Metrics for SCM Analysis

Project Evaluation

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Contents

1 foobar: Big picture

foobar: Is a Software Development Company focused in web data mining applications and result interpretation.

Develop analysis from social media networks, crawlers and issue trackers to convert all the information to a human-readable solution for our clients. As some examples we are expertise in issue trackers visualization chars tools to convert the information into graphic that assist the project manager to make decisions faster and easily with just a look.

2 Integrate VCS

We need to implement a forge because our developers are in different physical locations and want to integrate all development and managing tools for more efficient management.

The tools that we want to integrate are:

- Version Control System VCS
- Issue Tracker
- Mail Server
- Continuous Integration Test
- Code Quality Analyzer

In this analysis we will begin the search for a VCS to suit our requirements.

3 VCS

VCS: Version Control System. A Version Control System is a tool for managing files and its life cycle within a project. Manages all actions performed on them, create, save, copy, delete, move. The information is reflected in a database, and providing historical creating a dynamic management of resources to users.

We will integrate a Version Control System to work in our software development company by analyzing a set metric tailored to our requirements.

3.1 Subversion: SVN

Subversion[1]: is a FLOSS[2] Centralized Version Control System. It was created in 2000 by the company Collabnet belonging to the Apache Foundation.

SVN is the VCS most used in FLOSS[3] and private projects as a Source Code Management (SCM) tool

3.2 Git

Git[4]: is a FLOSS Distributed Version Control System focused on branching methods.

Git was initially designed and developed by Linus Torvalds[5] for Linux[6] kernel development.

3.3 CVS

CVS[7]: Concurrent Versions System; is a version control system, an important component of Source Configuration Management (SCM). Is a FLOSS Centralized Version Control System.

Dick Grune developed CVS as a series of shell scripts in July 1986[8].

4 Requirements

Our initial requirements for the election of VCS tool are:

- GUI Management Tools.
- Integration with IDEs.
- Mature and Stable versions.
- Lower learning curve.
- Success cases.

[1] http://subversion.tigris.org/
[2] Free Libre Open Source Software
[3] http://www.ohloh.net/repositories/compare
[4] http://git-scm.com/
[5] https://plus.google.com/+LinusTorvalds/about
[6] http://www.linuxfoundation.org/
[7] http://subversion.tigris.org/
[8] http://ximbiot.com/cvs/manual/cvs-1.12.12/cvs_1.html

- License.
- Backup and restore.
- Migration guide.
- fork easily.

These requirements has to become metrics because in this way we can evaluate with a technical and standard process.

5 Metrics: Analysis

Metrics: These are a set of measurable attributes that provide quantifiable information for the test result.

It is to define a set of metrics to evaluate the VCS projects and be able to quantify the final note. In this way, we obtain a numerical result of the project under review.

This result can be compared by analyzing other existing solutions to our problem. Comparisons are made with the results obtained from the same premises for different version control systems and thus enables us to choose the most appropriate by value representation.

5.1 OpenBRR Model

Exist some analysis project models such OpenBRR which this analysis is based

OpenBRR was created as a project of unification of metrics for software projects. This model is considered free as it is project-oriented Free Software (FLOSS). Born in the year 2005 for this purpose but, as its website indicates, has failed to create a large community around.

Gives freedom when scoring each metric by a score of 1-5. Each section is divided to be more specific sub-metrics. Next, specific weight is given to each and thus be given greater weight to the metric that is considered more important by the user of the model. Generates output suitable for analysis.

The weight of the resulting metric provides personalized for the user and therefore nearest and manageable. For example: if the metric of documentation has a weight of 50 % as opposed to security-related metrics with 10 %, we are seeking a Software documentation which is the most important for our project and so both after data collection surely choose who has obtained the highest score with respect to documentation. It is an example roughly but quite clear. The weight is the most important because the final result depends on the value that we give to each section or metric. Thus we have an outcome directly related to our initial requirements.

We adapted OpenBRR model using scoring one to five (without 0 value) for each defined metric thus give us a wide range of possibilities and scalability to match a good result.

We found it difficult to find templates for OpenBRR model because the model state if mentioned in the previous paragraphs.

5.2 Metrics chosen

We have chosen a set of metrics to represent the most important values related to file management. This set is specific for evaluating software so we can reuse most metrics obtained for other software projects.

Extending the model *OpenBRR* have added some new metrics and eliminated other in order to create the specific model for our case.

Category
Initial Analysis
Functionality
Usability
Robustness
Development
Community
Documentation

5.3 Weight & Punctuation

After analyzing the requirements and scoring metrics, we proceed to give a weight to each section defined in the document. The weight given is what gives the final value that the user seeks to create a subjective result from an objective score. That is, to adapt to the needs of the company to the product being analyzed.

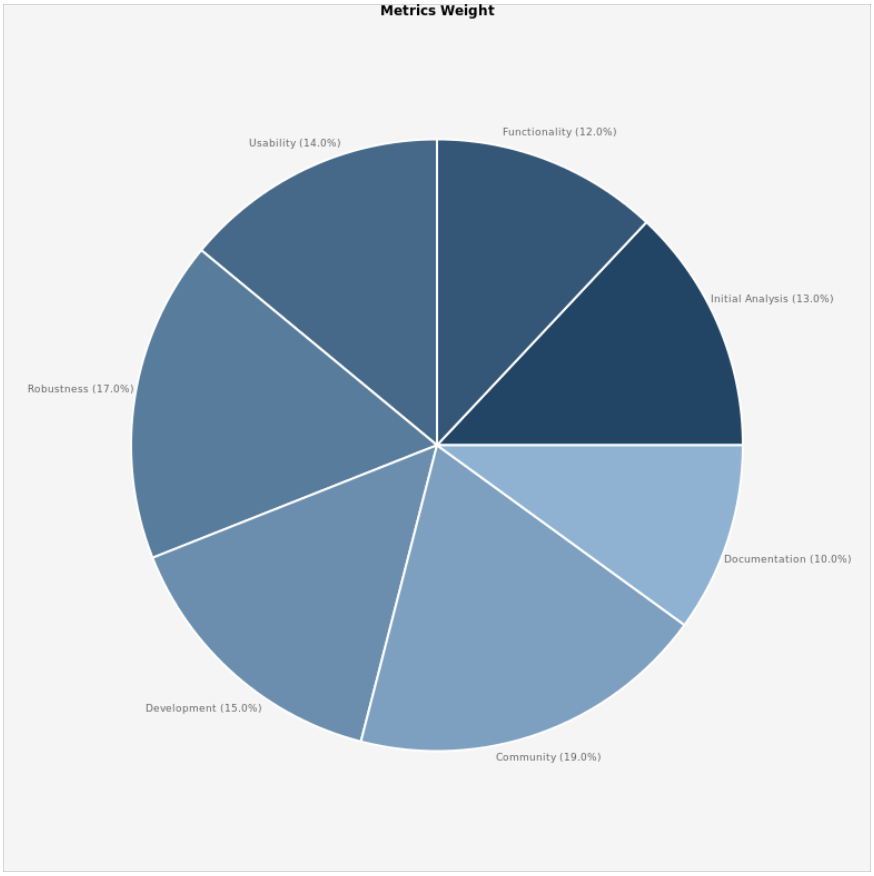

Figure 1: Weight defined for each Category

We defined the weight given to each category in figure 1.

Category	Weight
Initial Analysis	13,00%
Functionality	12,00%
Usability	14,00%
Robustness	17,00%
Development	15,00%
Community	19,00%
Documentation	10,00%

You can see that the value that is given more weight is Community with 19 %, followed Robustness with 17 % and Development with 15 %.

5.3.1 Community, Robustness and Development

We can see how the metric highlights related *Community* because being a FLOSS project depend in part on the interaction of the community, ie the health of it. At first it seems to be in good health because of its history but in recent years has been decreasing the work reflected in the community regarding email lists and commits per month. It can also be noted that the initial development team is not present in the current development of an active but this has not affected the development. There has been renewed core providing strength to the project developers.

- *Avg commits per month, last six months.*
  - Compare with other projects or **itself with other year results**. Comparison with six month and twelve earlier.

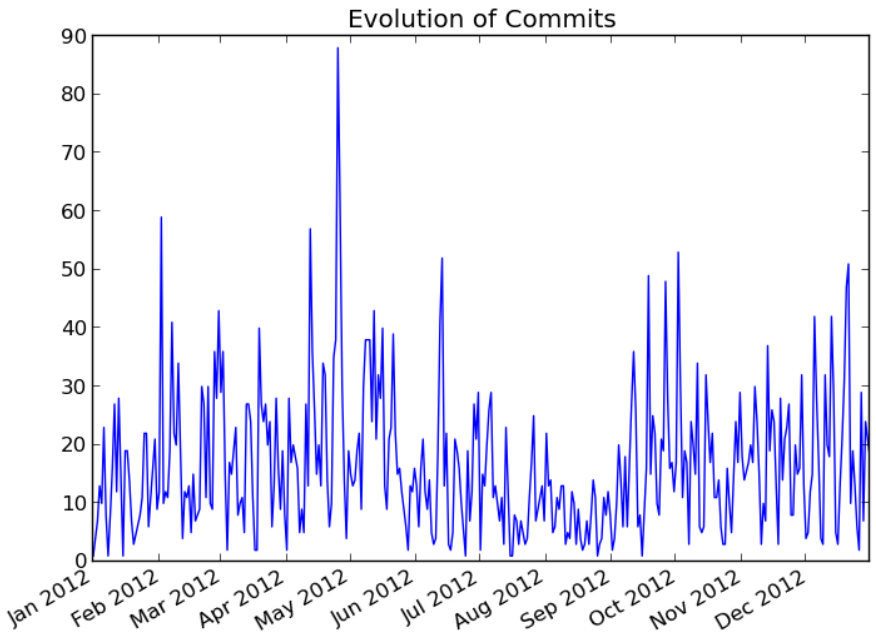

Figure 2: Commit evolution during 2012

  - **Result**: Less work than a year before on total commits (-,-,-,-,-,+) as show in figure 2:

- *Avg monthly volume of general mailing lists during the last six months.*
  - Compare with other projects or itself with other year results. Table from 2012:

Jan (4.5M)	Feb (2.5M)	Mar (3.5M)	Apr (2.1M)	May (1.8M)	Jun (1.8M)
-	+	-	-	-	-
Jul (1.4M)	Aug (3.3M)	Sep (1.9M)	Oct (1.7M)	Nov (1.7M)	Dec (497K)

  - **Decreases**.

- *Developers that left the project and those that started to participate (last year) (and also for the core team).*
  - Started to participate las year: **6**

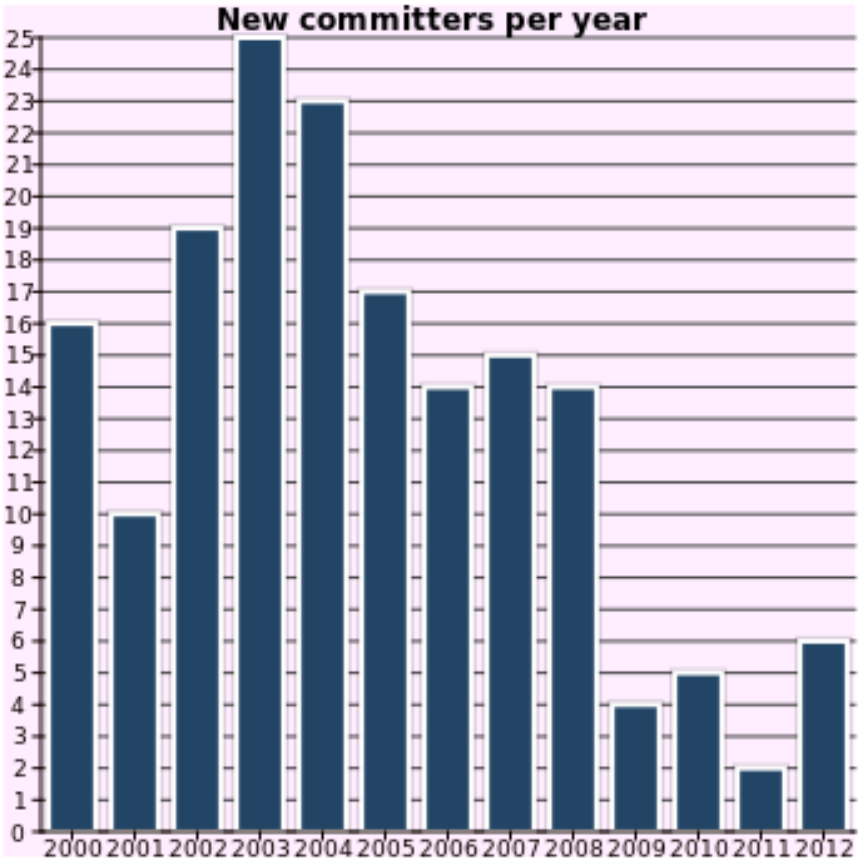

Figure 3: New committers per year.

- Knowledge concentration (territoriality): In 2012 year we can assume a territoriality over 80% with 8538 actions from the total of 10417 in files per one developer, so 81,96%.

- Is still the original developer/team active nowadays? Yes, innactive.
  - How did affect the project ? commits avg continued normal ?
  - Yes, the core team continues in the project but not with the same weight. This not affects the repository because commits per month is constant.

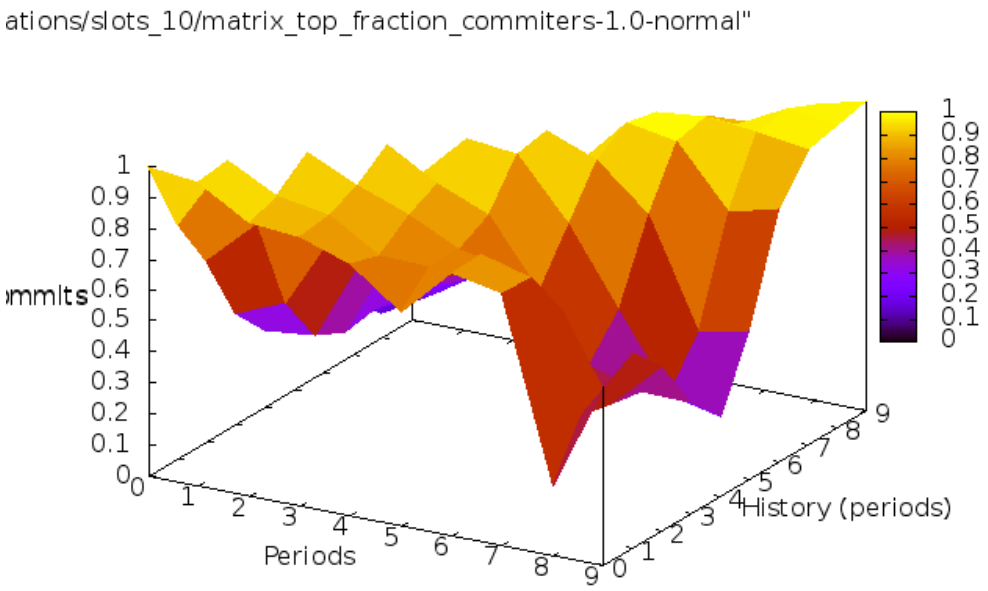

Figure 4: Evolution of core committers team.

  - As we can see from the figure 4, the first block of core committer evolves from the beginning to the last period in descending turn, we see that the new core group of committers in this period has supplanted the role of the first. Therefore, the core committers have been renovated in the Subversion project over different periods. The decline in core work of early committers, has not influenced the evolution of the project. Thereby enjoying good health by their developers.

By the *Robustness* can say that this is a complete project. We say this after observing the care that is in each of the versions that have been published and the treatment given to them. It keeps alive a previous version (1.6) only if there are security errors while development continues forward with the current version (1.7) fixing bugs and releasing each patch with an average of two months. These data were collected for 2012.

- *Versions.*

Version	Date	History	Problems solved
1.7.x	October 11, 2011	Fully supported	Fixes for all bugs
1.6.x	March 20, 2009	Partially supported	Only fixes for security issues and bugs which could cause data loss
1.5.x	June 19, 2008 and earlier	No longer supported	No longer supported

- *Num. point/patch releases last year.*
  - Number of releases is constant ? depends of the year ? Public roadmap for next versions[9].
  - Patches in last year is constant ? Average: two months[10].

Version	Date	Information
1.7.8	(Thursday, 20 December 2012)	Bugfix release.
1.7.7	(Tuesday, 9 October 2012)	Bugfix release.
1.7.6	(Wednesday, 15 August 2012)	Bugfix release.
1.7.5	(Thursday, 17 May 2012)	Bugfix/security release.
1.7.4	(Thursday, 8 March 2012)	Bugfix release.
1.7.3	(Monday, 13 February 2012)	Bugfix release.

Regarding *Development* we see that the score is good because it has various APIs (in various programming languages C and Java are the most widespread[11] and demanded in the market[12]) and is used in external projects so it is a widespread practice. But of course, you have to know how to program in order to understand the API.

- *Project API in the same web* - Client for Java and C.
- *Easy understanding* - Easy understanding for Software Developers.
- *Is it used in other projects not directly related?* - Yes, from extra plugins, functionalities, integrated in applications and forges.

The documentation included in the development is extensive and clear. There are various examples to initialize repositories and projects. The manuals include examples related to each option and the documentation is clear and concise. Svnbook has a book in different languages. Reading the book helps a lot in making contact with the tool. By the offline help, not much beyond the command **man** (own documentation of a tool), where there are no good examples of use.

[9] http://subversion.apache.org/roadmap.html
[10] http://subversion.apache.org/docs/release-notes/release-history.html
[11] http://www.ohloh.net/languages/compare?measure=loc_changed&percent=true
[12] http://www.tiobe.com/index.php/content/paperinfo/tpci/index.html

- *Online tutorials* - Development[13] and API documentation too.
- *Offline tutorials* - SVNBook[14]
- *Hello World* - Tutorial to initialize a Repository in 10 minutes.
- *Books from the author, authors or company* - SVNBook
- *Languages* - Various Languages (Deutsche — English — French — Spanish — Italian — Japanese — Norwegian — Portuguese — Russian — Chinese)

In a second group we can see that appear Usability 14 %, Initial Analysis 13 % and Functionality 12 %.

5.3.2 Usability, Initial Analysis and Functionality

Usability, in this case we refer to the usability related to the interaction between the user and the tool. The server configuration is a highlight that we see in the inner section *Client UI*. Several options are valid for the control management tool. Moreover we also observe that this tool is widespread and has a high learning curve but that you have to be a technical person to quickly take advantage of the functionality that presents Subversion.

- *UI client.*
  - Internal (server management) - Using *svnadmin* command in server mode.
  - Included - It's included in the installation.
  - Extra plugin - Has extra plugin to apply this functionalities but not depends on it.
  - Web client - User-Friendly SVN[15] promoted by Collabnet.
- *Easy learning.*
  - Too technical - Not too much technical to use.
  - Early adoption - Is the most VCS used around the world of Software Development.
  - Low learning curve - Yes, it's easy to get in touch and work.

Initial Analysis section includes two important values, the license under which the software is released and the time it takes to launch the first repository. As part of the license is the Apache License v2.0[16]. FLOSS License is an *standard* that is compatible

[13] http://subversion.apache.org/docs/
[14] http://svnbook.red-bean.com/
[15] http://www.usvn.info/
[16] http://www.apache.org/licenses/LICENSE-2.0

with *GPLv3*[17]. The Apache License v2.0 gives us full control over the code and provide inputs to the official distribution by third parties.

- *Private* - **No**.
- *Free Software: Non standard (My own license)* **No**.
- *Free Software:* ***Standard***. Included in list of most used FLOSS Licences in OSI[18] and FSF directory[19].
- *Dual Licensing*: **No**.
- *Compatible with others* - **Yes**: The result is a license that is supposed to be compatible with other open source licenses, while remaining true to the original goals of the Apache Group and supportive of collaborative development across both nonprofit and commercial organizations. The Apache Software Foundation is still trying to determine if this version of the Apache License is compatible with the GPL[20].

The time of the first test is very critical as far as I'm concerned. We see that in a time frame of 10 to 30 minutes you publish a Subversion repository for user access. This time is a success as the first contact is the most important and time is not wasted. Publish a functional online repository in between 10 to 30 minutes.

- *>4 hours*
- *1-4*
- *30 min - 1 hour*
- ***10 - 30*** - Install and publish the repository with **Apache** or **svnserve**[21].
- *<10 minutes*

In the category *Functionality*, UI foremost ranks with 40 % of the score. The multiple options to access Subversion repository management regardless of having the user level, make this tool your fast and easy access to the different types of users to be found.

- *Console client* - Yes included.
- *OS file explorer integration* - Collabnet Tortoise SVN - http://tortoisesvn.tigris.org/ GPL)
- *Graphic client* - Tortoise SVN.
- *Specific plugin for tools* - Eclipse Plugin by Tigris: Subclipse - http://subclipse.tigris.org/

[17] http://www.apache.org/licenses/GPL-compatibility.html
[18] http://opensource.org/licenses/index.html
[19] http://www.gnu.org/licenses/license-list.en.html
[20] http://www.apache.org/licenses/GPL-compatibility.html
[21] http://svnbook.red-bean.com/en/1.7/svn.ref.svnserve.html

- *Solution from the same company* - **Yes**, Collabnet - http://www.usvn.info/ using Cecill License (GPL Compatible)

One point to note is related to *Backup and restore*. This aspect has been very careful in Subversion. Includes a proprietary tool to manage copies of the database repository and a speedy recovery. Integrates with all operating systems and can be configured easily.

- *Nothing* - *Not necessary.*
- *Workaround solution* - *Not necessary.*
- *Extra plugin* - *Not necessary.*
- *Included* - **Yes**, has a tool to backup repository database included.
- *Easily Configurable* - *Backup from svn database* using *svnadmin dump* command total or incremental. Use *svnadmin load* to restore backup version.

In the security section known as Profile management, we see that Subversion structure is divided into directories, for Subversion are all directories. So also are granted permissions from directories, groups and users. It's the classic security system that offers a visual tool USVN online. For non-technical users to ignore the server settings and manage groups, users and permissions on projects.

Finally the Documentation section with a weight of 10 %. This section is also included within Development is valued so much documentation related to the development of the tool documentation as such.

5.3.3 Documentation

This section has weighed less in the total analysis. Notably, as we have done previously that has a very good online documentation for the services offered by the tool Subversion but takes more documentation offline.

- *Online tutorials* - Development
- *Offline tutorials* - SVNBook
- *Hello World* - Setup a Repository in 10 minutes
- *Books from the author, authors or company* - SVNBook
- *Languages* - Various Languages (Deutsch — English — French — Spanish — Italian — Japanese — Norwegian — Portuguese — Russian — Chinese)

6 Results

We can see that the result is a score of **4.29 out of 5**. This result is transferred to a score of **85.87 out of 100** (applying rounding to two decimal places for each calculation).

Category	Weight	Unweighted Rating	Weighted Rating
Initial Analysis	13,00%	4,06	0,53
Functionality	12,00%	4,37	0,52
Usability	14,00%	4,67	0,65
Robustness	17,00%	4,61	0,78
Development	15,00%	4,47	0,67
Community	19,00%	3,65	0,69
Documentation	10,00%	4,4	0,44

Following the model proposed by OpenBRR, the score of 100 is considered acceptable since it is within the range of 80 to 90 points. This score alone does not tell us much more than the number.

Now we have to make the comparison with other Version Control Systems using the same metrics described in the document. In this way we can obtain comparable numbers and choose the VCS that more suits our needs.

7 Compare Results

In the table below we can see a comparison of the results obtained from the analysis of the three possible solutions, *SVN*, *Git* and *CVS* using *Unweighted Rating (UR)* and *Weighted Rating (WR)*:

		Subversion		**Git**		**CVS**	
Category	**Weight**	**UR**	**WR**	**UR**	**WR**	**UR**	**WR**
Initial Analysis	13,00%	4,06	**0,53**	3,12	0,41	4,06	**0,53**
Functionality	12,00%	4,37	0,52	4,7	**0,56**	3,81	0,46
Usability	14,00%	4,67	**0,65**	3,53	0,49	3,93	0,55
Robustness	17,00%	4,61	0,78	4,73	**0,8**	3,03	0,52
Development	15,00%	4,47	0,67	4,67	**0,7**	3,78	0,57
Community	19,00%	3,65	0,69	4,1	**0,78**	1,96	0,37
Documentation	10,00%	4,4	0,44	5	**0,5**	3,3	0,33
Totals	100,00%	4,29	**85,87**	4,25	84,95	3,32	66,4

You get a better view of the result to convert numbers of key metrics in the table above to the graph in figure 5.

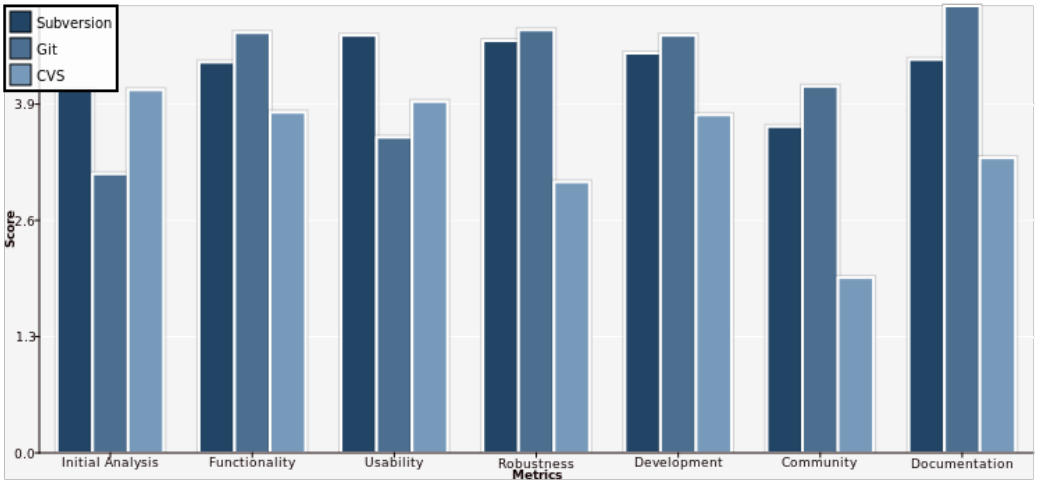

Figure 5: Main results from VCS metrics

At first glance it is seen that in the overall score **85.87 points** against **SVN** with minimal difference **Git 84.95**. CVS is relegated to a distant third with respect to both with 66.4 points. At first glance it is seen that in the overall score **stands SVN**. *SVN* gets a score of **85.87 points** with a minimum difference with *Git*. *Git* gets a score of **84.95 points**. *CVS* is relegated to a distant third with respect to both with **66.4 points**.

For further analysis, we divided the analysis in the same groups previously selected by the representation of requirements through the weights.

Although at first glance it seems that will fight to the death between SVN and Git as we can see in weighter final results per metric in figure 6:

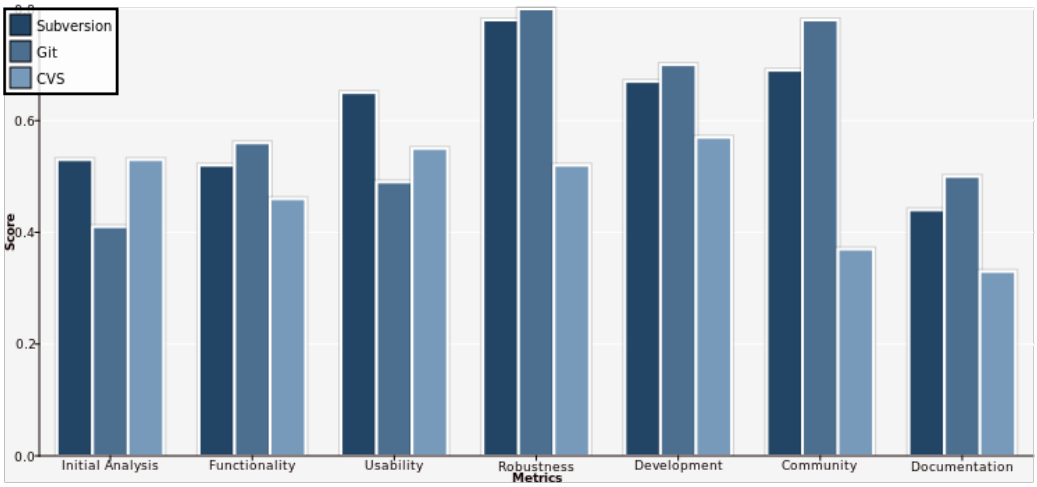

Figure 6: Weighted results from VCS metrics.

7.1 Community, Robustness and Development

Starting with the requirement for value, the *Community*, we see that in Git community is healthier than SVN and CVS course. CVS community is clearly outweighed by SVN and Git for double score.

In *Robustness* metric results we can appreciate *evenly between SVN and Git (0.78 vs. 0.8)*, whereas the score *CVS sinks back to 0.52*. SVN and CVS are on par with this paragraph.

Finally, the results obtained by the metric associated with the development, you see, again, a near tie between **SVN and Git** with *0.67 and 0.7 points respectively*. CVS *falls again* relegated to last place with **0.57 points**, not as far back as in the above metrics. This metric is important because it includes the score related documentation and API. These two points have to be taken into account because *we will have to work with them to integrate the VCS*.

We see that **Git** highlighted in this comprehensive set of metrics. Being the most important in relation to the initial requirements of the company.

7.2 Usability, Initial Analysis and Functionality

In this group of metrics, *Usability* is the most valuated by its weight. In this case we see how **SVN with 0.65 points** clearly leads the standings ahead of **CVS** and **Git** with

0.55 and 0.49 points respectively. Usability in SVN very careful as we see in the results. Furthermore compared to other tools strengthens.

Initial Analysis also led **SVN with 0.53 points tying with CVS**. One can say that being the oldest VCS weight we have given to the metrics relating to the qualities of the licenses they use and *easy setup of applications* are best suited to the detriment of **Git with 0.41 points**. Maybe that's immaturity in Git.

By the *Functionality* related metric can observe the good quality in **Git with 0.56 points**, *followed by SVN and CVS* with **0.52 points with 0.46 points**. The quality of the functionality in Git can claim to be high, because it has exceeded two VCS score established for over ten years.

In this metrics group we can see that **SVN is above Git and CVS** regarding *Usability, Functionality and Initial Analysis*. These qualities are important as *they are the key for user interaction with the VCS tool* so we have to take into account these results to the overall analysis.

7.3 Documentation

The last group contains only the metric only documentation. Has been relegated to the last place because it has more value to that included in Development. It is important because it contains the manuals and the *results of use and learning*.

Analyzing the results remains the general trend, **Git is in the lead with 0.5 points** while **SVN and CVS obtained 0.44 and 0.33 points respectively**. *Documentation and help* in Git stands for the quantity and quality, as we might say in *SVN*. The exception appears to **CVS**, it is not understandable that there is not level with the other two tools, being the oldest of the three, *seems not to have been able to manage the knowledge of the tool*.

8 Conclusions

After analyzing the results of the metrics applied to *Version Control Systems* considering the weight we have given to each of the metrics, we can say that:

For only look overall score results, **our chosen VCS would be : SVN**. *SVN* gets the highest score, but of course, *this choice would not be complete without a metric analysis to measure the results of a more specific way*.

So looking at the scores in order of preference in three groups. We have as a result that **Git** stands in *largest group* 7.1 in front of CVS and SVN. While **SVN** is at the head of *the second group* 7.2 ahead of Git and CVS. While *the latter group, not least*, the *Documentation* 7.3, **Git** again the highest score of the three systems analyzed.

So from the analysis *we can say that* Git *VCS is chosen to develop to be integrated in our company forge for development.* The facilities, the health professional and community support this decision ahead of SVN and CVS.

In this case the most suitable VCS is Git because the initial requirements consistent with the results obtained.

9 Further work

As notes for improving metrics, we would have made a more specific part of the community.

- More detailed analysis of e-mail lists. There are tools like MLStats[22] for e-mail list analysis.
- Measuring the efficiency of Issue tracker. As a tool you can use is BICHO[23] to measure efficiency.
- Level mentoring community, organization and rules. As such there is a tutorial for Subversion community[24].

Other points to consider would:

- If a foundation behind the product to manage project resources and a way forward in assemblies.
- Uses completely different to what the product was created.

  > One solution is good when you can use in completely different areas for which it was created.

Finally, another important point to be analyzed, it would be the quality of the source code. By using suitable metrics we can determine the quality of the source code for each project. Being different languages should use the same metrics for each of the languages. An example of a tool used for this purpose, is Sonar[25] and RoR with analysis of the various projects and Ratings Nemo[26].

And any idea that we might happen to improve Analysis Tools.

[22] https://github.com/MetricsGrimoire/MailingListStats
[23] https://github.com/MetricsGrimoire/Bicho
[24] http://subversion.apache.org/docs/community-guide/
[25] http://www.sonarsource.org/
[26] http://nemo.sonarsource.org/

10 Analysis Document

Analysis Document with all punctuations and comparisons between the three VCS could be found in github for downloading:

- https://github.com/ricardogarfe/mswl-project-evaluation/blob/master/final_report/scm-metrics.sxc

Here is the full metric list and its punctuation explanation. If you are interested in changing the weights of the metrics, open the sxc scm-metrics file and access Book Category Ranking. There is a summary of the results so you can do a quick scan to your preference among the three VCS elected.

You can change the assigned weights according to their requirements, while the total is 100 course, traps are not enabled yet.

Feel free to add it believes appropriate VCS has been left out of the analysis. As can be the case of mercurial, Bazaar, etc. This way you can get a more complete and robust document so it can be reused by more people.

11 Toolset

Tool: anything used as a means of performing an operation or achieving an end[27]. In this case the data collection and analysis are our end

For this analysis we have used various tools to get the necessary information.

11.1 Data sources

Data Sources from Internet:

- Website - http://subversion.apache.org/ & http://subversion.tigris.org/
- Source code management system - svn co http://svn.apache.org/repos/asf/subversion subversion
- Releases - http://subversion.apache.org/packages.html
- Wikis - http://wiki.apache.org/subversion/
- Documentation - http://subversion.apache.org/docs/
- Mailing lists -http://subversion.apache.org/mailing-lists.html
- Bug tracking system - http://subversion.tigris.org/issue-tracker.html

[27] http://www.wordreference.com/definition/tool

- Irc channel - IRC on channel #svn on irc.freenode.net

11.2 Data mining Applications

We used a pair of tools for obtaining related data repositories.

These two tools related to data mining are developed in python. Its main function is to make public information from a repository to a functional database with which you can easily obtain results about the activity of the community that the project develops.

- CVSAnaly[28] - The CVSAnalY tool extracts information out of source code repository logs and stores it into a database. Create a database with all the information regarding the repository, users, commits, files.
- libcvsanaly2[29] - Library to generate reports from the database created by CVSAnaly regarding actions on files in a repository.

11.3 Repository of Repositories: RoR

RoR are analysis repository tools. Display information about project communities: Committers, Groups, Application, Organizations, timelines in an easily visualization and configuration charts. For this analysis we used Ohloh.

- Ohloh[30] - Is a RoR where there are 581,685 open source projects analyzed. Contains many tools for displaying information and comparison among projects.

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