FEDERAL UNIVERSITY OF PERNAMBUCO
GRADUATION IN COMPUTER SCIENCE
INFORMATICS CENTER
2007.1

Visual Studio Team System – Implantation of the Microsoft Toolkit for the support to the Software Development Process in adherent Companies to CMMI level 2

GRADUATION WORK

Student: Renata de Avelar Alchorne (raa3@cin.ufpe.br)
Supervisor: Alexandre Marcos Lins de Vasconcelos (amlv@cin.ufpe.br)

Recife, August 22, 2007.

FEDERAL UNIVERSITY OF PERNAMBUCO
GRADUATION IN COMPUTER SCIENCE
INFORMATICS CENTER
2007.1

Visual Studio Team System – Implantation of the Microsoft Toolkit for the support to the Software Development Process in adherent Companies to CMMI level 2

GRADUATION WORK

Work presented to the Computer Science Graduation Program of the Computer Science Systems Department of the Federal University of Pernambuco as partial requirement to obtain the Bachelor's degree in Computer Science.

Student: Renata de Avelar Alchorne (raa3@cin.ufpe.br)
Supervisor: Alexandre Marcos Lins de Vasconcelos (amlv@cin.ufpe.br)

Recife, August 22, 2007.

Signatures

This Graduation Work is the result of Renata de Avelar Alchorne efforts under Alexandre Marcos de Lins Vasconcelos professor supervision, with the title "*Visual Studio Team System: Implantation of the Microsoft Toolkit for the support to the Software Development Process in adherent Companies to CMMI level 2*". All below agree with the content of this document and the results of this Graduation Work.

_____

Renata de Avelar Alchorne

_____

Alexandre Marcos de Lins Vasconcelos

To my mother,
Delcíria, and my love,
Marden.

Abstract

As a reaction to the market demand, that is, companies' adherent to the main quality models such as CMMI, ISO9001 and other, the great software development companies are, more than ever, searching for tools integration and services applied to the software development processes.

In this context of new integration tools, Microsoft Visual Studio Team System (VSTS) appears to help team project members as architects, developers, testers and project managers, beyond support areas as quality assurance, measurements and analysis, configuration management and other. Using this tool they can work in a more productive and integrated way during all project life cycle, helping teams to communicate and collaborate efficiently among them.

The work presented in this document is result of researches about the Visual Studio Team System and how it could be used in a real organization adherent to CMMI level 2.

Keywords: Quality assurance, CMMI, ISO9001, Visual Studio Team System

Acknowledgements

What you are reading at this moment would simply not exist without the help of some key people, including you. I'd like to thank everybody that, somehow, has helped me to be here now writing this work and apologies if I forget anybody.

I want to thank my supervisor, Alexandre Vasconcelos for having helped me through the best way to accomplish this work.

Thank especially to my old friends that have helped me at this closing moment of one more phase in my life. Thank to Elisa, Louise and Juliana to listen and give me counselors at happy and bad moments.

I'd like to acknowledge my friends that I knew at University. Friends that I'll have forever: Peu, Diana "Pinta", Patrícia and Thiaguinho. I don't have words to say how you are important for me. Thank to Jeje, Sylvinha and Shick, because you are wonderful people and professionals that have crossed my life. Thank to Gau for the talks, the great moments at University and for patience to review my work. I also thank to Gigil for his sincere friendship.

Thank to all wonderful professionals whom I work with, especially Tay that gave me the opportunity to work with something that I love and has allowed me to learn everything that I am as a professional today.

I'm grateful to my family for being always by my side and, mainly, to my mother, Delcíria, for the encouragement and comprehension. Because of her, I stay here. Also thank to my brother, Murilo, for his friendship. I couldn't forget my aunts, Délcia and Delciara that together with my mother form the wonderful "Fofocas" trio. Thank also to my cousin "Félipe" and my uncle Marcelo.

Last, but not least, I'd like to thank my love, Marden, whose support made this work possible. Thank for all wonderful moments by my side since the beginning of graduation. Thank for the several Sundays helping me with this work and for many future Sundays together.

Contents

List of Tables

List of Figures

1. Introduction

Nowadays, it's a common practice in industry that companies use support tools in order to increase the productivity of their software development process and to continuously improve their products' quality.

The need to integrate these tools in order to reach those objectives is a great challenge since the 80's, when the great technology companies started the production of support tools for software development, where each one of them has a different owner and different goals having plenty precariousness in the integration among those tools. In addition, the progress in integration was delayed by several subjects, as the inexistence of a standard and integrated development environment (IDE), the use of different technologies for a same project, the competition among companies' owners and even interested consumers' lack in acquiring a totally integrated environment in their projects and organizations[1].

The integration of CASE tools[2] can be defined as a group of tools capable to act in a combined and integrated way, offering support from the requirements analysis to the final product delivery. The use of integrated tools supplies several benefits to the software development process such as easiness in information changes among the tools, quality assurance, chained updating of generated documents, control project increase and great easiness and improvement in cooperation among team project.

As a reaction to the market demand, that is, companies' adherent to the main quality models such as CMMI[3], ISO9001[4] and other, the great software development companies are, more than ever, searching for tools integration and services applied to the software development processes. All this is necessary to reach their customers through larger productivity, costs reduction and continuous improvement of quality products, offering integrated solutions with the main existent platforms in the market.

In this context of new integration tools, Microsoft Visual Studio Team System[5] (VSTS) appears to help team project members as architects, developers, testers and project managers,

---

[1] Wikipedia – "*Ferramentas Integradas*".
Available at: http://pt.wikipedia.org/wiki/Ferramentas_Integradas. Site visited in 5/26/2007.
[2] Wikipedia – "*Computer-aided software engineering*".
Available at: http://en.wikipedia.org/wiki/Computer-aided_software_engineering. Site visited in 5/26/2007.
[3] CMMI – Capability Maturity Model Integration. Available at: http://www.sei.cmu.edu/cmmi/. Site visited in 5/16/2007.
[4] ISO – International Organization for Standardization. Available at:
http://www.iso.org/iso/en/ISOOnline.frontpage. Site visited in 5/26/2007.
[5] Visual Studio Team System official site. Available at: http://msdn.microsoft.com/vstudio/teamsystem. Site visited in 05/16/2007.

beyond support areas as quality assurance, measurements and analysis, configuration management and other. Using this tool they can work in a more productive and integrated way during all project life cycle, helping teams to communicate and collaborate efficiently among them using only one and power tool.

Visual Studio Team System is the most recent addition from Microsoft to the Visual Studio[6] tools development family. This release has been shown itself very significant, because for the first time Microsoft seeks the whole software development life cycle. Visual Studio Team System will be the theme of the work described in this document.

1.1 Context

Many software companies are finding their customers to be far more informed in relation to maturity models. Some companies are already finding their customers asking for CMMI level. According to Mick Spiers, senior consultant for QAI[7] in India, customers have also started to ask how recent the company's appraisal is and they are ignoring appraisals that are more than 18-24 months old. This trend is more prevalent in India compared to the rest of the world, but it's spreading to all countries. Therefore, software companies are moving to the CMMI model because of peer pressure and to retain their competitiveness.[8]

With the customers' demands increasing over the companies, an effort to reach certifications like CMMI is necessary, because it requires a process implantation and the most important: a change into the organization culture, which can be seen as the largest impact to be faced. The illustration below shows the search for CMMI certifications in some countries in 2005. Such illustration reflects the importance of investments of this type on software development in the market.

[6] Visual Studio 2005 official site. Available at: http://msdn2.microsoft.com/en-us/vstudio/default.aspx. Site visited in 05/16/2007.
[7] QAI – Quality Assurance Institute – Facilitating 'Operacional Excellence'. Available at: http://www.qaiindia.com/. Site visited in 05/29/2007
[8] Express Computer. India's No.1 IT Business Weekly. *"Software and Systems firms embrace CMMI"*. Available at: http://www.expresscomputeronline.com/20030310/indtrend1.shtml. Site visited in 05/26/2007.

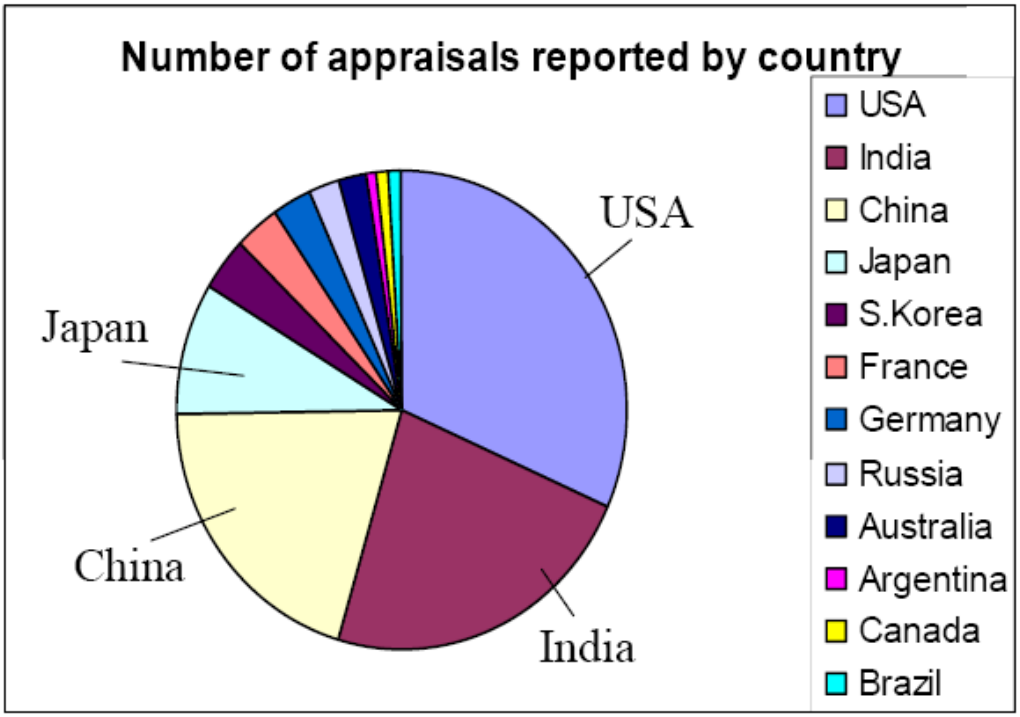


Figure 1 – Source: The SEI list of appraisals 2005.[9]

An efficient implantation of a quality model needs a set of factors such as high management commitment, employees' motivation and a good tools support. The last one is essential for the organization to have conditions to apply a defined process in an effective and efficient way, where the adherent process to models as CMMI, for example, doesn't become "heavy" if they don't have a good support in the use of these tools.

So, in this scenario, the VSTS shows that it's entirely feasible to automate great part of software development process through an integrated tool covering the whole practices and demands done by CMMI level 2, for this work, reducing substantially an overhead of communication and artifacts generation.

1.2 Objectives

The objective of this Graduation Work is to apply the VSTS in a real small to mid-size company adherent to the CMMI level 2 intents improving the interactions among the company software processes. The main benefits are the increase on productivity, and, at the same time that such company guarantees the quality of produced products, which are being aligned to the quality model wished.

[9] SeaSpin – Seatle, Eastside Area Software Process Improvement Network. VU, John D., Senior Scientist, "*CMMI Around the World*", May 15, 2006, Carnegie Mellon University. Available at: http://seaspin.org/files/folders/2006presents/entry21.aspx. Site visited in 05/26/2007.

The VSTS will be applied to provide the following functionalities:

- Provide covering in 6 of 7 process areas of CMMI level 2, except for the process area Supplier Agreement Management (SAM), because it's not demanded for the CMMI appraisal.
    - The process areas covered of level 2 are:
        - Requirements Management (REQM);
        - Project Planning (PP);
        - Project Monitoring and Control (PMC);
        - Measurement and Analysis (MA);
        - Process and Product Quality Assurance (PPQA);
        - Configuration Management (CM).
- Through VSTS, the intention is to become possible the institutionalization of a unique integration tool for organization needs in regards to the software development process.
- The VSTS allows a customization of the software development process adopted in the organization. So, whenever necessary, customizations will be done into the existing software development process.

1.3 Document Organization

Chapter 2 presents an overview of the State of Art: the Capability Maturity Model Integration showing characteristics of this model.

Chapter 3 introduces VSTS as a solution for integration problems and productivity increase inside of an adherent organization to CMMI level 2. Presents how VSTS deals with CMMI process areas.

Chapter 4 presents the main contribution of this Graduation Work: the VSTS implantation inside of a real small to mid-size company in accordance with the software development process adopted in the organization.

Chapter 5 discusses the results obtained after experiment using the proposed tool.

Finally, **Chapter 6** summarizes this work contributions, contrasts the proposed solution with related experiments and suggests topics for future works.

2. State of Art

Considered essential in the construction of a product with a high degree of excellence, quality assurance existed even before the 20th century. In past, to ensure the quality was responsibility of the ones who have made the product. The first activity related to security and control of quality was held in 1916, in the Bell Laboratories. Meanwhile, it was in the 1970s that a factor suddenly influenced the software's quality guarantee: the quality models that had arose from militaries contracts. Since then, the software quality models have been adopted by the trade world and nowadays they are widely used[10]. An evidence of this is the *Capability Maturity Model Integration (CMMI)*, developed by *Software Engineering Institute (SEI)*. With the progress of the world market for software, the CMMI is increasingly being adopted and replacing the CMM, because the CMMI takes account the quality requirements required at the market and the dynamism expressed by the organizations in currently days.

With the CMMI growth, the *Microsoft Solutions Framework (MSF) for CMMI Process Improvement* has been created to offer the organizations a framework for the software development capable to deal with both the results expectations of the companies and the requirements of CMMI, in this case, level 2.

The use of MSF has shown that it's quite extensive and flexible. So, MSF adds the VSTS automation, quality perception and results will be the prescription for the success of this case study. This chapter shows an overview of about CMMI.

2.1 CMMI

Since 1991, CMMs have been developed for several disciplines. Some of the most notable is the model for systems engineering, software engineering, software procurement, management and development of the work force and Integrated Product and Process Development – IPPD.

Although these models have proven to be useful for many organizations, the use of multiple models has been problematic. Many organizations would like to concentrate efforts to improve the disciplines of their organizations. Thinking about it, the CMMI project was drawn up to solve the problem of use multiple CMMs. Some basic models were combined in a single framework for the improvement to be used by organizations that in search of an improvement of processes covering the enterprise as a whole.

[10] BERK, J.; BERK, S. Administração da qualidade total: o aperfeiçoamento contínuo. São Paulo: IBRASA, 1997, 284p.

The work of CMMI project is sponsored by Department of Defense of the United States, such as CMM. The first version was published in 1997. From this release many change requests were made and the version 1.0 was released in 2000. Shortly after it was launched to version 1.1. Recently, in this year (2007), any company that wishes to certificate in CMMI should be adapt theirs processes, because was released a new version 1.2 of CMMI.

2.1.1 Representations

It's very important to be prepared to decide which CMMI model is the best to follow to achieve the organization's objectives.

CMMI adopts two representation ways, it's because the people whom participated of the CMMI development team were pursuing different views. In addition there were legacies of other models, anyway, to choose a single approach has become difficult so, it was agreed that, initially, it would be addressed two representations of the model with equivalent content.

There are many valid reasons for selecting a representation or another. The organization can use the representation that it's more familiar. Figure 2 presents some of the advantages of the two representations: Staged and Continuous.

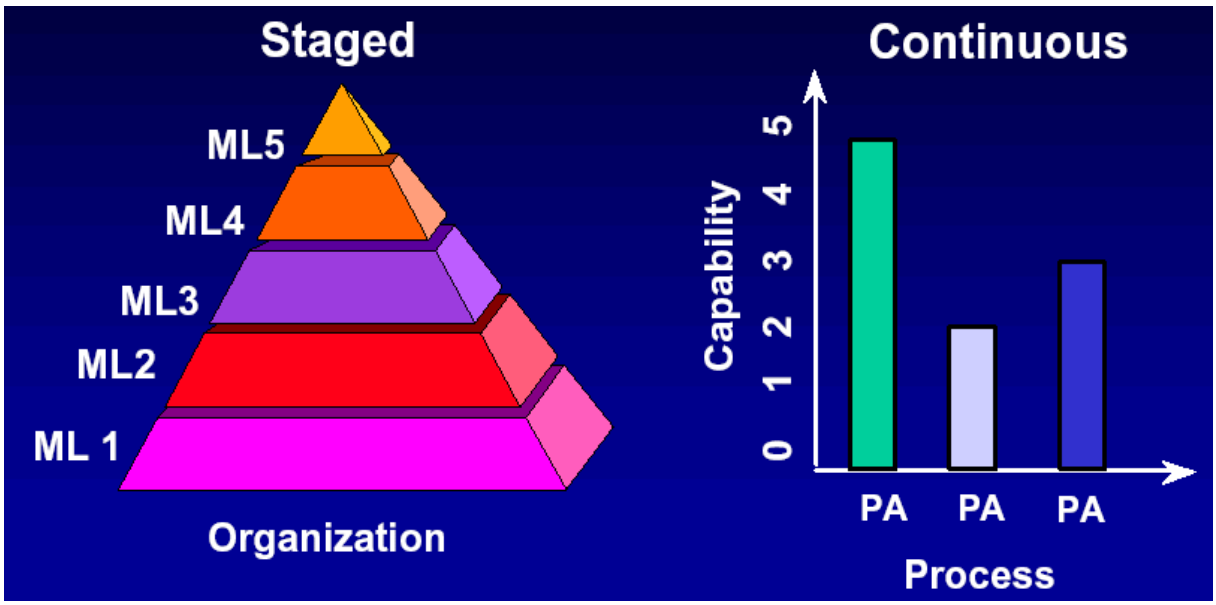


Figure 2 – Two representations of CMMI.

Continuous Representation

A capability level is a well-defined plan that describes the capability of a process area. There are six capability levels. Each level represents a layer for the continuous process improvement. So, capability levels are cumulative. A capability level higher includes the attributes of the lower levels.

Below are presented some advantages of continuous representation:

- Provides more flexibility on focusing in specific process areas, according to business goals;
- Allows a comparison among process areas of different organizations;
- Consists in a "family structure" for those who are up of the community of systems engineering;
- Has a well-defined focus in specific risks of each process area;
- Has a structure compatible with the ISO/IEC 15504[11] standard.

Figure 3 presents the capability levels of continuous representation.

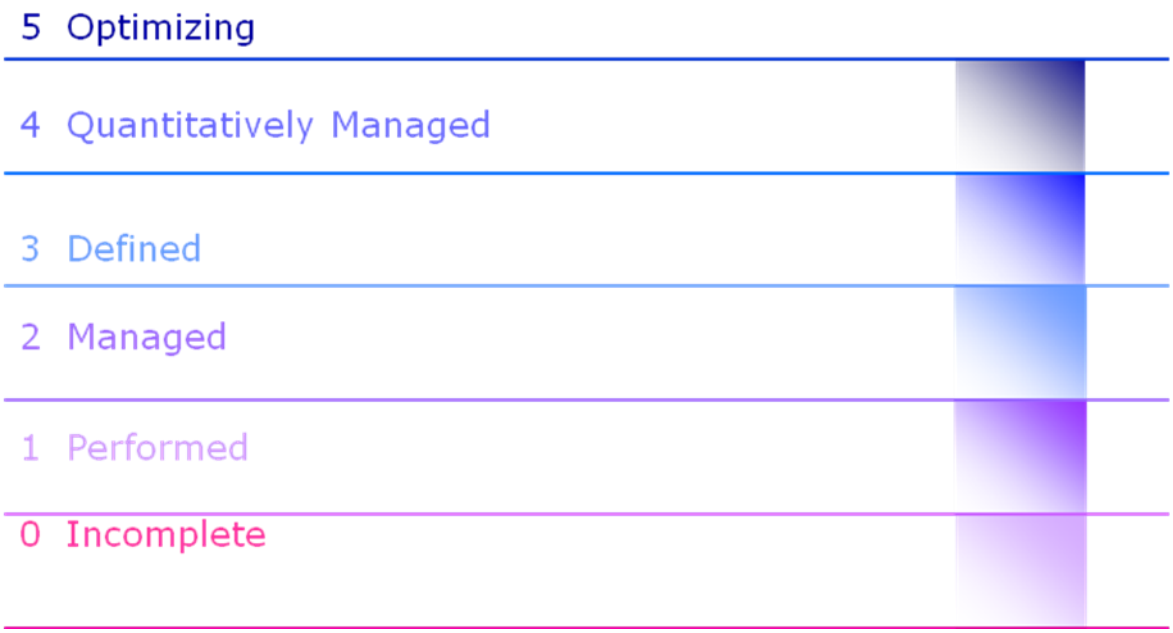


Figure 3 – CMMI Capability Levels: Continuous representation.

Staged Representation

A maturity level is a well-defined plan of a way to turn the organization riper. There are five maturity levels. Each level represents a layer for the continuous process improvement.

Below are presented some advantages of staged representation:

- Allows a comparison among process areas of different organizations;
- Supplies ability to manage processes through the organization;
- Supplies an implementation route through:
  - Groups of process areas;
  - Sequential implementation;

[11] Software Engineering Institute – ISO/IEC 15504. Available at: http://www.sei.cmu.edu/cmmi/faq/15504-faq.html. Site visited in: 06/24/2007.

- Each level works like a foundation for the next level.

Figure 4 presents the maturity levels of staged representation.

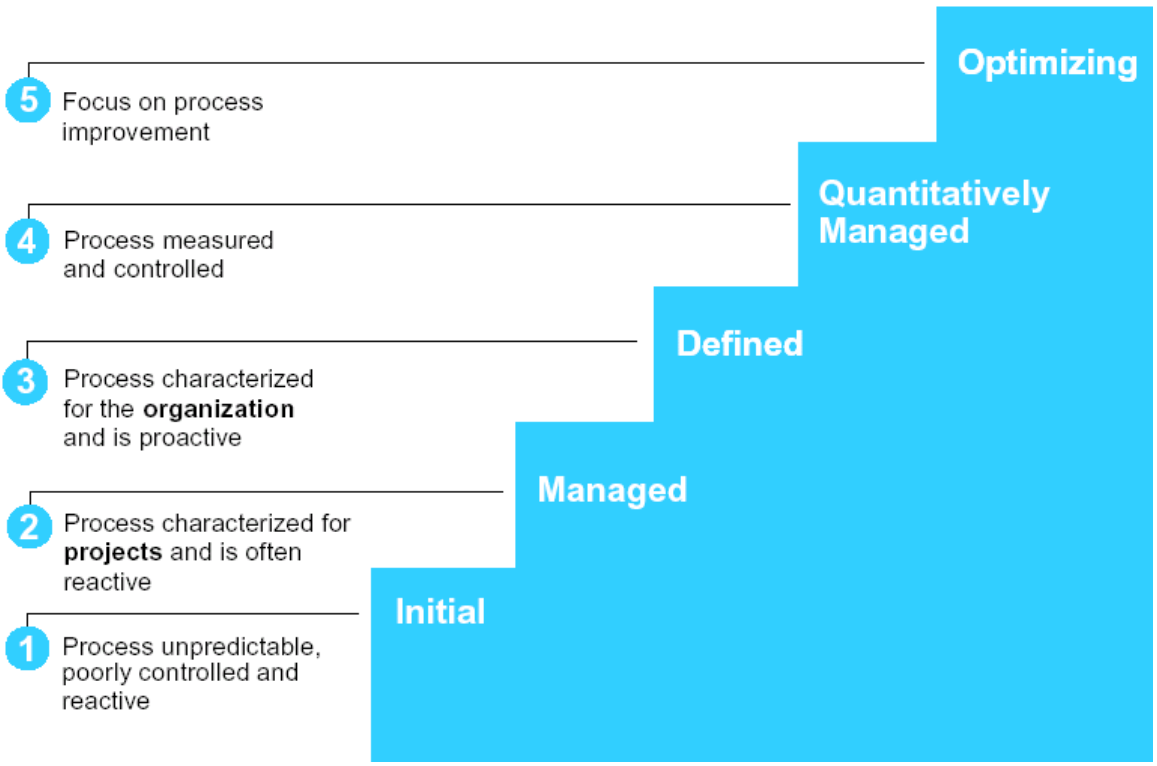


Figure 4 – CMMI Maturity Levels: Staged representation.

3. Visual Studio Team System

Building software these days is very difficult. Today's enterprise-scale applications have many layers and services. These projects require more development effort and are held to a higher standard than similar projects from a few years ago. Project Managers use Microsoft Office Project and Microsoft Office Excel to track requirements, iterations, phases, milestones, and deliverables. Architects use Microsoft Office Visio or third-part tools to diagram their datacenters, networks, application services, and classes. The developers have it easy. They have and continue to use Visual Studio to implement these services and classes. Developers and testers who want to test their software will also need tools to perform unit tests, code coverage, static analysis, load and Web testing. The end result of using so many tools is a hard drive full of software from various manufacturers. Newly hired team members will need weeks of training to gain experience on all these niche applications.

Another problem with using multiple tools relates back to communication. Not between team members, but with the project. The project itself needs to communicate with the project manager and the other stakeholders. These individuals need to have their fingers on the

pulse of the project at all times. Today's managers have to rely on Project or Excel to provide them with such a detailed and accurate view. The status of the project presented by these tools, however, is only as accurate as the data recently typed into Project or Excel documents. This is a dependency that can cause problems when ad hoc reports are needed and the data is missing. Ideally, the project metrics should be relayed to the project manager in real time, without additional aggregation. Such metrics might include outstanding tasks, satisfied tasks, code churn, team efficiency, and bugs. These metrics should be available remotely and accessed in an easy-to-use way, such as from a Web browser.

Some software development problems will never be solved. In many problematic situations, the customer, team, project, budget, and/or time frame difficulties are beyond the help of any tool or methodology. Straightening out such problematic situations is beyond the scope of Team System.[12]

With the Visual Studio Team System, Microsoft studied the ways that software shops and teams successfully, and sometimes, unsuccessfully, developed software. Then, it built a product that will increase the predictability of a successful project. From start to finish, Team System provides the guidance and collaboration to achieve this level of predictability. Visual Studio no longer is Visual Studio just an IDE for development. Team System transforms it into an excellent tool that integrates the entire team with entire solution across the life cycle.

Team System is based on the same suite of tools that Microsoft uses internally to successfully plan, build, and deploy its software to customers.

Visual Studio 2005 Team System is designed to achieve the primary goals:

- Increase the project's predictability of success;
- Increase the team's productivity by reducing the complexity of delivering modern service-oriented solutions;
- Increase the team's collaboration by integrating all the tools;
- Increase the team's capability by allowing remote users to work in a robust, secure, and scalable environment;
- Be extensible by allowing its tools and services to be customized and extended.[13]

[12] HUNDHAUSEN, R. Working with Microsoft Visual Studio 2005 Team System, Microsoft Press, 2006, Page 5.
[13] Idem, Page 7.

3.1 Architecture

Team System is actually a series of role-based editions. It's not really intended for solo professionals or consultants. Its value is realized for teams that include project manager, architect, developer, and tester roles.[14]

Visual Studio 2005 Team Edition for Software Architects

This edition is specially designed for both the infrastructure and application architect roles. It includes visual designers, referred to as the *distributed application designers or service-oriented architecture (SOA) designers*. The architect can create diagrams to represent the logical datacenter, the application, applications systems, and the deployment of the application.

Visual Studio 2005 Team Edition for Software Developers

This is the edition for the developers or programmers on the team. This will probably be the most common of the Team System role-based editions. In addition to all of the base Visual Studio 2005 professional features, developers will get the static code analyzer, unit testing, code coverage, and code profiler.

Visual Studio 2005 Team Edition for Software Testers

Whether a team member is a developer or exclusively a tester, this edition will provide access to all the coverage, quality, and load testing facilities needed to thoroughly test a project, ensuring that it works from all angles. The Team Edition for Testers includes load Web testing, Unit Testing, Code Coverage, as well as test-case management tools for managing all the tests and running and monitoring them from a centralized area.[15]

For this project, the tests part won't be explore, because it's not scope of CMMI level 2.

Visual Studio 2005 Team Foundation Server

This edition of Visual Studio will provide many back-end databases and Web services to enable the team to collaborate, by sharing work items, source code, builds, and other artifacts.

Team Foundation Server includes a standalone client called Team Explorer. This client is essentially a light weight edition of Visual Studio 2005 that offers an alternate way – besides

[14] Idem, Page 13.
[15] Idem, Page 14.

using one of the other Visual Studio editions, Excel, or Project – of creating and managing work items.

Visual Studio 2005 Team Suite

For the team who plays more than one role, or for the consultant who plays all the roles, there is the Team Suite. Microsoft was wrapped up all three role-based editions (architect, developer, and tester) into a single edition for simplicity.[16]

Figure 5 shows the Visual Studio Team System architecture.

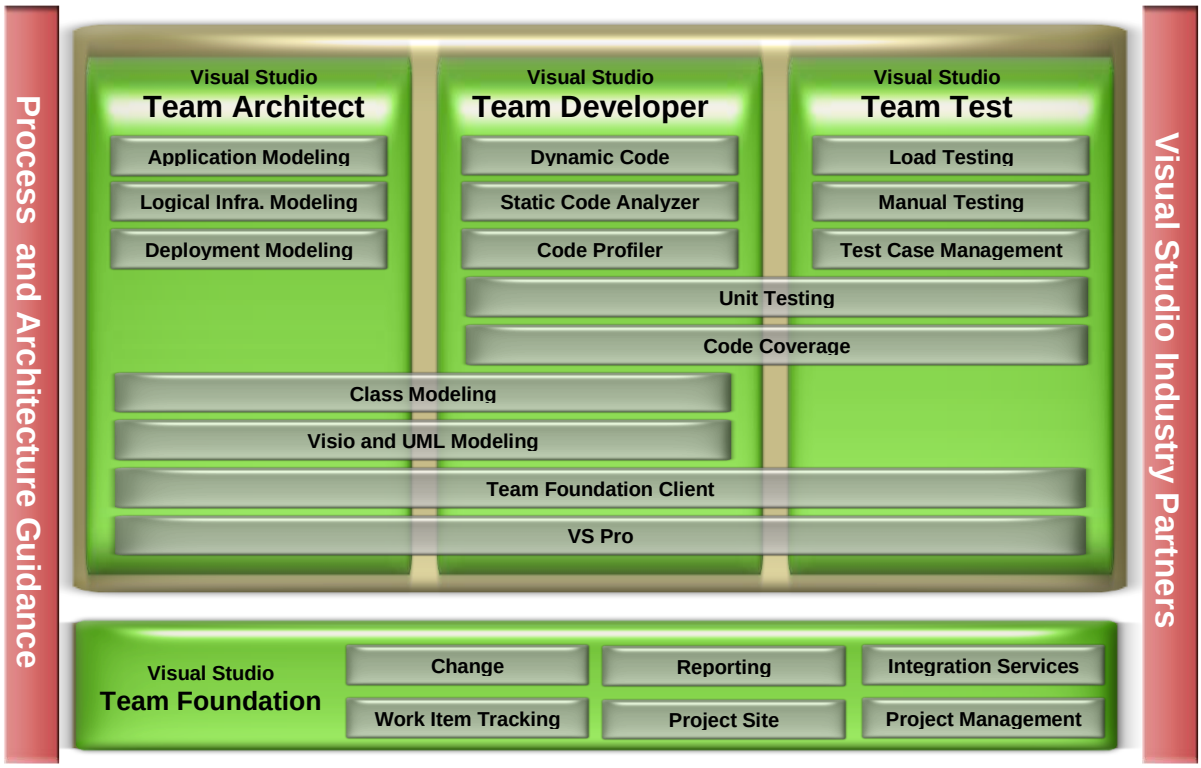


Figure 5 – Visual Team System architecture.

3.2 VSTS, MSF and CMMI

Microsoft Solutions Framework (MSF) is a set of software development processes, principles, and proven practices that enable developers to achieve success in the software development life cycle. MSF is rooted in well-know industry best practices. First introduced in 1994, MSF has aggregated 25 years of guidance from both internal and external sources.

Over the years, MSF has morphed to meet the changing needs of developers. MSF version 4.0 ships with Team System, breaks downs into two versions, which are essentially two philosophies on how to develop software: *MSF for Agile Software Development* and *MSF for CMMI Process Improvement*. MSF for Agile Software Development will appeal to the "agilists"

[16] Idem, Page 15.

out there – that is, teams accustomed to more rapid, ready-for-change environments that are tightly coupled with the customer. MSF for CMMI Process Improvement will appeal to larger shops or larger projects that feature many reporting levels. These are typically projects in which long-range planning and communication are more important than constant deliverables and feedback. This last methodology will be use in this work.

Team System implements CMMI for Process Improvement that is specific to software engineering. This is an excellent process to use on project if the company is attempting to achieve a measured baseline competency in software development[17].

4. VSTS Project Implantation

This chapter presents how the VSTS assists the activities described in the software development process of a real organization adherent at CMMI level 2.

Through the instantiation of *MSF for CMMI*, VSTS loads all practices of CMMI process areas, making it possible to execute all activities of the software development process in accordance with the practices demanded by the organization.

Section 4.1 shows how this real organization works today – without VSTS implantation – and the tools that it uses for each phase of software development process and process area. This section also shows the integration existence among these tools used by the organization.

Section 4.2 shows how to implant the VSTS tool in the considered organization and how it will substitute efficiently the other used tools.

4.1 How the organization works

The organization considered in this study is a mid-size company located in Recife, Pernambuco, Brazil. It has a great amount of services and one of them is software development. In the software development unit there are about 50 people working, including managers, developers, SQA's, testers, support and other.

At the beginning of 2006, the company decided to implant a quality program to reach CMMI level 2 for strategic reasons. Since then, much work have been made to define a software development process adherent to CMMI level 2 and at the same time adjusted for reality of the organization. During this time of process implantation, one of the concerns was the use of tools that optimize the work of teams' projects, because the course of teams' activities could not be slowed down due to a "heavy" process.

[17] Idem, Page 9 and 10.

Using many tools of different owners or even free, does not always allow establishing the integration desired. Many times, this causes rework and serious difficulties of maintenance of the generated artifacts. For this reason, this Graduation Work considers the use of an only tool that supplies the integration need, giving agility for the process.

4.1.1 Used tools

The software development process of the considered organization considered has 5 phases: Planning, Development, Tests, Implantation and Closing. Beyond the phases of software development life cycle, there are processes that give support for all the life cycle: Project Monitoring and Control, Measurement and Analysis, Process and Product Quality Assurance and Configuration Management. Some of these represent process areas of CMMI level 2 and 3. The other process areas are distributed over the five phases of software development life cycle.

For each phase of the software development process, there is a set of activities that represents the workflow of the phase and these activities have an actor, inputs and outputs. Depending on the activity, these inputs and outputs can be mandatory. So, the activities communicate with each other until closing the project and then it releases a version of the system.

This section presents for each practice of process areas of CMMI level 2 the activities of software development process of the organization and which tools are used to reach the specific practices and, for consequence, the specific goal for the process area.

Further on, we will be able to see how VSTS goes to optimize all the software development life cycle and to provide integration for them. Figure 5 is a representation of the software development life cycle adopted in a real organization.

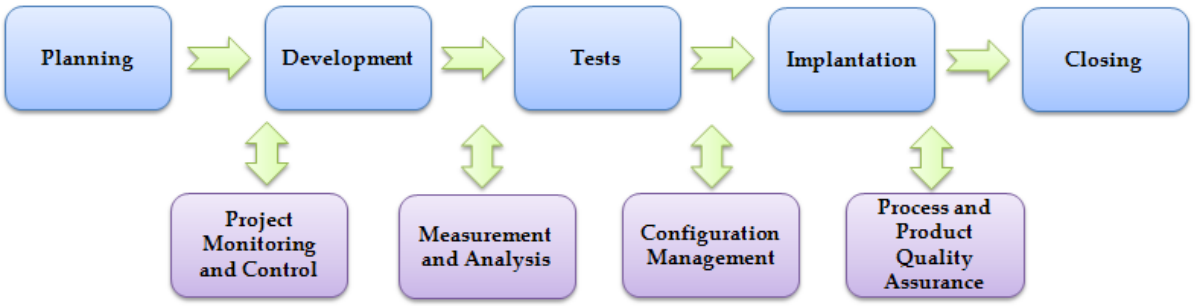


Figure 6 – Software Development Life Cycle.

The following tables show all process areas of CMMI level 2, their Specific Goals (SG), Specific Practices (SP). For each Specific Practice the activity related to the process of the organization.

For each Specific Practice there is a list of typical work products (in agreement with CMMI), work products generated by the organization, tools used for generation of these work products and the problems or disadvantages in the use of those tools. It's important to understand that it's not all of activities that have disadvantages in the organization. For some of activities, the VSTS doesn't support the needs of the organization and the solution used today is enough.

Process Area: Requirements Management

The purpose of Requirement Management (REQM) is to manage the requirements of the project's products and products components and to indentify inconsistencies between those requirements and the project's plans and work[18].

Table 1 – [REQM] Specific Goal 1 – Manage Requirements.

Specific Goal: SG 1 – Manage Requirements	
Requirements are managed and inconsistencies with project plans and work products are identified[19].	
Specific Practice: SP 1.1 Obtain an Understanding of Requirements ***Activity in Process: Start Elicitation, Requirements Elicitation and Verify Requirements Based on Scope***	
Typical Work Products	
▪ Lists of criteria distinguishing appropriate requirements providers; ▪ Criteria for evaluation and acceptance of requirements; ▪ Results of analyses against criteria; ▪ An agreed-to set of requirements.	
Practice Implementation Indicator (PII)	Type of PII
Meeting record with list of criteria distinguishing appropriate requirements providers, criteria for evaluation and acceptance of requirements	Direct Artifact
Requirements Document	Direct Artifact
Checklist of noncompliance in requirements/use case	Direct Artifact
Used tools	Found problems
MS Office Word	None
MS Office Excel	The checklist of noncompliance in requirements/use case is used to register the understanding of requirements described in

[18] CHRISSIS, M.B.; KONRAD, M.; SHRUM, S. CMMI, Guidelines for Process Integration and Product Improvement, Addison Wesley, February 21, 2003, Page 485.
[19] Idem. Page 486.

	requirements document. This activity is made by the analyst of the project (different of who made the document). The checklist with noncompliance is sent to the author of the document and it's stored in the cvs.

Specific Practice: SP 1.2 Obtain Commitment to Requirements ***Activity in Process: Verify Requirements Based on Scope and Obtain***	
Typical Work Products	
▪ Requirements impact assessments; ▪ Documented commitments to requirements and requirements changes.	
Practice Implementation Indicator (PII)	Type of PII
Record approval of the requirements document for the customer	Direct Artifact
Requirements traceability matrix	Direct Artifact
Used tools	Found problems
MS Office Word	None
Enterprise Architect	None

Specific Practice: SP 1.3 Manage Requirements Changes ***Activity in Process: Accomplish Initial Analysis, Accomplish Viability Analysis, Obtain Customer's Approval and Incorporate the Change in the Project***	
Typical Work Products	
▪ Requirements status; ▪ Requirements database; ▪ Requirements decision database.	
Practice Implementation Indicator (PII)	Type of PII
Issue in Change request tool	Direct Artifact
Requirements traceability matrix	Direct Artifact
Meeting record of viability analysis	Direct Artifact
Customer's approval (This evidence is just requested when it's treated of a change in the project scope)	Direct Artifact
Used tools	Found problems
Mantis Bugtracking	None
CVS	None
Enterprise Architect	None

Specific Practice: SP 1.4 Maintain Bidirectional Traceability of Requirements ***Activity in Process: Consolidate Requirements and all activities that request an updating of the requirements and related artifacts***	
Typical Work Products	
▪ Requirements traceability matrix; ▪ Requirements tracking system.	
Practice Implementation Indicator (PII)	Type of PII
Requirements traceability matrix	Direct Artifact
Requirements tracking system	Direct Artifact
Used tools	Found problems
Enterprise Architect	None

Specific Practice: SP 1.5 Identify Inconsistencies between Project Work and Requirements

Activity in Process: Verify Requirements Consistency	
Typical Work Products	
▪ Documentation of inconsistencies including sources, conditions, and rationale; ▪ Corrective Actions.	
Practice Implementation Indicator (PII)	Type of PII
Requirements Inconsistencies Checklist	Direct Artifact
Corrective actions	Direct Artifact
Used tools	Found problems
MS Office Excel	There isn't integration between the noncompliance registered in requirements inconsistencies checklist and Mantis.
Mantis Bugtracking (Change request tool)	The same problem mentioned earlier.

Process Area: Project Planning

The purpose of Project Planning (PP) is to establish and maintain plans that define project activities[20].

Table 2 – [PP] Specific Goal 1 – Establish Estimates.

Specific Goal: SG 1 – Establish Estimates	
Estimates of project planning parameters are established and maintained[21].	
Specific Practice: SP 1.1 Estimate the Scope of the Project ***Activity in Process: Estimate Size and Effort***	
Typical Work Products	
▪ Task descriptions; ▪ Work package descriptions; ▪ WBS – *Work Breakdown Structure*.	
Practice Implementation Indicator (PII)	Type of PII
Effort Estimate Spreadsheet	Direct Artifact
Project Plan	Indirect Artifact
Used tools	Found problems
MS Office Excel	None
MS Office Word	None
Specific Practice: SP 1.2 Establish Estimates of Work Product and Task Attributes ***Activity in Process: Estimate Size and Effort , Elaborate Project Plan, Elaborate Schedule and Consolidate Project Plan***	
Typical Work Products	
▪ Technical approach; ▪ Size and complexity of tasks and work products; ▪ Estimating models; ▪ Attribute estimates.	
Practice Implementation Indicator (PII)	Type of PII
Effort Estimate Spreadsheet	Direct Artifact
Project Schedule	Direct Artifact
Project Plan	Direct Artifact

[20] Idem. Page 405.
[21] Idem. Page 406.

Test Environment Specification	Direct Artifact
Used tools	Found problems
MS Office Excel	None
MS Office Project	When the project schedule is elaborated, the tasks are attributed in the schedule so that the allocated resources need to consult the schedule to know their activities and to update it. There isn't a way the project resources to accomplish the task and the schedule to be updated automatically.
MS Office Word	None

Specific Practice: SP 1.3 Define Project Life Cycle ***Activity in Process: Elaborate Project Plan***	
Typical Work Products	
▪ Project life-cycle phases	
Practice Implementation Indicator (PII)	Type of PII
Project Plan	Direct Artifact
Software development process	Direct Artifact
Used tools	Found problems
MS Office Word	None

Specific Practice: SP 1.4 Determine Estimates of Effort and Cost ***Activity in Process: Estimate Size and Effort, Estimate Cost***	
Typical Work Products	
▪ Estimation rationale; ▪ Project effort estimates; ▪ Project cost estimates.	
Practice Implementation Indicator (PII)	Type of PII
Effort Estimate Spreadsheet	Direct Artifact
Cost Estimate Spreadsheet	Direct Artifact
Project Schedule	Indirect Artifact
Project Plan	Indirect Artifact
Used tools	Found problems
MS Office Excel	None
MS Office Word	None
MS Office Project	The same problem mentioned in previous sub-practice SP 1.2 Establish Estimates of Work Product and Task Attributes.

Table 3 – [PP] Specific Goal 2 – Develop a Project Plan.

Specific Goal: SG 2 – Develop a Project Plan
A project plan is established and maintained as the basis for managing the project[22].

Specific Practice: SP 2.1 Establish the Budget and Schedule ***Activity in Process: Elaborate Schedule***
Typical Work Products

[22] Idem. Page 413.

▪ Project schedules; ▪ Schedule dependencies; ▪ Project budget.

Practice Implementation Indicator (PII)	Type of PII
Project Schedule	Direct Artifact
Quality Team Schedule	Direct Artifact
Test Team Schedule	Direct Artifact
Project Budget Spreadsheet	Direct Artifact
Project Plan	Indirect Artifact
Used tools	**Found problems**
MS Office Project	The same problem mentioned in previous sub-practice SP 1.2 Establish Estimates of Work Product and Task Attributes.
MS Office Excel	None
MS Office Word	None

Specific Practice: SP 2.2 Identify Project Risks ***Activity in Process: Elaborate Project Plan***
Typical Work Products
▪ Identified risks ▪ Risk impacts and probability of occurrence ▪ Risk priorities

Practice Implementation Indicator (PII)	Type of PII
Project Risks Spreadsheet	Direct Artifact
Project Plan	Indirect Artifact
Used tools	**Found problems**
MS Office Excel	The project risks are listed in a spreadsheet; however they don't have integration with the tool of project management. Therefore, whenever the project is accompanied, it's necessary open the risks spreadsheet to verify the project risks.
MS Office Word	None

Specific Practice: SP 2.3 Plan for Data Management ***Activity in Process: Plan Configuration Management***
Typical Work Products
▪ Data management plan; ▪ Master list of managed data; ▪ Data content and format description; ▪ Data requirements lists for acquirers and for suppliers; ▪ Privacy requirements; ▪ Security requirements; ▪ Security procedures; ▪ Mechanism for data retrieval, reproduction, and distribution; ▪ Schedule for collection of project data; ▪ Listing of project data to be collected.

Practice Implementation Indicator (PII)	Type of PII
Configuration Management Guide	Direct Artifact
Standardization document	Direct Artifact
Project Plan	Indirect Artifact

Used tools	Found problems
MS Office Word	None

Specific Practice: SP 2.4 Plan for Project Resources ***Activity in Process: Elaborate Project Plan, Elaborate Schedule and Consolidate Project Plan***	
Typical Work Products	
▪ WBS work packages; ▪ WBS task dictionary; ▪ Staffing requirements based on project size and scope; ▪ Critical facilities/equipment list; ▪ Process/workflow definitions and diagrams; ▪ Program administration requirements list.	
Practice Implementation Indicator (PII)	Type of PII
Project Plan	Direct Artifact
Project Schedule	Direct Artifact
Quality Team Schedule	Direct Artifact
Test Team Schedule	Direct Artifact
Test Environment Specification	Direct Artifact
Used tools	Found problems
MS Office Word	None
MS Office Excel	None
MS Office Project	None

Specific Practice: SP 2.5 Plan for Needed Knowledge and Skills ***Activity in Process: Elaborate Project Plan and Elaborate Schedule***	
Typical Work Products	
▪ Inventory of skill needs; ▪ Staffing and new hire plans; ▪ Databases (e.g., skills and training).	
Practice Implementation Indicator (PII)	Type of PII
Document of collaborators' profiles	Direct Artifact
Project Plan	Indirect Artifact
Project Schedule	Indirect Artifact
Used tools	Found problems
HTML Editor (Published list of staffing requirements)	None
MS Office Word	None
MS Office Project	None

Specific Practice: SP 2.6 Plan Stakeholder Involvement ***Activity in Process: Evaluate Project Plan***	
Typical Work Products	
Stakeholder involvement plan	
Practice Implementation Indicator (PII)	Type of PII
Project Plan	Direct Artifact
Project Schedule	Direct Artifact
Used tools	Found problems
MS Office Word	None
MS Office Project	The same problem mentioned in previous sub-practice SP 1.2 Establish Estimates of

	Work Product and Task Attributes.

Specific Practice: SP 2.7 Establish the Project Plan ***Activity in Process: Elaborate Project Plan and Consolidate Project Plan***	
Typical Work Products	
▪ Overall project plan	
Practice Implementation Indicator (PII)	Type of PII
Project Plan	Direct Artifact
Project Schedule	Direct Artifact
Used tools	Found problems
MS Office Word	None
MS Office Project	The same problem mentioned in previous sub-practice SP 1.2 Establish Estimates of Work Product and Task Attributes.

Table 4 – [PP] Specific Goal 3 – Obtain Commitment to the Plan.

Specific Goal: SG 3 – Obtain Commitment to the Plan	
Specific Practice: SP 3.1 Review Plans That Affect the Project ***Activity in Process: Incorporate Changes in the Project Scope and Monitoring of Requirements Consistence***	
Typical Work Products	
▪ Record of the reviews of plans that affect the project	
Practice Implementation Indicator (PII)	Type of PII
Checklist of noncompliance in use case	Direct Artifact
Checklist of noncompliance in requirements	Direct Artifact
Requirements consistence checklist	Direct Artifact
Corrective actions	Direct Artifact
Used tools	Found problems
MS Office Excel	There isn't integration between noncompliance registered in checklists and Mantis (corrective actions).
Mantis Bugtracking	The same problem mentioned earlier.

Specific Practice: SP 3.2 Reconcile Work and Resource Levels ***Activity in Process: Incorporate Changes in the Project Scope, Accomplish Daily Meeting of the Project , Accomplish Weekly Meeting of the Project and Accomplish Meeting of the Project with the Director***	
Typical Work Products	
▪ Revised methods and corresponding estimating parameters (e.g., better tools, use of off-the-shelf components); ▪ Renegotiated budgets; ▪ Revised schedules; ▪ Revised requirements list; ▪ Renegotiated stakeholder agreements.	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director)	Direct Artifact
Viability analysis	Direct Artifact
Revised schedules	Direct Artifact
Revised requirements document	Direct Artifact

Used tools	Found problems
MS Office Project	None
MS Office Word	None

Specific Practice: SP 3.3 Obtain Plan Commitment ***Activity in Process: Obtain Approval of the Project Plan and Accomplish Meeting with the Project Team***	
Typical Work Products	
▪ Documented requests for commitments; ▪ Documented commitments.	
Practice Implementation Indicator (PII)	Type of PII
Communication	Direct Artifact
Meeting record	Direct Artifact
Project Plan approved	Indirect Artifact
Used tools	Found problems
MS Office Word	None
MS Office Outlook	None

Process Area: Project Monitoring and Control

The purpose of Project Monitoring and Control (PMC) is to provide an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan[23].

Table 5 – [PMC] Specific Goal 1 – Monitor Project Against Plan.

Specific Goal: SG 1 – Monitor Project Against Plan	
Actual performance and progress of the project are monitored against the project plan[24].	

Specific Practice: SP 1.1 Monitor Project Plan Parameters ***Activity in Process: Accomplish Daily Meeting of the Project , Accomplish Weekly Meeting of the Project and Accomplish Meeting of the Project with the Director***	
Typical Work Products	
▪ Records of project performance; ▪ Records of significant deviations.	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director)	Direct Artifact
Project Plan	Indirect Artifact
Project Schedule	Indirect Artifact
Project Risks Spreadsheet	Indirect Artifact
Project Costs Spreadsheet	Indirect Artifact
Used tools	Found problems
MS Office Project	None
MS Office Word	None
MS Office Excel	None

Specific Practice: SP 1.2 Monitor Commitments

[23] Idem. Page 391.
[24] Idem. Page 392.

Activity in Process: Accomplish Daily Meeting of the Project , Accomplish Weekly Meeting of the Project and Accomplish Meeting of the Project with the Director	
Typical Work Products	
▪ Records of commitment reviews	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director)	Direct Artifact
Project Plan	Indirect Artifact
Used tools	Found problems
MS Office Word	None
MS Office Outlook	None

Specific Practice: SP 1.3 Monitor Project Risks *Activity in Process: Accomplish Daily Meeting of the Project , Accomplish Weekly Meeting of the Project and Accomplish Meeting of the Project with the Director*	
Typical Work Products	
▪ Records of project risk monitoring	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director)	Direct Artifact
Project Risks Spreadsheet	Indirect Artifact
Used tools	Found problems
MS Office Word	None
MS Office Excel	The project risks aren't in a tool integrated with a tool of management project.

Specific Practice: SP 1.4 Monitor Data Management *Activity in Process: Accomplish Daily Meeting of the Project , Accomplish Weekly Meeting of the Project and Accomplish Meeting of the Project with the Director*	
Typical Work Products	
▪ Records of data management	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director)	Direct Artifact
Configuration Management Guide	Indirect Artifact
Project Plan	Indirect Artifact
Used tools	Found problems
MS Office Word	None

Specific Practice: SP 1.5 Monitor Stakeholder Involvement *Activity in Process: Accomplish Daily Meeting of the Project , Accomplish Weekly Meeting of the Project and Accomplish Meeting of the Project with the Director*	
Typical Work Products	
▪ Records of stakeholder involvement	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director)	Direct Artifact
Project Schedule	Indirect Artifact
Issues in Change request tool	Indirect Artifact
Used tools	Found problems
MS Office Word	None

MS Office Project	None
Mantis Bugtracking	The issues registered by stakeholders in Mantis don't have integration with management tools (e-mail, for example).

Specific Practice: SP 1.6 Conduct Progress Reviews ***Activity in Process: Accomplish Weekly Meeting of the Project and Accomplish Meeting of the Project with the Director***	
Typical Work Products	
▪ Documented project review results	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director) of progress reviews	Direct Artifact
Corrective actions	Direct Artifact
Project Plan	Indirect Artifact
Project Schedule	Indirect Artifact
Measurement Spreadsheets	Indirect Artifact
Used tools	Found problems
MS Office Word	None
MS Office Project	None
MS Office Excel	To supply the measurements reports, the spreadsheet needs to be fed manually with data to generate the managerial reports. This work is very expensive for the involved teams: project team, quality team and test team.
Mantis bugtracking	The corrective actions identified during the progress reviews of the project are registered and monitored in Mantis. However those corrective actions also enter in the managerial reports and they need to be collected in the mantis and fed in the measurement spreadsheets.

Specific Practice: SP 1.7 Conduct Milestones Reviews ***Activity in Process: Accomplish Weekly Meeting of the Project and Accomplish Meeting of the Project with the Director***	
Typical Work Products	
▪ Documented milestone review results	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director) of milestones reviews	Direct Artifact
Corrective actions	Direct Artifact
Project Plan	Indirect Artifact
Project Schedule	Indirect Artifact
Project Risks Spreadsheet	Indirect Artifact
Used tools	Found problems
MS Office Word	None
MS Office Project	None
MS Office Excel	The project risks aren't in a tool integrated with a tool of management project.

Mantis bugtracking	The corrective actions identified during the milestones reviews should be registered and monitored. In mantis there isn't integration with a tool of project management.

Table 6 – [PMC] Specific Goal 2 – Manage Corrective Action to Closure.

Specific Goal: SG 2 – Manage Corrective Action to Closure	
Corrective actions are managed to closure when the project's performance or results deviate[25].	
Specific Practice: SP 2.1 Analyze Issues ***Activity in Process: Accomplish the Initial Analysis***	
Typical Work Products	
▪ List of issues needing corrective actions	
Practice Implementation Indicator (PII)	Type of PII
Meeting record (daily, weekly and with the director) with significant deviations	Direct Artifact
Issues in Change request tool	Direct Artifact
Project Plan	Indirect Artifact
Used tools	Found problems
Mantis Bugtracking	The issues of significant deviations are registered in Mantis and there isn't integration between the corrective action and the responsible for it. In other words, there isn't a mechanism in the tool that attributes a task automatically to the resource allocated for it.
MS Office Word	None. In this case, the project plan to guide what type of corrective action will be taken.
Specific Practice: SP 2.2 Take Corrective Action ***Activity in Process: Planning Corrective Actions and Take Corrective Actions***	
Typical Work Products	
▪ Corrective action plan	
Practice Implementation Indicator (PII)	Type of PII
Corrective Actions	Direct Artifact
Project Plan	Indirect Artifact
User Guide of Corrective Actions System	Indirect Artifact
Used tools	Found problems
Mantis Bugtracking	The corrective actions are registered in Mantis and there isn't integration between the corrective action and the responsible for it. In other words, there isn't a mechanism in the tool that attributes a task automatically to the resource allocated for this.
MS Office Word	None. In this case, the project plan is to guide what type of corrective action will be taken.

[25] Idem. Page 398.

Specific Practice: SP 2.3 Manage Corrective Action *Activity in Process: Manage Corrective Action*	
Typical Work Products	
▪ Corrective action results	
Practice Implementation Indicator (PII)	Type of PII
Report of project indicators	Direct Artifact
Corrective Actions	Direct Artifact
Used tools	Found problems
Mantis Bugtracking	The tool where is made the monitoring of corrective actions is Mantis.
MS Office Word	The report of indicators shows the status of the corrective actions of a certain project. It's made manually. Integration that allows the report generation and graphs doesn't exist.

Process Area: Measurement and Analysis

The purpose of Measurement and Analysis (MA) is to develop and sustain a measurement capability that is used to support management information needs[26].

Table 7 – [MA] Specific Goal 1 – Align Measurement and Analysis Activities.

Specific Goal: SG 1 – Align Measurement and Analysis Activities
Measurement objectives and activities are aligned with identified information needs and objectives[27].

Specific Practice: SP 1.1 Establish Measurement Objectives *Activity in Process: Elaborate Measurement and Analysis Plan of the Project*	
Typical Work Products	
▪ Measurement objectives	
Practice Implementation Indicator (PII)	Type of PII
Measurement and Analysis Guide	Direct Artifact
Measurement and Analysis Process	Indirect Artifact
Used tools	Found problems
MS Office Word	None

Specific Practice: SP 1.2 Specify Measures *Activity in Process: Elaborate Measurement and Analysis Plan of the Project*	
Typical Work Products	
▪ Specification of base and derived measures	
Practice Implementation Indicator (PII)	Type of PII
Measurement and Analysis Guide	Direct Artifact
Measurement and Analysis Process	Indirect Artifact
Project Plan	Direct Artifact
Used tools	Found problems
MS Office Word	None

[26] Idem. Page 247.
[27] Idem. Page 248.

Specific Practice: SP 1.3 Specify Data Collection and Storage Procedures *Activity in Process: Elaborate Measurement and Analysis Plan of the Project*	
Typical Work Products	
▪ Data collection and stored procedures; ▪ Data collection tools.	
Practice Implementation Indicator (PII)	Type of PII
Measurement and Analysis Guide	Direct Artifact
Measurement and Analysis Process	Indirect Artifact
Project Plan	Indirect Artifact
Configuration Plan	Direct Artifact
Used tools	Found problems
MS Office Word	None

Specific Practice: SP 1.4 Specify Analysis Procedures *Activity in Process: Elaborate Measurement and Analysis Plan of the Project*	
Typical Work Products	
▪ Data collection and stored procedures; ▪ Data collection tools.	
Practice Implementation Indicator (PII)	Type of PII
Measurement and Analysis Guide	Direct Artifact
Measurement and Analysis Process	Indirect Artifact
Project Plan	Indirect Artifact
Configuration Plan	Direct Artifact
Used tools	Found problems
MS Office Word	None

Table 8 – [MA] Specific Goal 2 – Provide Measurement Results.

Specific Goal: SG 2 – Provide Measurement Results	
Measurement results that address identified information needs and objectives are provided[28].	

Specific Practice: SP 2.1 Collect Measurement Data *Activity in Process: Collect Data of Project Measurements*	
Typical Work Products	
▪ Base and derived measurement data sets; ▪ Results of data integrity tests.	
Practice Implementation Indicator (PII)	Type of PII
Project Measurement Spreadsheet	Direct Artifact
PPQA Measurement Spreadsheet	Direct Artifact
Tests Measurement Spreadsheet	Direct Artifact
Used tools	Found problems
Hours Database of the Project	Database is not connected with measurement spreadsheet. It's necessary to collect the data manually directly of the base and to feed the measurement spreadsheet.
MS Office Project	The planned activities (including effort, milestones, requirements volatility) are

[28] Idem. Page 256.

	collected manually from project schedule and fed in the measurement spreadsheet.
Mantis Bugtracking (Change request tool)	Mantis is used to collect noncompliance registered during the process and product audits. Mantis doesn't generate noncompliance report; they are collected manually and fed in the measurement spreadsheet.

Specific Practice: SP 2.2 Analyze Measurement Data ***Activity in Process: Analyze Measurements of the Project***	
Typical Work Products	
▪ Analysis results and draft report	
Practice Implementation Indicator (PII)	Type of PII
Project Indicators Report	Direct Artifact
Measurement and Analysis Guide	Indirect Artifact
Used tools	Found problems
MS Office Excel	There isn't a connection between measurement spreadsheets generated and the Indicators Report. The report is generated manually with obtained information from measurement spreadsheets.

Specific Practice: SP 2.3 Store Data and Results ***Activity in Process: Analyze Measurements of the Project***	
Typical Work Products	
▪ Stored data inventory	
Practice Implementation Indicator (PII)	Type of PII
Project Measurement Spreadsheet	Direct Artifact
PPQA Measurement Spreadsheet	Direct Artifact
Tests Measurement Spreadsheet	Direct Artifact
Project Indicators Report	Direct Artifact
Used tools	Found problems
CVS	Data and Results are stored in project repository (CVS), but there isn't a unified system such as a database that stores these information and allows to the organization seek in just one system for historical data of the company.

Specific Practice: SP 2.4 Communicate Results ***Activity in Process: Communicate Results***	
Typical Work Products	
▪ Delivered reports and related analysis results; ▪ Contextual information or guidance to aid in the interpretation of analysis results.	
Practice Implementation Indicator (PII)	Type of PII
Measurement and Analysis Guide	Direct Artifact
Communication (e-mail, meeting record)	Indirect Artifact
Used tools	Found problems
MS Office Outlook	An e-mail is sent for all involved in the

	project containing the indicators report elaborated in the Measurement and Analysis process. There isn't integration between the automatic elaboration of that report and the propagation of the results. The e-mail is sent manually to each one of those involved.

Process Area: Process and Product Quality Assurance

The purpose of Process and Product Quality Assurance (PPQA) is to provide staff and management with objective insight into processes and associated work products[29].

Table 9 – [PPQA] Specific Goal 1 – Objectively Evaluate Processes and Work Products.

Specific Goal: SG 1 – Objectively Evaluate Processes and Work Products	
Adherence of the performed and associated work products and services to applicable process descriptions, standards, and procedures is objectively evaluated[30].	

Specific Practice: SP 1.1 Objectively Evaluate Process ***Activity in Process: Objectively Evaluate the Adherence to the Process***	
Typical Work Products	
▪ Evaluation reports; ▪ Noncompliance reports; ▪ Corrective actions.	
Practice Implementation Indicator (PII)	Type of PII
Process Evaluation Checklist	Direct Artifact
Corrective actions	Direct Artifact
Corrective action and noncompliance report	Direct Artifact
Used tools	Found problems
MS Office Excel	Tool used to record noncompliance identified during process audits. The spreadsheet is also used to generate corrective action and noncompliance report. Once again it happen duplication of information and rework when data are collected starting from the registrations in Mantis for the report.
Mantis Bugtracking (Change request tool)	The noncompliance are recorded in Mantis so that it's possible the subsequent collection of data for the PPQA measurements. There isn't integration between the Process Evaluation Checklist and Mantis Bugtracking. It causes reworking and duplication of information.

Specific Practice: SP 1.2 Objectively Evaluate Work Products and Services ***Activity in Process: Evaluate Artifacts Based on Acceptance Criteria***
Typical Work Products

[29] Idem. Page 429.
[30] Idem. Page 432.

▪ Evaluation reports; ▪ Noncompliance reports; ▪ Corrective actions.	
Practice Implementation Indicator (PII)	Type of PII
Product Evaluation Checklist	Direct Artifact
Corrective actions	Direct Artifact
Report of corrective action and noncompliance	Direct Artifact
Used tools	Found problems
MS Office Excel	Tool used to record noncompliance identified during product audits. The spreadsheet is also used to generate reports of noncompliance and corrective actions. Once again it happen duplication of information and rework when data are collected starting from the registrations in Mantis for the report.
Mantis Bugtracking (Change request tool)	The noncompliance are recorded in Mantis so that it's possible the subsequent collection of data for the PPQA measurements. There isn't integration between the Product Evaluation Checklist and Mantis Bugtracking. It causes reworking and duplication of information.

Table 10 – [PPQA] Specific Goal 2 – Provide Objective Insight.

Specific Goal: SG 2 – Specific Goal 2 – Provide Objective Insight	
Communicate quality issues and ensure resolution of noncompliance issues with the staff and managers[31].	
Specific Practice: SP 2.1 Communicate and Ensure Resolution of Noncompliance Issues Activity in Process: Planning Corrective Actions, Execute Corrective Actions and Monitoring Corrective Actions	
Typical Work Products	
▪ Corrective action reports; ▪ Evaluation reports; ▪ Quality trends.	
Practice Implementation Indicator (PII)	Type of PII
Corrective actions	Direct Artifact
Quality Plan	Indirect Artifact
Project Plan	Indirect Artifact
Project Indicators Report	Indirect Artifact
Used tools	Found problems
MS Office Word	The escalate policy of noncompliance is documented in Project Plan and Quality Plan. Results of audits are documented in Project Indicators Report and the corrective actions

[31] Idem. Page 433.

	associated are in Project Plan.
Mantis Bugtracking (Change request tool)	The noncompliance issues are recorded in Mantis where is possible monitoring them and track to resolution. Monitoring noncompliance is hard because there isn't a system that alerts open noncompliance issues.

Specific Practice: SP 2.2 Establish Records ***Activity in Process: Objectively Evaluate the Adherence to the Process, Evaluate Artifacts Based on Acceptance Criteria, Planning Corrective Actions, Execute Corrective Actions and Monitoring Corrective Actions***	
Typical Work Products	
▪ Evaluation reports; ▪ Noncompliance reports; ▪ Corrective actions.	
Practice Implementation Indicator (PII)	Type of PII
Product/Process Evaluation Checklist	Direct Artifact
Corrective actions	Direct Artifact
Corrective action and noncompliance report	Direct Artifact
Used tools	Found problems
MS Office Excel	Tool used to record identified noncompliance during product audits. The spreadsheet is also used to generate reports of noncompliance and corrective actions. Once again it happen duplication of information and rework when data are collected starting from the registrations in Mantis for the report.
Mantis Bugtracking (Change request tool)	The noncompliance are recorded in Mantis so that it's possible the subsequent collection of data for the PPQA measurements. There isn't integration between the Product Evaluation Checklist and Mantis Bugtracking. It causes reworking and duplication of information.
CVS	CVS maintain records in the project repository. Some of these records are duplicated in other tools such as Mantis.

Process Area: Configuration Management

The purpose of Configuration Management (CM) is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits[32].

Table 11 – [CM] Specific Goal 1 – Establish Baselines.

Specific Goal: SG 1 – Establish Baselines

[32] Idem. Page 157.

Baselines of identified work products are established[33].

Specific Practice: SP 1.1 Identify Configuration Items ***Activity in Process: Identify Configuration Items to Create Baseline***	
Typical Work Products	
▪ Identified configuration items	
Practice Implementation Indicator (PII)	Type of PII
Configuration Management Guide	Direct Artifact
Project Plan	Direct Artifact
Standardization Document – This document has patterns adopted by organization related with names of documents, structure of the project repository.	Direct Artifact
Used tools	Found problems
MS Office Word	None

Specific Practice: SP 1.2 Establish a Configuration Management System ***Activity in Process: Create Configuration Management Environment to the Project***	
Typical Work Products	
▪ Configuration management system with controlled work products ▪ Configuration management system access control procedures ▪ Change request database	
Practice Implementation Indicator (PII)	Type of PII
Configuration Management Guide	Direct Artifact
Closing baseline spreadsheet	Direct Artifact
Change requests	Direct Artifact
Recovery disaster document	Indirect Artifact
Used tools	Found problems
MS Office Word	None
MS Office Excel	The configuration items are in a spreadsheet called Closing baseline spreadsheet.
Mantis Bugtracking (Change request tool)	There isn't integration among Closing baseline spreadsheet, Mantis and CVS.
CVS	The same problem mentioned earlier.

Specific Practice: SP 1.3 Create or Release Baselines ***Activity in Process: Create Baseline***	
Typical Work Products	
▪ Baselines ▪ Description of baselines	
Practice Implementation Indicator (PII)	Type of PII
Issue in Change request tool	Direct Artifact
Closing baseline spreadsheet	Direct Artifact
Configuration items in the configuration management system	Direct Artifact
Used tools	Found problems
Mantis Bugtracking (Change request tool)	There isn't integration among Closing baseline spreadsheet, Mantis and CVS.
MS Office Excel	The configuration items are in a spreadsheet

[33] Idem. Page 160.

	and don't have integration with change request tool (Mantis).
CVS	There isn't integration between Mantis and CVS to make the current set of baselines readily available.

Table 12– [CM] Specific Goal 2 – Track and Control Changes.

Specific Goal: SG 2 – Track and Control Changes	
Change to the work products under configuration management are traced and controlled[34].	
Specific Practice: SP 2.1 Track Changes Requests ***Activity in Process: Identify Configuration Items to Create Baseline***	
Typical Work Products	
▪ Change requests	
Practice Implementation Indicator (PII)	Type of PII
Change requests in Mantis	Direct Artifact
Release Notes document	Direct Artifact
Used tools	Found problems
Mantis Bugtracking (Change request tool)	None
MS Office Word	None
Specific Practice: SP 2.2 Control Configurations Item ***Activity in Process: Create Configuration Management Environment to the Project***	
Typical Work Products	
▪ Revision history of configuration items ▪ Archives of the baselines	
Practice Implementation Indicator (PII)	Type of PII
Issues in Change request tool	Direct Artifact
Changes record in Mantis	Direct Artifact
Change request authorization	Direct Artifact
Used tools	Found problems
Mantis Bugtracking (Change request tool)	None.
CVS	Today there aren't check-in/check-out policies in the Control Version System to correct change incorporation.

Table 13 – [CM] Specific Goal 3 – Establish Integrity.

Specific Goal: SG 3 – Establish Integrity
Integrity of baselines is established and maintained[35].
Specific Practice: SP 3.1 Establish Configuration Management Records ***Activity in Process: Create Baseline and Perform Configurations Audits***
Typical Work Products
▪ Revision history of configuration items ▪ Change log ▪ Copy of the change requests

[34] Idem. Page 165.
[35] Idem. Page 167.

▪ Status of configuration items ▪ Differences between baselines	
Practice Implementation Indicator (PII)	Type of PII
Revision graph of configuration items	Direct Artifact
Log of configuration items in CVS	Direct Artifact
Issues in Change request tool	Direct Artifact
Release Notes document	Direct Artifact
Used tools	Found problems
Mantis Bugtracking (Change request tool)	The configuration management records are maintained in Mantis and also in the CVS, happening duplication of information.
MS Office Word	It's used to create Release Notes document to send to the customer.
CVS	CVS has a graph that shows revisions of configuration items and stores logs. But it isn't integrated with Mantis.

Specific Practice: SP 3.2 Perform Configurations Audits ***Activity in Process: Perform Configurations Audits and Communicate Results to Stakeholders***	
Typical Work Products	
▪ Configuration audit results ▪ Action items	
Practice Implementation Indicator (PII)	Type of PII
Closing baseline spreadsheet	Direct Artifact
Configuration audit checklist	Direct Artifact
Project Plan	Indirect Artifact
Configuration management guide	Indirect Artifact
Corrective actions	Direct Artifact
Used tools	Found problems
MS Office Excel	The noncompliance found during the configuration audits are registered in spreadsheet and replied manually as corrective action in Mantis.
Mantis Bugtracking (Change request tool)	The same problem mentioned earlier. It's used to register the noncompliance and corrective actions.
MS Office Word	None. The Project Plan and Configuration Management Plan have information to confirm compliance with applicable configuration management standards and procedures.

4.1.2 Tools summarize

After presenting for each specific practice which the tools used in the organization to generate the necessary work products, this section presents a table with the summary of the tools presented previously.

The intention of this table is to visualize all tools mentioned in the diagnosis section to make easier the understanding of the next section.

Table 14 – Summary of used tools.

Process Area: Requirements Management
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ Enterprise Architect; ▪ Mantis Bugtracking; ▪ CVS;

Process Area: Project Planning
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ MS Office Project; ▪ HTML Editor; ▪ Mantis Bugtracking; ▪ MS Office Outlook.

Process Area: Project Monitoring and Control
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ MS Office Project; ▪ Mantis Bugtracking.

Process Area: Measurement and Analysis
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ Hours Database; ▪ MS Office Project; ▪ Mantis Bugtracking; ▪ CVS; ▪ MS Office Outlook.

Process Area: Process and Product Quality Assurance
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ Mantis Bugtracking; ▪ CVS.

Process Area: Process and Product Quality Assurance
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ Mantis Bugtracking; ▪ CVS.

Process Area: Configuration Management
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ Mantis Bugtracking; ▪ CVS; ▪ Manual tests.

Process Area: Verification
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ Mantis Bugtracking.

Process Area: Validation
Used tools
▪ MS Office Word; ▪ MS Office Excel; ▪ Mantis Bugtracking.

4.2 VSTS Support for CMMI practices

The section above presented the result of the diagnosis accomplished to identify how the used tools by the studied organization support the implementation of the practices of CMMI level 2. Through this result it was possible to observe the organization liabilities against the use of those tools.

This section has the objective of presenting how VSTS can solve great part of the found problems.

Process Area: Requirements Management

Specific Goal: SG 1 – Manage Requirements

Table 15 – VSTS X REQM – SP 1.1 Obtain an Understanding of Requirements.

Specific Practice: SP 1.1 Obtain an Understanding of Requirements	
Practice Implementation Indicator (PII)	
▪ Meeting record with list of criteria distinguishing appropriate requirements providers, criteria for evaluation and acceptance of requirements; ▪ Requirements Document; ▪ Checklist of noncompliance in requirements/use case.	
Used tools	Found problems
MS Office Word	None
MS Office Excel	The checklist of noncompliance in requirements/use case is used to register the understanding of requirements described in

	requirements document. This activity is made by the analyst of the project (different of who made the document). The checklist with noncompliance is sent to the author of the document and it's stored in the cvs.

Solution proposed with VSTS
VSTS offers customization of their work items. Is possible create a work item to represent the noncompliance found in documents. The responsible for analyses the found noncompliance doesn't need have the Visual Studio installed in his machine to report the noncompliance. Through a spreadsheet excel that the Visual Studio offers with the work item, the analyst verifies the inconsistencies in the document and through Team Explorer he sends these information to Team Foundation Server in the database SQL Server 2005. The resources involved in the resolution of the noncompliance will receive a work item with the task to be accomplished. Like this, the checklist of noncompliance in Requirements Document and Use Case Document could be reported through work items and directly attributed to the responsible for analyzing those noncompliance.

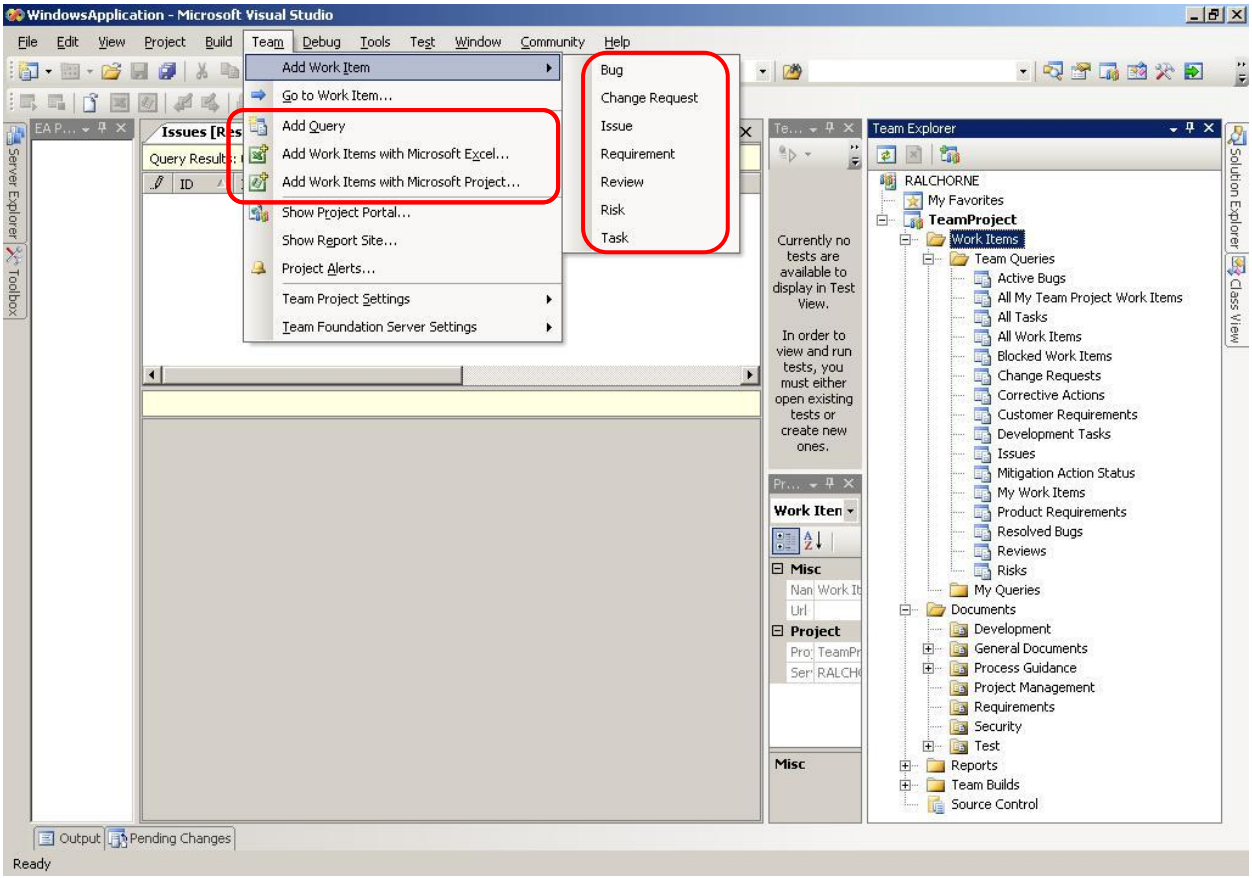


Figure 7 – Work Items in VSTS.

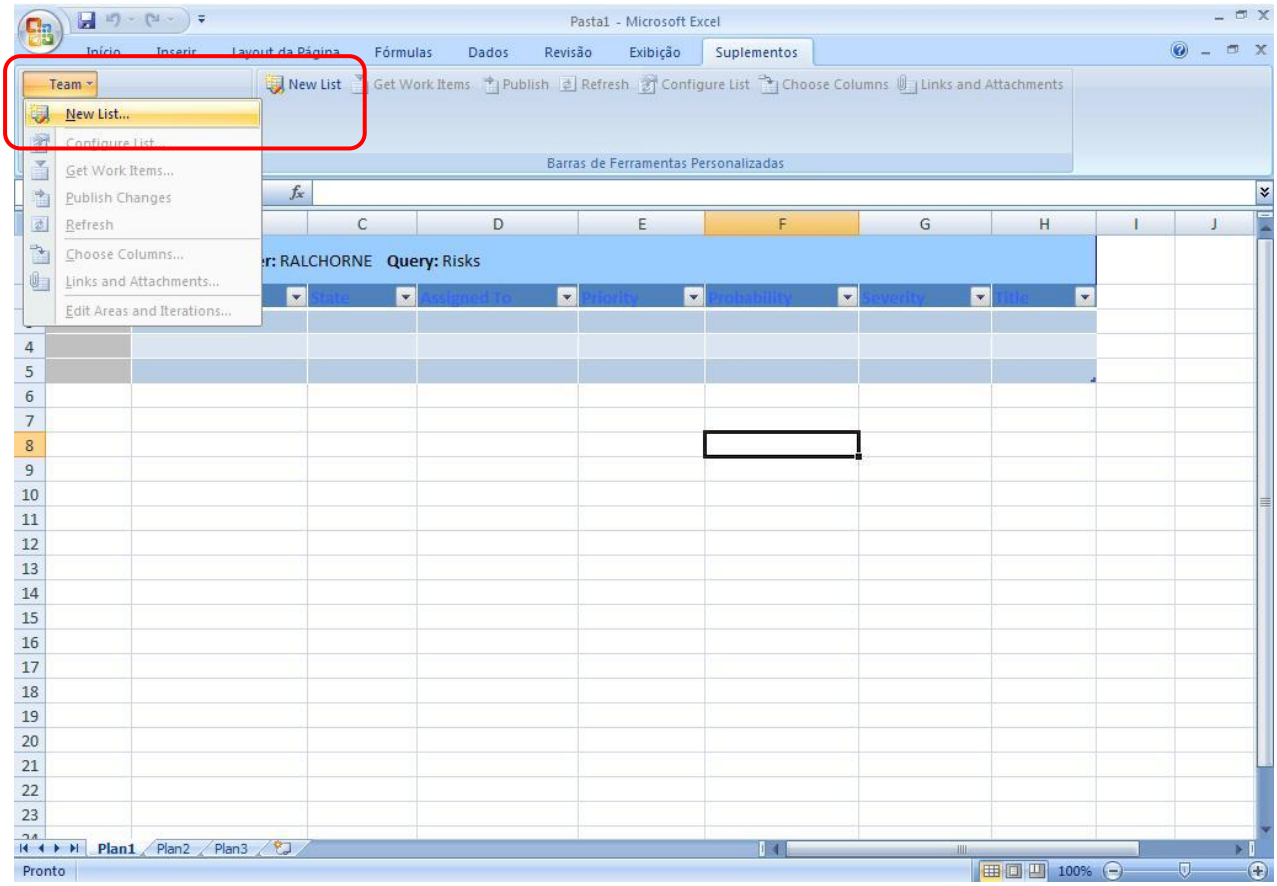


Figure 8 – Integration between Excel and Team Foundation Server through Team Explorer outstanding in the figure.

Table 16 – VSTS X REQM – SP 1.2 Obtain Commitment to Requirements.

Specific Practice: SP 1.2 Obtain Commitment to Requirements	
Practice Implementation Indicator (PII)	
▪ Record approval of the requirements document for the customer; ▪ Requirements traceability matrix.	
Used tools	Found problems
MS Office Word	None
Enterprise Architect	None
Solution proposed with VSTS	
The Enterprise Architect is used in the organization as modeling tool. In this are registered the requirements, use cases, data model, class diagrams and other. The traceability is maintained through a visual matrix offered by the tool where are presented the relationships established among the mentioned elements. The two tools are complementary and the organization already uses Enterprise Architect. For that integration between these two tools, Sparx Systems (Enterprise Architect's proprietary)[36] made available a module called MDG Integration for Visual Studio 2005.	

[36] Sparx Systems – MDG Integration for Visual Studio 2005. Available at: http://www.sparxsystems.com.au/products/mdg_integrate.html. Site visited in: 08/04/2007.

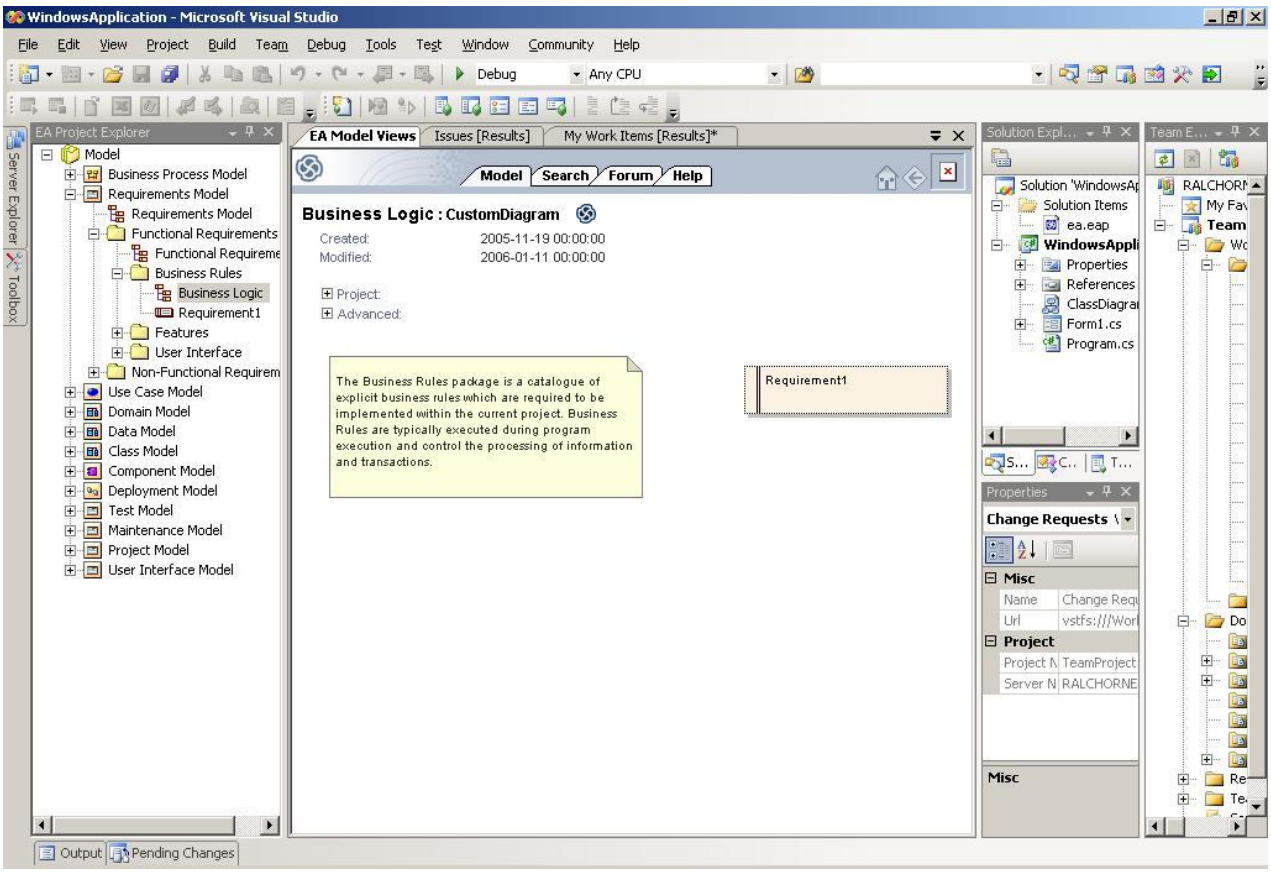


Figure 9 – Integration between Enterprise Architect and Visual Studio 2005.

Table 17 – VSTS X REQM – SP 1.3 Manage Requirements Changes.

Specific Practice: SP 1.3 Manage Requirements Changes	
Practice Implementation Indicator (PII)	
▪ Issue in Change request tool; ▪ Requirements traceability matrix; ▪ Meeting record of viability analysis; ▪ Customer's approval (This evidence is just requested when it's treated of a change in the scope of the project).	
Used tools	Found problems
Mantis Bugtracking	None
CVS	None
Enterprise Architect	None
Solution proposed with VSTS	
The standard tool for change request is the Mantis Bugtracking System. The purpose of this tool is to analyze if the request matches the change management process. In case the request is approved, all of the work products related are updated and stored in cvs. The solution proposed with VSTS is to use Team Explorer to report issues, bugs and change requests and attribute to the responsible for them. These work items reported are stored in	

Team Foundation Server.
In case the customer of the project doesn't have understanding of the use of Team Explorer, he can use a web tool called TeamPlain[37].
The TeamPlain allows anybody report issues, bugs and change requests through web application. The TeamPlain is connected to Team Foundation Server and report the work items for the project.

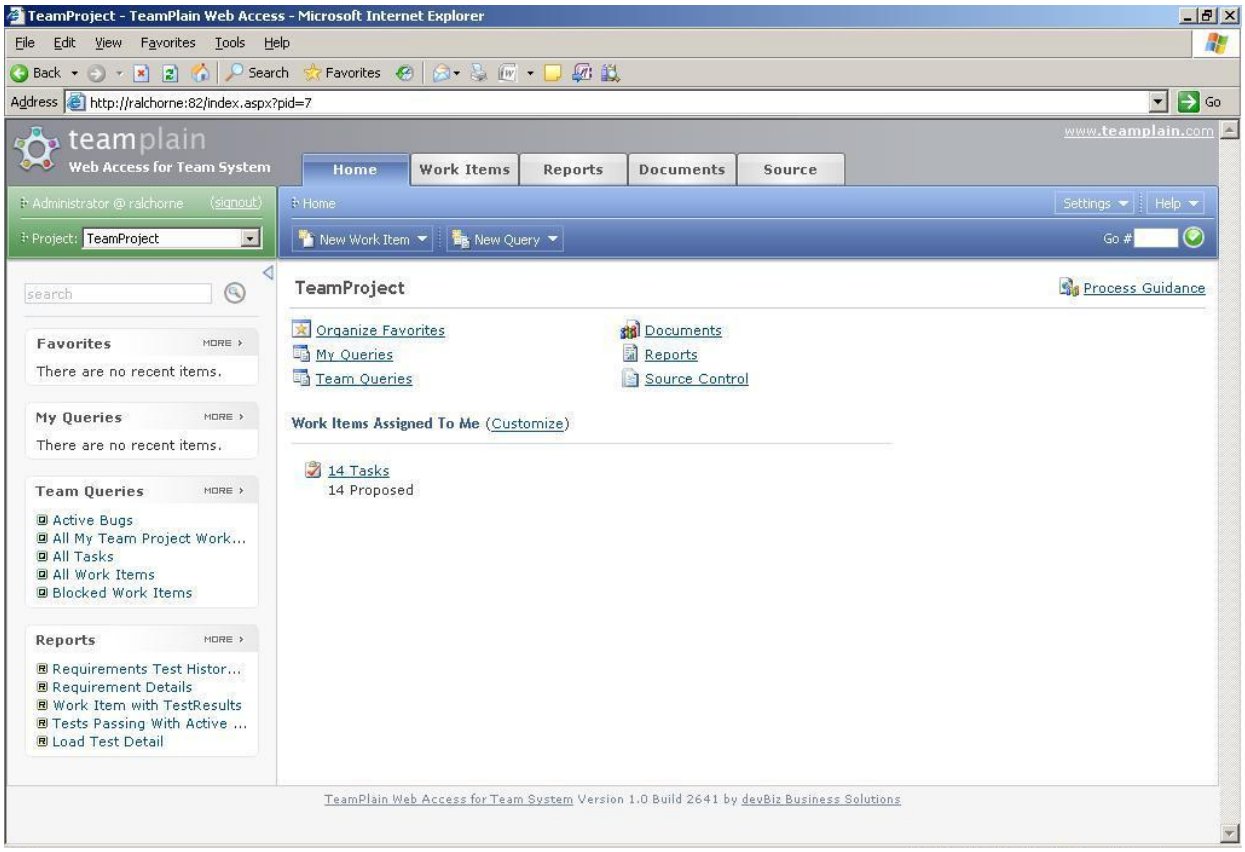


Figure 10 – TeamPlain web application.

Table 18 – VSTS X REQM – SP 1.4 Maintain Bidirectional Traceability of Requirements.

Specific Practice: SP 1.4 Maintain Bidirectional Traceability of Requirements	
Practice Implementation Indicator (PII)	
▪ Requirements traceability matrix; ▪ Requirements tracking system.	
Used tools	Found problems
Enterprise Architect	None
Solution proposed with VSTS	
The Enterprise Architect already supplies this need.	

[37] Team Plain Web Access for Team System. Available at:
http://www.devbiz.com/teamplain/webaccess/default.aspx. Site visited in: 08/05/2007.

Table 19 – VSTS X REQM – SP 1.5 Identify Inconsistencies between Project Work and Requirements.

Specific Practice: SP 1.5 Identify Inconsistencies between Project Work and Requirements	
Practice Implementation Indicator (PII)	
▪ Requirements inconsistencies checklist; ▪ Corrective actions.	
Used tools	Found problems
MS Office Excel	There isn't integration between the noncompliance registered in checklist of requirements inconsistencies and Mantis.
Mantis Bugtracking (Change request tool)	The same problem mentioned earlier.
Solution proposed with VSTS	
The solution for that specific practice is the same idea presented for *SP 1.1 Obtain an Understanding of Requirements*. VSTS offers customization of their work items. It's possible create a work item to represent the noncompliance found in project works and requirements. The responsible for analyses the found noncompliance doesn't need have the Visual Studio installed in his machine to report the noncompliance. Through the excel integrated with the Team System, the analyst verifies the inconsistencies of the plans that affect the project and through Team Explorer he sends these information to the Team Foundation Server in the database SQL Server 2005. The resources involved in the resolution of the noncompliance will receive a work item with the task to be accomplished. Like this, the checklist of noncompliance could be reported through work items and directly attributed to the responsible for analyzing those noncompliance.	

Process Area: Project Planning

Specific Goal: SG 1 – Established Estimates

Table 20 – VSTS X PP – SP 1.1 Estimate the Scope of the Project.

Specific Practice: SP 1.1 Estimate the Scope of the Project	
Practice Implementation Indicator (PII)	
▪ Effort Estimate Spreadsheet; ▪ Project Plan.	
Used tools	Found problems
MS Office Excel	None
MS Office Word	None
Solution proposed with VSTS	
The tools MS Office Word and Excel help the artifacts elaboration for this specific practice.	

Table 21 – VSTS X PP – SP 1.2 Establish Estimates of Work Product and Task attributes.

Specific Practice: SP 1.2 Establish Estimates of Work Product and Task Attributes	
Practice Implementation Indicator (PII)	
▪ Effort Estimate Spreadsheet; ▪ Project Schedule; ▪ Project Plan; ▪ Test environment specification.	
Used tools	Found problems
MS Office Excel	None
MS Office Project	When the schedule of the project is

	elaborated, the tasks are assigned in the schedule so that the allocated resources need to consult the schedule to know their activities and to update it. There isn't a way to a project resource to accomplish the task and the schedule be updated automatically.
MS Office Word	None
Solution proposed with VSTS	
For the problem of automatic updating of the project schedule, the Visual Studio Team System offers a communication between MS Project and Team Foundation Server. This communication is made in the following way: after registering resources in the team project, the project manager elaborates the schedule and defines the tasks and the responsible resources for them. The manager doesn't need to have the Visual Studio installed in his machine. He just needs to have the Team Explorer in MS Project. After ending the project schedule, the manager updates the database of Team Foundation Server and the defined tasks in the schedule are converted in work items. These work items are assigned to their respective resources automatically.	

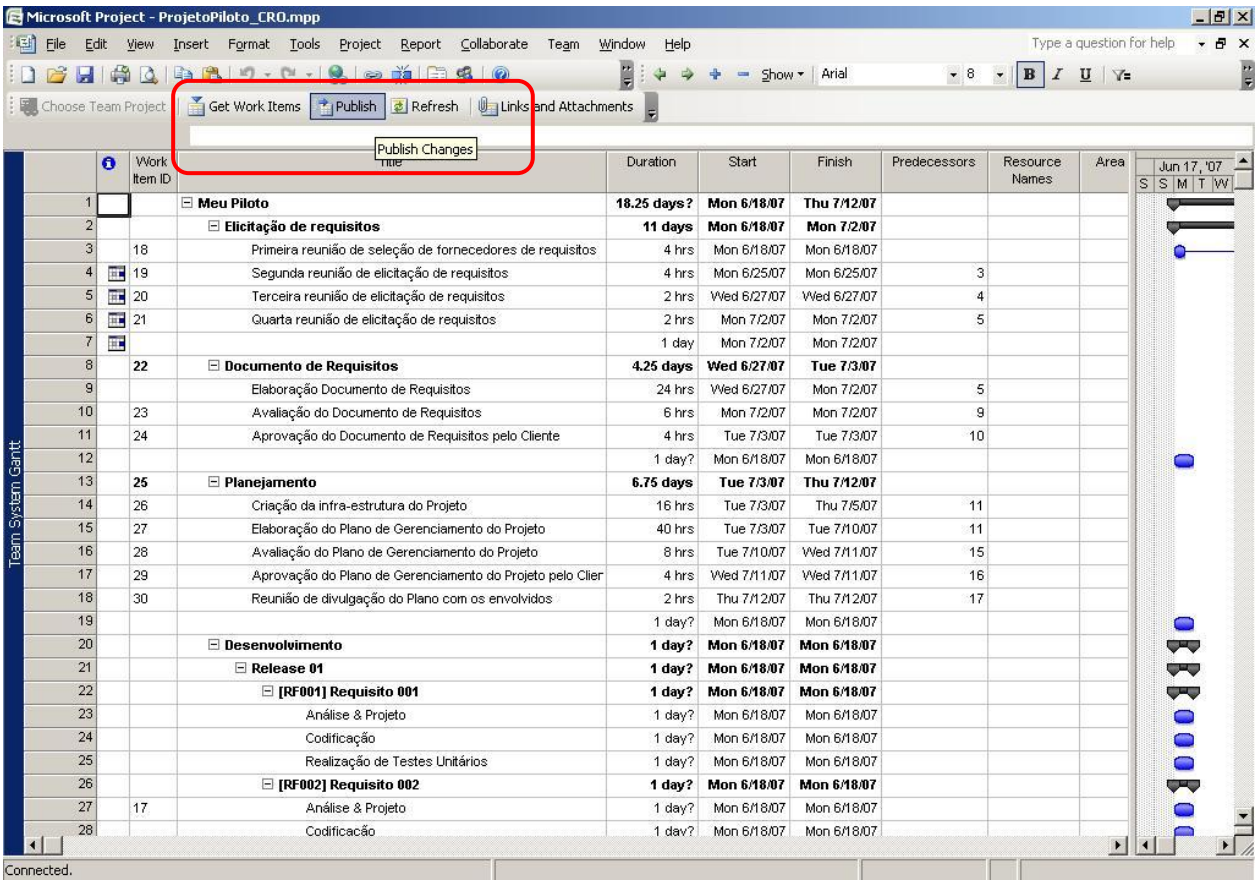


Figure 11 – Team Explorer in MS Project. The "Publish" button allows update to the Team Foundation Server.

Table 22 – VSTS X PP – SP 1.3 Define Project Life Cycle.

Specific Practice: SP 1.3 Define Project Life Cycle
Practice Implementation Indicator (PII)
▪ Project Plan; ▪ Software development process.

Used tools	Found problems
MS Office Word	None
Solution proposed with VSTS	
The project life cycle is predetermined by the software development process of the organization. This life cycle is described in Project Plan. One of the future works of this graduation work is to define inside of VSTS a template with the project life cycle.	

Table 23 – VSTS X PP – SP 1.4 Determine Estimates of Effort and Cost.

Specific Practice: SP 1.4 Determine Estimates of Effort and Cost	
Practice Implementation Indicator (PII)	
▪ Effort Estimate Spreadsheet; ▪ Cost Estimate Spreadsheet; ▪ Project Schedule; ▪ Project Plan.	
Used tools	Found problems
MS Office Excel	None
MS Office Word	None
MS Office Project	Happening the same problem mentioned in previous sub-practice SP 1.2 Establish Estimates of Work Product and Task Attributes.
Solution proposed with VSTS	
For this specific practice, VSTS offers the same solution that in *SP 1.2 Establish Estimates of Work Product and Task Attributes*.	

Specific Goal: SG 2 – Develop a Project Plan

Table 24 – VSTS X PP – SP 2.1 Establish the Budget and Schedule.

Specific Practice: SP 2.1 Establish the Budget and Schedule	
Practice Implementation Indicator (PII)	
▪ Project Schedule; ▪ Quality Team Schedule; ▪ Test Team Schedule; ▪ Project Budget Spreadsheet; ▪ Project Plan.	
Used tools	Found problems
MS Office Project	Happening the same problem mentioned in previous sub-practice SP 1.2 Establish Estimates of Work Product and Task Attributes.
MS Office Excel	None
MS Office Word	None
Solution proposed with VSTS	
VSTS doesn't give support to definition of costs and budget of the project, however all of the work products generated by the project are controlled by a control version system: Team Foundation Version Control.	

Table 25 – VSTS X PP – SP 2.2 Identify Project Risks.

Specific Practice: SP 2.2 Identify Project Risks	
Practice Implementation Indicator (PII)	
▪ Project Risks Spreadsheet; ▪ Project Plan.	
Used tools	Found problems
MS Office Excel	The project risks are listed in a spreadsheet; however they don't have integration with the tool of project management. Therefore, whenever the project is accompanied, it's necessary open the spreadsheet of risks to verify the project risks.
MS Office Word	None
Solution proposed with VSTS	
The Visual Studio Team System offers a communication between MS Excel and Team Foundation Server. This communication is made in the following way: after registering resources in the team project, the project manager elaborates the risks spreadsheet and defines the responsible resources for each one. The manager doesn't need have the Visual Studio installed in his machine, just the Team Explore in MS Excel. After end the list of risks, the manager updates the database of Team Foundation Server and the defined risks are converted in work items of type "Risk" and they are attributed to their respective resources automatically. The monitoring of the risks can be made in Excel and updated for Team Foundation Server. All team members will have access to the updated risks.	

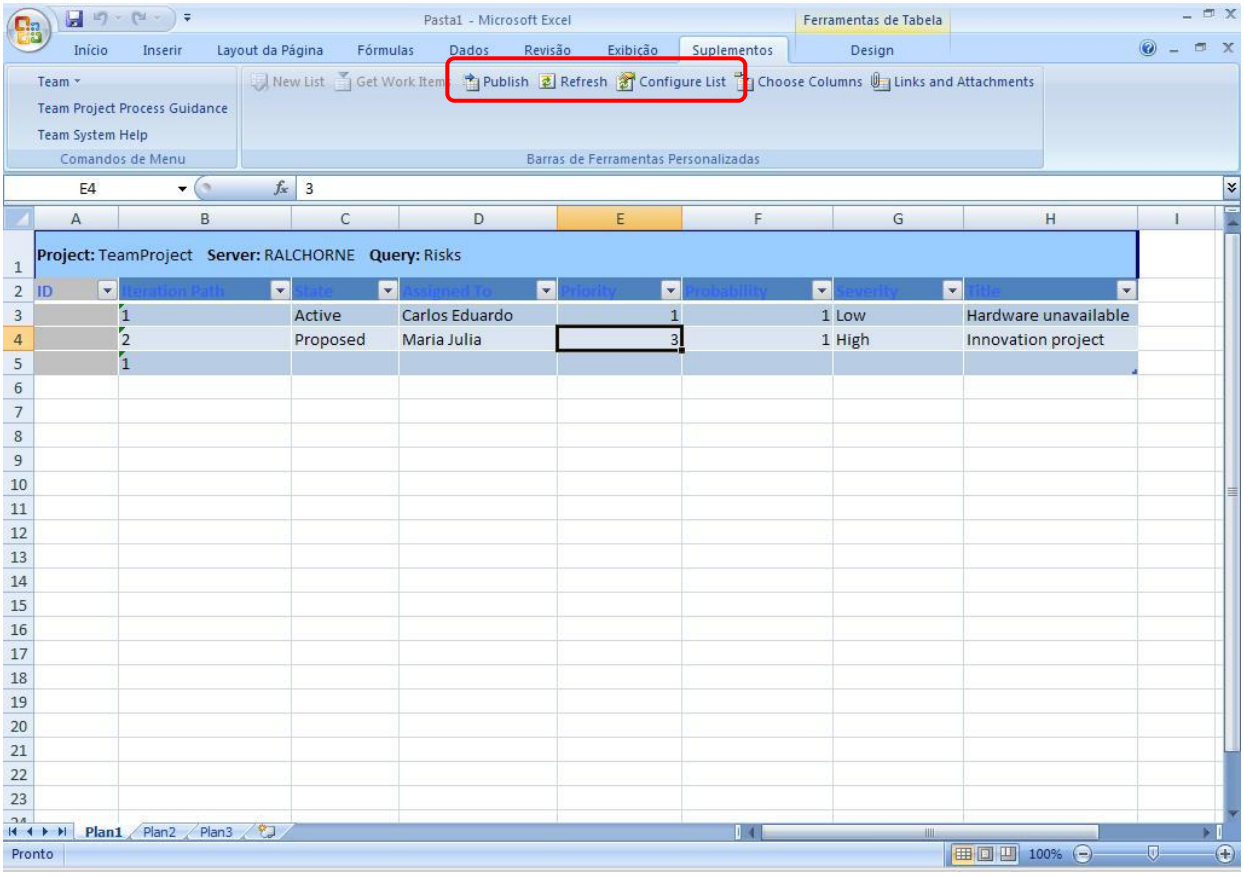


Figure 12 – Excel with a list of project risks and Team Explorer to update the database of Team Foundation Server.

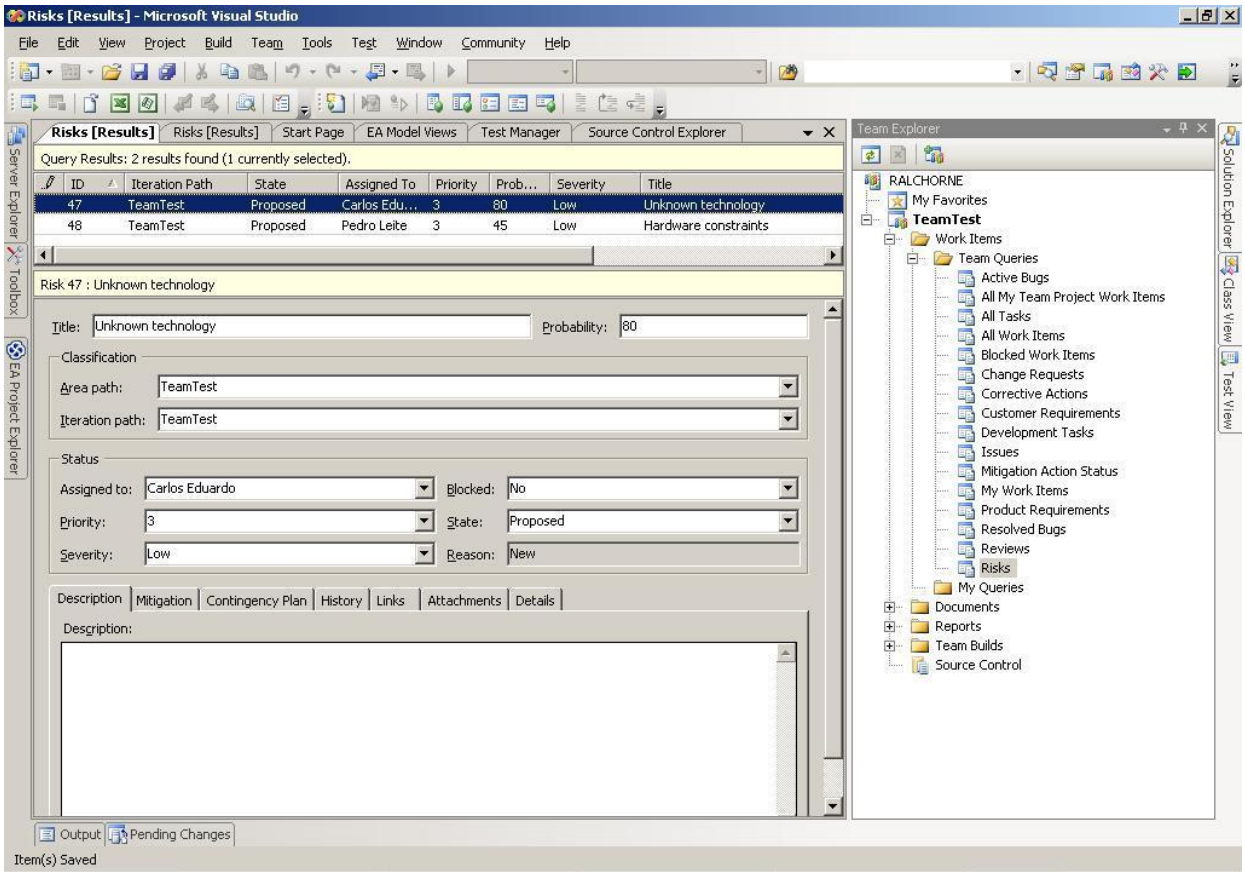


Figure 13 – The risk published from Excel and presented in VSTS.

Table 26 – VSTS X PP – SP 2.3 Plan for Data Management.

Specific Practice: SP 2.3 Plan for Data Management	
Practice Implementation Indicator (PII)	
▪ Configuration Management Guide; ▪ Standardization document; ▪ Project Plan.	
Used tools	Found problems
MS Office Word	None
Solution proposed with VSTS	
The Plan for Data Management is made with MS Word.	

Table 27 – VSTS X PP – SP 2.4 Plan for Project Resources.

Specific Practice: SP 2.4 Plan for Project Resources	
Practice Implementation Indicator (PII)	
▪ Project Plan; ▪ Project Schedule; ▪ Quality Team Schedule; ▪ Test Team Schedule; ▪ Test environment specification.	
Used tools	Found problems
MS Office Word	None
MS Office Excel	None
MS Office Project	None
Solution proposed with VSTS	
The integration between MS Project and the Team Foundation Server allows that the defined tasks in the schedule are seen and updated for the members of the project without need to have access to the MS project, just through Visual Studio or Team Explorer.	

Table 28 – VSTS X PP – SP 2.5 Plan for Needed Knowledge and Skills.

Specific Practice: SP 2.5 Plan for Needed Knowledge and Skills	
Practice Implementation Indicator (PII)	
▪ Document of collaborators' profiles; ▪ Project Plan; ▪ Project Schedule.	
Used tools	Found problems
HTML Editor (Published list of staffing requirements)	None
MS Office Word	None
MS Office Project	None
Solution proposed with VSTS	
The tools and the existent process in the organization to plan for needed knowledge and skills are enough.	

Table 29 – VSTS X PP – SP 2.6 Plan Stakeholder Involvement.

Specific Practice: SP 2.6 Plan Stakeholder Involvement
Practice Implementation Indicator (PII)

▪ Project Plan; ▪ Project Schedule.	
Used tools	Found problems
MS Office Word	None
MS Office Project	Happening the same problem mentioned in previous sub-practice SP 1.2 Establish Estimates of Work Product and Task Attributes.
Solution proposed with VSTS	
The solution proposed by VSTS is the same of SP 1.2 Establish Estimates of Work Product and Task Attributes.	

Table 30 – VSTS X PP – SP 2.7 Establish the Project Plan.

Specific Practice: SP 2.7 Establish the Project Plan	
Practice Implementation Indicator (PII)	
▪ Project Plan; ▪ Project Schedule.	
Used tools	Found problems
MS Office Word	None
MS Office Project	Happening the same problem mentioned in previous sub-practice SP 1.2 Establish Estimates of Work Product and Task Attributes.
Solution proposed with VSTS	
The solution proposed by VSTS for the elaboration of Project Schedule is the same of SP 1.2 Establish Estimates of Work Product and Task Attributes.	

Specific Goal: SG 3 – Obtain Commitment to the Plan

Table 31 – VSTS X PP – SP 3.1 Review Plans That Affect the Project.

Specific Practice: SP 3.1 Review Plans That Affect the Project	
Practice Implementation Indicator (PII)	
▪ Checklist of noncompliance in use case; ▪ Checklist of noncompliance in requirements; ▪ Requirements consistence checklist; ▪ Corrective actions.	
Used tools	Found problems
MS Office Excel	There isn't integration between noncompliance registered in checklists and Mantis (corrective actions).
Mantis Bugtracking	The same problem mentioned earlier.
Solution proposed with VSTS	
The solution for that specific practice is the same idea presented for *SP 1.1 Obtain an Understanding of Requirements* of process area "Requirements Management". VSTS offers customization of their work items. Is possible create a work item to represent the noncompliance found in plans that affect the project. The responsible for analyses the found noncompliance doesn't need have the Visual Studio installed in his machine to report the noncompliance. Through the excel integrated with the	

Team System, the analyst verifies the inconsistencies of the plans that affect the project and through Team Explorer he sends these information to the Team Foundation Server in the database SQL Server 2005. The resources involved in the resolution of the noncompliance will receive a work item with the task to be accomplished. Like this, the checklist of noncompliance could be reported through work items and directly attributed to the responsible for analyzing that noncompliance.

Table 32 – VSTS X PP – SP 3.2 Reconcile Work and Resource Levels.

Specific Practice: SP 3.2 Reconcile Work and Resource Levels	
Practice Implementation Indicator (PII)	
▪ Meeting record (daily, weekly and with the director); ▪ Viability analysis; ▪ Revised schedules; ▪ Revised requirements document.	
Used tools	Found problems
MS Office Project	None
MS Office Word	None
Solution proposed with VSTS	
The revision of the schedules is usually made by the project manager with the MS Project and updated through Team Explorer in Team Foundation Server. The other artifacts produced in this specific practice are maintained in Team Foundation Version Control. The last one will be explained better in the process area Configuration Management.	

Table 33 – VSTS X PP – SP 3.3 Obtain Plan Commitment.

Specific Practice: SP 3.3 Obtain Plan Commitment	
Practice Implementation Indicator (PII)	
▪ Communication; ▪ Meeting record; ▪ Project Plan approved.	
Used tools	Found problems
MS Office Word	None
MS Office Outlook	None
Solution proposed with VSTS	
The process used in the organization for the commitment plan assists the needs of the project.	

Process Area: Project Monitoring and Control

Specific Goal: SG 1 – Monitor Project Against Plan

Table 34 – VSTS X PMC – SP 1.1 Monitor Project Plan Parameters.

Specific Practice: SP 1.1 Monitor Project Plan Parameters
Practice Implementation Indicator (PII)
▪ Meeting record (daily, weekly and with the director); ▪ Project Plan; ▪ Project Schedule; ▪ Project Risks Spreadsheet; ▪ Project Costs Spreadsheet.

Used tools	Found problems
MS Office Project	None
MS Office Word	None
MS Office Excel	None
Solution proposed with VSTS	
The Project Schedule and the Project Risks Spreadsheet can be monitored and updated from the MS Project or MS Excel. These tools can be connected with Team Foundation Server through Team Explorer. Therefore, the user doesn't need to have the whole Team System suite of tools installed in his or her machine. Project monitoring can also be accomplished through Project Portal in Sharepoint, created when the project is conceived in the Visual Studio. In the Portal it's possible to determine all documents that will be made available even for the customer, such as managerial reports, project progress and communication with the project team. New documents, like meeting records, can be inserted through Sharepoint and updated too. The portal access permissions for the project members are made in agreement with the policies of the company. The other artifacts are maintained under the version control system – Team Foundation Version Control, that will be seen in details in the Configuration Management process area.	

Table 35 – VSTS X PMC – SP 1.2 Monitor Commitments.

Specific Practice: SP 1.2 Monitor Commitments	
Practice Implementation Indicator (PII)	
▪ Meeting record (daily, weekly and with the director); ▪ Project Plan.	
Used tools	Found problems
MS Office Word	None
MS Office Outlook	None
Solution proposed with VSTS	
The way used in the organization attends the specific practice and the need of it. The commitments are monitored in agreement with the Project Plan during attendance meetings registered in record meeting.	

Table 36 – VSTS X PMC – SP 1.3 Monitor Project Risks.

Specific Practice: SP 1.3 Monitor Project Risks	
Practice Implementation Indicator (PII)	
▪ Meeting record (daily, weekly and with the director); ▪ Project Risks Spreadsheet.	
Used tools	Found problems
MS Office Word	None
MS Office Excel	The project risks aren't in a tool.
Solution proposed with VSTS	
The risks can be monitored starting from an Excel spreadsheet during the attendance meetings of the project. The integration between Team Foundation Server and Excel allows monitoring the risks registered for the project through Team Explorer in Excel. They can be updated and published again for the rest of the project team.	

Table 37 – VSTS X PMC – SP 1.4 Monitor Data Management.

Specific Practice: SP 1.4 Monitor Data Management	
Practice Implementation Indicator (PII)	
▪ Meeting record (daily, weekly and with the director); ▪ Configuration Management Guide; ▪ Project Plan.	
Used tools	Found problems
MS Office Word	None
Solution proposed with VSTS	
The way used in the organization attends the specific practice and the need of it. The data management is monitored in agreement with the Project Plan during attendance meetings registered in record meeting.	

Table 38 – VSTS X PMC – SP 1.5 Monitor Stakeholder Involvement.

Specific Practice: SP 1.5 Monitor Stakeholder Involvement	
Practice Implementation Indicator (PII)	
▪ Meeting record (daily, weekly and with the director); ▪ Project Schedule; ▪ Issues in Change request tool.	
Used tools	Found problems
MS Office Word	None
MS Office Project	None
Mantis Bugtracking	The issues registered by stakeholders in Mantis don't have integration with management tools (e-mail, for example).
Solution proposed with VSTS	
The stakeholder involvement is monitored through meetings and registered in meeting record. Another form to monitor the stakeholder involvement is through the change request system. As it was mentioned in specific practice of the Planning process area, SP1.3 Manage Requirements Change, can be used the TeamPlain. It allows anybody report issues, bugs and change requests through web application. The TeamPlain is connected to Team Foundation Server and report the work items for the project. This tool serves as interface between the customer and the project team.	

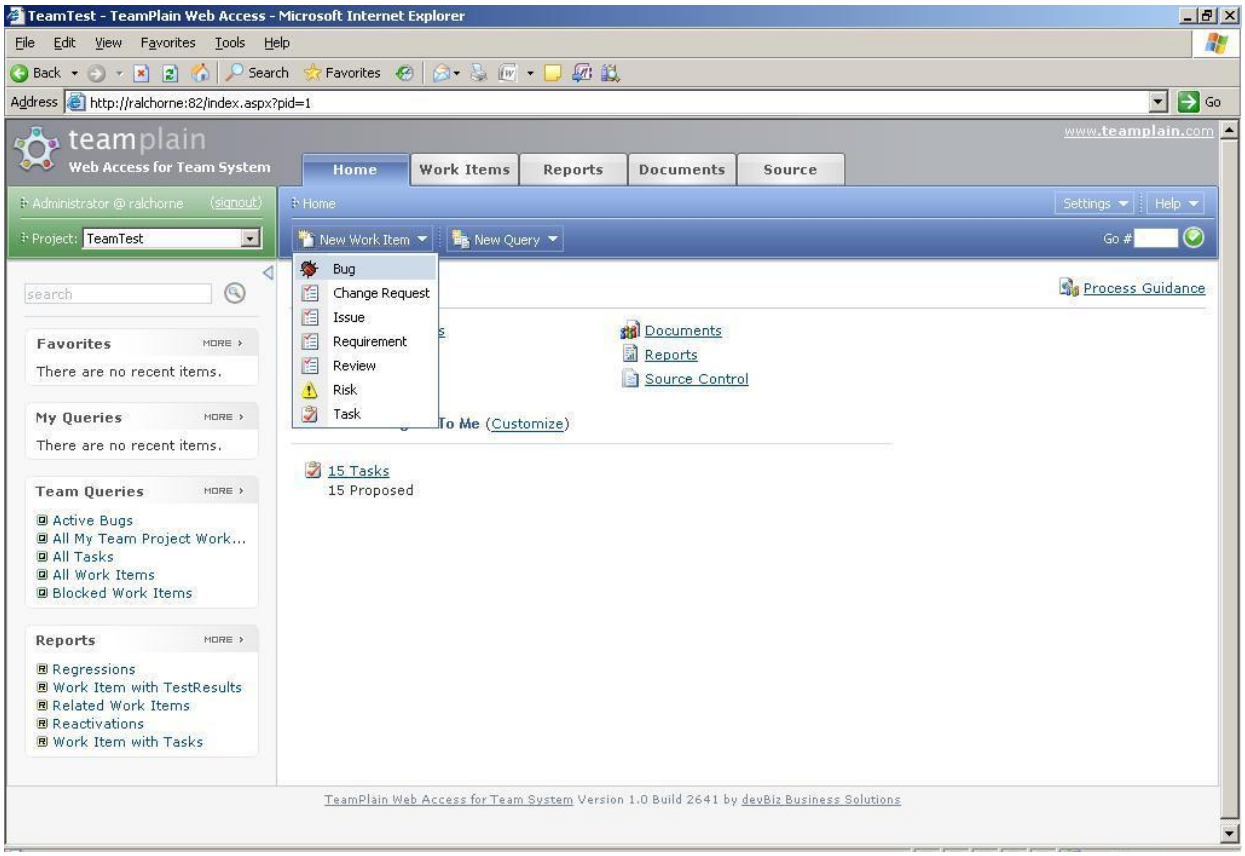


Figure 14 – A new work item created in TeamPlain.

Table 39 – VSTS X PMC – SP 1.6 Conduct Progress Reviews.

Specific Practice: SP 1.6 Conduct Progress Reviews	
Practice Implementation Indicator (PII)	
▪ Meeting record (daily, weekly and with the director) of progress reviews; ▪ Corrective actions; ▪ Project Plan; ▪ Project Schedule; ▪ Measurement spreadsheets.	
Used tools	Found problems
MS Office Word	None
MS Office Project	None
MS Office Excel	To supply the measurements reports, the spreadsheet needs to be fed manually with data to generate the managerial reports. This work is very expensive for the involved teams: project team, quality team and test team.
Mantis bugtracking	The corrective actions identified during the progress reviews of the project are registered and monitored in Mantis. However those corrective actions also enter in the managerial reports and they need to be collected in the mantis and fed in the measurement spreadsheets.
Solution proposed with VSTS	

To conduct rightly the revision of the project it's necessary to have in hands managerial tools that give support to decisions and aid in the corrective actions.
Through Team Foundation Server it's possible to extract information of the project from SQL Server in format of managerial reports. SQL Server acts as an OLAP[38] tool for generation of those reports using Reporting Services.
Visual Studio Team System offers some report templates that involve: Project Velocity, Quality Indicators, Unplanned Work, Bug Rates, Builds, Remaining Work and other.
Besides, Team System allows the customization of reports to assist the specific needs of the organization.
Therefore, the reports can be generated when necessary without great costs and it's easier to conduct project reviews.

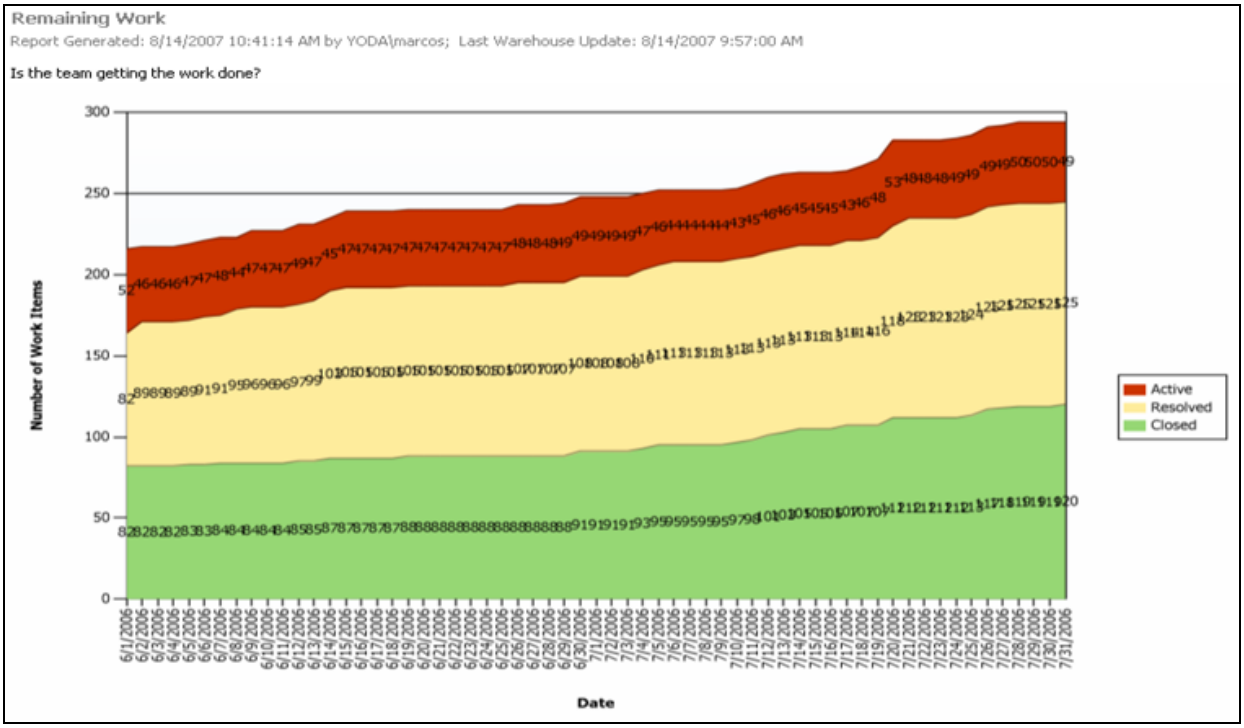


Figure 15 – Remaining work report.

Table 40 – VSTS X PMC – SP 1.7 Conduct Milestones Reviews.

Specific Practice: SP 1.7 Conduct Milestones Reviews	
Practice Implementation Indicator (PII)	
▪ Meeting record (daily, weekly and with the director) of milestones reviews; ▪ Corrective actions; ▪ Project Plan; ▪ Project Schedule; ▪ Project Risks Spreadsheet.	
Used tools	Found problems
MS Office Word	None
MS Office Project	None
MS Office Excel	The project risks aren't in a tool integrated

[38] OLAP – Online Analytical Processing. Available at: http://en.wikipedia.org/wiki/Online_analytical_processing. Site visited in: 08/08/2007.

	with a tool of management project.
Mantis bugtracking	The corrective actions identified during the milestones reviews should be registered and monitored. In mantis there isn't integration with a tool of project management.
Solution proposed with VSTS	
Some of the necessary tools to conduct milestones reviews are the project schedule and the spreadsheet of project risks. As it was already mentioned previously, both artifacts can be revised through independent tools of Team System, such as MS Project and MS Excel. However, these tools should be linked to Team Foundation Server by Team Explorer. The corrective actions identified during milestones review can be reported through the Visual Studio or TeamPlain, already shown previously.	

Specific Goal: SG 2 – Manage Corrective Action to Closure

Table 41 – VSTS X PMC – SP 2.1 Analyze Issues.

Specific Practice: SP 2.1 Analyze Issues	
Practice Implementation Indicator (PII)	
▪ Meeting record (daily, weekly and with the director) with significant deviations; ▪ Issues in Change request tool; ▪ Project Plan.	
Used tools	Found problems
Mantis Bugtracking	The issues of significant deviations are registered in Mantis and there isn't integration between the corrective action and the responsible for it. In other words, there isn't a mechanism in the tool that attributes a task automatically to the resource allocated for it.
MS Office Word	None. In this case, the project plan to guide what type of corrective action will be taken.
Solution proposed with VSTS	
The Visual Studio Team System has work items. Some of them are predefined and other the user can create inside of the tool. One of those work items is classified as "issue". For this specific practice, the issues are registered and stored in Team Foundation Server and they can be analyzed through a spreadsheet excel or even of a report configured by the manager.	

Table 42 – VSTS X PMC – SP 2.2 Take Corrective Action.

Specific Practice: SP 2.2 Take Corrective Action	
Practice Implementation Indicator (PII)	
▪ Corrective Actions; ▪ Project Plan; ▪ User Guide of Corrective Actions System.	
Used tools	Found problems
Mantis Bugtracking	The corrective actions are registered in Mantis and there isn't integration between the corrective action and the responsible for it. In other words, there isn't a mechanism in

	the tool that attributes a task automatically to the resource allocated for this.
MS Office Word	None. In this case, the project plan is to guide what type of corrective action will be taken.
Solution proposed with VSTS	
Nowadays, the organization uses a corrective actions attendance system that works inside of Mantis. That system, however, doesn't have integration to inform a certain action was taken. Besides, the report generated by this tool doesn't assist the real needs of the organization.	

Table 43 – VSTS X PMC – SP 2.3 Manage Corrective Action.

Specific Practice: SP 2.3 Manage Corrective Action	
Practice Implementation Indicator (PII)	
▪ Report of project indicators; ▪ Corrective Actions.	
Used tools	Found problems
Mantis Bugtracking	The tool where is made the monitoring of corrective actions is Mantis.
MS Office Word	The report of indicators shows the status of the corrective actions of a certain project. It's made manually. Integration that allows the report generation and graphs doesn't exist.
Solution proposed with VSTS	
The attendance of the corrective actions can be made by any tools through Team Explorer. With Reporting Services several types of reports can be generated to turn more effective the attendance and analysis of corrective actions.	

Process Area: Measurement and Analysis

Specific Goal: SG 1 – Align Measurement and Analysis Activities

Table 44 – VSTS X MA – SP 1.1 Establish Measurement Objectives.

Specific Practice: SP 1.1 Establish Measurement Objectives	
Practice Implementation Indicator (PII)	
▪ Measurement and Analysis Guide; ▪ Measurement and Analysis Process.	
Used tools	Found problems
MS Office Word	None
Solution proposed with VSTS	
The measurements objectives are documented in a measurement and analysis guide and in the software development process of the organization. VSTS doesn't have an active role in this case.	

Table 45 – VSTS X MA – SP 1.2 Specify Measures.

Specific Practice: SP 1.2 Specify Measures	
Practice Implementation Indicator (PII)	
▪ Measurement and Analysis Guide; ▪ Measurement and Analysis Process; ▪ Project Plan.	
Used tools	Found problems

MS Office Word	None
Solution proposed with VSTS	
The measures are specified in the Measurements and Analysis Guide. In this guide, are defined all the base measures, derived measures and indicators established by the organization. So, the project manager selects the indicators that will be measured for the project and put in on the Project Plan. VSTS doesn't have an active role in this case.	

Table 46 – VSTS X MA – SP 1.3 Specify Data Collection and Storage Procedures.

Specific Practice: SP 1.3 Specify Data Collection and Storage Procedures	
Practice Implementation Indicator (PII)	
▪ Measurement and Analysis Guide; ▪ Measurement and Analysis Process; ▪ Project Plan; ▪ Configuration Plan.	
Used tools	Found problems
MS Office Word	None
Solution proposed with VSTS	
The measures are specified in the Measurements and Analysis Guide. In this guide, for each indicator, it presents the collection form and storage procedures of the data. So, the project manager selects the indicators that will be measured for the project and put in on the Project Plan. The Configuration Plan too has information about data collection and storage procedures. VSTS doesn't have an active role in this case.	

Table 47 – VSTS X MA – SP 1.4 Specify Analysis Procedures.

Specific Practice: SP 1.4 Specify Analysis Procedures	
Practice Implementation Indicator (PII)	
▪ Measurement and Analysis Guide; ▪ Measurement and Analysis Process; ▪ Project Plan; ▪ Configuration Plan.	
Used tools	Found problems
MS Office Word	None
Solution proposed with VSTS	
In the Measurements and Analysis Guide, for each indicator there is an analysis procedure with the objective to determine what kind of decision will be taken. VSTS doesn't have an active role in this case.	

Specific Goal: SG 2 – Provide Measurement Results

Table 48 – VSTS X MA – SP 2.1 Collect Measurement Data.

Specific Practice: SP 2.1 Collect Measurement Data	
Practice Implementation Indicator (PII)	
▪ Project Measurement Spreadsheet; ▪ PPQA Measurement Spreadsheet; ▪ Tests Measurement Spreadsheet.	
Used tools	Found problems
Hours Database of the Project	Database is not connected with measurement spreadsheet.

	It's necessary to collect the data manually directly of the base and to feed the measurement spreadsheet.
MS Office Project	The planned activities (including effort, milestones, requirements volatility) are collected manually from project schedule and fed in the measurement spreadsheet.
Mantis Bugtracking (Change request tool)	Mantis is used to collect noncompliance registered during the process and product audits. Mantis doesn't generate noncompliance report; they are collected manually and fed in the measurement spreadsheet.

Solution proposed with VSTS
The work items of Visual Studio Team System have fields for the information storage along the project. These data are stored in SQL Server. Those data can be collected at any moment during the project and presented in reports through the Reporting Services. Therefore, the updating of the work items allows the data to concentrate on SQL Server base from where are extracted the metrics of the project. It's not more necessary store those data in spreadsheets. So, it's not necessary the replication of data, they are developing along the project. The Visual Studio Team System is widely customizable. It allows create new types of work items in agreement with the project need. In the same way, other types of reports can be created to represent the need of the organization. It's not the objective of this work discuss the customization of work items and reports, however it's treated of a possible theme for future works.

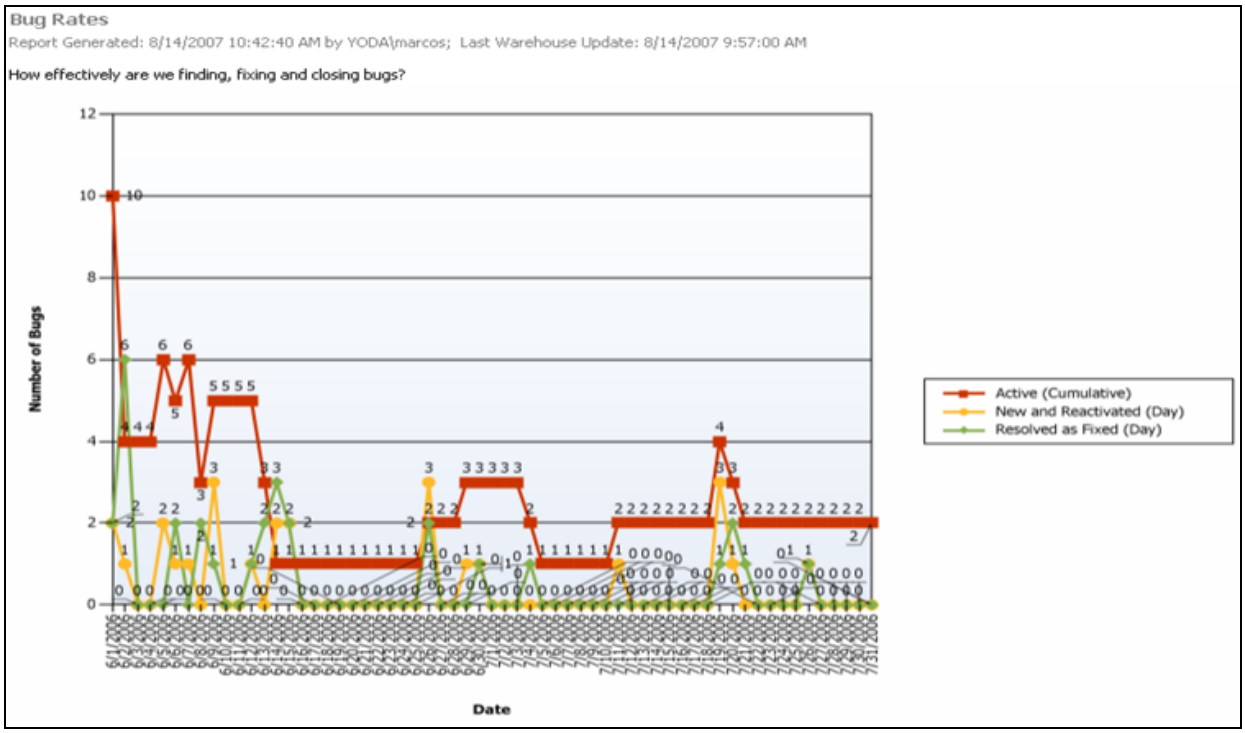


Figure 16 – Bug rates report.

Table 49 – VSTS X MA – SP 2.2 Analyze Measurement Data.

Specific Practice: SP 2.2 Analyze Measurement Data	
Practice Implementation Indicator (PII)	
▪ Project Indicators Report; ▪ Measurement and Analysis Guide.	
Used tools	Found problems
MS Office Excel	There isn't a connection between measurement spreadsheets generated and the Indicators Report. The report is generated manually with obtained information from measurement spreadsheets.
Solution proposed with VSTS	
As it was shown in the previous table, the VSTS generates reports from the data stored in SQL Server. These reports can be accompanied of other important information for the organization related to the project.	

Table 50 – VSTS X MA – SP 2.3 Store Data and Results.

Specific Practice: SP 2.3 Store Data and Results	
Practice Implementation Indicator (PII)	
▪ Project Measurement Spreadsheet; ▪ PPQA Measurement Spreadsheet; ▪ Tests Measurement Spreadsheet; ▪ Project Indicators Report.	
Used tools	Found problems
CVS	Data and Results are stored in project repository (CVS), but there isn't an unified system such as a database that stores these information and allows to the organization seek in just one system for historical data of the company.
Solution proposed with VSTS	
The project data are stored in SQL Server. They can be consulted at any moment, serving as historical data for the project. The storage of project data in a base as SQL Server allows larger safety and structuring of those data for subsequent use. At any moment, new reports can be generated on the stored data. The reports generated are stored in agreement to the Configuration Management Guide. The version control tool used is Team Foundation Version Control integrated with VSTS. This tool will be presented in the process area Configuration Management.	

Table 51 – VSTS X MA – SP 2.4 Communicate Results.

Specific Practice: SP 2.4 Communicate Results	
Practice Implementation Indicator (PII)	
▪ Measurement and Analysis Guide; ▪ Communication (e-mail, meeting record).	
Used tools	Found problems
MS Office Outlook	An e-mail is sent for all involved in the project containing the indicators report elaborated in the Measurement and Analysis

	process. There isn't integration between the automatic elaboration of that report and the propagation of the results. The e-mail is sent manually to each one of those involved.
Solution proposed with VSTS	
The communication of the measurements results can be made through the project portal created in Sharepoint in the beginning of the project. The same report generated from VSTS is made available in the project portal. Through the project portal, the stakeholders can see the reports of the accomplished measurements and also other documents that interest them.	

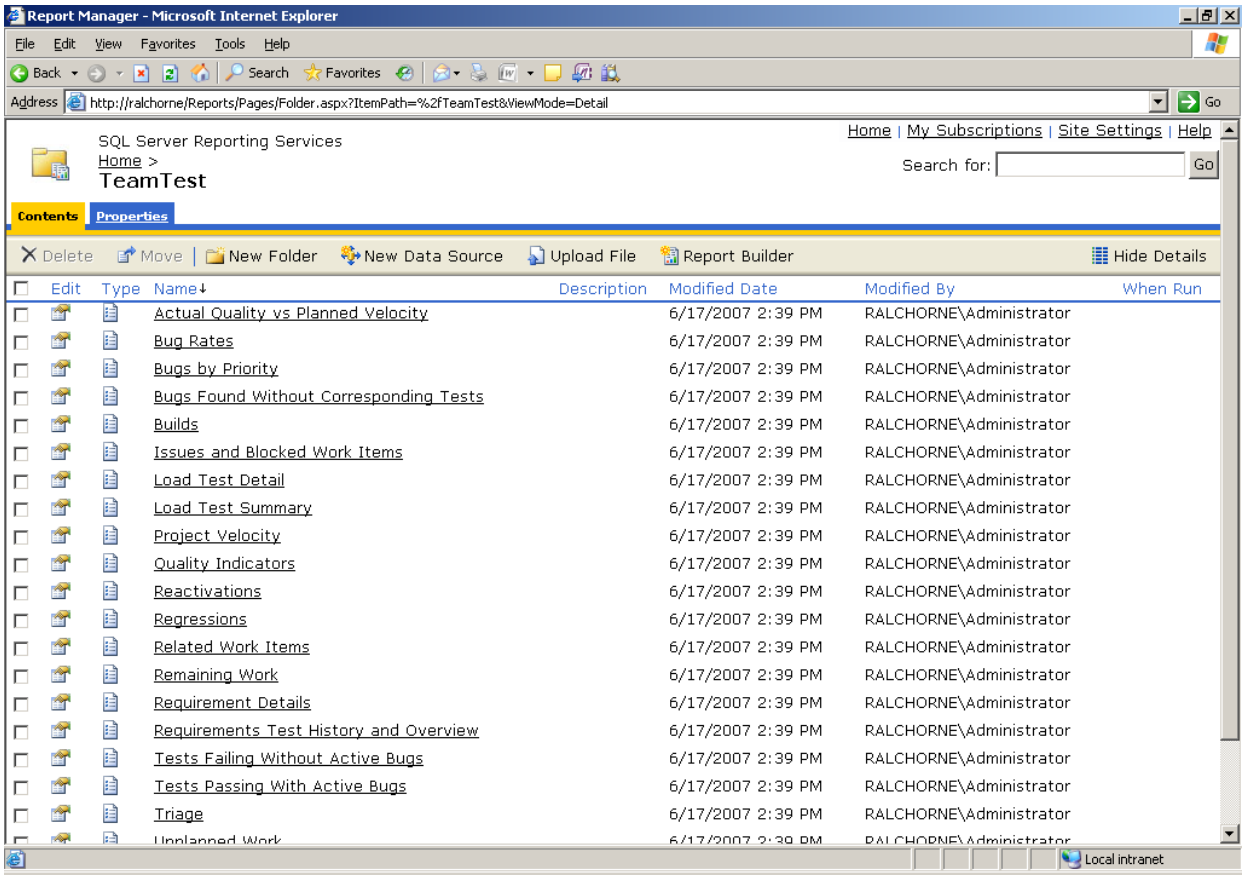


Figure 17 – Reports available through Sharepoint.

Process Area: Process and Product Quality Assurance

Specific Goal: SG 1 – Objectively Evaluate Processes and Work Products

Table 52 – VSTS X PPQA – SP 1.1 Objectively Evaluate Process.

Specific Practice: SP 1.1 Objectively Evaluate Process	
Practice Implementation Indicator (PII)	
▪ Process Evaluation Checklist; ▪ Corrective actions; ▪ Corrective action and noncompliance report.	
Used tools	Found problems

MS Office Excel	Tool used to record noncompliance identified during process audits. The spreadsheet is also used to generate report of corrective action and noncompliance. Once again it happen duplication of information and rework when data are collected starting from the registrations in Mantis for the report.
Mantis Bugtracking (Change request tool)	The noncompliance are recorded in Mantis so that it's possible the subsequent collection of data for the measurements of PPQA. There isn't integration between the Checklist of Process Evaluation and Mantis Bugtracking. It causes reworking and duplication of information.
Solution proposed with VSTS	
The Checklist of Process Evaluation continues being used to guide the SQA. For the process evaluation, a specific type of work item can be created with the fields requested for that evaluation type. However, the registration of the noncompliance and found observations are made directly in VSTS or in TeamPlain (already shown previously). So, it's not necessary that the SQA has the VSTS installed in her or his machine. He/she just needs to have the Team Explorer or the web application TeamPlain. That information is stored in the SQL server and recovered to generate quality metrics for the project.	

Table 53 – VSTS X PPQA – SP 1.2 Objectively Evaluate Work Products and Services.

Specific Practice: SP 1.2 Objectively Evaluate Work Products and Services	
Practice Implementation Indicator (PII)	
▪ Checklist of Product Evaluation; ▪ Corrective actions; ▪ Report Corrective action and noncompliance report.	
Used tools	Found problems
MS Office Excel	Tool used to record noncompliance identified during product audits. The spreadsheet is also used to generate reports of noncompliance and corrective actions. Once again it happen duplication of information and rework when data are collected starting from the registrations in Mantis for the report.
Mantis Bugtracking (Change request tool)	The noncompliance are recorded in Mantis so that it's possible the subsequent collection of data for the measurements of PPQA. There isn't integration between the Checklist of Product Evaluation and Mantis Bugtracking. It causes reworking and duplication of information.
Solution proposed with VSTS	
For the product evaluation, the same idea that process evaluation.	

Specific Goal: SG 2 – Provide Objective Insight

Table 54 – VSTS X PPQA – SP 2.1 Communicate and Ensure Resolution of Noncompliance Issues.

Specific Practice: SP 2.1 Communicate and Ensure Resolution of Noncompliance Issues	
Practice Implementation Indicator (PII)	
▪ Corrective actions; ▪ Quality Plan; ▪ Project Plan; ▪ Project Indicators Report.	
Used tools	Found problems
MS Office Word	The escalate policy of noncompliance is documented in Project Plan and Quality Plan. Results of audits are documented in Project Indicators Report and the corrective actions associated are in Project Plan. Results of audits are documented in Project Indicators Report and the corrective actions associated are in Project Plan.
Mantis Bugtracking (Change request tool)	The noncompliance issues are recorded in Mantis where is possible monitoring them and track to resolution. Monitoring noncompliance is hard because there isn't a system that alerts open noncompliance issues.
Solution proposed with VSTS	
The noncompliance registered in VSTS as a work item is assigned to responsible to resolve the problem. These work items are monitored by the quality team with the objective to ensure the resolution of noncompliance issues. Through escalate policy documented in Project Plan, is possible to assign work items to other project members.	

Table 55 – VSTS X PPQA – SP 2.1 Establish Records.

Specific Practice: SP 2.2 Establish Records	
Practice Implementation Indicator (PII)	
▪ Product/Process Evaluation Checklist; ▪ Corrective actions; ▪ Corrective action and noncompliance report.	
Used tools	Found problems
MS Office Excel	Tool used to record identified noncompliance during product audits. The spreadsheet is also used to generate reports of noncompliance and corrective actions. Once again it happen duplication of information and rework when data are collected starting from the registrations in Mantis for the report.
Mantis Bugtracking (Change request tool)	The noncompliance are recorded in Mantis so that it's possible the subsequent collection of data for the PPQA measurements.

	There isn't integration between the Checklist of Product Evaluation and Mantis Bugtracking. It causes reworking and duplication of information.
CVS	CVS maintain records in the project repository. Some of these records are duplicated in other tools such as Mantis.
Solution proposed with VSTS	
All noncompliance registered in VSTS as work item are stored in SQL Server. Using Reporting Services is possible generate reports about corrective actions and noncompliance situation. These reports are available in Project Portal through the Sharepoint to communicate the results of noncompliance project.	

Process Area: Configuration Management

Specific Goal: SG 1 – Establish Baselines

Table 56 – VSTS X CM – SP 1.1 Identify Configuration Items.

Specific Practice: SP 1.1 Identify Configuration Items	
Practice Implementation Indicator (PII)	
▪ Configuration Management Guide; ▪ Project Plan; ▪ Standardization Document – This document has patterns adopted by organization related with names of documents, structure of the project repository.	
Used tools	Found problems
MS Office Word	None
Solution proposed with VSTS	
The configuration items are identified in Project Plan in agreement to the Configuration Management Guide and Standardization Document of the organization.	

Table 57 – VSTS X CM – SP 1.2 Establish a Configuration Management System.

Specific Practice: SP 1.2 Establish a Configuration Management System	
Practice Implementation Indicator (PII)	
▪ Configuration Management Guide; ▪ Closing baseline spreadsheet; ▪ Change requests; ▪ Recovery disaster document.	
Used tools	Found problems
MS Office Word	None
MS Office Excel	The configuration items are in a spreadsheet called Closing baseline spreadsheet;
Mantis Bugtracking (Change request tool)	There isn't integration among Closing baseline spreadsheet, Mantis and CVS.
CVS	The same problem mentioned earlier.
Solution proposed with VSTS	
The Visual Studio Team System has a version control system called Team Foundation Version Control. The Version Control has a back end SQL Server. It handles tasks such as code branching and merging. It also includes new features such as code shelving, which allows developers to place their unfinished code in the repository without actually checking it in. It also provides different types of locks when checking out files from version control.	

You can decide to not lock the code at all, allow other to check out code but not check in code, or lock other developers from even checking out the code at all.
One of the major features of Team Foundation Server and Team System is that it allows the creation of version-control check-in policies. These policies can warn developers if they are trying to check in code that violates some stated policy. This policies can be defined by an administrator and include roles such as the following:

- The source code must have been reviewed by a senior developer;
- Unit tests most have covered more than 80 percent of the code;
- There are no violations of the corporate naming conventions guidelines;[39]
- The source code must have been compiled.

Table 58 – VSTS X CM – SP 1.3 Create or Release Baselines.

Specific Practice: SP 1.3 Create or Release Baselines	
Practice Implementation Indicator (PII)	
▪ Issue in Change request tool; ▪ Closing baseline spreadsheet; ▪ Configuration items in the configuration management system.	
Used tools	Found problems
Mantis Bugtracking (Change request tool)	There isn't integration among Closing baseline spreadsheet, Mantis and CVS.
MS Office Excel	The configuration items are in a spreadsheet and don't have integration with change request tool (Mantis).
CVS	There isn't integration between Mantis and CVS to make the current set of baselines readily available.
Solution proposed with VSTS	
The Project Manager can use TeamPlain to request the creation or release a baseline. This request will be done through a work item assigned to the Configuration Manager. Using Visual Studio the Configuration Manager creates the baseline applying a label and updates the work item status.	

Specific Goal: SG 2 – Track and Control Changes

Table 59 – VSTS X CM – SP 2.1 Track Change Requests.

Specific Practice: SP 2.1 Track Changes Requests	
Practice Implementation Indicator (PII)	
▪ Change requests in Mantis; ▪ Release Notes document.	
Used tools	Found problems
Mantis Bugtracking (Change request tool)	None
MS Office Word	None
Solution proposed with VSTS	
In Visual Studio Team System there is a work item called "change request". Those requests can be accomplished by the own Visual Studio, by Team Explorer (in case the user doesn't have the Visual Studio installed) or even for TeamPlain (in the case of request done by the customer, for example).	

[39] HUNDHAUSEN, R. Working with Microsoft Visual Studio 2005 Team System, Microsoft Press, 2006, page 131.

The work item is stored in Team Foundation Server. It can be analyzed with any of the tools mentioned.
Every work item created in Visual Studio has a unique identifier. So, it can be tracked until its closing.

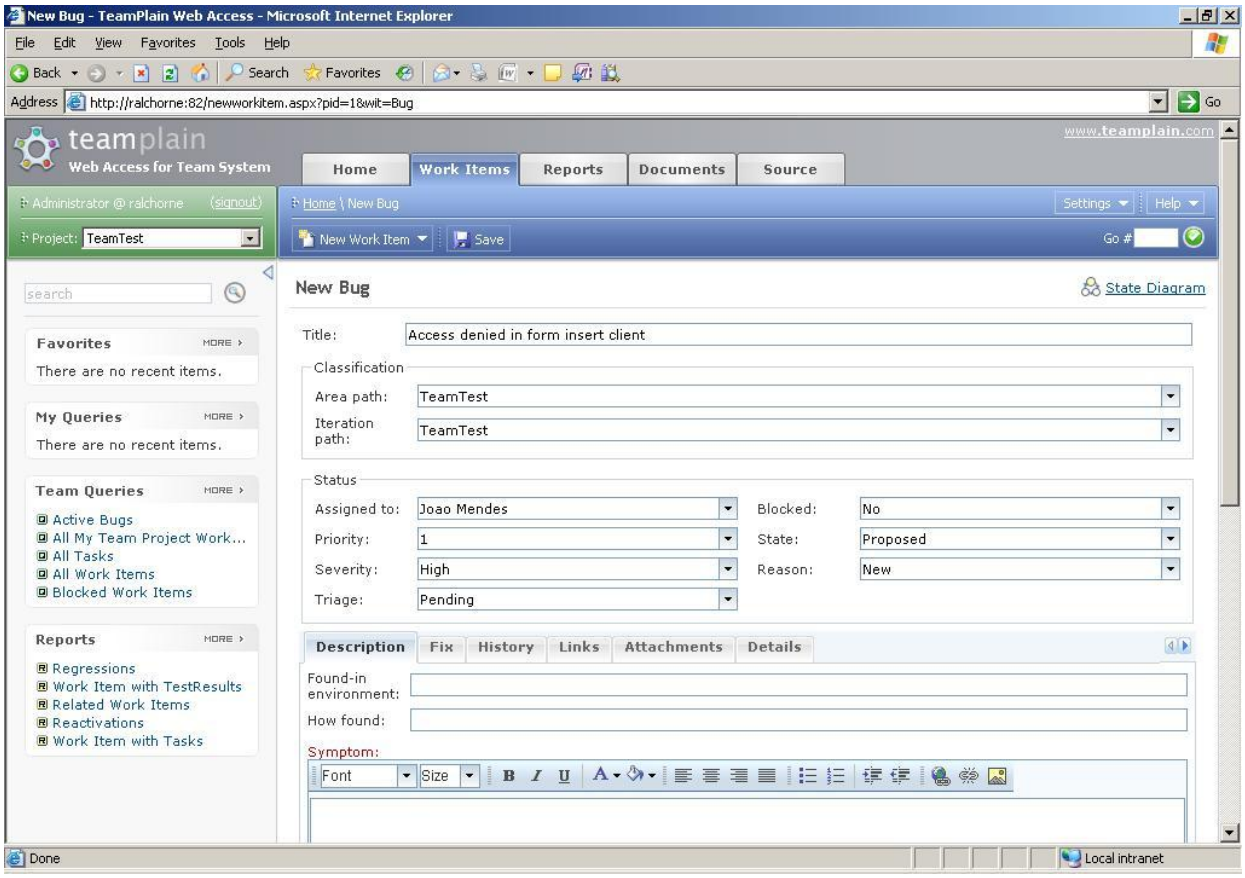


Figure 18 – A bug registered from TeamPlain.

Table 60 – VSTS X CM – SP 2.2 Control Configuration Item.

Specific Practice: SP 2.2 Control Configurations Item	
Practice Implementation Indicator (PII)	
▪ Issues in Change request tool; ▪ Changes record in Mantis; ▪ Change request authorization.	
Used tools	Found problems
Mantis Bugtracking (Change request tool)	None.
CVS	Today there aren't check-in/check-out policies in the Control Version System to correct change incorporation.
Solution proposed with VSTS	
The accomplished change request is analyzed with any of tools mentioned in the previous table. The CCB (Configuration Control Board)[40] analyzes the request in agreement to the Configuration Management Plan of the project. So, if a change request is accepted, it's incorporated by the project. The control configurations item, many times, is translated in check-in and check-out policies.	

[40] Software Engineering Institute, Carnegie Mellon. CMMI Configuration Control Board. Available at: http://www.sei.cmu.edu/cmmi/background/config-control-bd.html. Site visited in: 08/18/2007.

These policies can be defined in Visual Studio Team System for the whole team project.

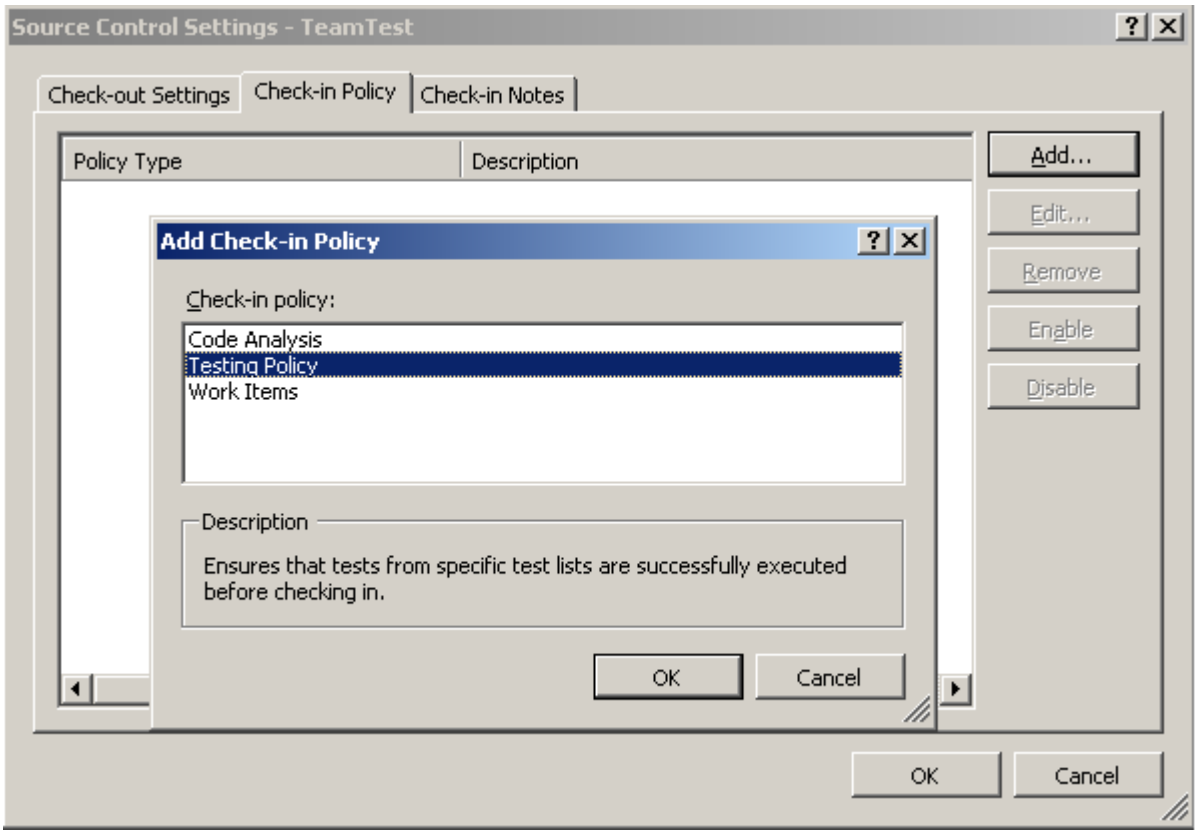


Figure 19 – Adding check-in policy in the Project configuration.

Specific Goal: SG 3 – Establish Integrity

Table 61 – VSTS X CM – SP 3.1 Establish Configuration Management Records.

Specific Practice: SP 3.1 Establish Configuration Management Records	
Practice Implementation Indicator (PII)	
▪ Revision graph of configuration items; ▪ Log of configuration items in CVS; ▪ Issues in Change request tool; ▪ Release Notes document.	
Used tools	Found problems
Mantis Bugtracking (Change request tool)	The configuration management records are maintained in Mantis and also in the CVS, happening duplication of information.
MS Office Word	It's used to create Release Notes document to send to the customer.
CVS	CVS has a graph that shows revisions of configuration items and stores logs. But it isn't integrated with Mantis.
Solution proposed with VSTS	
The configuration management records are stored in Team Foundation Server under	

Version Control management or the Sharepoint website. All work items related with change requests can be quickly recovery.
An important record is the Release Notes document that shows the difference between successive baselines. This document can be found through the Project Portal and it's available for the customers, for example.
The newest baseline version is stored in the Version Control and the previous versions can be recovery to show the differences among them.

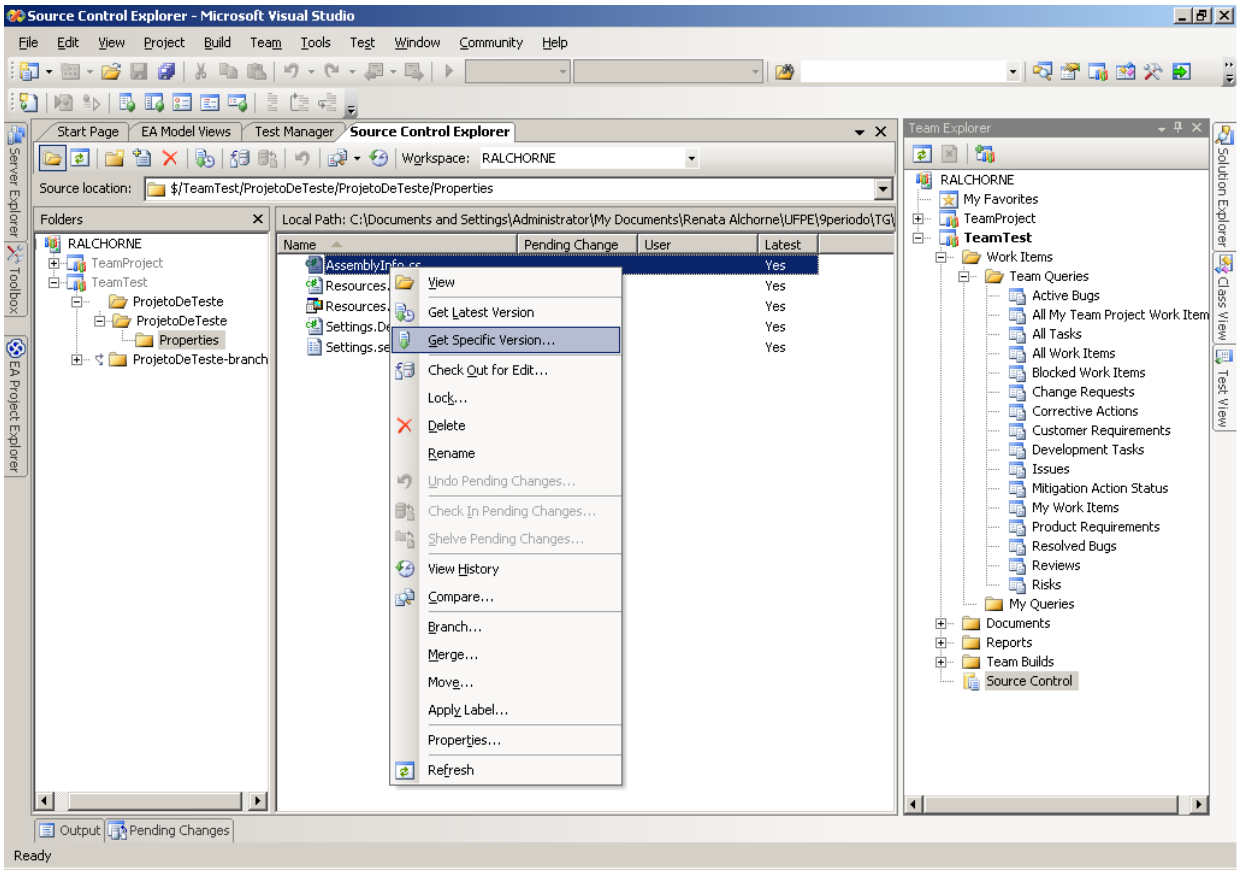


Figure 20 – Getting a specific version of a file in TFVC.

Table 62 – VSTS X CM – SP 3.2 Perform Configurations Audits.

Specific Practice: SP 3.2 Perform Configurations Audits	
Practice Implementation Indicator (PII)	
▪ Closing baseline spreadsheet; ▪ Configuration audit checklist; ▪ Project Plan; ▪ Configuration management guide; ▪ Corrective actions.	
Used tools	Found problems
MS Office Excel	The noncompliance found during the configuration audits are registered in spreadsheet and replied manually as corrective action in Mantis.
Mantis Bugtracking (Change request tool)	The same problem mentioned earlier. It's used to register the noncompliance and

	corrective actions.
MS Office Word	None. The Project Plan and Configuration Management Plan have information to confirm compliance with applicable configuration management standards and procedures.
Solution proposed with VSTS	
The Checklist of Configuration Audit continues being used to guide the Configuration Engineer. For the configuration audit, a specific type of work item can be created with the fields requested for that evaluation type. However, the registration of the noncompliance and found observations are made directly in VSTS or in TeamPlain (showed previously). That information is stored in the SQL server and recovered to generate configuration metrics for the project.	

5. Case Study

This chapter summarizes the results of a simulation that were made with data of a real organization whose characteristics have been presented along this work. This experiment aim to evaluate the effectiveness of the Visual Studio Team System usage in adherent organizations to the maturity model CMMI level 2.

The mainly goal is to show examples of usage of the tool through the functionalities presented in the previous chapters. At this simulation, the real project data used for it won't be exposing because it's private information of the organization. So, the data values presented in next section were modified.

The experiment has been executed with data from an ended project. Section 5.1 explains the scenario, the project phases and the main activities executed in the project. Section 5.2 lists the main points identified along the experiment and shows the obtained results.

5.1 Experiments

The experiment described in the next section included the execution of some phases of the software development life cycle of the organization. However, here it will just be shown the main activities that involve the use of Visual Studio Team System.

The software development process has 5 phases and 4 support areas in agreement with figure 5 of this document. The phases are: Planning, Development, Tests (it won't be covered in this document), Implantation and Closing. The support areas are: Project Monitoring and Control, Process and Product Quality Assurance, Configuration Management and

Measurements and Analysis. Every activity in this process supported by the Visual Studio according section 4 of this document will be shown here.

5.1.1 Experiment

Phase 1: Planning

Activity 1: Create the project repository

Using Team Explorer, the new Team Project is created selecting *MSF for CMMI Proccess Improvement – version 4.0* as the methodology. Version control is configured as well and the Project Portal is automatically created by Team Foundation Server. At this moment the Project Manager sends an e-mail to the entire team letting they know the URL to the Project Portal.

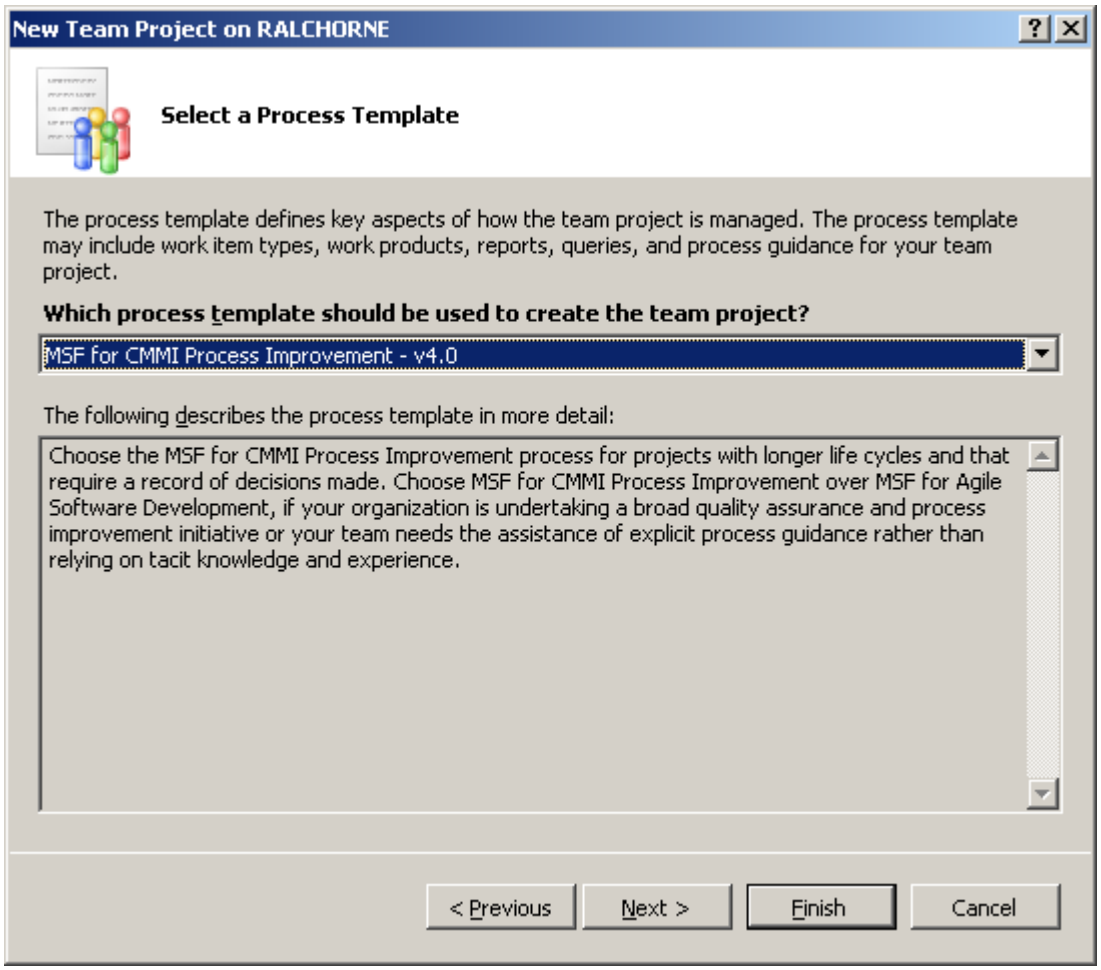
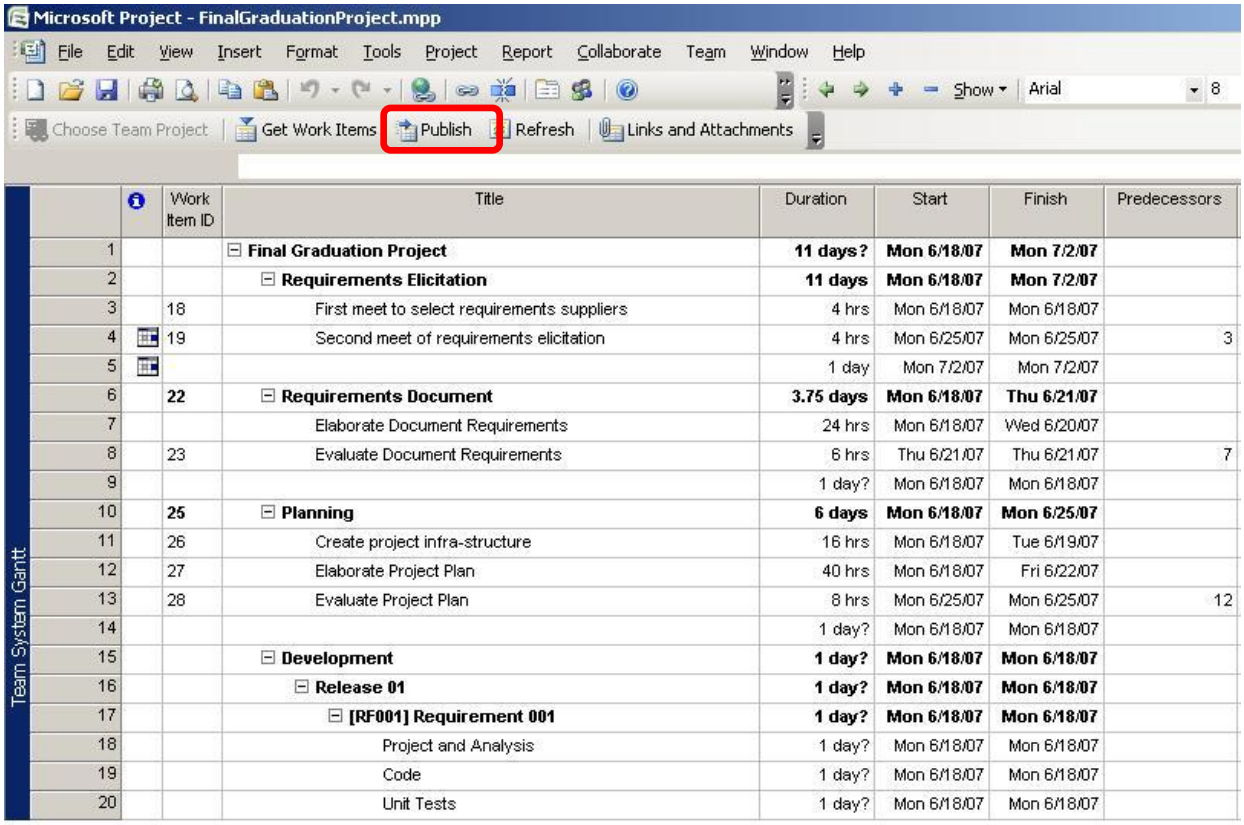


Figure 21 – Choosing the methodology for the new Team Project.

Activity 2: Elaborate the project schedule

The Project Manager uses the Microsoft Project to create the project schedule and each task of the schedule is a work item for Team Foundation Server. After ends the schedule, the Project Manager uses the "Publish" button to create the work item to each task in the schedule.



		Work Item ID	Title	Duration	Start	Finish	Predecessors
1			**Final Graduation Project**	**11 days?**	**Mon 6/18/07**	**Mon 7/2/07**	
2			**Requirements Elicitation**	**11 days**	**Mon 6/18/07**	**Mon 7/2/07**	
3		18	First meet to select requirements suppliers	4 hrs	Mon 6/18/07	Mon 6/18/07	
4		19	Second meet of requirements elicitation	4 hrs	Mon 6/25/07	Mon 6/25/07	3
5				1 day	Mon 7/2/07	Mon 7/2/07	
6		**22**	**Requirements Document**	**3.75 days**	**Mon 6/18/07**	**Thu 6/21/07**	
7			Elaborate Document Requirements	24 hrs	Mon 6/18/07	Wed 6/20/07	
8		23	Evaluate Document Requirements	6 hrs	Thu 6/21/07	Thu 6/21/07	7
9				1 day?	Mon 6/18/07	Mon 6/18/07	
10		**25**	**Planning**	**6 days**	**Mon 6/18/07**	**Mon 6/25/07**	
11		26	Create project infra-structure	16 hrs	Mon 6/18/07	Tue 6/19/07	
12		27	Elaborate Project Plan	40 hrs	Mon 6/18/07	Fri 6/22/07	
13		28	Evaluate Project Plan	8 hrs	Mon 6/25/07	Mon 6/25/07	12
14				1 day?	Mon 6/18/07	Mon 6/18/07	
15			**Development**	**1 day?**	**Mon 6/18/07**	**Mon 6/18/07**	
16			**Release 01**	**1 day?**	**Mon 6/18/07**	**Mon 6/18/07**	
17			**[RF001] Requirement 001**	**1 day?**	**Mon 6/18/07**	**Mon 6/18/07**	
18			Project and Analysis	1 day?	Mon 6/18/07	Mon 6/18/07	
19			Code	1 day?	Mon 6/18/07	Mon 6/18/07	
20			Unit Tests	1 day?	Mon 6/18/07	Mon 6/18/07	

Figure 22 – Project Schedule. The "Publish" button allows updating Team Foundation Server with the defined work items of the schedule.

Activity 3: Identify project risks

Using a Microsoft Excel spreadsheet, the Project Manager lists the risks. This spreadsheet is connected to Team Foundation Server, so each risk creates a risk work item in Team System. Each risk contains attributes such as the resource responsible for this risk.

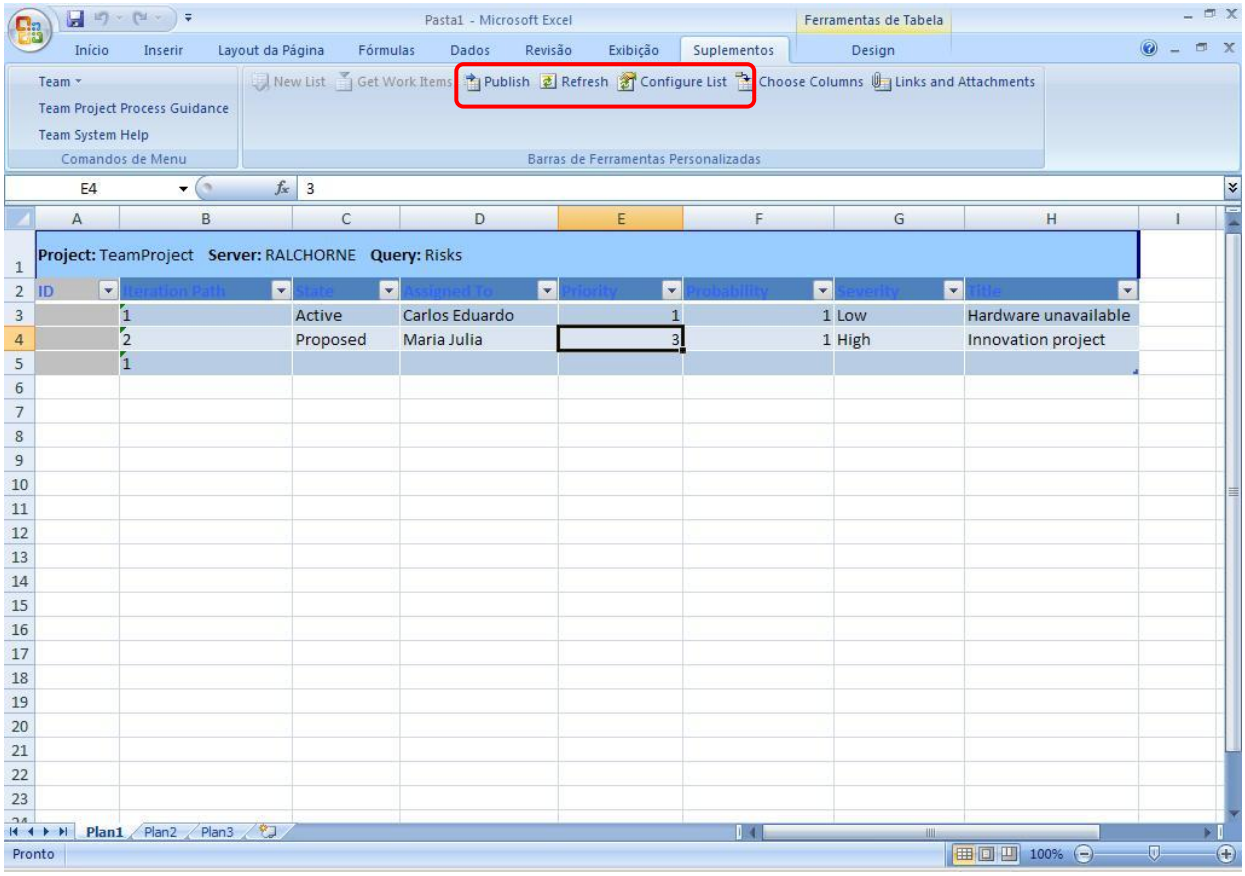


Figure 23 – Project risks spreadsheet.

Phase 2: Development

Activity 1: Deploy

The Configuration Manager establishes the code baseline applying a tag in a project release.

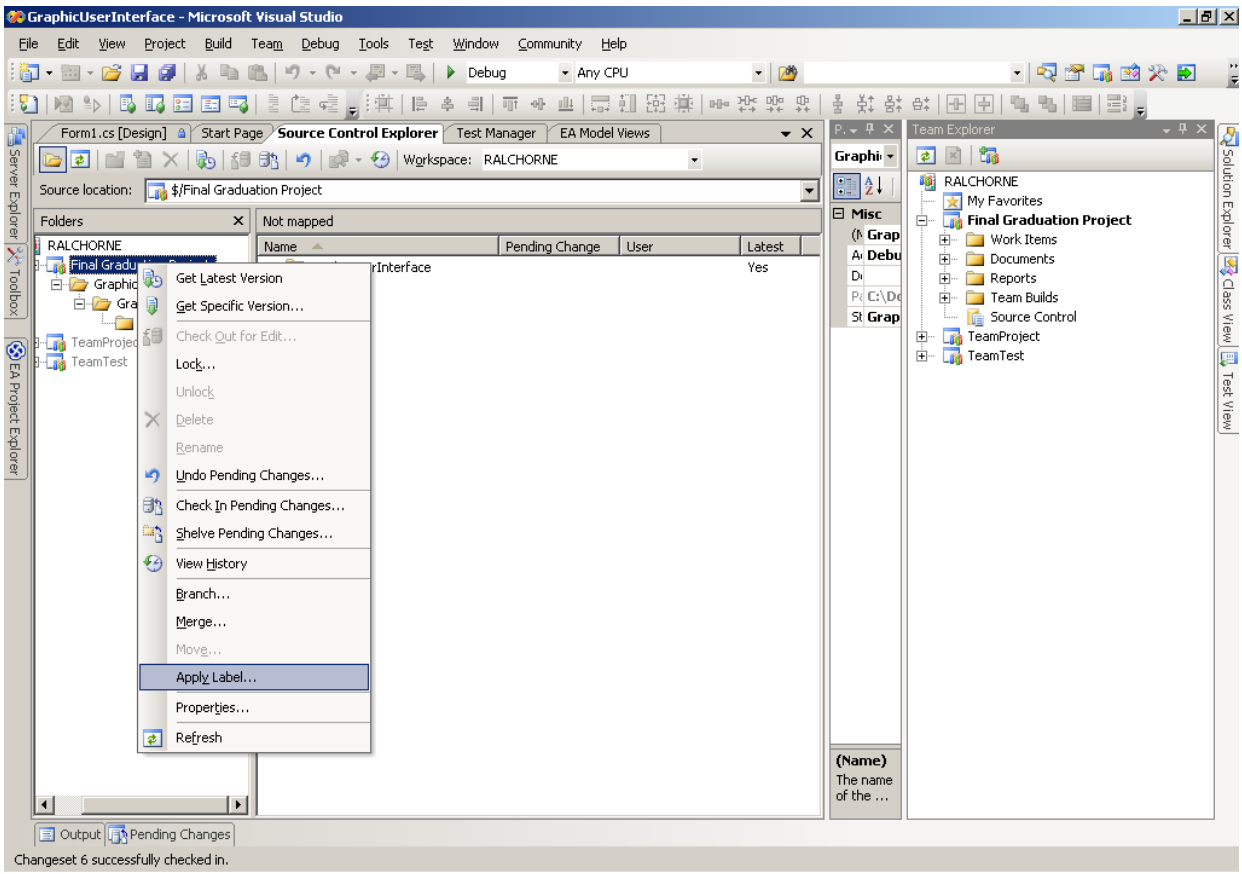


Figure 24 – Applying label in a project source code.

Phase 3: Tests – Not covered in this work

Phase 4: Project Monitoring and Control

Activity 1: Conduct progress reviews with the Director

The Director accesses the project portal and reviews the project progress reports. He uses his internet browser to access the project portal so he doesn't need to have any other tool installed in his machine.

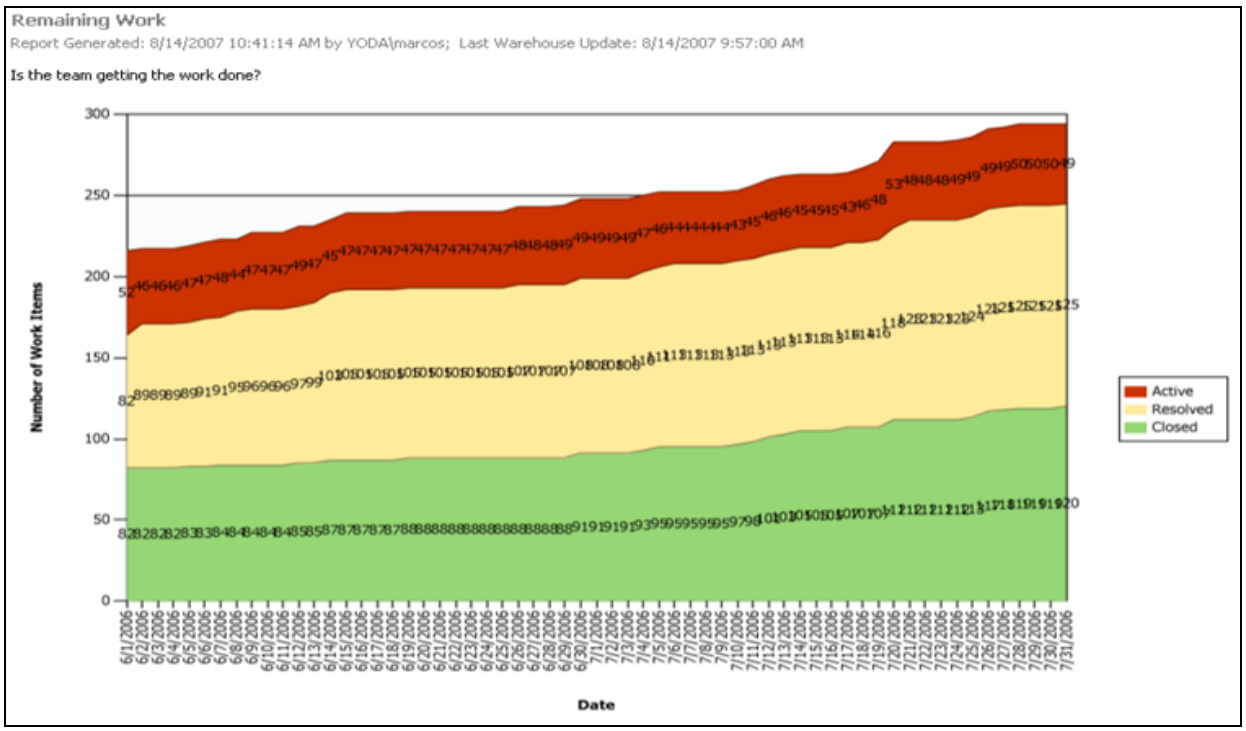


Figure 25 – Remaining Work report accessed through Sharepoint Project Portal.

Phase 5: Process and Product Quality Assurance

Activity 1: Evaluate process

The evaluate process generates results that is presented in a Quality Indicators report.

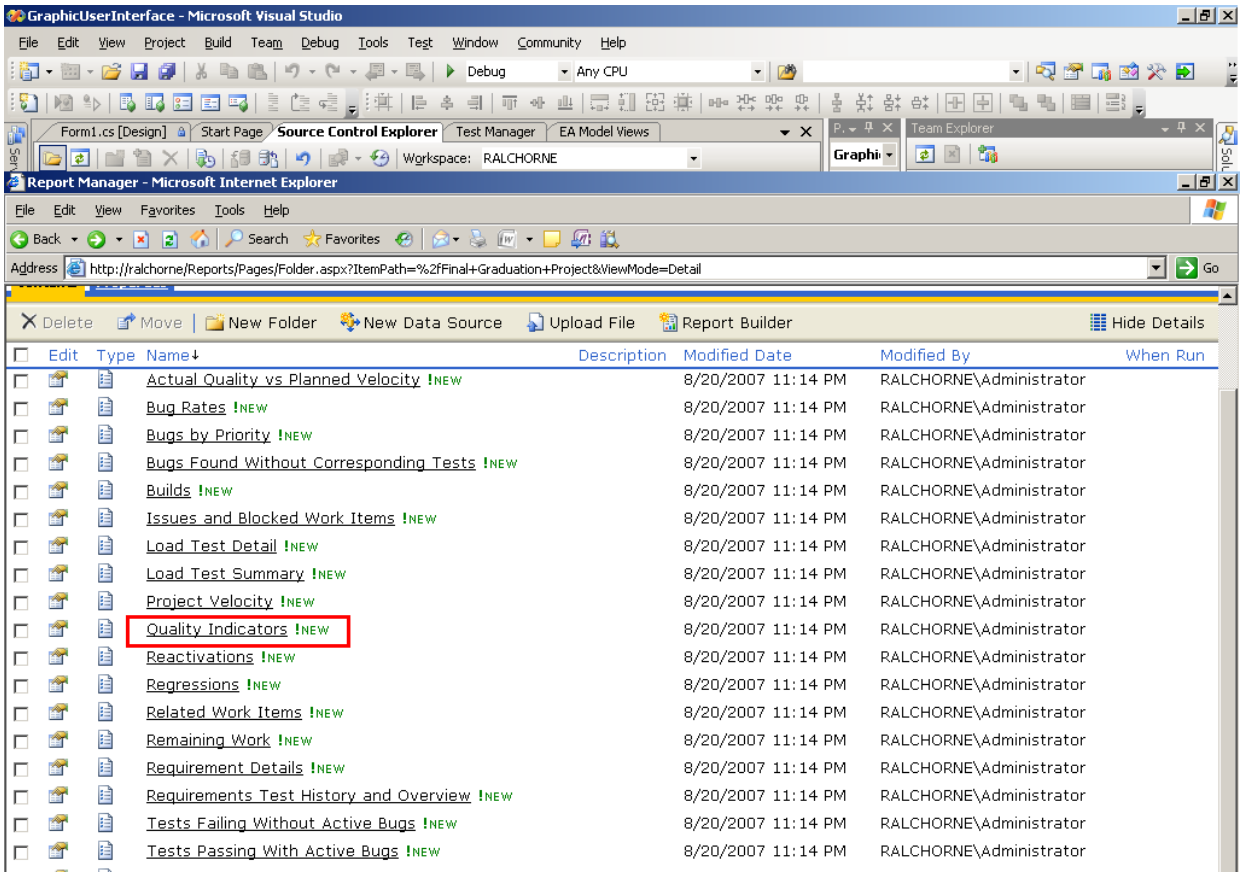


Figure 26 – Accessing the quality indicators report.

5.2 Obtained Results

The simulation has had satisfactory results, because all proposed activities have been done through the Visual Studio Team System, as it was foreseen. It shows the integration level offered by the VSTS.

An experiment is not enough to show what are the real benefits of the VSTS adoption by the organization, however it shows the great performance and communication earnings for the project team.

6. Conclusions

This work presented an approach to use the Visual Studio Team System to support the activities of a software development process adherent to CMMI level 2. This work helps to identify and analyze a way to improve the processes through the communication, collaboration and productivity increase through the use of tools. So, this work has shown that

the use of Microsoft Visual Studio Team System in the proposed scenario is an effective way to achieve the organization goals.

It's important to say that the tools implantation in an organization needs a careful study to decide which scenario the organization is inserted and the best way of using software development process support tools.

6.1 Future Works

This section contains some ideas to improve the VSTS usage in adherent companies to CMMI, not only level 2, but the other levels of this model.

6.1.1 Covering of the highest levels of CMMI

This work has presented a way how Visual Studio Team System can be used in organizations with a software development process adherent to CMMI level 2. However, the tool allows the implementation of the other model levels. Hence, the work demanded to implant this tool inside a company that desires to get the CMMI certificate for the level 2 will make possible the implementation of other maturity levels without reworking.

It's very important to remind, however, that for the highest levels, it can be necessary a larger than usual effort in the tool customization and new support tools to the Visual Studio Team System.

6.1.2 Templates customization

It was not possible to show in this work the templates customization of software development processes by the Visual Studio Team System. However, this tool offers quite simple forms for a programmer of personalizing the tool in agreement with the company processes. In other words, the activities workflow can be defined inside the tool. So, all project team members follow the activities described by the process in the tool.

Besides the definition of the process, other small customizations are offered by Visual Studio, such as to create new types of work items that are more appropriate to the reality of the company, definition of reports through Reporting Services and other.

7. Bibliography

[1] Wikipedia – *"Ferramentas Integradas"*.
Available at: http://pt.wikipedia.org/wiki/Ferramentas_Integradas. Site visited in 5/26/2007.
[2] Wikipedia – *"Computer-aided software engineering"*.
Available at: http://en.wikipedia.org/wiki/Computer-aided_software_engineering. Site visited in 5/26/2007.

[3] CMMI – Capability Maturity Model Integration. Available at: http://www.sei.cmu.edu/cmmi/. Site visited in 5/16/2007.

[4] ISO – International Organization for Standardization. Available at: http://www.iso.org/iso/en/ISOOnline.frontpage. Site visited in 5/26/2007.

[5] Visual Studio Team System official site. Available at: http://msdn.microsoft.com/vstudio/teamsystem. Site visited in 05/16/2007.

[6] Visual Studio 2005 official site. Available at: http://msdn2.microsoft.com/en-us/vstudio/default.aspx. Site visited in 05/16/2007.

[7] Express Computer. India's No.1 IT Business Weekly. *"Software and Systems firms embrace CMMI"*. Available at: http://www.expresscomputeronline.com/20030310/indtrend1.shtml. Site visited in 05/26/2007.

[8] QAI - Quality Assurance Institute – Facilitating 'Operational Excellence'. Available at: http://www.qaiindia.com/. Site visited in 05/29/2007.

[9] SeaSpin – Seatle, Eastside Area Software Process Improvement Network. VU, John D., Senior Scientist,"CMMI Around the World", May 15, 2006, Carnegie Mellon University. Available at: http://seaspin.org/files/folders/2006presents/entry21.aspx. Site visited in 05/26/2007.

[10] BERK, J.; BERK, S. Administração da qualidade total: o aperfeiçoamento

contínuo. São Paulo: IBRASA, 1997.

[11] Software Engineering Institute – ISO/IEC 15504. Available at: http://www.sei.cmu.edu/cmmi/faq/15504-faq.html. Site visited in: 06/24/2007.

[12] CHRISSIS, M.B.; KONRAD, M.; SHRUM, S. CMMI, Guidelines for Process Integration and Product Improvement, Addison Wesley, February 21, 2003.

[13] Sparx Systems – MDG Integration for Visual Studio 2005. Available at: http://www.sparxsystems.com.au/products/mdg_integrate.html. Site visited in: 08/04/2007.

[14] Team Plain Web Access for Team System. Available at: http://www.devbiz.com/teamplain/webaccess/default.aspx. Site visited in: 08/05/2007.

[15] OLAP – Online Analytical Processing. Available at: http://en.wikipedia.org/wiki/Online_analytical_processing. Site visited in: 08/08/2007.

[16] Software Engineering Institute, Carnegie Mellon. CMMI Configuration Control Board. Available at: http://www.sei.cmu.edu/cmmi/background/config-control-bd.html. Site visited in: 08/18/2007.

[17] HUNDHAUSEN, R. Working with Microsoft Visual Studio 2005 Team System, Microsoft Press, 2006.