Dipartimento - Nome):		Ufficio Tecnico - M. Montaldi	
Rilasciato da (Dipartimento - Nome):		Ufficio Tecnico - G. Braconcini	
Approvato da (Dipartimento - Nome):		Ufficio Qualità - S. Lia	
Part n°:	51.01401-5637	Rev.:	9
Draw n°:	2754824	Rev.:	9
f2a Part n°:	MNA2415637	Rev.:	

STEP N°	PROCESSO	A	NA	DESCRIZIONE	PROCEDURA \ ISTRUZIONE	COMMENTI \ NOTE
10	A.A.M.P. R.R.M.	A		ACCETTAZIONE ARRIVI MATERIA PRIMA	PROCEDURA : A3 CONTROL PLAN : CP N. 0683	ALLOY MATERIAL: EN AC 46000 EN 1706 - EN AC AlSi9Cu3(Fe)
20	(controllo qualità)	A		COLLAUDO LEGA	PROCEDURA : A3 CONTROL PLAN : CP N. 0683	
30	ALLOY STORAGE	A		STOCCAGGIO MATERIA PRIMA	PROCEDURA : L2 - A3 CONTROL PLAN : CP N. 0683	
40	MELTING ALLOY	A		FUSIONE LINGOTTI	PROCEDURA : P1 CONTROL PLAN : CP N. 0683	
50	UPKEEP MELTING	A		MANTENIMENTO LEGA FUSA	PROCEDURA : P1 CONTROL PLAN : CP N. 0683	
60	DIE CASTING (cono di bottiglia) 1P/Shift	A		PRESSOFUSIONE	PROCEDURA : P2 - P3 - P4 CONTROL PLAN : CP N. 0683	
70	TRIMMING OR REMOVE IN-GATE CHANNEL	A		TRANCIATURA \ SBAVATURA	PROCEDURA : P2 - P3 - P4 CONTROL PLAN : CP N. 0683	TRIMMING MNA2413408G
80	(controllo qualità)		NA	CONTROLLO COLLAUDO VOLANTE	PROCEDURA : A6 - A7 - A8 -A9 -A10 CONTROL PLAN : CP N. 0683	PROCESS QUALITY CHECK
90	INTERNAL OPERATION		NA	OPERAZIONE \ LAVORAZIONE INTERNA	PROCEDURA : P2 - P3 - P4 CONTROL PLAN : CP N. 0683	DEBURRING / SHOTBLASTING MNA2413408S1
100	(controllo qualità)		NA	CONTROLLO COLLAUDO VOLANTE	PROCEDURA : A4 - A8 - A10 CONTROL PLAN : CP N. 0000	
110	STORAGE	A		STOCCAGGIO PEZZI GREZZI	PROCEDURA : L2 CONTROL PLAN : CP N. 0683	RAW PARTS STORAGE
120	SHIPMENT SUPPLIER	A		SPEDIZIONE	PROCEDURA : L1 - L2 - A2 CONTROL PLAN : CP N. 0683	DEBURRING / SHOTBLASTING MNA2413408S1
130	1° EXTERNAL OPERATION 1P/Shift	A		LAVORAZIONE ESTERNA	PROCEDURA : A10 CONTROL PLAN : CP N. 0683	
140	DELIVERY 2A	A		SPEDIZIONE	PROCEDURA : L1 - L2 - A2 CONTROL PLAN : CP N. 0683	
150	(controllo qualità)	A		COLLAUDO A.A.	PROCEDURA : A4 - A8 - A10 CONTROL PLAN : CP N. 0683	PROCESS QUALITY CHECK
160	STORAGE	A		STOCCAGGIO	PROCEDURA : L2 CONTROL PLAN : CP N. 0683	
170	SHIPMENT SUPPLIER	A		SPEDIZIONE	PROCEDURA : L1 - L2 - A2 CONTROL PLAN : CP N. 0683	
180	2° EXTERNAL OPERATION 1P/Shift	A		LAVORAZIONE ESTERNA	PROCEDURA : A10 CONTROL PLAN : CP N. 0683	Machining + Washing + Leakage Test + Assembly + Laser Marking MNA2415637
190	DELIVERY 2A	A		SPEDIZIONE	PROCEDURA : L1 - L2 - A2 CONTROL PLAN : CP N. 0683	SHIPMENT TO 2A
200	(controllo qualità)	A		COLLAUDO A.A.		FINAL INCOMING INSPECTION
210	STORAGE		NA	STOCCAGGIO		
220	SHIPMENT SUPPLIER		NA	SPEDIZIONE		
230	3° EXTERNAL OPERATION		NA	LAVORAZIONE ESTERNA		
240	DELIVERY 2A		NA	SPEDIZIONE		
250	A.A.C R.A.C.		NA	ACCETTAZIONE ARRIVI COMPONENTI DELL'ASSEMBLATO		M12 THREAD INSERT 809282 STD745
260	(controllo qualità)		NA	COLLAUDO A.A.		
270	STORAGE		NA	STOCCAGGIO		
280	INTERNAL OPERATION		NA	OPERAZIONE \ LAVORAZIONE INTERNA		
290	(controllo qualità)		NA	CONTROLLO QUALITÀ		
300	STORAGE		NA	STOCCAGGIO		
310	SHIPMENT	A		SPEDIZIONE	PROCEDURA: L2 CONTROL PLAN : CP N. 0683	DELIVERY PARTS TO CUSTOMER

A APPLICABILE — NA NON APPLICABILE

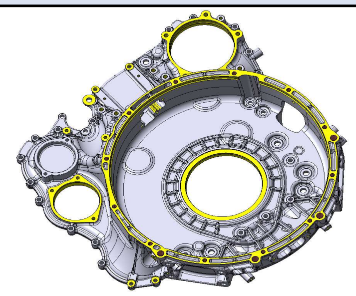
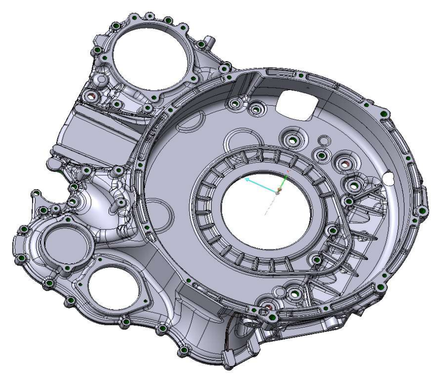
(rombo) CONTROLLO QUALITÀ — (rettangolo) ATTIVITÀ DI PROCESSO

(rettangolo rosso) CONO DI BOTTIGLIA — (operatore) NR. DI OPERATORI

Annexure No 04

Bill Of Material (BOM)

2a S.p.A.	Distinta Base / Bill Of Material			DB ID BOM ID	MNA2415637	04/04/2023 BOM_Master_Rev03
	Progetto/Project: CBE	Prototipo (P) / Serie (S) Protype (P) / Series (S): S	Cliente/Customer: German Company	NUMERO ST ST NUMBER	204608	
Revision BOM 1	Data/Date: 12/04/2024	Descrizione modifica:	Aggiornamento codici interni 2A per riferimento a PN MAN	Compilatore	M.Montaldi	
Revisione DB Revision BOM 0	Data/Date: 19/02/2024	Descrizione modifica:	Prima emissione	Compilatore	M.Montaldi	

Numero Parte Part Number	Codice Interno 2a Part Number 2a	Descrizione Operazione Description Operation	I	E	A	TBD	Prezzo Target Target Price €	Stima Tempo Ciclo Cycle Time Estimated pz / h	Nome Componente Part Name	Foto Picture	Usato su altri codici? In used on other codes?	Quantità Quantity	Unità di misura Unit of measure
2754824 **51.01401-5637**	**MNA2415637**	**Lavorazione Meccanica + Lavaggio + Prova Tenuta + Assemblaggio + Marcatura laser** ***Machining + Washing + Leakage Test + Assembly + Laser Marking***		X				2,53	**Flywheel Housing**		No	15,69	kg
809282					X		0,39 €		**M12 Thread insert 809282 STD745**		Sì	3	pcs
51.01401-3408	**MNA2413408S1**	**Sbavatura + sabbiatura** ***Manual deburring + Shotblasting***	X	X				40	**Flywheel Housing Casting**		Sì	1	pcs
	MNA2413408G	**Stampaggio** ***Casting***	X	X				9,2	**n°figure**: 1 **Adattamenti Pressa HPDC**: 3501, 4501, 4502		Sì	16,53	kg
		Tranciatura ***Trimming***	X	X				in tempo mascherato con lo stampaggio	**Adattamenti Pressa Trancia**: KZP-60 KZP-80				
	AS9_U3	**LEGA** **Alloy**			X		**NA**		**AlSi9Cu3** **EN AC 46000**		Sì		kg

Approvazione direzione tecnica	Data	12/04/2024	Firma
Approvazione direzione commerciale	Data	14/04/2024	Firma

Annexure No 5

2a S.p.A.

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

DATI DEL PROCESSO Process Data	
DENOMINAZIONE DEL PRODOTTO Product Name	FLYWHEEL HOUSING
CODICE DELLA PARTE Part Number	104173N1
INDICE DI MODIFICA Issue	D
NUMERO DEL DISEGNO Drawing Number	2774885
INDICE DI MODIFICA Drawing change	11

RAPPRESENTANTE CLIENTE Customer representative	GRUPPO DI LAVORO Team	
(X)	Nome Name	Incarico Responsibility
	S. LIA	QUALITY MANAGER_FONDERIE 2A
	G. BRACONCINI	TECHINICAL DEPT. MANAGER_FONDERIE 2A
	M. NICOLETTI	KEY ACCOUNT MANAGER_FONDERIE 2A
	E.RATTO	DIE TOOL DESIGN MANAGER_FONDERIE 2A
	P. RAMELLO	PRODUCTION MANAGER_FONDERIE 2A
	E. SCRIBONI	LOGISTIC MANAGER _FONDERIE 2A

GESTIONE DOCUMENTO Document Management	
RESP. COMPILAZIONE Filling Responsible	Matteo Montaldi
DATA PRIMA COMPILAZIONE Start Date	06/04/2024
DATA ULTIMA REVISIONE Last Rev. Date	

REVISIONE FMEA FMEA Issue	DATA Date	DESCRIZIONE Description
1	06/04/2024	PRIMA EMISSIONE/ FIRST RELEASE

GESTIONE AZIONI CORRETTIVE Corective action Management		
INDICE DI PRIORITA' DI RISCHIO Risk Priority Number	RPN	Valutazione Evaluation
1 ÷ 50		BASSO (Nessuna Azione Correttiva Richiesta) Low (Without corrective action)
51 ÷ 100		MEDIO (Nessuna Azione Correttiva Richiesta) MEDIUM (Without corrective action)
101 ÷ 200		ALTO (Con Azione Correttiva) HIGH (With corrective action)
> 201		MOLTO ALTO (Con Azione Correttiva) VERY HIGH (With corrective action)
GRAVITA' Risk Priority Number	G	Valutazione Evaluation
≤ 6		Nessuna Azione Migliorativa consigliata Without improve action
> 6		Con Azione Migliorativa Consigliata With improuve action

SAFETY PART	
	☐ SI - YES
	☑ NO - NOT

AZIONI DI PREVENZIONE SU PRODOTTI SIMILARI SIMILAR PRODUCT PREVENTIVE ACTION		
E' STATA VALUTATA LA NECESSITA' DI ESTENDERE LE AZIONI CORRETTIVE DI QUESTA PFMEA SU PRODOTTI SIMILARI?	SI - YES	☐
IT HAS BEEN ESTIMATED NEED TO EXTEND CORRECTIVE ACTIONS OF THIS PFMEA ON SIMILAR PRODUCTS?	NO - NOT	☐
	NON APPLICABILE - NOT APPLICABLE	☑

Nota Bene
Note

Per indici di " GRAVITA' " sul guasto valutati minori o uguali a 6 (secondo tabella A.I.A.I.G) non è necessaria la verifica \ approvazione o la conferma da parte del cliente, e l'approvazione del PPAP validarà il presente documento con gli indici scelti.
Per indici di " GRAVITA' " valutati maggiori a 6 (secondo tabella A.I.A.I.G) è necessaria l'approvazione da parte del cliente sulla corretta indicazione da riportatare nella presente analisi.
Nel caso in cui il cliente non comunichi gli indici da inserire la valutazione sarà eseguita dal gruppo di lavoro considerando la funzione e l'applicazione del particolare e le indicazioni sul livello di gravità delle caratteristiche riportate sul disegno.

- PFMEA_FLYWHEEL_HOUSING_104173N1 -

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta (SAFETY PART)	Class. Caratteristica (☐ SI - YES / ☑ NO - NOT)	POTENTIAL FAILURE MODE / MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE / EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) / GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE / CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) / PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION / ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) / RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
10	A.A.M.P. R.R.M		IMP.	MANCANZA COPERTURA IN PLASTICA SUI LINGOTTI	RISCHIO DI INSERIMENTO LINGOTTI BAGNATI NEI FORNI FUSORI	2	ISTRUZIONI DI IMBALLO NON RISPETTATE DAL FORNITORE DI MATERIA PRIMA	5	CONTROLLO VISIVO AL 100% PER PRESENZA COPERTURA IN PLASTICA SUI LINGOTTI SU OGNI PALLET	8	80							0					0
			IMP.	MANCATA IDENTIFICAZIONE DELL'IMBALLO	MATERIALE NON RINTRACCIABILE	2	ISTRUZIONI DI IMBALLO NON RISPETTATE DAL FORNITORE DI MATERIA PRIMA	5	VERIFICARE LA PRESENZA DELL'ETICHETTA IDENTIFICATIVA CON TIPO LEGA E NUMERO DI COLATA SU OGNI IMBALLO	8	80							0					0
			IMP.	ASSENZA DOC. CQC FORNITORE MP	IMPOSSIBILITA' ACCETTAZIONE MP	2	ERRORE FORNITORE	5	VERIFICA PRESENZA CQC FORNITORE PER OGNI LOTTO/COLATA	8	80							0					0
			IMP.	MANCATA IDENTIFICAZIONE DELLA LEGA CON COLORE SPECIFICO SU LINGOTTI	IMPOSSIBILITA' ACCETTAZIONE MP	2	ISTRUZIONI DI IMBALLO NON RISPETTATE DAL FORNITORE DI MATERIA PRIMA	5	CONTROLLO VISIVO AL 100% PER PRESENZA VERNICE COLORATA SUI LINGOTTI SU OGNI PALLET	8	80							0					0
			IMP.	IDENTIFICAZIONE DELLA LEGA CON COLORE ERRATO	RISCHIO DI MISCHIARE DIVERSI TIPI DI LEGA	2	ISTRUZIONI DI IMBALLO NON RISPETTATE DAL FORNITORE DI MATERIA PRIMA	5	CONTROLLO VISIVO AL 100% PER PRESENZA VERNICE COLORATA SUI LINGOTTI SU OGNI PALLET	8	80							0					0
			IMP.	MANCANZA DOC TRASPORTO	IMPOSSIBILITA' ACCETTAZIONE MP	1	ERRORE FORNITORE	2	VERIFICA PRESENZA DDT FORNITORE	8	16							0					0
			IMP.	DIFFERENZA Q.TA' CONSEGNATO E DICHIARATO	IMPOSSIBILITA' ACCETTAZIONE MP	3	ERRORE FORNITORE	2	PESATURA CAMION IN INGRESSO E USCITA	4	24							0					0
20	COLLAUDO LEGA CHECKING ALLOY		IMP.	COMPOSIZIONE CHIMICA DELLA LEGA NON CONFORME	CARATTERISTICHE LEGA DIFFERENTI DA SPECIFICA CLIENTE	2	ERRORE NELLA FORNITURA DI MATERIA PRIMA	5	VERIFICA DELLA COMPOSIZIONE CHIMICA DI OGNI LOTTO IN ARRIVO E CONGRUENZA CON CQC FORNITORE	7	70							0					0
30	STOCCAGGIO MATERIA PRIMA ALLOY STORAGE		IMP.	POSIZIONAMENTO LINGOTTI IN UN AREA SBAGLIATA	MATERIALE NON RINTRACCIABILE	3	ISTRUZIONI PER L'IMMAGAZZINAMENTO NON RISPETTATE DALL'OPERATORE	4	ISTRUZIONI PER L'IMMAGAZZINAMENTO NON RISPETTATE DALL'OPERATORE	8	96							0					0
			IMP.	POSIZIONAMENTO LINGOTTI IN UN AREA SBAGLIATA	MATERIALE NON DISPONIBILE	3	ISTRUZIONI PER L'IMMAGAZZINAMENTO NON RISPETTATE DALL'OPERATORE	4	ISTRUZIONI PER L'IMMAGAZZINAMENTO NON RISPETTATE DALL'OPERATORE	8	96							0					0
40	FUSIONE LINGOTTI MELTING ALLOY		IMP.	FUSIONE DI LINGOTTI DI DIFFERENTE LEGHE NELLO STESSO FORNO FUSORIO	CARATTERISTICHE LEGA DIFFERENTI DA SPECIFICA CLIENTE	4	ISTRUZIONI CARICO FORNI NON RISPETTATE DALL'OPERATORE	6	VERIFICA CONGRUENZA COLORE LEGA CON FORNO FUSORIO DEDICATO ED IDENTIFICATO / UTILIZZO CASSONI SCARTI MATEROZZE DELLO STESSO COLORE	8	192	VERIFICA UNA VOLTA PER TURNO CON SPETTROMETRO	QUALITA'	W46/2015	2	6	3	36	ESEGUITO	2	6	3	36

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A. — SAFETY PART — ☐ SI - YES / ☑ NO - NOT

Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	POTENTIAL FAILURE MODE MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
			IMP.	FUSIONE DI DIFFERENTI LEGHE NELLO STESSO FORNO FUSORIO	CARATTERISTICHE LEGA DIFFERENTI DA SPECIFICA CLIENTE	4	RICICLAGGIO SFRIDI CON INSERIMENTO NEL FORNO SFRIDI DI LEGHE DIVERSE	6	CARTELLI SU CASSONI SFRIDI	8	192	INSERIRE SUGLI STAMPI INCISIONE DELLA LEGA UTILIZZATA IN MODO CHE RIMANGA IMPRESSA SUL CANALE DI COLATA	UFF. TECNICO	W03/2016	2	6	7	84	INCISO	2	6	7	84
			IMP.	TEMPERATURA DEL BAGNO NON CONFORME (TROPPO ALTA/TROPPO BASSA)	OSSIDAZIONE O DIMINUZIONE COLABILITA' LEGA	4	ROTTURA DELLA TERMOCOPPIA NEL FORNO DI MANTENIMENTO	8	VERIFICA STATISTICA DELLA TEMPERATURA DEL BAGNO - PROGRAMMA DI MANUTENZIONE FORNO FUSORE	1	32							0					0
			IMP.	PRESENZA DI ELEVATA QUANTITA' DI GAS/SCORIE NEL BAGNO	DIMINUZIONE FUNZIONALITA' E DANNEGGIAMENTO FORNO FUSORE	2	OPERAZIONE DI DEGASAGGIO SCORIFICA NON CONFORME/NON ESEGUITA	5	CONTROLLO VISIVO E REGISTRAZIONE DELLE OPERAZIONI DI DEGASAGGIO E SCORIFICAZIONE / PROGRAMMA MANUTENZIONE FORNI	8	80							0					0
			IMP.	PRESENZA DI ELEVATA QUANTITA' DI GAS/SCORIE NEL BAGNO	LAVORABILITA E QUALITA DELGETTO COMPROMESSI	2	OPERAZIONE DI DEGASAGGIO SCORIFICA NON CONFORME/NON ESEGUITA	5	CONTROLLO VISIVO E REGISTRAZIONE DELLE OPERAZIONI DI DEGASAGGIO E SCORIFICAZIONE / PROGRAMMA MANUTENZIONE FORNI	8	80							0					0
			IMP.	CHIMICA DEL BAGNO NON CONFORME	CARRATTERISTICA LEGA DIFFERENTI	3	CAUSA TEMPI PERMANENZA NEL FORNO TROPPO ELEVATA	8	ANALISI CON SPETTOMETRO UNA VOLTA ATURNO	3	72							0					0
			IMP.	PRESENZA DI ELEVATA QUANTITA' DI GAS/SCORIE NEL BAGNO	LAVORABILITA E QUALITA DELGETTO COMPROMESSI	2	OPERAZIONE DI DEGASAGGIO SCORIFICA NON CONFORME/NON ESEGUITA	5	CONTROLLO VISIVO E REGISTRAZIONE DELLE OPERAZIONI DI DEGASAGGIO E SCORIFICAZIONE / PROGRAMMA MANUTENZIONE FORNI	8	80							0					0
50	MANTENIMENTO LEGA FUSA UPKEEP MELTING		IMP.	TEMPERATURA DEL BAGNO NON CONFORME (TROPPO ALTA/TROPPO BASSA)	OSSIDAZIONE O DIMINUZIONE COLABILITA' LEGA	2	ROTTURA DELLA TERMOCOPPIA NEL FORNO DI MANTENIMENTO O SPEGNIMENTO FORNI WEEKEND	5	VERIFICA STATISTICA DELLA TEMPERATURA DEL BAGNO - PROGRAMMA DI MANUTENZIONE FORNO FUSORE	6	60							0					0
			IMP.	PRESENZA DI ELEVATA QUANTITA' DI GAS/SCORIE NEL BAGNO	DIMINUZIONE FUNZIONALITA' E DANNEGGIAMENTO FORNO FUSORE	5	OPERAZIONE DI DEGASAGGIO SCORIFICA NON CONFORME/NON ESEGUITA	5	CONTROLLO VISIVO E REGISTRAZIONE DELLE OPERAZIONI DI DEGASAGGIO E SCORIFICAZIONE / PROGRAMMA MANUTENZIONE FORNI	3	75							0					0
			IMP.	PRESENZA DI ELEVATA QUANTITA' DI GAS/SCORIE NEL BAGNO	LAVORABILITA E QUALITA DELGETTO COMPROMESSI	5	OPERAZIONE DI DEGASAGGIO SCORIFICA NON CONFORME/NON ESEGUITA	5	CONTROLLO VISIVO E REGISTRAZIONE DELLE OPERAZIONI DI DEGASAGGIO E SCORIFICAZIONE / PROGRAMMA MANUTENZIONE FORNI	3	75							0					0
60	PRESSOFUSIONE DIE CASTING		IMP.	PARAMETRI MACCHINA NON CONFORMI	NON RISPETTO DEGLI STANDARD METALLOGRAFICI DEL CLIENTE	2	PARAMETRI STAMPAGGIO DIVERSI DA QUELLI CONGELATI	5	VERIFICA CONGRUENZA PARAMETRI DI STAMPAGGIO CON MODULO CONGELATO AD OGNI AVVIO PRODUTTIVO/PROGRAMMA PARAMETRI REGISTRATO SU	7	70							0					0
			IMP.	LUBRIFICAZIONE NON CONFORME O NON SUFFICIENTE	NON RISPETTO DEGLI STANDARD METALLOGRAFICI DEL CLIENTE	2	GUASTO AL LUBRIFICATORE	6	VERIFICA DEL SISTEMA DI LUBRIFICAZIONE DURANTE LA MANUTENZIONE PREVENTIVA PRESSE	7	84							0					0

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.

SAFETY PART

☐ SI - YES

☑ NO - NOT

Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	POTENTIAL FAILURE MODE / MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE / EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) / GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE / CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) / PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION / ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) / RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
			IMP.	BAVE SU DIVISIONI STAMPO	VARIAZIONI DIMENSONALI GETTO (SPESSORI CARTELLA)	5	MANUTENZIONE PREVENTIVA STAMPO NON ESEGUITA	6	CONTROLLO VISIVO SU CP - PROGRAMMA DI MANUTENZIONE	8	240	IMPLEMENTARE REGISTRAZIONE PER VERIFICA CORRETTA MANUTENZIONE STAMPO SU MODULO RA1	RESPONSABILE PRODUZIONE E QUALITA'	IMMEDIATA	2	6	8	96	IMPLEMENTATA LA PROCEDURA GESTIONE MANUTENZIONI	2	6	8	96
			IMP.			4	USURA STAMPO	4	CONTROLLO SUI PARTICOLARI PREVISTO SUL PIANO DI CONTROLLO - PROGRAMMA DI MANUTENZIONE STAMPO	7	112	MANUTENZIONE PREVENTIVA DELLO STAMPO / ESECUZIONE DISTENSIONI PARTI STAMPANTI	RESPONSABILE MANUTENZIONE	DURANTE LE PROVE STAMPO	3	4	7	84	MANUTENZIONE PREVENTIVA STAMPO CON CONTROLLO AGGIUSTAGGIO SU CHIUSURE	3	4	7	84
			IMP.	STRAPPATURE - METALLIZZAZIONI - FORI NON CONFORMI A SPECIFICHE CLIENTE	VARIAZIONI DIMENSONALI GETTO	4	METALLIZZAZIONI SU MASCHI STAMPO - STRAPPATURE SU FORI PARTICOLARE	6	CONTROLLO STATISTICO SU CP - PROGRAMMA DI MANUTENZIONE	4	96	ESEGUIRE TRATTAMENTO SUPERFICIALE SUI MASCHI STAMPO - REALIZZARE UNA SERIE DI MASCHI DI RICAMBIO	FORNITORE STAMPO	DOPO LA SECONDA PROVA STAMPO	3	6	4	72	TRATTAMENTO SUPERFICIALE ESEGUITO	3	6	4	72
			IMP.			4	STRESS DURANTE LO SHOCK TERMICO	6	CONTROLLO STATISTICO SU CP - PROGRAMMA DI MANUTENZIONE	6	144	PROGETTARE UN SISTEMA DI RAFFREDDAMENTO PER LE AREE CRITICHE	FORNITORE STAMPO	PRIMA DELLA 1 PROVA STAMPO	2	6	6	72	OPERAZIONE ESEGUITA E VERIFCA EFFETTUATA DURANTE LA 1 PROVA STAMPO	2	6	6	72
			IMP.	MASCHIO STAMPO PIEGATO	FORO CON TESTIMONE DI GREZZO / PERPENDICOLARITA' FORO KO / LOCALIZZAZIONE FORO OLTRE TOLLERANZA	4	DEFORMAZIONE DEL MASCHIO STAMPO PER FATICA DOVUTA DAI COLPI INIEZIONE LEGA	7	CONTROLLO STATISTICO SU CP - PROGRAMMA DI MANUTENZIONE	6	168	PROGETTARE MASCHI CON SOLUZIONI DI MATERIALI E TRATTAMENTI SPECIFICI PER AUMENTARNE LA RESISTENZA A FATICA	2A / FORNITORE STAMPO	DURANTE PROGETTAZIONE STAMPO	2	7	6	84					0
			IMP.								0	I MASCHI CHE HANNO LA PARTE STAMPANTE DI LUNGHEZZA SUPERIORE A 2,5 VOLTE IN DIAMETRO ALLA RADICE DEVONO AVERE TRATTAMENTO NITRURAZIONE O BALINIT	2A / FORNITORE STAMPO	DURANTE PROGETTAZIONE STAMPO	2	7	6	84					0
			IMP.								0	TUTTI I MASCHI DI RICAMBIO UTILIZZATI DEVONO CORRISPONDERE AL PROGETTO STAMPO COME DIMENSIONE, MATERIALE E TRATTAMENTI	2A / FORNITORE STAMPO	IMMEDIATA	2	7	6	84					0
			IMP.	CRICCATURE SULLE SUPERFICI IN PARTICOLARE PUNTI DI PARTENZA LAVORAZIONE MECCANICA CLIENTE	RUGOSITA' SUPERFICI NON CONFORMI ALLE SPECIFICHE CLIENTE NON CONFORMITA' ESTETICA	4	USURA ACCIAIO DELLO STAMPO	8	PIANO DI CONTROLLO	6	192	ESECUZIONE TRATTAMENTO SUPERFICI ACCIAIO PER RALLENTARE EFFETTO USURA	FORNITORE STAMPO	ENTRO 2° PROVA STAMPO	5	7	4	140	OPERAZIONE ESEGUITA	5	7	4	140
			IMP.								0	REVISIONE DEI CIRCUITI DI TERMOREGOLAZIONE DELLE MATRICI PER EQUILIBRIO TERMICO	FORNITORE STAMPO	ENTRO 2° PROVA STAMPO	4	7	4	112	OPERAZIONE ESEGUITA	4	7	4	112
			IMP.								0	PREVEDERE PIANO DI MANUTENZIONE PREVENTIVA MATRICI AD OGNI 30000 INIEZIONI	MANUTENZIONE STAMPI	IN PRODUZIONE	3	7	4	84	IMPLEMENTATO PIANO DI MANUTENZIONE PREVENTIVO	3	7	4	84
			IMP.			4	DIMENSIONI E GEOMETRIA DEI CANALI DI COLATA - POZZETTI NON CONFORMI	6	PIANO DI CONTROLLO	3	72	PROGETTARE CANALI DI COLATA E POZZETTI AL FINE DI PREVENIRE INTRAPPOLAMENTI ARIA - ESEGUIRE SE RITENUTO NECESSARIO UNA SMULAZIONE DI RIEMPIMENTO	RESPONSABILE SVILUPPO STAMPO - FORNITORE STAMPO	PRIMA DELLA 1 PROVA STAMPO	2	6	3	36	STAMPO REALIZZATO IN ACCORDO CON I PROGETTI - VERIFICATO DURANTE LA PROVA STAMPO	2	6	3	36

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.

Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta (SAFETY PART)	Class. Caratteristica (SI - YES / NO - NOT)	POTENTIAL FAILURE MODE / MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE / EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) / GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE / CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) / PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION / ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) / RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
			IMP.			7	ECCESSIVO DEPOSITO DI LUBRIFICANTE DURANTE LA LUBRIFICAZIONE	4	CONTROLLO VISIVO	7	196	STUDIO DEL CORRETTO SISTEMA DI LUBRIFICAZIONE	RESPONSABILE PRODUZIONE	PRIMA DELLA 1 PROVA STAMPO	3	4	7	84	VERIFICATO DURANTE LA PROVA STAMPO	3	4	7	84
			IMP.			7	SOVRA RAFFREDDAMENTO DELLO STAMPO DURANTE LA LUBRIFICAZIONE	4	PIANO DI CONTROLLO	7	196	STUDIO DEL CORRETTO SISTEMA DI LUBRIFICAZIONE - UTILIZZO DLLA TERMOCAMRA DURANTE LA PRODUZIONE	RESPONSABILE PRODUZIONE	PRIMA DELLA 1 PROVA STAMPO	4	4	7	112	VERIFICATO DURANTE LA PROVA STAMPO	4	4	7	112
			IMP.								0	STUDIO DEL CORRETTO SISTEMA DI LUBRIFICAZIONE E DI UTILIZZO DEL SISTEMA DI RAFFREDDAMENTO	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	3	4	7	84	VERIFICATO DURANTE LA PROVA STAMPO	3	4	7	84
		(safety symbol)	CR.	DEFORMAZIONE	VARIAZIONI DIMENSIONALI GETTO ASSEMBLAGGIO E LAVORAZIONE CLIENTE DIFFICOLTOSO	5	INCOLLAGGIO ANOMALO - VARIABILITA' PROCESSO DI STAMPAGGIO	6	PIANO DI CONTROLLO	5	150	DEFINIRE IL SISTEMA DI LUBRIFICA ADEGUATO AL FINE DI EVITAR FENOMENI DI INCOLLAGGIO	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	4	6	5	120	ESEGUITO	4	6	5	120
											0	CONTROLLO QUOTE CRITICHE IN ESTRAZIONE	QUALITA'	DURANTE LA PRODUZIOE	2	6	5	60	ESEGUITO	2	6	5	60
			IMP.			5	RITIRO ANOMALO	6	PIANO DI CONTROLLO ED ANALISI RX	5	150	DEFINIRE IL SISTEMA DI LUBRIFICA ADEGUATO AL FINE DI EVITAR FENOMENI DI RITIRI ANOMALI	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	3	6	5	90	SISTEMA DI LUBRIFICA DEFINITO	3	6	5	90
		(safety symbol)	CR	QUOTE CRITICHE DI SICUREZZA	VARIAZIONI DIMENSIONALI GETTO ASSEMBLAGGIO E LAVORAZIONE CLIENTE DIFFICOLTOSO	5	INCOLLAGGIO ANOMALO - VARIABILITA' PROCESSO DI STAMPAGGIO	9	PIANO DI CONTROLLO	7	315	DEFINIRE IL SISTEMA DI LUBRIFICA ADEGUATO AL FINE DI EVITAR FENOMENI DI INCOLLAGGIO	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	4	9	7	252	ESEGUITO	4	9	7	252
			IMP.								0	PROGETTAZIONE STAMPO CON SISTEMA DI TERMOREGOLAZIONE	UFF. TECNICO	PROGETTAZIONE	3	8	6	144	RTS STAMPO	2	9	5	90
				GIUNZIONI FREDDE	NON RISPETTO DEGLI STANDARD METALLOGRAFICI DEL CLIENTE	7	SOLIDIFICAZIONE ANOMALA E NON EQUILIBRATA	8	PIANO DI CONTROLLO	6	336	STUDIO DEL CORRETTO SISTEMA DI LUBRIFICAZIONE E DI UTILIZZO DEL SISTEMA DI RAFFREDDAMENTO	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	6	8	6	288	VERIFICATO DURANTE LA PROVA STAMPO	6	8	6	288
												PROGETTAZIONE STAMPO CON SISTEMA DI TERMOREGOLAZIONE	UFF. TECNICO	PROGETTAZIONE	3	8	6	144	RTS STAMPO	3	8	6	144
												REGISTRAZIONE PARAMETRI MACCHINA/STAMPAGGIO	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	2	8	6	96	VERIFICATO DURANTE LA PROVA STAMPO	2	8	6	96

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.

Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta (SAFETY PART)	Class. Caratteristica (SI - YES / NO - NOT)	POTENTIAL FAILURE MODE / MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE / EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) / GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE / CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) / PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION / ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) / RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
			IMP.	POROSITA'	NON RISPETTO DEGLI STANDARD METALLOGRAFICI DEL CLIENTE	5	INGLOBAMENTO D'ARIA NEL PARTICOLARE	6	PIANO DI CONTROLLO	6	180	CONTROLLI GIORNALIERI DENSITA' LEGA POST DEGASAGGIO	RESPONSABILE QUALITA'	DURANTE LE PROVE STAMPO E PRODUZIONE	4	6	6	144	CONTROLLI GIORNALIERI LEGA POST DEGASAGGIO	2	6	6	72
			IMP.								0	STUDIO COLATA E POZZETI	UFF. TECNICO	PROGETTAZIONE	2	6	6	72	STUDIO COLATA E POZZETETI	2	6	6	72
											0	REGISTRAZIONE PARAMETRI MACCHINA/STAMPAGGIO	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	2	8	6	96	VERIFICATO DURANTE LA PROVA STAMPO	2	6	6	72
												REGISTRAZIONE PARAMETRI MACCHINA/STAMPAGGIO	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	2	8	6	96	VERIFICATO DURANTE LA PROVA STAMPO	2	6	6	72
			IMP.	RITIRI	NON RISPETTO DEGLI STANDARD METALLOGRAFICI DEL CLIENTE	5	MANCANZA DI MATERIALE	7	PIANO DI CONTROLLO	6	210	REVISONE PROGETTAZIONE DISEGNO	UFF. TECNICO/COMMERCIALE	REVISIONE TECNICA CON IL CLIENTE	4	8	6	192	REVISIONE TECNICA CON IL CLIENTE	2	8	6	96
			IMP.								0	REGISTRAZIONE PARAMETRI MACCHINA/STAMPAGGIO	RESPONSABILE PRODUZIONE	DURANTE LE PROVE STAMPO	3	8	6	144	VERIFICATO DURANTE LA PROVA STAMPO	3	8	6	144
			IMP.								0	STUDIO COLATA	UFF. TECNICO	PROGETTAZIONE	2	6	6	72	STUDIO COLATA E POZZETETI	2	6	6	72
70-80	TRANCIATURA / SMATEROZZATURA / COLLAUDO TRIMMING / REMOVE IN-GATE / CHECK		IMP.	PRESENZA TESTIMONI ATTACCO COLATA E POZZETTI	NON CONFORMITA' FUNZIONALE , DIMENSIONALE , ESTETICO	4	ROTTURA ANOMALA DELLA COLATA E DEI POZZETTI	5	PIANO DI CONTROLLO	8	160	INTRODURRE NEL PROCESSO ATTREZZATURA TRANCIA BAVE	UFF. TECNICO	ENTRO PROD SERIE	2	5	8	80	ESEGUITO	2	5	8	80
			IMP.	DEFORMAZIONI O ROTTURA DEI PARTICOLARI	FUNZIONALE \ DIMENSIONALE ESTETICO NON CONFORME	4	ROTTURA ANOMALA DELLA COLATA E DEI POZZETTI	6	PIANO DI CONTROLLO	8	192	INTRODURRE NEL PROCESSO ATTREZZATURA TRANCIA BAVE	UFF. TECNICO	ENTRO PROD SERIE	2	6	8	96	#VALUE!	2	6	8	96
			IMP.	AMMACCATURE SGRAFFIATURE ETC.	ESTETICO NON CONFORME	4	MANIPOLAZIONE DEI PARTICOLARI NON ADEGUATA	7	PIANO DI CONTROLLO	5	140	IMPLEMENATARE ISTRUZIONI PER MANIPOLAZIONE EIMBALLAGGIO	UFF. TECNICO	ENTRO PROD SERIE	4	7	3	84	ESEGUITO	4	7	3	84
90-100	SBAVATURA E SABBIATURA/COLLADO-DEBURRING AND SAND BLASTING/QUALITY CHECK		IMP.	PRESENZA BAVE DOPO SABBIATURA	ESTETICO NON CONFORME / MANIPOLAZIONE PERICOLOSA PER OPERATORE	5	SBAVATURA NON ESEGUITA COME DA CICLO DI LAVORO.	4	CONTROLLO VISIVO	4	80	ISTRUZIONI OPERATIVE PER GLI ADDETTI ALLA SBAVATURA OPERAZIONE CONTROLLO SU CL	UFF. TECNICO	ENTRO PROD SERIE	4	4	3	48	CL AGGIORNATO	4	4	3	48

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.		SAFETY PART	SI - YES / NO - NOT	POTENTIAL FAILURE MODE	POTENTIAL EFFECT (S) OF FAILURE	SEVER (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE	OCCUR (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION	DETEC (R)	RPN	Azioni Correttive Previste			RPN PREVISTO				Azione correttive eseguite	RPN RAGGIUNTO			
Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	MODALITA' DEL GUASTO POTENZIALE	EFFETTO (I) POTENZIALE DEL GUASTO	GRAV. (G)	CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	PROB (P)	ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	RILEV (R)	RPN	Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	G	P	R	RPN	Azione Eseguita	G	P	R	RPN
			IMP.			3	SABBIATURA NON ESEGUITA COME DA CICLO DI LAVORO	6	CONTROLLO VISIVO	3	54	MESSA A PUNTO PARAMETRI TURBINA E DIAMETRO SABBIA SABBIATRICE	FORNITORE	ENTRO PROD SERIE	2	6	3	36	VERIFICA PROCESSO SABBIATURA	2	6	3	36
110	STOCCAGGIO			MANCANZA DI AVVISO PER IDENTIFICARE IL PARTICOLARE	IMPOSSIBILITA' DI TROVARE IL PARTICOLARE	4	ERRORE UMANO	5	CONTROLLO VISIVO	3	60	ISTRUZIONI OPERATIVE PER L'OPERATORE IN ACCETTAZIONE ARRIVI	LOGISTICA	ENTRO PRIMA PROVA STAMPO	3	5	3	45		3	5	3	45
120	SPEDIZIONE			MANCANZA DI AVVISO PER IDENTIFICARE IL PARTICOLARE	IDENTIFICAZIONE ERRATA DEL PARTICOLARE	4	ERRATA PROCEDURA DI ETICHETTATURA PER LA SPEDIZIONE-NESSUN NUOVO CODICE INSERITO A SISTEMA PER LA FASE IN QUESTIONE	5	CONTROLLO VISIVO	5	100	ISTRUZIONI OPERATIVE PER L'OPERATORE IN ACCETTAZIONE ARRIVI-CORRETTO INSERIMENTO DEI PARTICOLARI A SISTEMA PER OGNI FASE DEL PROCESSO	LOGISTICA	PRIMA DELLA PROVA STAMPO	2	5	5	50	CODICI E FASI DEL PROCESSO BENDEFINITE				0
130	EXTERNAL OPERATION MACHINING		IMP.	STOP OF THE CNC MACHINE	PRODUCTION RATE SLOWED DOWN	4	PLACEMENT PICES WRONG ON FIXTURE	6	VISUAL CHECK	3	72	CREATE THE	EUROSERVICE		2	6	3	36	DONE	2	6	3	36
			IMP.	NOT CORRECT PLACEMENT OF THE RAW PART ON FIXTURE	WRONG MACHINING - SCRAP PART	4	FAILURE OF THE CHECKING SISTEM FOR THE CORRECT PLACEMENT OF THE PIECE	5	CHECK THE PRESENCE OF THE PIECE BY USING THE REFERENCE "PEL" SYSTEM	2	40							0					0
			IMP.			7	WRONG PLACEMENT OF THE PIECE DONE BY THE WORKER	5	VISUAL CHECK	4	140	INSERTION OF ANTI LOCK PINS FOR PREVENT POSITIONING ERRORS OF THE PIECE	TECNOCONTROL	BEFORE PPAP	4	5	4	80	DONE	4	5	4	80
			IMP.			4		5	MAINTENANCE SCHEDULE	2								0					0
			IMP.		COLLISION	4	FAILURE OF THE CHECKING SISTEM FOR THE CORRECT PLACEMENT OF THE PIECE	5	CHECK OF THE PRESENCE OF THE PIECE USING THE "PEL" SYSTEM	2	40							0					0
			IMP.	INCORRECT LOCK OF THE PART TOO STRONG	IMPROPER WORK PART DUE TO ELASTIC DEFORMATION	4	FAILURE OF HYDRAULIC CLAMPING SYSTEM	5	MAINTENANCE SCHEDULE	2	40							0					0
			IMP.	INCORRECT LOCK OF THE PART TOO WICK	IMPROPER WORK PART DUE TO ELASTIC DEFORMATION	4	FAILURE OF HYDRAULIC CLAMPING SYSTEM	5	MAINTENANCE SCHEDULE	2	40							0					0
			IMP.	STARTING REFERENCE WITH THE PRESENCE OF CHIPS	WRONG MACHINING - SCRAP PART	4	FAILURE OF THE BLOW HOLE DURING REFERENCE PART CHANGE	5	HUMAN MISTAKE	2	40							0					0

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.

SAFETY PART

☐ SI - YES / ☑ NO - NOT

Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	POTENTIAL FAILURE MODE / MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE / EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) / GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE / CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) / PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION / ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) / RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
			IMP.			4	OBSTRUCTION OF THE NOZZLE	5	MAINTENANCE SCHEDULE	2	40							0					0
			IMP.	DISTORTION OF THE PIECE DURRING CLAMPING	PLANARITY OUT OF TOLLERANCE - SCRAP PART	3	PART TOO MUCH CLAMPED	7	CALIBRATED HYDRAULIC CLAMPING DEVICES	3	63	CONTROL PLAN OF THE MAINTENANCE AND TOOLS CNC CHECK OF PROPER OPERATION AND ADJUSTMENT OF THE HYDRAULIC CLAMPING DEVICES	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	DONE	3	7	3	63
			IMP.	EDGE CHIPING TOOL	ROUGHNESS OUT OF TOLLERANCE	3	TOOL WEARED	7	MANAGEMENT OF THE TOOL LIFE	3	63	STATISTICAL CHECK OF THE ROUGHNESS TO BE ADDED INTO THE CONTROL PLAN	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	DONE	3	7	3	63
			IMP.			4	INCLUSIONS IN THE RAW PART	7	CONTROL PLAN	4	112	MAKE SPECIFIC TOOLS FOR ALUMINUM CHIP REMOVAL	TECNOCONTROL	BEFORE PPAP	3	7	3	63	DONE	3	7	3	63
			IMP.		BURRS OF MACHINING - SCRAP PART	4	FAILURE MAINTENANCE OF THE TOOL	7	CONTROL PLAN	4	112	BURRS ELIMINATION OPERATION AT HE END OF THE MACHINING	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	4	84					0
			IMP.			5	IMPROPER MANAGEMENT TOOL SHARPENING	4	SCHEDULED MAINTENANCE OF THE TOOLS	4	80							0					0
			IMP.	EDGE CHIPING TOOL	WRONG MACHINING HOLE DIAMETER OUT OF TOLERANCE SCRAP PART	3	TOOL WEARED	7	MANAGEMENT OF THE TOOL LIFE	3	63	STATISTICAL CHECK OF THE HOLES TO BE ADDED INTO THE CONTROLL PLAN	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	DONE				0
			IMP.			4	INCLUSIONS IN THE RAW PART	7	CONTROLL PLAN	4	112	MAKE SPECIFIC TOOLS FOR ALUMINUM CHIP REMOVAL	TECNOCONTROL	BEFORE PPAP	3	7	3	63	DONE	3	7	3	63
			IMP.			5	IMPROPER MANAGEMENT TOOL SHARPENING	4	SCHEDULED MAINTENANCE OF THE TOOLS	4	80							0					0
			IMP.	BREAKAGE OF THE DRILLING or BORING TOOL	HOLE NOT MACHINED SCRAP PART	4	TOOL WEARED	7	POKA-YOKE TO CHECK PRESENCE AND INTEGRITY OF THE TOOL INTO CNC	2	56							0					0
			IMP.	HOLE SMALLER HOLE BIGGER Ref.to THE DRW TOLERANCES	SCRAP PARTS	4	TOOL DIAMETER SMALLER or BIGGER	7	MANAGEMENT SPARE TOOLS AND PRESETTING	3	84	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A. — SAFETY PART — ☐ SI - YES / ☑ NO - NOT

Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	POTENTIAL FAILURE MODE / MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE / EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) / GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE / CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) / PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION / ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) / RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
			IMP.	HOLE POSITION OUT OF TOLERANCE	SCRAP PARTS	3	WRONG POSITIONING OF THE PIECE IN THE REFERENCES DEVICE	4	CHECK THE PRESENCE OF THE PIECE BY USING THE REFERENCE "PEL" SYSTEM	3	36							0					0
			IMP.			3	MISTAKE IN THE PART PROGRAM	7	CONTROLL PLAN	4	84	PROCEDURE OF CNC PART-PROGRAM MANAGEMENT TO BE WRITTEN	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	4	84					0
			IMP.			3	DEFLECTION OF THE TOOLS	7	CONTROLL PLAN	3	63	CENTERING HOLES OPERATION TO BE ADDED TO AVOID DEFLECTION OF THE TOOLS	TECNOCONTROL	BEFORE PPAP	3	7	3	63	OPERATION ADDED IN THE PART PROGRAM	3	7	3	63
			IMP.			3	WRONG PRE-SETTING OF THE TOOLS	7	CONTROLL PLAN	3	63	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0
			IMP.	FORM & GEOMETRIC TOLERANCES OUT OF RANGE	SCRAP PARTS	3	TOOLS FORM NOT IN Acc.To THE DRAWING DIMENSIONING	7	CONTROLL PLAN	3	63	SPECIFIC LONG LIFE TOOLS FOR ALUMINIUM MACHING TO BE CREATED	TECNOCONTROL	BEFORE PPAP	3	7	3	63	DONE	3	7	3	63
			IMP.			3	WRONG PRE-SETTING OF THE TOOLS	7	CONTROLL PLAN	3	63	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0
			IMP.			3	DEFLECTION OF THE TOOLS	7	CONTROLL PLAN	3	63	CENTERING HOLES OPERATION TO BE ADDED TO AVOID DEFLECTION OF THE TOOLS	TECNOCONTROL	BEFORE PPAP	3	7	3	63	OPERATION ADDED IN THE PART PROGRAM	3	7	3	63
			IMP.			3	VIBRATION OF THE PIECE	7	CONTROLL PLAN	3	63	ANTI-VIBRATING DEVICES TO BE ADDED ON CLAMPING FIXTURES	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ANTI-VIBRATING DEVICES ADDED ON CLAMPING FIXTURES	3	7	3	63
			IMP.	BREAKAGE OF THE THREADED TOOL	THREADED HOLE NOT MACHINED SCRAP PART	4	TOOL WEARED	7	POKA-YOKE TO CHECK PRESENCE AND INTEGRITY OF THE TOOL INTO CNC	2	56							0					0
			IMP.	TAPPING SHORT	FAILURE TO FUNCTION OF THE THREADED HOLE SCRAP PART	3	WRONG PRE-SETTING OF THE TOOL	7	CONTROLL PLAN	3	63	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0
			IMP.	CORE DIAMETER BIGGER	SEAL FAILURE OF THREAD SCRAP PART	4	DRILLED PRE-HOLE BIGGER	7	CONTROLL PLAN	3	84	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.		SAFETY PART	☐ SI - YES ☑ NO - NOT	POTENTIAL FAILURE MODE	POTENTIAL EFFECT (S) OF FAILURE	SEVER (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE	OCCUR (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION	DETEC (R)	RPN	Azioni Correttive Previste			RPN PREVISTO				Azione correttive eseguite	RPN RAGGIUNTO			
Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	MODALITA' DEL GUASTO POTENZIALE	EFFETTO (I) POTENZIALE DEL GUASTO	GRAV. (G)	CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	PROB (P)	ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	RILEV (R)	RPN	Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	G	P	R	RPN	Azione Eseguita	G	P	R	RPN
			IMP.	CORE DIAMETER SMALLER	IMPOSSIBLE OPERATION OF FIXING SCRAP PART	3	THREADER TOOL WEARED	7	MANAGEMENT OF THE TOOL LIFE	3	63	STATISTICAL CHECK OF THE THREADED HOLES TO BE ADDED INTO THE CONTROLL PLAN	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0
			IMP.			3		7	MANAGEMENT SPARE TOOLS AND PRESETTING	3	63	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0
			IMP.	CHIPS INSIDE THE BLIND HOLES	SCRAP PARTS	4	EVACUATION CHIPS NOT ADEQUATE	7	CONTROL PLAN	3	84	MAKING TOOLS WITH INTERNAL HIGH PRESSURE LUBRICATION TO DISCHARGE CHIPS	TECNOCONTROL	BEFORE PPAP	3	7	3	63	TOOLS WITH INTERNAL HIGH PRESSURE LUBRICATION ADOPTED	3	7	3	63
			IMP.	PARTIAL MACCHINING IN OP.10	SCRAP PARTS	4	MANUAL CYCLE MANAGEMENT	7	CONTROL PLAN	3	84	PROCEDURE OF THE WORKSTATION FLOW MANAGEMENT DURING SPECIAL MAINTENANCE, CORRECTION AND START UP CYCLE TO BE WRITTEN	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0
			IMP.	PRESENCE CHIPS ON OP 20 REFERENCES	WRONG WORKING - SCRAP PARTS	5	NOT CORRECT BLOWING OF THE PIECE AT THE END OF OP. 10	6	VISUAL CHECK	7	210	INSERT RINSE PART OPERATION AT THE END OF EACH MACHINING	TECNOCONTROL	BEFORE PPAP	3	6	3	54	ACTION DONE	3	6	3	54
			IMP.	NICK | STRIPES ON MACHINED SURFACE	SCRAP PART	4	MOVEMENT OF THE PIECE	7	CONTROL PLAN	4	112	MOVEMENT OF THE PIECE AND TIPPING STATIONS DESIGNED IN ORDER TO PREVENT THE RISK OF COLLISION DURING THE MOVEMENT OF THE PARTICULAR	TECNOCONTROL	BEFORE PPAP	3	7	3	63		3	7	3	63
			IMP.	INCORRECT POSITIONINIG OF THE PIECE ON REFERENCES	WRONG WORKING- SCRAP PART	4	FAILURE OF THE CHECK SYSTEM FOR THE PLACEMENT OF THE PIECE	5	CHECK THE PRESENCE OF THE PIECE BY USING THE REFERENCE "PEL" SYSTEM	2	40							0					0
			IMP.			7	INCORRECT PLACEMENT OF THE PIECE DONE BY THE WORKER	5	VISUAL CHECK	4	140	INSERTION OF ANTI LOCK PINS TO PREVENT POSITIONING ERRORS OF THE PIECE	TECNOCONTROL	BEFORE PPAP	4	5	4	80	ACTION DONE	4	5	4	80
			IMP.			4		5	MAINTENANCE SCHEDULE EQUIPMENT	2	40							0					0
			IMP.		COLLUSIONS	4	FAILURE OF THE CHECK SYSTEM FOR THE PLACEMENT OF THE PIECE	5	CHECK THE PRESENCE OF THE PIECE BY USING THE REFERENCE "PEL" SYSTEM	2	40							0					0
			IMP.	INCORRECT LOCK OF THE PART DONE TOO STRONG	IMPROPER WORK OF THE PART DUE TO ELASTIC DEFORMATION	4	FAILURE OF HYDRAULIC CLAMPING SYSTEM	5	MAINTENANCE SCHEDULE EQUIPMENT	2	40							0					0

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.

Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta (SAFETY PART)	Class. Caratteristica (SI - YES / NO - NOT)	POTENTIAL FAILURE MODE / MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE / EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) / GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE / CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) / PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION / ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) / RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
			IMP.	INCORRECT LOCK OF THE PART DONE TOO WEAK	IMPROPER WORK DUE TO THE MOVEMENT OF THE PIECE DURING MACHINING	4	FAILURE OF HYDRAULIC CLAMPING SYSTEM	5	MAINTENANCE SCHEDULE	2	40							0					0
			IMP.			4	OBSTRUCTION OF THE NOZZLE FOR BLOWING	5	SCHEDULED MAINTENANCE OF THE TOOLS	2	40							0					0
			IMP.			6	HUMAN MISTAKE AT THE BEGINING OF THE CICLE	5	TRAINING AND EDUCATION SCHEDULE FOR THE WORKER	4	120	MAKING PROPER INSTRUCTIONS TO PERFORM ALL CYCLE START ACTIVITIES	MACHINING DEPARTMENT RESONSABILE	BEFORE PPPA	4	5	4	80	ACTION DONE	4	5	4	80
			IMP.	FORMING PART DURING THE CLAMPING	MANCATO RISPETTO DEI REQUISITI DI PLANARITA' PEZZO DI SCARTO NOT CORRECT REQUIRMENTS OF FLATNESS NOT RESPECTED - SCRAP PART	3	EXCESSIVE CLAMPING OF THE PIECE (HYOERSTATIC)	7	CALIBRATED HYDRAULIC CLAMPING	3	63	PREVEDERE SU PIANO MANUTENZIONE CNC E ATTREZZI LA VERIFICA DEL FUNZIONAMENTO E CORRETTA TARATURA DEI MANOMETRI DELLA CENTRALINA IDRAULICA	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	CHIPPING TOOL	ROUGHNESS NOT RESPECTED - SCRAP PIECE	3	EXCESSIVE USE OF THE TOOL	7	AUTOMATIC CHECK FOR TOOL LIFE	3	63	ADD TO CONTROL PLAN THE STATISTIC CHECK OF THE ROUGHNESS	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			4	INCLUSIONS IN RAW PART	7	CONTROL PLAN	4	112	MAKE SPECIFIC TOOLS FOR ALUMINUM CHIP REMOVAL	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.		HIGH BURRS DUE TO MACHINING	4	NOT CORRECT LIFE MAINTANANCE	7	CONTROL PLAN	4	112	INSERT BURRS REMOVAL OPERATION AT THE END OF MACHINING	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	4	84	ACTION DONE	3	7	4	84
			IMP.			5	NON CORRETTA GESTIONE AFFILATURA UTENSILE	4	MANTAINANCE SCHEDULE FOR THE TOOL	4	80							0					0
			IMP.	CHIPPING OF THE TOOL	WRONG MACHINING-DIAMETER INCREASED-PIECE OF SCRAP	3	EXCESIVE USE OF THE TOOL	7	GESTIONE AUTOMATICA VITA UTENSILE	3	63	PREVEDERE SU PIANO DI CONTROLLO LA VERIFICA STATISTICA DEI FORI	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63					0
			IMP.			4	INCLUSIONS IN RAW PART	7	CONTROL PLAN	4	112	MAKE SPECIFIC TOOLS FOR ALUMINUM CHIP REMOVAL	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			5	NOT CORRECT FILING	4	AUTOMATIC PROGRAM FOR THE MANTAINACE OF THE TOOLS	4	80							0		0	0	0	0

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.

		SAFETY PART	☐ SI - YES / ☑ NO - NOT	POTENTIAL FAILURE MODE	POTENTIAL EFFECT (S) OF FAILURE	SEVER (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE	OCCUR (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION	DETEC (R)	RPN	Azioni Correttive Previste			RPN PREVISTO				Azione correttive eseguite	RPN RAGGIUNTO			
Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	MODALITA' DEL GUASTO POTENZIALE	EFFETTO (I) POTENZIALE DEL GUASTO	GRAV. (G)	CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	PROB (P)	ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	RILEV (R)	RPN	Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	G	P	R	RPN	Azione Eseguita	G	P	R	RPN
			IMP.	BREAKING OF THE TOOL	THE HOLE NOT DONE - SCRAP PART	4	OVER USE OF THE TOOL	7	POKA-YOKE TO CHECK PRESENCE AND INTEGRITY OF THE TOOL INTO CNC	2	56							0		0	0	0	0
			IMP.	BIGGER / SMALLER HOLE	SCRAP PART	4	THE DIAMETER OF THE TOOL BIGGER/ SMALLER	7	ADMINISTRATION OF THE CHANGING TOOLS	3	84	INSERT ON THE MANAGEMENT CHAINGIN TOOL'S SCHEDULE AND APPLY AN LABEL SIGNED FOR THE CORRECT ESECUTION OF THE PRE'SETTING	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63		3	7	3	63
			IMP.	POSITION GEOMETRIC TOLERANCES NOT RESPECTED	SCRAP PART	3	NOT CORRECT PLACEMENT OF THE PIECE	4	CHECK THE PRESENCE OF THE PIECE WITH THE USE OF "PEL"	3	36							0		0	0	0	0
			IMP.			3	ERROR IN PART PROGRAM	7	CONTROL PLAN	4	84	HANDEL PART OPERATION - SCHEDULE OF CNC	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	4	84		3	7	4	84
			IMP.			3	TOOL'S BENDING	7	COTNROL PLAN	3	63	INSERT THE OPERATION OF CENTERING THE HOLES TO AVOID BENDING THE TOOLSI	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			3	ERROR IN PRE-SETTING THE TOOL	7	CONTROL PLAN	3	63	INSERT ON THE MANAGEMENT CHAINGIN TOOL'S SCHEDULE AND APPLY AN LABEL SIGNED FOR THE CORRECT ESECUTION OF THE PRE'SETTING	MACHINING DEPARTMENT RESPONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	GEOMETRIC TOLLERANCES NOT RESPECTED	SCRAP PART	3	TOOL'S SHAPE NOT ADEQUATE	7	CONTROL PLAN	3	63	MAKE SPECIFIC TOOLS FOR ALUMINUM CHIP REMOVAL	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			3	ERROR IN PRE-SETTING THE TOOL	7	CONTROL PLAN	3	63	INSERT ON THE MANAGEMENT CHAINGIN TOOL'S SCHEDULE AND APPLY AN LABEL SIGNED FOR THE CORRECT ESECUTION OF THE PRE'SETTING	MACHINING DEPARTMENT RESPONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			3	BENDING TOOLS	7	CONTROL PLAN	3	63	INSERT THE CENTRING OPERATION FOR THE HOLES TO AVOID THE BENDING OF THE TOOLS	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			3	VIBRATION OF THE PIECE	7	CONTROL PLAN	3	63	INSERT ANTI-VIBRATIONS ON THE CLAMPING TOOLS	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	BROKE OF THE PIN	NOT CORECT TAPPING OF THE THREAD	4	THE USE OF THE TOOL	7	POKA-YOKE PRESENZA E INTEGRITA' UTENSILE SU CNC	2	56							0	ACTION DONE	0	0	0	0

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

S.p.A.

		SAFETY PART	☐ SI - YES ☑ NO - NOT	POTENTIAL FAILURE MODE	POTENTIAL EFFECT (S) OF FAILURE	SEVER (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE	OCCUR (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION	DETEC (R)	RPN	Azioni Correttive Previste			RPN PREVISTO				Azione correttive eseguite	RPN RAGGIUNTO			
Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	MODALITA' DEL GUASTO POTENZIALE	EFFETTO (I) POTENZIALE DEL GUASTO	GRAV. (G)	CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	PROB (P)	ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	RILEV (R)	RPN	Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	G	P	R	RPN	Azione Eseguita	G	P	R	RPN
			IMP.	SCREW THREAD TOO SHORT	NOT POSSIBILE TO CORRECT USE THE SCREW THREAD HOLE - SCRAP PART	3	ERRORE DI PRE-SETTING UTENSILE	7	CONTROL PLAN	3	63	INSERT ON THE MANAGEMENT CHAINGIN TOOL'S SCHEDULE AND APPLY AN LABEL SIGNED FOR THE CORRECT ESECUTION OF THE PRE'SETTING	MACHINING DEPARTMENT RESPONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	PRESENCE OF THE CHIPS IN THE BLIND HOLES	SCRAP PART	4	ELIMINATION OF THE CHIPS NOT CORRECT	7	COTNROL PLAN	3	84	MAKING TOOL WITH INTERNAL HIGH PRESSURE LUBRICATION TO ENSURE THE EVACUATION OF THE CHIP	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	MACHINIG NOT COMPLETE FOR OP 20	SCRAP PART	4	HANDLE MANAGEMNT OF THE CYCLE	7	CONTROL PLAN	3	84	PROCEDURE OF THE WORKSTATION FLOW MANAGEMENT DURING SPECIAL MAINTENANCE, CORRECTION AND START UP CYCLE TO BE WRITTEN	MACHINING DEPARTMENT RESPONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	SCRATCHES ON MACHINED SURFACES	SCRAP PART	4	MOVEMENT OF THE PIECE	7	CONTROL PLAN	4	112	MOVEMENT OF THE PIECE AND TIPPING STATION PLANNED IN ORDER TO PREVENT THE RISK OF COLLUSION DURING THE MOVEMENT OF THE PIECE	MACHINING DEPARTMENT RESPONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	NOT CORRECT PLACEMENT OF THE PIECE ON THE REFERENCES	LAVORAZIONE SCORRETTA PEZZO DI SCARTO	4	WRONG MACHINIG - SCRAP PART	5	CHECK THE PRESENCE OF THE PIECE BY USING THE REFERENCE "PEL" SYSTEM	2	40							0	ACTION DONE	0	0	0	0
			IMP.			7	INCORRECT PLACEMENT OF THE PIECE DONE BY THE WORKER	5	VISUAL CHECK	4	140	INSERT OF ANTI LOCK PINS FOR THE PLACEMENT OF THE PIECE	TECNOCONTROL	BEFORE PPAP	4	5	4	80	ACTION DONE	4	5	4	80
			IMP.		COLLUSIONS	4	FAILURE OF THE CHECK SYSTEM FOR THE PLACEMENT OF THE PIECE	5	CHECK THE PRESENCE OF THE PIECE BY USING THE REFERENCE "PEL" SYSTEM	2	40							0	ACTION DONE	0	0	0	0
			IMP.	INCORRECT LOCK OF THE PART DONE TOO STRONG	IMPROPER MACHINING PART DUE TO ELASTIC DEFORMATION	4	MANCATO FUNZIONAMENTO DELLA CENTRALINA IDRAULICA DELLE CHIUSURE PEZZO	5	MANTAINANCE SCHEDULE FOR THE TOOL	2	40							0	ACTION DONE	0	0	0	0
			IMP.	NON CORRETTO BLOCCAGGIO DELL' ELEMENTO TROPPO DEBOLE	LAVORAZIONE SCORRETTA DOVUTA AL MOVIMENTO DEL PEZZO DURANTE LA LAVORAZIONE	4	MANCATO FUNZIONAMENTO DELLA CENTRALINA IDRAULICA DELLE CHIUSURE PEZZO	5	MANTAINANCE SCHEDULE FOR THE TOOL	2	40							0	ACTION DONE	0	0	0	0
			IMP.			6	HUMAN MISTAKE AT THE BEGINING OF THE CYCLE FOR PLACEMENT OF THE PIECE	5	TRAINIG AND EDUCATION PROGRAMM FOR THE WORKER	4	120	MAKING PROPER INSTRUCTIONS TO PERFORM ALL CYCLE START ACTIVITIES	MACHINING DEPARTMENT RESONSABILE	BEFORE PPPA	4	5	4	80	ACTION DONE	4	5	4	80
			IMP.	DISTORTION OF THE PIECE DURRING CLAMPING	PLANARITY OUT OF TOLLERANCE - SCRAP PART	3	PART TOO MUCH CLAMPED-HYPERSTATIC	7	CALIBRATED HYDRAULIC CLAMPING DEVICES	3	63	CONTROL PLAN OF THE MAINTENANCE AND TOOLS CNC CHECK OF PROPER OPERATION AND ADJUSTMENT OF THE HYDRAULIC CLAMPING DEVICES	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.		SAFETY PART	☐ SI - YES / ☑ NO - NOT	POTENTIAL FAILURE MODE	POTENTIAL EFFECT (S) OF FAILURE	SEVER (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE	OCCUR (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION	DETEC (R)	RPN	Azioni Correttive Previste			RPN PREVISTO				Azione correttive eseguite	RPN RAGGIUNTO			
Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	MODALITA' DEL GUASTO POTENZIALE	EFFETTO (I) POTENZIALE DEL GUASTO	GRAV. (G)	CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	PROB (P)	ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	RILEV (R)	RPN	Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	G	P	R	RPN	Azione Eseguita	G	P	R	RPN
			IMP.	SCRATCHES OF THE TOOLS	ROUGHNESS OF THE SURFACE NOT IN CONFORMITY	3	TOOLS USED TOO MUSCH	7	AUTOMATIC MANAGEMNT OF THE TOOLS LIFE	3	63	STATISTICAL CHECK OF THE ROUGHNESS TO BE ADDED INTO THE CONTROL PLAN	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			4	INCLUSIONS IN THE RAW PART	7	COTNROL PLAN	4	112	MAKE SPECIFIC TOOLS FOR ALUMINUM CHIP REMOVAL	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.		BURRS OF MACHINING - SCRAP PART	4	FAILURE MAINTENANCE OF THE TOOL	7	COTNROL PLAN	4	112	BURRS ELIMINATION OPERATION AT HE END OF THE MACHINING	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	4	84	ACTION DONE	3	7	4	84
			IMP.			5	IMPROPER MANAGEMENT TOOL SHARPENING	4	SCHEDULED MAINTENANCE OF THE TOOLS	4	80							0	ACTION DONE	0	0	0	0
			IMP.	EDGE CHIPING TOOL	WRONG MACHINING HOLE DIAMETER OUT OF TOLERANCE SCRAP PART	3	TOOL WEARED	7	MANAGEMENT OF THE TOOL LIFE	3	63	STATISTICAL CHECK OF THE HOLES TO BE ADDED INTO THE CONTROLL PLAN	MACHINING DEPARTMENT RESONSABILE	[3	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			4	INCLUSIONS IN THE RAW PART	7	CONTROLL PLAN	4	112	MAKE SPECIFIC TOOLS FOR ALUMINUM CHIP REMOVAL	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			5	IMPROPER MANAGEMENT TOOL SHARPENING	4	SCHEDULED MAINTENANCE OF THE TOOLS	4	80							0	ACTION DONE	0	0	0	0
			IMP.	BREAKAGE OF THE DRILLING or BORING TOOL	HOLE NOT MACHINED SCRAP PART	4	TOOL WEARED	7	POKA-YOKE TO CHECK PRESENCE AND INTEGRITY OF THE TOOL INTO CNC	2	56							0	ACTION DONE	0	0	0	0
			IMP.	HOLE SMALLER HOLE BIGGER Ref.to THE DRW TOLERANCES	SCRAP PARTS	4	TOOL DIAMETER SMALLER or BIGGER	7	MANAGEMENT SPARE TOOLS AND PRESETTING	3	84	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	HOLE POSITION OUT OF TOLERANCE	SCRAP PARTS	3	WRONG POSITIONING OF THE PIECE IN THE REFERENCES DEVICE	4	CHECK THE PRESENCE OF THE PIECE BY USING THE REFERENCE "PEL" SYSTEM	3	36							0					0
			IMP.	0	0	3	MISTAKE IN THE PART PROGRAM	7	CONTROLL PLAN	4	84	PROCEDURE OF CNC PART-PROGRAM MANAGEMENT TO BE WRITTEN	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	4	84	ACTION DONE	3	7	4	84

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.

		SAFETY PART	☐ SI - YES / ☑ NO - NOT	POTENTIAL FAILURE MODE	POTENTIAL EFFECT (S) OF FAILURE	SEVER (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE	OCCUR (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION	DETEC (R)	RPN	Azioni Correttive Previste			RPN PREVISTO				Azione correttive eseguite	RPN RAGGIUNTO			
Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	MODALITA' DEL GUASTO POTENZIALE	EFFETTO (I) POTENZIALE DEL GUASTO	GRAV. (G)	CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	PROB (P)	ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	RILEV (R)	RPN	Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	G	P	R	RPN	Azione Eseguita	G	P	R	RPN
			IMP.	0	0	3	DEFLECTION OF THE TOOLS	7	CONTROLL PLAN	3	63	CENTERING HOLES OPERATION TO BE ADDED TO AVOID DEFLECTION OF THE TOOLS	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	0	0	3	WRONG PRE-SETTING OF THE TOOLS	7	CONTROLL PLAN	3	63	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	FORM & GEOMETRIC TOLERANCES OUT OF RANGE	SCRAP PARTS	3	TOOLS FORM NOT IN Acc.To THE DRAWING DIMENSIONING	7	CONTROLL PLAN	3	63	SPECIFIC LONG LIFE TOOLS FOR ALUMINIUM MACHING TO BE CREATED	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	0	0	3	WRONG PRE-SETTING OF THE TOOLS	7	CONTROLL PLAN	3	63	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	0	0	3	DEFLECTION OF THE TOOLS	7	CONTROLL PLAN	3	63	CENTERING HOLES OPERATION TO BE ADDED TO AVOID DEFLECTION OF THE TOOLS	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	0	0	3	VIBRATION OF THE PIECE	7	CONTROLL PLAN	3	63	ANTI-VIBRATING DEVICES TO BE ADDED ON CLAMPING FIXTURES	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	BREAKAGE OF THE THREADED TOOL	THREADED HOLE NOT MACHINED SCRAP PART	4	TOOL WEARED	7	POKA-YOKE TO CHECK PRESENCE AND INTEGRITY OF THE TOOL INTO CNC	2	56	0		0				0					0
			IMP.	TAPPING SHORT	FAILURE TO FUNCTION OF THE THREADED HOLE SCRAP PART	3	WRONG PRE-SETTING OF THE TOOL	7	CONTROLL PLAN	3	63	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	CORE DIAMETER BIGGER	SEAL FAILURE OF THREAD SCRAP PART	4	DRILLED PRE-HOLE BIGGER	7	CONTROLL PLAN	3	84	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	MACHINING DEPARTMENT RESONSABILE	set-08	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	CORE DIAMETER SMALLER	IMPOSSIBLE OPERATION OF FIXING SCRAP PART	3	THREADER TOOL WEARED	7	MANAGEMENT OF THE TOOL LIFE	3	63	STATISTICAL CHECK OF THE THREADED HOLES TO BE ADDED INTO THE CONTROLL PLAN	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.			3		7	MANAGEMENT SPARE TOOLS AND PRESETTING	3	63	ADD INTO THE "MANAGEMENT SPARE TOOLS AND PRESETTING APPLICATION" LABEL WITH SIGNATURE OF VALIDATION OF THE CORRECT EXECUTION OF PRESETTING OPERATION	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63

P.F.M.E.A. Process Failure Mode and Effect Analysis

Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.

Rif. Op. Ciclo	Descrizione Operazione Ciclo	SAFETY PART Caratteristica Coinvolta	SI - YES / NO - NOT Class. Caratteristica	POTENTIAL FAILURE MODE MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) RILEV (R)	RPN	Azioni Correttive Previste Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO G	P	R	RPN	Azione correttive eseguite Azione Eseguita	RPN RAGGIUNTO G	P	R	RPN
			IMP.	CHIPS INSIDE THE BLIND HOLES	SCRAP PARTS	4	EVACUATION CHIPS NOT ADEQUATE	7	CONTROL PLAN	3	84	MAKING TOOLS WITH INTERNAL HIGH PRESSURE LUBRICATION TO DISCHARGE CHIPS	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	PARTIAL MACCHINING IN OP.10	SCRAP PARTS	4	MANUAL CYCLE MANAGEMENT	7	CONTROL PLAN	3	84	PROCEDURE OF THE WORKSTATION FLOW MANAGEMENT DURING SPECIAL MAINTENANCE, CORRECTION AND START UP CYCLE TO BE WRITTEN	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	STOP OF THE CNC MACHINE	PRODUCTION RATE SLOWED DOWN	4	PLACEMENT PICES WRONG ON FIXTURE	6	VISUAL CHECK	3	72	INSERT ANTI EROOR S DO SYSTEM FOR ANTI-ARROR PLACEMENT FOR THE RAW PART ON THE LOADING STATION	TECNOCONTROL	BEFORE PPAP	2	6	3	36	ACTION DONE	2	6	3	36
			IMP.			3	DETECTORS FOR PICES NOT WORKING	6	VISUAL CHECK	3	54	INSERIRE ALLARME TO IDENTIFY THE INCORRECT FUNCION OF THE SENSORS	TECNOCONTROL	BEFORE PPAP	3	6	3	54	ACTION DONE	3	6	3	54
			IMP.	STOP OF THE CNC MACHINE	PRODUCTION RATE SLOWED DOWN	4	PLACEMENT OF THE PIECE ON THE LOADING STATION NOT IN CONFORMITY	6	VISUAL CHECK	3	72	DO ANTI-ERROR SYSTEM FOR THE PLACEMENT OF THE PIECE	TECNOCONTROL	BEFORE PPAP	2	6	3	36	ACTION DONE	2	6	3	36
			IMP.			3	PRESENCE DETECTION SENSORS FOR THE PART THAT DO NOT WORK	6	VISUAL CHECK	3	54	INSERT ALLARM TO IDENTIFY THE MALFUNCTION OF HTE SENSORS	TECNOCONTROL	BEFORE PPAP	3	6	3	54	ACTION DONE	3	6	3	54
			IMP.	OXIDATIONS OF THE PARTS	SCRAP PARTS	3	WASHING LIQUID NOT CORRECT	6	SCHEDULED MAINTENANCE PLAN	3	54	I WRITE ON CONTROL PLAN TO CHECK THAT THE OXIDATION IS NOT PRESENT		BEFORE PPAP	3	6	3	54	ACTION DONE	3	6	3	54
			IMP.	PIECES THAT HAVE CHIPS FROM MACHINING (NOT CORRECTLY	SCRAP PARTS	3	FILTER TUB WASHING LIQUID	6	SCHEDULED MAINTENANCE PLAN	4	72	WRITE ON THE CONTROL PLAN THE CHECK OF THE CONTAMINATION OF THE PART	MACHINING DEPARTMENT RESONSABILE	BEFORE PPAP	3	6	4	72	ACTION DONE	3	6	4	72
			IMP.			3		6		4	72	INSERT ERROR SIGNAL FOR THE CHANGE OF THE FILTERS	TRITON	BEFORE PPAP	3	6	3	54	ACTION DONE	3	6	3	54
			IMP.	PIECE TOO WARM (T> 20% Tamb)	RESULT OF THE LEAKEAGE TEST NOT CORRECT	3	POSTION OF THE PIECE IN THE WASHING MACHINE < 10 MIN	6	AUTOMATIC CYCLE FOR THE PART	7	126	CHECK THE POSSIBILITY TO INSERT A SENSOR FOR THE TEMPERATURE OF THE PIECE	TECNOCONTROL	BEFORE PPAP	3	6	3	54	ACTION DONE	3	6	3	54
			IMP.	NICK | STRIPES ON MACHINED SURFACE	SCRAP PART	4	MOVEMENT OF THE PIECE	7	CONTROL PLAN	3	84	THE PLACEMENT OF THE PIECE IN ORDER TO ELIMINATE THE RISCK OF COLLISION	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63

P.F.M.E.A. Process Failure Mode and Effect Analysis

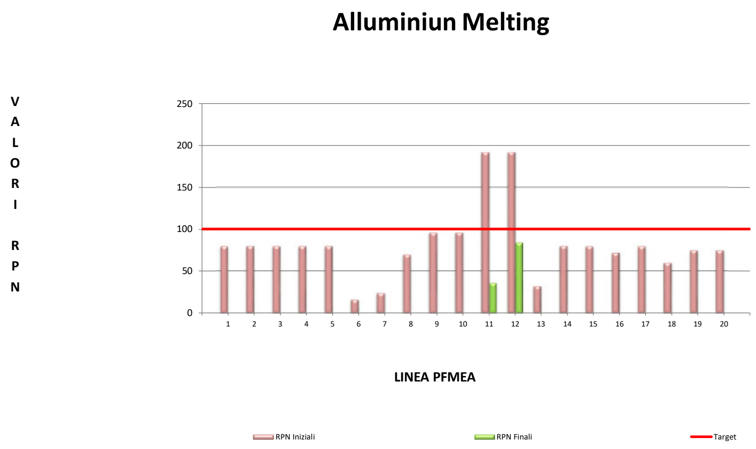
Analisi dei Modi e degli Effetti di Guasto del Processo

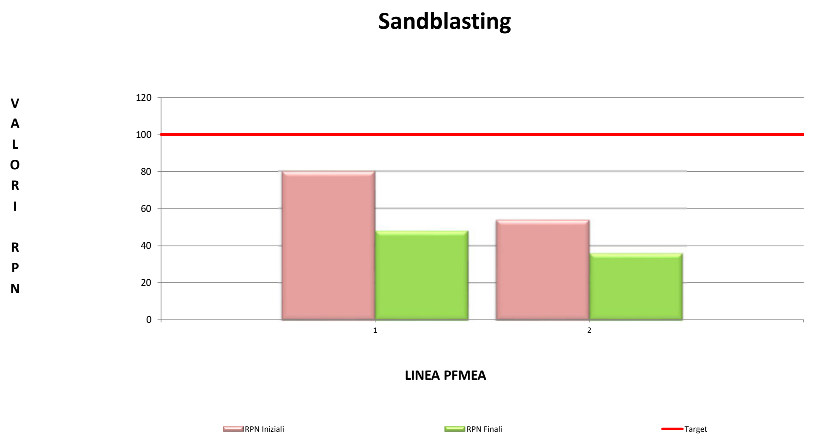
Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta (SAFETY PART)	Class. Caratteristica (SI - YES / NO - NOT)	POTENTIAL FAILURE MODE / MODALITA' DEL GUASTO POTENZIALE	POTENTIAL EFFECT (S) OF FAILURE / EFFETTO (I) POTENZIALE DEL GUASTO	SEVER (G) / GRAV. (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE / CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	OCCUR (P) / PROB (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION / ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	DETEC (R) / RILEV (R)	RPN	Azioni Correttive Previste: Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	RPN PREVISTO: G	P	R	RPN	Azione correttive eseguite: Azione Eseguita	RPN RAGGIUNTO: G	P	R	RPN
			IMP.			4		7		3	84	DO THE TOOLS FOR THE PLACEMENT AND THE PICK OF THE PIECE FROM THE STATION WITH ANTI-SHOCK PROTECTION	TECNOCONTROL	BEFORE PPAP	3	7	3	63	ACTION DONE	3	7	3	63
			IMP.	LATCH SYSTEM	PRODUCTION RATE SLOWED DOWN	4	PLACEMENT OF THE PIECE NOT CORRECTELU	6	VISUAL CHECK	3	72	DO ANTI-ERROR SYSTEM FOR THE PLACEMENT OF THE PIECE	TECNOCONTROL	BEFORE PPAP	2	6	3	36	ACTION DONE	2	6	3	36
			IMP.			3	PRESCENS SENSORS NOT WORKING	6	VISUAL CHECK	3	54	HAVE AN ALARM TO IDENTIFY MALFUNCTION FO THE SENSOR	TECNOCONTROL	BEFORE PPAP	3	6	3	54	ACTION DONE	3	6	3	54
			IMP.	MISSING THE COMPONENTS	SCRAP PART	6	NOT DONE BY THE WORKER	6	COTNROL PLAN	4	144	PRECONT COMPONET FOR THE COMPSUNTION ONE PALLET	SUPPLIER	26/09/2018	2	6	3	36	ACTION DONE	2	6	3	36
			IMP.	MISSING PINS	SCRAP PARTS	4	PROCESS ERROR	7	VISUAL CHECK	3	84	PRECONT COMPONET FOR THE COMPSUNTION ONE PALLET	SUPPLIER	26/09/2018	2	7	3	42	ACTION DONE	2	7	3	42
			IMP.	WRONG PINS POSITION	SCRAP PARTS	4	PROCESS ERROR	7	VISUAL CHECK	3	84	POKA YOKE	SUPPLIER	BEFORE PPAP	1	7	3	21	ACTION DONE	1	7	3	21
			IMP.	MISSING PLATE	SCRAP PARTS	4	PROCESS ERROR	7	VISUAL CHECK	3	84	PRECONT COMPONET FOR THE COMPSUNTION ONE PALLET	SUPPLIER	BEFORE PPAP	2	7	3	42	ACTION DONE	2	7	3	42
			IMP.	MISSING SCREW	SCRAP PARTS	4	PROCESS ERROR	7	VISUAL CHECK	3	84	PRECONT COMPONET FOR THE COMPSUNTION ONE PALLET	SUPPLIER	BEFORE PPAP	2	7	3	42	ACTION DONE	2	7	3	42
			IMP.	WRONG TORQUE SCREW	SCRAP PARTS	6	SCREWDRIVER NOT CALIBRATED	7	VISUAL CHECK	4	168	PERIODIC CHECK OF SCREWER CALIBRATION	SUPPLIER	BEFORE PPAP	3	7	4	84	ACTION DONE	3	7	4	84
			IMP.	NOT RESPECTED ALL THE CLIENT REQUIRMENTS	SCRAP PART	4	PROCESS ERROR	6	CONTROL PLAN	4	96	MANAGMENT OF NOT RESPECTED REQUIRMENTS	QUALITY RESPONSABILE	PRODUCTION	4	6	3	72	ACTION DONE	4	6	3	72
			IMP.	NICK | STRIPES ON MACHINED SURFACE	SCRAP PART	3	PACKAGING OPERATION NOT CARRIED OUT ACCORDING TO SPECIFIC	5	CONTROL PLAN	4	60	HAVE A SCHEDULE FOR THE TRAINING OF THE WORKERS DONE BETTER	QUALITY RESPONSABILE	BEFORE PPAP	3	5	3	45	ACTION DONE	3	5	3	45

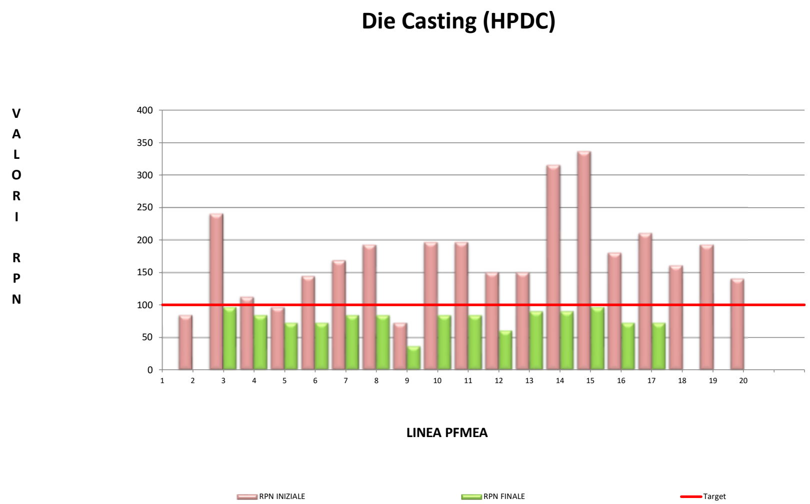
P.F.M.E.A. Process Failure Mode and Effect Analysis

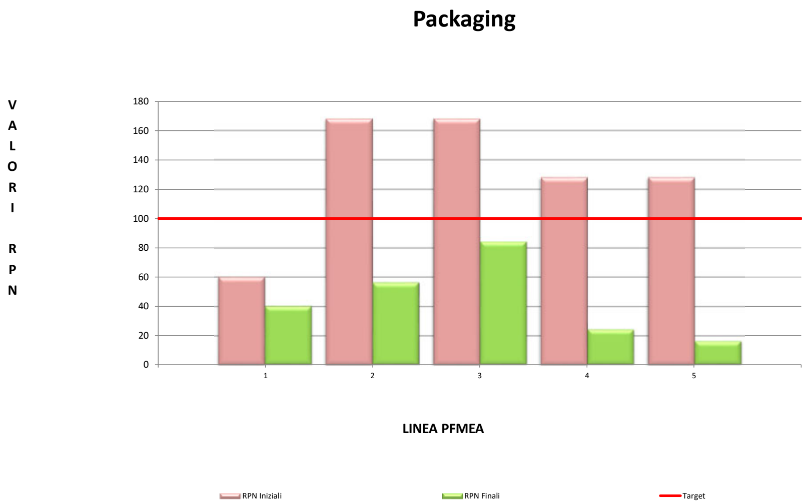
Analisi dei Modi e degli Effetti di Guasto del Processo

2a S.p.A.		SAFETY PART	☐ SI - YES ☑ NO - NOT	POTENTIAL FAILURE MODE	POTENTIAL EFFECT (S) OF FAILURE	SEVER (G)	POTENTIAL CAUSES (S) MECHANISM (S) OF FAILURE	OCCUR (P)	CURRENT PROCESS CONTROL PREVENTION DETECTION	DETEC (R)	RPN	Azioni Correttive Previste			RPN PREVISTO				Azione correttive eseguite	RPN RAGGIUNTO			
Rif. Op. Ciclo	Descrizione Operazione Ciclo	Caratteristica Coinvolta	Class. Caratteristica	MODALITA' DEL GUASTO POTENZIALE	EFFETTO (I) POTENZIALE DEL GUASTO	GRAV. (G)	CAUSE \ MECCANISMI POTENZIALI DEL GUASTO	PROB (P)	ATTUALI MEZZI DI CONTROLLO PREVENZIONE E RILEVAZIONE DEL GUASTO	RILEV (R)	RPN	Azione Correttiva	Responsabile gestione Azione Correttiva	Data di Implementazione	G	P	R	RPN	Azione Eseguita	G	P	R	RPN
			IMP.	CORRECT DDT (SHIPMENT DOCUMENT)	THE DATA ON THE SHIPMENT DOCUMENT NOT IDENTIFY THE CORRECT MATERIAL	2	HUMAN MISTAKE WHEN THE DDT IS WRITTEN	5	VISUAL CHECK	3	30							0	ACTION DONE	0	0	0	0
140	SPEDIZIONE			MANCANZA DI AVVISO PER IDENTIFICARE IL PARTICOLARE	IDENTIFICAZIONE ERRATA DEL PARTICOLARE	4	ERRATA PROCEDURA DI ETICHETTATURA PER LA SPEDIZIONE-NESSUN NUOVO CODICE INSERITO A SISTEMA PER LA FASE IN QUESTIONE	5	CONTROLLO VISIVO	5	100	ISTRUZIONI OPERATIVE PER L'OPERATORE IN ACCETTAZIONE ARRIVI-CORRETTO INSERIMENTO DEI PARTICOLARI A SISTEMA PER OGNI FASE DEL PROCESSO	LOGISTICA	PRIMA DELLA PROVA STAMPO	2	5	5	50	CODICI E FASI DEL PROCESSO BENDEFINITE				0
150-160	COLLAUDO/ STOCCAGGIO			MANCANZA DI AVVISO PER IDENTIFICARE IL PARTICOLARE	IMPOSSIBILITA' DI TROVARE IL PARTICOLARE	4	ERRORE UMANO	5	CONTROLLO VISIVO	3	60	ISTRUZIONI OPERATIVE PER L'OPERATORE IN ACCETTAZIONE ARRIVI	LOGISTICA	ENTRO PRIMA PROVA STAMPO	3	5	3	45		3	5	3	45
310	IMBALLO		IMP.	AMMACCATURE DEFORMAZIONE DI SUPERFICI O PIANI	PEZZO DI SCARTO	3	OPERAZIONE D'IMBALLAGGIO NON ESEGUITA SECONDO SPECIFICA	5	PIANO DI CONTROLLO	4	60	RINFORAZARE PIANO DI FORMAZIONE DEL PERSONALE	QUALITA'	ENTRO PROD SERIE	2	5	4	40	INSERITO GESTIONE IMBALLO SU CICLO DI LAVORO	2	5	4	40
			IMP.	DEFORMAZIONE GEOMETRIA	PERDITA FUNZIONALITA'	6	MANIPOLAZIONE PARTICOLARI	7	PIANO DI CONTROLLO	4	168	PER TUTTI I CODICI REVISIONE PROPOSTA IMBALLO CLIENTE	QUALITA'	ENTRO PROD SERIE	2	7	4	56	INSERITO GESTIONE IMBALLO SU CICLO DI LAVORO	2	7	4	56
			IMP.	AMMACCATURE	ESTETICO NON CONFORME	6	MANIPOLAZIONE PARTICOLARI	7	PIANO DI CONTROLLO	4	168	IMPLEMENTARE ISTRUZIONE PER MANIPOLAZIONE PARTICOLARI	UFF. TECNICO	ENTRO PROD SERIE	4	7	3	84	INSERITO GESTIONE IMBALLO SU CICLO DI LAVORO	4	7	3	84
310	DELIVERY		IMP.	CONSEGNA IN IMBALLO NON CONFORME	POTENZIALE DEFORMAZIONE PEZZO + SCARTO DA CLIENTE	8	ERRATA ESECUZIONE ISTRUZIONI DI IMBALLO	4	PIANO DI CONTROLLO	4	128	IMPLEMENTARE ISTRUZIONI IMBALLO	UFF. TECNICO	ENTRO PROD SERIE	3	4	2	24	IMPLEMENTARE ISTRUZIONI IMBALLO	3	4	2	24
			IMP.			8	ERRATO INSERIMENTO DOCUMENTAZIONE RICHIESTA DA CLIENTE PER IMBALLO	4	PIANO DI CONTROLLO	4	128	IMPLEMENTARE ISTRUZIONI IMBALLO + FORMAZIONE PERSONALE ADDETTO	UFF. TECNICO	ENTRO PROD SERIE	2	4	2	16	IMPLEMENTARE ISTRUZIONI IMBALLO + FORMAZIONE PERSONALE ADDETTO	2	4	2	16


Alluminiun Melting
VALORI RPN
LINEA PFMEA
RPN Iniziali
RPN Finali
Target


Sandblasting
VALORI RPN
LINEA PFMEA
RPN Iniziali
RPN Finali
Target


Die Casting (HPDC)
VALORI RPN
LINEA PFMEA
RPN INIZIALE
RPN FINALE
Target


Packaging
VALORI RPN
LINEA PFMEA
RPN Iniziali
RPN Finali
Target

Annexure No 6

2a S.p.A.

PIANO DI CONTROLLO
(CONTROL PLAN)

ID. Piano di Controllo *(ID. Control Plan)*	**699**

Dati Prodotto
(Product data)

Cliente *(Customer)*	A GERMAN COMPANY-Cannot Dis-close		
Denominazione prodotto *(Part Name)*	FLYWHEEL HOUSING		
Codice cliente *(Part Number)*	51.01401-5637	***Indice di revisione*** *(Issue\Revision)*	9
Numero Disegno *(Drawing Number)*	2754824	***Indice di revisione*** *(Issue\Revision)*	9
Codice Interno - 2a Spa *(Internal Code - 2a Spa)*	MNA2354824		

Particolare di Sicurezza *(Safety Part)*	***Si*** *(Yes)*	***No*** *(Not)*	***Gestione di tutte le caratteristiche*** *(Management of all characteristics)*	***Si*** *(Yes)*	***No*** *(Not)*
		X		X	

Livello di qualificazione del Piano di Controllo
(Control Plan Qualification Status)

Prototipi *(Prototype)*		***Preserie*** *(Pre-launch)*		***Produzione*** *(Production)*	X

Revisione \ Aggiornamento
(Revison \ Update)

Ind. Rev. *(Issue Rev.)*	**Data** *(Date)*	**Motivazione della modifica** *(Cause of update)*
0	26/02/2024	DATA PRIMA COMPILAZIONE

Rilascio
(Release)

	Nome - Dipartimento *(Name - Department)*	**Firma** *(Signature)*
Compilato da: *(Filling by:)*	M. Montaldi	Montaldi Matteo
Validato da *(Validation by:)*	G. Braconcini	
Approvato da: *(Approval by:)*	S. Lia	

Distribuzione & Archiviazione
(Distribution & Storage)

	Stabilimento *(Plant)* Stb. Santena *(Santena Plant)*	Stb Villastellone *(Villastellone Plant)*	Stb. Borgaro *(Borgaro Plant)*
Applicazione *(Application)*	X		
Distribuzione *(Distribuition)*	X	X	
Archiviazione *(Storage)*	X		

CONTROL PLAN COMPLETO
(COMPLETE CONTROL PLAN)

2a S.p.A.

ID. Piano di Controllo *(ID. Control Plan)* **699** ***Revisione*** *(Revision n°)* **0**

ID Op	Descrizione Op. Processo Title Process Op	Elenco Caratteristiche da controllare List of the parameter to check				IGC	METODO Method					PIANO DI REAZIONE REACTION PLAN
		n°		Caratteristica di Prodotto Product Characteristic Pd	Caratteristica di Processo Process Characteristic Pc		Rif. per valutazione Rif. for evaluation	Strumento Measurement Equip.	Frequenza di controllo Frequency of check		Registraz. Recording	
		Pd.	Pc.						Quando When	Quanto How		
10	*A.A.M.P. (Acceptance of raw material) (Ingot of Alluminium EN AC 46000)*		*1*		*PRESENCE OF CERTIFICATION OF THE SUPPLIER*	*IMP*	PROCEDURE A3.6.3- ACCORDING TO THE STD. UNI EN 1706	*VISUAL*	*100%*	*EVERY BATCH*	*DOSSIER A.A.M.P.*	*PROCEDURE A3.6.6 - PROCEDURE A3.6.6.1 - PROCEDURE A8*
			2		*CONFORMITY OF THE PACKAGING*	*IMP*	PROCEDURE A3.6.3- ACCORDING TO THE SUPPLY CONTRACT	*VISUAL*	*100%*	*EVERY BATCH*	*DOSSIER A.A.M.P.*	*PROCEDURE A3.6.6 - PROCEDURE A8*
			3		*PAINT IDENTIFICATION OF THE ALLOY*	*IMP*	*EN AC 46000 (YELLOW)*	*VISUAL*	*100%*	*EVERY BATCH*	*DOSSIER A.A.M.P.*	*PROCEDURE A8*
			4		*LABEL IDENTIFICATION OF THE ALLOY*	*IMP*	PROCEDURE A3.6.3- PRESENCE OF IDENTIFICATION LABEL WITH BATCH NUMBER	*VISUAL*	*100%*	*EVERY BATCH*	*DOSSIER A.A.M.P.*	*PROCEDURE A3.6.6 - PROCEDURE A8*
20	*VERIFICATION OF ALLOY*	*1*		*CHEMICAL COMPOSITION*		*IMP*	PROCEDURE A3.6.4- VERIFICATION OF THE CHEMICAL COMPOSITION OF THE INGOTS ACCORDING TO THE STD EN 1706	*SPECTROMETER*	*1 SAMPLE*	*EVERY N° OF BATCH*	*OK/KO*	*PROCEDURE A3.6.7 - PROCEDURE A8*
30	*ALLOY STORAGE*		*1*		*STORAGE IN THE SPECIFIC AREA*	*IMP*	*PROCEDURE A3.6.4*				*OK/KO*	*PROCEDURE A8*
40	*MELTING ALLOY*		*1*		*TEMPERATURE OF FLUID MOLTEN POOL (710±10°)*	*IMP*	*PROCEDURE P1.6.1.1*	*PYROMETER*		*EVERY TIME*	*DOSSIER R.R.F.M.*	*PROCEDURE A8*

ID Op	Descrizione Op. Processo Title Process Op	Elenco Caratteristiche da controllare List of the parameter to check n° Pd.	Pc.	Caratteristica di Prodotto Product Characteristic Pd	Caratteristica di Processo Process Characteristic Pc	IGC	METODO Method Rif. per valutazione Rif. for evaluation	Strumento Measurement Equip.	Frequenza di controllo Frequency of check Quando When	Quanto How	Registraz. Recording	PIANO DI REAZIONE REACTION PLAN
			2		REGISTRATION DATA ALLOY	CR	PROCEDURE P1.6.2.1.1			EVERY TIME	DOSSIER R.C.F.	PROCEDURE A8
			3		SCORIFICATION (~700°C)	CR	PROCEDURE P1.6.2.3	VISUAL	1 TIME	EVERY 8 HOURS	DOSSIER R.R.F.M.	PROCEDURE A8
			4		DEGASING OF FLUID MOLTEN POOL	CR	PROCEDURE P1.6.2.3		1 TIME	EVERY 8 HOURS	DOSSIER R.R.F.M.	PROCEDURE A8
		5		CHEMICAL COMPOSITION Alluminium EN AC 46000		IMP	INSTRUCTION N°53	SPECTROMETER	1 TIME	EVERY 8 HOURS	VARIABLE	PROCEDURE A8
45	LEAD ALLOY		1			IMP	PROCEDURA P1.6.2.5			EVERY TIME		
50	UPKEEP MELTING		1		TEMPERATURE OF FLUID MOLTEN POOL (660-680°C)	IMP	PROCEDURE P1.6.3.1	PYROMETER		EVERY TIME	DOSSIER R.F.A.A.	PROCEDURE A8
			2		SCORIFICATION (~700°C)	CR	PROCEDURE P1.6.2.3	VISUAL	1 TIME	EVERY DAY	DOSSIER R.F.A.A.	PROCEDURE A8
			3		DEGASING OF FLUID MOLTEN POOL	CR	PROCEDURE P1.6.2.3		1 TIME	EVERY DAY	DOSSIER R.F.A.A.	PROCEDURE A8
		4		CHEMICAL COMPOSITION Alluminium EN AC 46000		IMP	INSTRUCTION N°53	SPECTROMETER	1 TIME	EVERY 8 HOURS	VARIABLE	PROCEDURE A8
			6		CLEANING	IMP	ISTR.202 /BIS	VISUAL		EVERY 2 HOURS	DOSSIER RA1	

ID Op	Descrizione Op. Processo Title Process Op	Elenco Caratteristiche da controllare List of the parameter to check n° Pd.	n° Pc.	Caratteristica di Prodotto Product Characteristic Pd	Caratteristica di Processo Process Characteristic Pc	IGC	METODO Method Rif. per valutazione Rif. for evaluation	Strumento Measurement Equip.	Frequenza di controllo Frequency of check Quando When	Quanto How	Registraz. Recording	PIANO DI REAZIONE REACTION PLAN
60	*DIE CASTING*		*1*		*SETTING MACHINE PARAMETERS*	*IMP*	*PROCEDURE P2.7.1*	*PLC EQUIPMENT*	*1° TIME*	*EVERYDAY*	*DOSSIER R.P.S AND R.P.S.P.L.C*	*PROCEDURE P2.7.2 AND P2.7.4*
			2		*CONTROL MACHINE PARAMETERS*	*IMP*	*PROCEDURE P2.8.1*	*VISUAL*	*1° TIME*	*EVERYDAY*	*DOSSIER RA1*	*PROCEDURE A8*
		3			*CONTROL START MACHINE*	*IMP*	*ISTR. 502*	*VISUAL*		*EVERY TIME NEW PRODUCTION*	*DOSSIER RA1*	*PROCEDURE A8*
70	*TRIMMING TRANCIATURA*		*1*		*PREVENTIVE MAINTENANCE*	*IMP*	*PROCEDURE P4*	*VISUAL*		*EACH START PRODUCTION*	*RMS*	*PROCEDURE A8*
80	*PRODUCTION QUALITY CHECK*		*1*		*START PRODUCTION APPROVAL*	*IMP*	*ISTR. 54*	*VISUAL Xray room Gauge and Caliper*	*1° TIME 3 Parts*	*EVERY SOP*	*DOSSIER RA1*	*PROCEDURE A8*
		1		*VISUAL CHECK*	*SEE: ISTR_AUT_AI01 AND ISTR_CV_AI02 AND PROCEDURE A6.6.2*							
		2		*XRAY INSPECTION*	*ISTR_CV_AI02 AND PROCEDURE A6.6.3*							
		3		*DIMENSIONAL CHECK*	*ISTR_CV_AI02 AND PROCEDURE A6.6.3*							
		4		*PRODUCT IDENTIFICATION*		*IMP*	*PROCEDURE L2.6*	*VISUAL*	*100%*	*EACH PALLET*	*DOSSIER COLORED PAPER*	*PROCEDURE A8*
90	*INTERNAL OPERATION (SHOT BLASTING + DEBURRING)*	*1*		*ABSENCE OF FLASHES ASSENZA BAVE*		*IMP*	*REF. SAMPLE*	*VISUAL*	*100%*	*EVERY PALLET OGNI PEDANA*	*OK/KO*	*PROCEDURE A8*

ID Op	Descrizione Op. Processo Title Process Op	Elenco Caratteristiche da controllare List of the parameter to check				IGC	METODO Method					PIANO DI REAZIONE REACTION PLAN
		n°		Caratteristica di Prodotto Product Characteristic Pd	Caratteristica di Processo Process Characteristic Pc		Rif. per valutazione Rif. for evaluation	Strumento Measurement Equip.	Frequenza di controllo Frequency of check		Registraz. Recording	
		Pd.	Pc.						Quando When	Quanto How		
		2		ABSENCE OF SAND INTERNAL OF BLIND HOLE ASSENZA DI SABBIA INTERNO FORI CIECHI		IMP	REF. SAMPLE	VISUAL	100%	EVERY PALLET OGNI PEDANA	OK/KO	PROCEDURE A8
100	PRODUCTION QUALITY CHECK CONTROLLO QUALITA' PRODUZIONE		1	SEE: ISTR_CV_SHOT-BLASTING								
110	PART STORAGE		1		PACKAGING	IMP	PROCEDURE L2.5.6	VISUAL	100%	EACH PALLET	DOSSIER S.I.	PROCEDURE A8
			2		QUALITATIVE ANALYSIS CONTAINER	IMP	PROCEDURE L2.5.4	VISUAL	100%	EACH PALLET	OK/KO	PROCEDURE A6 AND PROCEDURE A8 AND PROCEDURE L2.5.4.1
			3		STORAGE IN THE SPECIFIC AREA	IMP	PROCEDURE L2.12	VISUAL	100%	EACH PALLET	OK/KO	PROCEDURE A8
120	SHIPMENT		1		PRESENCE OF THE DELIVERY NOTE	IMP	PROCEDURE L2.8	VISUAL	100%	EVERY BATCH	OK/KO	PROCEDURE A8
130	MACHINING	1		SEE: CP_MACHINING SUPPLIER								
140	SHIPMENT		1		PRESENCE OF THE DELIVERY NOTE	IMP	PROCEDURE L2.8	VISUAL	100%	EVERY BATCH	OK/KO	PROCEDURE A8
150	PRODUCTION QUALITY CHECK	1		ISTR_AA 1_AI03								
160	PART STORAGE		1		PACKAGING	IMP	PROCEDURE L2.5.6	VISUAL	100%	EACH PALLET	DOSSIER S.I.	PROCEDURE A8

ID Op	Descrizione Op. Processo Title Process Op	Elenco Caratteristiche da controllare List of the parameter to check				IGC	METODO Method					PIANO DI REAZIONE REACTION PLAN
		n°							Frequenza di controllo Frequency of check			
		Pd.	Pc.	Caratteristica di Prodotto Product Characteristic Pd	Caratteristica di Processo Process Characteristic Pc		Rif. per valutazione Rif. for evaluation	Strumento Measurement Equip.	Quando When	Quanto How	Registraz. Recording	
			2		*QUALITATIVE ANALYSIS CONTAINER*	*IMP*	*PROCEDURE L2.5.4*	*VISUAL*	*100%*	*EACH PALLET*	*OK/KO*	*PROCEDURE A6 AND PROCEDURE A8 AND PROCEDURE L2.5.4.1*
			3		*STORAGE IN THE SPECIFIC AREA*	*IMP*	*PROCEDURE L2.12*	*VISUAL*	*100%*	*EACH PALLET*	*OK/KO*	*PROCEDURE A8*
310	*DELIVERY TO CUSTOMER*		1		*DELIVERY TO CLIENT*	*IMP*	*PROCEDURE L2.8*	*VISUAL*	*200%*	*EVERY BATCH*	*OK/KO*	*PROCEDURE A9*