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Improvement of Project Management Practices: A Car Industry Case Study

Master Dissertation

Integrated Master of Industrial Engineering and Management

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ABSTRACT

The present master dissertation project was developed on a competence center (MFT3 section) at Bosch Car Multimedia in Braga. It has as main objective the improvement of project management practices in order to enhance the performance of this particular section in the organization, translated into a set of four sub-objectives: 1) redefinition of an integrated project management process; 2) definition of a template for project planning supported with Work Breakdown Structure (WBS) tool; 3) customization of a software tool to support the project management process; and 4) development of a performance measurement system.

Firstly, a literature review was performed in order to understand which project management improvements could be proposed to MFT3 section at Bosch Car Multimedia in Braga. Important subjects were studied, such as organizational project management, including project, program and portfolio management; project planning and WBS; tools to support project and portfolio management; and project management success through performance measurement systems. Secondly, having a better theoretical knowledge about project management approaches, some improvements were proposed to accomplish the project's dissertation objectives. The software customized to support the project management process was the software Track&Release which integrates the WBS template and improves time tracking, the visualization of every activity with its respective status, planning, prioritization of work and communication as well as decreases unproductive time and misunderstandings through organization of all team work. The Track&Release also allows data extraction in order to have relevant information to create interesting performance measurement indicators graphics. These graphics were created through an EXCEL file developed to transform the data from Track&Release to well-established key performance indicators graphics.

Besides some difficulties on this research, namely the totally new environment for the researcher and the lack of time of Bosch collaborators, the established objectives were fulfilled and there was a significant contribution to the improvement of project management practice to MFT3 section at Bosch Car Multimedia in Braga, which makes this master dissertation project a successful one.

KEYWORDS

Project Management, Portfolio Management, WBS, Project Management tools, Performance Measurement System

RESUMO

A presente dissertação de mestrado foi desenvolvida no Centro de Competências de montagem de PCBs (secção MFT3) da *Bosch Car Multimedia* em Braga. A fim de melhorar o desempenho e organização desta secção, foi proposto como principal objetivo a melhoria das práticas de gestão de projetos, subdividindo este em quatro objetivos mais específicos: 1) redefinição do processo de gestão de projetos integrado; 2) definição de um *template* de planeamento de projetos apoiado pela ferramenta *Work Breakdown Structure* (WBS); 3) customização de um *software* para suporte da gestão de projetos; e 4) desenvolvimento de um sistema de medição de desempenho.

Inicialmente foi realizada uma revisão da literatura de modo a apurar quais as melhorias que poderiam ser propostas à secção MFT3 da *Bosch Car Multimedia* em Braga. Vários assuntos foram estudados, tais como, organização da gestão de projetos, incluindo gestão de projeto, programa e portefólio; planeamento de projetos e WBS; ferramentas de apoio à gestão de projetos e portefólio; e sucesso aplicado à gestão de projetos por meio de sistemas de medição de desempenho.

Após um conhecimento teórico mais sólido, foram propostas algumas melhorias para alcançar os objetivos do projeto de dissertação. Deste modo, o *software* personalizado para suportar o processo de gestão de projetos foi o *Track&Release* que integra o *WBS template* e acrescenta melhorias a nível do controlo de tempo, visualização de todas as atividades com seu respetivo *status*, planeamento, priorização de trabalho e comunicação, assim como diminui o tempo improdutivo e equívocos através da organização de todo o trabalho da equipa. O *Track&Release* também permite a extração de dados a fim de ter informações relevantes para criar gráficos de medição de indicadores de desempenho. Estes gráficos são criados através de um ficheiro de EXCEL desenvolvido para transformar os dados do *Track&Release* nos gráficos predefinidos.

Apesar das dificuldades encontradas, nomeadamente a pouca experiência do investigador e a falta de tempo dos colaboradores da Bosch, os objetivos estabelecidos foram cumpridos e houve uma contribuição significativa para a melhoria da prática de gestão de projetos para a seção MFT3 na *Bosch Car Multimedia* em Braga.

PALAVRAS-CHAVE

Gestão de Projetos, Gestão de Portfolio, WBS, Ferramentas GP, Sistema de medição de performance

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LIST OF ABBREVIATIONS

APM: Association for Project Management

BoK: Body of Knowledge

CM: Car Multimedia

CoC: Centre of Competence

CPR: Component Processability Release

CSF: Critical Success Factors

E-4: Establish Extract Evaluate Execute

ENAA: Engineering Advancement Association of Japan

GP: Gestão de Projetos (means Project Management)

IT: Information Technology

JPMF: Japanese Project Management Forum

KPI: Key Performance Indicators

LE: Layout Design

MAE: Machinery and Equipment

MFT: Manufacturing Technology

MS: Microsoft

nonPEP: non Product Engineering Process

OPM: Organization Project Management

PCB: Printed Circuit Board

PEP: Product Engineering Process

PM: Project Manager or Project Management

PMBoK: Project Management Body of Knowledge

PMI: Project Management Institute

PMO: Project Management Office

QGC: Quality Gate Customer

RBPM-BoK: Robert Bosch Project Management Body of Knowledge

SBMAC: Sample Build Maturity Approval Checklist

SMART: Specific Measurable Accountable Realistic Timely

T&R: Track&Release software

TG: Technology Gate

USA: United States of America

WBS: Work Breakdown Structure

1. INTRODUCTION

The first chapter of this master dissertation is the introduction that will contextualize this research through motivation and background, objectives and a brief description of the dissertation structure.

1.1 Motivation and Background

The present dissertation emerged under the scope of the integrated Master on Industrial Engineering and Management at Minho University. The master dissertation project was developed at PCB assembly center of competences (MFT3 section) of Bosch company in Braga with the focus on improving project management practices.

Bosch is a multinational company that it is growing really fast, especially in Braga. Particularly at MFT3 section, this growth is clearly visible bringing additional difficulties on resources management, planning and organization in general.

These difficulties and the perceived value of project management motivated this research, materialized by two master dissertation projects, supporting each other. In this specific project the main purpose is the improvement of project management practices in MFT3 section through new planning templates, software customization to support the project management process and a performance measurement system.

Project Management (PM) is an area which has been growing very fast, becoming increasingly attractive for companies due to the value that it can add (Zhai, Cheng, & Xin, 2009). Project management implementation is fundamental to have a better organization performance through its efficient way of controlling deadlines and resources (Oliveira, 2013). According to the PMBoK of Project Management Institute (PMI, 2013, pp. 5), project management is *"the application of knowledge, competences, tools and techniques to project activities to meet project requirements"*. Bosch considers it as a core competence, having, as a guide, the body of knowledge of the Project Management Institute (PMBoK of PMI). Therefore, PMI's PMBoK becomes one of the most referenced sources of this dissertation. Despite these facts, PM is new for Bosch's MFT3 section, increasing the necessity to improve its practices, particularly centered on project planning, portfolio management and performance measurement.

PMI (2013) defines portfolio as a group of projects, programs, sub-portfolios and operations that are managed to achieve organizational strategic goals. Portfolio management

has as main purpose the optimization and prioritization of resource allocation (PMI, 2013; Cooper, Edgett, & Kleinschmidt, 2000).

Project planning is essential to project success; it is one of the most important activities of project management, since no project should initiate execution without a plan (PMI, 2013). One of the most important tools and techniques of project planning is the Work Breakdown Structure (WBS). WBS organizes hierarchically the project team work, being a crucial tool to support PM (PMI, 2006). The WBS technique can be implemented with the support of the WBS standard of PMI, and through the implementation of WBS templates, contributing to the PM standardization approach, one important strategy to achieve success (PMI, 2006).

The concept of success is subjective, having generated many theories and studies (Jugdev & Muller, 2005). Some authors distinguish the project success from project management success believing that the project management success is an internal concern and project success is a more embracing concern that involves specific project objectives and constraints (Ika, 2009). Success can be judged through criteria or critical success factors (CSF) and should be measured by a performance measurement system.

The performance measurement system is *"a balanced and dynamic system that is able to support the decision-making process by gathering, elaborating and analyzing information"* (Neely et al., 2002 in Garengo, Biazzo, & Bititci, 2005, pp. 25)

Project management practices can be supported by PM software, such as an enterprise project management system, agile software and social tools. Some of their useful features are resource management, time tracking, reporting, charts, portfolio management, collaboration, process /methodology and so on (Ahmad & Laplante, 2006).

In conclusion, integrated project management, project planning, portfolio management and a performance measurement system are the key topics to address, according to the problems identified, being implemented through supportive software.

1.2 Objectives

The main objective of this research is the improvement of project management practices, in order to improve the performance of the section where this master dissertation was developed – MFT3 section of Bosch in Braga. More specifically the objectives are:

- Objective 1: Redefinition of an integrated project management process;
- Objective 2: Definition of a WBS template to support project planning;
- Objective 3: Customization of a software to support project management practices;

- Objective 4: Development of a performance measurement system.

Objective 1 was developed jointly with a colleague that developed the other master dissertation project mentioned on "1.1 Motivation and Background" subchapter, once this was the common basis to be able to achieve the subsequent objectives.

1.3 Structure of the Dissertation

The present master dissertation is divided in six Chapters with the aim of logically organizing and structuring the work performed during the project.

Chapter 1 is the introduction chapter, which is where the author contextualizes and sets out the study, including its motivation and objectives.

Chapter 2 presents the literature review divided in six subchapters: organizational project management, brief overview on project management evolution, project planning, project management standardization, software to support project and portfolio management and project and project management success.

In Chapter 3, the research methodology used in the empirical work is explained and justified.

Chapter 4 presents the case study analysis, starting with the contextualization of MFT3 section which includes the introduction of Bosch, company features related to project management, the existent Track&Release Software and the section MFT3 description. After the company contextualization it is also presented a descriptive analysis with data gathering that support the improvements proposal described subsequently.

Chapter 5 presents the results and their discussion.

Finally, Chapter 6 presents the main conclusions attained in this master dissertation project and highlights its distinctive contributions as well as its limitations and future work opportunities.

2. LITERATURE REVIEW

Based on the objectives established in Chapter 1 a literature review was conducted in the following topics: organizational project management; evolution of PM; project planning; PM standardization; software to support project and portfolio management and project and PM success.

The project management concepts adopted in this study are aligned with PMI, as the PMBoK is the reference body of knowledge of Bosch. Other project management associations have developed their own bodies of knowledge (BoKs) in order to map out concepts and knowledge of PM (Morris, Crawford, Hodgson, Shepherd, & Thomas, 2006).

2.1 Organizational Project Management

Organizational project management (OPM) (Figure 1) is a concept that links project, portfolio and program management with organizational practices and strategy in order to obtain better results, performance and a sustainable competitive advantage (PMI, 2013).

Figure 1: Organizational Project Management (Based on PMBoK of PMI, 2013)

Figure 1 shows the relation between project, portfolio and program management. The simplistic definitions there presented for each type of management describes their main functions, which have in consideration all the other circles depicted on the Figure.

In 2007, Aubry, Hobbs, and Thuillier emphasizes that OPM is a way of management suited to complex environments with multiple programs, portfolios and parallel activities. OPM is project and strategy oriented and, usually, it is managed by a project management office (PMO) (Aubry, Hobbs, & Thuillier, 2007). PMO is *"an organizational structure that standardizes the project-related governance processes and facilitates the sharing of resources, methodologies, tools and techniques"* (PMI, 2013, pp. 554). Inclusively, Aubry, Hobbs, and Thuillier (2007) argue that PMO is part of OPM.

After this brief characterization of OPM, three relevant concepts need to be explained in more detail: project management, portfolio management and program management.

2.1.1 Project Management

Project management (PM) is part of OPM and it is mainly focused on projects. So, to a better understanding of this concept, firstly, the concept of project is going to be introduced.

Projects have been increasingly used through the years and, nowadays, they are a common way of work. It is important to clarify the meaning of project because, sometimes, it is difficult to distinguish it from activities/processes (Jugdev & Muller, 2005).

According to PMBoK of PMI (2013), a project is a temporary endeavor undertaken to create a unique product, service or result with clear-cut objectives, a starting point, an ending point and (usually) a limited budget. The main characteristic is its exclusivity, even for projects with the same objectives, they always have differences.

A project is defined in time, what means that it always has a beginning and an ending, independently of its duration - it can last hours or years. It is fundamental to have clear-cut objectives that take into consideration the budget available and the client's requirements. The objectives have to be objective, specific, quantifiable, unambiguous and clear to explain to everyone what the project should accomplish (Biafore, 2013). When a project does not have these features, it cannot be defined as a project, it can be called an activity.

A project is constituted by phases that all together are called as life cycle. PMI (2013, pp. 554) defined it as *"the series of phases that a project passes through from its initiation to its closure"*. Some of these phases are sequential, meaning that most of the series depend on each other, what forces to a more efficient control and management. Some writers say that the beginning is when the project is authorized but, according to Lock (2014), the cycle starts and

ends with the customer, forming a true cycle (Figure 2) that must be continuously followed by project managers.
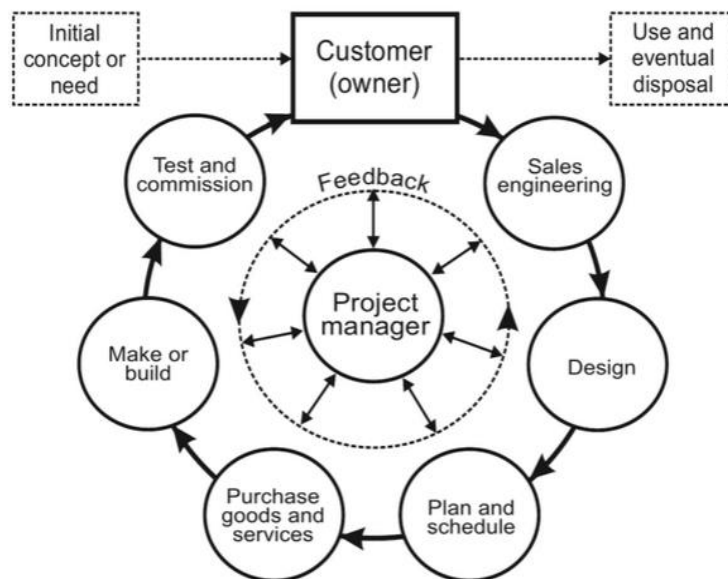
Figure 2: Project life cycle (Lock, 2014)

Figure 2 shows a simplistic version of the project life cycle, just to understand the concept, since the phases of the projects can have many variants and they can overlap. There is not an ideal structure to every project.

As it is also shown on Figure 2, project manager should follow the project life cycle having his own project management phases often divided in: initiating, planning, executing, monitoring, controlling and closing (PMI, 2013).

Project management is an old concept which has emerged in the time of the Second World War. It appeared as a methodology for a long intensive work with a clear objective that needed speed and planning and very tight control (Fewings, 2013). PMI (2013) defines PM as the application of knowledge, skills, tools and techniques to project activities to meet the project requirements. Nowadays, it is recognized as a strategic competence that is indispensable to business success (PMI, 2016).

Project management has the responsibility of planning, monitoring and controlling all of the aspects of a project. It is considered an art of achieving the goals of scope, cost, time, quality and satisfaction through direction and coordination of all kind of resources during the project life cycle (Fewings, 2013). Project management is conducted by a **project manager** who is the responsible for leading the team and achieving the project's objectives (PMI, 2013). The project manager should be goal-oriented – drives business results (Schwaibe, 2015) – and customers-

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oriented – thinks on what customers want and believe in order to get a better collaboration and achieve goals successfully through clients' satisfaction (Lin, Wei, & Fei, 2007).

The project manager should also be comfortable with change, complexity and pressure; a person who develop trust and communication; good on resolving problems; guided by the improvement (PMI, 2016); organized; passionate (Schwaibe, 2015) and with leadership ability (Lin, Wei, & Fei, 2007).

In 2007, Lin, Wei, and Fei conducted a study concluding that project manager's leadership ability has a strong influence on project performance, in terms of personality, also translated into ability on solving problems, authorization skills and communication skills.

2.1.2 Portfolio Management

Portfolio is defined as *"a group of projects that share and compete for the same resources and are carried out under the sponsorship or management of an organization"* by Martinsuo and Lehtonen (2007, pp.). In 2013, PMI adds to portfolio programs, sub-portfolios and operations, and strengthens that portfolio is managed in order to achieve organizational strategic goals.

While the project management purpose is to do projects in a right way, **portfolio management** focus on doing the right projects (Cooper, Edgett, & Kleinschmidt, 2000). It is a way to select projects by prioritizing resource allocation (PMI, 2013; Cooper, Edgett, & Kleinschmidt, 2000) and optimizing it (Martinsuo, 2013).

Portfolio allows the analysis of how human resources and capital are being spent and which projects are being invested in (Cooper, Edgett, & Kleinschmidt, 2000).

Portfolio management is seen as a rational, systematized decision process highly relevant in big companies and which promotes their efficiency. However, Martinsuo (2013), based on theory, suggests to see it also as a negotiation and bargaining process and as structural reconfiguration. This process is for and between people as well as it is for and between companies, increasing the competition on the capability market.

To reflect the importance of this approach, Cooper, Edgett and Kleinschmidt (2000) found the following reasons:

- maximize the financial return;
- maintain the business's competitive position;
- allocate properly scarce resources;
- forge the link between project selection and business strategy;
- achieve a stronger focus;

- yield the right balance of projects and investments;
- communicate project priorities both vertically and horizontally within the organization;
- provide greater criteria in project selection.

But, they also found some problems as resource balancing, prioritizing projects against each other (selection methods), making go/kill decisions in the absence of solid information and having too many minor projects in the portfolio.

To avoid these problems, they propose a set of steps detailed below.

1. <u>First things first</u>: all depend on the quality of information (input), so it should be the process overhaul.

    <u>Example</u>: the installation of Stage-Gate process - it defines the main tasks and activities; deliverables for the key decision and criteria at each gate against which the project is judged.

2. <u>Introduce resource capacity analysis</u>: analyze resource demand for project versus availability of resources. Analysis can be done in terms of the right resources to the current projects or enough resources to the new projects.

    It detects the necessity to prioritize projects (due to the huge number of them), makes rethinking the goals and identifies the bottlenecks.

3. <u>Develop a product innovation and technology strategy for your business</u>: definition of goals, arenas for focus, deployment of resources and attack plan (strategic stance).

4. <u>Integrate portfolio management</u>: integrates all the previous steps and accomplishes the role of portfolio management – resource balancing and project prioritization.

Blichdeldt and Eskerod (2008) tried to go deeper and search about the theory in practice through interviews in 30 companies. Even following the theory, companies found problems in project portfolio management such as delayed projects, resource struggles, stress and a lack of overview. This failure is caused by the fact that the portfolio contains only major projects. Human resources have many activities, therefore they are not assigned to the portfolio projects 100% as the portfolio assumes. Unlike theory, the daily work prevails against project work and, consequently, the time and resources are under pressure. This time is not always possible to measure what makes management difficult. Due to these detected problems, two solutions were suggested: embracing all type of projects and setting up a pool of loosely-controlled resources.

The first solution proposal is to try to include the smaller, un-enacted projects on the portfolio. The second one is to make a rule of allocation, for example: 20/80 rule - resources dedicated 80% of the time on portfolio management and 20% in other activities. However, both solutions bring additional need for reflection and decision-making.

In conclusion, the biggest challenge is to decide which projects should be part of the portfolio. If it does not include all kinds of projects, two more variants appear:

- decision about the boundary that sets enacted from un-enacted projects;
- decision of degrees of enactment – how many resources should be set for the project outside the portfolio.

Thus, it is possible to reduce the resources struggles by settling which projects need management attention and which ones are better left to other employees. No rules have been suggested for this because this analyses depend on company, employees and projects.

2.1.3 Program Management

PMI (2013) defines **program** as being a group of projects, subprograms and program activities whose relationship can bring benefits if managed together. Thiry (2015, pp. 18) suggests other definition: *"collection of change actions purposefully grouped together to realize value for a number of stakeholders"*. This definition emphasizes the intention of grouping actions in order to find their important interdependencies and stakeholders synergy.

Program management has as objective the fulfillment of program requirements and the improvement of control and benefits through project grouping management (PMI, 2013).

According to Savla (2008) program management includes:

- **Planning**: decomposition of program goals into multiple manageable tracks – to perform effective management and focus.
- **Risk Management**: identification, analyses and mitigation of risks – to increase the probability of success and to prevent surprises.
- **Stakeholder Management**: management of stakeholders needs and expectations – to ensure successful program (ensure stakeholder involvement to a rigorous decision making process, communication processes and planning meetings).
- **Performance Management**: measurement of performance in relation to program objectives – to increase success through implementation of strategies to decrease negative deviations.

- **Organization change management**: acceptance and orientation of chances – to align all stakeholders.

- **Communication Management and Governance**: interfaces between stakeholders, processes and organizations – to enable communication and faster decisions.

2.2 Brief Overview on Project Management Evolution

With the aim of having a better understanding of how and why is the "past/old" and the "present/new" view on PM, a brief overview of the PM evolution will be addressed. Project management has been changing over time; its slow growth has started by the late 1940s.

PM is the evolution of systems management (Kerzner, 2013). The main difference between project and systems management lies in the detail: systems management looks to the total picture while project management goes through the individual components. For a better understanding of the concept of system, the example of our body can be used, since it has many different subsystems that are interrelated but with different specialties (organs, muscles, skin and so on) working together (Kerzner, 2013).

- Traditional project management (PM 0.1)

Going back to the beginning of the project management, we face the time of the post-World War II, when the necessity of having someone who had total responsibility through all project phases emerged – a project manager. Therefore, NASA started to use project management for all the projects of the Space Program. To improve that practice, the Government implemented its standardization, especially in planning, controlling and in reporting of information. So, the Government creates a life-cycle planning and control model, a cost monitoring system and created a group of auditors to make sure that the implementation was well-done (Kerzner, 2013). That it is how the traditional project management was born. Its implementation was not easy due to the resistance to change but the necessity and the project complexity growth excelled and companies began to use it.

Complexity is not a clear concept. In the Cambridge dictionary online, complexity is defined as: *"the state of having many parts and being difficult to understand or find an answer to"*. This definition can be divided in two parts. The first one guides us to the differentiation (the number of different elements) and independence or connectivity (the degree of elements interrelationship) and, in the second part, complexity is subjectivity, what means that it does not form a consistent basis for the formulation of standards for companies (Baccarini, 1996).

According to Baccarini (1996), before mentioning the complexity of the project, it must be clarified its definition. His proposal is to define it as the first part with the dictionary definition and distinguish it from uncertainty and size. To Baccarini, a project can deal with two different complexities: technological and organizational. On the other hand, in 1999, Williams relied on theory from different authors to summarize the concept of project complexity in two dimensions as it is schematized on Figure 3:
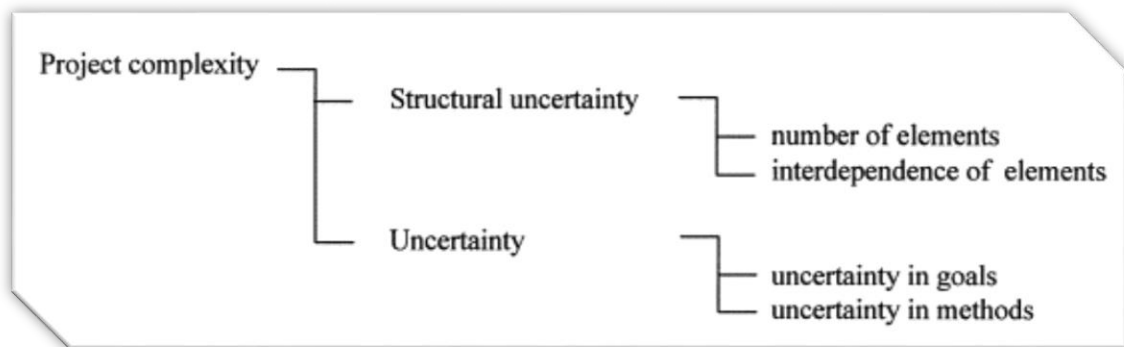
Figure 3: Project Complexity (Williams, 1999)

Complexity drives us to PM but the traditional PM are appropriate only for some grades of complex projects and for solving simplistic problems. With the world changing and the complexity growth in projects, that structure does not work always in an appropriate way (Pollack, 2007), as the following challenges suggest (Levitt, 2011):

- planners know how to use project planning tools but do not always know about construction or have manufacturing experience;
- with the world changing, the baseline plan is not always valid;
- the team cannot feel commitment to the plan if it does not participate in its planning;
- variances can spin out of control;
- the team do not use their creativity to think and impact in a high-level of the project outputs.

Traditional project management has specific objectives, prerequisites and a desired sequence of actions to fulfill (Pollack, 2007); goes through the detail, centralized planning, decentralized execution and centralized control of large projects (Levitt, 2011) but these characteristics started to be insufficient and projects started to be unmanageable with it, what forces its improvement.

- Modern project management (PM 2.0)

Complexity growth was provided by the environmental, market and geopolitics quick change (Levitt, 2011). Adding the big evolution of technology that led to the appearance of the WEB 2.0 new generation, project management was forced to keep up with that changing and evolved to PM 2.0. This modern approach is focused on dynamic and unpredictable projects of the 21st century due to the world turbulence that do not let us consider the scope as fix or lock in a baseline plan. So, project planning and execution must be extremely agile (Levitt, 2011).

Agility is difficult to define. Many authors have their definition but, usually, it is defined with the following characteristics: adaptive, iterative and incremental and people oriented (Abbas, Gravell, & Wills, 2008).

PM 2.0 is team-oriented and the organization must be agile that means that should achieve shared global awareness and have self-synchronization. Communication is very important and with web 2.0 is becoming easier and faster. Organizations should have an easy and fast communication of information in real time to follow the change and the complexity. This communication from everyone to everyone is also necessary to create global awareness but, sometimes, it is too much information to take in and some organizations restrict it according to hierarchies and permissions' matrices. Nowadays, with the intelligent filtering of tools, reductions of information overload become easier.

This modern PM allowed answers became faster, more coherent and combined all the resources available, because of all that global information, and due to delegation of authority to well-trained, well-motivated and autonomous teams (Levitt, 2011).

- PM 0.1 vs. PM 2.0

During the years, the globalization changed the requirements for project management and it began to be more collaborative as knowledge work (Fernandez & Fernandez , 2008). Flexibility was needed to adjust challenges and opportunities.

In order to clarify the differences between the two variances of project management, PM 0.1 and PM 0.2, it was created a summary table (Table 1).

Table 1: PM 0.1 vs. PM 0.2 – Summary table

PM 0.1 (Traditional/Plan-driven)	PM 0.2 (Agile)
Not agile/traditional	Agile
Operational	Strategic
Discipline	Flexible
WEB 0.1	WEB 0.2
Traditional knowledge	Engage all available knowledge
Stability and predictability (political, economic and technological)	Continuous world changing
Lead by project management	Team autonomy
All steps already defined	Allow creativity
Centralized planning and control	People-oriented
Simplest projects	Dynamic, unpredictable and complexity projects
All documented	Interpersonal knowledge
Bigger team	Smaller team
Slower	Faster
Restrict information	Shared global awareness and self-synchronization

Compiling all the previous information we can conclude that PM 0.1 and PM 0.2 have many differences. In 2003, Boehm and Turner (pp. 32) distinguished them as:

- PM 0.1 (Plan-driven): *"promise predictability, stability and high assurance."*
- PM 0.2 (Agile): *"promise higher customer satisfaction, lower defect rates, faster development times and a solution to rapidly changing requirements."*

Nevertheless, Boehm and Turner (2003) also say that the two types have similarities: their target, both of them are guided by the customer satisfaction fulfilling an appropriate cost, and schedule parameters. So, these authors suggest the integration of both methods in one having all the strengths together and minimizing weaknesses.

2.3 Project Planning

Project planning is one of the main functions of PM. It is the process definition, preparation and coordination of all smaller plans of the project and integration of all in one (PMI, 2013). The following Figure (Figure 4) resumes this concept under the PMI perspective. It evidences how the different concepts are related to project management plan.
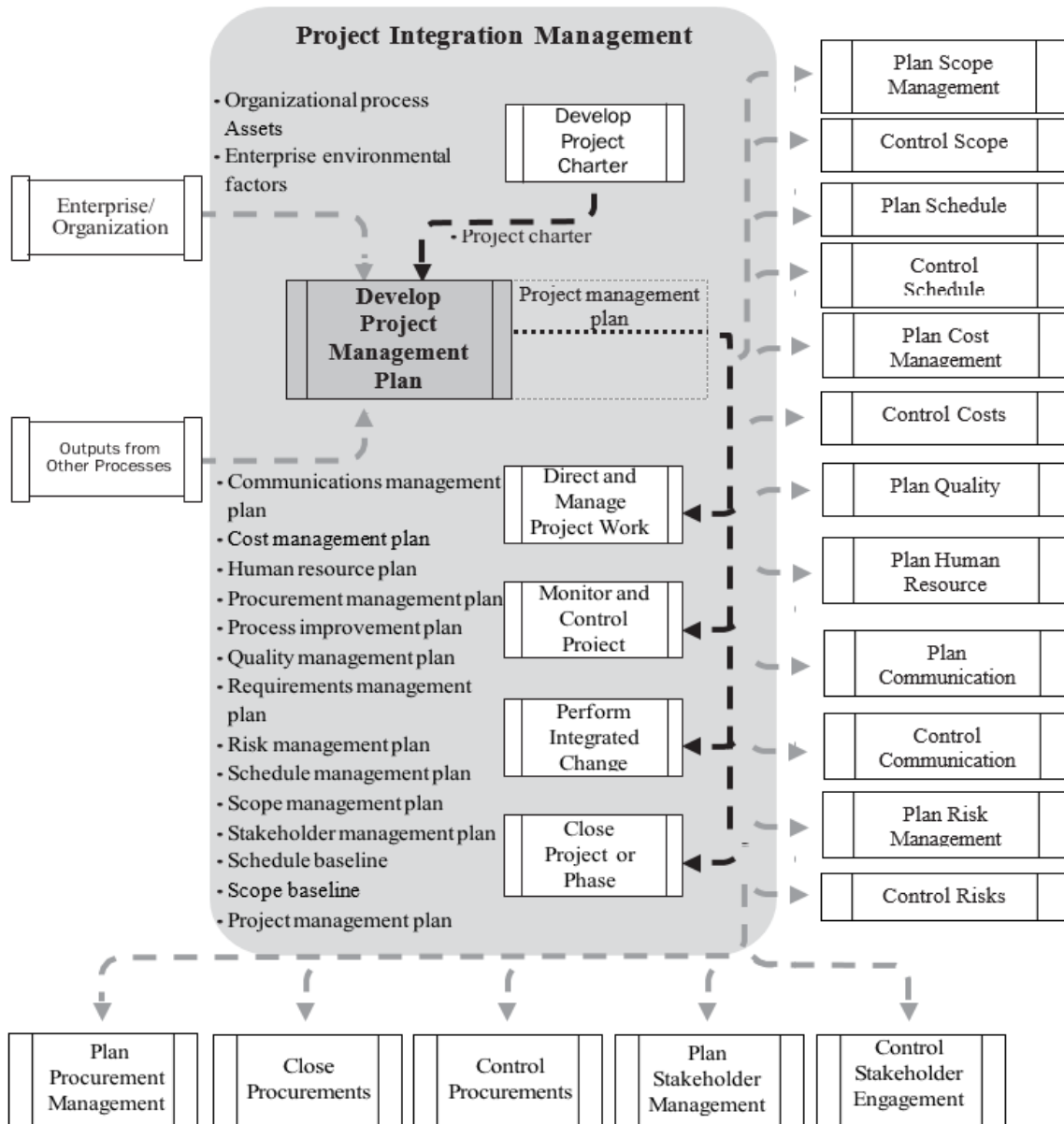
Figure 4: Project Management Plan Data Flow Diagram (PMI, 2013)

To plan a project, it is essential to have the objectives, restrictions and requirements of the project from the client or sponsor/responsible.

The planning should rely on some tool(s)/technique(s) to simplify its process. One proposal is to organize a structure with three parts charts: constraints, work breakdown structure and milestones (Fernandes, 2014), detailed below.

- **Constraints Chart** includes the dependencies that are external to the project team, which means that do not depend on the project team internal work.
- **Work Breakdown Structure** integrates the project management work and the product (or service) development work.
- **Milestones Chart includes** all events that mark a significant project change or stage.

The initial planning should be saved as a baseline, in terms of time, scope and budget, to allow the comparison of the planned with the executed. However, the project can be replanned during the project (Fernandes, 2014).

As it was said, planning should be supported with some tools and techniques. The following points are going to explain one important technique (WBS) and one tool that integrates it (MS Project).

- Work Breakdown Structure (WBS)

Work Breakdown Structure (WBS) is a hierarchical decomposition that subdivides deliverables and work into more manageable components (PMI, 2013). It is deliverable-oriented and articulates the project scope as well as provides a structured vision of the entire project and clarifies all the tasks that should be done (PMI, 2006).

According to PMI (2006), the WBS levels reflect the major deliverables divided logically by the major phases of project life cycle in order to improve assessing the team and the individual performance through communication, cost measurement and schedule performance.

Each person, according with the organization, decides the division of its project's WBS and should numerate each division by logical levels. The first level is about the subject of WBS that can be divided into phases of work and the phases can be further divided and so on (Demeulemeester & Herroelen, 2002). The following Figure (Figure 5) demonstrates an example of a WBS to construct a bicycle. The components have numbers according to the levels.
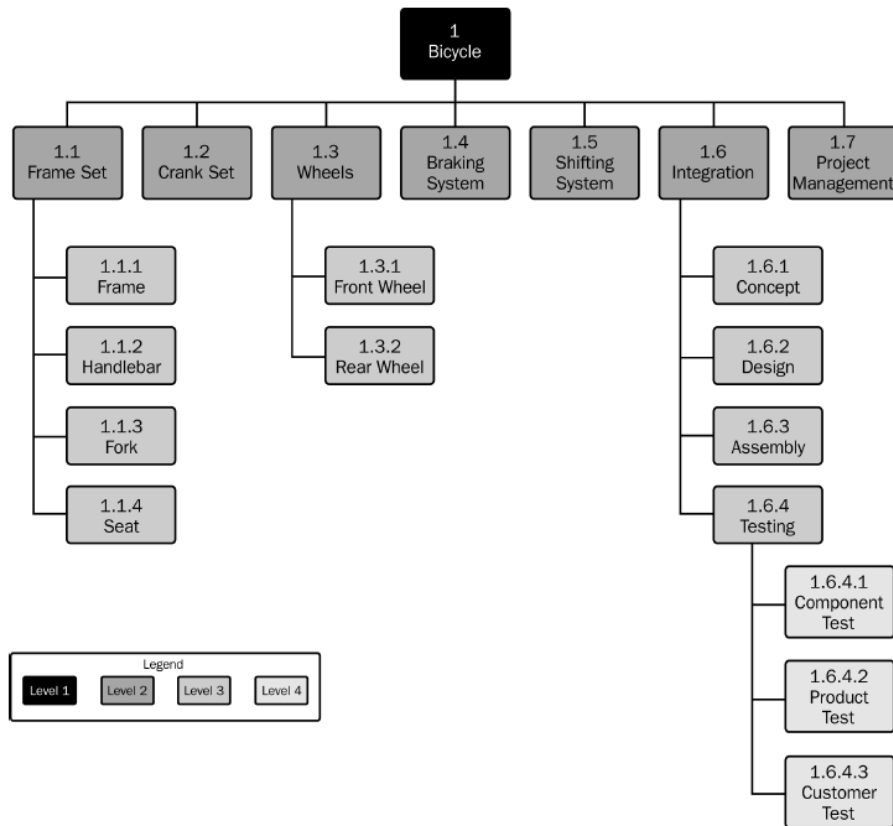
Figure 5: WBS Bicycle Example (PMI, 2006)

There are different methods to support the creation of WBS. They are important in terms of promoting consistency and repeatability; promoting and enforcing the principals of organization's WBS guidelines; reducing the development effort and simplifying WBS process. Some examples of these methods are (PMI, 2006):

- **Top-Down**: Starts by defining the major deliverables until decomposing to a detailed level.
  - o Challenges:
    - Constant attention that no work packages are overlooked.
    - Elaboration of sufficiently detailed level to be manageable.
- **Bottom-Up**: Starts with all deliverables and works backwards until grouping them into upper levels, having all work packages aggregated to a single parent (the project).
  - o Challenges:
    - Identification of all deliverables (in the first step).
    - Logically grouping of work packages.
    - Not losing the focus on the big picture.

- **WBS standards**: Set of principles to create a WBS, including numbering, naming convention or required elements.

  One disadvantage is that some projects cannot fit into higher specific standardization.

  o Challenges:
    - Fit the project into standardization.
    - Not including unnecessary deliverables or including all specific deliverables.

- **WBS templates**: Sample of WBS with hierarchical elements filled in some level of detail or generic information to be completed with the project information.

  One disadvantage is that some projects cannot fit into specific templates.

  o Challenges:
    - Fit the project into standardization.
    - Not including unnecessary deliverables or including all specific deliverables.

Independently of the method chosen, WBS has to describe all the project work hierarchically organized, and has to consider some factors, such as (PMI, 2006):

- **WBS element** represents only one <u>single deliverable</u> and is <u>compatible</u> with organization and accounting structures. It is associated <u>to only one parent</u> and its <u>child elements represents 100%</u> of its work.

- **Deliverables** can be <u>tangible</u> (all reporting and others) or <u>intangible</u> (information/communication, integration, administration, training, process management, procurement and others).

  They are <u>unique</u> and <u>distinct</u> and have to be <u>all included</u> on WBS structure with only <u>one team responsible</u>.

- **WBS development process** has to be <u>iterative</u>, <u>reviewed</u> and <u>revised</u> along project planning progress. Provides <u>flexibility</u>.

WBS technique increases project success depending on its quality (PMI, 2006). A high-quality WBS is constructed in order to satisfy all the project requirements, representing the full scope of work. It avoids common mistakes on WBS construction and supports the project manager on managing the varying degrees of scope, budget, schedule and risk.

- MS Project

MS Project is one example of tool that supports project planning. Microsoft created it for project management, in terms of project scheduling and costing, tasks management, reporting and business intelligence (Microsoft, 2016). MS Project has become the dominant PC-based PM software (Sajad, Sadiq, Naveed, & Iqbal, 2016). Some of its features are (Sajad, Sadiq, Naveed, & Iqbal, 2016):

- Milestone view (Figure 6);
- Resource Management (Figure 7);
- Calendar view (Figure 6);
- User control scheduling;
- Fine tuning the project plan;
- Gantt chart view (Figure 6);
- File management;
- Tracking progress.

MS Project integrates well-known PM techniques, such as: Gantt chart and WBS. WBS, the technique discussed previously, is integrated with schedule and resources. And the Gantt chart is one of the most common techniques used for project management. The Gantt chart is a powerful visual tool, easy to understand and construct, that indicates time lines for the tasks according to the plan (Maylor, 2001; Kumar, 2005). The Gantt chart is a useful interface that allows users to define problems and provides a better understanding and acceptance of solutions (Wilson, 2003).
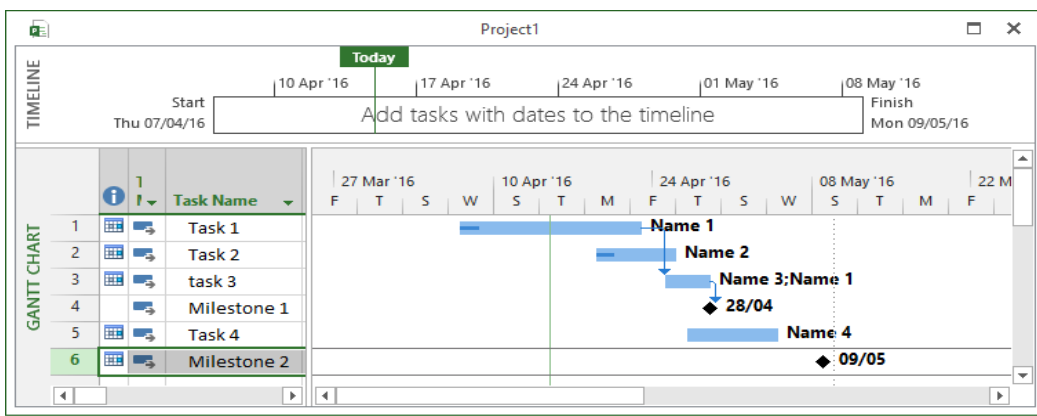
Figure 6: Gantt chart example
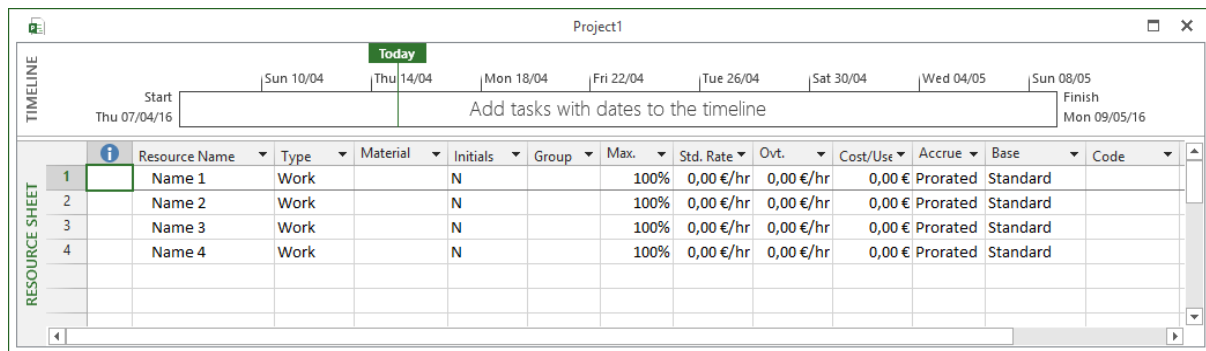
Figure 7: Resource Sheet - MS Project

2.4 Project Management Standardization

PM standardization is adopted by some companies as a strategy for project management improvement and, consequently, to enhance project success.

Cambridge Online Dictionary (2016) defines standardization as *"the process of making things of the same type have the same basic features"*.

In 2001, Milosevic, Inman and Ozbay studied project standardization in industries context and they concluded that it impacts on project effectiveness. Their focus was on standardization of project structure (includes process, organization and information technology), project systems (PM methods and metrics) and project culture (PM culture and leadership). In 2005, Milosevic and Patanakul emphasized again the importance of PM standardization on project success. This time, the focus was on the specific standardization of PM tools, leadership and process (also covered by the previous study).

Based on both studies on industry context, standardization can have positive influences on: more punctual schedules, more satisfied customers, better cost-effectiveness and higher quality on accomplishments. The three types of standardization addressed on both studies can provide the following features:

- ✓ Project leadership standardization (Project culture): provides functions of planning, organizing and controlling projects, develops project vision and communication and motivates participants;

- ✓ PM process standardization (Project Structure): builds a repeatable process, increases the knowledge of the process improving speed and quality, decreasing the time, costs, rework, mistakes, snags and delays;

- ✓ PM tools standardization (Project system): Syncs the work and integrates other standardizations.

Even using standardization, project managers should be able to make changes and adaptations to PM according to the projects' issues. Project managers have to be processes experts that can manage procedures according to the rules instead of being standardization's slaves. So, the standardization has to be flexible and at an organizational project management level (Milosevic & Patanakul, 2005).

2.5 Project and Project Management Success

Along the present literature review, success has been appearing many times. In this section will be explained the concept of success on project and project management context. Performance measurements systems will be also addressed, in order to evaluate and control it.

The success does not have the same meaning for everyone and depends on its context (Jugdev & Muller, 2005). In projects this definition is not different; there are many studies about the understanding of project success because of its complexity and ambiguity.

Some authors argue that project success should be distinguished from project management success. One of the most common meaning to **project management success** is the ability to fall within time, cost and quality (iron triangle) (Ika, 2009). However, in PMBoK of PMI (2013), that concept was significantly enlarged to the ability to fall within time, cost, quality, scope, resources and risk, measured by project manager. Project management success is about efficiency and it is a concern of the project team. On the other hand, the definition of **project success** is still vague and ambiguous, but, according to some authors, project success is more than project management success and should involve efficiency and effectiveness. Being efficiency defined as "*do things right or to maximize output for a given quantity of inputs or resources*" (Peter Drucker in Ika, 2009, pp. 7) and effectiveness as *"do the right things or to attain the project's goals and objectives"* (Peter Drucker in Ika, 2009, pp. 7). Project management can lead to project success but the opposite does not happen (Ika, 2009).

One theory is that project management success is an internal concern that cares about doing the activities, and project success is a more embracing concern that involves specific project objectives and its constraints as time, costs, quality and satisfaction and cares about achieving business results (Ika, 2009).

Success can be judged through project success criteria or critical success factors (CSF). These concepts are defined by the Cambridge Online Dictionary (2016) as:

- ✓ Criterion: "*a standard by which you judge, decide about, or deal with something*";
- ✓ Factor: *"a fact or situation that influences the result of something"*.

Some examples of criteria are the iron triangle (time, costs and quality), functional and technical specifications while some example of factors are project mission, top management support, project schedule/plan, client consultation and acceptance, monitoring and feedback, troubleshooting and communication. The definition of success criteria and CSFs depend on projects, thus, it is not possible to develop a list that meets the needs of all projects (Ika, 2009).

Over the past 50 years, the understanding of these concepts has increased (Jugdev & Muller, 2005). Ika in 2009 summarized this progress by analyzing concepts as success criteria, success factors and emphasis, since 1960s until 21st century (Table 2).

Table 2: Measuring success across time (Ika, 2009)

Research Focus	Period 1 1960s-1980s	Period 2 1980s-2000s	Period 3 21st century
Success Criteria	• "Iron Triangle" (time, cost, quality)	• Iron triangle • Client satisfaction • Benefits to organization • End-user's satisfaction • Benefits to stakeholders • Benefits to project personnel	• Iron triangle • Strategic objective of client organizations and business success • End-user's satisfaction • Benefits to stakeholders • Benefits to project personnel and symbolic and rhetoric evaluation of success and failure
Success Factors	Anecdotic lists	CSF lists and frameworks	More inclusive CSF frameworks and symbolic and rhetoric success factors
Emphasis	Project management success	Project/product success	Project/product, portfolio, and program success and narratives of success and failure

The holistic project success frameworks are being used in practice and, since the beginning of 21st century, the support and the investment on project management has been looked forward as an asset with increasing strategic relevance (Jugdev & Muller, 2005).

One way to measure success is through **Performance Measurement Systems**. As Ebert (2009, pp. 22) said *"in almost every area of life, setting goals and monitoring achievement are the foundations for success"*.

Performance measurement systems are essential to lead an organization (Krishman, 2008) by evaluating and controlling the overall business operation to check if the performance is according to their targets in terms of goals and objectives (Bhatti, Awan, & Razaq, 2013). They are constituted by the following features (Bourne & Bourne, 2011):

- **Framework:** the organization of structures. It simplifies the representation of objectives giving protagonism to important success factors. Examples: Balanced Scorecard and Performance Prism.
- **Objectives:** the points to achieve according to the organization strategy.
- **Measures:** quantify performance and show the progress to fulfill the objective.
- **Targets**: the tangible levels of performance to fulfill objectives.
- **Initiatives for improvement:** improvements to achieve a better performance.

Neely (2002 in Garengo, Biazzo, & Bititci, 2005, pp. 25) defines performance measurement system as *"a balanced and dynamic system that is able to support the decision-making process gathering, elaborating and analyzing information"*.

Measuring the performance is not self-sufficient to fulfill organization success. It is necessary to bring together three elements: performance measurement, performance management and performance leadership (Bourne & Bourne, 2011).

Being measurements considered as management tools, they are an inherent part of a business process. Their own process is guided by objectives and their generic process is known as E-4 (Establish, Extract, Evaluate and Execute), based on the Deming cycle (Plan, Do, Check and Act) (Figure 8).
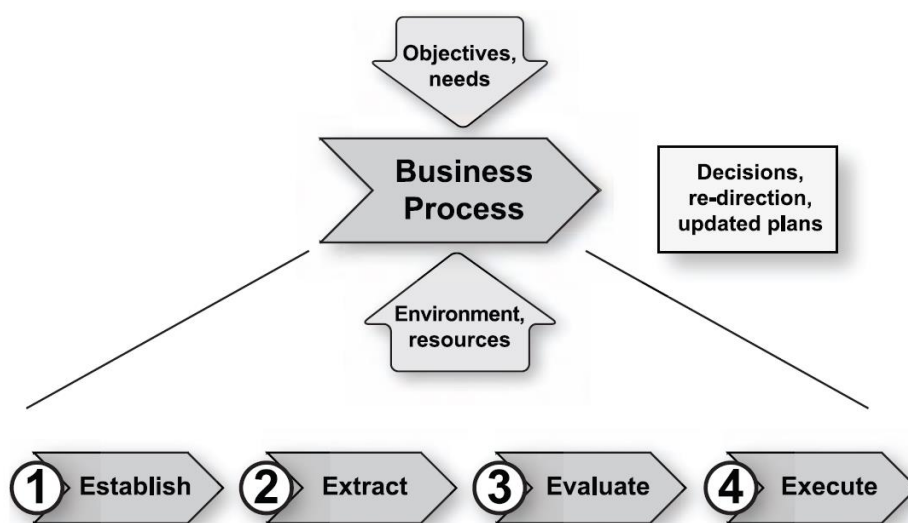
Figure 8: Generic Measurement Process (Ebert, 2009)

E-4 is one way of performance management that implements improvements through performance measurement in order to achieve success. Their actions meanings are (Ebert, 2009):

1. **Establish:** measurement program and preparation, activities support and objectives control.
2. **Extract:** performance measurement defined by control needs.
3. **Evaluate:** evaluation of measurements in terms of background of actual status and objectives.
4. **Execute:** implementation of improvements in order to decrease the differences between status and objectives.

Performance measurement should measure the daily performance, track the environmental changes and monitor the implementation of strategies (Bourne & Bourne, 2011). Performance measurements are not well defined in every organization (Parmenter, 2010). They have as function helping on the better understanding, management and improvement of what the organization do. They can describe how well is the performance, if it is according to the goals, if processes are controlled and if and where improvements are necessary (Anderson, et al., 1995). According to Parmenter (2010), Performance measures are divided in four types (Figure 9):

- Key Result Indicators (KRIs): measure what have been done, showing a clear picture of what are done and in which direction they are going.
- Result Indicators (RIs): indicate what was done.
- Performance Indicators (PIs): indicate what to do.
- Key Performance Indicators (KPIs): indicate what should be done to increase performance.
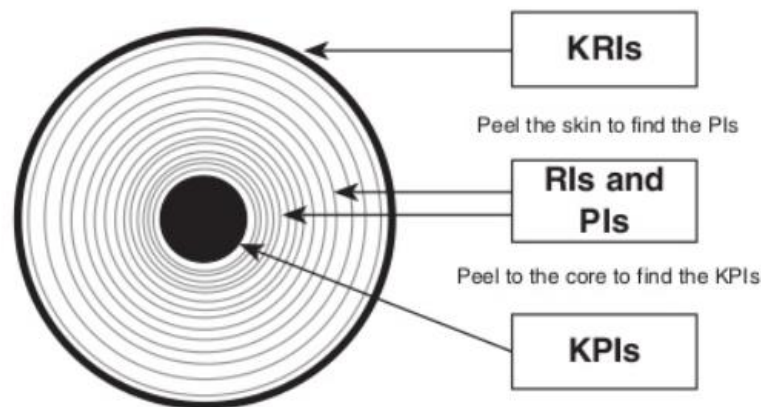
Figure 9: Four types of performance measures (Parmenter, 2010)

These definitions are not always explicit, a useful example to clarify them is the car's speedometer. The result indicator is the speed of the car and the performance indicator can be how economically it has been driven (how many miles per gallon) (Parmenter, 2010).

There is also the performance leadership that supports performance measurement and management. Besides setting the direction of the organization through definition of goals, priorities and vision, it has also to captivate people about the organization future. If people from outside and inside of the organization believe in its future, they will invest more and will have a better performance, respectively. Nevertheless, setting the direction definition is not sufficient to succeed, it has to be supported by a strong culture (how things are done) and values (beliefs). Values are about people beliefs, such as external relationships, openness, transparency and people treatment, while culture is a reflection of organization's values and direction (Bourne & Bourne, 2011).

Contextualizing for the specific cases of projects, measurements allow project's monitoring and control in order to help on decision-making, attention directing, performance evaluation, improvement tracking, target settings and planning. According to Ebert's consulting services (2009) the most important project measurements are:

- requirement status and volatility;
- product size and complexity;
- effort;
- schedule and time;
- project progress;
- quality.

These measurements are used with the view of tracking status, risks and progress as well as building up database history. If all the projects follow the same well-defined process and the same performance and tracking measurements, it is possible to compare them without much effort. All these relevant measurements should be reported in a standardized dashboard as it is shown in Figure 10 (Ebert, 2009).
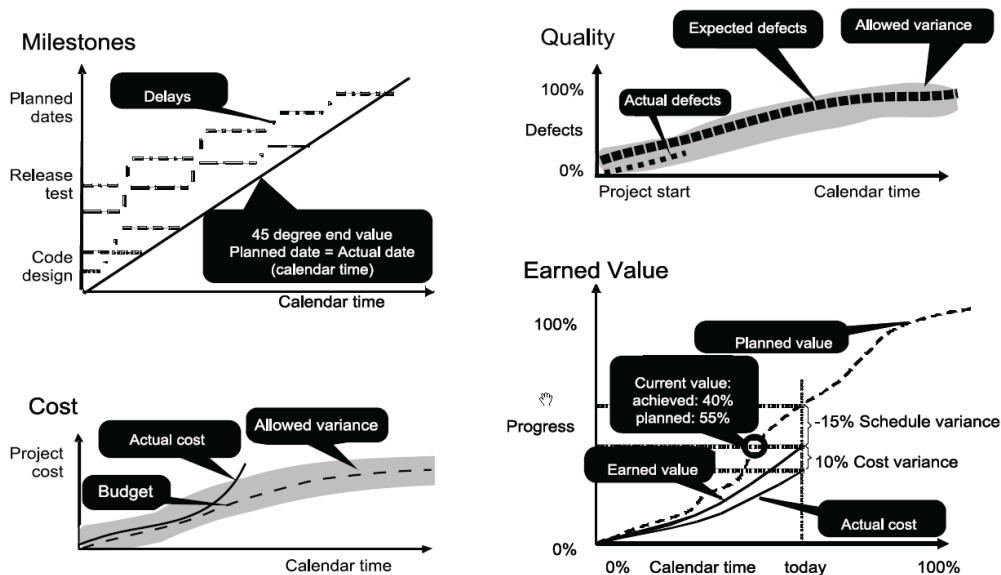
Figure 10: Measurement Dashboard Overview (Ebert, 2009)

Dashboards can be classified with a status traffic light. When the color is not green means that the status ran out the accepted limitation. These dashboards are useful to detect the cause of problems by reporting when and where the problem were caused, avoiding unnecessary investigations (Ebert, 2009).

The best way to measure and improve performance is through software measurement. It follows the concept of objective-driven: improvements are focused on objectives achievements. In this way, costs can have a considerable decrease and quality a considerable improve, what means that the capacity grows, giving place for innovation, higher margins and a better market positioning (Ebert, 2009).

According to Ebert (2009, pp. 25-26), software measurement follows eight steps, detailed below.

1. *"Identify the organization's improvement needs from its business goals"*: set the objectives.

2. *"Define and agree on the organization's key performance indicators (KPIs)"*: KPI should be standardized across the organization in order to ensure visibility, accountability and comparability.

3. *"Identify the organization's hot spots, such as areas where they are feeling the most pain internally or from customers"*: identify where the problems are.

4. *"Commit to concrete improvement objectives"*: these objectives should be SMART (Specific, Measurable, Accountable, Realistic and Timely).

5. *"Identify specific levers' to start improvements and connect them to ROI (Return On Investment) planning"*: guidance to improvements' implementation.

6. *"Perform a brief gap analysis of the selected process areas to identify strengths and weaknesses".*

7. *"Develop a concrete action plan for the identified weaknesses"*: planning through subdivision of improvement tasks taking into account the available resources, skills, external needs.

8. *"Implement improvements and deliver tangible results"*: implementation and measurement according to objective improvement.

To summarize, measurements should have a clear improvement objective. This objective has to be SMART (Specific, Measurable, Accountable, Realistic and Timely) and, once it is defined, it will be achieved through stimulation and direction provided from measurements. Managers should follow the E-4 process and ensure that decisions are based on facts and analyses with the aim of meeting objectives.

2.6 Software to Support Project and Portfolio Management

Project managers have many responsibilities that can be supported with software tools and manual techniques (Maserang, 2002). They should choose the best tools for their functions analyzing features as (Ahmad & Laplante, 2006):

- Task Scheduling – to track important milestones and attribute responsibilities to each task;
- Resource Management – to organize and trace requirements details to ensure the resources with the competences necessary to the project;
- Collaboration – to enable structured and free-flow sharing knowledge and best practice;
- Time tracking – to record, analyze and report according to project working routine;
- Estimating – to generate, manage and validate estimates of effort for a wide variety of projects;
- Risk Assessment – to help in identifying and planning for potential project risks;

- Change Management – to control schedules, resources and project deliverables.

- Reporting/ Charts – to provide charts and reports;

- File Attachment – to customize project tasks (sharing and document management system and web page authoring)

- E-mail notification – to integrate e-mail notification to keep team members informed;

- Process/Methodology – to develop and implement a consistent and standardized process workflow;

- Portfolio Management – to manage multiple projects.

PM tools (software and non-software) have grown significantly, bringing a vast number of available products on the market with different levels of sophistication and prices (Ahmad & Laplante, 2006). The following point will describe briefly some examples and types of PM tools.

2.6.1 Enterprise Project Management System

Enterprise project management system is a tool to have a more efficient and effective project management through visibility and control of projects, operations and resources of each area, department and organization (Fernandes, 2014). Its main functions are:

- time reporting through timesheet;
- have templates for planning;
- total vision of all projects;
- planning of resources;
- issues management;
- risk management;
- requests management;
- quality management;
- lessons learned management;
- portfolio management;
- documents management.

One of the characteristics of the enterprise project management system is portfolio management. So, it has to accomplish the portfolio management three goals: value maximization, seek balance and strategic direction (Cooper, Edgett, & Kleinschmidt, 2000).

Therefore, portfolio management tools may be used to include the following points (Cooper, Edgett, & Kleinschmidt, 2000):

- Value maximization (allocates resources to maximize business objectives). Examples:
  - Financial metrics;
  - Probabilities of technical and commercial success during decision process;
  - Check list;
  - Scoring model;
- Balance (long term projects versus short ones; high risk versus sure bets; and across various markets, technologies and project types):
  - Visual charts – Examples:
    - Portfolio maps or bubble diagrams, such as the risk-reward bubble diagram used at Procter & Gamble, plotting NPV, probability of success and time-to-market;
    - Pie charts (shows breakdown of projects or spending by project type, product lines or markets).
- Strategic direction (portfolio spending mirrors their strategic priorities):
  - Categorize projects by bucket and rank ordered by bucket.

MS Project Server (Figure 11) is one example of Enterprise Project Management System. It is an application of Microsoft SharePoint that enables business decision makers prioritize project portfolio investments and deliver the intended business value from virtually anywhere (Microsoft, 2016). MS Project Server has the following features:

- quickly start projects (by prioritizing project portfolio investments, and delivering results with the intended business value);
- anywhere access;
- work management;
- demand management;
- portfolio analytics and selection;
- resource management;
- schedule management;
- financial management;
- time and task management;

- team collaboration (social capabilities);

- issue and risk management;

- reporting and business intelligence;

- program management;

- governance (easy to create workflows);

- extensibility (by SharePoint Apps);

- active directory integration;

- administration (easy to use and control);

- support;

- project and portfolio management partner ecosystem.
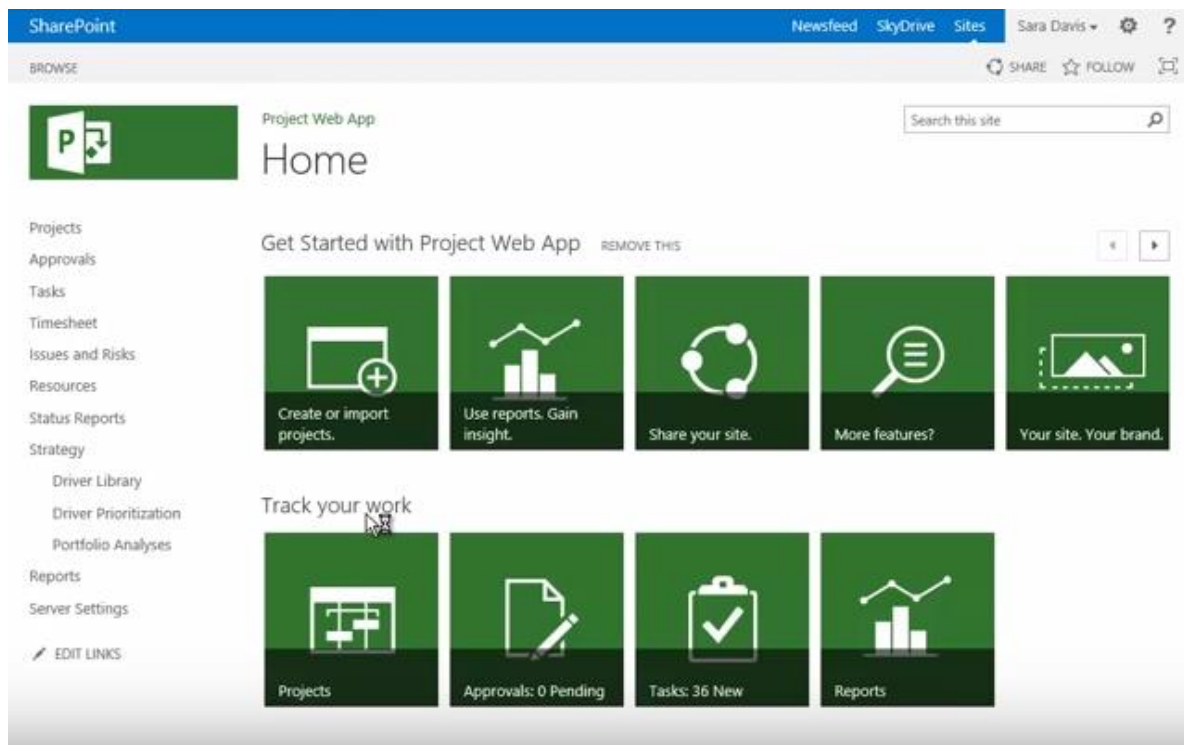
Figure 11: MS Project Server - First page view (EPMSolutions1, 2013)

2.6.2 Agile Software

Agile software is a tool suitable for PM 2.0 (described in the section 2.2. "Brief Overview on Project Management Evolution"), which has high degree of change and uncertainty. This type of tool decreases the risks and increases the productivity and quality but only if it is used under the right circumstances, such as constant change and team capable of using it (Coram & Bohner, 2005).

Kanban and Scrum are two examples of agile approaches. Both of them are agile – responding to change over following a plan - and lean thinking – continuous and empirical optimization and pull scheduling systems (Kniberg & Skarin, 2010).

Scrum organizes the work in cycles called sprints (Forgen, 2010). The work is done by a small team in a short time (sprints) to build a small thing that is integrated regularly with the rest to see the whole. It means that scrum split the organization, the work and time and optimizes the release plan and process (Kniberg & Skarin, 2010).

Kanban is a Japanese word that means "visual card" (Crisp, 2016). Kanban approach limits the work on progress and measures the lead time. It also splits the work into pieces and distributes them into columns of each workflow's phase on a visual platform which allows the total vision of workflow (Figure 12) (Kniberg & Skarin, 2010).
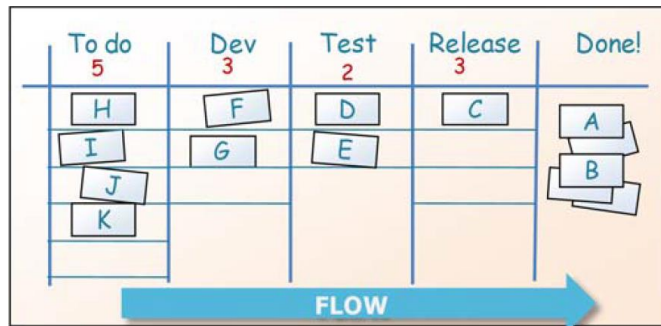
Figure 12: Kanban board (Kniberg & Skarin, 2010)

JIRA Software is one example of project management tools for agile teams. It is used to plan, track, release and report. It also has support with scrum boards, Kanban boards (Figure 13), agile reporting and portfolio planning (Atlassian Enterprise, 2016).
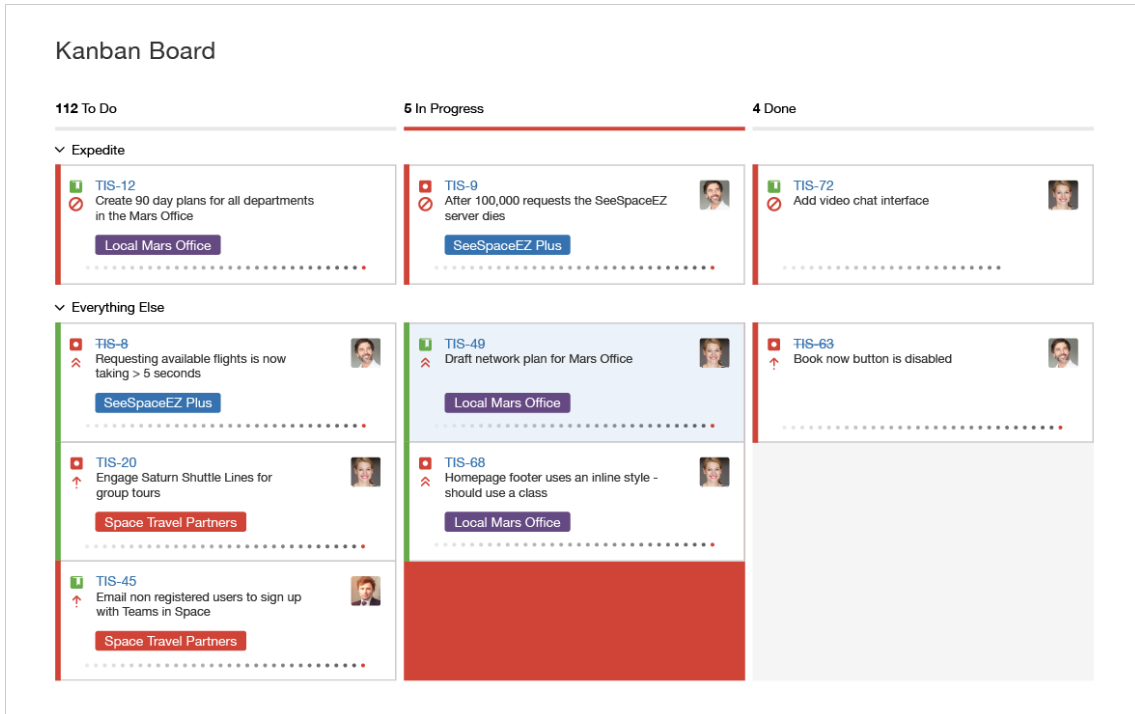
Figure 13: Kanban board of JIRA Software (Atlassian Enterprise, 2016)

JIRA software can be also combined with Portfolio for JIRA what enables portfolio management. The combination between JIRA and portfolio for JIRA allows:

- To plan and optimize schedule in real time and forecast realistic release dates (Figure 14).
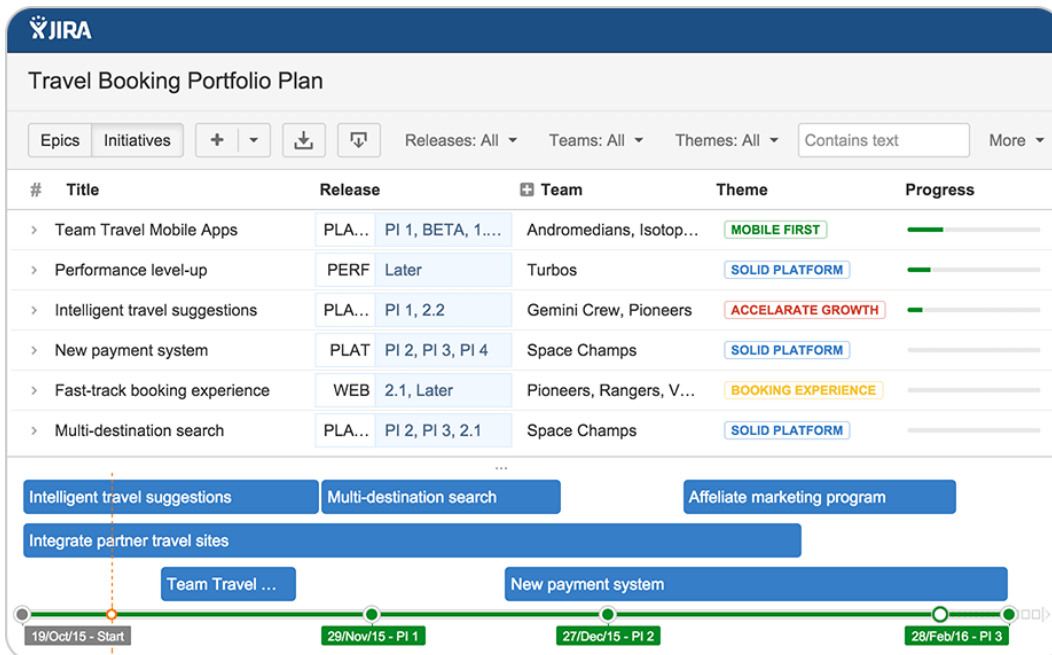
Figure 14: Portfolio Plan of JIRA Software – Planning (Atlassian Enterprise, 2016)

- To manage team availabilities and skill sets and adapt the plan (Figure 15) – faster prioritization and decisions making by seeing the impact of the "what-if".
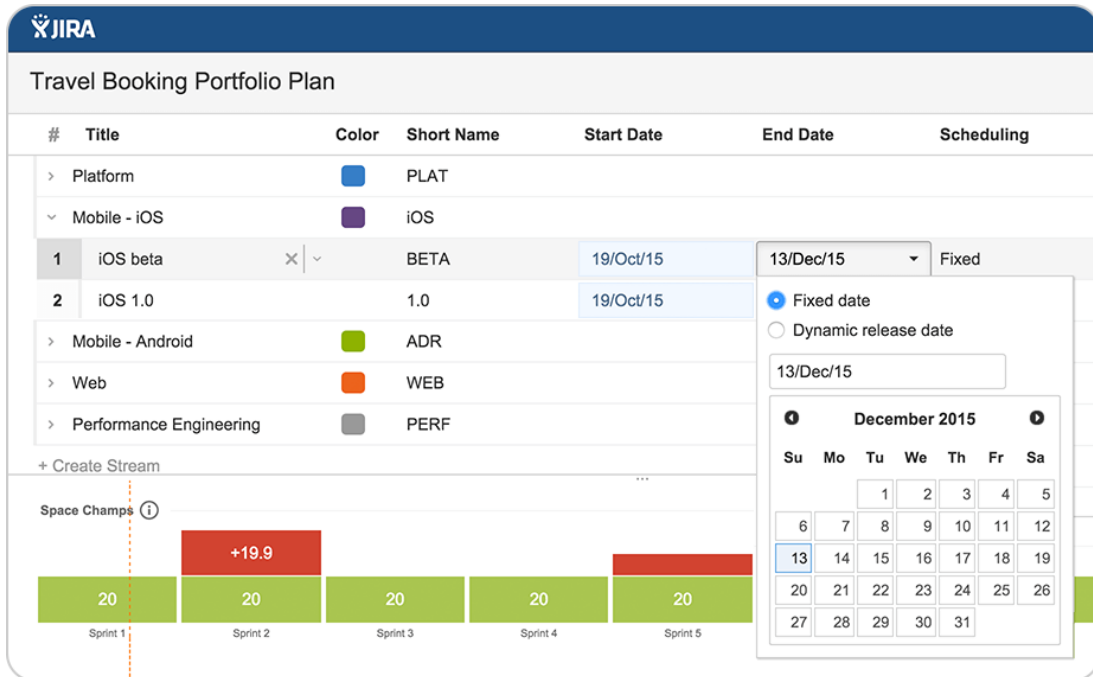
Figure 15: Portfolio Plan of JIRA Software - Management (Atlassian Enterprise, 2016)

- To track progress and report (Figure 16).
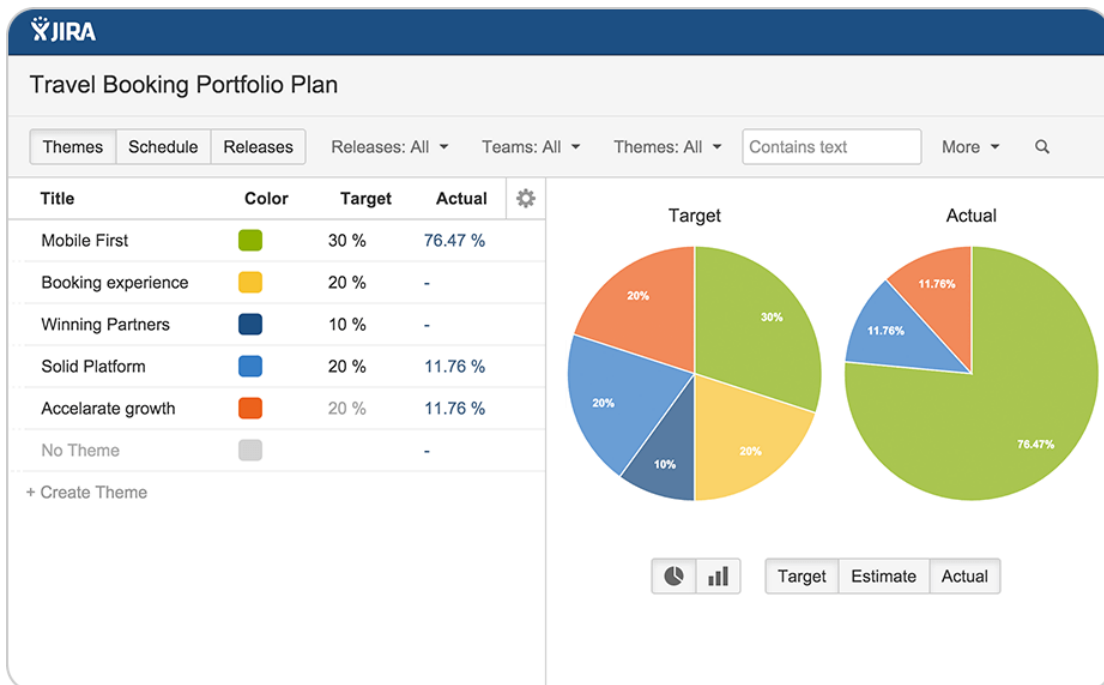
Figure 16: Portfolio Plan of JIRA Software - Reporting (Atlassian Enterprise, 2016)

2.6.3 Social tool

The evolution of WEB to WEB 2.0 makes the appearance of social media. Web 2.0 platforms are organized around people and their tools combine micro content from different users with a shared interest (Alexander & Levine, 2008). In other words, social web is *"an ecosystem of conversation among people. (...) are driven by human-generated content and made scalable by machine-readable data"* (Gruber, 2006, pp. 994).

Social tools are focused on communication and are an improvement for agile software. Good communication is essential to obtain higher quality and better progress, understanding as communication the meetings, conversations, documentations, inspections and so on (Hanakawa & Okura, 2004). Social tools can be a way to generate sense of community, trust and morale between team members (Merwe, 2016).

In project management context, social tools facilitate the connection and communication among teams and stakeholders by instant access and real time sharing from any location, at any time. For large teams in multi-national organizations, this feature is essential, empowering project managers *"to make decisions, share information and collaborate, to streamline processes and engage the team with stakeholders, partners and vendors"* (Merwe, 2016, pp. 140).

Some examples of social tools for project management are:

- LinkedIn;
- Facebook;
- Yammer;
- Google+;
- Twitter;
- Blogs;
- Wiki;
- Youtube;
- Whatsapp;
- Slideshare;
- Webinar;
- Podcasts.

Social tools have changed the way project communication is done and has become a measure of project success (Merwe, 2016).

2.6.4 Comparison of PM tools

The following table (Table 3) was done in order to compile and compare all the tools addressed during the literature review using the criteria proposed by Ahmad and Laplante (2006).

Table 3: Comparison of PM tools and techniques

	MS Project	Agile Software	Social Tool	Enterprise PM
Task Schedule	X	X		X
Resource Management	X	X	X	X
Collaboration		X	X	X
Time Tracking	X	X		X
Estimating	X			X
Risk Assessment		X		X
Reporting/ Charts	X	X		X
File Attachment		X	X	X
E-mail notification		X	X	X
Process/Methodology	X	X		X
Portfolio Management		X		X

As shown on Table 3, Enterprise PM (EPM) is the most complete tool, having all the functions of the criteria proposed. In other words, EPM tool integrates the features of MS Project, agile Software and social tool in one.

3. RESEARCH METHODOLOGY

This Chapter presents the research methodology adopted on this master dissertation project through general concepts, philosophies, approaches, strategies, time horizons, techniques and procedures.

Research is defined by the Oxford Online Dictionaries (2016) as *"the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions"*. The way to solve the research problem achieving that goal is called research methodology (Kothari, 2004).

According to Saunders, Lewis, & Thornhill (2009), the research process should accomplish the steps presented on Figure 17.
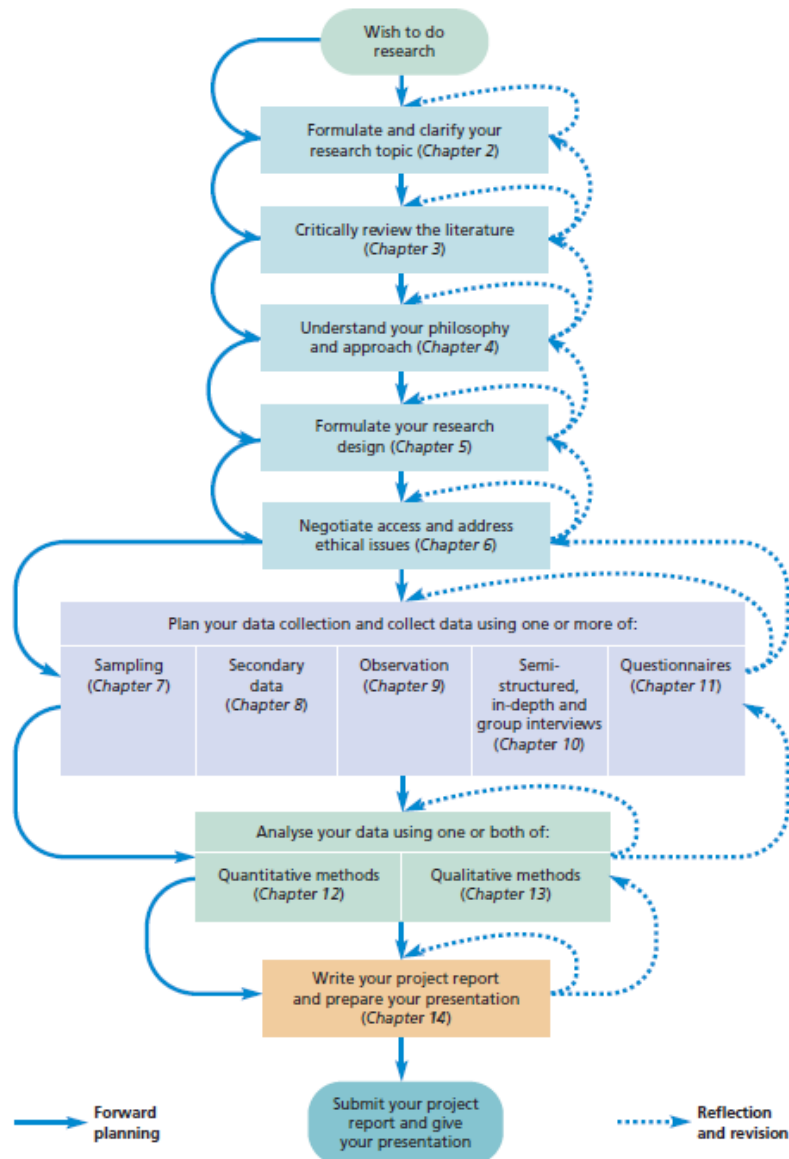
Figure 17: Research Process (Saunders, Lewis, & Thornhill, 2009)

As it is shown on Figure 18, the research methodology can be seen as a set of layers that need to be peeled off, one by one, starting by most common research philosophies, followed by approaches, strategies, choices, time horizons and techniques and procedures. The philosophy adopted influences the subsequent selections of the inner layers, because the philosophy chosen affects what to be done to solve the problem, but also how we understand it (Saunders, Lewis, & Thornhill, 2009).
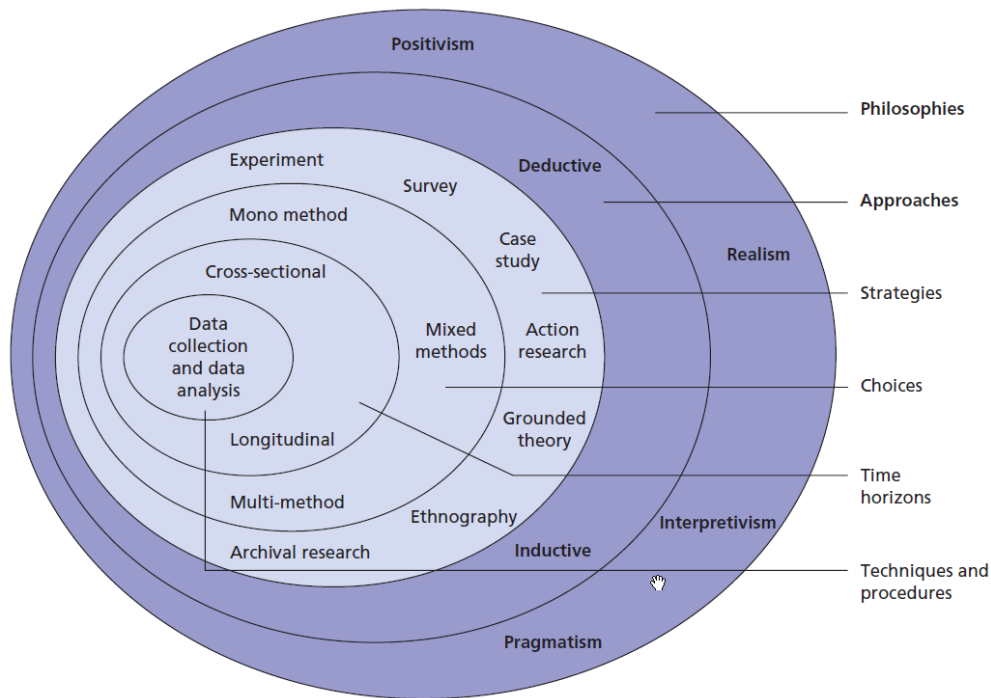
Figure 18: The research philosophy (Saunders, Lewis, & Thornhill, 2009)

- Philosophies

Research philosophy is related to the nature and development of knowledge and depends on our own perception of the world. The most common are (Saunders, Lewis, & Thornhill, 2009):

- Positivism: Natural scientist philosophical position. *"Working with observable social reality and that the end product of such research can be law-like generalizations similar to those produced by physical and natural scientists"* (Remenyi et al. 1998, pp. 32 in Sanders, Lewis, & Thornhill, 2009, pp. 113).

- Realism: Scientific enquiry. Assumes that reality is the truth and it is not related, or independent of our mind.

- Interpretivism: Follows the tradition that argues that we are continuously interpreting the social world and our own meanings and actions are influenced by it.

- Pragmatism: Assumes that knowledge is not a certainty, it is incomplete and estimated, dependent on the research question to be answered. Pragmatism applies different perspectives in practice, in order to support the collection and interpretation of data.

▪ Approaches

Research approaches can be deductive or inductive (Saunders, Lewis, & Thornhill, 2009):

- Deductive: Departs from existing theory, develops one or several hypotheses and, then, selects one or several strategies to collect data and test the hypotheses.
- Inductive: Departs from the data collected and develops a theory by analyzing them.

▪ Strategies

Strategies can be understood as a science that studies how research should be done with scientific rigor. Each research strategy will involve research methods and techniques for data collection and specific procedures, resulting in different strengths and weaknesses. Every selection will also consider the logic behind it by justifying and explaining which method or technique is more suitable (Kothari, 2004).

There are many different strategies, the most commonly used are described below (Saunders, Lewis, & Thornhill, 2009; Romero, 2015):

- Experiment (Figure 19) – close to natural sciences. Explanatory and exploratory research that answers questions as "how" and "why";
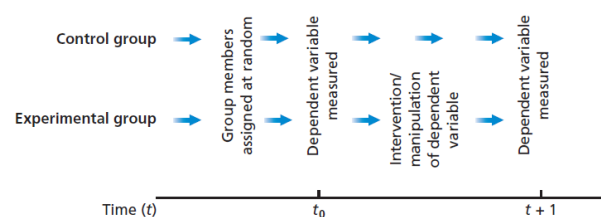
Figure 19: Experiment strategy (Sanders, Lewis, & Thornhill, 2009)

- Survey – frequently used in deductive approaches. It answers questions as "who", "what", "how much" and "for how much";
- Case Study – research detailed and intensive about one or several specific cases. It answers questions as "why" and "how";
- Action Research – Active and cyclical research process (see Figure 20) for continuous improvement, implying change and the active participation of the

researcher engaged with the workers (collaborative environment). It answers questions as "how";
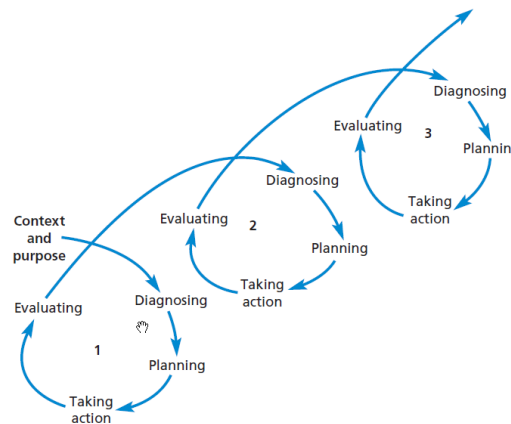
Figure 20: Action Research (Saunders, Lewis, & Thornhill, 2009)

- Grounded theory – theory building by induction and deduction;
- Ethnography – usually used under an inductive approach that presupposes that the researcher has a long contact with the object of study;
- Archival research – based on documents analysis.

▪ Time horizons

Time horizons of the research can be longitudinal or cross-sectional, depending on the time of the study. Cross-sectional is when the research is about a particular time and longitudinal is when the change and development are studied over time (Saunders, Lewis, & Thornhill, 2009).

▪ Techniques and procedures

Techniques and procedures (research methods) are also part of the research methodology, it is the way researchers obtain and analyze data, performing research operations (Kothari, 2004).

They can be divided in two steps: data collection and data analysis. Data can be qualitative or quantitative, requiring different methods of analysis. Some techniques for data collection are: sampling, observation, interviews and questionnaires. And, about data analysis, the methods can be qualitative (non-numeric or qualitative data) or quantitative (numeric data) (Saunders, Lewis, & Thornhill, 2009).

On this research, the methods on focus are:

- <u>Observation</u> – it is a method of data collection where the researcher collects information by his own observation without resourcing to data obtained by others, or asking anything (Kothari, 2004).

- <u>Interviews</u> – it is a method of data collection that involves interaction (Kothari, 2004). Can be structured (based on a predetermined questionnaire), semi-structured (researcher has some themes and questions that have to be answered) or non-structured (informal, free talk) (Saunders, Lewis, & Thornhill, 2009).

- <u>Documental analysis</u> – it is the analysis of the contents of documentary materials (books, reports, newspapers, letters, e-mails, etc.).

- <u>Focus group</u> – it is a group interview that focuses attention on an experience and its effects (Kothari, 2004). In other words, focus group is *"a technique involving the use of in-depth group interviews in which participants are selected because they are a purposive, although not necessarily representative, sampling of a specific population, this group being 'focused' on a given topic"* (Lederman in Rabiee, 2004, pp. 655).

  ▪ Considerations for the research on focus

Table 4 summarizes all the options made for the research methodology adopted for this master dissertation project.

Table 4: Choices of the research

Research Choices	
Philosophy	Pragmatism
Approach	Deductive
Strategy	Case study
Time horizon	Cross-sectional
Techniques and procedures	Observation, semi-structured interviews, document analysis and focus group

The main focus and the more critical choice concerned was the strategy. Analyzing all the strategies above described, the most suitable for the present research were case study and action research.

After a brief reflection, action research was excluded because of the cyclical nature of its research spiral (Figure 20) - the research time for a master dissertation was not sufficient to do

more than one cycle of diagnosing, planning, taking action and evaluating. Therefore, the research methodology adopted was case study.

Case study is a qualitative methodology that supports research on studying complex phenomena within their contexts (Baxter & Jack, 2008).

Case Study methodology is appropriate when (Baxter & Jack, 2008):

- The focus is on the answer for "why" and "how" questions;
- The behaviors of those involved in the study cannot be manipulated;
- It is difficult to separate the phenomenon and context;
- Contextual conditions are relevant to the phenomenon under study.

Case Study phases are schematized on the following Image (Figure 21):
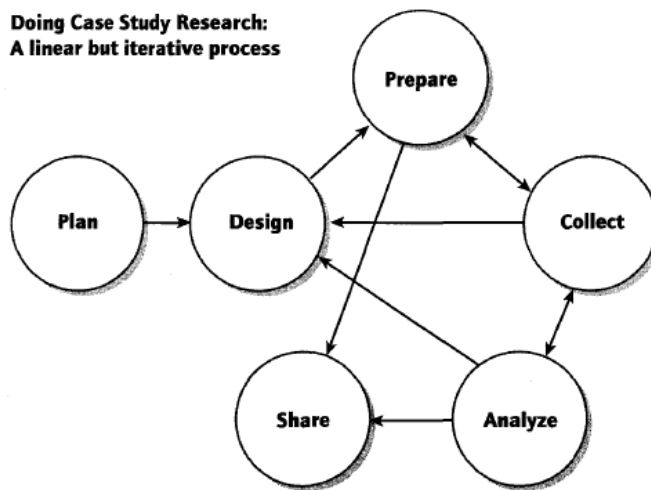
Figure 21: Case Study phases (Yin, 2009)

Contextualizing with the research, the phases followed were (Figure 22):
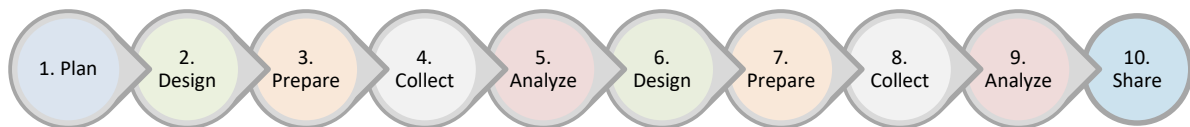
Figure 22: Case study phases done

1. **Plan:** Definition of research choices (Table 4) – Chapter "3. Research Methodology".
2. **Design:** Definition of specific research objectives – Section "1.2 Objectives".
3. **Prepare:** Adaptation to the study field, MFT3 Bosch section, and search of literature review – Chapter "2. Literature Review".

4. **Collect:** Collection of data through observation, document analysis and semi-structured interviews to coordinators of the section approaching questions about how they work and which are the main difficulties/problems – Chapter "4.5 Descriptive Analysis and Data Gathering"

5. **Analyze:** Data analysis in order to find out the problems and what should be done.

6. **Design:** Definition of improvement proposals – Chapter "4.6 Improvements proposal".

7. **Prepare:** Development of proposals in order to implement them – Chapter "5 Results and Discussion".

8. **Collect:** Inquire the impact of the improvements through focus group divided by knowledge area.

9. **Analyze:** Discussion of results and conclusions – Chapters "5 Results and Discussion" and "6. Conclusion and Future Work".

10. **Share:** Sharing the research through the report and implementation.

4. CASE STUDY ANALYSIS

This Chapter addresses contents about the case study characterization and analysis. Since this dissertation project was developed in a company, firstly, Bosch is introduced and the specific section where the research was developed, MFT3.

According to the context of this case of study, Bosch is described in a general way. Since the case study has as main subject the project management (PM), it is fundamental to understand how it works at Bosch, thus, information about project management at Bosch is also summarized. Additionally, Track&Release Software used at Bosch is addressed too, because it is the software used to develop some improvements proposed in this dissertation project.

Section 4.4 introduces the MFT3 section in a general way and mentions how they have been using the methodologies and tools previously mentioned, PM and T&R Software. Finally, Section 4.5 describes the case study problem and data gathering, and lastly Section 4.6 presents the improvements proposal.

4.1 BOSCH

Robert Bosch GmbH was born in 1886 and founded by Robert Bosch as "Workshop for Precision Mechanics and Electrical Engineering" in Stuttgart, Germany. Nowadays, Bosch is around the world with 360 subsidiaries and regional companies in over 50 countries and sales and service partners in 150 countries. The business sectors are divided in four: mobility solutions, industrial technology, energy and building technology and consumer goods. And it is known by the following logo (Figure 23):

Figure 23: Logo of Bosch (Bosch, 2015a)

One particular thing about Bosch is its culture. It has the slogan "We are BOSCH" and they are guided by the codes of the following picture (Figure 24):

Figure 24: Bosch conduct code (Bosch, We are Bosch, 2015c)

The business sector in focus is mobility solution, which is divided in nine divisions: Gasoline Systems, Diesel Systems, Chassis System Control, Electrical Drives, Starter Motors and Generators, Car Multimedia, Automotive Electronics, Automotive Aftermarket and Automotive Steering.

This master dissertation was developed in the division Car Multimedia in the factory of Braga, Portugal. Car Multimedia division follows the guide lines of Bosch, but has also other motivated slogan: "Be One, CM. Be One CM" (Figure 25). It means, in the first part, that they are guided to be the best ones in their business area and, the second part, that they work together, as one group, to achieve the first part. It is client-driven and has focus on excellence.

Figure 25: "Be One, CM. Be One CM"

Table 5 presents the products developed at Bosch Car Multimedia division:

Table 5: Products made by Bosch Car Multimedia (Bosch, 2015)

Driver information systems	Display solutions	Solutions for commercial vehicles
Navigation		Coach entertainment
Infotainment	Head-up displays	Truck entertainment
Smartphone integration	Freely programmable instrument clusters	Truck telematics
Software services and smartphone apps	DualView displays	
Eco. Logic Coasting		

Beyond the factory in Braga, Car Multimedia Division is worldwide as is shown on Figure 26.

Figure 26: Car Multimedia Division factories' location

The main factory of this division is "Bosch Car Multimedia, S.A." in Braga, Portugal, which won many awards as Bosch Quality Award (2011), Energy Efficiency Award (2011), Bosch Quality Award (2008), Good Practice Award (2008), Company "Recognized for Excellence" (2007) and EFQM European Award for Excellence (2015). They are one reflection of its importance and success.

Braga factory opened in 1990 and has been growing until now, 2016. It is one of the largest employers in Braga, with 2153 collaborators and 515.6 million euros in sales. There are production lines, departments of research and development, an Electronic Service and a Centre of Bosch IT, Electronic Services (both responsible for Iberia) and Competence Centers. The departments and section of Bosch in Braga are shown on Figure 27 and 28.
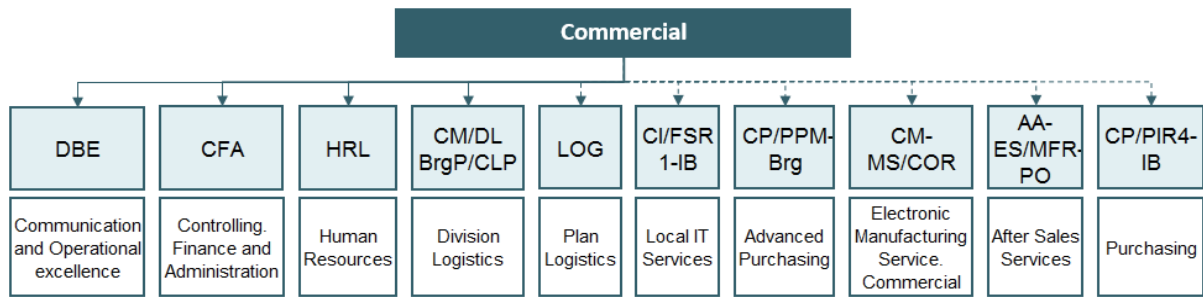
Figure 27: Departments and Section of Commercial area of Bosch in Braga
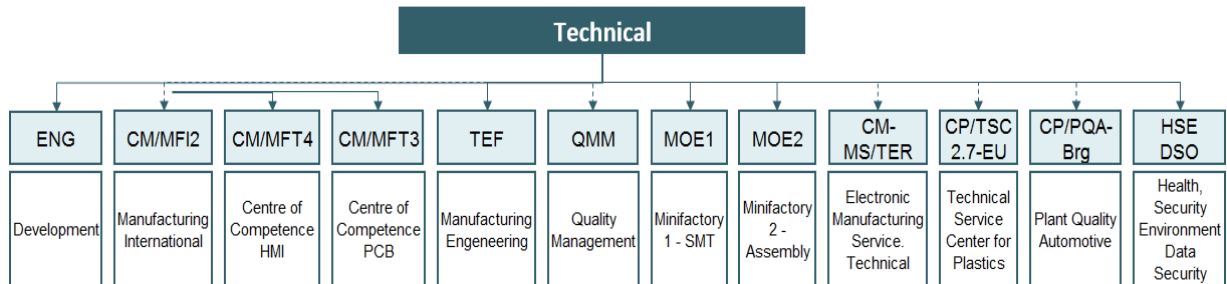
Figure 28: Departments and Section of Technical area of Bosch in Braga

4.2 Project Management at Bosch

Bosch considers project management as a core competence. In order to improve and standardize it, Bosch created a central directive named "Project Management at Bosch" and a book "Robert Bosch Project Management Body of Knowledge" (RBPM-BoK) based on PMBoK of PMI (Bosch, 2015b).

PM at Bosch has the main focus on assessment and review that it is the result of the connection between: strategy and leadership; support; qualification and career; and processes and methods (Figure 29).

Figure 29: Organization of PM at Bosch (Bosch, 2015b)

PM definitions adopted by Bosch are very similar to PMI's definitions presented previously, in the literature review. Bosch adopted the PM grouping process of PMI (initiating; planning; executing; monitoring and controlling; and closing) and created a project management life cycle adequate to its own processes, shown on Figure 30.
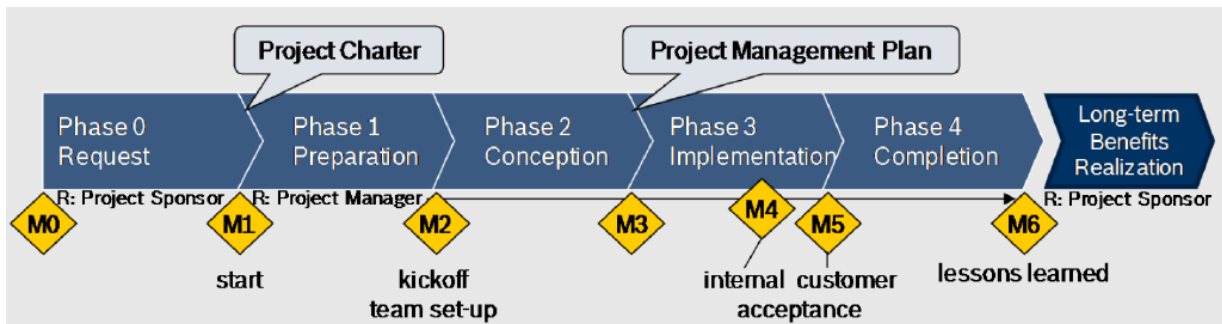
Figure 30: Bosch Project Management Life Cycle (Bosch, 2015b)

In Figure 30, the yellow lozenges represent the project milestones that usually are called as quality gates (QG).

Bosch has different types of project, they can be product engineering process (PEP) or production process development (nonPEP). The type of projects studied was the projects related to production process development, which has the project life cycle shown on Figure 31. These projects follow CM Directive: Production process development.
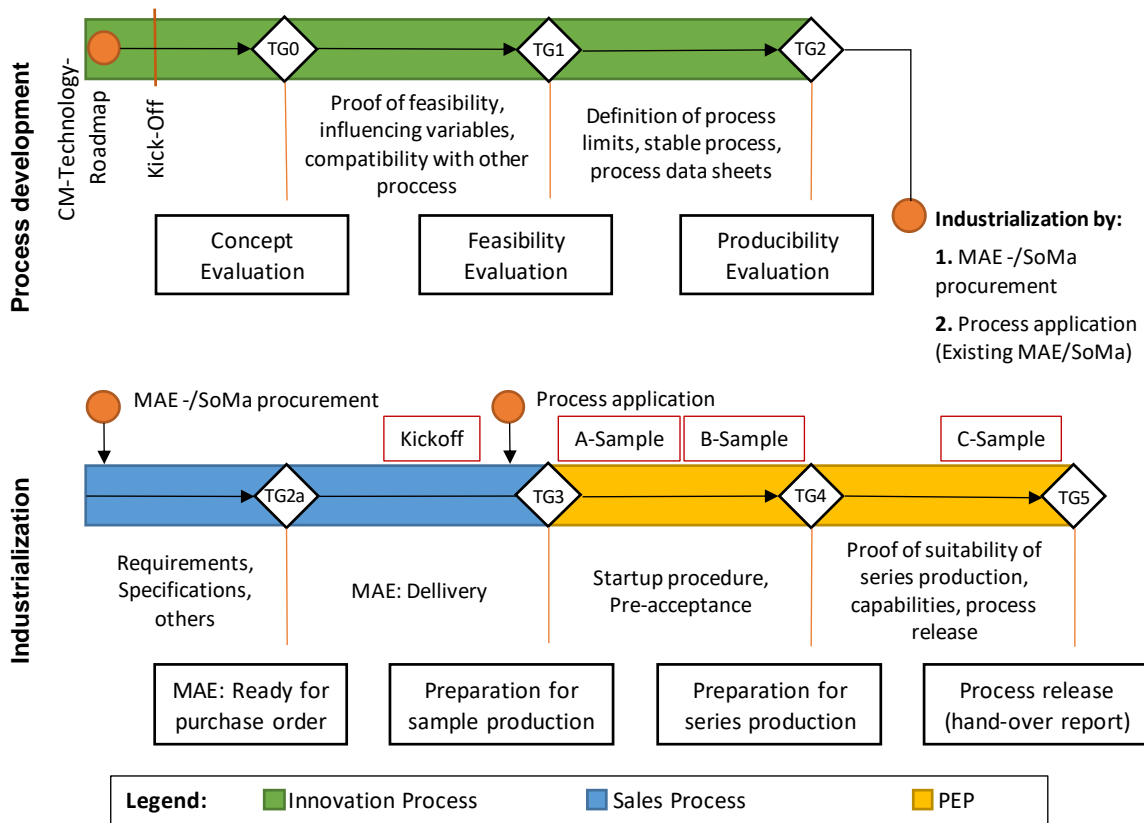
Figure 31: Project life cycle to development projects (nonPEP) (Bosch, 2016)

TG means Technology Gate which has the objective to assure the production process development, from the beginning to the end of the project, contributing to preventive quality assurance. It is not necessary to do all the TGs mentioned on Figure 31, mandatory TGs depend on project type (Bosch, 2016).

Bosch non-PEP projects can be classified in four types: A, B, C and non-Project. The first approach is to classify if the project is considered a non-project or not. To be a project, it has to accomplish the following requirements (Bosch, 2015d):

- Limited in time and unique;
- The results constitute a new status;
- The time exceeds 6 months;
- The results are also used by other departments;
- It is needed a separate budget;
- Resources from other departments are also required;
- The sponsor demands project monitoring in a steering committee or costs exceed 50.000€.

If the project satisfies those requirements, further it can be classified as type A, B or C, according to the characteristics shown on Table 6. In Table 6, it is also shown which TGs are mandatory or not according to the project type. Non-projects do not have to do TGs, they are optional.

Table 6: Types of CM Projects (Bosch, 2015d)

Type	TG0	TG1	TG2	TG2a	TG3	TG4	TG5	Characteristics
A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	• Long-term impact to CM • New in new framework • Multiple cultures • Multiple fields of expertise • Highly complex structures • Core competence
B	Yes	Opt.	Yes	Opt.	Yes	Opt.	Yes	• Mid-term impact to CM • New within existing framework • Several cultures • Several fields of expertise • With few sub-projects • Key competence
C	Yes	Opt.	Opt.	Opt.	Yes	Opt.	Yes	• Short-term impact to CM • None innovation • One cultures • One field of expertise (standard) • Without sub-projects • Standard competence

Project documents and information from projects are stored on Docupedia, one tool available on Bosch intranet (Bosch, 2016).

4.3 Track&Release Software at Bosch

Track&Release (T&R) is a Bosch tool powered by Atlassian JIRA. T&R is an issue tracking platform that allows professional, systematic and effective management of tasks of any kind (OPL, software bugs, project tasks, change requests, improvements, etc.) (Bosch, 2015d).

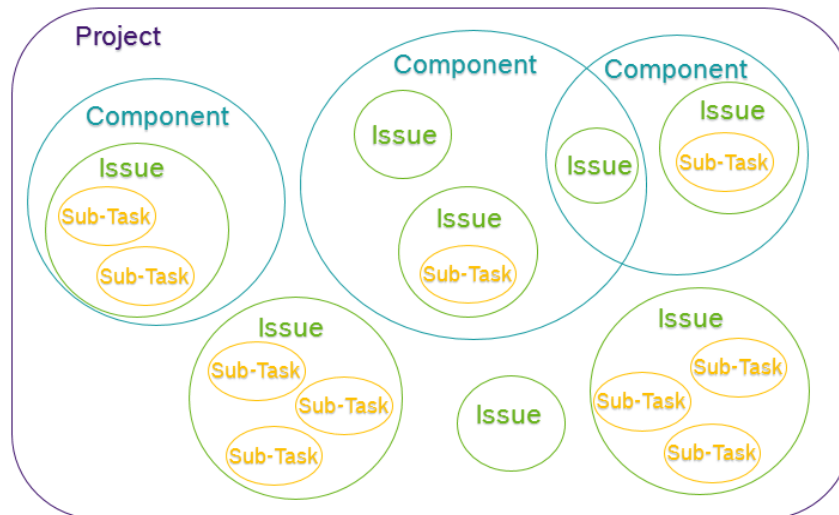It has a logical organization explained in Figure 32.

Figure 32: Organization of T&R (Project, Component, Issue, Sub-task)

- <u>T&R Project:</u> It is the main group of T&R that contains all issues, components, subtasks, and so on.

- <u>T&R Component:</u> It is a sub-section of a project that collects issues in smaller groups allowing management and categorization of issues in a better way.

- <u>T&R Issue:</u> It is a building block of a project. Can be a task, a request, a bug, a meeting and so on.

Every issue is part of a project and can be associated to one or more components.

The issue name contains the key of the project to help on identifying it.

- <u>T&R Sub-task:</u> It is a smaller task inside of a main task (or other issue type).

- <u>T&R Versions:</u> It is a milestone for the project. Issues can be associated to versions.
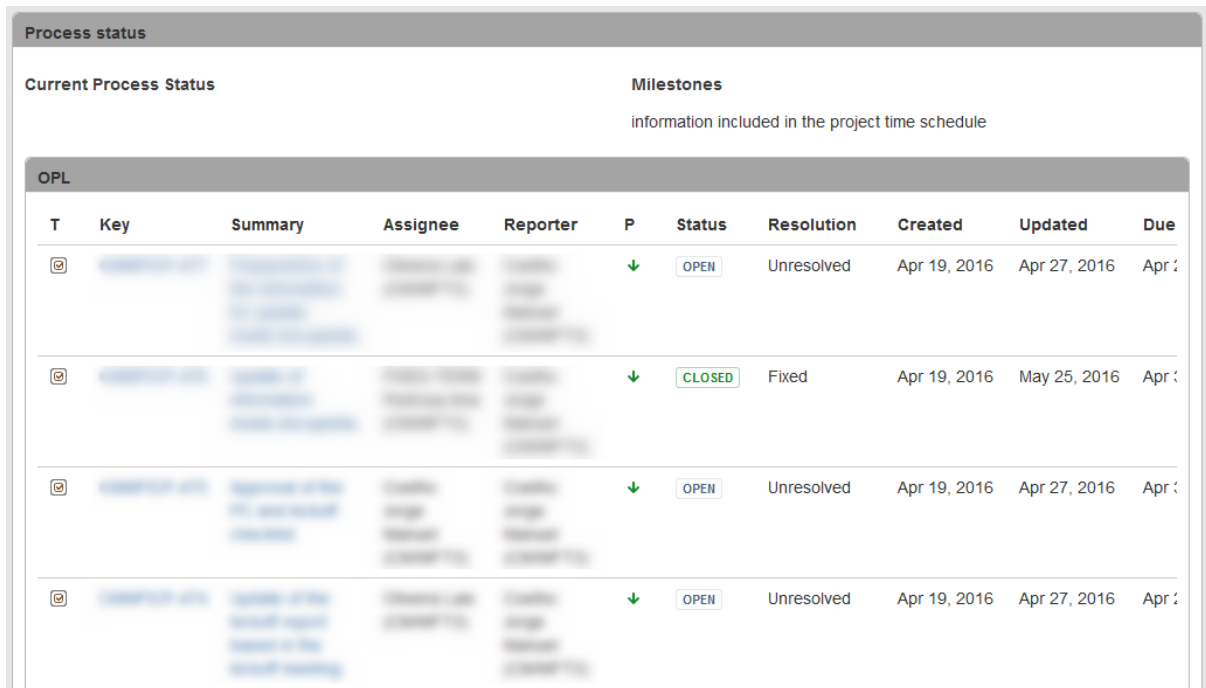
For example: Some issues have to be done before some sample of the product. That sample of the product is a version and those issues are associated to it.

The main objectives of this tool are:

- to capture and organize issues, prioritize and take action on what is important and stay up to date with what is going on around;
- to use powerful reporting functionalities (e.g. monitor progress on project tasks, cost overview);
- to be immediately notified about changes and updates.

Optionally, it can be added agile option providing boards as Kanban and sprints to help planning and visualizing the issues.

In the case of MFT3 section, they use T&R software for projects in order to list their activities with respective status (open or closed) (Figure 33).

Figure 33: Vision of T&R issues in Docupedia

In this case, the main objective of T&R software is to represent open point lists of a project through automatic synchronization to Docupedia (Docupedia is a platform to share information online, similar to a web-page).

4.4 Section MFT3

Section MFT3 is a PCB (Printed Circuit Board) assembly competence center located in Braga which reports directly to its head department (Manufacturing Technology – MFT) located in Hildesheim, Germany. The present master dissertation was developed in this section in order to contribute for a better organization of it.

MFT3 is divided into four sub-sections (Figure 34): process industrialization and plants support; assembly and interconnection technologies; reliability and laboratory; processability and footprint design; and project office and information management.
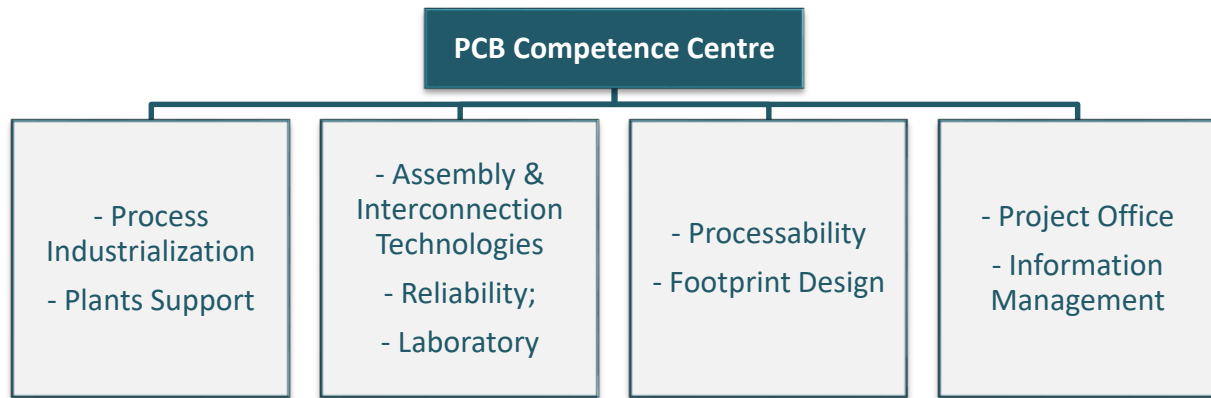
Figure 34: Organization of the section of PCB Competence Centre

Those sub-sections have different activities and responsibilities but all the work is connected. All MFT3 section activities are related to PCB assembly, namely activities related to processes; layout design; sample build maturity approval checklist (SBMAC); component "processability" release (CPR); activities of laboratory and projects.

The sub-section of project office and information management has, as one of the main objectives, the integration of all sub-sections, bridging between them.

Projects are the type of activity where the collaboration is more evident. Independently of sub-sections, all of them have to work as one team oriented by the project manager.

MFT3 projects are nonPEP, which means that they are about production process development instead of being a product engineering process. Projects have to follow CM directive for production process development (process mentionated on the previous section "Project Management at Bosch"). MFT3 section receives project requests every year, having an average of 23 projects open per month. Usually, a MFT3 project emerges under the scope of a new process or technology. Each project has a duration of approximately 1,5 year with an average cost of 72.000 euros.

In order to support the team integration, Bosch has many available software tools. The main tools found as MTF3 tools were:

- Track&Release (explained with more detail on the previous section "4.3 Track&Release Software of Bosch"): it is an issue tracking platform that can help handling the processes in Release Management, Incident Management, IT Transport Management and other IT related areas.
- Bosch Connect: it is a social tool to share information;
- Docupedia: it is a web-page to share information;

- <u>Microsoft package</u>: for example, Outlook, SharePoint, OneNote and the basic ones as Word, Excel, Power Point, MS Project.

Most of them are not much explored and embedded at MFT3 section. Microsoft package, excluding SharePoint, is the tool most used to perform the section's work. Docupedia is also used to share information about projects.

4.5 Descriptive Analysis and Data Gathering

Bosch is growing really fast, everything is continuously changing, what makes the following of that growth a difficult task. Therefore, the company is committed to continuous improvement, supporting it with collaborative researches with universities.

In this particular master dissertation project, the main problem to tackle was the poor organization of MFT3 section owing to its fast growing of resources in recent years and the increased interest in project management. In 10 years the growth of collaborators, in MTF3, was of 500% (3 collaborators to 30 collaborators), so appeared the necessity to separate functions, create new ones and clarify the division of all subsections. Project management is an example of a new function that appeared in 2013 due to the emergence of project requests with more rigorous project management practices.

Problem solving is a complex process. Being a problem defined as an obstacle, problem solving is finding a way to cross the obstacle. The more common steps to problem solving are (Jonassen, 2011):

1. Understand the problem.
2. Make a plan (improvements).
3. Carry out the plan.
4. Evaluate its effectiveness.

Therefore, to intervene according to the study requirements from the PCB assembly Competence Centre, first, it was important to understand its actual situation and its real necessities. This was achieved through four semi-structured interviews (guideline in Appendix I) with responsible people of each subsection and the head of the section, observation and documents analysis. The main issues were detected as being:

- The lack of clarification of the division of the MFT3 subsections;
- Difficulties on the flow of information (sharing);
- The lack of standardization of processes;

- Difficulties on planning;
- Difficulties on justifying the MFT3's needs (e.g. new resources, more budget) and in how to make visible the work done;
- Few collaboration and communication between the section team.

Crossing the objective of this dissertation - the improvement of the project management practices in order to improve the functioning of the section - with the specific problems detected, it was possible to evaluate and propose some important improvements.

4.6 Improvements Proposal

After the analysis of the actual situation through interviews, observation, documents analysis, the problems origin was quickly detected – weak definition of structures of processes with the respective person responsible. Having identified the problems and matching them with the general objective of this dissertation, the improvement of project management practices, specific objectives were defined: 1) redefinition of an integrated project management process; 2) definition of a WBS template to support project planning; 3) customization of a software tool to support project management practices and 4) the development of a performance measurement system. To achieve these four goals, the following steps were proposed:

1. **Structuring of every process** performed by MFT3, identifying inputs, outputs and responsibilities for each process's task – Standardizing the processes for everyone, including new collaborators (also helping in their integration at MFT3 section) and defining who do what.

Table 7: 1st Improvement Proposal

Problem	Solution	Results/ Benefits
• The lack of clarification of the partition of the MFT3 subsections • Difficulties on the flow of information (sharing) • The lack of standardization of processes	**Processes Structuring**	• Identification of inputs, outputs and responsibilities for each task • Standardization of the processes • Better understanding of the work/information flow • Better integration of new collaborators (by better understanding of processes)

2. Standardization of project management by creating templates, allowing a better planning of all the activities and its performance evaluation.

Table 8: 2nd Improvement Proposal

Problem	Solution	Results/ Benefits
• Difficulties on the flow of information (sharing) • The lack of standardization of processes • Difficulties on planning	**Standardization of PM**	• Creation of a WBS template • Attribution of responsibilities for each project task • Standardization of PM • Easier and faster project planning • Better understanding of the work/information flow

3. Exploring the software tools available at Bosch to support the project management processes.

Table 9: 3rd Improvement Proposal

Problem	Solution	Results/ Benefits
• All problems	**Exploring Bosch software tools**	• Support of activities • Automation • Faster work • Easier communication

4. Customizing an enterprise project management tool to organize all the activities and to help in the planning and tracking.

Table 10: 4th Improvement Proposal

Problem	Solution	Results/ Benefits
• Difficulties on the flow of information (sharing) • Difficulties on planning • Few collaboration and communication between the section team	**Customization of an enterprise PM tool**	• Support of activities • Faster work • Easier Communication • Automation • Total Vision

• Difficulties on justifying the MFT3 needs and in how to show the work done		• Portfolio management • Easier planning and tracking • Resource allocation support • Integration of all the information in a single tool

5. Identifying performance measurement indicators to guide evaluation and to obtain relevant results.

Table 11: 5ᵗʰ Improvement Proposal

Problem	Solution	Benefits/ Results
• Difficulties on justifying the MFT3 needs and in how to show the work done	**Identification of performance measurement indicators**	• Definition of success criteria and critical success factors • Definition of the key tasks

6. Obtain performance measurement system automatically – to obtain indicators which describe the work done and section vision without increasing the work to get it.

Table 12: 6ᵗʰ Improvement Proposal

Problem	Solution	Benefits/ Results
• Difficulties on justifying the MFT3 needs and in how to show the work done	**Development of performance measurement system (Supported by EPM tool)**	• Vision of the MFT3 section work status; • Way of justification of needs or results; • Implementation of improvements; • Automatic obtainment – do not increase work. • Increasing project success

5. RESULTS AND DISCUSSION

The purpose of this Chapter is to present the results and their discussion. In order to have a better understanding, the results were cross checked with the objectives, dividing this chapter accordingly, by the four objectives of this dissertation: redefinition of an integrated project management process; definition of a WBS template to support project planning; customization of a software tool to support project management processes and development of a performance measurement system. Thus, the results obtained for each objective will be addressed.

The improvement proposals were evaluated and the work was developed to try to implement them. Most of the proposals were successfully implemented, but the time available to finalize the dissertation project did not allow implementing them all.

5.1 Redefinition of an integrated project management process

The first objective of the dissertation is the redefinition of an integrated project management process in order to standardize it, defining responsibilities, inputs and outputs. This objective is covered by the first improvement proposal: creation of structures of every process performed at MFT3.

The structuring of processes should be the first step, since an overall picture of the whole process, dependencies and outcomes will facilitate real time control and monitoring, fostering increased performances.

It was not possible to obtain enough support to structure all the processes due to the lack of time of MFT3 collaborators. So, the focus was centered on project management. Along this line, the project process was redefined attributing inputs, outputs and responsible for each task based on Bosch Car Multimedia (CM) directives.

Mapping structuring was the technique used, which is a visual representation that connects tasks (can also connect inputs and outputs), shows the workflow and clarifies tasks, providing a total vision (Anjard, 1996), resulting in a flowchart.

The flowchart (Appendix II) was divided into project phases defined at Bosch CM directive for production process development: concept evaluation, feasibility evaluation, producibility evaluation, machinery and equipment (MAE), preparation for sample production, preparation for series production and process release (described in Section 4.2). TGs and every step required in each phase are represented. In this way, it is also possible to see what it is necessary to be done for each TG. Since the only difference in different project categories are the TGs required, it was decided to map the most complete project process possible, being a

common departing structure adequate for all projects' categories (A, B, C and non-project). Then this structure will only need to be customized for each project category by excluding some step(s) previewed for the non-applicable TGs.

In order to validate the flowchart, two meetings took place, one with MFT3 head of section and the four sub-section responsible and the other with all MTF3 team. The validation was accomplished until TG1 (phase concept evaluation and feasibility evaluation) due to lack of time of MFT3 collaborators. Despite considering important the validation of the flowchart, the daily work prevailed against these meetings. Thus, the steps after TG1 should remain as proposals. However, a similar methodology could be followed as a future work to finish the validation process.

This redefinition was done jointly with another M.Sc. student previously mentioned, since both needed the results of this work to develop both master dissertation projects.

5.2 Definition of a WBS template to support project planning

Since projects managing at MFT3 section was adopted, the improvement of PM practices was defined as an objective. Being project planning one of the main aspects of PM, it seemed essential to improve it through the creation of a WBS template for project planning. This objective is included in the second improvement proposal: standardization of project management.

Based on the redefinition of an integrated PM process done previously, a WBS template was created (see WBS technique in Section 2.3), with the aim to create a repeatable process improving the knowledge of it and its success.

The WBS has as first level the vision of end product that, in these cases, are the name of the project. Then, the work is divided into work packages in order to help on managing through evaluation if the project plan matches with the scope and objectives. The WBS have to include all the work done and its decomposition should increase some scope of work (PMI, 2006).

The structuring division proposal on literature review for the second level of project WBS are: constraints chart, project's WBS and milestones chart.

The constraints chart has the external work as the request, project charter approval and sample production. The project depends on these tasks but they are out of project management control.

Project's WBS describes the work done by the team in order to achieve the objectives. Project's WBS can be divided in two work packages (third level): project management and process development.

Project management work package groups all the tasks done by project manager in order to manage the project, known as project management life cycle, which, usually, has the following phases: initiating, planning, executing, monitoring, controlling and closing. In this case, the division was done in less phases in order to simplify it, being them the initiating, planning, project following and closing.

Process development work package groups all the tasks that have to be done by the team to achieve the specific project objectives. It matches with the product life cycle that, in this case, are divided, according to Bosch CM directive for production process development, in the following phases: concept evaluation, feasibility evaluation, producibility evaluation, machinery and equipment (MAE), preparation for sample production, preparation for series production and process release.

At last work package of second level, there is the milestone chart which describes all tasks that mark a significant project change or stage. For this template, it was defined as milestone the project charter (marks the beginning of the project), TGs (technology gates which are audits of the project) and handover report (marks the project end).

The template was done with the support of MS Project and it was attributed a responsible and a estimating time duration for each task with the purpose of improving the organization, allocation and control of work, developing also a better communication and motivation through team work.

Nevertheless, the project manager still has power to change and adapt the WBS template to better adjust to each specific project. The WBS template is presented in Appendix III.

Since this template is based on the redefinition of an integrated project management process, the status of its validation is the same of the flowchart, previously addressed.

5.3 Customization of a software tool to support project management processes

After redefinition and standardization, it was time to explore Bosch software tools. Bosch has many internal software tools that are not much explored. The third and fourth improvement proposals were tackled jointly, in order to find a tool with functionalities of an enterprise project management to support, namely, portfolio management.

In section 2.6.1 an example of an enterprise project management system MS Project Server, was described. Since Bosch has Microsoft package including SharePoint, this possibility – getting MS Project Server –, seemed to be the better one because, besides having all the features sought, it can also integrate the other Microsoft tools (outlook, project and so on) commonly used by MFT3 collaborators. It was a long search inside intranet of Bosch in order to obtain some information about the restriction of MS Project Server at Bosch. With the aim of a better understanding and certification if it is possible to get it or not, I was also contacted local informatics department and some collaborators of USA Bosch, since they are owners of the pages of intranet that mentioned the MS Project Server. In conclusion, other people were also interested in the obtainment of this software but, due to Bosch restrictions, "MS Project Server" was not possible.

The more adequate tool found, taking into account the restrictions of software tools available at Bosch, was Track&Release (T&R), detailed in Section 4.3 "Track&Release Software at Bosch". It was possible to customize this tool in order to adapt it for MFT3 activities and projects, with the support of the Informatics department.

Track&Release is a software to manage activities. Every activity is considered as an issue and it can be organized into groups called "components". T&R also fits in portfolio management principles, allowing the projects selection based in resource allocation.

Due to common problems in portfolio management, such as, resource struggles and a lack of the overall projects and activities overview to take better decisions (Blichdeldt & Eskerod, 2008), it was proposed to include every activity of the MFT3 section in T&R. Usually, the daily work prevails over project work (roughly 85% and 15%, respectively) and the solution found to decrease this resource struggle was the insertion of the maximum activities in this T&R software, since T&R does not permit to allocate percentages of work occupation to collaborators. Thereby, the proposals improved the MFT3 resource management, one of the section main difficulties, as well as portfolio management. Other advantage, it is the creation of a database with all what it is done in MFT3 section.

The customization is presented on Appendix IV and it is summarized on Table 13.

Features	Benefits
More issues type	Register of all activities
Kanban board	Better vision and self-organization
Time tracking	Measure the effort of each activity
Files attachment	Better communication and collaboration
Security level	Restriction of information
WBS template for projects	Standardization of project WBS and simplification of work (easier and faster)
Gantt Chart	Improving time management through Gantt chart (time lines)
Approval status	Permit approval workflow

Before the proposed customization, T&R had only one type of issue to create – "task", as it is shown in Figure 35. This type is a general issue that did not embrace all MFT3 activities.
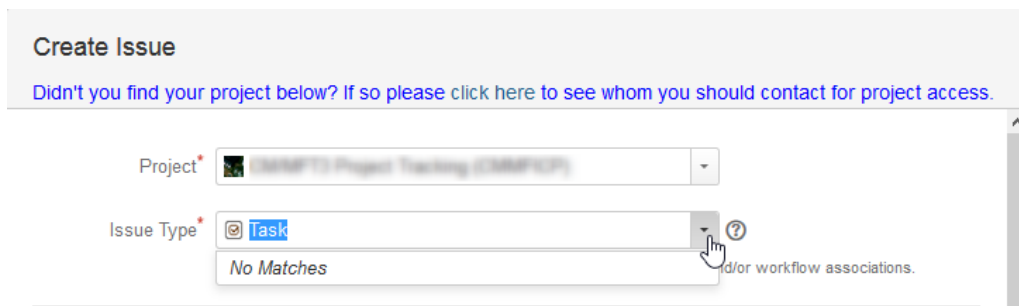

Figure 35: Issues type of T&R standard

So, more issues type (Figure 36) were defined with other fields to embrace all activities:

- Meetings – Allows to track open point list resulting from the meeting and to extract a meeting minute;

- Request – Allows to receive requests from other departments and to register them;

- Cost – Allows to register all purchases done;

- Analysis – Allows to receive requests for MFT3 laboratory from other departments and to register them;

- CPR – Allows to register component process ability release (CPR, one activity of MFT3 with specific characteristics).
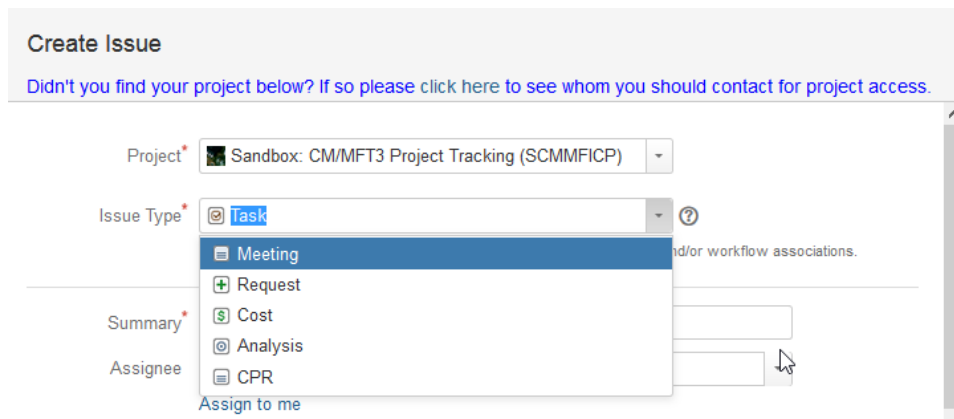
Figure 36: Issues Type of T&R customized

It was also defined a structure to organize the issues through groups ("components"). Every project, process and general activity (as component "processabilily" release (CPR), layout review, layout design (LE), Sample Build Maturity Approval Checklist (SBMAC), step-stencil, purchases and material approval) is defined as a "component", being like a group that have issues inside describing the work done. One issue can be part of more than one "component".

It is possible to filter the issues (Figure 37) by groups, fields or resources in order to have total vision of all activities with the same characteristics or to extract to excel to better analyze the data. Other vision option is the Kanban board (Figure 38) that was created, mainly, to organize and prioritize the self-work through the Kanban columns "to do", "in progress" and "done", where all own issues are divided into status. Although, it is possible to have a vision of Kanban board with other filters, for example, vision of all issues of one project into status, independently of the responsible. As the common T&R filters shown in Figure 37, in Kanban board is also possible to filter issues by the same criteria, appearing always divided into columns status.
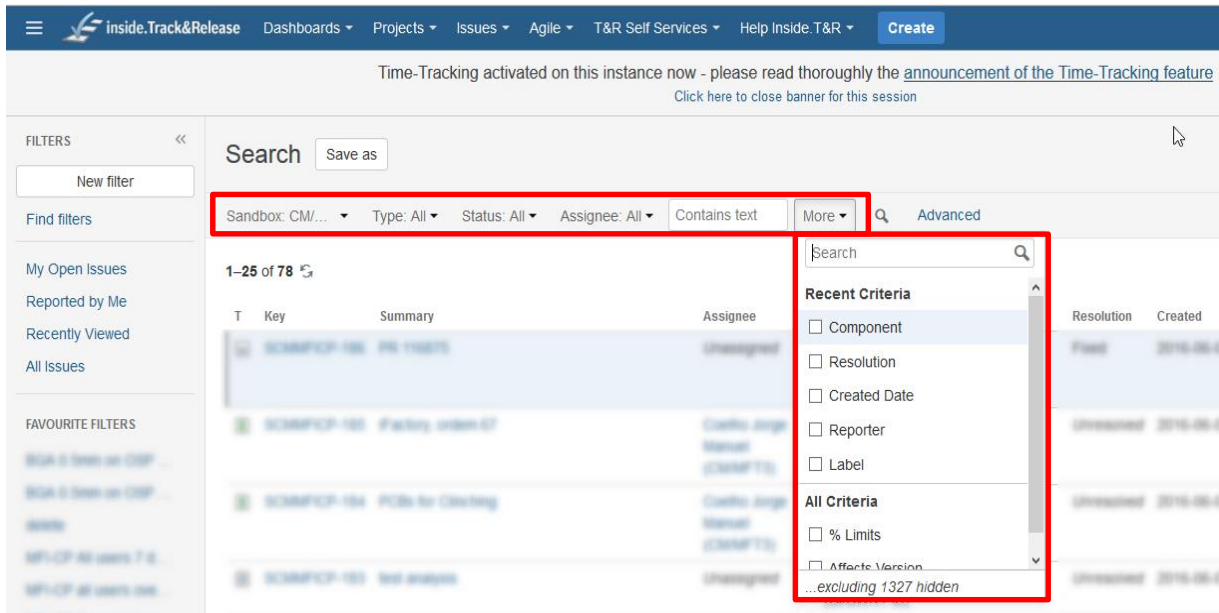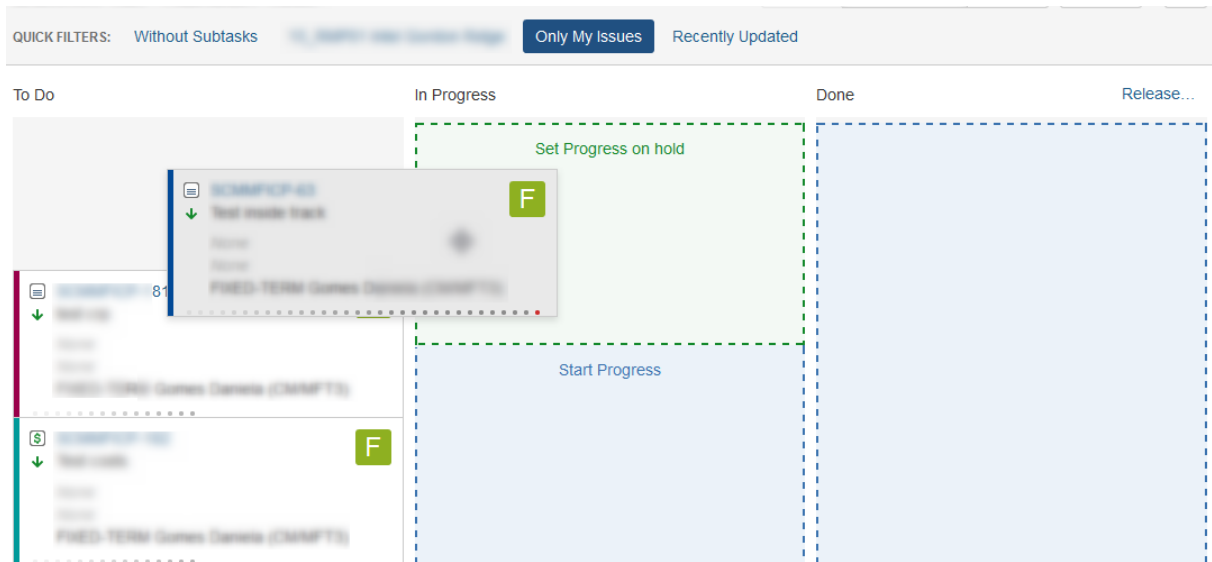
Figure 37: T&R Filtering

Figure 38: T&R Kanban Board

Besides those vision options, a Gantt chart was also implemented, similar to MS Project, to provide a better vision through time lines. As the previous options, Gant chart works also through filters. In Figure 39, it is shown which new fields Gantt chart brought.
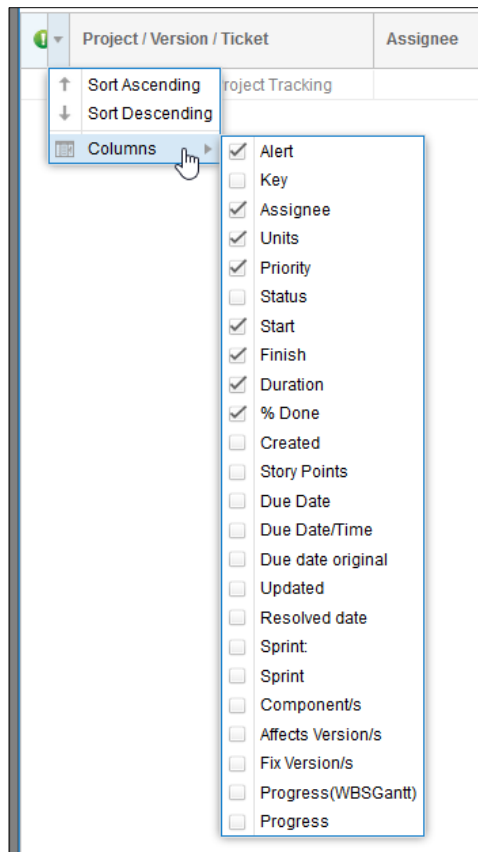
Figure 39: Fields of Gantt Diagram

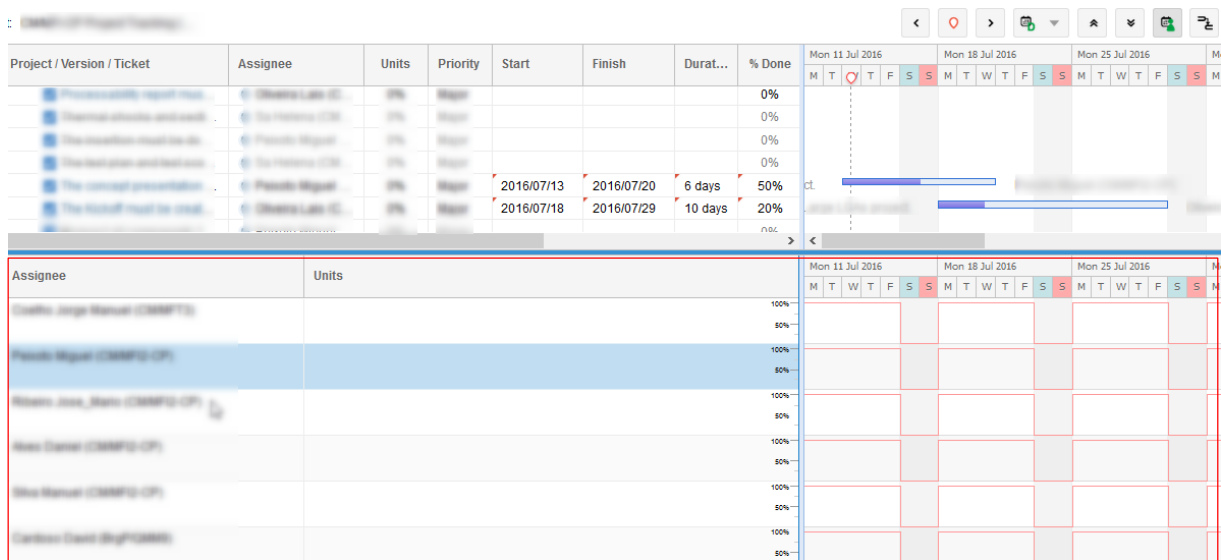The definition of the critical path as well as resource management also possible (Figure 40).

Figure 40: Resource Management of Gantt chart

T&R is also a collaborative tool through comments and assignment to other collaborators. With the purpose of achieving a better collaboration, it is possible to attach temporary files as

a way to facilitate the communication. Other functionality is the connection with outlook through notifications.

Other features were added, such as time tracking (Figure 41) and security level, in order to measure the effort of every activity and to restrict the information, respectively.
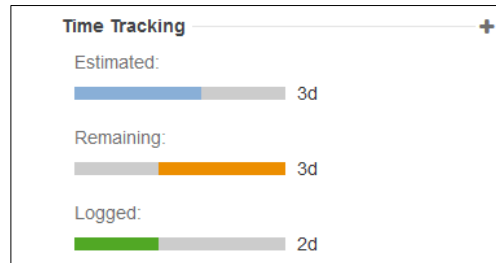

Figure 41: T&R time tracking

An approval status was also integrated to simplify approval workflows, registering all approvals of tasks such as report approvals or some tasks/request approval by the section head.

Finally, directly related to project management, the main improvement was the creation of a WBS template based on the template shown on Appendix III.

As it is shown in Appendix V, the T&R template suffered some adjustments due to T&R restriction of having only two levels of WBS structure. The template created (Appendix V) was for the more complete projects cases. However, the template is editable before its creations, being adaptable to all types of project.

After the creation of every project issues, every collaborator with issues assigned can create sub-tasks in order to develop the issue asked. Every user has to follow the rules of the manual "Instructions and Use Cases for MFT3 T&R" (Appendix VI). It was also created a document to help T&R administrators (Appendix VII).

To help on the adoption of this software by collaborators, work instructions were prepared (Appendix VI), as it was mentioned, and individual meetings with everyone took place with the aim of explaining and testing T&R. After some tests, focus groups dividing collaborators by knowledge area and activities were organized, in order to receive feedback and build consensus about T&R implementation to the respective type tasks. These focus groups had the support of the MFT3 section Head.

5.4 Integration of a performance measurement system

To finalize the execution of the improvement proposals, it will be discussed the identification of measurement indicators and the implementation of a performance measurement system, addressing the last objective of this dissertation project.

Firstly, it was necessary to match the indicators found on the literature with the reality of MFT3 in order to define what should be measured. As Ebert (2009) found in his consulting services' clients, MFT3 has also problems as the lack of historic database to decide on release criteria as well as the unclear definition of how they get work status, decrease risks and improve performance.

The indicators definition was not an easy task since it is difficult to translate the work done in indicators, as well as making them visually clear. Other difficulty was about concepts. In practical situations indicators are not distinguished through performance or result type. Bosch defines every indicator as a performance indicator. And, key indicators are distinguished from others through importance assigned. If indicators are really important to organization, they are key indicators.

Therefore, it was necessary to identify the main activities that have to be followed. The key activities defined are: activities of CoC process; Layout Design; Sample Build Maturity Approval Checklist (SBMAC); component "processability" release (CPR); activities of laboratory and projects. The literature is not very explicit of how we should measure these types of activities, excluding the case of projects. Thus, indicators were proposed based on difficulties found on justifying the MFT3's needs (e.g. new resources, more budget) and in how to show the work done. Therefore, the objectives were knowing the work load status and if the number of resources were adequate, in order to decrease the difficulties found, identify problems and implement improvement actions.

To measure capacity and work status, the more reasonable unit found was the hours of effort because, sometimes, units of activities (ex: reports) do not tell anything about how was the work, it can last hours or months to do one single report. Thus, the following indicator (Table 14) was defined for each area:

Table 14: Measurement indicator for MFT3 activities

Indicator	Metric	Periodicity	Objective	Source	Target
Effort	Hours	Monthly	Measure if resource capacity is adequate to work load	Data from T&R	Resource capacity

In order to standardize the indicator representation, it was proposed the structure shown on Figure 42 representing the effort hours of an activity "example" in each month, the respective accumulation, a target line (represents the resource capacity) and the visual comparison of the last year indicator performance against the target for the actual year.
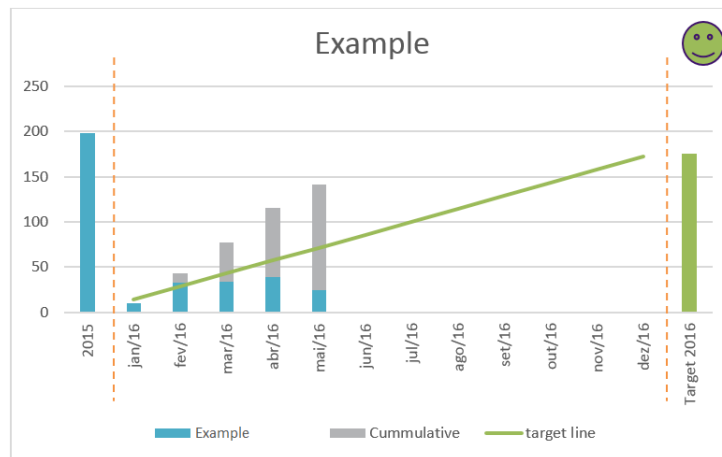
Figure 42: Standard representation structure for KPI

The target line is based on plan and it is a way to evaluate the performance against the expectation in order to rate a smile with the visual status of the activity. The main concern on the definition of this structure was making its interpretation easy and intuitive.

It can be concluded if the target was completed and can be compared with the past year, thus improvements can be decided if necessary.

Going back to project indicators, the literature is richer. In Section 2.5 the following project measurements were identified: requirement status and volatility; product size and complexity; effort; schedule and time; project progress and quality.

Crossing with MFT3 projects, other measures (Table 15) were defined as quantity of TGs done and with which result; the alignment of TG4 with QGC2 (Quality Gate Customer) of product project; cost plan fulfillment and the ratio of plan vs non plan projects.

Table 15: Measurement indicator for MFT3 projects

Indicator	Metric	Periodicity	Objective	Source	Target
Quantity of TGs done	Unit	Monthly	- Requirement status & volatility - Schedule & time	Data from T&R	Resource capacity
The alignment of TG4 with QGC2 of product project	%	Monthly	- Quality	Data from T&R	TGs plan
Cost plan fulfillment	€	Monthly	- Requirement status & volatility	Data from T&R	Budget
The ratio of plan vs non plan projects	% and unit	Monthly	- Effort/planned capacity	Data from T&R	n.a.

The ratio of plan vs non plan projects is only an indicator (Figure 43) measuring if the capacity planned is adequate to the quantity of projects. That is why a target was not defined or the visual (smile) status. In the beginning of the year, it is planned which projects have to be done and the respective resources, however, during the year other non-planned projects appear.
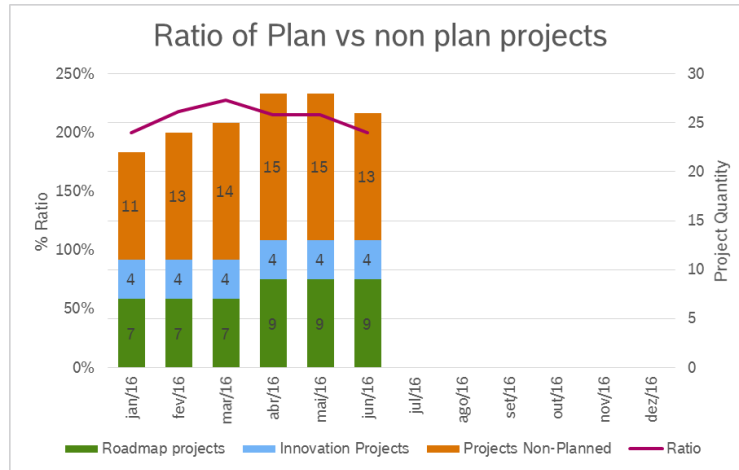

Figure 43: Example of ratio indicator of Plan vs non plan projects

The Key Performance Indicator (KPI) "quantity of TGs done" evaluates if the TGs are positive and if the schedules planned are satisfied. Another requirement for MFT3 projects is to have the results of TG4 before the QGC2 of the product project (quality gate customer - audit of PEP project), so it is important to measure that too. Examples of both of these KPIs are shown on Figure 44. TGs are audits to the projects that are mentioned on Section 4.2. "Project Management at Bosch" and are important milestones to the project. In the TGs measurements, the target of 2016 and target line are based on projects plans.
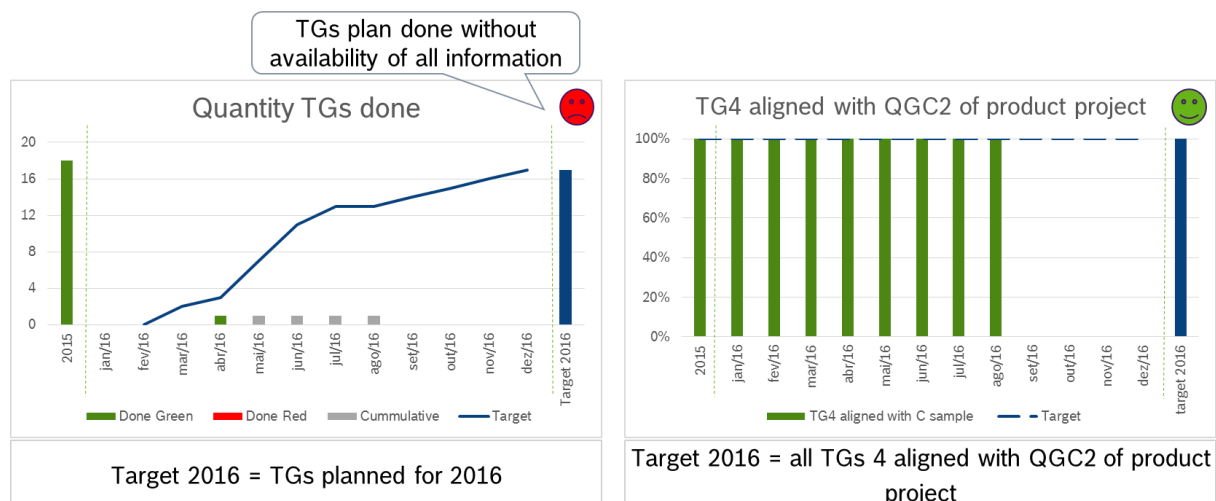

Figure 44: Examples of KPI of TGs done and TG4 aligned with QGC2 of the product project

As long as money is what captures attention, there is one KPI (Figure 45) of costs in order to know if the money spent on projects fulfills the budget available. Roadmap projects are the projects that are defined to do during the year. They are defined in an annual meeting.
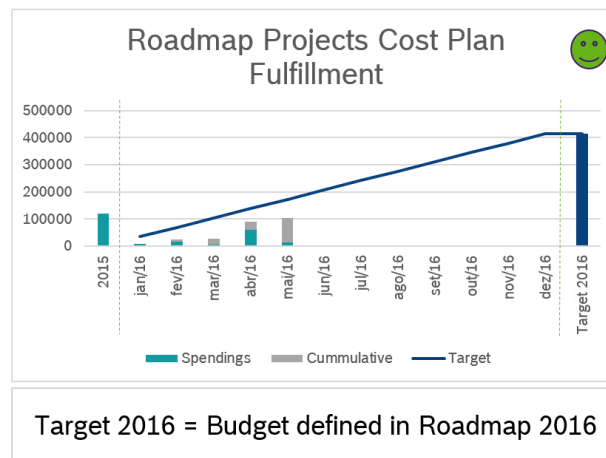

Figure 45: Example of KPI of project cost plan fulfillment

Taking advantage of T&R features, it was possible to extract an EXCEL file of all issues with the respective spent time (effort in hours) and other features. Having that, another EXCEL file was programed to extract the data to construct the KPI's graphics.

The EXCEL file programmed has three visible sheets (Appendix VIII), one is the main sheet with legend and the KPI graphics; other has the TG plan for the current year and the resource allocation; and, the last one has the projects management status.

The user only has to fill the sheet two "resource & TG plan", the other two are protected and filled through programming.

The main sheet of the EXCEL file has a header (Figure 46) with the identification of MFT3 section and a bottom to calculate the KPIs. As it is mentioned in the Figure 46, the sheet "Resources & TGs plan" should be updated before the KPI calculation.

Figure 46: Header of EXCEL file (bigger version in Appendix VIII)

When the bottom is clicked, a programming code (Appendix IV) is activated which will:

1. open the window (Figure 47) to select the EXCEL file extracted from T&R and show a message if any file were selected;
2. copy the T&R data from the file searched to a hide sheet ("Sheet2");
3. format the "Sheet2" to set auto filters to the columns;

4. create nine columns with information about the beginning (year and month), last closing (year and month), the number of months opened, effort of previous year, effort per month and the number assigned to each date (translation to number months considering 2015 as year 0);

5. save the excel file;

6. show the window to update the budget for the current year (figure 48) that will activate other code:

    a. show a message if the gap was not filled;

    b. copy the budget to a cell in a hide sheet ("Sheet3");

    c. activate the bottom of sheet "projects status" which runs a code that:

        i. find all projects done and open and copy them to the first column of sheet "projects status";

        ii. write a header with all project documents, TGs and the QGC2 of product project;

        iii. format all sheet;

        iv. write, for each project, the date of all documents done, TGs and the QGC2 of product project;

        v. create a table with information about month and year of start and close of the respective project, TG4 and QGC2.

    d. calculate the averages according to the current month in order to compare the current situation to set a status smile;

    e. change the color of the graphics smiles according to the current situation (the parameters are in the legend in the main sheet, Figure 49);
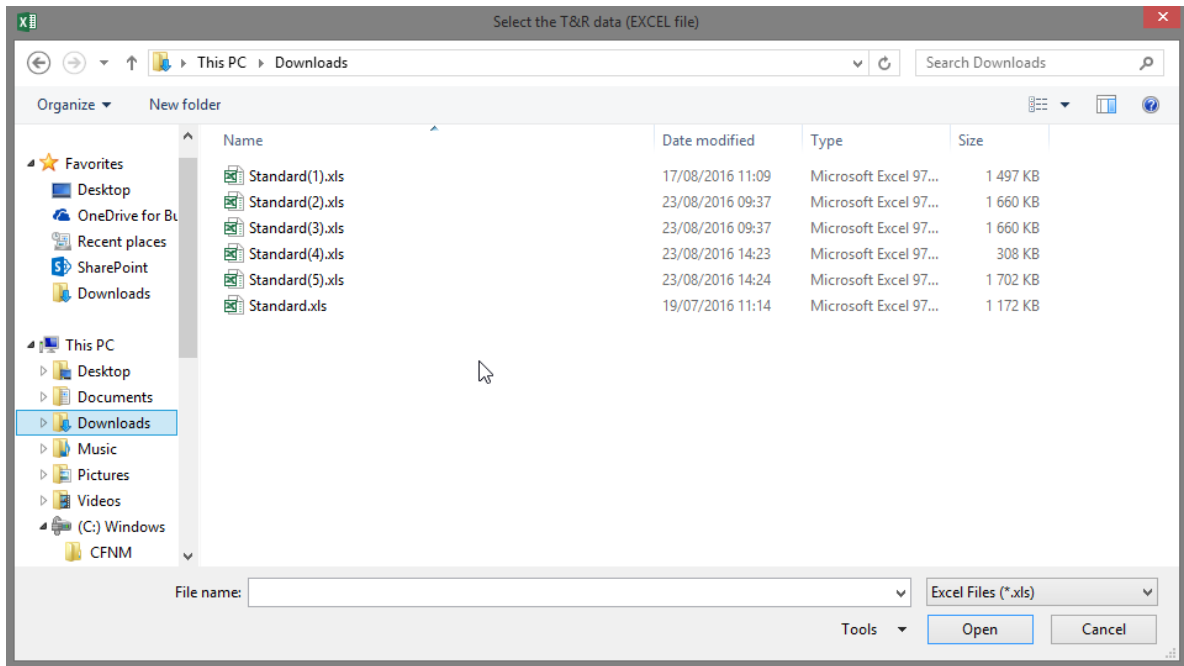
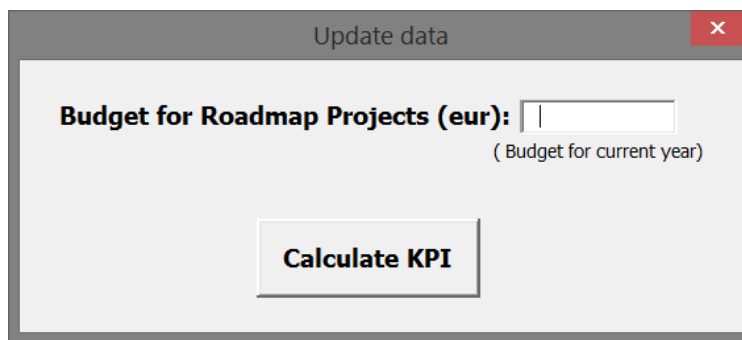*Figure 47: Window to select the EXCEL file extracted from T&R*

Figure 48: Window to update data

Figure 49: Legend of EXCEL file (bigger version in Appendix VIII)

After that, the KPI graphics and the table of projects status updated automatically for the current month and year, appearing in the main sheet and the sheet "projects status", respectively.

The sheet "projects status" (Appendix VIII) also has a bottom to update its table without updating the all KPI graphics. The bottom activate the code described in the point 1, 2, 3 and 6c, previously presented.

In the addition to the programming code, there is a hide sheet ("Sheet3" - Appendix VIII) that have all the calculations to construct the graphics. All the cells have functions to restrict the information to the respective month, year and other characteristics. All the information come from the columns made through the code in sheet "Sheet2" and sheet "projects status".

The logic argument behind is:

- **Effort graphics** of each activity group (CoC Process, Layout Design, SBMAC, CPR, Laboratory, Projects and innovation projects) have:
  - Capacity for current year: number of resources x 22days x 11months x 8days.
  - Effort (per month): sum the monthly effort of every task that has the component of the respective activity group; that are closed in current year or are open; and that the close and current month are between the respective month.
  - Effort of previous year: sum effort of previous year that has the component of the respective activity group.
  - Cumulative (per month): adds the effort of past months.
  - Trend: line with the expected development of effort, in other words, increases $\frac{capacity}{12 \text{ months}}$ each month.

- **All MFT3 costs graphic** has:
  - Costs (per month): sum costs that were made in the current year and in the respective month.
  - Cumulative (per month): adds the costs of past months.

- **Roadmap projects cost plan fulfillment graphic** has:
  - Costs (per month): sum costs that were made in the current year, in the respective month and are a roadmap project (it is identified through the standard name for roadmap projects: YY_RMPXX).
  - Budget: it is asked when the bottom to calculate KPIs is clicked.
  - Cumulative (per month): adds the costs of past months.
  - Costs of previous year: sum costs that were made in the previous year and are a roadmap project.

- **Quantity TGs done graphic** has:
  - <u>Done green (per month):</u> count the issues that are TGs, had the label "TG_Green", and that are done in the respective month of the current year.
  - <u>Done red (per month):</u> count the issues that are TGs, that had the label "TG_Red", and that are done in the respective month of the current year.
  - <u>Cumulative (per month):</u> adds the TGs done on past months.
  - <u>Planned (per month):</u> sum the TG plan of sheet "resource & TG plan" and add the TG plan of last months.
  - <u>All done (per month):</u> done red + done green (to calculate averages through programming code to set a smile status).
  - <u>Planed (month) (per month):</u> sum the TG plan of sheet "resource & TG plan" (to calculate averages through programming code to set a smile status).
  - <u>Planned current year:</u> sum of all TGs planned in sheet "resource & TG plan".
  - <u>Done green on previous year:</u> count the issues that are TGs, that had the label "TG_Green", and that are done in the previous year.
  - <u>Done red on previous year:</u> count the issues that are TGs, that had the label "TG_Red", and that are done in the previous year.

- **TG4 before the QGC2 of product project graphic** has:
  - <u>TG4 aligned with QGC2 (per month):</u> $\frac{TGs4\ aligned\ done\ (Figure\ 50)}{Target\ (number)}$.
  - <u>Not aligned (per month):</u> 1-TG4 aligned with QGC2 (per month)
  - <u>TG4 aligned with QGC2 of previous year:</u> $\frac{TGs4\ aligned\ done\ (previous\ year)}{Target\ (number)}$.
  - <u>Not aligned of previous year:</u> 1-TG4 aligned with QGC2 of previous year.
  - <u>Target (per month):</u> 100%.
  - <u>Target (number) (per month):</u> TGs4 aligned + TGs4 not aligned, that are calculated according to the following scheme (Figure 50 and 51):
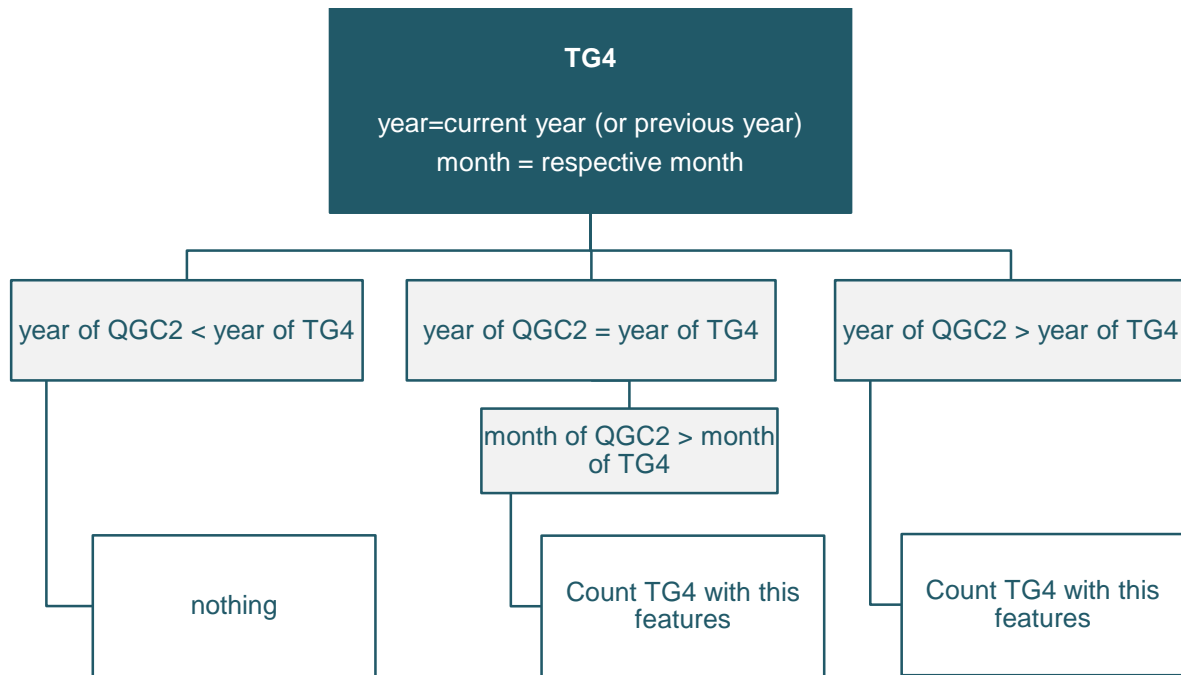
Figure 50: Logic argument for calculation of TG4 aligned with QGC2
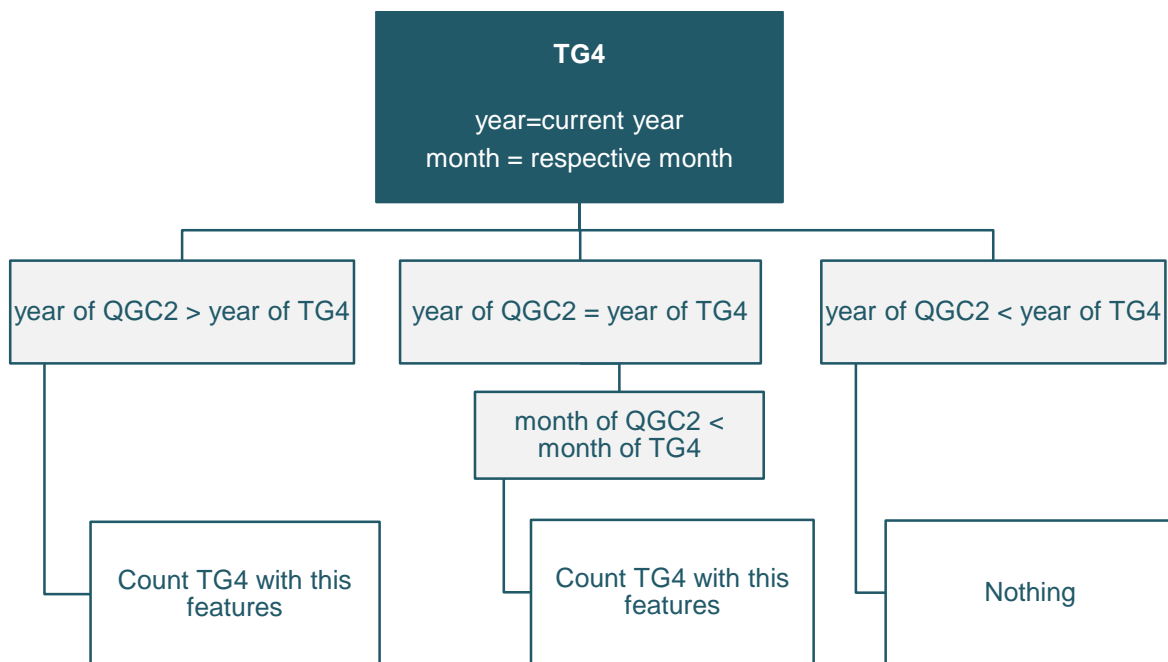

Figure 51: Logic argument for calculation of TG4 aligned with QGC2

- **Ratio of Plan vs non plan projects graphic** has:

    Roadmap projects
    Innovation projects   — follow the logic argument of Figure 52.
    AIT projects

$$\text{Ratio (\%):} \frac{\text{Roadmap projects+Innovation projects+AIT projects}}{\text{Roadmap projects+Innovation projects}}.$$
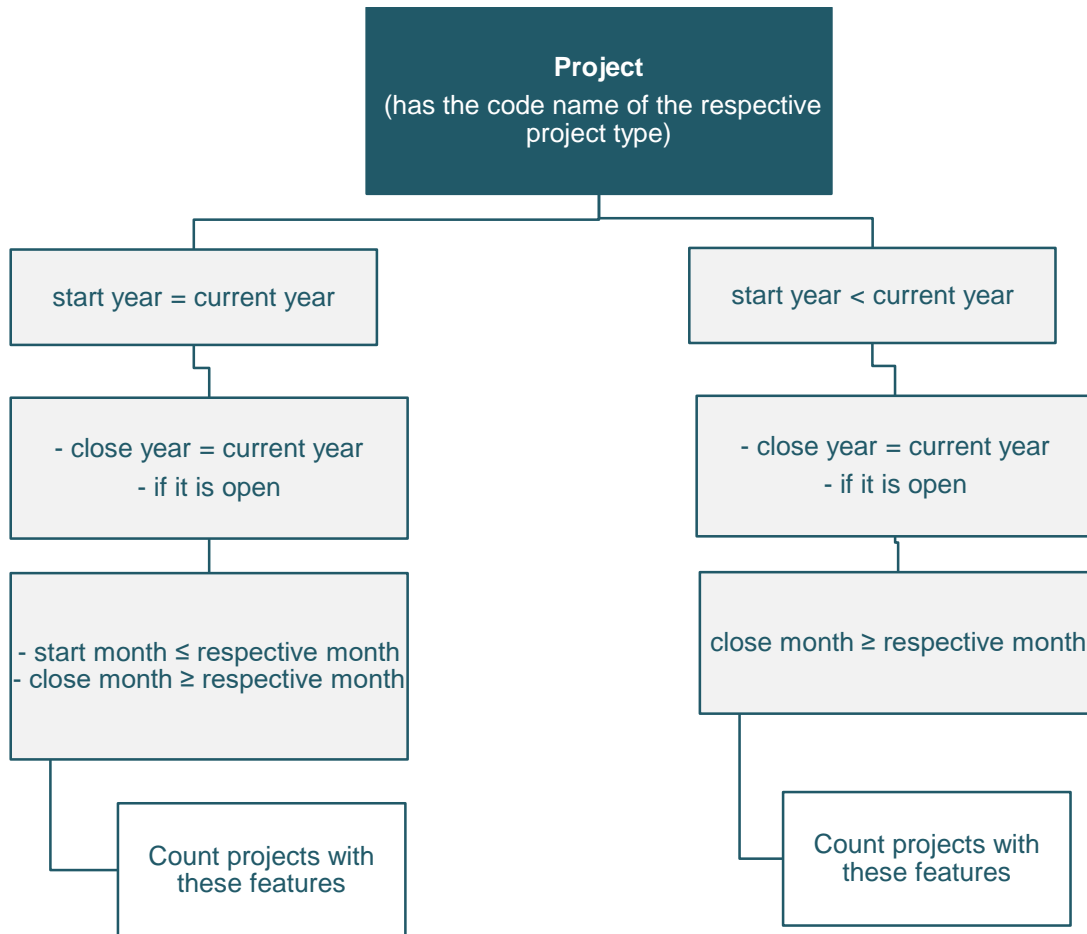

Figure 52: Logic argument to count how many project was done in the current year for each month

Having this system to extract automatically performance measurements, it will require no extra work for the production of KPIs graphics, avoiding the creation of non-productive activities. This EXCEL file will also help on project management through automatically creation of a table with status of every project.

The performance measurement system provides a useful visualization of the MFT3 section status and will allow a more efficient performance evaluation and management. It is essential to plan improvements and follow an E-4 (Establish Extract Evaluate Execute) process to implement them, all supported by the KPIs' graphical information provided.

As it was explained in section 2.5, the steps of 4-E are:

1. **Establish:** measurement program and preparation, activities support and objectives control.

2. **Extract:** performance measurement defined by control needs.

3. **Evaluate:** evaluation of measurements in terms of background of actual status and objectives.

4. **Execute:** implementation of improvements in order to decrease the differences between status and objectives.

In summary, the results are in accordance with the four objectives established – 1) redefinition of an integrated project management process; 2) definition of a template for project planning supported with Work Breakdown Structure (WBS) tool; 3) customization of a software tool to support the project management process; and 4) development of a performance measurement system – and can be resumed in the following points:

1. Redefinition of project management process in order to standardize it;

2. Creation of a template for project planning in order to standardize it and increase the project success and knowledge as well as decrease the time spent on doing the planning;

3. Customization of the software T&R in order to have a better and easier management, organization and communication as well as a database registration.

4. Definition of key performance indicators and integration of a performance measurement system in order to identify problems and have a clear vision of work status.

All the steps are integrated in each other.

6. CONCLUSION AND FUTURE WORK

This master dissertation project had the focus on project management improvement on a specific section of Bosch Car Multimedia in Braga – MFT3 section. Improvements were developed in order to have better project management practices and organization inside MFT3 section. The research work followed a case study strategy.

The main scientific area of the research project, project management, constituted a big challenge since it was not a specific topic of the integrated Master in Engineering and Industrial Management, therefore, the topic was new and the search and background study was more demanding. This topic was not only new for the researcher, it was also new for the MFT3 section meaning that both grew together in this area, being considered as another difficulty regarding the reduced experience of both parts.

The starting point was the literature review and the characterization of the problem. Having that, four objectives were defined:

- Objective 1: Redefinition of an integrated project management process;
- Objective 2: Definition of a WBS template to support project planning;
- Objective 3: Customization of a software to support project management practices;
- Objective 4: Development of a performance measurement system.

As it was expected, the four objectives had a good impact on the section's improvement but they also had some difficulties and limitations associated. The following points will summarize each objective under the three major aspects - improvements, difficulties and limitations.

Objective 1: Redefinition of an integrated project management process

The first objective was the redefinition of an integrated project management process, but the improvement proposal for MFT3 section was more ambitious, involving also the structuring of every process. This proposal was considered the best starting point to organize the MFT3 section, being one crucial improvement.

Due to situations that were out of our control, the structuring of every process was not possible to implement, only the redefinition of an integrated project management process was fulfilled. However, its validation was not fully done. The first steps, that embrace the more doubtful points, were approved through team meetings, but all the other steps were considered as proposals, being one limitation of this objective result.

The main improvement of the implementation of this objective, objective one, was the contribution to project standardization, helping on the success achievement.

The redefinition of an integrated project management process was done with another master student and it was the base to develop objective two.

Objective 2: Definition of a WBS template to support project planning

The second objective was the definition of a WBS template to support project planning being a useful improvement in terms of reducing the time spent and increase the quality, efficiency, planning, communication and team work, avoiding some internal discussions and inconsistencies. In others words, this improvement helps achieving success through standardization like the first objective. All projects started to follow the same process with a defined responsible person. However, since a project is always unique, the process can be readjusted by the project manager with his/her team.

During the development of this WBS template, the main difficulty found was the division of all the steps in more reasonable levels and sub-levels. And, since it was based on objective one, the WBS template has the same level of validation and limitations of the previous objective: first steps are approved and the others still being proposals.

Objective 3: Customization of a software to support project management practices

The third objective was the customization of a software to support project management practices which faces another challenge since it was difficult to find one adequate tool due to Bosch software restrictions.

Track&Release was the software tool chosen, integrating the WBS template developed and other improvements as time tracking, Kanban board, Gantt chart and collaborative work through document attachment and comments as well as adapting the features of issues to MFT3 section activities. The advantage of Track&Release is essentially the overall visualization of all in one, allowing the improvement not only of project management but also of portfolio management.

Due to the difficulty on changing routines and habits, the main limitation of this software was the collaborators resistance to change and the daily discipline required to actualize the software data. Track&Release needs some discipline on actualizing issues, status, time spent and so on, since this is the only way to make it useful. In the beginning it may seem that its usage increases the work but, actually, the work is decreased due to the prioritization, self-

organization, data registering, faster and an easier communication and easier access to information of everything that it is done. However, the adaptation will definitely take some months.

In order to validate this customization focus groups organized by activities' area collaborators took place, as well as meetings to explain how the T&R works and test its application.

Objective 4: Development of a performance measurement system

The fourth and last objective was the development of a performance measurement system. According to Cooper, Edgett and Kleinschmidt (2000, pp. 29), "*you cannot manage what you cannot measure*", following this principle, a performance measurement system is essential to manage an organization by evaluating, controlling and checking if the performance is according to targets (Bhatti, Awan, & Razaq, 2013). Its creation includes the definition of what should be measured, how it should be shown and how to do it in an automatic way, with the aim of helping management activities instead of increasing the work.

The result was an EXCEL file that automatically creates KPI graphics from T&R data extraction, as well as creating a projects status table with all projects and the respective documents and important milestones dates. The graphics measure the effort on MTF3 activities and some requirements of project management as budget fulfilment, quantity of TGs done with the respective result (green or red), percentage of TG4 done before QGC2 of product project and ratio of project planned vs non-planned.

Major limitations of this improvement are:

- it only works if all information were inserted on T&R (in a correct way) and the tracking time of it were well updated;
- the results can only be seen after some months when real data were inserted in T&R – the EXCEL file was tested using simulated data.
- The EXCEL can take more than one hour to update the graphics and project status table.

During the development of this objective, some difficulties were found. One of them was the definition of what should be measured because some MTF3 activities were new and they were not well-defined. Besides that, the collaborators also did not know how they can translate what they do using visual graphics. The creation of an EXCEL file with a programming code was also a difficulty, since it was a new skill to learn that involves rigorous attention.

These improvements have resolved some important problems of MFT3 but there is still room to further developments, under a continuous improvement philosophy. Therefore, for future work it is proposed to invest on social project management since one evident problem is the communication and sharing inside the MFT3 section. Docupedia and Bosch Connect are two Bosch tools that can help on it, if their implementation were well explored. And, as it was said before, structuring all the remaining processes that were not tackled by this work, is one of the most important improvements to do, since it impacts highly on any section performance, thus also on the MFT3 section performance.

Continuous improvement should also be focused on the improvements already done within this dissertation project, in order to mature them and eliminate any limitations as well as some failures that might occur. Having the improvements implemented, the responsibility to maintain and perfect them is of the MFT3 section.

Since the implementation of all the improvements developed still in progress, it was not possible to obtain numerical results. However, the responsible of project management of MTF3 section gave his feedback in order to have a better conclusion about the effects of this project in MFT3 section. The responsible of MFT3 PM believes that this project will decrease their daily emails; increase their activities through activities prioritization; provides an easier and better tracking, a clearer vision of work status and easier integration of new collaborators; increase their time through the better planning, the date definition and tracking and the clearer objectives. As limitations, he referred the slow feedback from the informatics department that caused a delay on improvements implementation; the necessity of support to help on integration of the improvements by collaborators (mainly on T&R software) and the dependency on MFT3 collaborators to have success – it will only be useful if the collaborators respect and apply the improvements created.

As final conclusion, the general feedback received from MTF3 collaborators was that the difficulties were outlined and the main objective was fulfilled – the MFT3 section improved its own organization and project management practices – constituting a successful project that will increase the MFT3 section performance.

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APPENDIX I – INTERVIEW

Guidelines for semi-structured interview

Can you give us a general view about the following questions:

- What is the focus area of the sub-section that you lead?
- What are your inputs, outputs and the flow of work?
- What are the main documents that you create and manage?
- What are your general opinion about the section?
- How do you share the information?
- For whom do you report your results?
- What are your main difficulties?
    - Information access
    - Information sharing
    - Understanding your tasks
    - Management of emails
    - Deadline accomplishments
    - Management of resources
    - …
- What do you think that should be our improvement focus? Any suggestions?

Phase	INPUT — Methods/Documents/Templates	FLOWCHART	OUTPUT — Process performance/work results	MFT3 - Industrialization and plants support	MFT3 - Assembly&Interconnection Technologies and Reliability	MFT3 - Processability and Footprint desing	MFT3 - Project Management	Project Leader	Head of CM/MFT3	CM/MFT3 Coordinators	CM/MFI-Q	Project Sponsor	CM/MFI-MFT	CM/MFI	Project review committee	CP/PIR32-IB	Central purchase department
		Roadmap Project															
	Technology roadmap; Email from development/other plants	Request	Start of the project development; Database/Ticket T&R				I		I			R			C		
	Request	Evaluation of the request	Approval of the request; Definition of the project leader, project manager and project team	C	C	C	R	C	R	R							
Concept Evaluation	Template project folder	Project structure	Structured project documentation in SharePoint/Docupedia;	I	I	I	R	I									
		1st meeting															
	Template project category; Datasheet; Project description; Market scouting; Best practices; Application notes; Requirements reliability	Definition of project category	Project Category	S	S	S	R				S						
	Request; Datasheet; Project description; Market scouting; Best practices; Application notes; Requirements reliability, Lessons Learned	Technical evaluation steps	Requirement collection; Concept study; Cost Calculation sheet; DOE; Target cross; Project Orga	S	S	S	R	S		I							
	Project charter BP version; Request; Datasheet; Project description; Market scouting; Best practices; Application notes; Requirements reliability	Development of Project Charter	Project Charter final	C	C	C	R	S									
	Project charter final	Project Charter approved?							A	A		A			A		
	Comments from approvers	Requirements? — Revise project charter	Project Charter revised	C	C	C	R	S									
		Project canceled or put on hold	Information about result (Project cancelled; on hold; postponed)	I	I	I	R	I	I	I		I			I		
	Kick-of checklist template; Project charter final; Requirements selection	Final Kick-off meeting	Activities plan; Risk assessment; Project contracting (services); OPL; DOE definition per area; Kick-off checklist; Kick-off report	S	S	S	R		A	S		A					
	Project Category; Template Project schedule	Development of Project plan	Project Schedule (matching with Project charter final (milestones))	C	C	C	R	S	I								
	Project Schedule (matching with Project charter final (milestones))	According to Project Charter? — Revise project charter	Project Charter revised	S	S	S	R	A	A			A			A		

RESPONSIBILITY MATRIX
R = Responsible; A = Accountable; C = Consult; I = Informed; S = Supportive

Phase	Input	Process step	Output	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Technology Gate 0 (TG0)		Ask for templates for TG	Questionaire and TG templates				R										
	Template questionaire; TG0 template; All documents created/envolved during the project	Review for TG assessment	Invitation of all stakeholders; TG questionaire and TG cover sheet fullfiled; Docupedia and track&release updated	C	C	C	R										
	Call up all stakeholders; questionaire; TG0 document; Docupedia and track&release updated	TG assessment → TG reached? (No)		C	C	C	C	C	C	C	R	C			C		
	TG questionaire and TG cover sheet	Work on	TG Feedback sponsor and stakeholders	I	I	I	A		A		R	A	A	A			
		Continuation? (No → Project canceled or put on hold) (Yes) — TG0 Process	Docupedia and BGN room updated	I	I	I	R		I	I		I			I		
Feasibility Evaluation	Project schedule	Process specification list	Process specification list (all important items to be considered during the project	R	R	R	S										
	Concept study	Concept presentation / Specification	Concept presentation; Beginning of PRE Process	R					R								
TG1		TG1 Process															
Productibility Evaluation	Project Charter; Kick-off; Risk Management SW	Risk Management meeting	Risk analysis report(process risk and product risk); OPL list; Time schedule update	C	C	C	R										
	Risk analysis report; equipment	System validation at run time	Information of system validation	S	S	S	I	R									
TG2		TG2 Process															
MAE		New MAE? (No) (Yes)															
	Plant specifications; ISO 50001	Create requirement specifications	MAE specification list	R	C	R	I		I	I							
	MAE specification list	Send MAE requirements specification	Supplier quotations;	C	C	C	I		I	I							R
	Suplier information; Equipment's, Tool's and Material's detail's;	Supplier Analysis	Supplier selected; Supplier evaluation matrix	C	C	C	I		I	I							R
	Supplier selected	Purchasing process	Equipment/Tools/Materials	I	I	I	I		I	I							R
TG2a		TG2a Process															
Preparation of samples production	WBS; Project Charter; Equipment/Tools/Materials	Tryout Methodology	Test Plan	R	R	R	I			I							
	Test Plan	Tryout Result and Verification	Capability studies; performance report (processability and reliability); Cmk Flowchart; PRP (Part/Machine Release Preassessement)	R	R	R	A		A	A							
TG3		TG3 Process															
...aration of series care	Information from development or plant	Pilot/Project selection	Identification of the plant and products	I	I	I	I		I	I	R			R			
	Presentation of concept study; legislation/norms	Rules of series care	Process flowchart; Process specification; PRP creation; FMEA/CP creation; User manual; training material;	R	R	R	I		I	I							

Phase	Input	Process step	Output	1	2	3	4	5	6	7	8	9	10	11	12
Prepa	Definition of tests	Process Release	Release report	R	R	R	A	A	A						
TG4		TG4 Process													
Process Release		New MAE? (No/Yes)													
	List of failures identified	Failure list report	Failure list reports	R	I	R	I	I	I						
	Project Charter; Failure list reports	Sample data analysis	Data analysis report	R	I	R	I	I	I						
	MAE requirements; plant specifications	Describe the environment optimum working condition	Description of environment optimum working condition	R	I	R	I	I	I						
	Release report; Processability report; PRPs; Risk analysis; Kick-off	PRP/PRE FMEA/CP publication	PRP/PRE new/update; FMEA/CP new/updated	R	I	R	I	A	A						
	Processability report; Concept study; flowchart; release report; PRP/PRE; FMEA/CP	Material Handling	Training material	R	I	R	I	I	I						
		MAE? (No/Yes)													
	Processability report; Concept study; flowchart; release report	Maintenance Plan	Calibration requirements; Measurements capabilities; Process capabilities; Maintenance plan; Spare part list	R	I	R	I	I	I						
	All the documents produced	Project Release	Handover report	S	S	S	R	A	A		A		A		
		Aproved? (No/Yes)													
TG5	Handover report	TG5 Process													
		Project close-out	Docupedia and BGN room updated	I	I	I	R	I	I	I	I	I			I

Optional steps of TG process according to the type of the project

Glossary:
BGN - Bosch Global Network
BP - Business Plan
Cmk - QuantitativeMachine capability
CP - Control Plan
CPR - Component Processability Release
DFMEA - Design FMEA
DOE - Design of Experiments
FMEA - Failure Mode Evaluation Analysis
ISO - International Organization for Standardization
LE - Layout Design
MAE - Machinery and Equipment
OPL - Open Point List
PFMEA - Process FMEA
PLE - Preassessement LE
PRE - Process Rules for Engineering
PRP - Process Rules for Production
QFD - Quality Function Deployment
SW - Software
T&R - Track & Rele
TG - Technology Gate
WBS - Work Breakdown Structure

APPENDIX III – PROJECT WBS TEMPLATE

		Task Mode	Task Name	Deadline	Duration	Start	Finish	Predece	Function	Comments
0			⊿ **Project Plan template**	**NA**	**564 days**	**Fri 05/02/16**	**Wed 04/04/18**			**Legend: Green - activities; Red - deliverables; Blue - workpackages**
1			⊿ **1 Constraints Chart**	**NA**	**0 days**	**Fri 05/02/16**	**Fri 05/02/16**			
2			1.1 Request	NA	0 days	Fri 05/02/16	Fri 05/02/16		Requester	
3			1.2 Project Charter approval	NA	0 days	Fri 05/02/16	Fri 05/02/16		Approval team	
4			1.3 Concept apresentation approval	NA	0 days	Fri 05/02/16	Fri 05/02/16			
5			1.4 Information from MAE supplier	NA	0 days	Fri 05/02/16	Fri 05/02/16		Supplier	Only if it's necessary to buy a new equipment
6			⊿ **2 WBS Project**	**NA**	**564 days**	**Fri 05/02/16**	**Wed 04/04/18**			
7			⊿ **2.1 Project Management**	**NA**	**142 days**	**Fri 05/02/16**	**Mon 22/08/16**		**PM**	
8			⊿ **2.1.1 Initiating**	**NA**	**33 days**	**Fri 05/02/16**	**Tue 22/03/16**		**PM**	
9			2.1.1.1 Meeting to evaluate the request	NA	1 day	Fri 05/02/16	Fri 05/02/16	2	PM	
10			2.1.1.2 Project category	NA	2 days	Mon 08/02/16	Tue 09/02/16	9	PM	Proj. A do all TGs; Proj.B do TGs 0,2,3,4,5; Proj.C do TGs 0 and 5
11			2.1.1.3 Project Charter definition	NA	8 days	Wed 10/02/16	Fri 19/02/16	12SS	PM	
12			2.1.1.4 Kick-off meetings	NA	30 days	Wed 10/02/16	Tue 22/03/16	10	PM	
13			2.1.1.5 Kick-off checklist	NA	1 day	Tue 22/03/16	Tue 22/03/16	12FF	PM	
14			⊿ **2.1.2 Planning**	**NA**	**5 days**	**Wed 10/02/16**	**Tue 16/02/16**	**3;12SS**	**PM**	
15			2.1.2.1 Time Schedule/ WBS	NA	5 days	Wed 10/02/16	Tue 16/02/16		PM	
16			2.1.2.2 Target Cross	NA	5 days	Wed 10/02/16	Tue 16/02/16		PM	
17			2.1.2.3 Cost Calculation	NA	5 days	Wed 10/02/16	Tue 16/02/16		PM	
18			2.1.2.4 Project Orga	NA	5 days	Wed 10/02/16	Tue 16/02/16		PM	
19			⊿ **2.1.3 Project following**	**NA**	**133 days**	**Wed 17/02/16**	**Fri 19/08/16**	**14**	**PM**	
20			2.1.3.1 Risk Management	NA	1 day	Wed 17/02/16	Wed 17/02/16		PM	
21			2.1.3.2 Risk Management meeting	NA	1 day	Mon 15/08/16	Mon 15/08/16	53	PM	
22			2.1.3.3 Risk analysis report	NA	5 days	Mon 15/08/16	Fri 19/08/16	21SS	PM	

	ⓘ	Task Mode	Task Name	Deadline	Duration	Start	Finish	Predece	Function	Comments
23			2.1.3.4 Process of Purchase	NA	90 days	Wed 17/02/16	Tue 21/06/16		PM	Only if it's necessary to buy something internal or external
24			2.1.4 Clossing (Lessons learned)	NA	1 day	Mon 22/08/16	Mon 22/08/16	19	PM	
25			◢ **2.2 Process Development**	**NA**	**563 days**	**Mon 08/02/16**	**Wed 04/04/18**			
26			◢ **2.2.1 Concept Evaluation**	**NA**	**44 days**	**Mon 08/02/16**	**Thu 07/04/16**			
27			2.2.1.1 Requirement list	NA	8 days	Mon 08/02/16	Wed 17/02/16	9	PL	
28			◢ **2.2.1.2 Concept Study, DOE and activities of project**	**NA**	**15 days**	**Wed 10/02/16**	**Tue 01/03/16**	**12SS**	**PL**	
29			2.2.1.2.1 Concept Study, DOE and activities of Solder Paste Printing	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
30			2.2.1.2.2 Concept Study, DOE and activities of SMD Automatic Insertion	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
31			2.2.1.2.3 Concept Study, DOE and activities of Reflow soldering	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
32			2.2.1.2.4 Concept Study, DOE and activities of Radial	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
33			2.2.1.2.5 Concept Study, DOE and activities of Automatic Glue Dispensing and Curing	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
34			2.2.1.2.6 Concept Study, DOE and activities of Glue Dispensing with iPAG system	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
35			2.2.1.2.7 Concept Study, DOE and activities of Automatic Cleaning process	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
36			2.2.1.2.8 Concept Study, DOE and activities of Automatic Clinch	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
37			2.2.1.2.9 Concept Study, DOE and activities of Wave Soldering	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
38			2.2.1.2.10 Concept Study, DOE and activities of Milling	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
39			2.2.1.2.11 Concept Study, DOE and activities of Gap Filler	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
40			2.2.1.2.12 Concept Study, DOE and activities of Automatic Pin Insertion (CC)	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	

		Task Mode	Task Name	Deadline	Duration	Start	Finish	Predece	Function	Comments
41			2.2.1.2.13 Concept Study, DOE and activities of Glue Component with RTV744 (silicon)	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
42			2.2.1.2.14 Concept Study, DOE and activities of Laser Printing PCB	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
43			2.2.1.2.15 Concept Study, DOE and activities of Selective Soldering	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
44			2.2.1.2.16 Concept Study, DOE and activities of Conformal Coating (PC88)	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
45			2.2.1.2.17 Concept Study, DOE and activities of Conformal Coating (Peters)	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
46			2.2.1.2.18 Concept Study, DOE and activities of Press fit process	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
47			2.2.1.2.19 Concept Study, DOE and activities of Component Processability	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
48			2.2.1.2.20 Concept Study, DOE and activities of Footprint design	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
49			2.2.1.2.21 Concept Study, DOE and activities of Reliability	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
50			2.2.1.2.22 Concept Study, DOE and activities of PCB Handling (SMT, Manual and Final Assembly Area)	NA	15 days	Wed 10/02/16	Tue 01/03/16		CoC	
51			2.2.1.3 Kick-off report development	NA	10 days	Wed 23/03/16	Tue 05/04/16	12	PL	
52			2.2.1.4 Preparation for TG0	NA	2 days	Wed 06/04/16	Thu 07/04/16	51	PM	
53			◢ 2.2.2 Feasibility Evaluation	NA	91 days	Fri 08/04/16	Fri 12/08/16	26		
54			2.2.2.1 Process Specification list	NA	30 days	Fri 08/04/16	Thu 19/05/16		PL	
55			2.2.2.2 Concept presentation	NA	1 day	Fri 20/05/16	Fri 20/05/16	54	PL	
56			2.2.2.3 PRE	NA	60 days	Mon 23/05/16	Fri 12/08/16	55;4		
57			2.2.2.4 Preparation for TG1	NA	2 days	Mon 23/05/16	Tue 24/05/16	55;4	PM	
58			◢ 2.2.3 Producibility Evaluation	NA	22 days	Wed 25/05/16	Thu 23/06/16	57		
59			2.2.3.1 OPL List	NA	1 day	Wed 25/05/16	Wed 25/05/16		PM	

		Task Mode	Task Name	Deadline	Duration	Start	Finish	Predece	Function	Comments
60			2.2.3.2 System validation at Run Time	NA	20 days	Wed 25/05/16	Tue 21/06/16		PL	
61			2.2.3.3 Preparation for TG2	NA	2 days	Wed 22/06/16	Thu 23/06/16	60	PM	
62			◢ 2.2.4 MAE	NA	182 days	Fri 24/06/16	Mon 06/03/17	58	CoC	Only if it's necessary to buy a new equipment
63			2.2.4.1 MAE requirement specification	NA	30 days	Fri 24/06/16	Thu 04/08/16		CoC	
64			2.2.4.2 Supplier analysis	NA	60 days	Fri 05/08/16	Thu 27/10/16	63;5FF	CoC	
65			2.2.4.3 Purchasing Process	NA	90 days	Fri 28/10/16	Thu 02/03/17	64	PM	
66			2.2.4.4 Preparation for TG2a	NA	2 days	Fri 03/03/17	Mon 06/03/17	65	PM	
67			◢ 2.2.5 Preparation of Sample Phase	NA	184 days	Tue 07/03/17	Fri 17/11/17	62		
68			2.2.5.1 Tryout Methodology - test plan	NA	15 days	Tue 07/03/17	Mon 27/03/17		PL	
69			◢ 2.2.5.2 Tryout Result and Verification	NA	182 days	Tue 07/03/17	Wed 15/11/17		PL	
70			2.2.5.2.1 Capability studies	NA	30 days	Tue 07/03/17	Mon 17/04/17		PL	
71			2.2.5.2.2 Performance report (e.g. processability and reability)	NA	150 days	Tue 18/04/17	Mon 13/11/17	70	CoC	
72			2.2.5.2.3 Cmk Flowchart	NA	2 days	Tue 14/11/17	Wed 15/11/17	71	PL	
73			2.2.5.2.4 Part/machine Release	NA	2 days	Tue 14/11/17	Wed 15/11/17	71	CoC	
74			2.2.5.3 Preparation for TG3	NA	2 days	Thu 16/11/17	Fri 17/11/17	73;72	PM	
75			◢ 2.2.6 Preparation of Series Cares	NA	60 days	Mon 20/11/17	Fri 09/02/18	67		
76			2.2.6.1 Pilot/Project selection	NA	2 days	Mon 20/11/17	Tue 21/11/17	56	Γ3 coordinat	
77			2.2.6.2 Process Flowchart	NA	2 days	Mon 20/11/17	Tue 21/11/17		PL	
78			2.2.6.3 Process specification	NA	10 days	Mon 20/11/17	Fri 01/12/17			
79			2.2.6.4 PRP creation	NA	60 days	Mon 20/11/17	Fri 09/02/18			
80			2.2.6.5 FMEA ana CP Creation	NA	2 days	Mon 20/11/17	Tue 21/11/17			
81			2.2.6.6 User Manual	NA	5 days	Mon 20/11/17	Fri 24/11/17		PL	
82			2.2.6.7 Training material	NA	10 days	Mon 20/11/17	Fri 01/12/17		PL	
83			2.2.6.8 Release report	NA	5 days	Mon 20/11/17	Fri 24/11/17		PL	
84			2.2.6.9 Preparation for TG4	NA	2 days	Mon 20/11/17	Tue 21/11/17		PM	

	❶	Task Mode	Task Name	Deadline	Duration	Start	Finish	Predece	Function	Comments
85			▲ **2.2.7 Project Release**	NA	**38 days**	**Fri 09/02/18**	**Wed 04/04/18**	**75**		
86			2.2.7.1 Failure list report	NA	2 days	Mon 12/02/18	Tue 13/02/18		PL	
87			2.2.7.2 Sample data analysis	NA	2 days	Wed 14/02/18	Thu 15/02/18	86	PL	
88			▲ **2.2.7.3 Process Rules**	NA	**5 days**	**Fri 09/02/18**	**Fri 16/02/18**			
89			2.2.7.3.1 Describe the environment optimum working condition	NA	2 days	Mon 12/02/18	Tue 13/02/18			
90			2.2.7.3.2 PRE, PRP, FMEA and CP publication	NA	0 days	Fri 09/02/18	Fri 09/02/18			
91			2.2.7.3.3 Material Handling	NA	5 days	Mon 12/02/18	Fri 16/02/18			
92			2.2.7.4 Maintenance plan	NA	30 days	Mon 19/02/18	Fri 30/03/18	88	PL	
93			2.2.7.5 Final Report (handover) development	NA	1 day	Mon 02/04/18	Mon 02/04/18	92;19		
94			2.2.7.6 Preparation for TG5	NA	2 days	Tue 03/04/18	Wed 04/04/18	104;93	PM	
95			▲ **3 Milestones**	NA	**553 days**	**Fri 19/02/16**	**Wed 04/04/18**			
96			3.1 Project Charter	NA	0 days	Fri 19/02/16	Fri 19/02/16	11	PM	
97			3.2 TG0	NA	0 days	Thu 07/04/16	Thu 07/04/16	52	Approval team	Optional for non-project
98			3.3 TG1	NA	0 days	Tue 24/05/16	Tue 24/05/16	57	Approval team	Optional for non-proj., Proj. C and Proj. B
99			3.4 TG2	NA	0 days	Thu 23/06/16	Thu 23/06/16	61	Approval team	Optional for non-proj. and Proj. C
100			3.5 TG2a	NA	0 days	Mon 06/03/17	Mon 06/03/17	66	Approval team	Only if it's necessary to buy a new equipment
101			3.6 TG3	NA	0 days	Fri 17/11/17	Fri 17/11/17	74	Approval team	Optional for non-project
102			3.7 TG4	Thu 12/09/19	0 days	Tue 21/11/17	Tue 21/11/17	84	Approval team	Optional for non-proj., Proj. C and Proj. B
103			3.8 TG5	NA	0 days	Wed 04/04/18	Wed 04/04/18	94	Approval team	Optional for non-project
104			3.9 Final Report (handover)	NA	0 days	Mon 02/04/18	Mon 02/04/18	93	PM	

Issue Type	Task				Request				Meeting				CPR				Analysis				Cost			
	name	type	values	obs.	name	type	values	obs.	name	type	values	obs.	name	type	values	obs.	name	type	values	obs.	name	type	values	obs.
Time Tracking	Spent time			mandatory on closing	Spent time			mandatory on closing	Spent time			mandatory only on its subtasks	Spent time			mandatory on closing	Spent time			mandatory on closing	Spent time			mandatory on closing
Create menu	The same as Edit menu				Summary	text		mandatory	The same as Edit menu				The same as Edit menu				Summary	text		mandatory	The same as Edit menu			
					Priority	combo											Item Serial No.	text		mandatory				
					Description	text		mandatory									Product	text		mandatory				
					BU	combo											Project name	text						
					Due date	date		mandatory									Cost center	text						
					Product	text											Objective	text		mandatory				
																	Description	text						
																	Due date	date						
																	Priority	combo						
																	BU	combo						
Edit menu	Summary	text		mandatory	Summary	text		mandatory	Meeting label	combo	Internal, CM/CN, Plant, Private	mandatory	Summary	text		mandatory	Summary	text		mandatory	Summary	text		mandatory
	Assignee				Assignee				Summary	text		mandatory	Assignee				Assignee				Assignee			
	Priority	combo	critical, high, minor, blocker		Priority	combo			Description	text			Part number	text			Item Serial No.	text		mandatory	Project name	text		
	Component/s	combo		mandatory	Description	text		mandatory	Participants			mandatory	Project name	text			Product	text		mandatory	Sub-Project	text		
	Fix Version	combo			BU	text			Assignee				Description	text			Project name	text			Type	combo	costs, investments	
	Due Date	date		mandatory	Due date	text		mandatory	Security level	combo			Supplier	text			Cost center	text			Test Relevant	combo	Test, other	
	Description	text			Product	text			Component	combo		mandatory	General Package	text			Objective	text		mandatory	Cost Center	number		mandatory
	Product	text			Component	combo		mandatory	Assistance			mandatory	Division	combo	CM, IS, SEM, TT, AA		Description	text			Description	text		

Field	Type	Options	Field	Type	Field	Type	Field	Type	Options	Note	Field	Type	Note	Note	Field	Type	Options	Note
BU	combo		Labels		Labels		Priority	combo	critical, high, minor, blocker		Priority	combo			BANF number	text		
Task type	combo	Project Type A, Project Type B, Project Type C, non-project, activity, travel/training	Security level	combo	Original Estimate	time	Component	combo	CPR	pre-definition	Component		Laboratory	pre-definition	Supplier	text		
Security level	combo	CM/CN, CM/CoC_PCB, Participants, Plants, Private	Assistance		Remaining Estimate	time	Labels				Due date	date			Buyer	text		
Linked issues	combo		Fix Version/s				Fix Version	combo			BU	combo			Estimated cost	text		mandatory
issue	combo		Original estimating				Due date	text		mandatory	Labels				Order number	text		PO
Assistance							BU	combo			Assistance				Inventory number	text		
Labels							Result	text			Linked issues	combo			GEIME number	text		
Original Estimate	time						Linked issues	combo			issue	combo			Priority	combo	critical, high, minor, blocker	
Remaining Estimate	time						issue	combo			Original Estimating				Component		Purchases	pre-definition
							Assistance				Security level	combo			Labels			
							Labels								Fix Version	combo		
							Original Estimate	time							Linked issues	combo		
															issue	combo		
							Remaining Estimate	time							Assistance			
							Security level		CM/CoC_PCB	pre-definition					Security level		CM/CoC_PCB	pre-definition

Close menu	Time tracking			fields of time tracking	Time tracking			fields of time tracking	Time tracking			fields of time tracking	Time tracking			fields of time tracking	Time tracking			fields of time tracking	Time tracking			fields of time tracking
	Comments	text			Comments	text			Comments	text			Comments	text			Comments	text			Comments	text		
													Result	text										

	Status	Transition	Status	Transition	Status	Transition	Status	Transition	Status	Transition	Status	Transition
Workflow	Open	Start progress	Open	Start progress	Open	Start progress	Open	Start progress	Open	Start progress	Open	Start progress
		Close		Close		Close		Close		Close		Close
		Set On Hold		Set On Hold		Set On Hold		Set On Hold		Set On Hold		Set On Hold
		Approval		Approval		Approval		Approval		Approval		Approval
	In Progress	Stop Progress	In Progress	Stop Progress	In Progress	Stop Progress	In Progress	Stop Progress	In Progress	Stop Progress	In Progress	Stop Progress
		Close		Close		Close		Close		Close		Close
		Set On Hold		Set On Hold		Set On Hold		Set On Hold		Set On Hold		Set On Hold
		Create subtasks for multiple users		Create subtasks for multiple users		Create subtasks for multiple users		Create subtasks for multiple users		Create subtasks for multiple users		Create subtasks for multiple users
		Approval		Approval		Approval		Approval		Approval		Approval
	On Hold	Start progress	On Hold	Start progress	On Hold	Start progress	On Hold	Start progress	On Hold	Start progress	On Hold	Start progress
		Close		Close		Close		Close		Close		Close
		Approval		Approval		Approval		Approval		Approval		Approval
	Reopen	Close	Reopen	Close	Reopen	Close	Reopen	Close	Reopen	Close	Reopen	Close
		Approval		Approval		Approval		Approval		Approval		Approval
		Start Progress		Start Progress		Start Progress		Start Progress		Start Progress		Start Progress
	Approval	Open	Approval	Open	Approval	Open	Approval	Open	Approval	Open	Approval	Open
		Start progress		Start progress		Start progress		Start progress		Start progress		Start progress
		On hold		On hold		On hold		On hold		On hold		On hold
		Close		Close		Close		Close		Close		Close
	Closed	reopen	Closed	reopen	Closed	reopen	Closed	reopen	Closed	reopen	Closed	reopen
Other												
Extra general features	Kanban Board											
	Gant Chart											
	Time tracking											
	File attachment											

APPENDIX V – PROJECT WBS TEMPLATE FOR MFT3 T&R
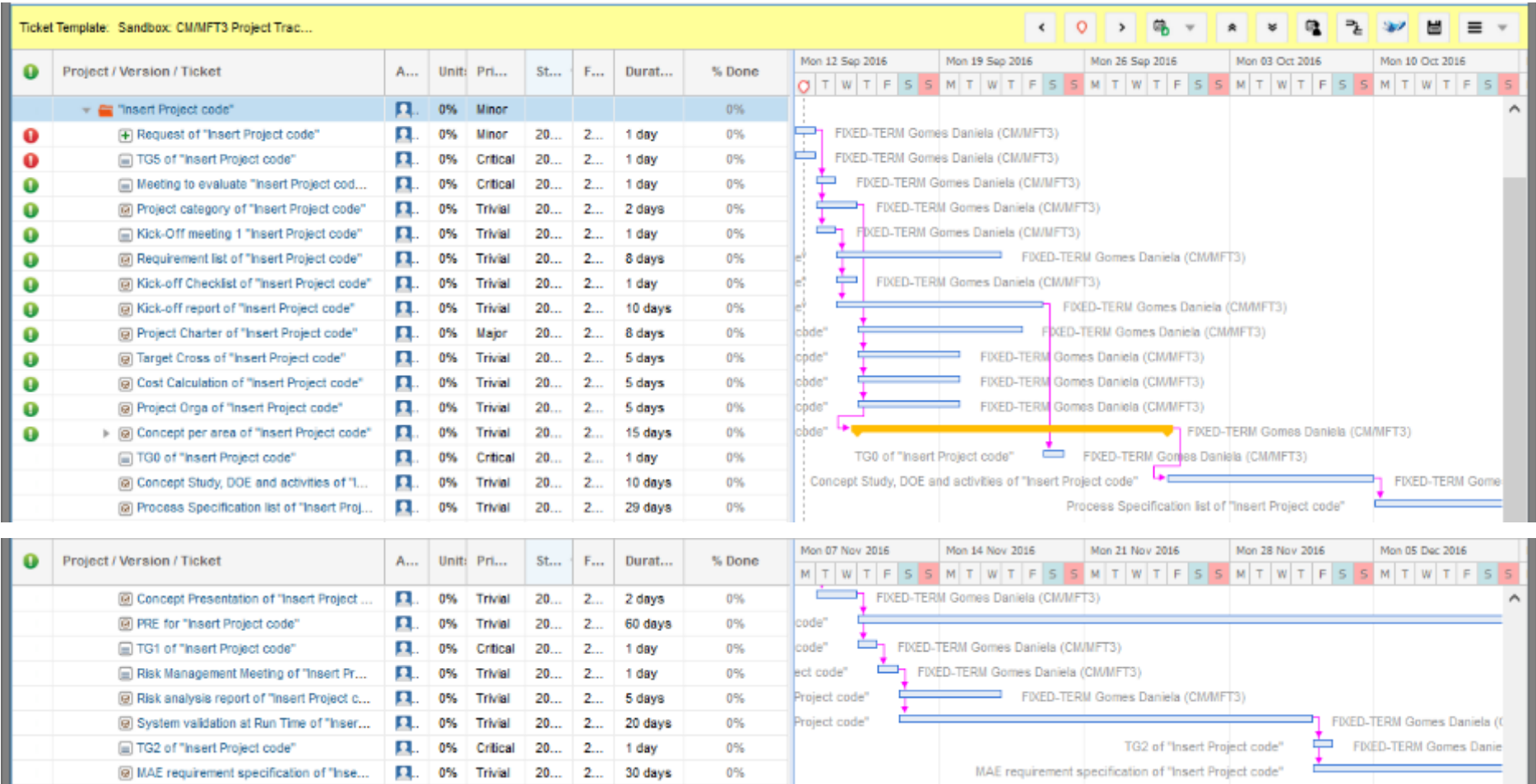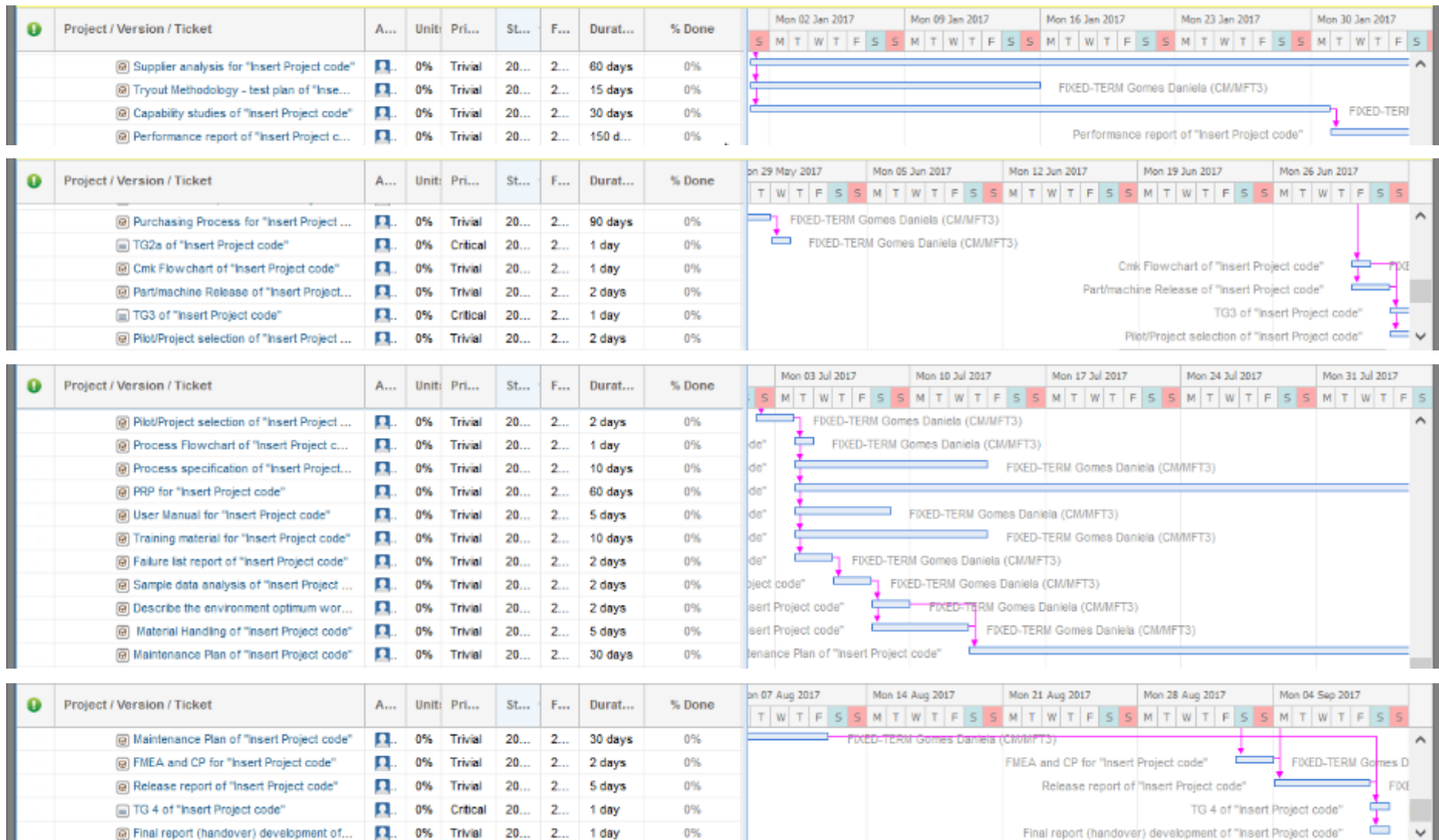
APPENDIX VI – INSTRUCTIONS AND USE CASES FOR MFT3 T&R

BOSCH

	Track&Release – MFT3 **Instructions and Use Cases for MFT3 T&R**	Issue/Amendment	Page 1/52
From CM/MFT3		Our Reference Daniela Gomes	Date September 30, 2016

Table of contents

1 Subject matter, objective, and purpose

This document describes Track&Release (T&R) Software customized for MFT3 through description, general use guides and use cases.

The main objective is to guide users, implementing a standard of how T&R of MFT3 should be used.

The purpose of T&R is to track all the activities developed in MFT3, in order to know the allocation of resources, the quantity of activities/occupation, to provide a schedule view, to organize and distribute work.

2 Description and features

"**Inside.Track&Release** is an issue tracking platform that can help you handle the processes in Release Management, Incident Management, IT Transport Management and other IT related areas. It allows professional, systematic and effective management of tasks of any kind (OPL, software bugs, project tasks, change requests, improvements, etc.)" [in inside.docupedia: T&R Home, 2015].

- **T&R Issue:** It is a building block of a project. Can be a task, a request, a bug, a meeting and so on.
  Every issue is part of a project and can be associated to one or more components.
  The issue name contains the key of the project to help on identifying it.

- **T&R Sub-task:** It is a smaller task inside of a main task (or other issue type).

- **T&R Project:** It is the main group of T&R that contains the rest (issues, components, …).

- **T&R Component:** It is a sub-section of a project that collect issues in smaller groups allowing management and categorization of issues in a better way.

BOSCH

Track&Release – MFT3 **Instructions and Use Cases for MFT3 T&R**		Issue/Amendment	Page 3/52
From CM/MFT3		Our Reference Daniela Gomes	Date September 30, 2016
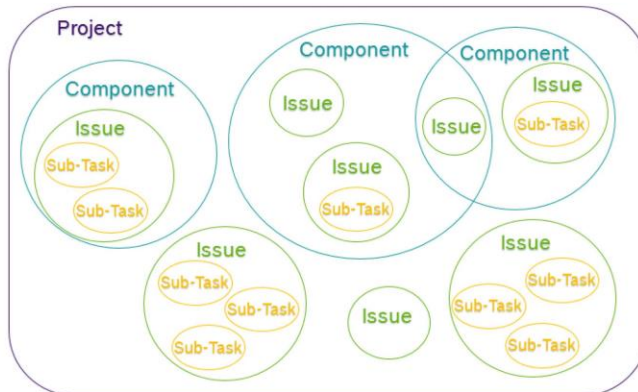
Figure 1: Organization of T&R (Project, Component, Issue, Sub-task)

> *Note:*
>
> *For more information or training, consult inside docupedia of T&R:*
>
> *https://inside-docupedia.bosch.com/confluence/pages/viewpage.action?pageId=329416829*

2.1   T&R by MFT3

Contextualizing for customized T&R by MFT3, the previous actual features are:

- **Project**:"CM_CoC_PCB" – Only the section have total vision of it.
- **Components** are divided for a better management. The components are:
    - *Each project* – Project manager is the component owner;
    - *Each process* – Each CoC is the component owner of their processes.
    - *Other activities*:
        - CPR;
        - Layout Review;
        - LE;
        - SBMAC;
        - Step-Stencil;
        - Work Instruction;
        - Purchases.

▪ **Issues type**:

- **Task:** issue type to create tasks. The more common issue type to general work.

→ Issue Type*: Task.

→ Summary*: Name to identify the task – should be short, objective and standard (if applicable).

→ Assignee: Responsible of task.

→ Priority: Priority of task (blocker, critical, major, trivial, minor, n.a.)

→ Component/s*: all components that are addressed on task.

→ Fix Version/s: milestone (version) of task.

→ Due Date*: Due date of task

→ Description: Brief description of task – should be simple and objective.

→ Product: the product associated to the task (if applicable).

→ BU: Business Unit which is the client. To choose more than one option is necessary to press *ctrl*.

→ Task type: classification of task in terms of project (type of project - A, B, C or non-project), activity or travel/training.

→ Security Level: Restriction of access. Should be CM/CoC_PCB unless some extern needs access to it.

→ Linked Issues: association to another issue.

→ Assistance: collaborators that assist the work.

→ Labels: labels to help on identifying some features of task (ex: Roadmap_Project).

→ Original Estimate: Estimate time to complete the task.

→ Remaining Estimate: Time missing. Not necessary to fill.

- **Meeting:** issue type to do a minute of the meeting and to create OPL as a Sub-task (other issue type). It allows to following the OPL and the meeting. The permission of vision is decided to the issue creator (reporter).

→ Issue Type*: Meeting.

→ Meeting label*: type of meeting based on permissions (Internal, CM/CN, Plant, Private)

→ Summary*: Name to identify the meeting – should be short, objective and standard (if applicable).

→ Description: Brief description of meeting – should be simple and objective.

→ Participants*: People that attend the meeting.

→ Assignee: Responsible of meeting.

→ Security level: Define who has to have access to that meeting (CM/CM,

CM/CoC_PCB, participants, plants, private)

→ Component/s*: all components that are addressed on task.

→ Assistance: collaborators that help on organizing the meeting.

→ Labels: labels to help on identifying some features of meeting.

→ Original Estimate: Estimate time to complete the task.

→ Remaining Estimate: Time missing. Not necessary to fill.

- **Request:** issue type to receive requests from other departments.

→ Issue Type*: Request.

→ Summary*: Name to identify the request – should be short, objective and standard (if applicable).

→ Priority: Priority of task (blocker, critical, major, trivial, minor, n.a.)

→ Description*: Brief description about what it is asking – should be simple and objective.

→ Assignee: Responsible of task.

→ BU: Business Unit which is the client. To choose more than one option is necessary to press *ctrl*.

→ Due Date*: Due date of task

→ Product: the product associated to the task (if applicable).

→ Component/s: all components that are addressed on request.

→ Labels: labels to help on identifying some features of request.

→ Security Level: Restriction of access. Should be CM/CoC_PCB unless some extern needs access to it.

→ Assistance: collaborators that assist the work.

→ Fix Version/s: milestone (version) of request.

→ Original Estimate: Estimate time to complete the task.

→ Remaining Estimate: Time missing. Not necessary to fill.

- **Analysis:** issue type to receive requests to laboratory.

→ Issue Type*: Analysis.

→ Summary*: Name to identify the analysis – should be short, objective and standard (if applicable).

→ Assignee: Responsible of task.

→ Item Serial No*: Serial Number of the product.

→ Product*: the product associated to the analysis.

→ Project Name: Project name that the analysis is made for.

→ Cost Center: Number of cost center that will pay the analysis.

→ Objective*: Main objective of analysis.

→ Description: Brief description about what it is asking – should be simple and objective.

→ Priority: Priority of task (blocker, critical, major, trivial, minor, n.a.).

→ Component/s: all components that are addressed on request.

→ Due Date*: Due date of analysis.

→ Labels: labels to help on identifying some features of request.

- **Cost:** issue type to register purchases.

→ Issue Type*: Cost.

→ Summary*: Name to identify the purchase – should be short, objective and standard (if applicable).

→ Assignee: Responsible of purchase.

→ Project Name: Project that purchase is associated.

→ Sub-Project: Part of project (ex: reliability).

→ Type: type of purchase: by investment or cost (≤1000 eur).

→ Test Relevant: if it is a purchase for a test or other.

→ Cost Center*: Cost center which pay the purchase.

→ Description: Identification of what is bought.

→ BANF number: BANF number of SAP

→ Supplier: Supplier

→ BU: Business Unit which is the client. To choose more than one option is necessary to press *ctrl*.

→ Assistance: collaborators that assist the work.

→ Security Level: Restriction of access. Should be CM/CoC_PCB unless some extern needs access to it.

→ Original Estimate: Estimate time to complete the task.

→ Remaining Estimate: Time missing. Not necessary to fill.

→ Buyer: Responsible from purchase department

→ Estimated Cost*: Price of purchase (in euros)

→ Order Number: PO number.

→ Inventory number: Inventory number of the new material (if applicable,)

→ GEIME number: GEIME number of the new equipment (if applicable: in case of calibration).

→ Priority: Priority of purchase (blocker, critical, major, trivial, minor, n.a.).

→ Component/s: all components that are associated to the purchase.

→ Labels: labels to help on identifying some features of purchase.

→ Fix Version/s: milestone (version) of purchase.

→ Linked Issues: association to another issue.

→ Assistance: collaborators that assist the work.

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- **CPR:** issue type to register and follow CPR.

→ Issue Type*: CPR.

→ Summary*: Name to identify the CPR (PRN)

→ Assignee: Responsible for CPR.

→ Part number: Part number

→ Project Name: Project name

→ Description: Brief description of CPR, if necessary. Can have project details.

→ Supplier: Supplier.

→ General Package: General package (example: BGA).

→ Package detail: Package detailed (example: FPBGA).

→ Division: Division which the CPR is done for.

→ Priority: Priority of task (blocker, critical, major, trivial, minor, n.a.).

→ Component/s*: all components associated to CPR.

→ Labels: labels to help on identifying some features of CPR.

→ Fix Version/s: milestone (version) of CPR.

→ Due Date*: Due date of CPR.

→ BU: Business Unit which is the client. To choose more than one option is necessary to press *ctrl*.

→ Result: Result of Component release.

→ Linked Issues: association to another issue.

→ Assistance: collaborators that assist the work.

→ Original Estimate: Estimate time to complete the task.

→ Remaining Estimate: Time missing. Not necessary to fill.

- **Sub-task:** issue type that can be a sub-level of the other issues type. It has the same fields of task.

> **NOTE:** Fields with asterisk (*) are mandatory.

▪ <u>**Security levels**</u> is the restriction of access to issues.

- CM/CoC_PCB: collaborators of MFT3 (pre-definition).

- CM/CN: collaborators of competence network.

- Participants: participants – only used in meeting issue.

- Plants: responsible collaborators of CM factories.

- Private: reporter and assignee.

NOTE: All the levels permit the access to the reporter and assignee (independently of their groups).

2.2 Benefits

This Software will bring the following benefits:

- Easier communication;
- Less e-mails;
- Interconnection of all activities;
- Better organization;
- Easier tracking;
- Full vision (through Kanban, Gantt chart, lists);
- Better following of meetings and its OPL;
- Filtering.

Valid issue only in Intranet. No change service for print-outs.

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3 Guide of Use

In this chapter will be described a general use of T&R in a simplistic way. The practical cases are going to be explained in the next chapter through use cases.

One objective of Track&Release is **organize your own work**. So, it is proposed to **use it every day** by open it in the morning to organize/prioritize the daily work. **Issues status and time tracking** should be **updated** at least once a day, depending on what you do.

An easy way is to organize through Kanban board that will be explained on subchapter 3.7.

The following sub-chapters are going to be explained the main functions of T&R as create issues, follow up issues, search issues, email notification, Kanban, Gantt chart, dashboard and other general guides.

3.1 Create Issues

1 – The option to create issues is in the header (Figure 2).
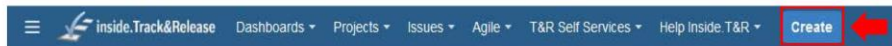
Figure 2: Create Issue

2 – Choose the issue type (Figure 3).

Valid issue only in Intranet. No change service for print-outs.

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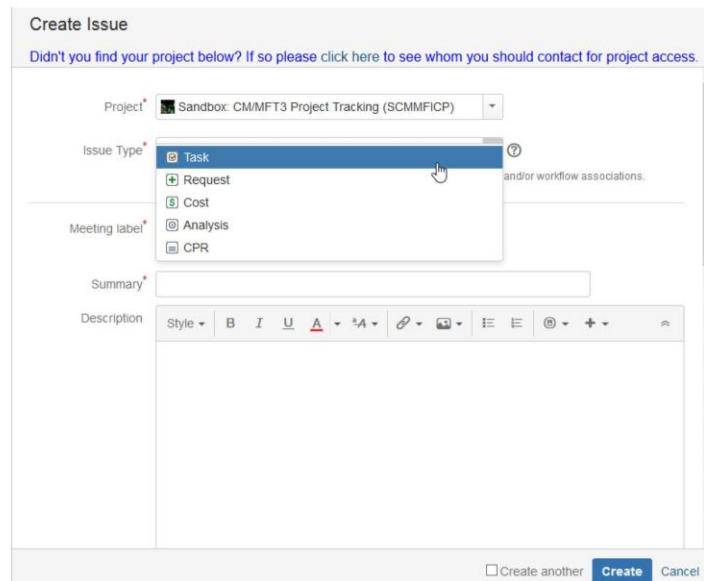
Figure 3: Issue type

3 – Fill the maximum fields possible. Fields with red asterisk are mandatory.

4 – Press "Create" bottom.

If you want to create issues inside issues (subtasks), it is necessary to press the option "more" on the main issue and choose the option "create sub-task" (to create one subtask) or "create multiple sub-tasks" (to create more than one subtask at the same time) (Figure 4).

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Figure 4: Create Subtasks

3.2 Follow up issues

When the issue is started, it is necessary to go to the issue and press the "Start Progress" bottom (Figure 5).
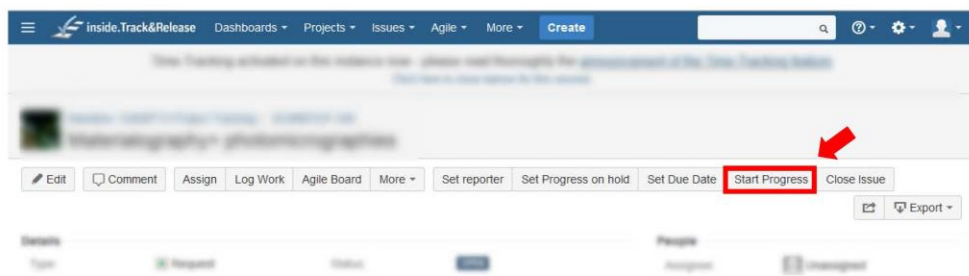
Figure 5: Start Progress of Issue

It is important to always update the issue status (hold, close, stop, reopen, approval,...).

One way to follow up issues is using mail notification and issue filtering, both explained on the next sub-chapters.

3.3 Search issues

Issues can be filtered through many different ways: general filtering, component filtering, Kanban board filtering and Gant Chart filtering.

3.3.1 Search by filters

a. Press the option "all issues" in the main page of the project (Figure 6 and 7).
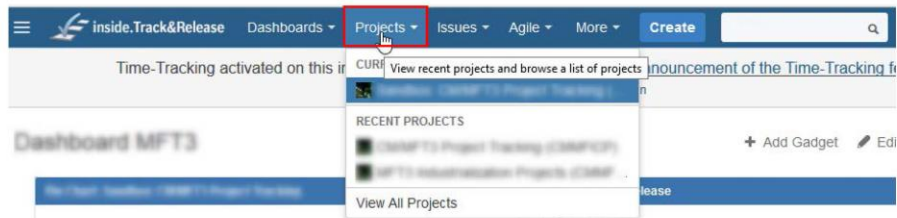
Figure 6: Choose MTF3 project
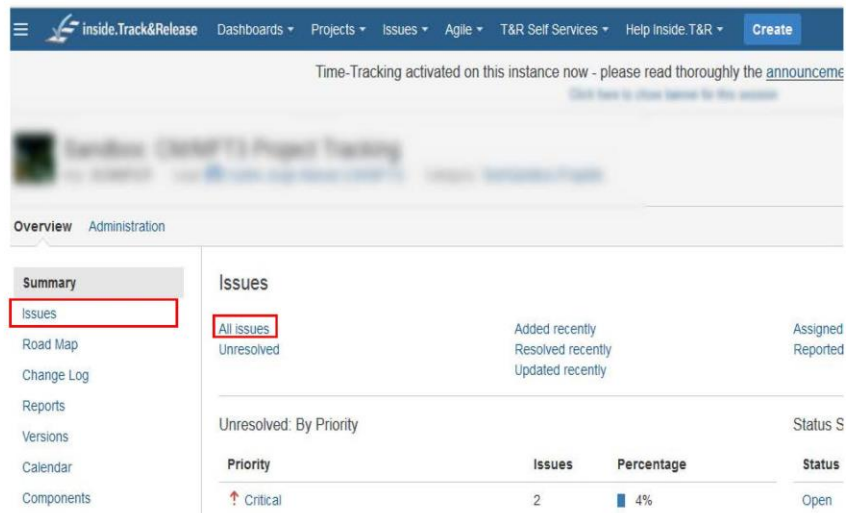
Figure 7: All issues option

b. Can use filters to find particular issues. The filters can be project, components, status, assignee and so on (Figure 8).

Valid issue only in Intranet. No change service for print-outs.

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Figure 8: Search by Filters

c. Can be created quick filter by saving it after the search (Figure 9). Then the filters will appear on "favorite filters" and it is faster to find by just clicking on it.
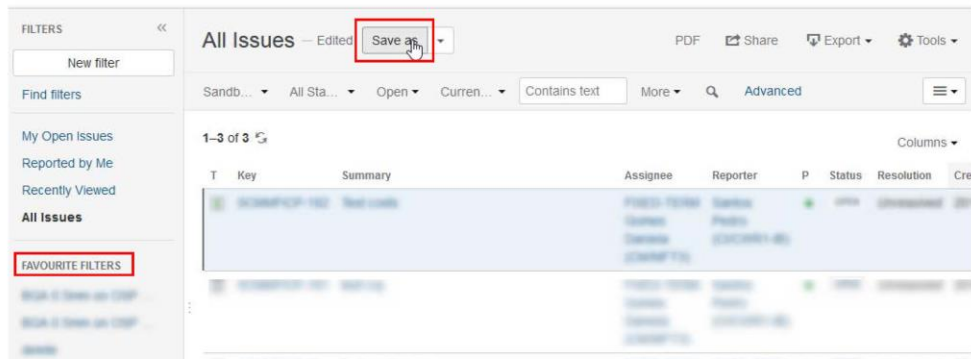
Figure 9: Save filters

3.3.2 Search by component

d. Press the field "components" in the main page (Figure 10). Choose the component and click on it to see all the issue associated.

Figure 10: Components option

3.3.3 Visual Search by Kanban board (Figure 11)

Figure 11: Kanban option

Explained more detailed on sub-chapter 3.7. "Kanban".

3.3.4 Visual Search by Gantt chart (Figure 12)
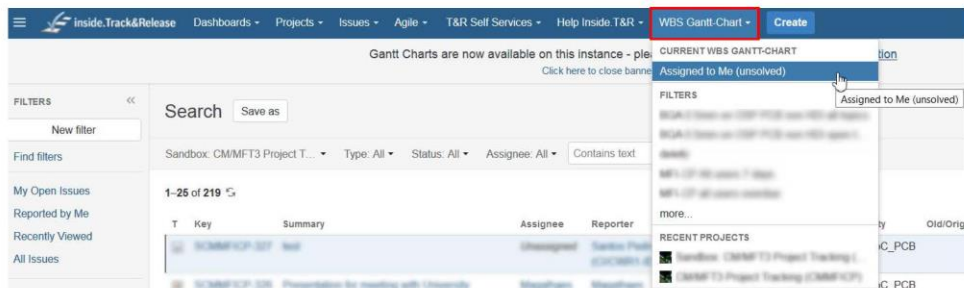
Figure 12: WBS Gantt-Chart option

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Explained more detailed on sub-chapter 3.8. "Gantt Chart".

3.4   Time Tracking

Time tracking (Figure 13) is one way to measure the effort of each issue or component. It is essential for resource allocation and extraction of KPIs.
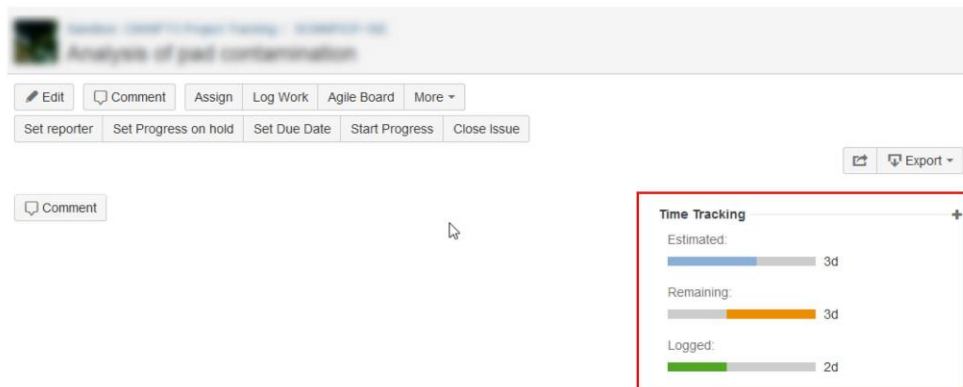
Figure 13: Vision of time tracking inside an issue

It is **mandatory to fill** the time spent of time tracking. Original estimation appears as a field when an issue is created; and, to fill "time spent", it is necessary to click on "time tracking" inside the issue and fill it (Figure 14) or fill in the menu that appears when issue status is changed.

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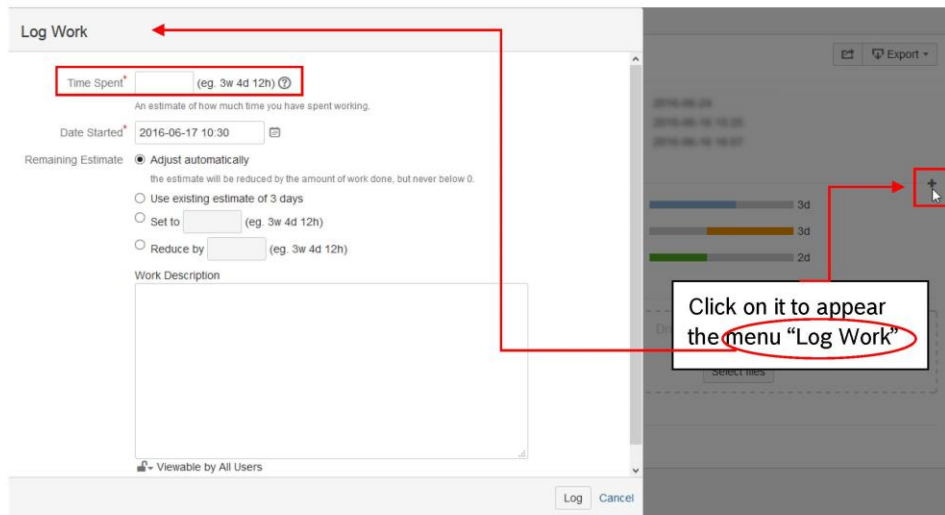
Figure 14: Fill Time Spent on Time Tracking

3.5   Share documents

Track&Release does not have as main functionality the document sharing but, to facilitate team work in this collaborative tool, it is possible to attach documents on issues. This field is called "Drag and Drop" and it appear inside of the issue (Figure 15).

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Figure 15: Drag and Drop option

The files are added just by clicking on "Select files". Then, the file will appear as attachment and **it is recommended to delete the file after using it** (Figure 16).
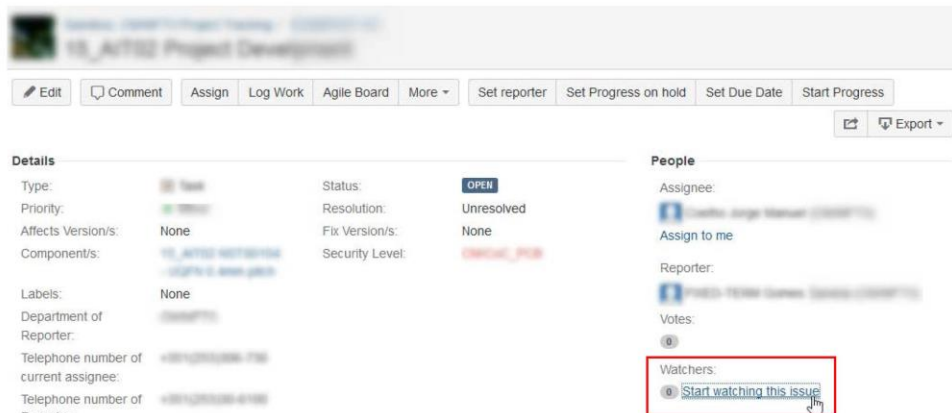
Figure 16: Delete attachment

3.6 Email notification

To receive mail notification about updates of some issues, users can be defined as watchers. To do that, the user should go to the issue and press the option "start watching this issue", as it is shown in Figure 17.

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Figure 17: Start watching this issue

Every user can define other collaborators to be watcher of some issue (Figure 18).

Figure 18: Add watchers

Other way to define mail notification is through subscribing filters (Figure 19 and 20).

Figure 19: Manage filters
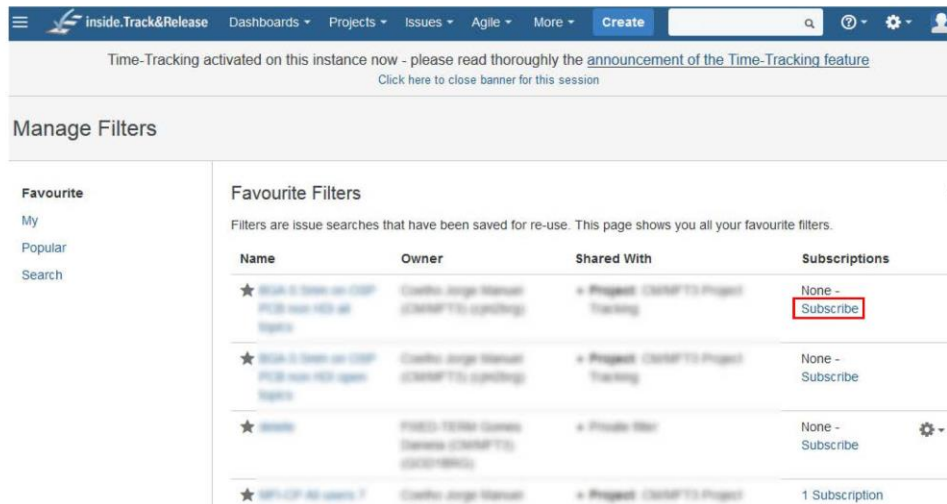
Figure 20: Subscribe Filter

And then can be defined the frequency of remaining (Figure 21).

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Figure 21: Frequency definition

3.7 Kanban

Kanban is a board that distribute work in columns according with its status (to do, in progress and close). It allows the total vision of workflow, enabling the organization of work.

In dashboard is possible to see the Kanban board but to work on it, it is necessary to go to the real Kanban board as it shown on Figure 22.
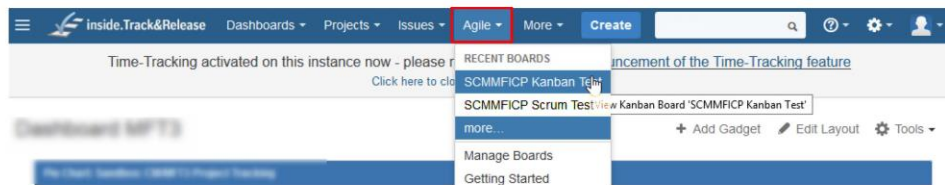
Figure 22: Kanban board

The more useful view is by filtering "Only my issues" (Figure 23) to organize the own work. But other filters can be chosen (it is possible to select more than one filter, showing the common issues of both filters).

Figure 23: Filtering Kanban

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Kanban board allows to drag issues in order to organize them and update its status (Figure 24).
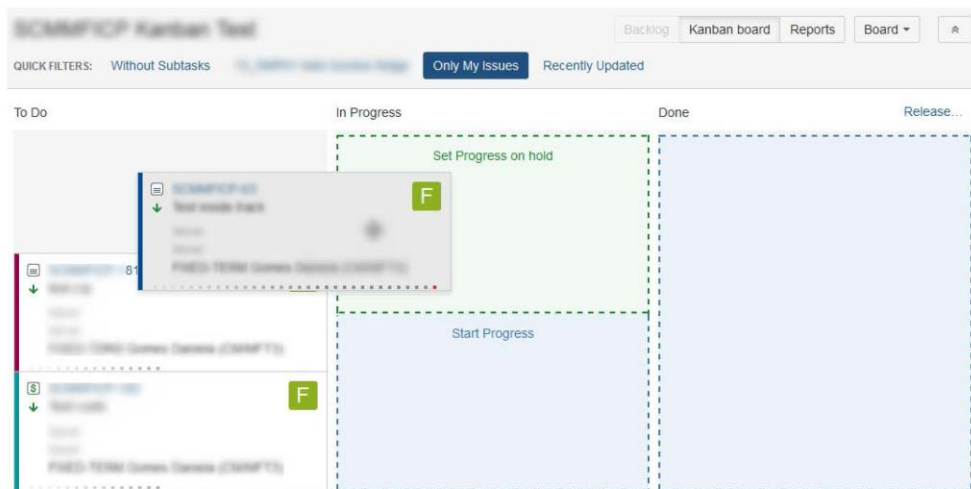
Figure 24: Drag issues

It is also possible to see for how long an issue stays in the same column (Figure 25).
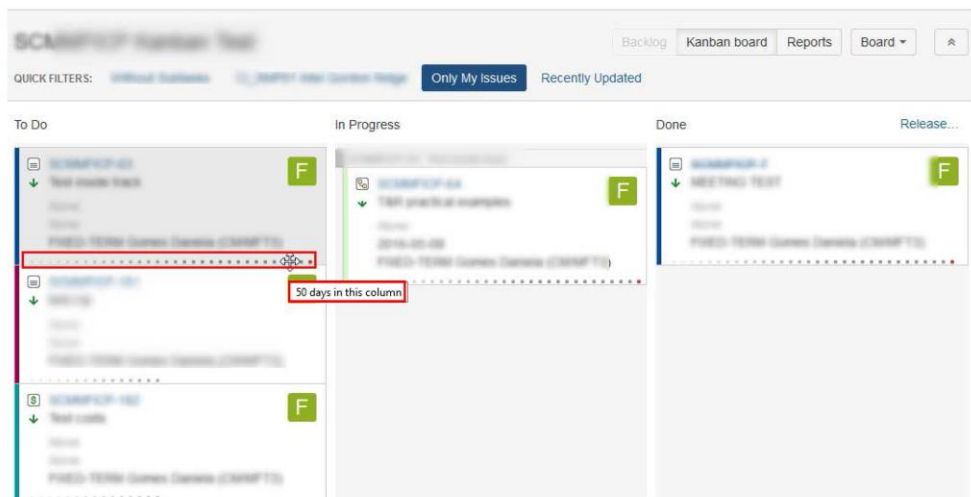
Figure 25: Time that an issue stays in the same column

3.8   WBS Gantt chart

WBS Gantt chart a better vision of issues through time lines. In Figure 26 is shown how the Gantt chart can be found.
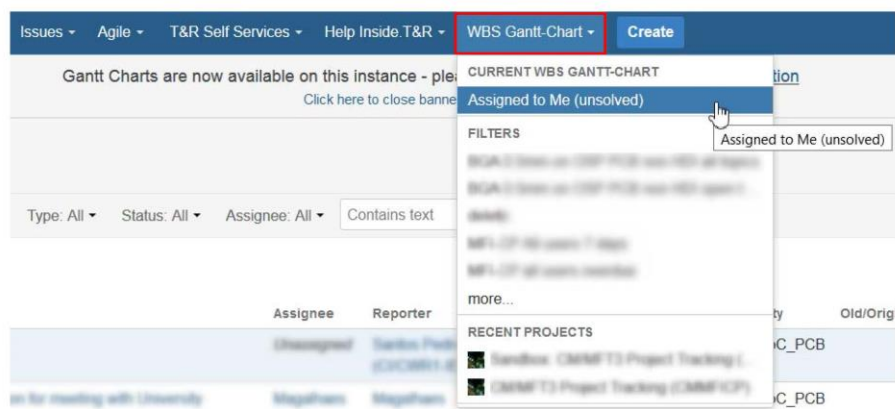
Figure 26: WBS Gantt-Chart option

When the WBS Gantt-Chart option is pressed, appears many options to choose a filter. To appear these filters, they have to be saved first (as it is explained on section 3.3.1.).

WBS Gant-Chart only have utility if the **issues status were always updated.**

In addition of having the time lines, the Gant-Chart also can have many columns with different information that can be chosen by any arrow in the column header (Figure 27).

It also allows resource management (Figure 28) and the vision of critical path (Figure 29).

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Figure 27: Options to choose columns information
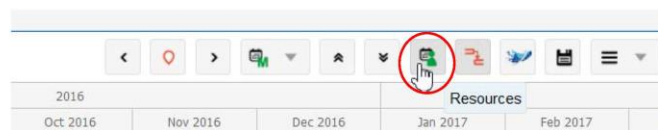
Figure 28: Resource Option

Figure 29: Critical path option

3.9   Dashboard

Dashboard is a board that can be used as main page in order to simplify T&R practice. It has some shortcuts and graphics. The figure 30 shows the way to go this dashboard.

If the option "Dashboard MFT3" does not appear, press the other option "Manage Dashboard" to search the dashboard through the window shown in Figure 31. Choose the option "search" on left menu, then choose "shared with project", find your project and press "search". Add "Dashboard MFT3" as favorite (Figure 32).
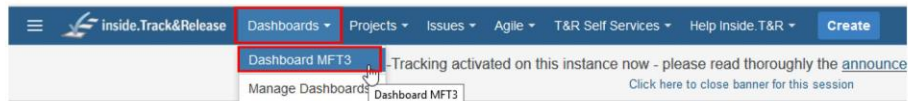
Figure 30: Go to dashboard
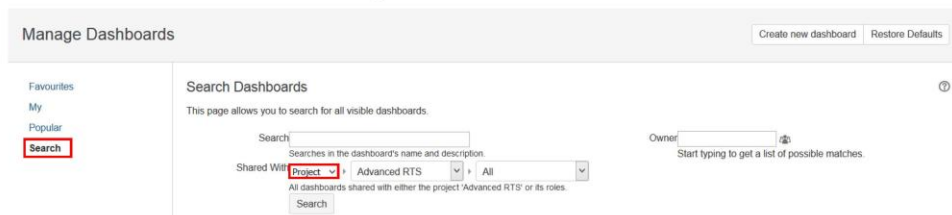
Figure 31: Search for Dashboard

Figure 32: Add "Dashboard MFT3" as favourite

The "Dashboard MFT3" (Figure 33 and 34) is only a proposal, all the users can create one for them or for their team.

Figure 33: Dashboard (part 1)
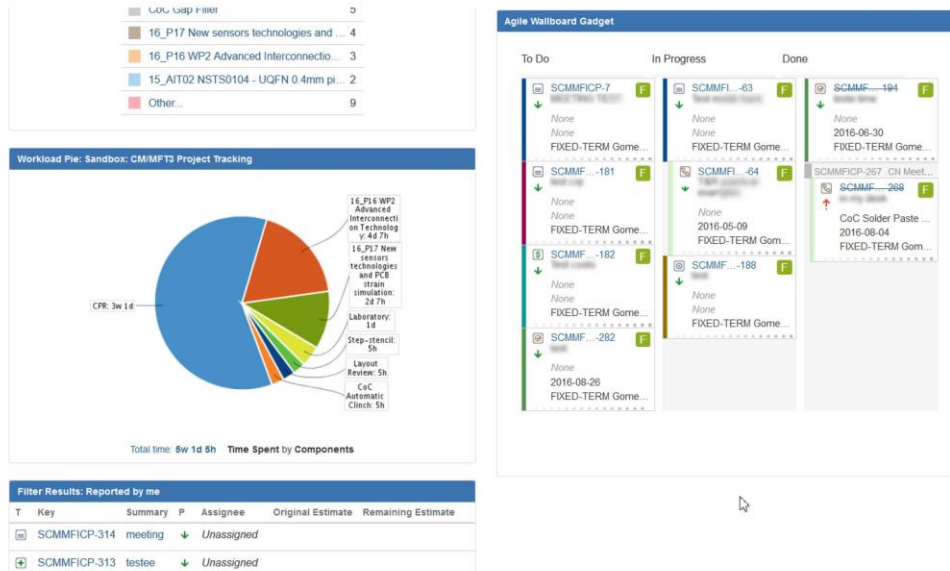
Figure 34: Dashboard (part 2)

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3.10 General guides

- It is mandatory to set a component to all issues.
- Fill the maximum possible issue fields.
- Tasks responsible has to follow his tasks and always update its status and relevant or/and useful comments.
- Component leader has to follow all issues associated to his component and support it.
- Time tracking is mandatory to fill with approximate hours of effective work.
- It is recommended to check all tasks every week. It can be supported with Kanban board or WBS Gantt chart with a total view of work assigned to you (or other criteria of filtering).
- It is recommended to delete the file attached after using it.
- It is important to register all the activities in order to have total vision of all the work and occupation.
- It is not possible to delete issues.
- Excluding the issue type "cost", all the other issues have to have only one component.
- The components can be only created by T&R administrators.
- Subtasks have the same security level of its parent issue.
- Once it is not possible to settled 0h as spent time, so it is proposed to fill with 0,001h to external or cancelled issues (e.g.TG cancelled, QGC2).

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4   Use Cases

In order to simplify the use of Track&Release, it will be presented some use cases for the following subjects: Projects, CoC processes components, Laboratory component, other components (CPR, LE, Step-Stencil, Layout review, SBMAC, Purchases), request issues and meeting issues.

4.1   Use Case: Meetings

Use Case

You have one meeting that you schedule.

It is important to write a minute and control the OPL resulted from the discussion (if applicable).
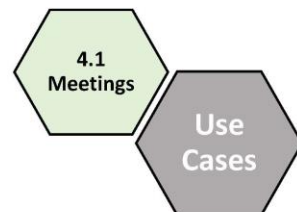
When you do a meeting, it is important to follow the next steps:

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1. Create Issue of meeting type

When the meeting begins, it should be created an issue of meeting type (procedure on Figure 35 and 36).

Figure 35: Create Issue
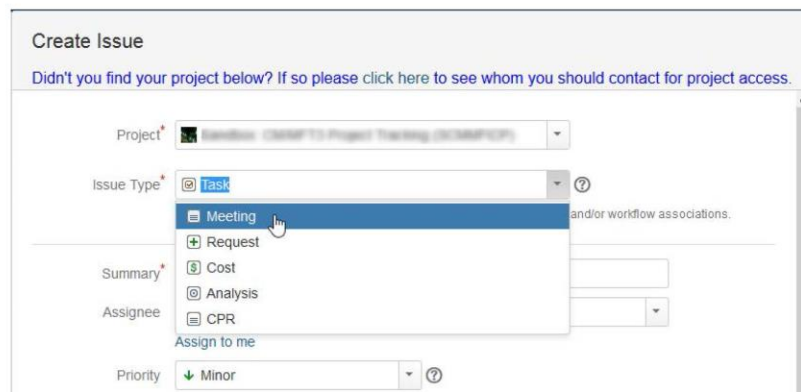
Figure 36: Choose Meeting as Issue Type

2. Fill the fields

It is necessary to fill the fields (fields with red asterisk are mandatory). And, after filling that fields and create the issue, it is necessary to start the progress of the issue (Figure 37).
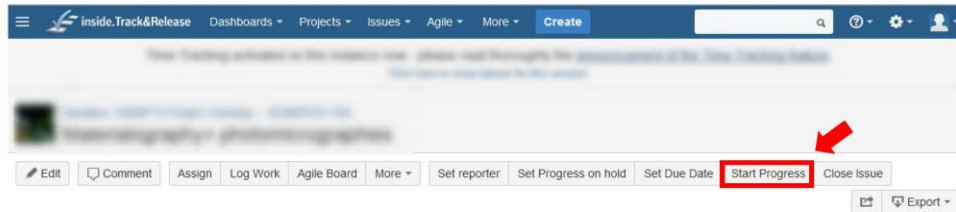
Figure 37: Start Progress of Issue

3. Create an OPL through sub-tasks

To create an OPL to the meeting, it is necessary to click on "more" option inside the meeting issue and choose the option "Create Sub-Task" or "Create Multiple Sub-Tasks" (Figure 38).

The option "Create Sub-Task" is to create one sub-task at each time and the option "Create Multiple Sub-Tasks" is to create more than one sub-task at the same time.
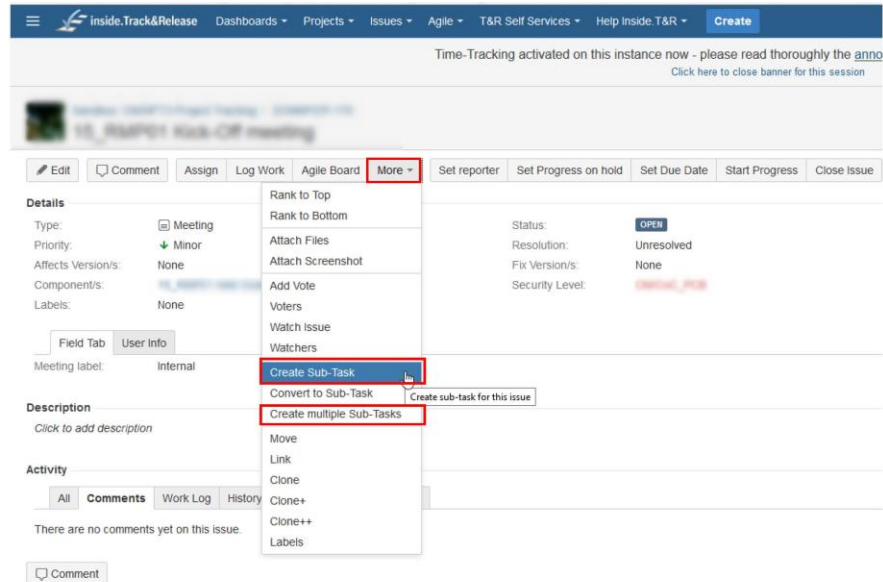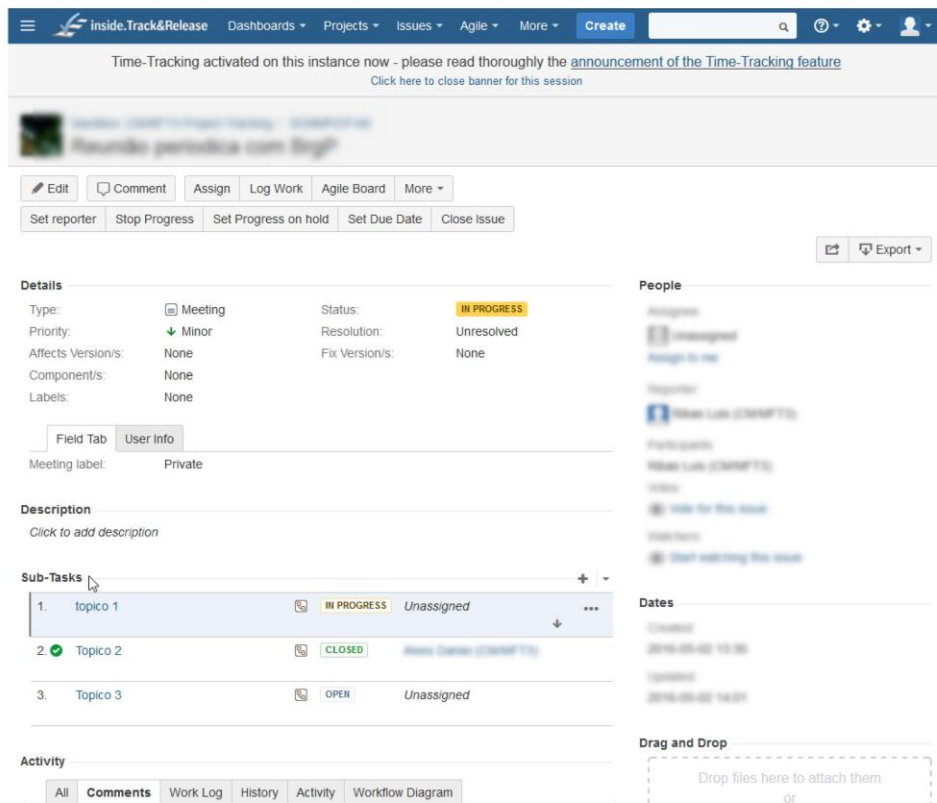
Figure 38: Create Sub-Task (OPL for meetings)

4. Follow OPL

It is important to follow the OPL and always update the status of sub-tasks and of the main task. It can be followed through issue view (Figure 39), filters or Kanban (explained on chapter "3.3. Search issues").

Figure 39: Issue Meeting view with sub-tasks

5. Export a report (if necessary)

If it is necessary to have a meeting minute or some document about the meeting to send by mail or to achieve, it can be exported a report (Figure 40).

Figure 40: Export a report (Word file)

4.2 Use Case: Project

Use Case

- You are a project manager and you want to start a project. T&R will support you on planning and controlling.

- You are project leader or other project team member is useful to follow the project and organize the work assigned to you.

Increase the communication and cooperation between team.
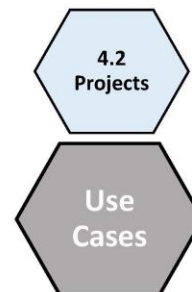
4.2.1 For project manager:

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1. **Create a component with the name of the project**

   Create a component with project name and project manager as component lead (Figure 41). **It is mandatory to put the project code in the name** (ex: YY_RMPXX, YY_AITXX, YY_P16 or YY_P17).
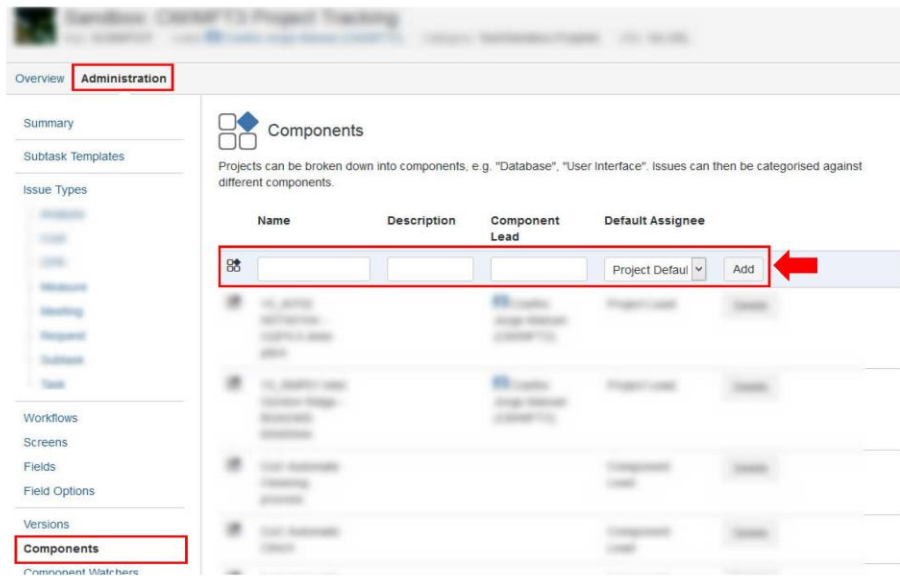
Figure 41: Create a component

2. **Create all tasks of the project**

   The proposal is to create all tasks by using the WBS template available.

   To find the templates available, it is necessary to select the option "WBS Gantt-Chart" on the header and choose the MFT3 project as a filter. Then, click on the project name with the right bottom of the mouse and create a ticket by choosing the template as it is shown in Figure 42.

Figure 42: Create all tasks of a project

The WBS template should be edited before its creation in order to readjust the dates, the assignee or other relevant field of each issue (procedure in administration document).

The name of the template that appear when it is select the creation of the template (Figure 43) should be the code of the project (e.g. 16_RMP01).

- If the task were cancelled or were not applicable, the issue must be closed with the value zero on spent time. In the case of QGC2 the spent time must be zero as well, since it is an external work **(Once it is not possible to settled 0h as spent time, it is proposed to fill with 0,001h)**

- If project manager find useful, can be added labels on the tasks with the phases of the project: Concept evaluation, Feasibility Evaluation, Productibility Evaluation, MAE, Preparation of Samples Production, Preparation of Series Care, Proof of Suitable, Process Rules, Maintenance and Process Release.

- The TGs issues have to have a label with its result: TG_Green or TG_red.

- Inside each task should be created subtasks with all activities done during it.

- If some tasks were related to other component, it should be mention on labels, since the **tasks have to have only one component assigned**.

3. Control all the tasks and replan, if necessary

One mission of project manager is to control the project and replan it, if necessary. This is supported with T&R by having a total vision of a project with issues status, responsible, dates and so on. To have this total vision, issues can be filtered by component (clicking on it).

Other filters can be applied depending on what project manager is looking for. In chapter 3.3 "Search issues" is explained some options to do it.

4. Close project

When the project ends, it is necessary to verify if all issues are close and, if some of them are not, investigate the reasons and close them with the more suitable resolution.

To an easy interpretation, can be written on the beginning of the name of project component the word "close" or "cancelled", depending on the situation.
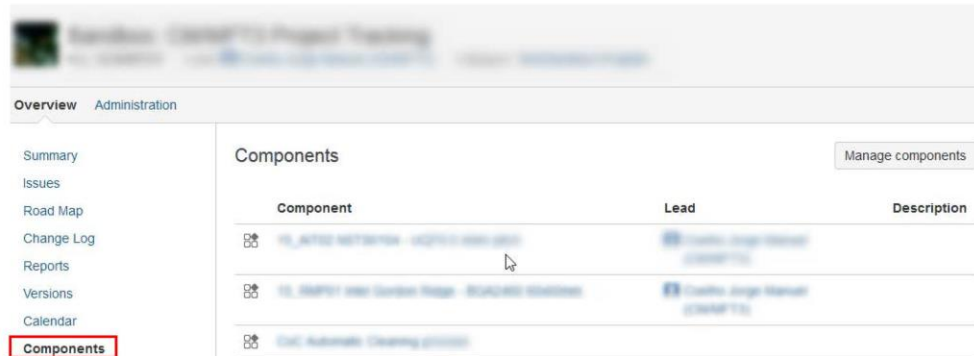
4.2.2 For project team:
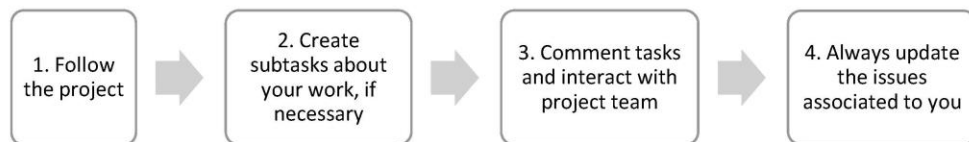
1. Follow the project

Project team should follow the project to contextualize themselves. The easy way to do it is by clicking on project component and have a total vision of all issues of it. In Figure 43 is shown where can be found the component. Other ways to filter issues in order to have other useful vision are explained on chapter 3.3 "Search issues".

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Figure 43: Components

More important than follow all the project, it is **mandatory to follow your own issues**. In dashboard you can have a total vision of all the issues assignee to you and you can receive mails remember you of them (explained on chapter 3.6 "Email notification"). Searching by filters can be useful because you can also filtering by issues assign to you and add some other filters as issue type, component, and reporter and so on.

2. **Create subtasks about your work, if necessary**

Usually, project manager creates all issues of project but you can add some new issues or subtasks to subdivide the work assigned to you to a better management of it. When something completely new is needed, it is necessary to inform project manager.

3. **Comment tasks and interact with project team**

One feature of T&R is its social interaction. Doubts, comments, questions and information should be shared through comments. Communication between project team is essential to its success.

4. **Always update the issues associated to you**

Besides following the issues assigned to you, it is also necessary **to update always its status**. Project manager only can manage the project if he has information about everything that is done.

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4.3   Use Case: CoC processes
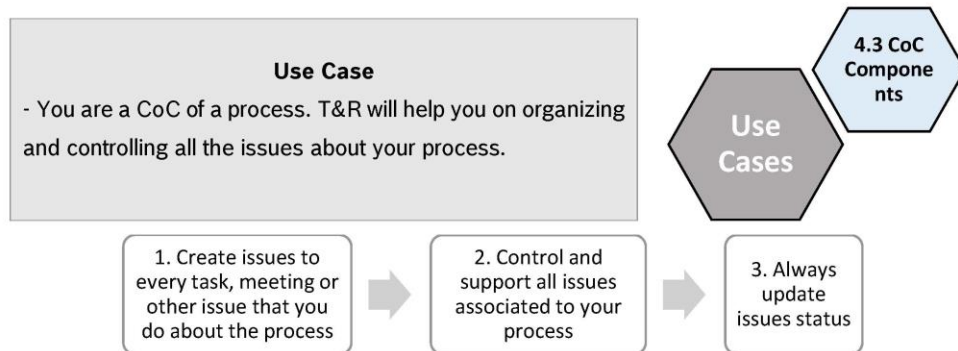
1. **Create issues to every task, meeting or other issue that you do about the process**

   It is important to register all the issues done related to a process in order to have a better controlling and following of activities and effort of CoCs. It facilitate the organization, communication and tracking of activities.

   In the Figure 44 and 45 are shown how to create issues.

Figure 44: Create Issue
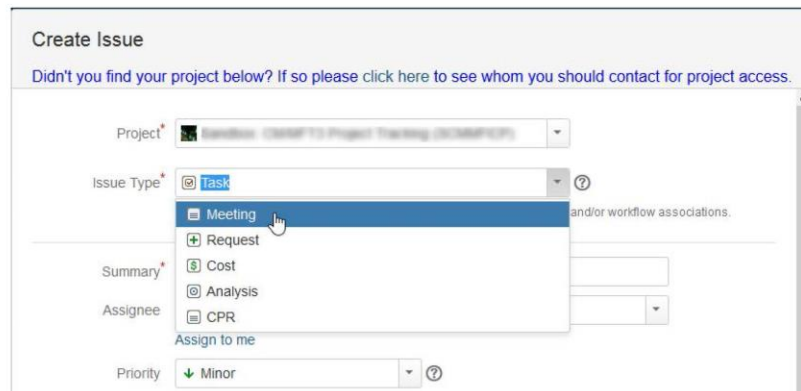
Figure 45: Choose Issue type

To organize issues, it is proposal to use the technique WBS with two levels (tasks and subtask). To create subtasks, it has to press the option "more" on the main issue and choose the option "create sub-task" (to create one subtask) or "create multiple sub-tasks" (to create more than one subtask at the same time) (Figure 46).

The organization of the component and its issues is responsibility of the CoC of the process.

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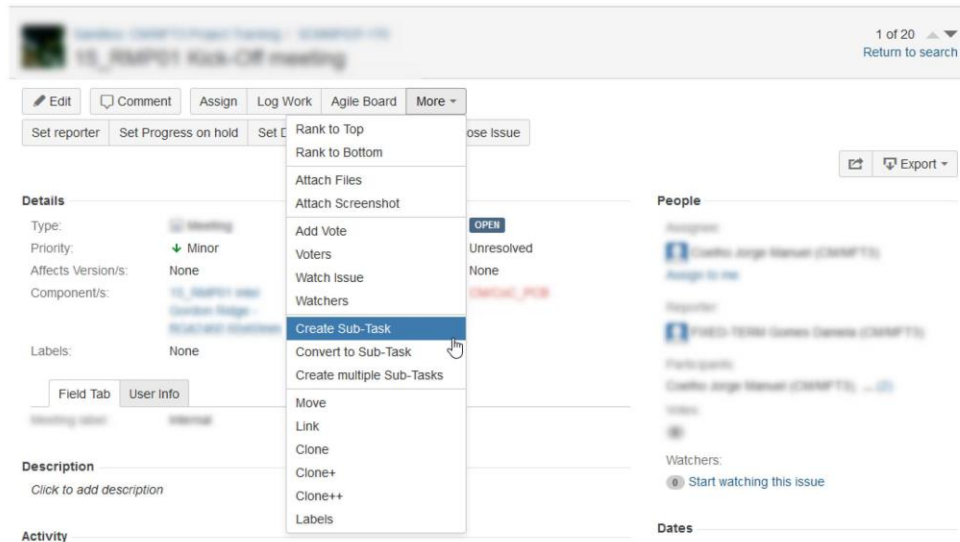
Figure 46: Create Subtasks

2. Control and support all issues associated to your process

Being CoC, you should support all issues about your process. The proposal is to view all issues associated to your process through pressing your component and receiving notifications to your mail with all updates (Filtering and email notification are explained on chapter 3.3. "Search issues" and 3.6 "Email notification", respectively).

3. Always update issues status

T&R functionalities only work if it is well used. It is mandatory to **update issues status** and **to fill the time tracking** of each issue. Being time spent of time tracking the approximation of time that you actually spend on doing it.

4.4 Use Case: Requests

Use Case

You want to ask for some service from MTF3, you should create an issue "request".

NOTE: *requests for laboratory should be the issue "analysis" (explained on chapter 4.6)*

Use Cases

4.4 Requests
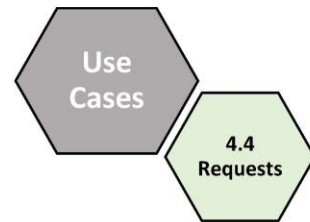
Request issues can be from outside of department or inside. If there are some new project or other activity that you know that it is necessary to do, you can create a request to register as future work that will be started when possible.

1. Create issue "request" → 2. Follow the issue and comment it, if necessary → 3. Receive an answer by comment
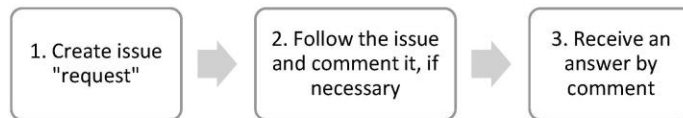
1. **Create issue "request"**

If you want some service from MFT3 you should create (Figure 47) an issue "request" type (Figure 48).

Figure 47: Create Issue
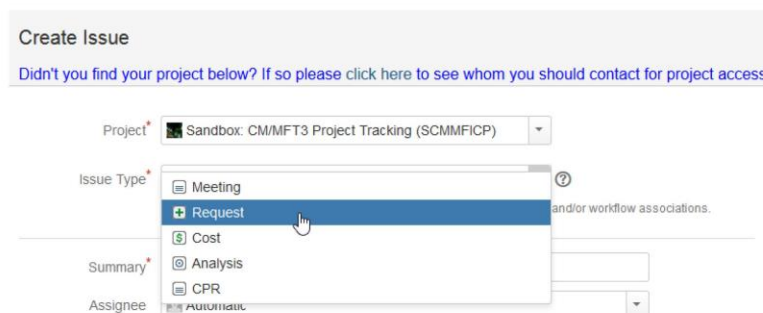
Figure 48: Choose issue type (request)
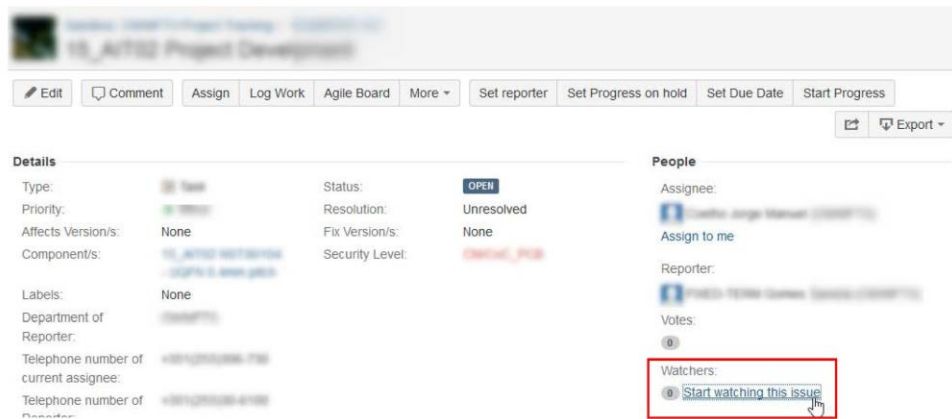
Valid issue only in Intranet. No change service for print-outs.

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2. Follow the issue and comment it, if necessary

Follow the issue to know the progress of it and comment to communicate to the responsible.

It is proposed to set the option "start watching this issue", as it is shown on Figure 49, to receive mail notification about updates of the issue.

Figure 49: Start watching this issue

3. Receive an answer

When the issue closes, the responsible will give you an answer by closing it and, if necessary, comment it or attaching some file (explained on sub-chapter 3.5 Share documents).

4.5 Use Case: Other components as CPR, Layout Review, LE, SBMAC, Step-Stencil, Purchases

Use Case

You will do some issue about the components CPR, LE, SMBAC, Step-Stencil, Layout Review or Purchases, you should create a T&R issue and associated it to them.

Component owner is responsible to control and follow all the issues.

Use Cases

4.5 Other Components: CPR, LE, SMBAC, Step-Stencil, Layout Review, Purchases
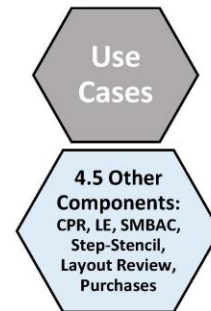
All the activities done inside MFT3 should be registered on Track&Release. Issues that are related to these components should be associated with it on issue definitions.

For the components as CPR, LE, SMBAC, Step-Stencil, Layout Review and Purchases, T&R will be similar to a data base to register all of what is done and the effort spent on them. Can be created all type of issues according to the work done.

It should also be used as collaborative tool.

1. Create issue → 2. Follow the issue and update its status → 3. Export a report
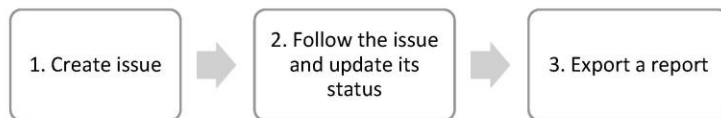
1. Create issue

It is important to register all the issues done in order to have a better controlling and following of activities and effort of MFT3 team. It facilitate the organization, communication and tracking of activities.

In the Figure 50 and 51 are shown how to create issues.

Figure 50: Create Issue
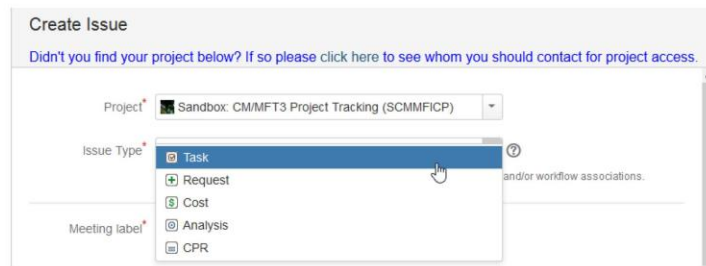
Figure 51: Choose Issue type

Can be attached files to facilitate team work in this collaborative tool. This field is called "Drag and Drop" and it appears inside of the issue (explained on 3.5 "Share documents"). It is recommended to delete the files after using it.

- For LE, SBMAC, Step-Stencil and Layout review is propose to use issues of task type and to adopt WBS technique with two levels (tasks and subtask).

To create subtasks, it has to press the option "more" on the main issue and choose the option "create sub-task" (to create one subtask) or "create multiple sub-tasks" (to create more than one subtask at the same time) (Figure 52).

Valid issue only in Intranet. No change service for print-outs.

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Figure 52: Create Subtasks

- For <u>CPR</u> is propose to use issues of CPR type. This issue is adapted to CPR features. To organize them, it is propose to have CPR as main issue with PRN number as summary and as "CPR subtasks" the respective PLE and PRP. Other possibility to organize is to create CPR, PLE PRP as "CPR subtask" and create a "task" as main issue in order to group them.

Since the PLE and PRP are done first, they can start as main CPR issue and then converted to subtask (Figure 53).

Figure 53: Convert to subtask

- For <u>purchases</u> is propose to use issue of cost type. This issue is adapted to purchase features. It is propose to link the issue to the component or task from where it appeared.

Other proposal is to identify as a label if the purchase is for a project and which type of it is (example: "Roadmap_Project").

2. **Follow the issue and update its status**

T&R functionalities only work if it is well used. It is mandatory to **update issues status** and **to fill the time tracking** of each issue. Being time spent of time tracking the approximation of the time that you actually spend on doing it.

3. **Export a report**

If it is necessary to have a report of an activity (ex: report of component release), it can be exported a report automatically from T&R (Figure 54).

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Figure 54: Export a report (Word file)

4.6 Use Case: Laboratory

Use Case

If you need some service from MTF3 laboratory, you should create an issue "analysis".

It is also useful to control and follow all the issues of laboratory.

Use Cases
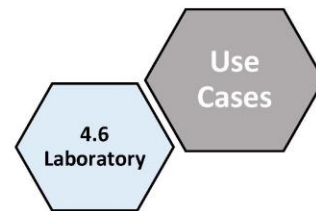
4.6 Laboratory

Laboratory component groups all activities that laboratory do. Issues key is used to identify orders and reports. It is essential the well use of T&R since laboratory is going to be certificate. This tool is according to audits parameters.

4.6.1 For requester:

1. Create issue → 2. Follow the issue and comment it, if necessary → 3. Receive an answer

1. **Create issue**

To ask for a service from laboratory you should create an issue "analysis" (Figure 55 and 56).

Figure 55: Create issue

Figure 56: Choose issue type (Analysis)

Other issues as meetings and tasks can be created in order to register all the activities and effort of laboratory.

> *Note: Even creating an analysis issue, it is mandatory to fill the paper for requisitions (green paper).*

2. **Follow the issue and comment it, if necessary**

Follow issues to know the progress of it and comment to communicate with responsible.

It is propose to set the option "start watching this issue", as it is shown on Figure 57, to receive mail notification about updates of the issue.

Valid issue only in Intranet. No change service for print-outs.

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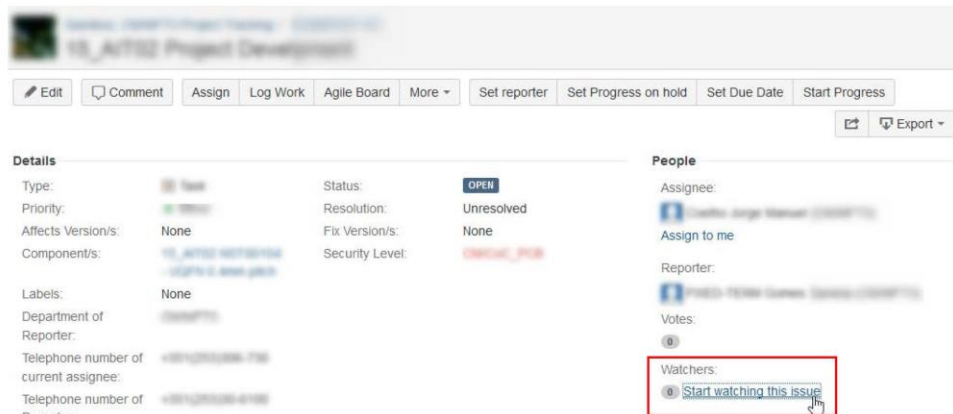
Figure 57: Start watching this issue

3. Receive an answer

When the issue closes, the responsible will give you an answer by closing it and attaching the report or sending it by email.

4.6.2 For laboratory collaborator:
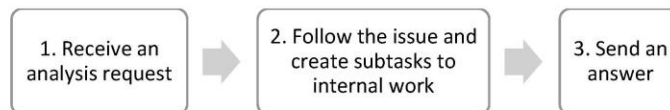
1. Receive an analysis request

When an analysis request is received, it is necessary to verify all the fields and complete them. It is necessary to allocate the issue to one responsible (field "assignee").

To receive all the analysis request, even the ones that does not have any assignee, it can be created a filter (subchapter 3.3 "Search issues") with email notification (subchapter 3.6 "Email notification").

One proposal is to define as label the type of analysis.

Valid issue only in Intranet. No change service for print-outs.

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2. **Follow the issue and create subtasks to internal work**

When the work it is started, it is necessary to change the issue status (Figure 58).
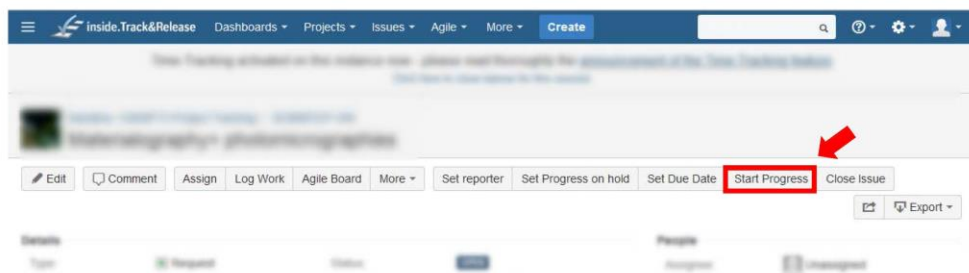
Figure 58: Start Progress

Follow issues to know the progress of it and comment to communicate with team and requester. It is mandatory to **update issues status** and **to fill time tracking** of each issue. Being spent time of time tracking the approximation of the time that you actually spend on doing it.

For internal steps of work can be created subtasks (Figure 59). The subtasks will have the same security level of its parent issue.

Valid issue only in Intranet. No change service for print-outs.

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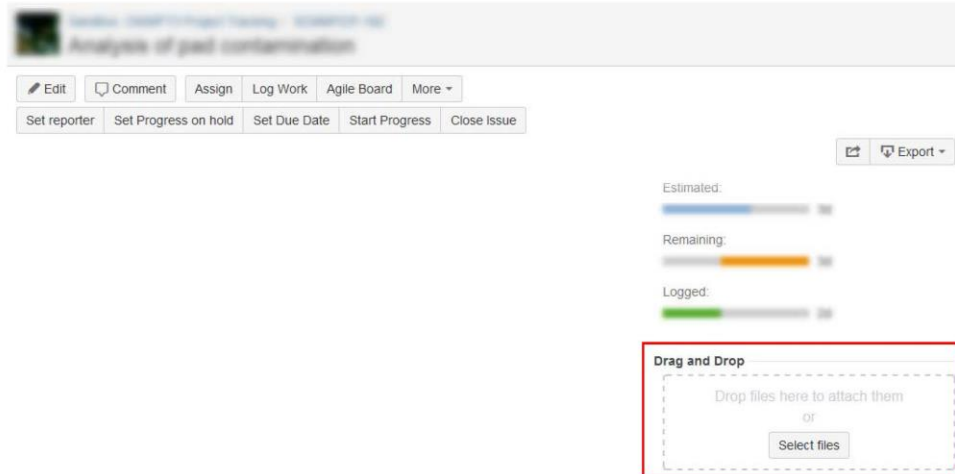
Figure 59: Create Subtasks

If the work done have to have restricted access, it can be created other issue linked with this one.

3. **Send an answer**

Close the issue when it is done and send an answer to the requester by attaching the report in the issue (Figure 60) or sending it by email.

Figure 60: Attach files

Valid issue only in Intranet. No change service for print-outs.

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List of abbreviations

CoC: Centre of Competence

CPR: Component Processability Release

KPI: Key Performance Indicators

LE: Layout Design

OPL: Open Point List

PLE: Preassessement LE

PRP: Part Release Preassessment

QGC: Quality Gate Customer

SBMAC: Sample Build Maturity Approval Checklist

T&R: Track&Release

Revision History

Issue	Date	Editor	Description of amendment

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APPENDIX VII – MFT3 T&R ADMINISTRATORS

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From CM/MFT3		Our Reference Daniela Gomes	Date Oct 11, 2016

Table of contents

1   Subject matter and purpose

This document addresses some considerations that administrators of MFT3 T&R should have.

The purpose of T&R is to track all the activities developed in MFT3, in order to know the allocation of resources, the quantity of activities/occupation, to provide a schedule view, to organize and distribute work. T&R also allows the download of a excel file with all the activities registered in order to create KPI graphics.

2   T&R general guides

- It is mandatory to set a component to all issues.
- Fill the maximum possible issue fields.
- Tasks responsible has to follow his tasks and always update its status and relevant or/and useful comments.
- Component leader has to follow all issues associated to his component and support it.
- Time tracking is mandatory to fill with approximate hours of effective work.
- It is recommended to check all tasks every week. It can be supported with Kanban board or WBS Gantt chart with a total view of work assigned to you (or other criteria of filtering).
- It is recommended to delete the file attached after using it.
- It is important to register all the activities in order to have total vision of all the work and occupation.
- It is not possible to delete issues.
- Excluding the issue type "cost", all the other issues have to have only one component.
- The components can be only created by T&R administrators.
- Subtasks have the same security level of its parent issue.
- Once it is not possible to settled 0h as spent time, so it is proposed to fill with 0,001h to external or cancelled issues (e.g.TG cancelled, QGC2).

3   Administrator functions

Administrators are responsible for MFT3 T&R. They should ensure the well use by collaborators. The following points describes some of their functions.

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3.1   Creation of components

Components groups the issues per subject. Only administrators can create components but they should analyse their utility first.

Components are divided by process, activity and project. It is advisable the creation of the smallest possible number of component to simplify their management.

The component should have a leader that it is the collaborator responsible for the activity or process or, in case of a project, the project manager.

> ***Note:***
>
> *Issues should have only one component.*
> *In the case of CoC processes, issues can have more than one CoC component.*

3.2   Support MFT3 users

MFT3 T&R administrators should support users. The guides are settled in "Instructions and Use Cases for MFT3 T&R".

3.3   Importation of OPL

MFT3 T&R administrators can create issues imported from OPL of an excel file.

The option to import issues are demonstrated in Figure 1.

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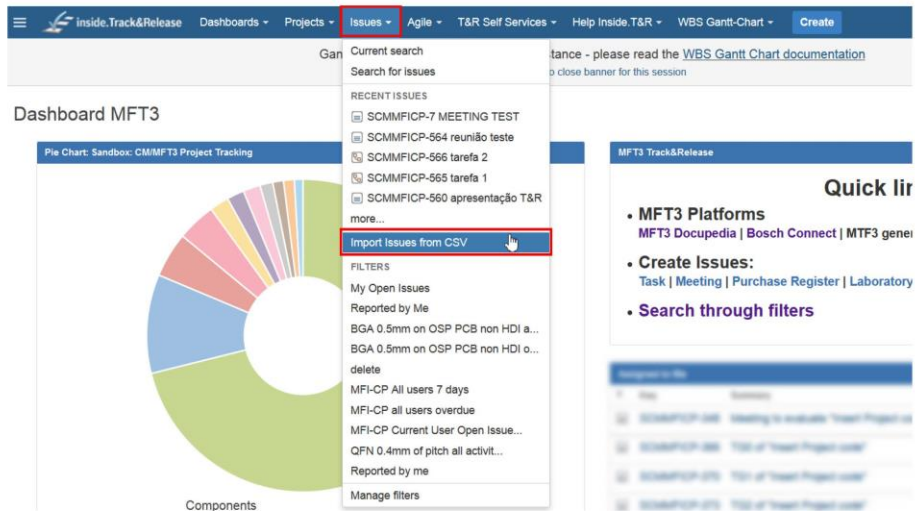
Figure 1: Import Issues

3.4   Creation of Templates

Creation of templates is a way to simplify the work. Templates are mostly used in projects. It is possible to create template though Gantt chart or in multiple subtasks.

3.4.1   Creation of Templates through Gantt chart

Gantt chart has the functionality of creation templates with every issue type. This feature is used mostly in project to save time and effort.

To go to templates should be pressed the option *ticket templates* as it is shown in Figure 2.
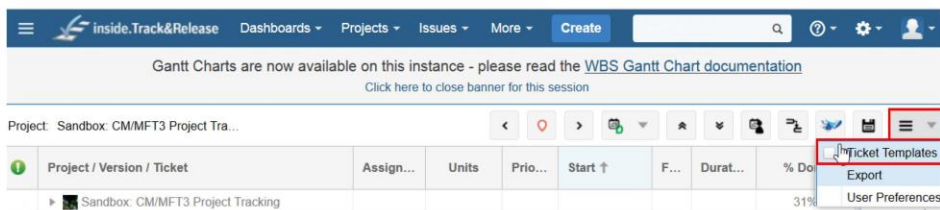
Figure 2: Ticket Templates Option

Inside of the name of the project, in that case *"Sandbox: CM/MFT3 Project Tracking"* in the left side of the Gantt, appears all the template created.

To create a new template, it is necessary to click with the right side of the mouse on project name and press the option *add template* (Figure 3).
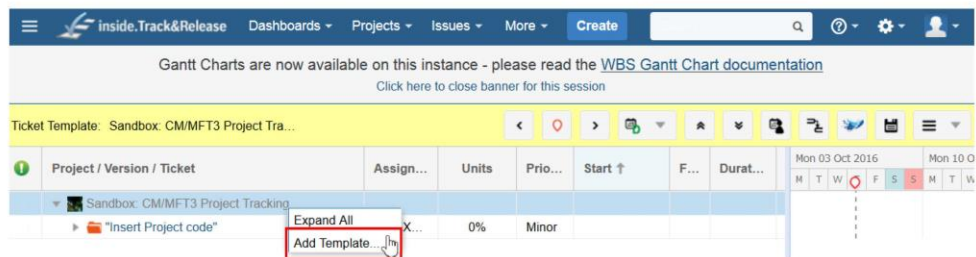
Figure 3: Add template option

When the option *add template* is pressed, appear a window to attribute a name for the template (Figure 4). The name will appear in the name of every issue created inside the template (when the template is transferred to issues, the template name is changed by the creator).
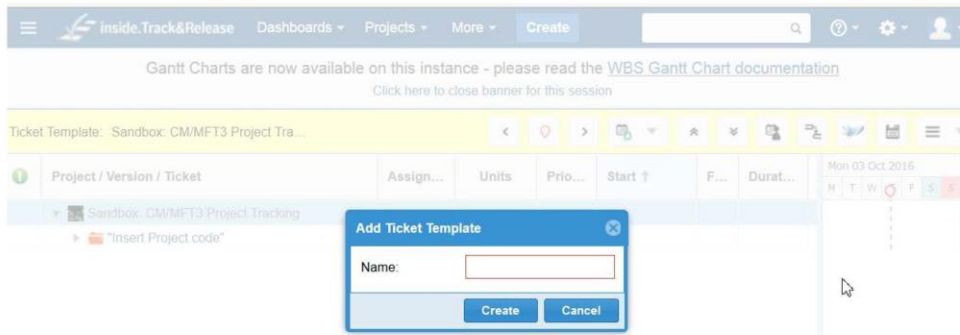
Figure 4: Add template window

After template creation, it can be added issues of every type by clicking with the right side of the mouse on template name, as it is shown in Figure 5.

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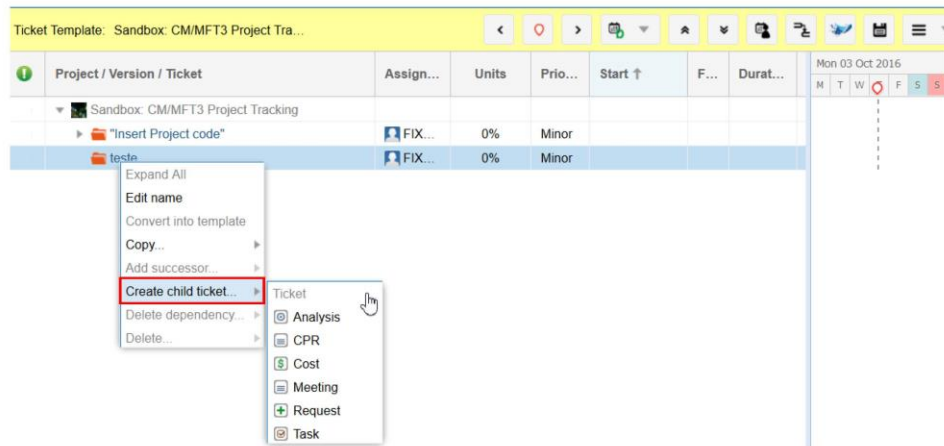
Figure 5: Creation of issues inside template
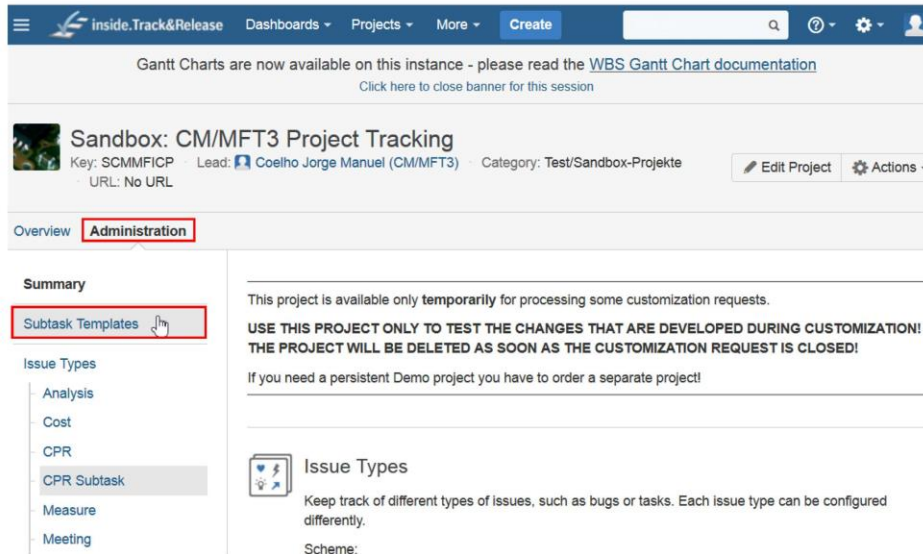
It can be created subtasks, successors, dependencies and the other fields available in Gantt chart. Its use is similar to *MS Project*.

The instruction to use the template is explained in the document "*Instructions and Use Cases for MFT3 T&R*" in chapter 4.2.1.

3.4.2 Creation of Templates through multiple subtasks

Other functionality of T&R is the creation of templates to subtask. In the Figure 6 is shown where that option are.

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Figure 6: Subtask templates option

This option opens a window with the field to create new templates (Figure 7) and with the templates already existents.

In the beginning of the window, there are some examples and instructions to create the templates with summary and other fields. An example it is shown in Figure 8, where some subtasks are created with a summary and assignee defined.

Valid issue only in Intranet. No change service for print-outs.

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Figure 7: Creation of Subtasks templates

Valid issue only in Intranet. No change service for print-outs.

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CM/MFT3		**Daniela Gomes**	Oct 11, 2016
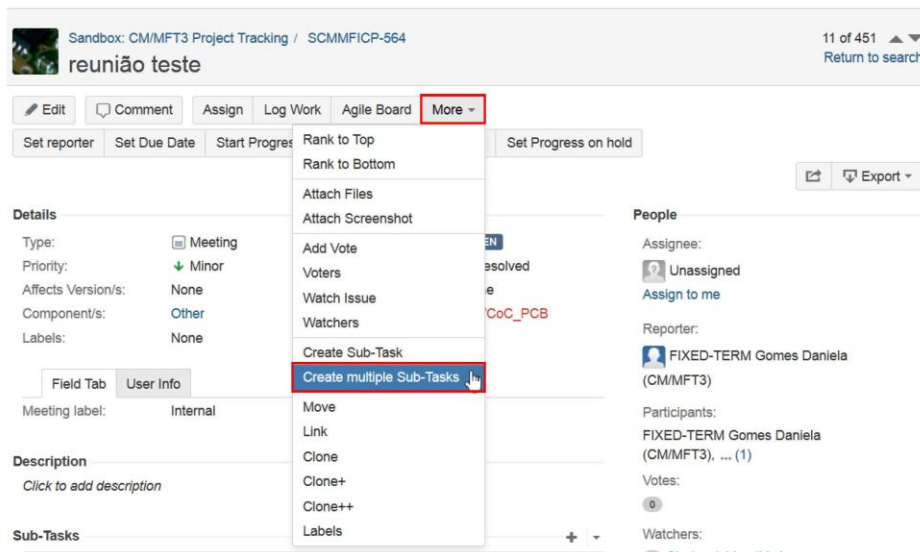
Figure 8: Example of how subtasks template can be created

To use this templates with the aim of creating multiple subtasks, it have to press the option *create multiple sub-tasks* and then choose a template, as it is shown in Figure 9 and 10.

In Figure 10, the issue type have to be changed to *subtask*. It can be also created multiple subtasks without a template, following the same instructions.

Figure 9: Creation of Multiple subtasks option

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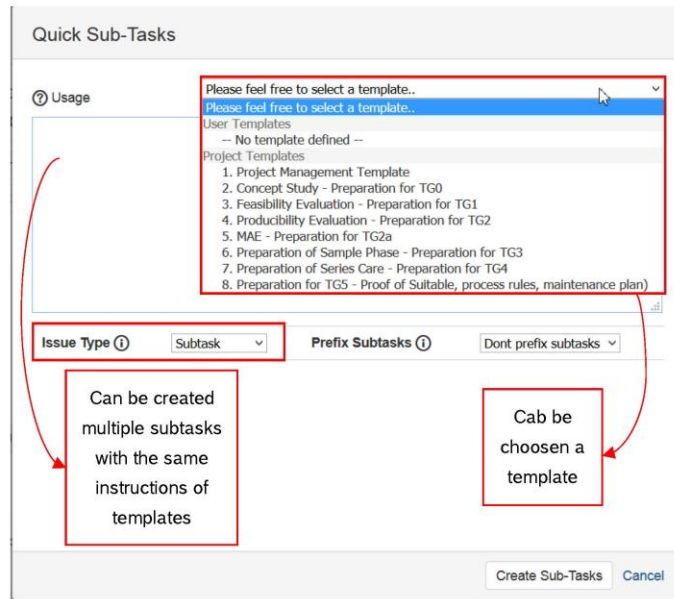
Figure 10: Creation of multiple subtasks

3.5 Update groups of access

Administrators should update the groups of MFT3 T&R:

- **Coc_PCB_all_users**: all collaborators of MFT3 section.

- **CM/MFT3_CompetenceNetwork:** collaborators of competence network (way of management of CN meetings)

- **CM/MFT3_Plants:** collaborators from plants, usually the responsible collaborators, but can be involved every collaborator that have requests to MFT3.

To check who already are members of the groups, it is necessary to go to *T&R Self Services* and choose the option *Show groups with member and WPD/...*, as it is shown in Figure 11. After that, it is only necessary to look for the name of the group (mentioned above) and click on it.
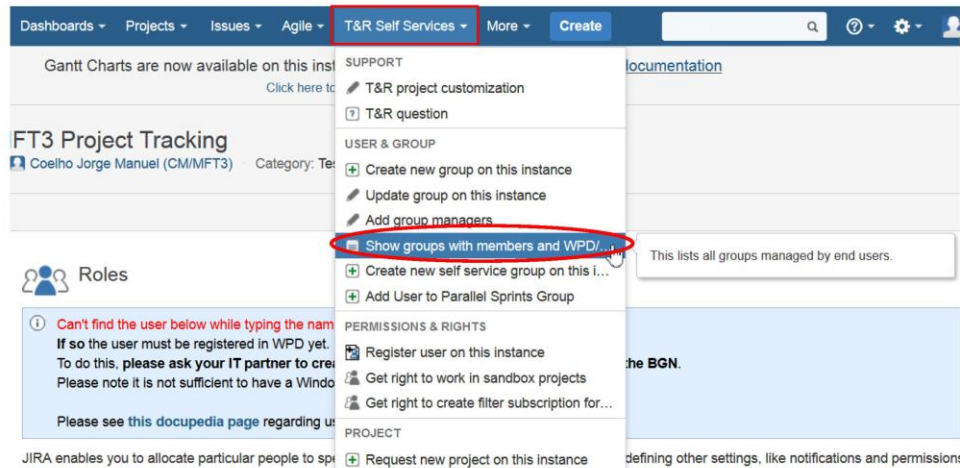
Figure 11: Option to check the members of T&R groups

To add members the option to choose is *update group on this instance* also in *T&R Self Service*.

3.6   Update field options

Some fields of issues are combo box and the option can be updated by administrators.

To find this functionality, it is necessary do choose the option *administration* in the main page of the project and choose *Field Options* (Figure 12 and 13).
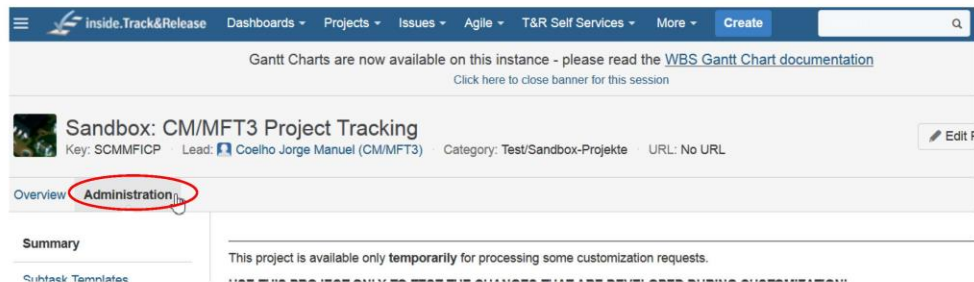
Figure 12: Administration option

Figure 13: Fields Options

Inside of the option, it can be chosen one of the option and edit the possibilities available.

3.7 Update roles

The roles are the T&R users and groups that have access to the different roles available: project-administrators, project-developers, project-reporters, project-viewers and subscriber.

The option is also available in the menu of *administration* with the name of *roles*.

3.8 Update filters of Kanban

The Kanban board has some quick filters that can be changed.

In the page of the Kanban, can be chosen the option *board* and then *configure* as it is shown in the Figure 14.

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Figure 14: Configure Kanban

Then, there is the option to edit the quick filters, as it is shown in Figure 15.
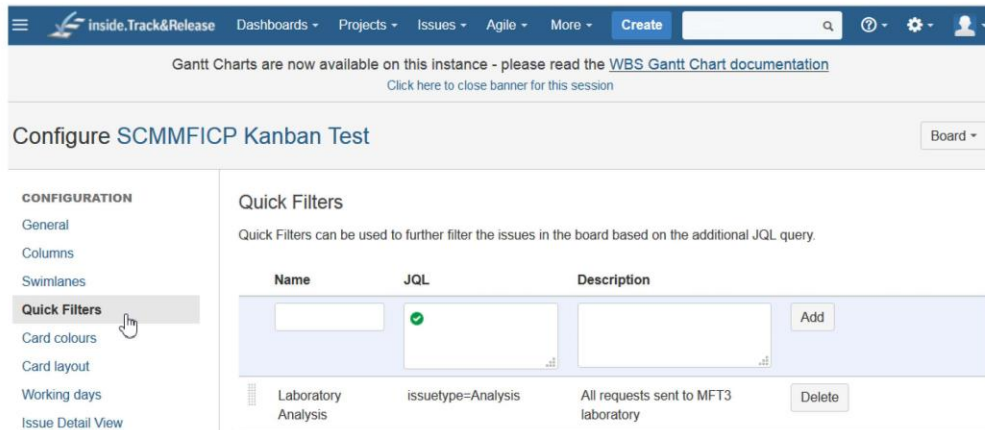
Figure 15: Edit Quick Filters of Kanban

4 KPI excel

KPI calculation excel file is a file created to work the data extracted from T&R.

Firstly, it is necessary to export all the data to an excel file – *Export*: *Excel* **(all fields)** option – as it is shown in Figure 16. The search has to have only the restriction of the project (it is mandatory to select MFT3 project as a filter).
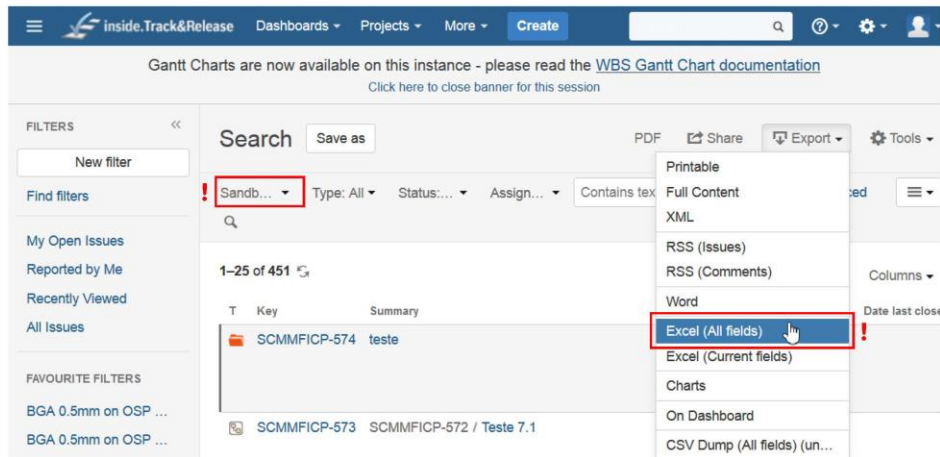
Figure 16: Export T&R data
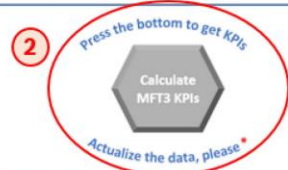
Then, it is necessary to open *KPI calculation* excel file and fill the sheet *Resources & TG plan* (number one of Figure 17) and then press the bottom (number two of Figure 17).

The bottom will run some programming code and it will appeared two windows (Figure 18 and 19) to fill in. The first window will search for excel file exported from T&R and the second window will update the budget available for the current year.

When the code were all processed, the KPI graphics will be updated as well as the page *Project status* with the dates of documents and milestones of each MFT3 projects.

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Figure 17: *KPI calculation* excel file

Figure 18: Selection of excel exported from T&R

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Figure 19: Update the budget available for Roadmap projects

4.1   Some considerations

KPI calculation excel file have some considerations to pay attention to guarantee the reliability of the graphics.

4.1.1   General considerations

- Pay attention to the component of each issue to avoid the counting of the issue effort in two different graphics, doubling the effort of the issue.

- 2015 is considered the year 0 (zero).

- The date of the creation of the issue is the start date for KPI graphics.

- The issue considered in the graphics has to have the spent time equal or bigger than 1h.

- The effort is divided equally by each month between the creation of the issue and the last close of it.

4.1.2   Graphics

1. **Effort graphics**: evaluate the capacity of resources for each activity.

   - CoC Processes:

     → Graphics involves all issues that contains "CoC" in the name.

     → The issues of these components can have more than one component **but only if the component also have "CoC"** in the name.

- Layout Design; SBMAC; CPR; laboratory:

    → Graphics involves all issues that have the component equal to the name of the activity.

    → The issues **only can have one component.**

- Projects:

    → Graphics involves all issues that contains some code of project in the name ("AIT" and "RMP").

    → The issues **only can have one component.**

- Innovation projects:

    → Graphics involves all issues that contains some code of project in the name ("P16" and "P17").

    → The issues **only can have one component.**

2. **Costs graphics**: provide an overview of all the money spent by MFT3 and if the spending are according to the budget available (for Roadmap projects).

    - All MFT3 costs:

        → Graphics involves all issues with the field *estimated cost*.

        → Does not consider any components.

        → Cost issues can have different components.

    - Roadmap projects cost plan fulfilment:

        → Graphics involves all issues that contains the code of Roadmap projects (RMP) and the field *estimated cost*.

3. **Projects graphics**: compare the quantity of TGs done versus the plan; evaluate if the requirement for MFT3 projects is accomplished – TG4 before QGC2 of product project; and compare the quantity of project panned versus the project that actually are done.

    - Quantity TGs done:

$\rightarrow$ The planned are according the sheet *Resources & TG plan*.

$\rightarrow$ The TGs done are the issues that contains "TG" in the name; a label with "TG_Red" or "TG_Green", respectively; and with spent time equal or bigger than 1h.

▪ TG4 before the QGC2 of product project:

$\rightarrow$ Target is all the TG4 before QGC2 of product project (100%).

$\rightarrow$ Compare if TG4 close date is before QGC2 (due date).

▪ Ratio of plan vs non plan projects:

$\rightarrow$ Number of project of each type through the code (AIT, RMP, P16, P17).

4.1.3 Project Status

• The project name (first column) appears when an issue of project charter is created.

• The date of documents and TGs are the last close date.

• The date of QGC2 is the due date.

• Cannot have more than one issue for each project with the following names: "project charter", "Kick-off checklist", "time schedule", "target cross", "cost calculation", "project orga", "tg0", "tg1", "risk analysis report", "TG2", "TG3", "TG 4", "QGC2", "Handover report", "TG5" (T&R project template is according with this).

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List of abbreviations

MFT3: Manufacturing Technology 3 (Centre of Competence of PCB assembly)

KPI: Key Performance Indicators

OPL: Open Point List

MS: Microsoft

TG: Technology Gate

QGC: Quality Gate Customer

Revision History

Issue	Date	Editor	Description of amendment

APPENDIX VIII – PERFORMANCE MEASUREMENT EXCEL FIRST PAGE

Main sheet of EXCEL file

This shape is a bottom that when it is clicked the code presented on appendix VI runs.

Press the bottom to get KPIs

Calculate
MFT3 KPIs

Actualize the data, please *

MFT3 KPI

MFT3

* Always update the data in the sheet "Resources & TGs Plan" before KPI calculation

Legend

| Industrialization | Processability | Laboratory | Management |

Current year = 2016

** Effort Target = number of resources*' x 11 month x 22 days x 8 hour
*' number according to resource table of sheet "Resources & TG"

Status Green
According to capacity/budget (bellow limit)

*** When there isn't negative results and it is done more than 80% of the plan

Status Yellow
Between capacity/budget/target and capacity/budget + 20%

*** When:
- There isn't negative results and they are between (or equal) 50% and 80% of the plan;
- The negative results are between 0 and 50% of the positive results and all together are more than 80% of the plan.

Status Red
Above capacity/budget + 20%

*** When:
- The results are less than 50% of the plan;
- The negative results are more than 50% of the positive results;
- There is some negative result and all the results are between (or equal) 50% and 80% of the plan.

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Effort

Effort Coc Processes (hour)

Effort | Cumulative | Trend

Effort Layout Design(hour)

Effort | Cumulative | Trend

Effort SBMAC(hour)

Effort | Cumulative | Trend

Effort CPR (hour)

Effort | Cumulative | Trend

Effort Laboratory (hour)

Effort | Cumulative | Trend

Effort Projects (hour)

Effort | Cumulative | Trend

Effort Projects Innovation (hour)

Effort | Cumulative | Trend

Costs

All MFT3 Costs (eur)

Legend: Costs, Cumulative

Roadmap Projects Cost Plan Fulfillment (eur)

Legend: Costs, Cummulative, Trend

Projects

Quantity TGs done ***

Legend: Done green, Done red, Cumulative, Planned

TG4 before the QGC2 of product project (%) ***

Legend: TG4 aligned with QGC2, Not aligned, Target

Ratio of Plan vs non plan projects

Legend: Roadmap Projects, Innovation Projects, AIT Projects, Ratio (%)

Sheet "Resource & TG plan" of EXCEL file

Number of TGs Planned (for current year)

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
TG 1												
TG 2												
TG 3												
TG 4												
TG 5												

Industrialization	Processability	Projects	Laboratory

*It was taken until 20% of time for non-productive tasks, travels and some meetings.

Resources

	CoC Process	CPR	SBMAC	Layout Design (LEs, Step-Stencil, Layout review)	Laboratory	Projects	Project innovation	Total*
Number of Resources	8,5	2,2	0,1	2,2	3,0	3,4	4,0	
						32%	13%	85%
	70%					5%	5%	80%
		75%				10%		85%
	70%					5%	5%	80%
							85%	85%
		75%				10%		85%
	70%					10%		80%
	70%					10%		80%
						80%		80%
							85%	85%
						60%	25%	85%
	70%					10%		80%
				75%		10%		85%
	70%					10%		80%
	70%					10%		80%
		65%	10%			10%		85%
	70%					10%		80%
					90%			90%
				65%		10%	5%	80%
	70%					10%		80%
							85%	85%
	70%					10%		80%
	70%					10%		80%
					90%			90%
				75%		10%		85%
	40%				25%	10%	5%	80%
							85%	85%
					90%			90%

Sheet "Projects Status" of EXCEL file

Projects	Project Charter	Kick-off Checkli	Time Schedu	Target Cros	Cost Calculati	Project Orga	TG0	TG1	Risk Analysis Report	TG2	TG3	TG4	Product C sampl	Handover Repo	TG5
████	12/05/2014	15/04/2015													
1)_RMP01 Intel Gordon Ridge - BGA2460 60x60mm	15/02/2016														

Press the bottom to update the table

Update

Hide sheet "Sheet3" of EXCEL file

				Data for KPI graph											

				Year	**2016**	**9**	**Month**
				Previous Year	**2015**		

CoC Process

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Capacity of current year **	Average
Effort	0	0	0	0	0	0	0	5	0	0	0	0	0	16456	0,56
Cumulative		0	0	0	0	0	0	0	5	5	5	5	5		
Trend		1371	2743	4114	5485	6857	8228	9599	10971	12342	13713	15085	16456		1371

Layout Design

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Capacity of current year **	Average
Effort	0	0	0	0	0	0	0	11	0	0	0	0	0	4162	1,22
Cumulative		0	0	0	0	0	0	0	11	11	11	11	11		
Trend		347	694	1041	1387	1734	2081	2428	2775	3122	3469	3816	4162		347

SBMAC

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Capacity of current year **	Average
Effort	0	0	0	0	0	0	0	0	0	0	0	0	0	194	0,00
Cumulative		0	0	0	0	0	0	0	0	0	0	0	0		
Trend		16	32	48	65	81	97	113	129	145	161	177	194		16

CPR

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Capacity of current year **		Average
Effort	0	0	0	0	0	0	3	29	145	0	0	0	0	4162		19,56
Cumulative		0	0	0	0	0	0	3	31	176	176	176	176			
Trend		347	694	1041	1387	1734	2081	2428	2775	3122	3469	3816	4162			347

Laboratory

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Capacity of current year **		Average
Effort	0	0	0	0	0	0	0	8	0	0	0	0	0	5711		0,89
Cumulative		0	0	0	0	0	0	0	8	8	8	8	8			
Trend		476	952	1428	1904	2380	2856	3332	3807	4283	4759	5235	5711			476

Projects

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Capacity of current year **		Average
Effort	0	0	0	0	0	0	0	0	0	0	0	0	0	6621		0,00
Cumulative		0	0	0	0	0	0	0	0	0	0	0	0			
Trend		552	1104	1655	2207	2759	3311	3862	4414	4966	5518	6069	6621			552

Project Innovation

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Capacity of current year **		Average
Effort	0	0	0	0	0	0	0	30	31	13	0	0	0	7705		8,11
Cumulative		0	0	0	0	0	0	0	30	61	73	73	73			
Trend		642	1284	1926	2568	3211	3853	4495	5137	5779	6421	7063	7705			642

Costs

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Target current year
Costs	0	0	0	0	0	0	505	2164	0	0	0	0	0	n.a
Cumulative		0	0	0	0	0	0	505	2670	2670	2670	2670	2670	n.a
Trend	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a

Roadmap Projects Costs

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Budget		Average
Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	1534		0,00
Cummulative		0	0	0	0	0	0	0	0	0	0	0	0			
Trend		128	256	384	511	639	767	895	1023	1151	1278	1406	1534			128

Quantity of TGs done

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Plan current year		Average	Sum
Done green	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
Done red	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
Cumulative		0	0	0	0	0	0	0	0	0	0	0	0				
Planned		0	0	0	0	0	0	0	0	0	0	0	0				
all done		0	0	0	0	0	0	0	0	0	0	0	0			0	
Planned (month)		0	0	0	0	0	0	0	0	0	0	0	0			0	

TG4 before the QGC2

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Plan current year		Average	
TG4 aligned with QGC2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	100%		1	9
Not aligned	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0	
Target		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%			1	
Target (number)	0	0	0	0	0	0	0	0	0	0	0	0	0			0	

Plan vs non plan projects

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Target current year
Roadmap Projects	n.a.	0	0	0	0	0	0	0	0	0	0	0	0	n.a
Innovation Projects	n.a.	0	0	0	0	0	0	0	0	0	0	0	0	n.a
AIT Projects	n.a.	0	0	0	0	0	0	0	0	0	0	0	0	n.a
Ratio (%)	n.a.	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	n.a

Number of TG4 before the QGC 2

	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TG4 aligned with C sample	0	0	0	0	0	0	0	0	0	0	0	0	0
Not aligned	0	0	0	0	0	0	0	0	0	0	0	0	0

Number of projects

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Roadmap Projects	0	0	0	0	0	0	0	0	0	0	0	0
Innovation Projects	0	0	0	0	0	0	0	0	0	0	0	0
AIT Projects	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX IV – PROGRAMMING CODE

Code of bottom of main sheet to calculate KPI

```vb
Sub Oval1_Click()

        ' Definition of variable's data type
        Dim Filter As String, Title As String
        Dim FilterIndex As Integer
        Dim Filename As Variant
        Dim data As Workbook
        Dim thisfile As Workbook
        Dim I As Integer

        ' Definition of the search filters of files
        Filter = "Excel Files (*.xls),*.xls,"
        ' The standard filter is *.*
        FilterIndex = 3
        ' Definition of the Caption
        Title = "Select the T&R data (EXCEL file)"
        ' Definition of the search drive
        ChDrive ("C")
        ChDir ("C:\")

        Sheets("Sheet2").Unprotect

        With Application
            ' Open a window to select the file
            Filename = .GetOpenFilename(Filter, FilterIndex, Title)

            If Filename = False Then

                ' Exit when it is cancelled with a message
                MsgBox "No file selected."
                Exit Sub

            Else

                ' Definition of the variables
                Set data = Workbooks.Open(Filename)
                Set thisfile = Workbooks("KPI calculation.xlsm")

                ' Copy and paste data from other excel file
                Application.CutCopyMode = False
                thisfile.Worksheets("Sheet2").Cells.ClearContents
                data.Worksheets("general_report").Cells.COPY
                thisfile.Worksheets("Sheet2").Cells.PasteSpecial
                data.Close SaveChanges:=False

                ' Formatation of Worksheet
                thisfile.Worksheets("Sheet2").Rows("1:3").Select
                Selection.Delete Shift:=xlUp
                thisfile.Worksheets("Sheet2").Rows("1:1").Select
                Selection.AutoFilter

                ' Creation of Columns to help on KPI calculation
                I = 2
```

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```vba
                    Do While thisfile.Worksheets("Sheet2").Range("C" & I).Value
<> ""
                            ' Column with year of close or actual year (if it
is still open)
                            thisfile.Worksheets("Sheet2").Range("DT" &
I).Select
                            ActiveCell.FormulaR1C1 = "=IF(YEAR(RC[-
24])=1900,YEAR(NOW()),YEAR(RC[-24]))"

                            ' Column with month of close or actual month (if it
is still open)
                            thisfile.Worksheets("Sheet2").Range("DU" &
I).Select
                            ActiveCell.FormulaR1C1 = "=IF(YEAR(RC[-
25])=1900,MONTH(NOW()),MONTH(RC[-25]))"

                            ' Column with a number of months assigned according
to date (considering 2015 as a year 0)
                            thisfile.Worksheets("Sheet2").Range("DV" &
I).Select
                            ActiveCell.FormulaR1C1 = "=((((RC[-2]-
2015)+1)*12))+RC[-1]"

                            ' Column with year of start
                            thisfile.Worksheets("Sheet2").Range("DW" &
I).Select
                            ActiveCell.FormulaR1C1 = "=YEAR(RC[-116])"

                            ' Column with month of start
                            thisfile.Worksheets("Sheet2").Range("DX" &
I).Select
                            ActiveCell.FormulaR1C1 = "=MONTH(RC[-117])"

                            ' Column with a number assigned according to date
(considering 2015 as year 0)
                            thisfile.Worksheets("Sheet2").Range("DY" &
I).Select
                            ActiveCell.FormulaR1C1 = "=(((RC[-2]-
2015)+1)*12)+RC[-1]"

                            ' Column with number of month that it was opened
                            thisfile.Worksheets("Sheet2").Range("DZ" &
I).Select
                            ActiveCell.FormulaR1C1 = "=(RC[-4]-RC[-1])+1"

                            ' Column with number of month of previous year
                            thisfile.Worksheets("Sheet2").Range("EA" &
I).Select
                            ActiveCell.FormulaR1C1 = "=IF(RC[-
7]=Sheet3!R3C13,IF(RC[-4]<Sheet3!R3C13,RC[-6],IF(RC[-4]=Sheet3!R3C13,((RC[-
6]-RC[-3])+1),0)),IF(RC[-7]=Sheet3!R2C13,IF(RC[-4]<Sheet3!R3C13,12,IF(RC[-
4]=Sheet3!R3C13,(12-(RC[-3])+1),0)),0))"

                            ' Column with effort (hours) of previous year
                            thisfile.Worksheets("Sheet2").Range("EB" &
I).Select
                            ActiveCell.FormulaR1C1 = "=(RC[-1]*(RC[-99]/RC[-
2]))/3600"

                            ' Column with effort (hours) per month
```

```vba
                            thisfile.Worksheets("Sheet2").Range("EC" &
I).Select

                            ActiveCell.FormulaR1C1 = "=RC[-100]/RC[-3]/3600"

                            I = I + 1
                    Loop


                    ' Save excel file
                    Workbooks("KPI calculation.xlsm").Save

                    ' Reset the Path
                    ChDrive (Left(.DefaultFilePath, 1))
                    ChDir (.DefaultFilePath)
                End If

        End With

        ' Return the path
        OpenFileDialog = Filename

        ' Show the table to fill the current year
        UserForm1.Show

        Sheets("Sheet2").Protect UserInterfaceOnly:=True

        End Sub
```

Code of bottom of useform to calculate KPI

```vba
Private Sub CommandButton1_Click()
    ' Definition of variables
    Dim S3 As Worksheet
    Dim KPI As Worksheet
    Dim S2 As Worksheet

    Set S3 = Worksheets("Sheet3")
    Set KPI = Worksheets("KPI")
    Set S2 = Worksheets("Sheet2")

    S3.Unprotect
    KPI.Unprotect
    S2.Unprotect

    ' Clear the cell
    S3.Cells(62, "O").ClearContents

    ' Copy of values written to cells of sheet 3
    If TextBox2 = "" Then
    MsgBox "Please fill the empty gap!"
    Else
    S3.Cells(62, "O").Value = UserForm1.TextBox2.Value
    Unload Me
    End If

    Call Projects Click

    ' Calculation of averages
    If S3.Range("N2") = 1 Then
        S3.Range("Q13").FormulaR1C1 = "=RC[-14]"
    Else
```

```vba
        If S3.Range("N2") = 2 Then
            S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
            Else
                If S3.Range("N2") = 4 Then
                    S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                Else
                    If S3.Range("N2") = 5 Then
                        S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-10])"
                    Else
                        If S3.Range("N2") = 6 Then
                            S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-9])"
                        Else
                            If S3.Range("N2") = 7 Then
                                S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-8])"
                            Else
                                If S3.Range("N2") = 8 Then
                                    S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-7])"
                                Else
                                    If S3.Range("N2") = 9 Then
                                        S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-6])"
                                    Else
                                        If S3.Range("N2") = 10 Then
                                            S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-5])"
                                        Else
                                            If S3.Range("N2") = 11 Then
                                                S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-4])"
                                            Else
                                                If S3.Range("N2") = 12 Then
                                                    S3.Range("Q13").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-3])"
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
                End If
            End If
        End If

    If S3.Range("N2") = 1 Then
        S3.Range("Q7").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q7").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q7").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
```

```vba
                Else
                    If S3.Range("N2") = 4 Then
                        S3.Range("Q7").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                    Else
                        If S3.Range("N2") = 5 Then
                            S3.Range("Q7").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
10])"
                        Else
                            If S3.Range("N2") = 6 Then
                                S3.Range("Q7").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
9])"
                            Else
                                If S3.Range("N2") = 7 Then
                                    S3.Range("Q7").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-8])"
                                Else
                                    If S3.Range("N2") = 8 Then
                                        S3.Range("Q7").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-7])"
                                    Else
                                        If S3.Range("N2") = 9 Then
                                            S3.Range("Q7").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-6])"
                                        Else
                                            If S3.Range("N2") = 10 Then
                                                S3.Range("Q7").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-5])"
                                            Else
                                                If S3.Range("N2") = 11 Then
                                                    S3.Range("Q7").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-4])"
                                                Else
                                                    If S3.Range("N2") = 12 Then
                                                        S3.Range("Q7").FormulaR1C1
= "=AVERAGE(RC[-14]:RC[-3])"
                                                    End If
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
                End If

    If S3.Range("N2") = 1 Then
        S3.Range("Q20").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q20").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q20").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
            Else
                If S3.Range("N2") = 4 Then
                    S3.Range("Q20").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                Else
                    If S3.Range("N2") = 5 Then
```

```vba
                        S3.Range("Q20").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
10])"
                    Else
                        If S3.Range("N2") = 6 Then
                            S3.Range("Q20").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-9])"
                        Else
                            If S3.Range("N2") = 7 Then
                                S3.Range("Q20").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-8])"
                            Else
                                If S3.Range("N2") = 8 Then
                                    S3.Range("Q20").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-7])"
                                Else
                                    If S3.Range("N2") = 9 Then
                                        S3.Range("Q20").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-6])"
                                    Else
                                        If S3.Range("N2") = 10 Then
                                            S3.Range("Q20").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-5])"
                                        Else
                                            If S3.Range("N2") = 11 Then
                                                S3.Range("Q20").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-4])"
                                            Else
                                                If S3.Range("N2") = 12 Then
                                                    S3.Range("Q20").FormulaR1C1
= "=AVERAGE(RC[-14]:RC[-3])"
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
                End If
            End If

    If S3.Range("N2") = 1 Then
        S3.Range("Q27").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q27").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q27").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
            Else
                If S3.Range("N2") = 4 Then
                    S3.Range("Q27").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                Else
                    If S3.Range("N2") = 5 Then
                        S3.Range("Q27").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
10])"
                    Else
                        If S3.Range("N2") = 6 Then
```

```vba
                            S3.Range("Q27").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-9])"
                        Else
                            If S3.Range("N2") = 7 Then
                                S3.Range("Q27").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-8])"
                            Else
                                If S3.Range("N2") = 8 Then
                                    S3.Range("Q27").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-7])"
                                Else
                                    If S3.Range("N2") = 9 Then
                                        S3.Range("Q27").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-6])"
                                    Else
                                        If S3.Range("N2") = 10 Then
                                            S3.Range("Q27").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-5])"
                                        Else
                                            If S3.Range("N2") = 11 Then
                                                S3.Range("Q27").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-4])"
                                            Else
                                                If S3.Range("N2") = 12 Then
                                                    S3.Range("Q27").FormulaR1C1
= "=AVERAGE(RC[-14]:RC[-3])"
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
            End If

        If S3.Range("N2") = 1 Then
        S3.Range("Q34").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
            Else
                If S3.Range("N2") = 4 Then
                    S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                Else
                    If S3.Range("N2") = 5 Then
                        S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
10])"
                    Else
                        If S3.Range("N2") = 6 Then
                            S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-9])"
                        Else
                            If S3.Range("N2") = 7 Then
```

```vba
                                S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-8])"
                            Else
                                If S3.Range("N2") = 8 Then
                                    S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-7])"
                                Else
                                    If S3.Range("N2") = 9 Then
                                        S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-6])"
                                    Else
                                        If S3.Range("N2") = 10 Then
                                            S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-5])"
                                        Else
                                            If S3.Range("N2") = 11 Then
                                                S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-4])"
                                            Else
                                                If S3.Range("N2") = 12 Then
                                                    S3.Range("Q34").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-3])"
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
                End If
            End If
        End If
    End If

        If S3.Range("N2") = 1 Then
        S3.Range("Q41").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q41").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
    Else
        If S3.Range("N2") = 3 Then
            S3.Range("Q41").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
        Else
            If S3.Range("N2") = 4 Then
                S3.Range("Q41").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
            Else
                If S3.Range("N2") = 5 Then
                    S3.Range("Q41").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-10])"
                Else
                    If S3.Range("N2") = 6 Then
                        S3.Range("Q41").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-9])"
                    Else
                        If S3.Range("N2") = 7 Then
                            S3.Range("Q41").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-8])"
                        Else
                            If S3.Range("N2") = 8 Then
```

```vba
                                                S3.Range("Q41").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-7])"
                                            Else
                                        If S3.Range("N2") = 9 Then
                                            S3.Range("Q41").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-6])"
                                            Else
                                            If S3.Range("N2") = 10 Then
                                                S3.Range("Q41").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-5])"
                                                Else
                                            If S3.Range("N2") = 11 Then
                                                S3.Range("Q41").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-4])"
                                                Else
                                                If S3.Range("N2") = 12 Then
                                                    S3.Range("Q41").FormulaR1C1
= "=AVERAGE(RC[-14]:RC[-3])"
                                                    End If
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
                End If
        End If

        If S3.Range("N2") = 1 Then
        S3.Range("Q48").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q48").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q48").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
            Else
                If S3.Range("N2") = 4 Then
                    S3.Range("Q48").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                Else
                  If S3.Range("N2") = 5 Then
                    S3.Range("Q48").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
10])"
                    Else
                        If S3.Range("N2") = 6 Then
                            S3.Range("Q48").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-9])"
                        Else
                            If S3.Range("N2") = 7 Then
                                S3.Range("Q48").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-8])"
                            Else
                                If S3.Range("N2") = 8 Then
                                    S3.Range("Q48").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-7])"
                                Else
                                    If S3.Range("N2") = 9 Then
```

```vba
                                                S3.Range("Q48").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-6])"
                                        Else
                                            If S3.Range("N2") = 10 Then
                                                S3.Range("Q48").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-5])"
                                            Else
                                                If S3.Range("N2") = 11 Then
                                                    S3.Range("Q48").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-4])"
                                                Else
                                                    If S3.Range("N2") = 12 Then
                                                        S3.Range("Q48").FormulaR1C1
= "=AVERAGE(RC[-14]:RC[-3])"
                                                    End If
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
                End If

    If S3.Range("N2") = 1 Then
        S3.Range("Q62").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q62").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q62").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
            Else
                If S3.Range("N2") = 4 Then
                    S3.Range("Q62").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                Else
                    If S3.Range("N2") = 5 Then
                        S3.Range("Q62").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
10])"
                    Else
                        If S3.Range("N2") = 6 Then
                            S3.Range("Q62").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-9])"
                        Else
                            If S3.Range("N2") = 7 Then
                                S3.Range("Q62").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-8])"
                            Else
                                If S3.Range("N2") = 8 Then
                                    S3.Range("Q62").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-7])"
                                Else
                                    If S3.Range("N2") = 9 Then
                                        S3.Range("Q62").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-6])"
                                    Else
                                        If S3.Range("N2") = 10 Then
```

```vba
                                                    S3.Range("Q62").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-5])"
                                                Else
                                                    If S3.Range("N2") = 11 Then
                                                        S3.Range("Q62").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-4])"
                                                    Else
                                                        If S3.Range("N2") = 12 Then
                                                            S3.Range("Q62").FormulaR1C1
= "=AVERAGE(RC[-14]:RC[-3])"
                                                        End If
                                                    End If
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
                End If
            End If

    If S3.Range("N2") = 1 Then
        S3.Range("Q74").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q74").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q74").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
            Else
                If S3.Range("N2") = 4 Then
                    S3.Range("Q74").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                Else
                    If S3.Range("N2") = 5 Then
                        S3.Range("Q74").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
10])"
                    Else
                        If S3.Range("N2") = 6 Then
                            S3.Range("Q74").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-9])"
                        Else
                            If S3.Range("N2") = 7 Then
                                S3.Range("Q74").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-8])"
                            Else
                                If S3.Range("N2") = 8 Then
                                    S3.Range("Q74").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-7])"
                                Else
                                    If S3.Range("N2") = 9 Then
                                        S3.Range("Q74").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-6])"
                                    Else
                                        If S3.Range("N2") = 10 Then
                                            S3.Range("Q74").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-5])"
                                        Else
                                            If S3.Range("N2") = 11 Then
```

```vba
                                                       S3.Range("Q74").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-4])"
                                                   Else
                                                       If S3.Range("N2") = 12 Then
                                                           S3.Range("Q74").FormulaR1C1
= "=AVERAGE(RC[-14]:RC[-3])"
                                                       End If
                                                   End If
                                               End If
                                           End If
                                       End If
                                   End If
                               End If
                           End If
                       End If
                   End If
               End If

    If S3.Range("N2") = 1 Then
        S3.Range("Q73").FormulaR1C1 = "=RC[-14]"
    Else
        If S3.Range("N2") = 2 Then
            S3.Range("Q73").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-13])"
        Else
            If S3.Range("N2") = 3 Then
                S3.Range("Q73").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-12])"
            Else
                If S3.Range("N2") = 4 Then
                    S3.Range("Q73").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-11])"
                Else
                    If S3.Range("N2") = 5 Then
                        S3.Range("Q73").FormulaR1C1 = "=AVERAGE(RC[-14]:RC[-
10])"
                    Else
                        If S3.Range("N2") = 6 Then
                            S3.Range("Q73").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-9])"
                        Else
                            If S3.Range("N2") = 7 Then
                                S3.Range("Q73").FormulaR1C1 = "=AVERAGE(RC[-
14]:RC[-8])"
                            Else
                                If S3.Range("N2") = 8 Then
                                    S3.Range("Q73").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-7])"
                                Else
                                    If S3.Range("N2") = 9 Then
                                        S3.Range("Q73").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-6])"
                                    Else
                                        If S3.Range("N2") = 10 Then
                                            S3.Range("Q73").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-5])"
                                        Else
                                            If S3.Range("N2") = 11 Then
                                                S3.Range("Q73").FormulaR1C1 =
"=AVERAGE(RC[-14]:RC[-4])"
                                            Else
                                                If S3.Range("N2") = 12 Then
```

```vba
                                                                        S3.Range("Q73").FormulaR1C1
= "=AVERAGE(RC[-14]:RC[-3])"
                                                        End If
                                                    End If
                                                End If
                                            End If
                                        End If
                                    End If
                                End If
                            End If
                        End If
                    End If
                End If

        'Smile of effort CoC Process

        ' green
        If S3.Range("Q7").Value <= S3.Range("Q9").Value Then
            With KPI.Shapes.Range(Array("Smiley Face 22")).Fill
            .Visible = msoTrue
            .ForeColor.ObjectThemeColor = msoThemeColorAccent6
            .ForeColor.TintAndShade = 0
            .ForeColor.Brightness = 0
            .Transparency = 0
            .Solid
            End With
            KPI.Shapes.Range(Array("Smiley Face 22")).Adjustments.Item(1) =
0.04653

        Else

            ' yellow
            If S3.Range("Q9").Value < S3.Range("Q7").Value And
S3.Range("Q7").Value <= (S3.Range("Q9").Value * 1.2) Then
                KPI.Shapes.Range(Array("Smiley Face 22")).Adjustments.Item(1) =
0.00234
                With KPI.Shapes.Range(Array("Smiley Face 22")).Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 255, 0)
                .Transparency = 0
                .Solid
                End With

            ' red
            Else

                If S3.Range("Q7").Value > (S3.Range("Q9").Value * 1.2) Then
                    KPI.Shapes.Range(Array("Smiley Face
22")).Adjustments.Item(1) = -0.04653
                    With KPI.Shapes.Range(Array("Smiley Face 22")).Fill
                    .Visible = msoTrue
                    .ForeColor.RGB = RGB(255, 0, 0)
                    .Transparency = 0
                    .Solid
                    End With
                End If

            End If
```

```vba
        End If


        'Smile of effort Layout Design
        ' green
        If S3.Range("Q13").Value <= S3.Range("Q15").Value Then
            With KPI.Shapes.Range(Array("Smiley Face 2")).Fill
                .Visible = msoTrue
                .ForeColor.ObjectThemeColor = msoThemeColorAccent6
                .ForeColor.TintAndShade = 0
                .ForeColor.Brightness = 0
                .Transparency = 0
                .Solid
            End With
            KPI.Shapes.Range(Array("Smiley Face 2")).Adjustments.Item(1) =
0.04653

    Else

        ' yellow
        If S3.Range("Q15").Value < S3.Range("Q13").Value And
S3.Range("Q13").Value <= S3.Range("Q15").Value * 1.2 Then
            KPI.Shapes.Range(Array("Smiley Face 2")).Adjustments.Item(1) =
0.00234
            With KPI.Shapes.Range(Array("Smiley Face 2")).Fill
            .Visible = msoTrue
            .ForeColor.RGB = RGB(255, 255, 0)
            .Transparency = 0
            .Solid
            End With

        ' red
        Else

            If S3.Range("Q13").Value > (S3.Range("Q15").Value * 1.2) Then
                KPI.Shapes.Range(Array("Smiley Face
2")).Adjustments.Item(1) = -0.04653
                With Selection.ShapeRange.Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 0, 0)
                .Transparency = 0
                .Solid
                End With
            End If

        End If

    End If

    'Smile of effort SBMAC

    ' green
    If S3.Range("Q20").Value <= S3.Range("Q22").Value Then
        With KPI.Shapes.Range(Array("Smiley Face 8")).Fill
            .Visible = msoTrue
            .ForeColor.ObjectThemeColor = msoThemeColorAccent6
            .ForeColor.TintAndShade = 0
            .ForeColor.Brightness = 0
            .Transparency = 0
            .Solid
        End With
```

```vba
        KPI.Shapes.Range(Array("Smiley Face 8")).Adjustments.Item(1) =
0.04653

    Else

        ' yellow
        If S3.Range("Q22").Value < S3.Range("Q20").Value And
S3.Range("Q20").Value <= (S3.Range("Q22").Value * 1.2) Then
            KPI.Shapes.Range(Array("Smiley Face 8")).Adjustments.Item(1) =
0.00234
            With KPI.Shapes.Range(Array("Smiley Face 8")).Fill
            .Visible = msoTrue
            .ForeColor.RGB = RGB(255, 255, 0)
            .Transparency = 0
            .Solid
            End With

        ' red
        Else

            If S3.Range("Q20").Value > (S3.Range("Q22").Value * 1.2) Then
                KPI.Shapes.Range(Array("Smiley Face
8")).Adjustments.Item(1) = -0.04653
                With KPI.Shapes.Range(Array("Smiley Face 8")).Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 0, 0)
                .Transparency = 0
                .Solid
                End With
            End If

        End If

    End If

    'Smile of effort CPR

    ' green
    If S3.Range("Q27").Value <= S3.Range("Q29").Value Then
        With KPI.Shapes.Range(Array("Smiley Face 9")).Fill
            .Visible = msoTrue
            .ForeColor.ObjectThemeColor = msoThemeColorAccent6
            .ForeColor.TintAndShade = 0
            .ForeColor.Brightness = 0
            .Transparency = 0
            .Solid
        End With
        KPI.Shapes.Range(Array("Smiley Face 9")).Adjustments.Item(1) =
0.04653

    Else

        ' yellow
        If S3.Range("Q29").Value < S3.Range("Q27").Value And
S3.Range("Q27").Value <= (S3.Range("Q29").Value * 1.2) Then
            KPI.Shapes.Range(Array("Smiley Face 9")).Adjustments.Item(1) =
0.00234
            With KPI.Shapes.Range(Array("Smiley Face 9")).Fill
            .Visible = msoTrue
            .ForeColor.RGB = RGB(255, 255, 0)
            .Transparency = 0
```

```vba
                .Solid
            End With


        ' red
        Else


            If S3.Range("Q27").Value > (S3.Range("Q29").Value * 1.2) Then
                KPI.Shapes.Range(Array("Smiley Face
9")).Adjustments.Item(1) = -0.04653
                With KPI.Shapes.Range(Array("Smiley Face 9")).Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 0, 0)
                .Transparency = 0
                .Solid
                End With
            End If


        End If


    End If


    'Smile of effort Laboratory


    ' green
    If S3.Range("Q34").Value <= S3.Range("Q36").Value Then
        With KPI.Shapes.Range(Array("Smiley Face 10")).Fill
            .Visible = msoTrue
            .ForeColor.ObjectThemeColor = msoThemeColorAccent6
            .ForeColor.TintAndShade = 0
            .ForeColor.Brightness = 0
            .Transparency = 0
            .Solid
        End With
        KPI.Shapes.Range(Array("Smiley Face 10")).Adjustments.Item(1) =
0.04653


    Else


        ' yellow
        If S3.Range("Q36").Value < S3.Range("Q34").Value And
S3.Range("Q34").Value <= (S3.Range("Q36").Value * 1.2) Then
            KPI.Shapes.Range(Array("Smiley Face 10")).Adjustments.Item(1) =
0.00234
            With KPI.Shapes.Range(Array("Smiley Face 10")).Fill
            .Visible = msoTrue
            .ForeColor.RGB = RGB(255, 255, 0)
            .Transparency = 0
            .Solid
            End With


        ' vermelho
        Else


            If S3.Range("Q34").Value > (S3.Range("Q36").Value * 1.2) Then
                KPI.Shapes.Range(Array("Smiley Face
10")).Adjustments.Item(1) = -0.04653
                With KPI.Shapes.Range(Array("Smiley Face 10")).Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 0, 0)
                .Transparency = 0
                .Solid
```

```vba
                End With
            End If

        End If

    End If

    'Smile of effort Projects

    ' green
    If S3.Range("Q41").Value <= S3.Range("Q43").Value Then
        With KPI.Shapes.Range(Array("Smiley Face 11")).Fill
            .Visible = msoTrue
            .ForeColor.ObjectThemeColor = msoThemeColorAccent6
            .ForeColor.TintAndShade = 0
            .ForeColor.Brightness = 0
            .Transparency = 0
            .Solid
        End With
        KPI.Shapes.Range(Array("Smiley Face 11")).Adjustments.Item(1) =
0.04653

    Else

        ' yellow
        If S3.Range("Q43").Value < S3.Range("Q41").Value And
S3.Range("Q41").Value <= (S3.Range("Q43").Value * 1.2) Then
            KPI.Shapes.Range(Array("Smiley Face 11")).Adjustments.Item(1) =
0.00234
            With KPI.Shapes.Range(Array("Smiley Face 11")).Fill
            .Visible = msoTrue
            .ForeColor.RGB = RGB(255, 255, 0)
            .Transparency = 0
            .Solid
            End With

        ' red
        Else

            If S3.Range("Q41").Value > (S3.Range("Q43").Value * 1.2) Then
                KPI.Shapes.Range(Array("Smiley Face
11")).Adjustments.Item(1) = -0.04653
                With Selection.ShapeRange.Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 0, 0)
                .Transparency = 0
                .Solid
                End With
            End If

        End If

    End If

    'Smile of effort Project innovation

    ' green
    If S3.Range("Q48").Value <= S3.Range("Q50").Value Then
        With KPI.Shapes.Range(Array("Smiley Face 12")).Fill
            .Visible = msoTrue
            .ForeColor.ObjectThemeColor = msoThemeColorAccent6
```

```vba
            .ForeColor.TintAndShade = 0
            .ForeColor.Brightness = 0
            .Transparency = 0
            .Solid
        End With
        KPI.Shapes.Range(Array("Smiley Face 12")).Adjustments.Item(1) =
0.04653

    Else

        ' yellow
        If S3.Range("Q50").Value < S3.Range("Q48").Value And
S3.Range("Q48").Value <= (S3.Range("Q50").Value * 1.2) Then
            KPI.Shapes.Range(Array("Smiley Face 12")).Adjustments.Item(1) =
0.00234
            With KPI.Shapes.Range(Array("Smiley Face 12")).Fill
            .Visible = msoTrue
            .ForeColor.RGB = RGB(255, 255, 0)
            .Transparency = 0
            .Solid
            End With

        ' red
        Else

            If S3.Range("Q48").Value > (S3.Range("Q50").Value * 1.2) Then
                KPI.Shapes.Range(Array("Smiley Face
12")).Adjustments.Item(1) = -0.04653
                With KPI.Shapes.Range(Array("Smiley Face 12")).Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 0, 0)
                .Transparency = 0
                .Solid
                End With
            End If

        End If

    End If

    'Smile of Planned Projects Costs

    ' green
    If S3.Range("Q62").Value <= S3.Range("Q64").Value Then
        With KPI.Shapes.Range(Array("Smiley Face 13")).Fill
            .Visible = msoTrue
            .ForeColor.ObjectThemeColor = msoThemeColorAccent6
            .ForeColor.TintAndShade = 0
            .ForeColor.Brightness = 0
            .Transparency = 0
            .Solid
        End With
        KPI.Shapes.Range(Array("Smiley Face 13")).Adjustments.Item(1) =
0.04653

    Else

        ' yellow
        If S3.Range("Q64").Value < S3.Range("Q62").Value And
S3.Range("Q62").Value <= (S3.Range("Q64").Value * 1.2) Then
```

```vba
            KPI.Shapes.Range(Array("Smiley Face 13")).Adjustments.Item(1) =
0.00234
            With KPI.Shapes.Range(Array("Smiley Face 13")).Fill
            .Visible = msoTrue
            .ForeColor.RGB = RGB(255, 255, 0)
            .Transparency = 0
            .Solid
            End With


        ' red
        Else

            If S3.Range("Q62").Value > (S3.Range("Q64").Value * 1.2) Then
                KPI.Shapes.Range(Array("Smiley Face
13")).Adjustments.Item(1) = -0.04653
                With KPI.Shapes.Range(Array("Smiley Face 13")).Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 0, 0)
                .Transparency = 0
                .Solid
                End With
            End If

        End If

    End If

    'Smile of Quantity TGs done

    ' green
    If S3.Range("Q73").Value >= S3.Range("Q74").Value * 0.8 And
S3.Range("R70").Value = 0 Then
        With KPI.Shapes.Range(Array("Smiley Face 32")).Fill
            .Visible = msoTrue
            .ForeColor.ObjectThemeColor = msoThemeColorAccent6
            .ForeColor.TintAndShade = 0
            .ForeColor.Brightness = 0
            .Transparency = 0
            .Solid
        End With
        KPI.Shapes.Range(Array("Smiley Face 32")).Adjustments.Item(1) =
0.04653

    Else

        ' yellow
        If ((S3.Range("Q74").Value) * 0.5) <= S3.Range("Q73").Value And
S3.Range("Q73").Value < S3.Range("Q74").Value * 0.8 And
S3.Range("R70").Value = 0 Then
            KPI.Shapes.Range(Array("Smiley Face 32")).Adjustments.Item(1) =
0.00234
            With KPI.Shapes.Range(Array("Smiley Face 32")).Fill
            .Visible = msoTrue
            .ForeColor.RGB = RGB(255, 255, 0)
            .Transparency = 0
            .Solid
            End With

        Else
```

```vba
            If S3.Range("Q73").Value >= ((S3.Range("Q74").Value) * 0.8)
And 0 < S3.Range("R70").Value And S3.Range("R70").Value <
((S3.Range("R69").Value) / 2) Then
                KPI.Shapes.Range(Array("Smiley Face
32")).Adjustments.Item(1) = 0.00234
                With KPI.Shapes.Range(Array("Smiley Face 32")).Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 255, 0)
                .Transparency = 0
                .Solid
                End With

            Else

                ' red
                If S3.Range("Q73").Value < ((S3.Range("Q74").Value) *
0.5) Then
                    KPI.Shapes.Range(Array("Smiley Face
32")).Adjustments.Item(1) = -0.04653
                    With KPI.Shapes.Range(Array("Smiley Face 32")).Fill
                    .Visible = msoTrue
                    .ForeColor.RGB = RGB(255, 0, 0)
                    .Transparency = 0
                    .Solid
                    End With

                Else

                    If S3.Range("R70").Value >=
((S3.Range("R69").Value) / 2) Then
                        KPI.Shapes.Range(Array("Smiley Face
32")).Adjustments.Item(1) = -0.04653
                        With KPI.Shapes.Range(Array("Smiley Face
32")).Fill
                        .Visible = msoTrue
                        .ForeColor.RGB = RGB(255, 0, 0)
                        .Transparency = 0
                        .Solid
                        End With

                    Else

                        If (((S3.Range("Q74").Value) * 0.5) <=
S3.Range("Q73").Value And S3.Range("Q73").Value < S3.Range("Q74").Value *
0.8 And S3.Range("R70").Value > 0) Then
                            KPI.Shapes.Range(Array("Smiley Face
32")).Adjustments.Item(1) = -0.04653
                            With KPI.Shapes.Range(Array("Smiley
Face 32")).Fill
                            .Visible = msoTrue
                            .ForeColor.RGB = RGB(255, 0, 0)
                            .Transparency = 0
                            .Solid
                            End With
                        End If

                    End If

                End If

            End If
```

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```vba
                End If

            End If

        End If


        'Smile of TG4 before the C sample

        ' green
        If S3.Range("Q79").Value = 1 Then
            With KPI.Shapes.Range(Array("Smiley Face 33")).Fill
                .Visible = msoTrue
                .ForeColor.ObjectThemeColor = msoThemeColorAccent6
                .ForeColor.TintAndShade = 0
                .ForeColor.Brightness = 0
                .Transparency = 0
                .Solid
            End With
            KPI.Shapes.Range(Array("Smiley Face 33")).Adjustments.Item(1) =
0.04653

        Else

            ' yellow
            If 0.8 <= S3.Range("Q79").Value And S3.Range("Q79").Value < 1 Then
                KPI.Shapes.Range(Array("Smiley Face 33")).Adjustments.Item(1) =
0.00234
                With KPI.Shapes.Range(Array("Smiley Face 33")).Fill
                .Visible = msoTrue
                .ForeColor.RGB = RGB(255, 255, 0)
                .Transparency = 0
                .Solid
                End With

            ' red
            Else

                If S3.Range("Q79").Value < 0.8 Then
                    KPI.Shapes.Range(Array("Smiley Face
33")).Adjustments.Item(1) = -0.04653
                    With KPI.Shapes.Range(Array("Smiley Face 33")).Fill
                    .Visible = msoTrue
                    .ForeColor.RGB = RGB(255, 0, 0)
                    .Transparency = 0
                    .Solid
                    End With
                End If

            End If

        End If

    S2.Protect UserInterfaceOnly:=True
    S3.Protect UserInterfaceOnly:=True
    KPI.Protect UserInterfaceOnly:=True


End Sub

Private Sub Label3_Click()
```

```vba
End Sub

Private Sub TextBox2_Change()

'Definition of variables
Dim TextBox2 As Integer

End Sub
```

Code of bottom of sheet "projects status" to update table

```vba
Sub Status_Click()

 'The same code of Module 1

        'Definition of variable's data type
        Dim Filter As String, Title As String
        Dim FilterIndex As Integer
        Dim Filename As Variant
        Dim data As Workbook
        Dim thisfile As Workbook
        Dim I As Integer

        ' Definition of the search filters of files
        Filter = "Excel Files (*.xls),*.xls,"
        ' The standard filter is *.*
        FilterIndex = 3
        ' Definition of the Caption
        Title = "Select the T&R data (EXCEL file)"
        ' Definition of the search drive
        ChDrive ("C")
        ChDir ("C:\")

        Sheets("Sheet2").Unprotect

        With Application
            ' Open a window to select the file
            Filename = .GetOpenFilename(Filter, FilterIndex, Title)

            If Filename = False Then

                ' Exit when it is cancelled with a message
                MsgBox "No file selected."
                Exit Sub

            Else

                ' Definition of the variables
                Set data = Workbooks.Open(Filename)
                Set thisfile = Workbooks("KPI calculation.xlsm")

                ' Copy and paste data from other excel file
                Application.CutCopyMode = False
                thisfile.Worksheets("Sheet2").Cells.ClearContents
                data.Worksheets("general_report").Cells.COPY
                thisfile.Worksheets("Sheet2").Cells.PasteSpecial
                data.Close SaveChanges:=False
```

```vba
                    ' Formatation of Worksheet
                    thisfile.Worksheets("Sheet2").Rows("1:3").Select
                    Selection.Delete Shift:=xlUp
                    thisfile.Worksheets("Sheet2").Rows("1:1").Select
                    Selection.AutoFilter

                    ' Save excel file
                    Workbooks("KPI calculation.xlsm").Save

                    ' Reset the Path
                    ChDrive (Left(.DefaultFilePath, 1))
                    ChDir (.DefaultFilePath)
                End If

            End With

            ' Return the path
            OpenFileDialog = Filename

            Sheets("Sheet2").Protect UserInterfaceOnly:=True

        Call Projects_Click

End Sub


Sub Projects_Click()

    ' Definition of variables
    Dim I As Integer
    Dim X As Integer
    Dim S1 As Worksheet
    Dim S2 As Worksheet

    Set S1 = Sheets("Projects Status")
    Set S2 = Sheets("Sheet2")

    S1.Unprotect
    S2.Unprotect

    'Clean contents
    S1.Range("A:AH").ClearContents

    'Find all projects and copy them to Sheet 1
    Sheets("Sheet2").Range("$A$1:$DG$200").AutoFilter Field:=3,
Criteria1:="=*project charter*", Operator:=xlAnd
    Sheets("Sheet2").Range("Q:Q").COPY Destination:=S1.Range("A:A")
    Sheets("Sheet2").Range("$A$1:$DG$200").AutoFilter Field:=3
    S1.Cells(1, "A").ClearContents

    'Write header
    S1.Cells(1, "A").Value = "Projects"
    S1.Cells(1, "B").Value = "Project Charter"
    S1.Cells(1, "C").Value = "Kick-off Checklist"
    S1.Cells(1, "D").Value = "Time Schedule"
    S1.Cells(1, "E").Value = "Target Cross"
    S1.Cells(1, "F").Value = "Cost Calculation"
    S1.Cells(1, "G").Value = "Project Orga"
    S1.Cells(1, "H").Value = "TG0"
    S1.Cells(1, "I").Value = "TG1"
    S1.Cells(1, "J").Value = "Risk Analysis Report"
```

```vba
    S1.Cells(1, "K").Value = "TG2"
    S1.Cells(1, "L").Value = "TG3"
    S1.Cells(1, "M").Value = "TG4"
    S1.Cells(1, "N").Value = "QGC2 of product project"
    S1.Cells(1, "O").Value = "Handover Report"
    S1.Cells(1, "P").Value = "TG5"

    'Formatation

    With S1.Range("A1:P1").Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorAccent5
        .TintAndShade = -0.499984740745262
        .PatternTintAndShade = 0
    End With
    With S1.Range("A1:P1").Font
        .ThemeColor = xlThemeColorDark1
        .TintAndShade = 0
    End With
    With S1.Range("A1:P1").Font
        .name = "Arial"
        .Size = 11
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ThemeColor = xlThemeColorDark1
        .TintAndShade = 0
        .ThemeFont = xlThemeFontNone
    End With
    With S1.Range("A1:P1")
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlCenter
        .WrapText = True
        .Orientation = 0
        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = False
    End With

    S1.Rows("1:1").RowHeight = 35
    S1.Rows("1:1").Borders(xlDiagonalDown).LineStyle = xlNone
    S1.Rows("1:1").Borders(xlDiagonalUp).LineStyle = xlNone
    S1.Rows("1:1").Borders(xlEdgeLeft).LineStyle = xlNone
    S1.Rows("1:1").Borders(xlEdgeTop).LineStyle = xlNone
    S1.Rows("1:1").Borders(xlEdgeBottom).LineStyle = xlNone
    S1.Rows("1:1").Borders(xlEdgeRight).LineStyle = xlNone
    S1.Rows("1:1").Borders(xlInsideVertical).LineStyle = xlNone
    S1.Rows("1:1").Borders(xlInsideHorizontal).LineStyle = xlNone


    'Creation of a table with dates to help on management and creation of
columns to help on KPI calculation
    I = 2

    Do While S1.Range("A" & I).Value <> ""
```

```vba
        X = 2

        Do While S2.Range("C" & X).Value <> ""

            If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
S2.Range("C" & X).Text, "project charter", vbTextCompare) > 0 And
S2.Range("AG" & X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                S2.Range("CV" & X).COPY Destination:=S1.Range("B" & I)
                S1.Range("AA" & I).FormulaR1C1 = "=YEAR(RC[-25])"
                S1.Range("AB" & I).FormulaR1C1 = "=MONTH(RC[-26])"
                S1.Range("Z" & I) = 1

            End If

            If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
S2.Range("C" & X).Text, "Kick-off checklist", vbTextCompare) > 0 And
S2.Range("AG" & X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                S2.Range("CV" & X).COPY Destination:=S1.Range("C" & I)

            End If

            If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
S2.Range("C" & X).Text, "time schedule", vbTextCompare) > 0 And
S2.Range("AG" & X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                S2.Range("CV" & X).COPY Destination:=S1.Range("D" & I)

            End If

            If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
S2.Range("C" & X).Text, "target cross", vbTextCompare) > 0 And
S2.Range("AG" & X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                S2.Range("CV" & X).COPY Destination:=S1.Range(" E" & I)

            End If

            If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
S2.Range("C" & X).Text, "cost calculation", vbTextCompare) > 0 And
S2.Range("AG" & X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                S2.Range("CV" & X).COPY Destination:=S1.Range("F" & I)

            End If

            If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
S2.Range("C" & X).Text, "project orga", vbTextCompare) > 0 And
S2.Range("AG" & X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                S2.Range("CV" & X).COPY Destination:=S1.Range("G" & I)

            End If

            If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
S2.Range("C" & X).Text, "tg0", vbTextCompare) > 0 And S2.Range("AG" &
X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                S2.Range("CV" & X).COPY Destination:=S1.Range("H" & I)
```

```vba
                End If

                If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
        S2.Range("C" & X).Text, "tg1", vbTextCompare) > 0 And S2.Range("AG" &
        X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                        S2.Range("CV" & X).COPY Destination:=S1.Range("I" & I)

                End If

                If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
        S2.Range("C" & X).Text, "risk analysis report", vbTextCompare) > 0 And
        S2.Range("AG" & X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                        S2.Range("CV" & X).COPY Destination:=S1.Range("J" & I)

                End If

                If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
        S2.Range("C" & X).Text, "TG2", vbTextCompare) > 0 And S2.Range("AG" &
        X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                        S2.Range("CV" & X).COPY Destination:=S1.Range("K" & I)

                End If

                If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
        S2.Range("C" & X).Text, "TG3", vbTextCompare) > 0 And S2.Range("AG" &
        X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                        S2.Range("CV" & X).COPY Destination:=S1.Range("L" & I)

                End If

                If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
        S2.Range("M" & X).Text, "TG 4", vbTextCompare) > 0 And S2.Range("AG" &
        X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                        S2.Range("CV" & X).COPY Destination:=S1.Range("C" & I)
                        S1.Range("AE" & I).FormulaR1C1 = "=IF(YEAR(RC[-
        18])=1900,0,YEAR(RC[-18]))"
                        S1.Range("AF" & I).FormulaR1C1 = "=IF(YEAR(RC[-
        19])=1900,0,MONTH(RC[-19]))"

                End If

                If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
        S2.Range("C" & X).Text, "QGC2", vbTextCompare) > 0 Then

                        S2.Range("R" & X).COPY Destination:=S1.Range("N" & I)
                        S1.Range("AG" & I).FormulaR1C1 = "=IF(YEAR(RC[-
        20])=1900,0,YEAR(RC[-19]))"
                        S1.Range("AH" & I).FormulaR1C1 = "=IF(YEAR(RC[-
        20])=1900,0,MONTH(RC[-20]))"

                End If

                If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
        S2.Range("C" & X).Text, "Handover report", vbTextCompare) > 0 And
        S2.Range("AG" & X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then
```

```vba
                S2.Range("CV" & X).COPY Destination:=S1.Range("O" & I)

            End If

            If S2.Range("Q" & X).Text = S1.Range("A" & I).Text And InStr(1,
    S2.Range("C" & X).Text, "TG5", vbTextCompare) > 0 And S2.Range("AG" &
    X).Value <> "" And S2.Range("AG" & X).Value >= 3600 Then

                S2.Range("CV" & X).COPY Destination:=S1.Range("P" & I)

            End If

            S1.Range("AC" & I).FormulaR1C1 = "=IF(YEAR(RC[-
    13])=1900,YEAR(NOW()),YEAR(RC[-13]))"
            S1.Range("AD" & I).FormulaR1C1 = "=IF(YEAR(RC[-
    14])=1900,MONTH(NOW()),MONTH(RC[-14]))"


        X = X + 1
        Loop

        'Formatation

        With S1.Rows(I & ":" & I)
            .VerticalAlignment = xlCenter
            .Orientation = 0
            .AddIndent = False
            .IndentLevel = 0
            .ShrinkToFit = False
            .ReadingOrder = xlContext
            .MergeCells = False
        End With
        With S1.Rows(I & ":" & I)
            .HorizontalAlignment = xlCenter
            .VerticalAlignment = xlCenter
            .Orientation = 0
            .AddIndent = False
            .IndentLevel = 0
            .ShrinkToFit = False
            .ReadingOrder = xlContext
            .MergeCells = False
        End With
        S1.Rows(I & ":" & I).NumberFormat = "m/d/yyyy"
        S1.Rows(I & ":" & I).RowHeight = 28
        S1.Rows(I & ":" & I).Borders(xlDiagonalDown).LineStyle = xlNone
        S1.Rows(I & ":" & I).Borders(xlDiagonalUp).LineStyle = xlNone
        S1.Rows(I & ":" & I).Borders(xlEdgeLeft).LineStyle = xlNone
        S1.Rows(I & ":" & I).Borders(xlEdgeTop).LineStyle = xlNone
        S1.Rows(I & ":" & I).Borders(xlEdgeBottom).LineStyle = xlNone
        S1.Rows(I & ":" & I).Borders(xlEdgeRight).LineStyle = xlNone
        S1.Rows(I & ":" & I).Borders(xlInsideVertical).LineStyle = xlNone
        S1.Rows(I & ":" & I).Borders(xlInsideHorizontal).LineStyle = xlNone

        With S1.Range("A" & I)
            .HorizontalAlignment = xlLeft
            .VerticalAlignment = xlCenter
            .WrapText = True
            .Orientation = 0
            .AddIndent = False
            .IndentLevel = 0
```

```vba
            .ShrinkToFit = False
            .ReadingOrder = xlContext
            .MergeCells = False
        End With
        S1.Range("A" & I).NumberFormat = "General"
        S1.Range("Z" & I).NumberFormat = "General"
        S1.Range("AA" & I).NumberFormat = "General"
        S1.Range("AB" & I).NumberFormat = "General"
        S1.Range("AC" & I).NumberFormat = "General"
        S1.Range("AD" & I).NumberFormat = "General"
        S1.Range("AE" & I).NumberFormat = "General"
        S1.Range("AF" & I).NumberFormat = "General"
        S1.Range("AG" & I).NumberFormat = "General"
        S1.Range("AH" & I).NumberFormat = "General"


    I = I + 1
    Loop

    S1.Range("A1:P1").AutoFilter
    S1.Protect UserInterfaceOnly:=True
    S2.Protect UserInterfaceOnly:=True

End Sub
```