Evaluation of FOSS4G software projects for environmental applications. Evaluation of gvSIG.

Summary:
CASCADOSS team inventoried 98 FOSS4G software projects from five functional groups: general interest, development libraries, database management systems, desktop applications and server applications. Moreover 18 FOSS Environmental Applications software were inventoried. 45 of FOSS4G and all 18 of the inventoried EA projects were documented, evaluated and given a score based on its performance with regard to each individual software potential: marketing, technical and economical. The gvSIG project has been evaluated in the group of FOSS EA applications, gaining the scores of: 47, 44 and 45 for potentials: marketing, technical and economical, respectively. This gives around 75% of maximum 60 points for each potential. The result places gvSIG among the best three of evaluated FOSS EA project, however there is still room for improvement of the project within all of three potentials.

Keywords: software evaluation, FOSS4G, environmental applications, CASCADOSS.

Acknowledgments: the Cascadoss Project is financed by the European Commission under the Sixth Framework Programme

Authors: Wawer R.[1], Steenberghen T.[1], Rusztecka M.[2], Podolczak A.[3], Orlitova E.[4].
[1]Katholieke Universiteit Leuven Spatial Applications Division, Celestijnenlaan 200E, 3001 Heverlee, Belgium, Rafal.Wawer@sadl.kuleuven.be; Thetese.Steenberghen@sadl.kuleuven.be
[2]UNEP-GRID Warsaw. ul. Sobieszyńska 8, 00-764 Warszawa, Poland. monika@GRIDW.PL
[3] Compet-Terra Szervezo és Tanacsado BT. Kalvin tér 2 Szeged, H-6721, Hungary. adam.podolcsak@GMAIL.COM
[4] GISAT s.r.o. Charkovska 7 Praha 10, 101 00 Czech Republic. erika.orlitova@gisat.cz

1. Introduction

The objective of the present evaluation is to evaluate Open Source GIS & RS (Ramsey, 2006) software for environmental applications that have high market potential, good software quality and affordable costs. The objects of the evaluation are those GIS and RS software products that could be used by geospatial end-users, especially those users relate to the use of GMES services.

Ideally, an iterative evaluation process as in Goal Question Metric Approach (Basili et al., 1994; Rosenberg, Hyatt, 1996)), developed by the NASA Goddard Space Flight Centre would identify some desirable products based on an evaluation matrix that is evolving according to the lessons learnt during the evaluation process. The GQM method presents a top-down goal-driven structure that defines measurement goals, raises questions to address the goals, and identifies metrics that provide answers to the questions.

However, and in order to ease the implementation of CASCADOSS project which aims to organize training, the iterative step is not used. Instead, a number of evaluation criteria (Van den Berg, 2005; Wheeler, 2007) have been considered based on the three main goals mentioned above.

Most of the criteria identified below apply to all software packages, furthermore a weight or importance is given for every individual criterion, this weight will differ for the evaluation of

different software types. In this document, the weight of the criteria is proposed with evaluation of GIS & RS OSS in mind.

2. Evaluation methodology

In order to evaluate GIS &RS OSS products in the CASCADOSS context three main goals can be identified, marketing potential, technical potential and economic potential

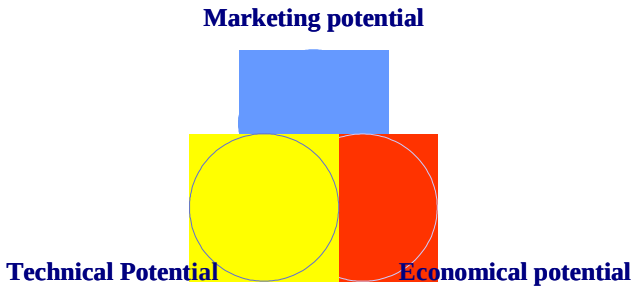

Figure 1. Software potentials.

The meaning of these aspects is that a desirable GIS & RS OSS product has strong marketing position, its technical features match to the requirements of GMES end-users and the product is affordable and more economical than the proprietary products.

Marketing potential.

From this point of view, the economic power and market potential of an Open Source Software Product can be assessed. The indicators for evaluation can be absolute number, e.g. number of end users, relative number e.g. the marketing potential depends on the maturity, the strength of the community, level of support, existing market share and the business options that the licence makes possible.

Some criteria seem to overlap with the technical potential. Namely the documentation and the portability. From marketing point of view the approach of the project to the documentation and the portability is evaluated and not their compliance to the technical requirement that is subject of the evaluation defined by the next chapter.

Main components of marketing potential evaluation are:

1) Maturity of the Project, taking into account "Software Process Maturity and the Success of Free Software Projects" (MICHLMAYR, 2006).
2) Strength of Community. The community of an Open Source software project is the driving force behind the project. It will usually consist of a developer, user and supporter communities. The community provides (usually free) support for users of all levels, and is responsible for the evolution of an OSS project.
3) Market Share. The popularity of an OSS project is important. It has repercussions on the community interest, and attracts new developers. How many relevant hits about the OSS product using an internet search engine like Google? It can be risky since there are many tricks to cheat on searching engines. Is OSS product mentioned in Wikipedia or GIS portal websites?

4) Legal/License Issues. Which license is used for the OSS product? (f.i. the GPL, which is the most popular of the OSS licenses). Are you entitled to develop further on the OSS product? What are the restrictions? Is the licence among the OSI list of standard OSS licences (OSI, 2006)?
5) Collaboration with Other Projects. Synergy between OSS products, if successful, can significantly increase the value of an OSS product. Does the OSS project collaborate with other OSS projects?

Technical Potential

The technical Potential depends on the software quality. The quality model of ISO 9126 gives a good basis for evaluation of the value of GIS & RS OSS products

The technical evaluation begins with the Quality Requirement Definition to specify requirements according to the ISO 9126 quality characteristics and some relevant sub-characteristics. Requirements express the generalised user needs and reflect to the typical environment for the software products by GIS & RS OSS product groups.

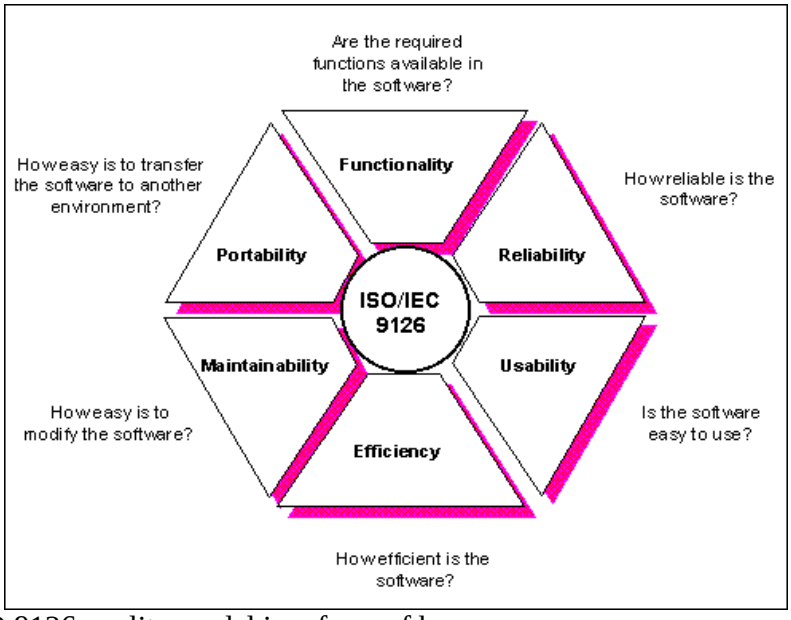

Figure 2.The ISO 9126 quality model in a form of hexagon.

The following points presents the definitions of the standard and comments on their use in the GIS & RS OSS domain.

1) Functionality: The ISO 9126 standard defines this characteristic as: The capability of the software to provide functions which meet stated and implied needs when the software is used under specified conditions;
2) Reliability The ISO 9126 standard defines this characteristic as: The capability of the software to maintain the level of performance of the system when used under specified conditions;
3) Usability. The capability of the software to be understood, learned, used and liked by the user, when used under specified conditions;
4) Efficiency. The capability of the software to provide the required performance, relative to the amount of resources used, under stated conditions;
5) Maintainability. The capability of the software to be modified;
6) Portability. The capability of software to be transferred from one environment to another.

Economical Potential

The goal is to evaluate that how economical is the adoption and operation of the OSS software in subject comparing to proprietary ones. The economic potential of an Open Source Software Product is the sum of saving that can be made by choosing OSS and the benefit that of becoming member of the OSS Community of the adopted OSS product.

1) Cost of Migration.
2) Cost of Installation.
3) Cost of Operation

While evaluating software, a set of candidates was required. In order to divide the bulk of currently available GIS and RS OSS projects, it is sensible to make a subdivision based on functionality related classes. The complete range of GIS and RS OSS projects covers a very broad functionality spectrum. Functionality requirements can differ substantially between different functional classes. For the evaluation of the functionality criterion, only comparison of OSS projects within the same functional class makes sense.

Obviously, some OSS projects can belong to more than one of the functional classes. A list of the proposed candidates as follows:

1) Desktop Applications: GIS, RS
2) Development Libraries: GIS, RS
3) Server Applications: Web services, Web tools, metadata catalogues
4) Data Management Systems
5) Other

After inventorying GIS&RS OSS projects, we compared the projects in each subclass, evaluating them, where possible, relying on existing user reviews.

Each individual software project was evaluated and given a score between one and three based on its performance with regard to each individual criterion. The total score per criterion was the multiplication of the criterion fixed weight times the software own score. The final score per software was the summation of its total score for all evaluated criteria per evaluated potential separately.

3. Evaluation results.

CASCADOSS team inventoried 98 FOSS4G software projects from five functional groups: general interest, development libraries, database management systems, desktop

applications and server applications. Moreover 18 FOSS Environmental Applications software were inventoried. 45 of FOSS4G and all 18 of the inventoried EA projects were documented, evaluated and given a score between one and three based on its performance with regard to each individual criterion. The total score per criterion was the multiplication of the criterion fixed weight times the software own score. The final score per software was the summation of its total score for all evaluated criteria per evaluated potential separately.

gvSIG project has been evaluated in both groups: FOSS GIS/RS (gvSIG 1.1.2) and FOSS EA (gvSIG 1.1) applications, gaining the scores of: 50, 40 and 41 as GIS/RS application and 47, 44 and 45 as EA application for potentials: marketing, technical and economical, respectively. This gives around 75% of maximum 60 points for each potential. The result places gvSIG among the best three of evaluated FOSS EA project, however there is still room for improvement of the Project within all of three potentials.

The evaluation has been performed April 30th 2008.

Table 1. Evaluation of gvSIG as FOSS EA software, compared to GRASS GIS project.

Evaluated software	Marketing potential						Technical potential							Economical potential				Overall score
	Maturity of the project	*Strength of Community*	*Market Share*	*Legal/Licence issues*	*Integration with other*	*Total*	*Functionality*	*Reliability*	*Usability*	*Efficiency*	*Maintainability*	*Portability*	*Total*	*Cost of installation*	*Cost of migration*	*Cost of operation*	*Total*	
Maximum score	**15**	**15**	**12**	**9**	**9**	**60**	**15**	**9**	**9**	**9**	**9**	**9**	**60**	**24**	**18**	**18**	**60**	**180**
GRASS	13.8	13.9	10.0	9.0	9.0	**55.7**	12.6	4.2	8.2	6.9	7.4	8.4	**47.8**	24.0	7.1	10.8	**47.9**	151.4
gvSIG	8.5	12.0	8.0	9.0	9.0	**46.5**	10.9	6.0	6.4	7.5	5.4	7.5	**43.7**	24.0	10.0	10.8	**44.8**	135.1

The strengths of gvSIG's marketing potential include:

- extensive documentation for users: user guide, installation manual, tutorials and sample data in several languages;
- webpage in Spanish, English, Catalan and Chinese;
- program in a large number of languages: Spanish, Valencian, Gallego, English, Czech, German, Basque, French, Italian, Portuguese, Chinese, Romanian and Polish;
- use the most common formats;
- continuous development.

Weak points of the project remain:

- lack of bug tracking system;
- limited transparency on developing team;
- no vendors or software providers participating in the project;
- project is not registered at http://sourceforge.net .

From the technical point of view of EA specific functions, gvSIG can perform operations: contour, aspect, slope, contour, hillshade, visibility, kernel density, density maps, calculate area, calculate distance, calculate length, clip, intersect, select (queries), split, basin, merge, union, dissolve, watershed, flow direction, flow accumulation, flow length, buffer zones, modeling based on DEM.

The project still lacks some useful functions: cut/fill, viewshed, visibility, observer points, point density, line density, generalization, sink, fill, snap pour point, stream link, stream order, stream to feature, interpolation, modeling.

The overall score for technical potential, although high, has been lowered by lacks of:

- capability to provide a history of changes of the data managed;
- logging mechanism;
- no user authentication mechanism;
- no user data backup/restore facilities;
- lerneability and availability of documentation: lack of multimedia courses, reference guide, quick start, help files and external documentation.
- no indexing of data or data versioning.

The results for economical potential proved gvSIG to be a good solution for fast and inexpensive transition from proprietary desktop GIS software towards FOSS4G. The improvements can be made within the software updating services: automatic update, information on new releases. An autosave function is also desirable.

4. Bibliographic references

1. Basili, V.R., Caldiera G.H. Rombach D.H., 1994. "The Goal Question Metric Approach". ftp://ftp.cs.umd.edu/pub/sel/papers/gqm.pdf
2. MICHLMAYR M., 2006. Software Process Maturity and the Success of Free Software Projects. http://opensource.mit.edu/papers/michlmayr1.pdf
3. Open Source Initiative, 2006. Open Source Licences. http://www.opensource.org/licenses/alphabetical
4. Ramsey P., 2006. The State of Open Source GIS. Digital Article. http://www.refractions.net/white_papers/oss_briefing/2006-06-OSS-Briefing.pdf, pp.42.
5. Rosenberg L., Hyatt L., 1996. Developing An Effective Metrics Program. European Space Agency Software Assurance Symposium, Netherlands, March, 1996. http://satc.gsfc.nasa.gov/support/ESA_MAR96/metrics/esa_met.html
6. Van den Berg K., 2005. Finding Open options. An Open Source software evaluation model with a case study on Course Management Systems. Master Thesis Tilburg University, pp.99.
7. Wheeler D.A., 2007. How to evaluate Open Source Software / Free Software (OSS/FS) Programs. Digital article http://www.dwheeler.com/oss_fs_eval.html