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Configuration Management Improvement

Stream-overview generator

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ABSTRACT

Context: Configuration management is one of the important support processes within IT. Configuration management is involved in IT phases such as design, development, test and deployment.

Stream overview as an important document for communication with teams; it helps people to determining the project strategy. Stream overview generator can play an important role in configuration management.

Objective: This thesis will identify the gap in configuration management. The master thesis project consists of finding a solution to visualize and maintain project stream overview. The research report is valuable to people involved in configuration management who want to improve the work process.

Method: Concerning the configuration management in real industry, the research study has been carried out with case study methodology. This thesis was performed at the IXR (Interventional X-Ray) department in Philips healthcare.

Results: The necessary visual elements are defined, and the stream overview generator was created based on the research results. The stream overview generator allows configuration managers to create and maintain the stream overview.

Conclusion: The stream overviews for planning propose is essential to have a good solution.The proposed model of stream overview generator shows how to deal with the issues on planning and maintaining the stream overview in the configuration management process.

Key words: configuration management, visualize, stream overview, parallel project,

Contents

Preface

This master thesis project was initiated from Philips Healthcare, Best (Netherlands).It has been a privilege for me to do my final thesis in Philips Healthcare, Netherlands, which has given me a good insight of the work at a global organization.

This study consists of investigation into stream views in configuration management, analyzing requirements, designing and building the support tools. The research was carried with in DCM (development configuration management) Group at the IXR (Interventional X-Ray) department in Philips healthcare from October 2009 to March 2010 by a master student at Department of Applied Information Technology, University of Gothenburg.

This part of the project has been carried out with Pascal van Kempen as company mentor and Alan B. Carlson as academic supervisor. I would like to thank all the DCM group members. Especial thanks my mentor at Philips healthcare, Pascal van Kempen for his support and for giving me the opportunity to work in this challenging project. I would also like to thank my Program manager Miroslaw Staron, Thesis course coordinator: Kari Wahll and university supervisor Alan B. Carlson who gave me many helps. I couldn't spend my fantastic 6 months in Netherlands without them. I also acknowledge Alan B. Carlson for valuable comments on this paper.

It should be noted that the study could never have been conducted without the interviews with members in IXR (Interventional X-Ray) department. I would Special thanks: Sander Mathijssen, Roel Kersten, Mark de bont in DCM group and some other group members such as Alex Visser, and Aleksander Slusarczyk who always response my survey in time.

Finally, I would like to thank my family and my friends for their encouragement and support.

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Jie Ma

1 Introduction

1.1 Background

Configuration management has been adapted in industry for many years. Good configuration management strategy helps the development team work effectively. Configuration management tools and the way of interaction influence the efficiency of group working. (Desai N et al, 2005)

Configuration management has a number of facets, for management aspects, P Feiler and G Downey (1990) classified into:

- Change management: initiation, evaluation, and approval of change through mechanisms of change requests and change control boards.
- Release management: identification and packaging of releases, tracking of customer installations, relating problem reports and fixes to releases.
- Corporate product management: identification and tracking of product spectrum; impact analysis of new or upgraded products and components on spectrum.
- Contract development management: identification and tracking of deliverables in contracted software development.
- Acquisition management: acquisition of off-the-shelf products and their upgrades from multiple vendors.

When many projects are running in parallel, relations of all the projects can be massive, such as milestones, integration-points. A number of software has employed in industry for supporting the parallel project now days. In order to co-ordination and synchronization of the working teams, many project stream views are produced.

Brad (et al.1998) introduced the configuration management patterns for managing branching in parallel development projects. By presenting branching and merging patterns for decomposing a project's work flow into separate lines of development, Stream overview present the graphical view to help configuration manager to handle the branches and tags. (See figure 1.1)

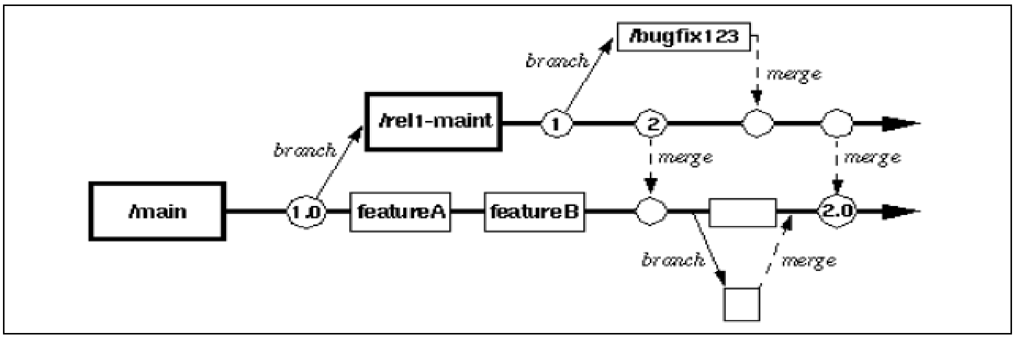


Figure 1.1 A sample of stream view diagram (Appleton et al. 1998).

The originating branch is called the parent branch, the upstream branch which maintained by different organizations or individuals, or the backing stream. Child branches are branches that have a parent; a branch without a parent is referred to as the trunk or the mainline.

Maintaining all these projects stream views is a big challenge. Some tools such as Microsoft Project, Visio, Excel and PowerPoint can present the project overview in graphical way, which can support the configuration managers for interacting and managing with development team. However, these tools have limitations to maintain the overview of projects over a long period of time. “We tried to find a tool to generate stream overview for planning purpose, but we didn’t find any good solution” said a configuration manager from Philips healthcare, “I also worked for Ericsson before, and absolutely they have the quite similar problem”.

A good interaction between the developers and configuration manager is one of the key factors to build the successful software. Examples of interaction include plans, and standard operating procedures. These mechanisms supplement forms of social interaction like e-mail, video conferencing, and other forms of communication (Grinter RE, 1995). Information visualization technology in configuration management can support development team members in communication, since the graphical presentation of the project overview is easier to be understood. For the configuration management group, Configuration managers need to make adjustments to project overviews regarding every change in project process. The project overview keeps the project configuration process on track. Thus, the solution for Visualized project overview should easily allow configuration managers to make changes, delete parts, and propagate.

1.2 Problem statement and Purpose

A complex system projects typically involve many people for many sub projects. Each development teams work on different sub projects, merge and integration will happen until a suitable development milestone. As a key parts of the parallel development process, configuration management provides consistency by recording and identifying all changes. By visualizing projects overviews, people can track and identify versions in each project. Different people need different projects overviews: from high level to detailed level. The development team members work at different rates and on different tasks with the CM system supporting. Many of CM systems such as IBM Clearcase supports the creation of a numbers of independent views. (IBM info center), however, many CM tools do not directly address stream overview for planning purpose. (See chapter 3.4 and chapter 5.3)

In order to having the project stream view for planning purpose, the configuration manger begins to draw the views by themselves. Project stream overviews are usually represented in a graphical way by some tools such as Visio, PowerPoint and Excel. When the relations are changed or new projects are added, maintaining these graphical overviews is very labor-intensive. “In worst case, a complete redesign of the drawing is required. “ said by a configuration manager in Philips Healthcare.

The research question that is addressed in this thesis project is:

"How the stream overview can be automatically generated for planning purpose in configuration management?"

The master thesis project consists of finding a solution to visualize project stream overview automatically, and to maintain project stream overview without too much manual work. During the case study in Philips healthcare, I have interviewed people to collect requirements, made a design and implemented a tool for stream-overview.

1.3 Structure of this Report

This thesis is divided into 5 chapters. Chapter 1 is the background and focal area of this study. The scope of the research was identified. In Chapter 2, by describing research objective, the research questions and the research method, the boundaries of this research is determined. Chapter 3 presents the theoretical context in configuration management. I introduce the configuration management concept, and raise the concern of visualization information in configuration management. I also bring up some issues regarding the current tools for visualizing project stream overviews. Chapter 4 describes "Stream-overview generator" project as a case study in Philips healthcare. The limitations of the tools give the implications to the new design of the stream overview tool. Chapter 5 is the evaluation for the stream overview generator. Chapter 6 is discussion about this study. Chapter 7 summarizes this study, gets conclusions from the research.

2 Research Framework

2.1 Research objective

This research consists of finding the solution to improve the configuration management by visualizing stream overview. The solution should make configuration manager create and maintain stream overview easily and comfortable—by entering or editing data attributes such as milestones, start- and endpoints of merge arrows, stream-hierarchy, the tool can generate or regenerate the drawing. A central part of the work with this paper is to explore the solution to visualize and maintain the stream overview within configuration management. The main contribution is made to address the inefficiency of the current tool for visualize and maintain the stream overview, additionally, provide a model of stream overview generator for implementation.

2.2 Research Approach

This research study has been carried out with case study methodology. A case study approach is motivated by the problem which I need to solve in this study. Case study method is an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used. (Yin,Robert K 1994)

Case studies can be single or multiple-case designs. I use the single case study. First, as the step one I searched for existing tools for visualization techniques which can be used in project stream overviews. I investigated which visual solution is more adaptable in configuration management. Since the complexity of variables in the configuration management process; many tools can not elaborate all the aspects of the configuration management (Chapter 3.4). The limitation for the current technology directly gave many implications for the new model design. (Chapter 4.2)

Secondly, the case study is conducted. The case study is based on the experience in data collection (chapter 2.4). I continue to collect requirements from the industry, design a stream overview generator model and implement a tool for visualizing and maintaining the project stream view. In the end, the evaluation is done through interviews. The evaluation results could lead the further research in stream overview solution.

2.3 Data collection and Analysis

<u>Several sources of data</u>

Using more than one source of data to the investigation of a research question enhance confidence in the findings. To understand configuration management, literature review plus an empirical study has been done, meanwhile all kinds of diagrams and document for configuration management have been collected. Literature review helps to understand the context from both industrial and academic point of view.

To identify and localize relevant elements in configuration management, resource for data collection approach of the empirical research study mainly consists of:

- The company documentation includes drawings of project stream overview, presentations and some informal material
- Academic Papers, journals and books about configuration management and visualization technology.
- Discussions with the company members. Studying the existing problem and requirements in project overview.
- Questionnaire and interview. The questionnaire and interview was conducted in English.

My research strategy for visualizing project stream overview in configuration management is to look at the numbers of different problems. I have to keep in mind in this study with questions “Who, what, how, when, why”. Following questions are the guide line to design the questionnaire and interview:

- “Who”: Who is involved in configuration management and wants to use project stream overview?
- “What”: What information needs to be presented in project stream overview?
- “How”: How to present and maintain the data in project stream overview?
- “When”: When the project stream overview is needed?
- “Why”: Why is the visualized information in configuration management important?

Answering the questions mentioned above is critical to the solution of visualizing project stream overview. The answer to these questions are found in Literature review and the discussions with the people who are using the stream overview.

Questionnaires

Two questionnaires are used in the research. Firstly, a questionnaire (see Appendix 1) has been used to collect information to understand the current circumstances at the company and identify the issues in the stream overview. Secondly, another questionnaire (see Appendix 2) has been sent out to evaluate the new stream overview generator. The topics and the questions in the questionnaire were built up based on the research questions. There are both open questions and closed questions. I took some types of diagram applications as examples to guide the interviewee. The examples makes easier to connect their experience to answer the questions. Interviewees are able to think in same direction within the theme.

Interviews

Several interviews were arranged to collect information. The purpose of using interviews in empirical studies is often to collect data about phenomena that cannot be obtained using quantitative measures. (Hove SE, Anda B, 2005)

The selection of interviewees has been done based on the roles who are directly or closely involved in configuration management. The following roles are considered to be most relevant to project overview. (See table 2.1 Roles and Responsibilities.)They are system architects, system integrators, build managers and librarian (configuration managers). They usually have regular meetings to discuss the running projects, plan the next phase for software integrity and keep the traceability of the whole system.

Table 2.1 Roles and responsibilities

role	responsibility
System Architect	High-level designer for system structure, they define features and elements.
System Integrator	They are mainly focus on system integration. They make sure all the subsystems work well with system.
Librarian (configuration management group)	They handle the configuration items registered in the database they make sure the changes in projects are correct.
Build manager (configuration management group)	They manage the general release of projects, Oversee ongoing maintenance of software, scripts, and release transitions

The interviews were conducted in English. Two system architects, one system integrator, one build manager and two librarians participated in the interviews. All interviews were face to face, during the interview process, the notes have been taken for analyzing.

Semi-structured interviews are frequently used as a data collection technique within the field of software engineering (Hove SE, Anda B, 2005). The semi-structured approach is used for the interviews in this research. This approach has been chosen in order to gain some unforeseen answers besides the well controlled structure. I was able to get the information, which I initially look for solutions to improvement in the stream overview. The meetings with groups of people gave me the insight of their work situation, which is important to identify the problem in the project stream view.

3 Visualizing Configuration Management

3.1 Development management in the past

In the beginning of software development, in the era that there were hardly any sophisticated CM systems to support software development, projects run in serial.

The configuration management of the serial development is step by step based on the increments of previous versions. For instance, Project A started in an empty repository (a directory or shared disk). After project A was released, a new repository was created for project B. The source code of project A was copied to the new repository, and that acted as foundation for project B. In case an issue was found on project A, it was resolved twice--- Once in the repository of project A, and another time in the repository of project B.

Most of the CM solution involved manual procedures and policies: people would keep any CM information in their head or filing cabinet; or a librarian would be assigned to carry out the CM functions (Dart S, 1992). “This worked quite ok as long as there are not too many projects to maintain. Especially in the medical environment, the software typically has a long lifecycle (up to 15 years).” said a configuration manager. Hence there became a need for a more sophisticated approach to manage all these parallel maintenance projects.

3.2 Configuration management revolution

Many projects are running in parallel when there is a need for separate development paths to diverge from a common starting point, so that there is no longer a single "latest and greatest" version, but instead two or more concurrent "latest" configurations where new development is carried on (Bret T, 2004).These projects are often related to each other. Relations not only consist of starting points of new project, integration points between projects, but also milestones and release periods. Based on these relations, the release, test and integration strategy is determined.

Compared to a single project with only one latest version, parallel projects have two or more versions where the new development is carried on (Bret T, 2004). Configuration management needs to be adopted into parallel development. With the introduction of more powerful version management systems, also branch and merge techniques were introduced. Within one repository, people could maintain parallel tracks for parallel product development. The merging capability allowed developers to resolve an issue in product A, and merge it to product B. So, instead of resolving the issue twice, people can resolve it once, and by merging the resolution was duplicated to the other products.

This technique enabled parallel development, without the hassle of copying files over and back manually .Also feature based development became possible with the branching technique. Feature could be developed in separate streams, and integrated with a product line when required.

“In this period, most of the projects still were run in serial. A small overlap between the end of a project and start of a new project was common, but the projects did not run completely in parallel.” said a configuration manager in Philips healthcare, “Instead of huge system projects, smaller projects were introduced to deliver separate functionality in parallel. “

Configuration management plays a very important role in the field of project management, especially when there are multidisciplinary teams working together. From CM point of view, this meant many parallel tracks. One track representing the main product, and several parallel tracks for each (temporary) release. In the end, all parallel tracks are typically merged back to the main product, so at the end, only one product has to be maintained.

A good development configuration management pattern enables the team work easier and effective. Appleton B (et al) documented configuration management pattern for parallel development in 1998. It provides an in depth discussion of some branching patterns for parallel development. “Streamed Lines” is a pattern language for organizing related lines of development into appropriately diverging and converging streams of source code changes (Appleton et al. 1998). Stream line pattern makes the structure of configuration management process easier to understand. Brad Appleton refers to configuration management pattern as "file-oriented" and "project-oriented" branching. “file-oriented” branching pattern supports branches do so at “the granularity of a lone file or element”. For the "project-oriented", branching is the most conceptually powerful when viewed from a project-wide or system-wide perspective.

IEEE (IEEE/ANSI Standard 1042-1987) gives a standard definition for configuration management, which includes: Identification, Control, Status Accounting, Audit and review. BERSOFF,(1984) described the Configuration management elements as following:

- Identification: Identifying each unique definition of system baseline components.
- Control: Controlling stages of the system life cycle.
- Auditing: Auditing provides the mechanism for determining the degree to which the current state of the software system mirrors the software system pictured in baseline and requirements documentation.
- Status accounting: Status accounting is the administrative tracking and reporting of all software items formally identified and controlled.

The goals of the configuration manager are to ensure that procedures and policies for creating, changing, and testing of code are followed, as well as to make information about the project accessible (Dart S, 1991). Configuration management manages the changes in a controllable, consistent and reproducible way. Stream overview is a very important communication document, the project team can get information from the project overview: when and what is delivered to a customer, how the product is created and what changes are made. The project team can rebuild the complete product exactly as described.

3.3 Visualize information in Configuration Management

Visualization means using computer-generated graphics to help people understand and clarify visually the relationships inherent in data (Rosenblum & Brown1992). In the late 1700's, visual representations of abstract information have been used to demystify data and reveal otherwise hidden patterns (Heer J, et al, 2005). The configuration management pattern indicates how to present the information for project overview. Graphic view in configuration management is typically used for two purposes: review (auditing) and planning.
Shneiderman (1996) suggested the "Seeking Mantra" for visual design guidelines: Overview first, zoom and filter, then details-on-demand. For expanding "Seeking Mantra", Relate, History and extract are the next steps.

- Overview: Gain an overview of the entire collection.
- Zoom : Zoom in on items of interest
- Filter: Filter out uninteresting items.
- Details-on-demand: Select an item or group and get details when needed.
- Relate: View relationships among items.
- History: Keep a history of actions to support undo, replay, and progressive refinement.
- Extract: Allow extraction of sub-collections and of the query parameters.

The idea behind the guidelines is how to explore and interact with visualized data. On the other side, there are many elements and variables in configuration management. What kinds of data need to be visualized? The concerning for visualized data is all related to the certain attributes for each project. The following attributes are considered to be most relevant to visualize for each project in answering the questions:

For "How are the projects in the system organized?" the following attributes are considered to be most relevant to visualize:

- Project name
- Project type (parent branch or child branch)
- Author who is in charge of the project
- Project time scope

For the question "When they were last edited?" the following attributes are considered to be most relevant to visualize:

- Project start time
- Project end time
- Deliverables (milestones, versions)
- The time of deliverables

For the question "Where is the project for this feature?" the following attributes are considered to be most relevant to visualize:

- Version
- The time of Version

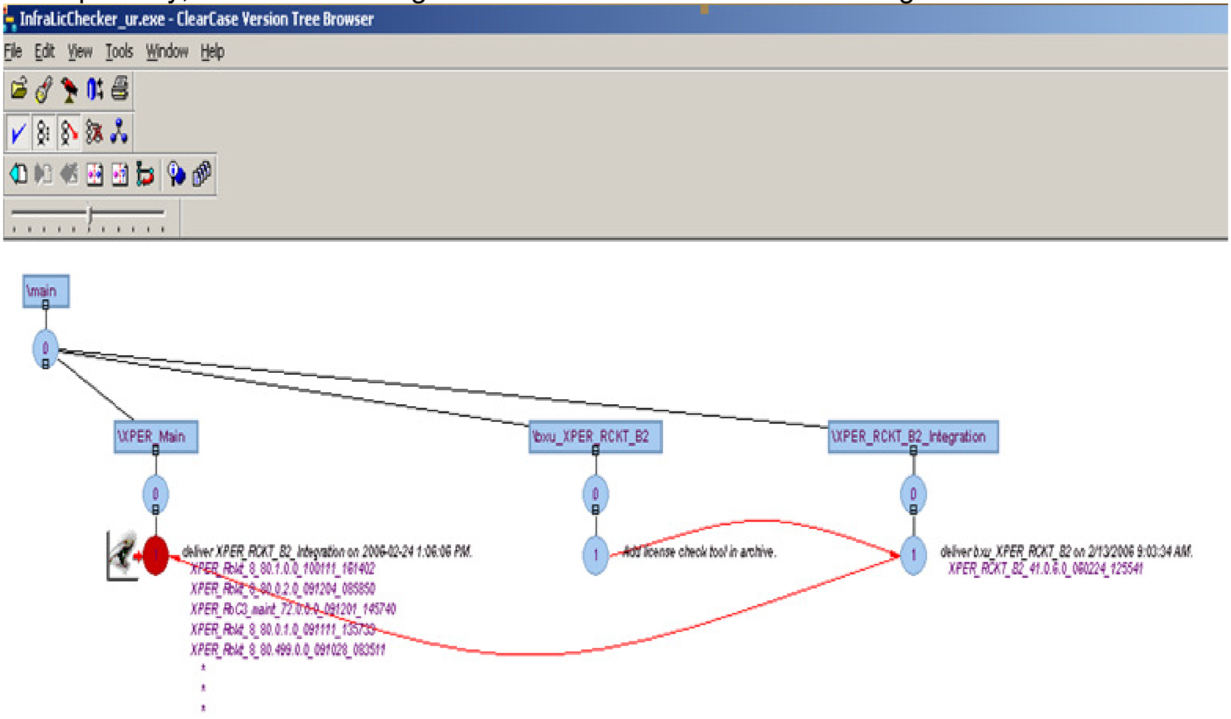
Finally, for the question “What version is stable for merging?” the following attributes are considered to be most relevant to visualize:

- Version
- Merge arrow

3.4 The limitations of the different tools

The following part presents a number of visual patterns and software visualization tools. These visual patterns have different features to support elements in configuration management and the “Seeking Mantra” guidelines I mentioned above.

Version Tree view is supported by most of the configuration management tools such as IBM Rational ClearCase. The ClearCase Version Tree view displays a graphical view of the version history for a ClearCase element (IBM infocenter,2009). Based on the repository, a review can be generated to indicate branch and merge information.


InfraLicChecker_ur.exe - ClearCase Version Tree Browser
File
Edit
View
Tools
Window
Help
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0
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\bxu_XPER_RCKT_B2
\XPER_RCKT_B2_Integration
0
0
0
1
1
1

deliver XPER_RCKT_B2_Integration on 2006-02-24 1:06:06 PM.
XPER_Rbld_8_80.1.0.0_100111_161402
XPER_Rbld_8_80.0.2.0_091204_085850
XPER_RbC3_maint_72.0.0.0_091201_145740
XPER_Rbld_8_80.0.1.0_091111_135733
XPER_Rbld_8_80.499.0.0_091028_083511
*
*
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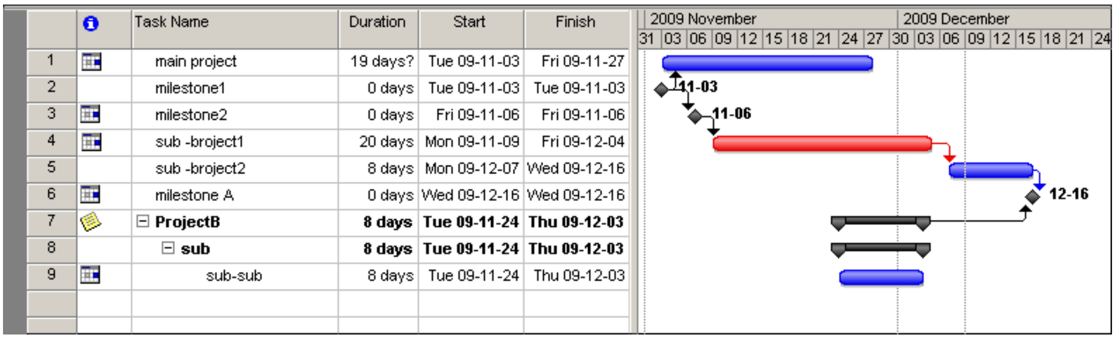
Add license check tool in archive.

deliver bxu_XPER_RCKT_B2 on 2/13/2006 9:03:34 AM.
XPER_RCKT_B2_41.0.6.0_060224_125541

Figure 3.1 a sample of Version Tree by Clearcase.

Figure 3.1 is the ClearCase Version Tree view .The ClearCase Version Tree view opens and displays a partial tree for the resource, the detailed information about a version, including any metadata attached to the version and the current state of the version (for example, checked-out). (IBM infocenter, 2009). Figure 3.1 illustrates several elements of ClearCase version trees: a single branch is named “main”, which has an empty version, numbered 0. ClearCase automatically assigns integer version numbers to versions. Each version can have one or more version labels. Three Branches are created at version 0, each branch with a user-defined name. However, Clearcase only can display the ClearCase version history of a resource. In addition, if a product consists of multiple baselines, the overview of the version tree might be incomplete, as not all baselines have been affected in the same way. Some might have been stable during the projects; others might have been changed and merged many times.

Gantt chart is another way to visualize the project information. There are many Gantt chart tools both commercial and free such as Microsoft Project. Microsoft Project (MSP) is a commercial tool which is a member of Microsoft office family. User can zoom in on the time period shown in the timescale (for example, change the view from days to hours) by clicking Zoom In. Likewise, user can zoom out from the time period (for example, change the view from days to weeks) by clicking Zoom Out. (Microsoft office online help).



	ⓘ	Task Name	Duration	Start	Finish
1		main project	19 days?	Tue 09-11-03	Fri 09-11-27
2		milestone1	0 days	Tue 09-11-03	Tue 09-11-03
3		milestone2	0 days	Fri 09-11-06	Fri 09-11-06
4		sub -broject1	20 days	Mon 09-11-09	Fri 09-12-04
5		sub -broject2	8 days	Mon 09-12-07	Wed 09-12-16
6		milestone A	0 days	Wed 09-12-16	Wed 09-12-16
7		⊟ **ProjectB**	**8 days**	**Tue 09-11-24**	**Thu 09-12-03**
8		⊟ **sub**	**8 days**	**Tue 09-11-24**	**Thu 09-12-03**
9		sub-sub	8 days	Tue 09-11-24	Thu 09-12-03

Figure 3.2 screen shot from MS Project

Figure 3.1 is the screen shot from MS Project. The length of Bar indicates the project time scope. The arrow shows the sequence of tasks. Take the red arrow as an example; sub-project2 can only start after finishing the sub-project1.

One configuration manager told me that: “We tried MS Project. Absolutely it’s not the tool we want.” Gantt charts is mainly used to plan project schedule management, the chart can’t present the project relations such as merge information. Arrows in MS Project only refer to time constrain. The arrow can not connect with each line as the branch structure. In addition, Gantt chart only refer to the minestrone as a task, the version for each project can not present in hierarchies. “We want the version in the corresponding project bar”, said a configuration manager in Philips.

Timeline view (figure 3.3) is a good approach for visualizing the configuration management. Timeline indicator presents the time periods and time constrains. Simile Widgets Timeline component can visualize information on an interactive drag-able timeline. Timeline component is a part of Simile project. Within Simile Exhibit framework, “Lenses, Views and Facets” feathers can be applied to visualization information in configuration management. Exhibit enables web site authors to create dynamic exhibits of their collections without resorting to complex database and server-side technologies. The collections can be searched and browsed using faceted browsing (Simile Exhibit: http://simile.mit.edu/wiki/Exhibit).

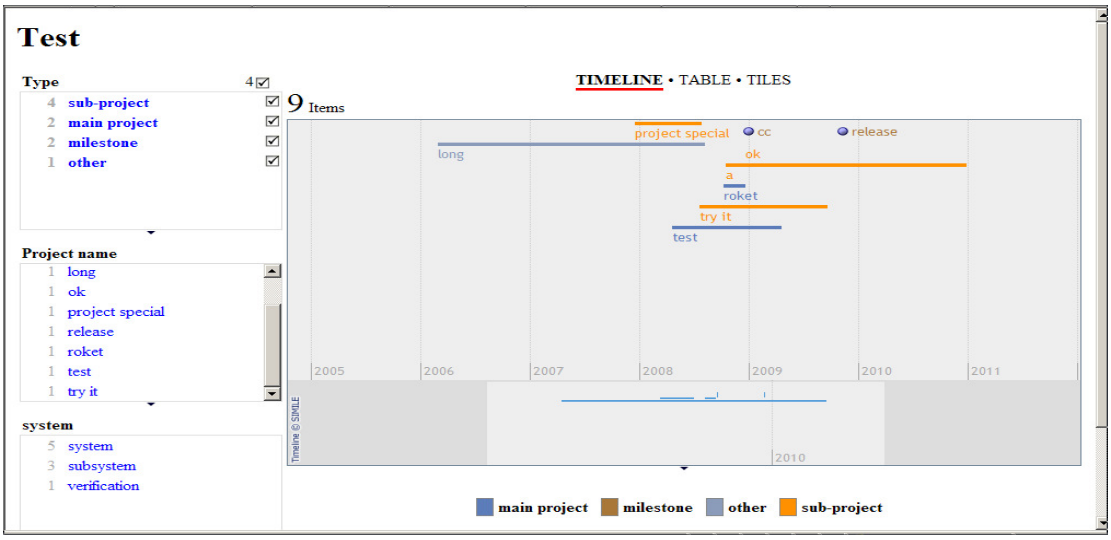


Figure 3.3 screen shot from Exhibits webpage

If the main interest is the time factor, Exhibit framework is a very good choice. The interface can present different categories data in timeline view, table view and tiles view. User can expose the properties of items for filtering and searching. "Double time line" is alternative to "zoom in and zoom out". The page can give user a high level overview first, and then user can choose the different types to see the stream line on the detailed view. User can drag both summary timeline and detailed timeline. Although Simile Exhibit is useful and valuable for chronology view, it can't represent the Project relation which means the system doesn't support the arrows between each stream lines.

There are many visual tools for drawing structured diagrams which can be used to visualize data in configuration management, notable commercial software is Microsoft Visio. A numbers of free drawing software are also popular such as Dia. Microsoft Visio and Dia are both powerful tools to draw diagrams, since several shape packages for different diagrams are available in the modular design, User can draw any kinds of diagram freely. They follow some parts of "Seeking Mantra" principle --user can zoom in and zoom out. User can choose the items in the shape packages for the various diagrams such as UML, ER diagrams.

4 Case study: “stream overview generator” project

4.1 Research site

Philips Electronics N.V. is founded in 1891 and is one of the largest electronics companies in the world. Philips Healthcare is the market leader in Medical Systems field. Philips’ professional healthcare offerings include diagnostic imaging systems, healthcare information technology solutions, patient monitoring and cardiac devices, as well as customer services such as financing, consultancy, and maintenance and repair. Philips also provides innovative solutions for the home that connect patients to their healthcare providers and support independent living for seniors and the chronically ill.

The Business Unit Cardio/Vascular X-Ray is, together with General X-Ray, Magnetic Resonance and Computed Tomography, part of the Imaging Systems group of Philips Healthcare. The department is responsible for the system specification, design and architecture, for the development of a number of system parts and for the integration, verification and validation of the newly developed system. These activities are performed in multidisciplinary teams where principles from electronics, mechanical engineering and information science are fused into ingenious systems fit to use for the clinical user. (Philips official website, 2010)

The work presented in this thesis has been based on research within IXR (Interventional X-Ray) Department. Configuration management group is an important part of the IXR department.” In our business we cannot afford to have our data lying around not being able to retrieve information on demand.” This is where configuration management group comes in. By working closely together with configuration management group, I have gained a deeper insight into configuration management.

4.2 Implications for design stream overview tool

<u>Current issues in project stream overview</u>

1. stream overviews for planning purpose

Unfortunately, there are no good tools available to support configuration manager for planning.” A configuration manager in Philips told me. Some CM tools such as Clearcase have possibilities to generate the stream overview, but only for the history so far (chapter 3.4). “Planning view is usually done in excel, PowerPoint or Visio. But this is quite labor intensive, especially when the entire planning has to be redrawn due to introduction or cancellation of projects.” A complete redesign of the drawing is required if people want to keep the drawings up to date

2. When the stream overviews are created, people lack standards to visualize the project information:

At this moment there are a lot of project stream overviews, “everyone uses a different way of annotating. Not all files are complete. Some knowledge is only available with certain people.” said by a configuration manager. Since the project overviews plays a very important role in communication between inside and outside of the project team, People want to have an easy and understandable visual overview of "integration" moments.

This issue leads to a debate: put all the project information in one project overview or separate the project overview into different view? One system architect suggested to me “Don’t try to put everything into one overview”, while as a configuration manager want a same view for the integration moments. “Drawing of the life cycle of a (sub)system (i.e. a product) shows parallel developments and (important) integration milestones. In fact, by thinking about it, the tool is some kind of MID generator (MID="Master Integration Diagram", which is widely used with the project group.” said a build manager in configuration group.

There are ambiguous meanings to the merge information. The arrows in the view could be understood as different meanings for different people. According to the survey, most of the people think the arrows mean” from one version to another version (release)”. However, some people think the arrows also means” from one project to another project”.

1. Difficulty of getting the whole picture

Chapter 4.4 shows some of the project stream overview. However it’s the small part of the whole picture. As the time goes by, the parallel projects become more and bigger, the stream view for the large system will be hard to understand and analyze.

2. Most of the project overviews are drawn by hands, people make mistakes.

Those mistakes usually happen because of the mismatch for the project time and some dependencies of the components. There are certain rules for the stream view, such as the merge arrow can not merge back to the date, the child project and versions should be in the period of the project time line. Those mistakes can be avoided if there is a mechanism to check and audit.

Although the project overview will be reviewed by other project team members, eliminating the mistakes at the earliest possible step is of great help.

3. Maintenance problems

Project stream overviews are created within each project team player’s domain. Many project stream views are produced. However, maintenance of the stream overview is difficult as the time goes by, especially for the project stream overview which is drawn by hands. Besides the human mistakes happen when the user make new changes, the stream overviews are extremely intensive and hard to maintain, since the projects changes could happen at any time. When the configuration management data is changed, a complete redesign of the drawing is required in the worst case.

When users create the stream overview, there are two different ways: draw the picture freely or follow the pattern. When users use free drawing software such as Visio and Dia, the stream views are usually very casual. For example, the branch start point is not precise in the stream line, see Figure 4.1. When the new branch comes, user needs to rearrange the other project branches by dragging and dropping. What's more, the items within the branch such as versions, merge arrows also need to be moved. If the project stream lines are a few, it's ok for a short period of time. However, the changes happen very often in the real situation, the cost of the freedom is the maintain problem.

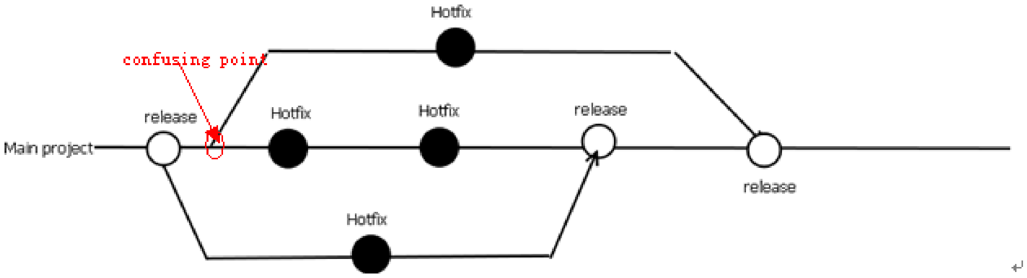


Figure 4.1 stream view drawn by Dia .

Finding the solution:

1. Stream View For Planning purpose

The raw data can be from user input, software export data. Based on the structure of raw data, the tool can map the data into graphical view. See the figure 4.2 as following.

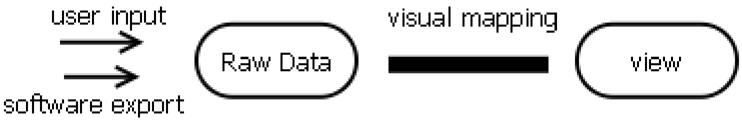


Figure 4.2 data flow.

When people create the stream view, they need a standard to indicate the project information as the visual elements. Branch mechanism is to support parallel development .However, these stream view lacks of exact time sense. Timeline can be added to the stream view to help team member identify the time stamp in each phase. Hence, all the elements should have an exact position and description when the data are mapping to the stream overview.

2. Standardizing the visual elements

The visualized Standard also refer to the maintain problems. Instead of the tools which allow the user draw picture freely, it's easier to maintain by using the tools which need user to follow the pattern. If the running projects information is changed, the stream overview can generate itself by entering or importing the project data.

In order to deal the issue of the "Master Integration Diagram", two solutions can be used for creating the stream view: creating one super stream view which contains all the project information, however, due to the complexity of the parallel projects, the super stream overview needs the lens for filtering the different details. The other solution is that we divide the stream views as different windows. The different windows view is easier to grasp the information for different domains. I chose the second solution.

I define and conclude a framework for visualization elements as four categories:

- Project base line: Project name, release items (version, milestones, deliverables), authors.
- Project time line: Each project time line consist of project start time and end time
- Project hierarchies: Parent project, child project, branch for certain project.
- Project relations: Merge information. For example, a child project needs to merge into its parent project.

The project overviews drawing which contains all the information in four categories are critical for the team interaction. Visualization techniques can be applied to display structure of parallel projects. The right picture of the running projects help project members tracking the process and making right decision.

3. Self-correction mechanism

The physical configuration audit is verification of the configuration item against its configuration document. Incorrect documentation could lead to incorrect decisions when implementing changes. (Schaap Renéet al, 2007). The Self-correction mechanism can help the user audit the stream overview. The tool should check and validate the data itself; warning also should popup before deleting and editing the data. After building the Self-correction mechanism, mistakes such as missing the essential data ,mismatching the time and release, duplicating the uniqueness of release, and mismatching the merge arrows can be end up in the early stage.

4. Following the “Seeking Mantra”.

The stream overview generator should not only allow user to gain an overview of the entire collection first, and also allow user to zoom in and zoom out on the stream overview. If the stream view is very large, the stream overview generator should have “search” features which allows the users find the certain data immediately.

If the users want to print a specific selection on the stream overview, not the entire overview, users can define a print area that includes just that selection. Then only the print area will be printed.

4.3 Stream overview requirement

<Functional area 1- data input>

- It shall be possible to add following data: Project name, project type, project time, project version, merge information (two versions, or one version and one start point), subsystem and comments

<Functional area 2- data storage>

- User can save stream overview raw data.

- Source data shall contain: Project name, project type, project time,, project version, merge information(two points) ,subsystem comments, and project start point(to identify the connection point)

- Source data which store all the project stream information is editable and accessible by Notepad

<Functional area 3- stream drawing>

- Time frame for the stream drawing is presented in week numbers on top

- System can group in main projects and related sub-projects

- Merge arrow can connect two project line without milestone

- System main-projects and sub-projects are in separate colors

- User can collapse and expand main projects and related sub-projects.

- System can print stream view on several formats (from A4 to A0)

Use cases are designed based on the requirements. (See appendix 3)

4.4 Results

To answer the questions which are mentioned in chapter 2.3, the answers are explained as following:

<u>Stream overview are involved several roles</u>

To answer and identify the people involved in the stream overview:

- Who is involved in configuration management and wants to use project overview?

Many people are involved in the configuration management. “System architect, system integrator and configuration manager are the main participants to discuss the stream view.” A configuration manager said. They usually have meeting together, review and plan for the next move of the projects. Hence they are the people who are chosen to investigate. (See table 4.1)

Table 4.1 numbers of participators

role	Numbers for Interview	Response the questionnaire 1	Response the questionnaire 2
System Architect	2	1	0
System Integrator	1	0	0
Librarian (configuration management group)	2	2	1
Build manager (configuration management group)	1	2	1

Project information in project stream overview

To identify the important data elements in the stream overview in configuration management:

- What information needs to be presented in project stream overview?

The elements and variables for raw data are massive in configuration management. In principle everything may be under configuration management. A configuration can be any possible part of a product defined as a configuration that it is necessary to have identified, produced, stored, used, and changed individually. (R Schaap et al 2007). If too many configuration items are presented in stream overview, it could result in too much work.

The following data is identified by the collected documents in Philips healthcare and questionnaire. These configuration elements are most wanted in project stream view.

Project name: name of the project stream

Project time: it includes the start time of the project and the end time of the project.

Project type: system main project and sub project.

Project release: version, reversion or milestone.

Project merges information: the relations among many branches.

Project additional information: comments and components

Present and maintain the data in project stream overview

To identify the current problem in project stream overview:

- "How": How to present and maintain the data in project stream overview?

Many tools such as Visio, Excel, Word and PowerPoint are used to draw the project overviews according to the answers to the questionnaire. Sometime people just draw the project streams on paper by hands.

An interviewee thinks the current tools which he is using (Visio) can present the stream view quite well, however, "It is not efficient to keep changing the drawings and difficult to keep the drawings up to date". He complained that "maintenance is difficult". Another interviewee explains what he wants in the new stream overview generator: "modifying start points and end points lack of tagging (e.g. labeling a merge arrow or stream). Basically you want to edit milestones, start and end points of merge arrows, stream hierarchy, etc. and let the tool regenerate the drawing. Additionally it shall be easy to drag and drop"

Different roles concern different elements for project overview. In order to understand the project overview from different viewpoints, several project stream overviews are collected. (All the stream views are the abstract picture from company's documents)

The Configuration manager is responsible for the processes around his project, and therefore also for the existence of the configuration planning. Figure 4.3 shows the project stream overview which is made by manual work.

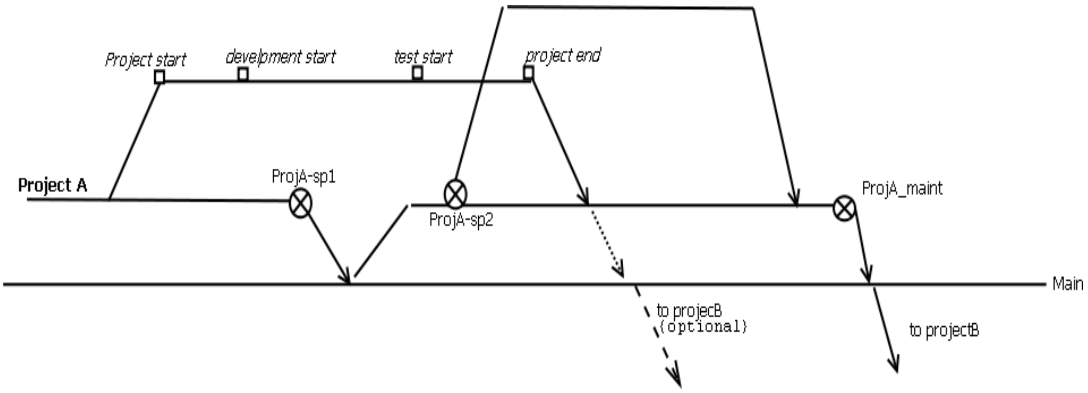


Figure 4.3 stream view 1 from the DCM group.

Figure 4.3 show that the milestones are understood as the project phase. New project (parent or child project) start, development start time, test tart time, test end time and project end time can be considered as the new milestone. Every new Children branch starts a new sub project. After the sub-project finishing, Children branch need to merge into main project line

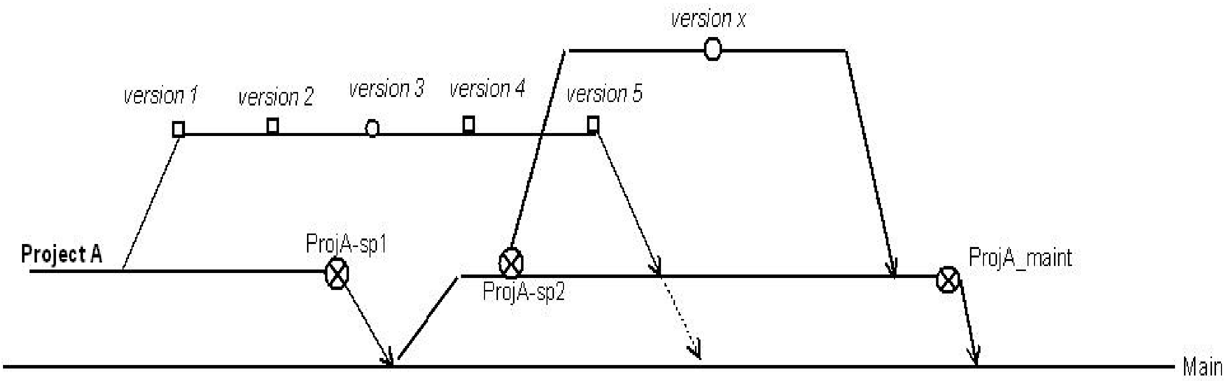


Figure 4.4 stream view 2 from the DCM group.

Figure 4.4 is another kind of stream view for DCM (development configuration management) group. Versions are instead of milestones in view 1 (Figure 4.3) are either unique version names or unique version numbers which indicate the unique states of the project process.

There are also other kinds of stream view in the company. From the System Architect point of view, they have their own notation, a system architect in Philips told me that: “For my role, there is no importance. But, for the DCM team and other stakeholders it is of great help to have a visual overview of ‘integration’ moments.” … “I create and maintain the project view myself in Microsoft Visio, and I don’t pay too much attention on the stream overview made by DCM group”. The System Architect concentrates more on “Product domain content” (PDC). As figure 4.5 shows, Hotfix is used to fix product problems or change the product behavior. Hotfix may take several days to months, and then a final version is released and merges back to main project. “Hotfix” is patches that are applied to running systems.

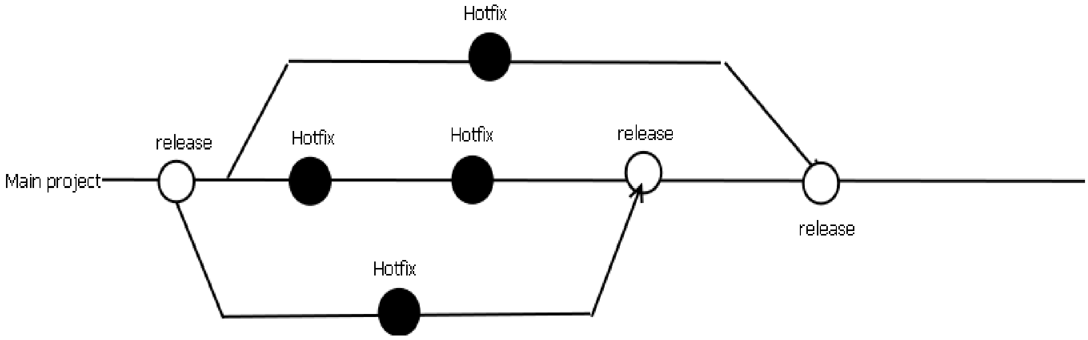


Figure 4.5 stream view 3 from a System Architect.

The integrators bring subsystem into one system and ensure the subsystems work well with system. They are also responsible to the baseline, so that they need to work on the product baseline report together with configuration management group. “The System Architect’s overview is not enough for me; it’s like a ‘Metro map’ which is not as enough information as a real ‘city map’.” one system integrator said. They can get information from configuration manager’s project stream overview so that the integrator can discuss and determine the integration process.

Project stream overviews solution are needed

To answer the question:

- When the project stream overview is needed?

Project stream overview as the important document for communication, they relate with successful configuration management. According to the IEEE definition for configuration management (IEEE/ANSI Standard 1042-1987), Stream overview could be used in every stage of the configuration management such as Identification, Control, Status Accounting, Audit and Review. Furthermore, the Stream overview is also for planning purpose when people make decision on the release, test and integration moments.

Within an individual project or organizational unit performing configuration management the configuration manager is responsible for the creation of a configuration management plan (Schaap R et al 2007). The running multiple tracks in parallel has some drawbacks. Besides the technical impact (merging software in parallel tracks can lead to problems too), also planning becomes essential. A merge and integration strategy is set up in the beginning of a project, but what happens if one of the tracks is delayed (illness of the developer, additional requirements etc.)? The planning has to be adjusted, and the integration and dependency diagram has to be redrawn.

Importance of the visualized information in project process

To identify the importance of the visualization technology in CM:

- Why is the visualized information in configuration management important?

All people who were interviewed and responded the questionnaire think visualized information in project process is important. “A graphical overview is much better readable and explainable than just text. It’s key to my work.” said one of the build managers. The team leader of configuration management group thinks the graphical overview helps to find issues that otherwise may be overlooked. “Visualized overview information provides an overview over all main projects. We are able to discuss merges and deliveries between these projects in the stream overview diagram.”

Information visualization seeks to augment human cognition by leveraging human visual capabilities to make sense of abstract information, providing means by which humans with constant perceptual abilities can grapple with increasing hordes of data. (Heer J, et al, 2005) The project team wants to keep an overview of projects and their relations between them. With the aid of the visualized project stream overview, the project team members can notice what the latest status is at a certain point in time. The process of the project development becomes predictable. The developer can assess the integrity of his product, and the configuration managers can assess the integrity of the product he is managing for.

4.5 Visualization design

Visualization approach to configuration management depends critically on local factors. Standardized software can't fit the specified expectations. People also need time to handle new software. Finally I choose to develop a plug-in tool in Excel using VBA (Visual Basic for Applications). Almost every people in the company know excel .People prefer a tool that they are used to. While using a plug-in tool users are working in the well-known Office environment, which means that all configuration management documents can be created and edited easily and quickly. On the other hand, Excel, as a powerful spreadsheet tool, features sorting, filtering, and zooming in and out already. I can concentrate with drawing pattern by VBA programming.

VBA (Visual Basic for Applications) is subset of Visual Basic (MSDN, 2009). VBA expands macros and enables to automate task in excel. VBA provides form to communicate with user so that the checker can be added to make sure the data is correct within constrains.

A plug-in is a small software computer program that extends and enhances the capabilities and functionalities of a larger program. Before designing plug-in tool in Excel, the limitations were considered. Early version of Excel is not enough to handle the big project drawing. Take Excel 2003 for example, Maximum columns are 256 columns and the maximum rows are 65536. However, Excel 2007 "Big Grid" increases the maximum number of rows per work sheet from 65,536 to over 1 million, and the number of columns from 256 (IV) to 16,384 (XFD).(MSDN, 2009). Excel 2007 is enough to keep record of large system development.

In the stream overview the horizontal axis in ISO week numbers represents time. The ISO week date system is part of the ISO 8601 date and time standard (Gent R.H., 2005). An ISO week-numbering year has 52 or 53 full weeks (364 or 371 days). Weeks start with Monday .The system is widely used in business for fiscal years. In the format, the two digits in prefix are year; the last two digits are week number. For example, 1051 is the 51st week of 2010.

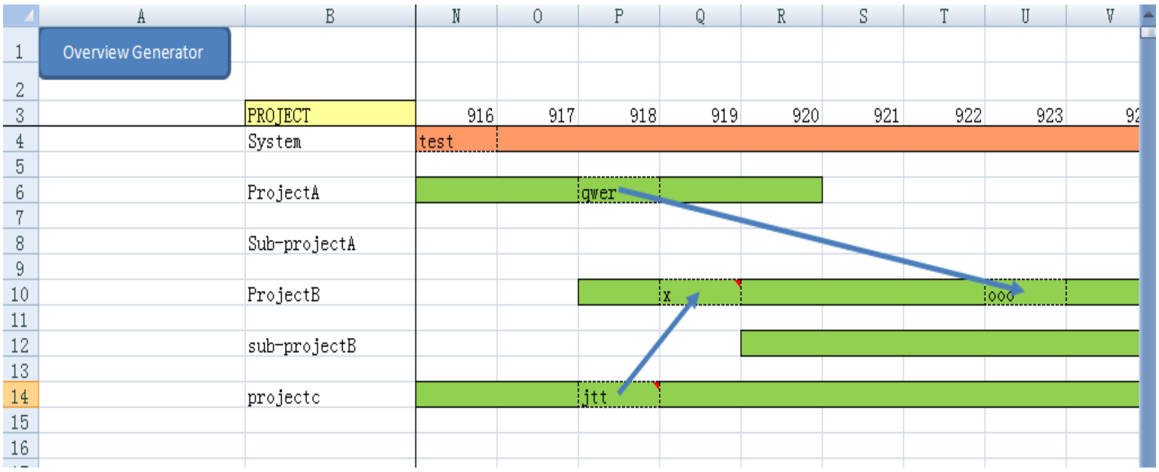


Figure 4.6 stream overview in excel (generated by the plug-in tool)

Figure 4.6 is the screen shot of the stream overview generated by the plug-in tool. For the left sides, the project names are the vertical axis. Under the time axis and near the vertical axis, the area is for the stream overview. When mapping the time with the project stream line in the visible dimensions, two obvious choices for visualization are a line and a bar. Since user wants the versions which belongs to the corresponding project can be presented in the bar, the bar design is chosen at the very beginning of the visual design.

Table 4.2 Visual elements

Visual items	***Description***	***Representation***
Project name	Name of a project	Project name label show on project bar.
Time line	Time scope for the project overview	Time line is on the top of visualization
Project start time	It indicate the start time of a project	Start point of project bar according to time line.
Project end time	It indicate the end time of a project	End point of the project according to time line
Project duration	It indicate how much time for the project	Project horizon bar starts with "start time", ends with "end time".
Release items	It can be milestone, version in the project time scope.	Release label is inside the project bar according to each project line
System project	Main project line	system project present as red bar
Sub-project	Sub-project line which is the branch of system project	system project present as green bar
Merge	Merge happens when sub-project are combined with system project or two sub-projects are synchronized	arrows coming from One project into another. Usually the connection points are Release points

“Freeze panes” allows user to lock specific rows and columns so that they will always be visible on screen. Stream overview workbook initialize the first sheet: the project name column in the project basic table and the week number row are locked no matter how far the users scroll to the right or down, because the project name and the week numbers are a part of the stream view. The "freeze panes" feature avoids user wasting time in making certain the right spot back and forth.

There are bars in different colour of the corresponding project type. The orange bar is the main system project; the green bar is the child project. Each bar contains many columns in the time period corresponding to that bar. The versions are in each column area within a bar bounded. User also can choose to show the comment information of each version. The blue arrow is the merge information which is defined as the start point (branch out) and end point (merge in). The standardized visual elements are list as table 4.2

4.6 Stream overview generator implementation

The stream overview generator tool is completely integrated in Microsoft Excel 2007. It consists of three layers: raw data layer, presentation layer and application logic layer. (Figure 4.8)
For the raw data layer, there are three sheets in the template. Every sheet has a table which is related to each other. (Figure 4.7)The overview is generated based on three tables in separate sheets. The first table contains project name, parent project name, project start time, project end time, and project type. The version table is in the second sheet, it contains version name, version time, project name for each version. For merge information table in the third sheet, there are first project names (branch out), second project (branch in), "from version" and" to version". (See Table4.3, 4.4, and 4.5)

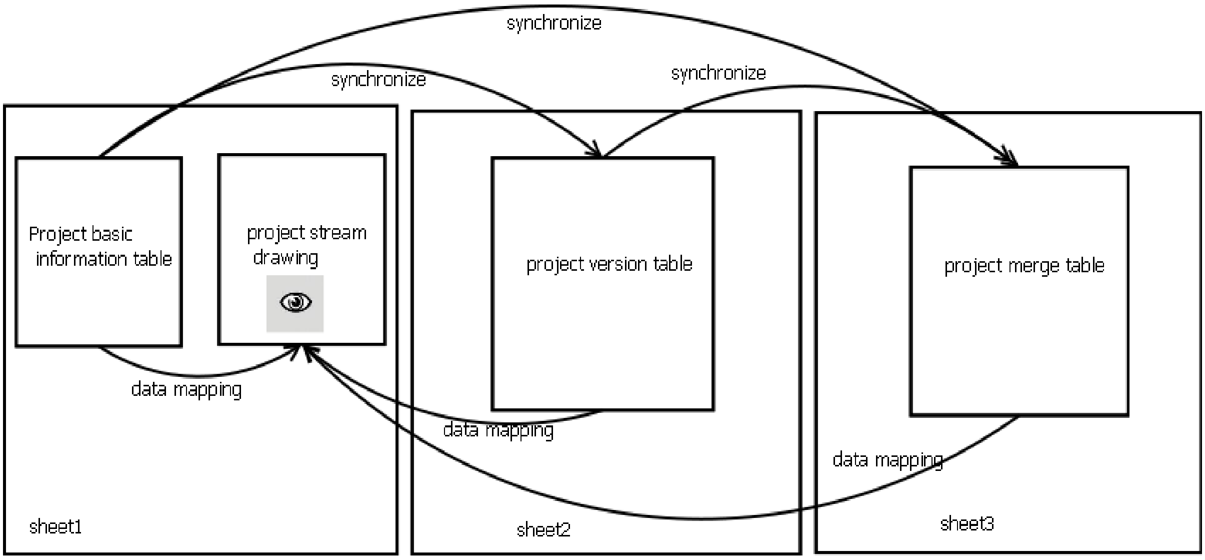


Figure 4.7 architecture of the tool.

Visual data match three tables into stream view. When user updates one of the tables from GUI (Graphic user interface) of plug-in tool, other two tables will be synchronized by application logic layer. After synchronizing tables in raw data layer, plug-in tool map the data from three tables and present as stream overview in presentation layer.

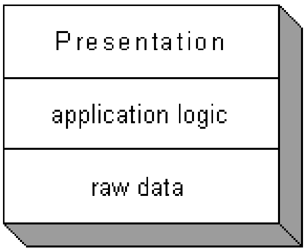


Figure 4.8 Logical View

The overview generator works in several sheets. Whenever the data changes in the table, it requires updating other tables. The Basic information table is same as stream view in the sheet 1. The project name in the basic information table is vertical axis for the stream overview. The project version table in sheet 2 has the same project name attribute, hence the project name will synchronize with the Basic information table. For the project merge table in sheet 3, the project names are synchronized with basic information table while as the project version name are synchronized with project version table. After the synchronizing process, the three tables are ready to generate the stream overview.

Table 4.3 basic information table

Attribute	Description
project name	Same row as visualize project line
parent project name	Project belongs to which parent project
project start time	It indicates the start point of project line
project end time	It ends the start point of project line
project type	It indicates the project is system project or sub-project.

Table 4.4 project version table

Attribute	Description
project name	Synchronizing in project basic table
version name	Version belongs to certain project
version time	It indicates the time of the version

Table 4.5 project merge table

Attribute	Description
First Project	Arrow comes from this project
First version	The start point of arrow line
Second project	Arrow point to this project
Second version	The end point of arrow line

There are three steps to map the raw data to visual stream view. At first step, application logic layer maps the data from basic information table, time line and project line are generated. Time line has dynamic scope depending on the start time for the projects. After generating time line in the top, an axis which has time line and project name can be used to decide the position of the project version. For the next step, project versions which from the project version table are write into project bars. At last, merge arrows are added to connect two versions according to project merge table.

4.7 User interaction with overview generator

As the user requirement described in chapter 4.2, the user graphic interface gets the user input as raw data layer. Then the logic layer checks the data with the self-correction mechanism. Users are operating the tables until clicking the “Generate overview” button. After the clicking “Generate overview” button, the mapping event is trigger, the application logic layer map three tables into the stream overview.

Self-correction mechanism:

Self-correction mechanism can help the user audit the stream overview as Chapter 3.5 described, the self-correction mechanism in the overview generator is important for users. The followings are the self-correction which implemented in the plug in tool.

- All the necessary data needs to be filled in. Otherwise the warning window pops up.
- The Project dates shall be entered in the ISO week numbering format (e.g. 0948 for week 48 in 2009). A check has to be performed if the end date is after the start date.
- Checks has to be performed on If the given week number for the version is within the time-scope of the project
- Merge arrow can not merge back.
- If the version is deleted, the tool will check if the version is coupled with the merge arrow.

  Check the uniqueness of the versions, project names and merge arrows, if the version, project or merge arrow exists in the table, it cannot be added again.

“Seeking Mantra”

When users click on the “View” tab on the top of the excel 2007, it comes out a Workbook Views group of buttons. The Zoom group lets user zoom in and zoom out on a part of the selection for stream view. Excel allows the user to zoom with mouse wheel when the users hold down the “Ctrl” key. As the user turning the mouse wheel up or down, it increases or decreases the zoom factor by 15%

Excel “Search” feature allows the users find the certain data quickly if the stream view is very large. Users can find and select specific text, or type of information within the workbook. (The “find & Select” button is in Home tab, editing group. keyboard shortcuts: Ctrl + F)

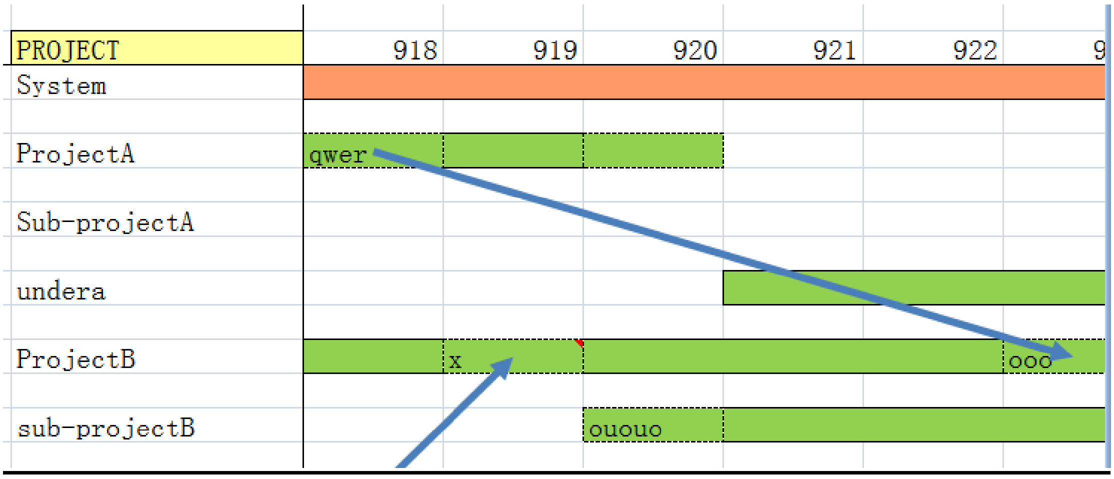


Figure 4.9 stream view – zoom in

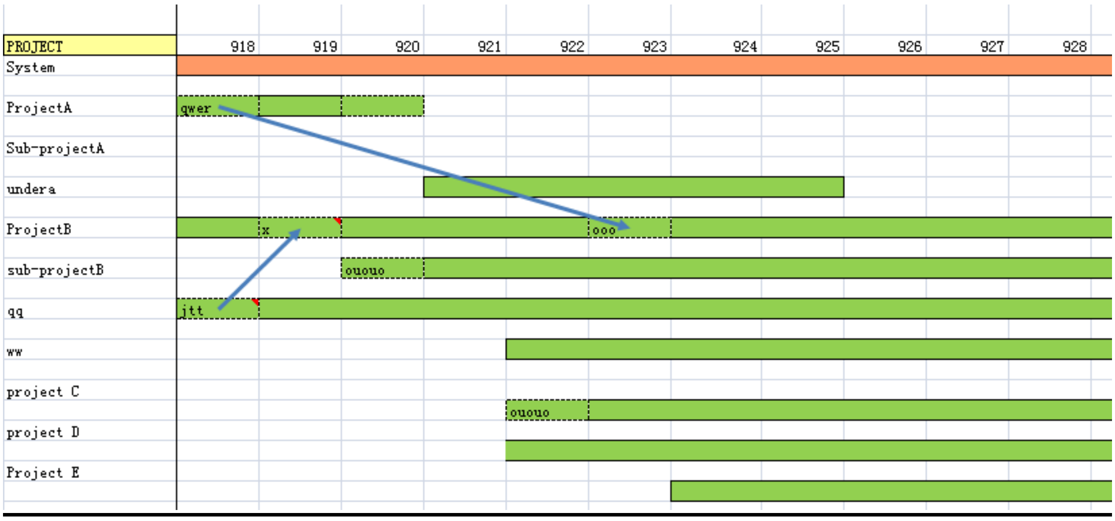


Figure 4.10 stream view – zoom out

Figure 4.9 and 4.10 show that user can zoom in and zoom out the certain area. Then the user can define a print area that includes just that selection. This means user can select an item or group and get details when needed.

Maintenance

The overview generator works in several sheets. Each sheet is a useful view for the project stream information as chapter 4.6 described.

Sheet 1 is for the project basic information table and stream view, sheet 2 includes the version table. Sheet 3 has the merge information table. Sheet 4 or further can be used for other kinds of stream view.

When the new project comes, user just enter the new project, the stream overview generator will arrange the right position in the stream view according to the changes for the running projects. For example, user add sub project “undera” which is the sub project of the project A, User just need to enter the data in the stream overview, then click “generate”, the tool will re-arrange all the position of other elements, such as the versions, merge arrows and comments etc. (figure 4.11 and 4.12)

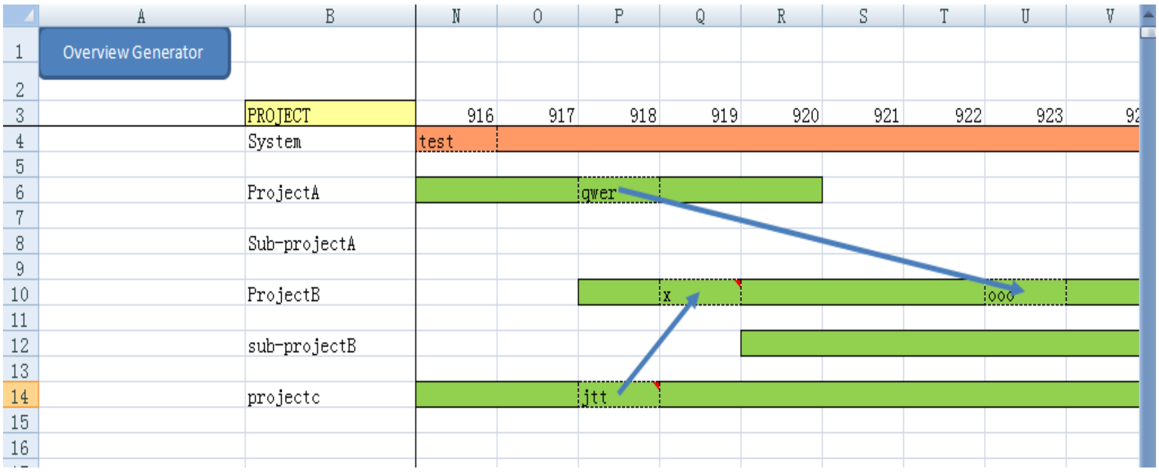


Figure 4.11 stream view – before add the new project

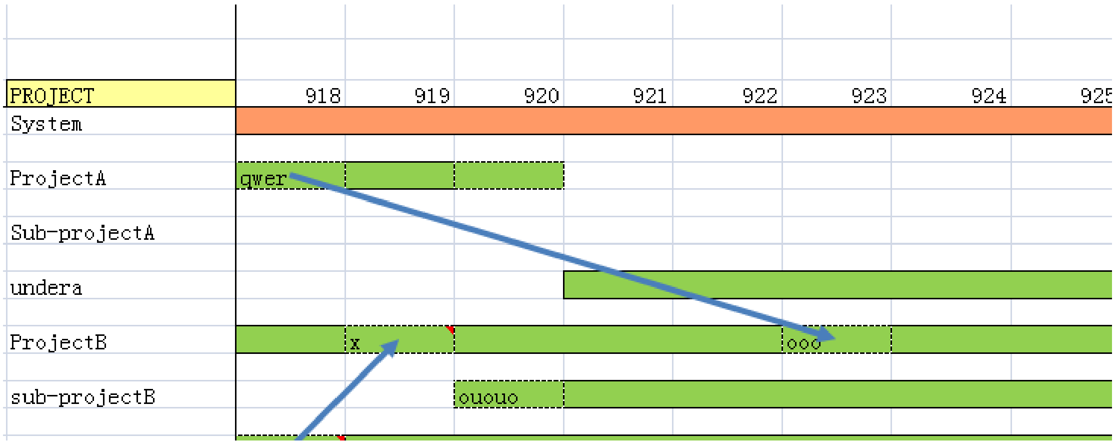


Figure 4.12 stream view – after adding the new project.

In stead of redrawing the stream overview manually, the stream overview generator makes the corresponding changes according to the user input In the GUI.

5 Evaluation

Stream overview generator is designed to improve the maintainability for the stream views in configuration management. Patterns and regularities are followed in the stream view. Users just input and edit the project information, and then the stream overview can be generated automatically.

To evaluate the stream overview generator, the tool is investigated if it answers the questions mentioned in chapter 3. The questionnaire (appendix 2) has also been sent out after my presentation in a meeting with development configuration group. After that, the stream overview is compared to other tools.

5.1 Answering the questions

All the project elements: Project base line, Project time line, Project hierarchies and Project relations are matched in the stream overview produced by the plug-in tool. Each sheet in the workbook for stream overview generator is useful information for the users. Using stream overview generator, it is easy to answer questions as chapter 3.3 mentioned:

To present “How are the projects in the system organized? “, the elements are visualized as:

- Project name : name column is mapped in front of the project bar
- Project type : different colours are to identify the parent project and child project
- Author : it is put as the comments in tooltip
- Project time scope: the length according to the time line is the corresponding time scope

To present “When projects were last edited”, the elements are visualized as:

- Project start time: to be mapped in the start point of the project bar
- Project end time: to be mapped in the end point of the project bar
- Deliverables : considered as the versions
- The time of deliverables: to be mapped in the right position of the time line axis and project names axis.

To present “Where is the sub project for this feature”, the elements are visualized as:

- Version: to be mapped in the highlighted column in the corresponding project bar at the right position in time line axis and project names axis.
- The time of version: to be mapped according the time line axis and project names axis.

To present “What version is stable for merging”, the elements are visualized as:

- Version: the stable version for merging is mapped in project bar.
- Merge arrow: to be mapped as an arrow line connecting one version to another version.

Following the user requirements, the interactions with the overview generator describe the way of producing the stream view. Users just need to focus on the input data, after entering all the necessary data, user click the generate button, the stream view will come up in Excel worksheet.

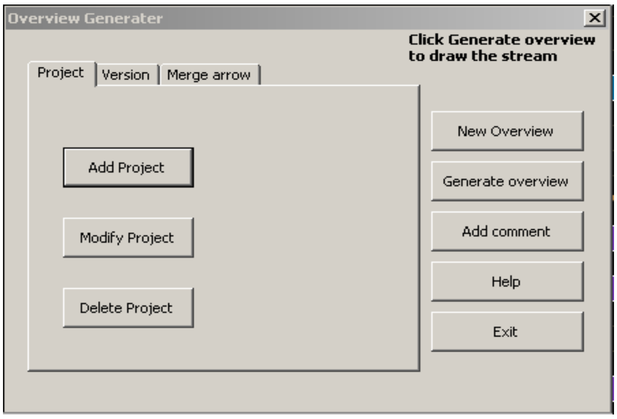


Figure 5.1 main control panel

The main control panel of Stream overview generator can be opened by clicking the “overview generator” button which embeds in the workbook. There are three tabs in the main panel: Project tab, Version tab, Merge arrow tab.

Option for the project basic information: On the project tab, user can add a new project, modify a project and delete a project.
A project data consists of:

- Project Name
- Project Type (system main-project or subproject)
- In case of subproject, the parental system project must be selected from a list
- Project start date
- Project end date

Option for the project version information: On the version tab, user can add a new version, modify a version and delete a version.
A version data consists of:

- Project name: this has to be selected from a list
- Date (week number format)
- The uniqueness of the version number

Option for the merge information: On the merge arrow tab, user can add new merge arrow and delete a merge arrow. Merge arrow data consists of:

- Project name
- Connection points: Two versions

Option for additional information:

- Comments for the project
- Comments for the Version

5.2 Feedback from the users

Three interviewees participated in the evaluation process. One build manager stated that “When the stream views are demonstrated, I found the stream overviews are easy to interpret.”

Another configuration manager told me that the overview which is made by the stream overview generator can help to define stream strategy during the project start and also helps the configuration manager in showing management the complexity. The following paragraphs present some advantages and disadvantages of for the stream overview generator based on the feedbacks:

Advantages:

- Easy to use
- Good for planning purpose
- The users can discuss difficult configuration management issues that are on system level (between system project)
- The uses can gain overview of all subsystem deliveries to subsystem for software.

Disadvantages:

- Align modifications with the maintainer.
- Marcos enable settings make some potential danger.

The stream overview is completely fit in the Excel 2007. The “Seeking Mantra”, as chapter 3 describing for the visual design guideline, has been fulfilled by Excel itself. Some of the user requirement in chapter 4.2 can also match the use cases in Excel 2007.

People need to align modifications with the maintainer. In fact, the main user should be responsible for the stream view. Appleton (et al. 1998) thinks if everyone is responsible for a thing, then often no one is. Features, changes, components, and milestones need responsible owners who understand their purpose and are held accountable for the success of their outcomes.

5.3 Related work: Comparisons with other tools

Other visualization tools can be found on internet. The following tools are divided into three groups:

Group 1: This group is the CM tools which has the visual utility. They are:

IBM Clearcase (www.rational.com/products/clearcase):

(described in chapter 3.4)

CVS (www.nongnu.org/cvs):

There are many GUI tools for CVS. An example of visual utility for CVS is CvsGraph. (http://www.akhphd.au.dk/~bertho/cvsgraph/) It creates a graphic representation of the revisions and branches in acvs/rcs repository.

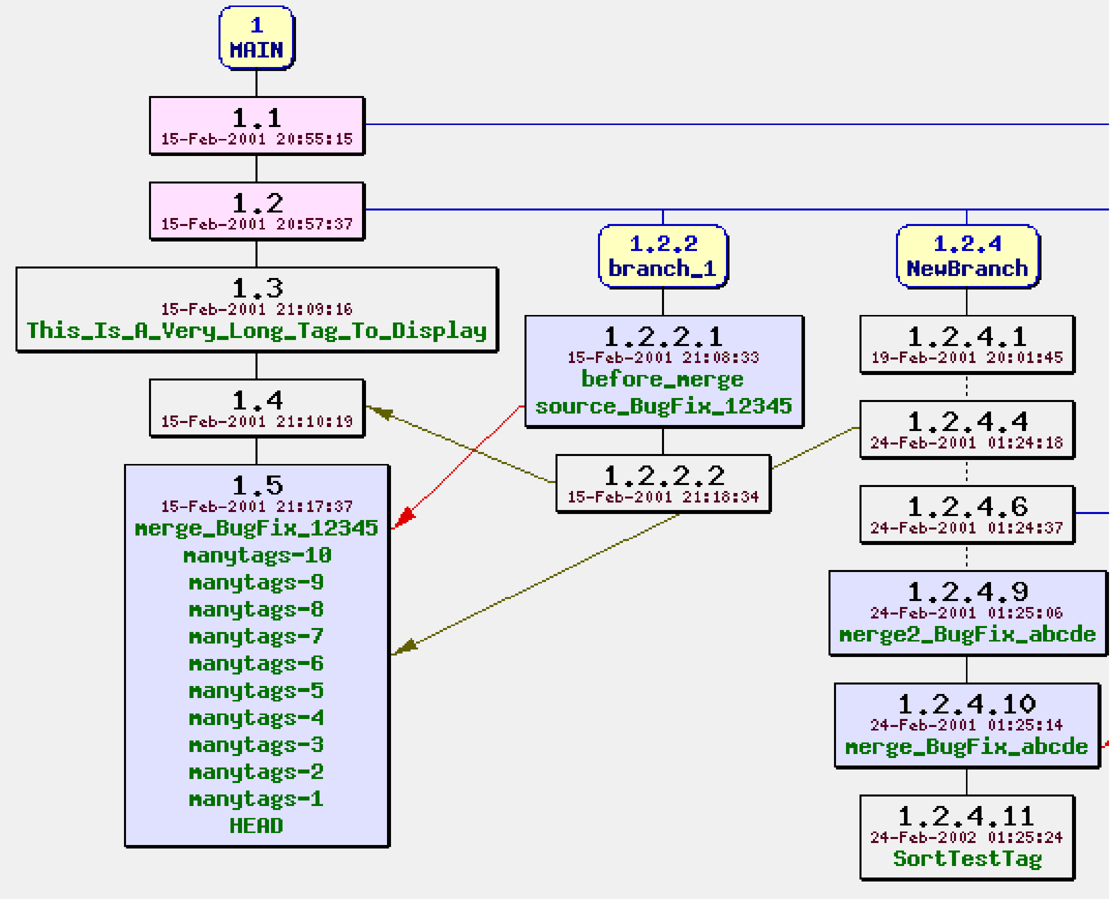
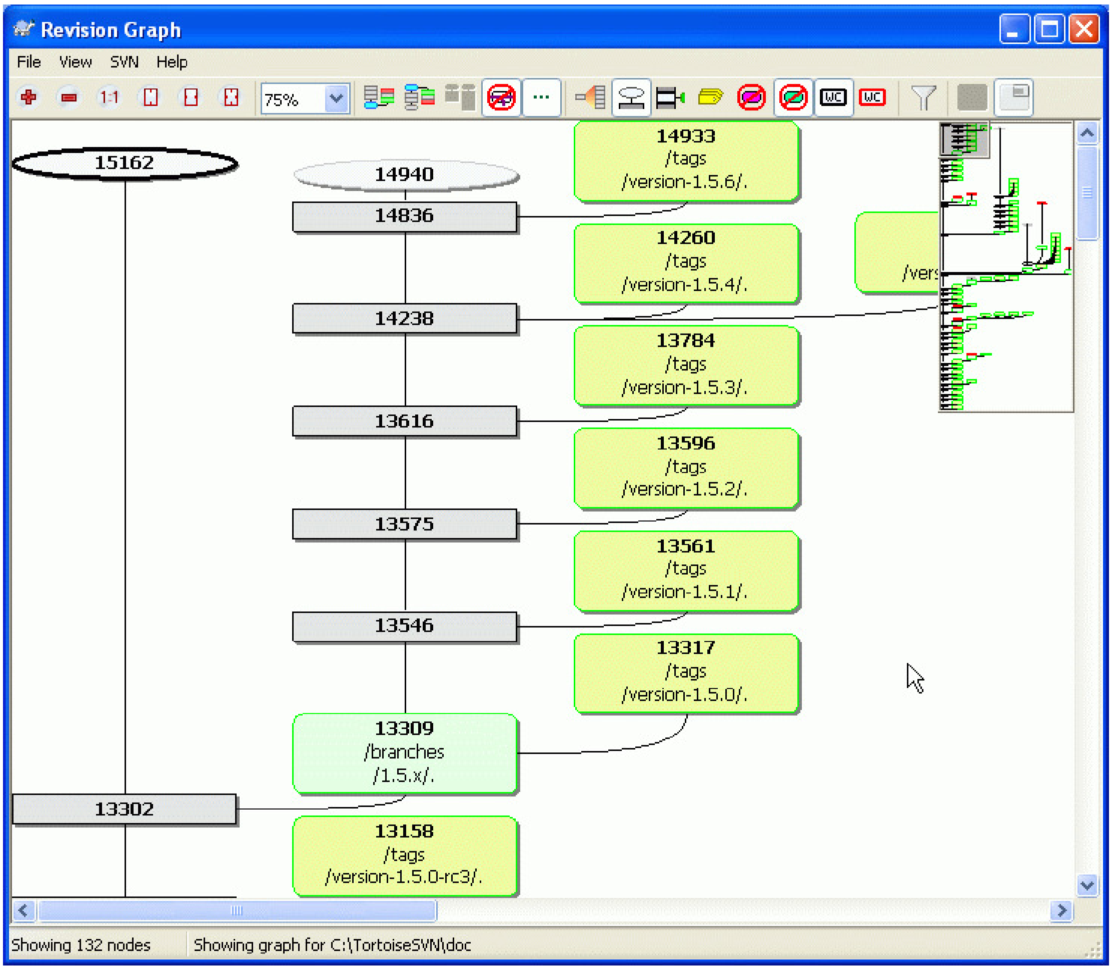


Figure 5.2 history view by CvsGraph (http://www.akhphd.au.dk/~bertho/cvsgraph/)

SVN (subversion.apache.org):

SVN is quite similar as CVS. There are also many GUI tools for SVN. Take the svn-graph as a example. Svn-graph can generates plots based on the logs of Subversion repositories.(http://wiki.freaks-unidos.net/svn-graph)

Another notable SVN tool for windows is TortoiseSVN,
(http://tortoisesvn.net/docs/release/TortoiseSVN_en/help-onepage.html) .
TortoiseSVN fetch all log messages from the repository root to generate the graph.


Revision Graph
File
View
SVN
Help
75%
15162
14940
14836
14238
13616
13575
13546
13302
14933 /tags /version-1.5.6/.
14260 /tags /version-1.5.4/.
13784 /tags /version-1.5.3/.
13596 /tags /version-1.5.2/.
13561 /tags /version-1.5.1/.
13317 /tags /version-1.5.0/.
13309 /branches /1.5.x/.
13158 /tags /version-1.5.0-rc3/.
/vers

Showing 132 nodes

Showing graph for C:\TortoiseSVN\doc

Figure 5.2 history view by TortoiseSVN (http://tortoisesvn.net/docs/release/TortoiseSVN_en/help-onepage.html)

Group 2: This group contains the tools which are general-purpose diagramming software,they are:

Microsoft Visio (office.microsoft.com/en-us/visio)

Dia (live.gnome.org/Dia/)

Group 3: This group of tools is used as other purpose in visualizing, but they may be used in Configuration management. They are:

Smile framework (simile.mit.edu/wiki/Exhibit)

MS project (office.microsoft.com/en-us/project) (see chapter 3.4)

Table 5.1 tools Comparisons

Software Name	**Status Platform**	**type**	**Branch and merge pattern**	**Stream View For Planning purpose**	**maintainable mechanism for Stream View for**
IBM Rational ClearCase	AIX, z/OS, Linux, HP-UX, Solaris and Windows	Commercial	Yes	No	Yes
CVS	Unix-like, Windows	GPL	Yes	No	Yes
SVN	Cross-platform	Apache License	Yes	No	Yes
MS Visio	Windows	Commercial	Yes	Yes	No
Dia	Cross-platform	GPL	Yes	Yes	No
Simile Exhibit	Cross-platform	BSD License	No	Yes	Yes
MS Project	Windows	Commercial	No	Yes	Yes

The table 5.1 lists the tools in three groups in different colors. The first three tools in group 1: Clearcase, CVS and SVN are widely used in configuration management. These tools generate an overview based on the history in the database which is build up during development. User can't modify repository data directly for the overview, which means they don’t support the view for planning. Visio and Dia are the representative software that user can draw diagram feely, however its maintainability is weak. MS Project is a typical project management tool, it supports the project view for planning, but as the chapter 3.4 described, this kind of tool does not support the branch and merging structure in configuration management. Simile framework is a good approach for timeline view, but no merging features.

The evaluation results shows that there is some overlap in functionality among the other visualize tools. Take the Clearcase view as an example, the Clearcase view is important history view in configuration management. The stream overview generator can be also used for the history view for reviewing and auditing .However, the stream overview generator does not tend to instead all the tools in configuration management but enhance and improve the maintainability of the stream view. Compare with the Visio and Dia, The stream overview generator is strictly defined the visual elements so that it increase the maintainability. For other CM tools such as Clearcase , CVS,and SVN, they don’t have the visual utilities for planning, stream overview generator solve the stream view which can be used as planning purpose.

6 Discussion

Project information visualization:

In Chapter 4.4, several diagrams are discussed. Some Users use “Version”, some use “milestone” in stream view. These terms can be in common but they also have different meanings. Version refers to the version control in configuration management; milestone is the start or end of stage for a project phase. The version belongs to the file-oriented stream overview while as the milestone should be in the project-oriented domain. In order to avoid the mixed information, dividing all the information to different views is better.

Stream overview generator

The early stage of the study is to build the stream overview generator which the configuration managers want. The plug-in tool was designed and developed as a case study in this research work.The plug-in tool embeds in a workbook in Excel 2007, the workbook file extension end with xlsm (Excel 2007 XML Macro-Enabled Workbook). The tool use more than 256 columns and rows 65536 which exceed the maximum range of the excel 2003, hence the plug-in tool can only run in the excel 2007 right now. However, after the stream overview is generated, user can choose to save as Excel 97-2003 format so that the old version of excel can also open and view the stream overview.

Because the stream overview generator needs the user allow the macros in Excel, there are some potentially dangerous for the macro viruses. VBA can execute when documents are opened, it has access to most Microsoft Windows system calls. This makes it easily to infect a computer with macro viruses. However, current anti-virus programs can detect macro viruses as well as other types and immediately counteract such attacks.

Colors for the stream overview were discussed; all the users think the different colors can help them to identity elements in stream view. Dark red and dark green are chosen for color scheme at first, but the user feel the lighter color is comfortable on the screen and causes less eyestrain. Hence the bar’s color changed to light color.

The positions of the stream line are not close to each other but there is one blank row between two bars. This makes the streamline easy to read. If the user adds the child project, the stream overview will generate the child project bar under the parent project bar.

Maintainer for the stream view:

The plug-in tool is for single user, if other users want to use the stream overview generator, they need to align modifications with the maintainer. The maintainer takes charge of the stream overview. At the beginning of the design, the web system which can be used for multi-users was planed. However, the security of the web system for stream overview needs to be considered for the multi-user. Due to the strict security policy for the web server in the company, the BS (browser- server) model was given up and I tried to design the tool which can run without the internet.

7 Conclusion

This master thesis explores how to present a project stream overview in a graphical way, and also find a solution to both maintaining and planning the project stream view. The result of study, supported by literature review and case study results, is that the graphic view in configuration management for planning purpose is needed. Although some tools support the graphic view for parallel project, they have many limitations.

Most of the CM tools just generate the history view of the project stream (chapter 5.3). For the planning of the stream view, people usually use the general-purpose diagramming software for visualizing the project stream information. However, these visualization tools lack the standard which specifies the structure of the stream overview. There are several different ways of annotating for the stream view. Hence some of the overviews are composed of various non-standard attributes and some of the elements are ambiguous for the audience. These general-purpose diagramming tools also have maintainability and inaccuracy issues as time goes by.

One lesson is learned from Philips is that: People lack of a stream overview generator which has standardized visual elements, good maintainability and self-correction mechanism. What I did in the research study is valuable for the new visual CM tools design for other companies. The stream overview generator must fit in the configuration management. The user inter-action design should be also concerned of “Seeking Mantra” (Shneiderman B, 1996) -- Overview first, zoom and filter, then details-on-demand. This research study shows that there is a gap in configuration management.The stream overviews for planning propose is necessary to have a good solution.

In the case study, the plug-in tool is completely embedded in Excel workbook and gains advantages of Excel 2007 in the field of “Seeking Mantra”. It shows how we can optimize presenting and maintaining for the stream overview in configuration management. The complexity of managing the parallel projects leads to the advanced configuration management technology. The stream overview as an important communication documents are very important for Identification, Control, Status Accounting, Audit, review, and planning. Hence, the stream overview generator is essential in industry.

Future research in this field could improve on the architecture for multi-users management in generating the stream views. The “clients-Server” architecture would be interesting to be investigated. By supporting collaborative activities and their coordination for creating and maintaining the stream overview, the stream overview tool can increase its usability. Another issue is the components relations behind each sub project, considering the re-use engineering; each sub project may have several related components. When the projects are modified or added, the development team including the configuration management group need be aware of the components. In the future, the possibility to view streams at component level help people avoid the mistakes in the potential relations among the projects. This can be valuable to see dependencies for different components in the system.

8 References

Appleton, Brad, Berczuk Steve, Cabrera Ralph, and Orenstein Robert. 1998. "*Streamed Lines: Branching Patterns for Parallel Software Development.*" PLoP 98conference.Available: http://www.cmcrossroads.com/bradapp/acme/branching/ (Last access, 2010-01-27)

Berczuk Stephen P, Appleton Brad: *Software Configuration Management Patterns: Effective Teamwork, Practical Integration*. Addison Wesley, ISBN : 0-201-74117-2, 2002.

Bret Tom, Confluence Systems Ltd (2004) *Parallel Development Strategies for Software Configuration Management*, published in the Summer 2004 issue of Methods & Tools

CvsGraph (http://www.akhphd.au.dk/~bertho/cvsgraph/)(Last access, 2010 july.07)

Dart, Susan. 1992. "*The Past, Present, and Future of Configuration Management.*" Software Engineering Institute.

Denzin, N. K. (1970). *The Research Act in Sociology*. Chicago: Aldine.

EDWARD H. BERSOFF: Elements of Software Configuration Management. *IEEE TRANSACTIONS ON SOFTWARE ENGINEERING,* VOL. SE-10, NO. 1, JANUARY 1984, pp. 79-86.

Desai N, Bradshaw R, Matott S, Bittner S, Coghlan S, Evard R, Lueninghoener C, Leggett T, Navarro J , Rackow G, Stacey C, and Stacey T, *A Case Study in Configuration Management Tool Deployment.* In Proc. of the Large Installations Systems Administration (LISA) Conference, December 2005

Feiler P, Downey G (November 1990), *Transaction-Oriented Configuration Management: A Case Study*. Carnegie-mellon University.

Grinter RE, *Using a Configuration Management Tool to Coordinate Software Development*.1995, University of California

Heer Jeffrey, Card Stuart K., Landay James (2005). "*Prefuse: a toolkit for interactive information visualization*". In: ACM Human Factors in Computing Systems CHI 2005.

Hove SE, Anda B, *Experiences from Conducting Semi-Structured Interviews in Empirical Software Engineering Research.* Simula Research Laboratory Simula Research Laboratory, - 11th IEEE International Symposium Software Metrics, 2005

IBM infocenter,*2009, IBM Rational ClearCase, ClearCase Version Tree.* http://publib.boulder.ibm.com/infocenter/cchelp/v7r0m1/index.jsp?to pic=/com.ibm.rational.clearcase.doc/topics/u_ccvtree.htm (Last access, 2009-12-09)

IEEE *Guide to Software Configuration Management.* 1987. IEEE/ANSI Standard 1042-1987.

Microsoft office online help http://office.microsoft.com (Last access, 2010-01-15)

Microsoft MSDN, 2007 Microsoft Office System: http://msdn.microsoft.com/en-us/library/aa730921.aspx (Last access, 2009-12-22)

Philips official website http://www.philips.com (Last access, 2010 Jan 5)

Rosenblum, L.J., Brown Bruce E., *Visualization*, IEEE Computer Graphics & Applications, July 1992, 18-20

Schaap René, Bendix L, Hass AM, et al, *Certified professional in configuration management.* 2007.07, INTCCM

Simile project: http://simile.mit.edu/ (Last access, 2009-12-09)

Shneiderman Ben, *The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations*. July 1996, University of Maryland, College Park, Maryland 20742

Tellis, W. (1997, July). Introduction to case study. *The Qualitative Report* [On-line serial], *3*(2). Avalable: http://www.nova.edu/ssss/QR/QR3-2/tellis1.html. (Last access, 2009-12-09)

TortoiseSVN,http://tortoisesvn.net/docs/release/TortoiseSVN_en/help-onepage.html(Last access, 2010 july.07)

van Gent R.H., 2005, *The Mathematics of the ISO 8601 Calendar*, http://www.phys.uu.nl/~vgent/calendar/isocalendar.htm (Last access, 2010 May 5)

Yin, Robert K, *Case Study Research. Design and Method*, 1994, Second edition. Thousand Oaks: Sage)

Appendix 1 Questionnaire 1

1.What is your role? *

○ Architect

○ Intergrator

○ Librarian

○ build manager

● Specify your own value:

2. what is your responsibility? *

3. Do you think visualized information in project process is important?

3.a) why is the visualized information in configuration management important to you?

4.What are your information needs?

□ Project name

□ project type(level)

□ project time

□ version

□ PBL

□ PDC

□ subsystem

□ Merge arrow

□ Comments

□ Specify your own value:

5.How do you understand and specify "merge arrow"?

□ from one version to another version(release)

□ from one project to another project

□ Specify your own value:

6.Who do you need to communicate with directly before you presenting data?

□ Developer

□ System Architect

□ System Integrator

□ Librarian

□ Build manager

□ Specify your own value:

7.what's current tool are you using to visualize project information? *

□ Excel

□ Visio

□ PowerPoint

□ By hand in paper

□ Specify your own value:

8.What's the limitations for your current tools for drawing?

9.Is visulized timeline one of your concerns?

○ yes

○ no

● Specify your own value:

10.Do you think the colour help you to identity elements in stream view?

● Yes

○ No

11.What's your other concern on Visualize information for stream overview? any comments?

Appendix 2 Questionnaire 2

Question

1	Your role?
2	Can you briefly describe how you use stream overview in your work?
3	What is the advantage of this tool in your opinion?
4	What is the disadvantage of this tool in your opinion?
5	Do you miss any information in this way of presenting?
6	Any other comments?
7	Is it possible to contact you later and go through the results that I found out, and evaluate them? If yes, please leave your email or other contact information.

Appendix 3 use case overview

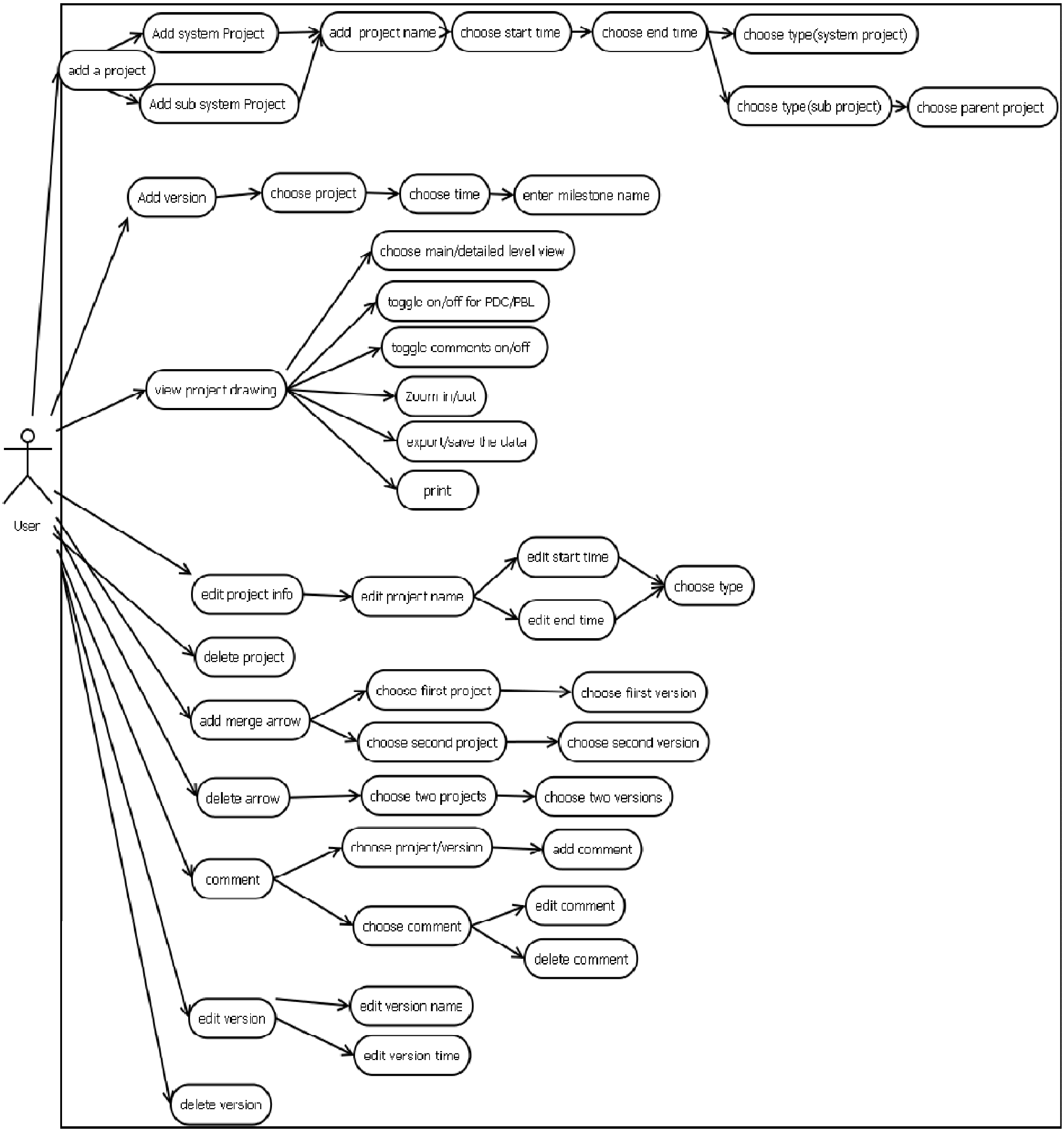


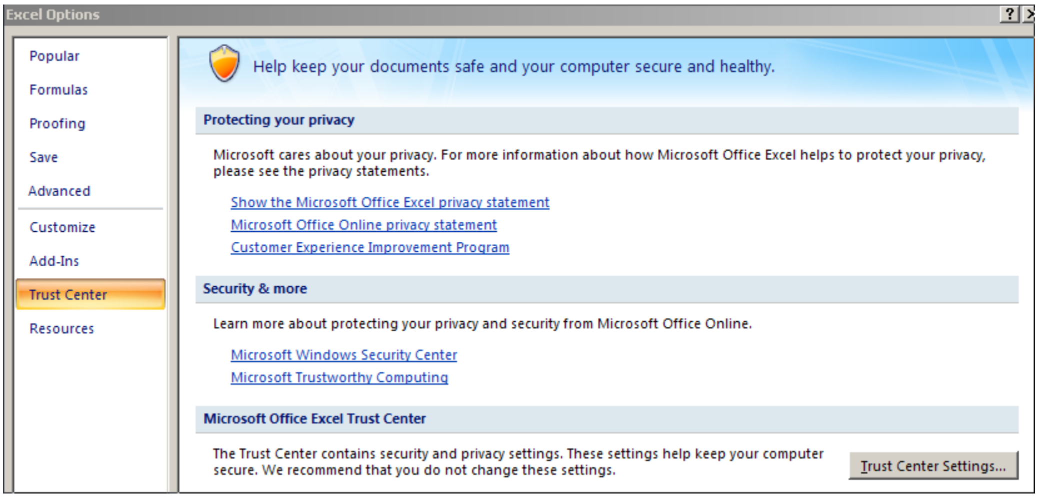
Figure 9.1 use case overview

My mentor in Company is also involved during the design and evaluations of the prototype. As the main stakeholder of the stream overview tool, we had many regular meetings. (Figure 9.1 shows the use cases)

Appendix 4 Configuration for the plug-in tool in Excel 2007

User needs to enable the Marcos in Excel 2007.follow the instruction below:

1. Click the Microsoft Office Button , and then click Excel Options.
   Excel Options
2. Trust Center, click Trust Center Settings, and then click Macro Settings.



Help keep your documents safe and your computer secure and healthy.

Protecting your privacy

Microsoft cares about your privacy. For more information about how Microsoft Office Excel helps to protect your privacy, please see the privacy statements.

Show the Microsoft Office Excel privacy statement
Microsoft Office Online privacy statement
Customer Experience Improvement Program

Security & more

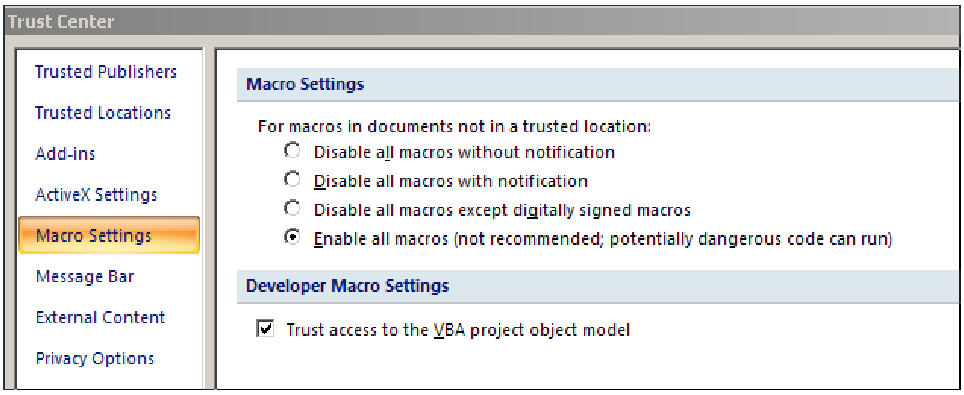
Learn more about protecting your privacy and security from Microsoft Office Online.

Microsoft Windows Security Center
Microsoft Trustworthy Computing

Microsoft Office Excel Trust Center

The Trust Center contains security and privacy settings. These settings help keep your computer secure. We recommend that you do not change these settings.

Figure7.1 Trust center setting



Macro Settings

For macros in documents not in a trusted location:

○ Disable all macros without notification
○ Disable all macros with notification
○ Disable all macros except digitally signed macros
● Enable all macros (not recommended; potentially dangerous code can run)

Developer Macro Settings

☑ Trust access to the VBA project object model

Figure7.2 Macro settings

3. Enable all macros (not recommended, potentially dangerous code can run): Click this option to allow all macros to run.
4. Trust access to the VBA project object model: this setting is for developers and is used to deliberately lock out or allow programmatic access to the VBA object model from any Automation client. In other words, it provides a security option for code that is written to automate an Office program and programmatically manipulate the Microsoft Visual Basic for Applications (VBA) environment and object model. This is a per user and per application setting, and denies access by default. This security option makes it more difficult for unauthorized programs to build "self-replicating" code that can harm end-user systems. For any Automation client to be able to access the VBA object

model programmatically, the user running the code must explicitly grant access. (Microsoft office online)

Appendix 5 GLOSSARY & DEFINITIONS

ART: Application Release Test

BS model: Browser- Server model

CS model: Clients-Server model

BSD: Berkeley Software Distribution

CT: Computed Tomography

CM: configuration management

DCM: development configuration management

ER diagram: Entity-relationship diagram

GUI: Graphic user interface

GPL: GNU General Public License

IEEE: Institute of Electrical and Electronics Engineers

ISO: International Organization for Standardization

IXR: Interventional X-Ray

MID: Master Integration Diagram

MR: Magnetic Resonance

MSDN: Microsoft Developer Network

MSP : Microsoft Project

PDF: Portable Document Format (PDF)

PDC: Product Domain Content

PBL: Product base line

SCM: software configuration management

UML: Unified Modeling Language

VBA: Visual Basic for Applications

XML: Extensible Markup Language

XPS: XML Paper Specification, a Microsoft royalty-free fixed-layout document format

ZIP: The ZIP file format is a data compression and archive format