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Adoption of OSS Development Practices by the Software Industry: A Survey

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Abstract. The paper presents a survey of aspects related to the adoption of Open Source Software by the software industry. The aim of this study was to collect data related to practices and elements in the development process of companies that influence the trust in the quality of the product by potential adopters. The work is part of the research done inside the QualiPSo project and was carried out using a qualitative study based on a structured questionnaire focused on perceptions of experts and development practices used by companies involved in the Open Source Software industry. The results of the survey confirm intuitive concerns related to the adoption of Open Source Software as: the selection of the license, the quality issues addressed, and the development process tasks inside Open Source Software projects. The study uncovered specific aspects related to trust and trustworthiness of the Open Source Software development process that we did not find in previous studies as: the standards implemented by the OSS project, the project's roadmap is respected, and the communication channels that are available.

1 Introduction

The Open Source Software (OSS) industry is continuously growing and it is influencing also practices that are part of the traditional software development process [4, 17, 20]. OSS development is supported by software companies and OSS projects are not interesting only to enthusiasts and volunteers [6]. Similar initiatives are not limited to the software area alone, but they are encompassing also areas as book publishing, scientific publishing, and other familiar areas [8]. The benefits that OSS brings are an interesting research area [16] and many studies have been conducted in the past decade. An important research initiative is focused in the definition of measures that based on empirical values characterise the OSS, and allow standard measurement of its quality. The grouping of these measures in a form of an assessment methodology provides to the software industry a convenient tool that can be used before adopting a new OSS product.

The number of OSS projects implementing similar functions is large. The quality of those projects depend on the development process used inside the project and the

skills of participants in the community that are participating to the development. Companies interested in reusing OSS components should be able to select the OSS product that best suits their needs. This is usually a challenging task that requires assessment tools and skills but it also takes time to be performed. Several assessment methods for OSS have been proposed and new ones are under development; some of the already available are:

- the QualiPSo OpenSource Maturity Model (OMM) (2009) [14],
- the Open Business Readiness Rating (OpenBRR) (2005) [24],
- the Open Source Maturity Model (OSMM) from Cap Gemini (2003) [7],
- the Open Source Maturity Model (OSMM) from Navica (2004) [12],
- the Open Business Quality Rating (Open BQR) (2007) [21], and
- the Methodology of Qualification and Selection of Open Source software (QSOS) (2004) [1].

The aim of the study was to understand which are the key OSS development activities perceived as important by experts from the software industry. Those activities will influence the creation of a new assessment method that is addressing the OSS development process. The methods listed (except QualiPSo OMM) are focused in the OSS product and not in the development process. The development process has an important role when deciding to adopt an OSS product. Product characteristics alone are usually not a sufficient indicator of quality for stakeholders that are interested to actively participate in the OSS project. Specially for software integrators that plan to create a new software product reusing OSS components.

Adoption and integration of a OSS product is strongly related to further modifications of the product, therefore a good interaction with the community developing the product is essential. Process aspects have to be identified and assessed; the best known process assessment methodology in the software domain is the Capability Maturity Model Integrated (CMM/CMMI) [9, 19]. However, the CMMI is not appropriate for assessing OSS projects. It is complex, it does not focus on single projects but on the software company, and it does not address OSS specific aspects as: contribution level, reputation of the project, licenses used, etc. The aim of the new assessment methodology is to propose a CMMI-like method able to address OSS specific aspects. Software companies are knowledgeable in CMMI, therefore we planed to leverage on this skills of experts working in software companies.

The development of a OSS development process assessment methodology is one of the results of the EU funded project QualiPSo [15]. The basic task for defining the methodology was to conduct the survey, presented in this paper, and collect data related to the practices and trust elements in the development process of surveyed companies. Even if a higher quality of OSS products in comparison with closed source software products was demonstrated in several case studies [5, 10, 11], OSS is generally still perceived of low quality. The trustworthiness of OSS is an aspect we consider critical for a larger usage of OSS.

We included in our study more than 50 professionals working for 20 European software companies including: Siemens (Germany), Engineering Ingegneria Informatica (Italy), Bull (France), Atos (Spain), IBM, Mandriva (France), Thales (France), and others. A similar survey focused on OSS communities was published in

2008 [13].

The results of the study provided a set of best practices related to the OSS development process and a set of elements that bring trust to participants of the survey. Trustworthy elements are elements that when addressed during the OSS development process, guarantee to developers, users, and software integrators that the project is of good quality.

The paper is organized as follows: in Section 2 we describe the survey with the presentation of the methodology used. Section 3 is dedicated to the results of the survey, highlighting key aspects of the OSS development process. The last section contains conclusions and indications of possible future work.

2 The survey

The European software industry is interested in OSS because it is an expanding market alternative to the closed source software market where non-EU, mainly US, software companies have a strong position [3]. OSS is an area where European software companies can offer their expertise and implement new business models [22]. The study presented in this paper is part of a large research conducted with the aim to improve the adoption of OSS by the software industry.

2.1 Interviews with European software companies

The qualitative study gives an overview of OSS related development practices used in European software companies, the adoption of new OSS development procedures, and the usage of OSS products. Interviewees were asked which factors influence their perception of the quality of the OSS process and what is their opinion about a wider adoption of OSS in the company. The questionnaire was developed by defining specific topics and identifying possible questions. We decided which questions are important for the OSS development process and which aspects characteristics of the final OSS product should be also collected to understand better the development process. The complete questionnaire is available as part of the results of the QualiPSo project at www.qualipso.org.

2.2 Methodology

The design of the research was based on the approach proposed by Silverman [18]. The approach requires the design of a structured and formal research involving two basic and partially related decisions:

- The method, that is, whether performing a quantitative or a qualitative investigation.
- The methodology and the specific technique for gathering data (with an interview, a questionnaire, with observations, etc.).

The decision is based on the evaluation of major goals of the research and the type of information required. As far as opinions on OSS products were concerned, our goal was to investigate those OSS product factors that influence the trustworthiness of the

OSS development process. Following the approach proposed by Silverman, this kind of information requires a qualitative investigation. Our research methodology was based on a semi-structured questionnaire where some of the questions were closed (offering a limited list of possible answers) and other questions were open allowing to provide any answer from the interviewee. The questionnaire has been filled in during face-to-face or telephone interviews. The interviewees were employees of European software companies. The first set of interviewees was selected by the companies that were involved in the QualiPSo project (19 partners) [15]. An additional set of companies was selected based on their involvement in OSS projects. The total number of interviewees was 53.

During the second phase, we conducted a quantitative study by creating a shorter questionnaire on key elements and submitting the questionnaire to mailing lists, conferences, and using it during personal meetings. We designed a web version of the questionnaire and we collected most of the answers through a web form. The second questionnaire reused many questions from the first version and additionally (randomly) listed answers obtained during the first iteration of the research. We closed most of the questions (providing possible answers) aiming to identify the priority of answers compared between them. We excluded outliers and incomplete answers from the first iteration. The results of the on-line questionnaire are just one part of the results of the study presented in this paper. We compared the results obtained with personal interviews and results obtained with the survey; the syntheses of the results of the two iterations is presented in this paper.

The overall structure of the research was based on the Goal Question Metric (GQM) approach [2]:

1. **Goal:** Identify trust related issues in the adoption of OSS in the European software industry.
2. **Question:** The questionnaire includes 53 questions with additional sub-questions. They were developed to ask the interviewee on specific goal related issues.
3. **Metric:** Metrics about the level of adoption and the trust in OSS process are selected to be able to measure answers to questions defined in the precedent step.

The final form of the questionnaire was achieved through several iterations of drafts. The questionnaire was divided into sections covering different topics related to the OSS development process. The three main sections focused on:

1. trust and quality related aspects;
2. stakeholders related aspects as the roles and responsibilities used inside the development process; and
3. aspects related to the technology used.

The data gathering process was organized as follows:

- The respondents were contacted to determine their general interest in the study.
- The questionnaire was sent to the respondents to verify the actual availability.
- Data were collected by personal or telephone interviews in English.

•The results of the interviews were recorded and the interviewees were asked for a final check.

The majority of interviews was conducted at the interweave working place. We travelled to meet the majority of interviewees. Only in few cases the interview was done through a conference call. The duration of the interviews was not specially recorded and varied between different interviews. However the interviews lasted approximately one hour. We were not able to measure the duration of the surveys performed on the web. However, we have tested the survey questionnaire with colleagues before publishing it on the web and the mailing lists and the time necessary to complete the questionnaire varied between thirty and forty-five minutes. There were always two interviewers present during interviews. One was usually reading questions and the other was writing the answers. Two persons were able to collect more detailed responses from the interviewed person and limited the duration of interviews. Soon after the end of the interview, the answers recorded in the protocol were sent back to the interviewed person. Only upon a positive feedback from the interviewee, the questionnaire was considered accepted and the data were processed.

Participants were guaranteed anonymity and the information reported was reviewed so that no single person or company can be identified. The number of individuals interviewed from each company varied from one up to six employees per company. The people interviewed were developers and managers in companies included in the study.

3 Results

We present the results about three types of aspects in separate subsections, to summarize the results of: quality related aspects, OSS development stakeholder related aspects, and technology aspects. Some of the 53 collected questionnaires were not filled completely; however, the key questions that were focused on topics presented in this paper were filled in more than 90% of the questionnaires. During the second phase of the study, we obtained 56 filled questionnaires. The subjects involved in the two phases were different, nevertheless the results of the second phase confirmed the results obtained during the first phase.

3.1 Trust and quality related aspects

The interviewees spontaneously mentioned various factors that influence the trust they have in the OSS process. The most frequently mentioned criteria were:

•the availability and the quality of the documentation about the OSS product,

•the number of downloads and the number of potential users of the OSS product, and

•open standards used for the development of the product.

A list of the most important characteristics and the percentage of respondents that

think that a characteristic influences trust is presented in Fig. 1. For example, the popularity of the product was listed as important by 81% of the respondents. Identified characteristics confirm the results of previous studies; however, some unexpected aspects have been reported. Interviewers asked the respondents only what they consider important when they think about trustworthiness of the OSS development process. This focus allowed to discover some aspects that are considered important specially for the trustworthiness. Some additional interesting aspects recorded were: the importance of companies and the industry that is sponsoring the OSS project, the presence of an independent body that checks the product and the development process used. We were especially interested in the perception of the importance of the development process. Half of the surveyed participants were working for companies that are concerned about the development process. The other half reported that they are almost completely uninterested in the process and the interest was merely focused on the characteristics of the OSS product. The companies that just wanted to use the product were in general not interested in the development process. On contrary, the companies that wish to further develop the product were interested also in the development process.

The cost of the license was one of the characteristics addressed specifically by a question in our questionnaire. We considered this factor important because it is one of the most influential aspect emerging from the results of previous OSS studies [23]. Interviewees stressed the importance of the license cost of OSS in comparison with proprietary software. An additional question was if the total cost of the ownership (TCO) affects the importance of the cost of the license; and the answer was unexpectedly negative. The absence of an initial license cost allows users to test and experiment code modifications; this is a positive aspect of OSS in comparison with proprietary software. The absence of license costs contributes strongly to an easier and larger adoption of OSS products. Subsequent training and maintenance costs encountered are considered less important than the benefits users have at the beginning of the use of a OSS product.

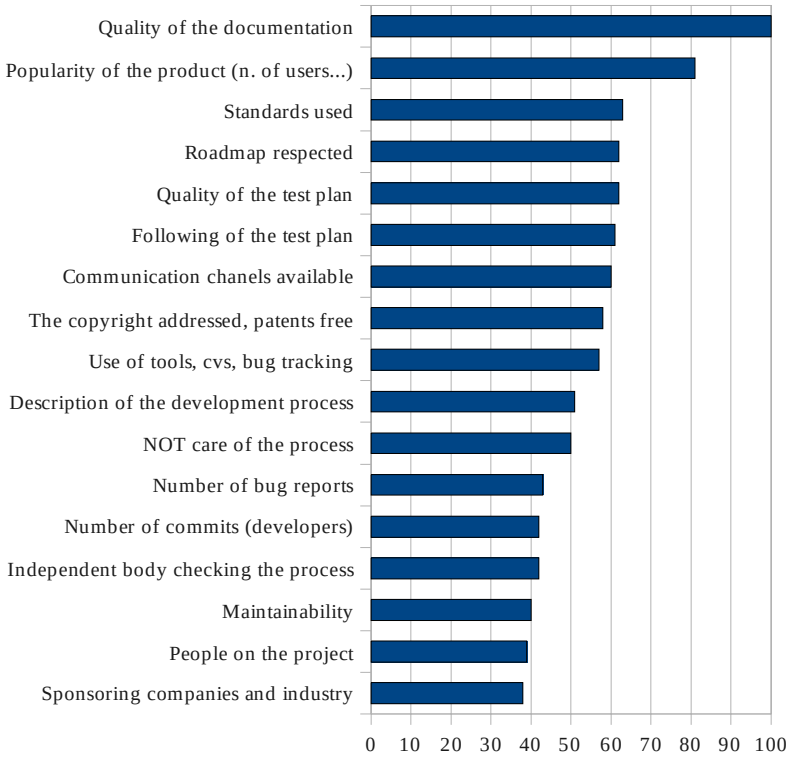

Fig. 1. Trustworthy factors related to the OSS development process.

The survey confirmed that testing is an important part of the adoption process of a new OSS product. Surveyed companies test OSS using manual and automatic tests. Manual tests are usually unstructured and often done ad-hoc. Automatic tests are structured and standardized. Details of the testing procedure depends on the importance the new OSS product has for the company.

Despite the availability of some assessment methodologies as QSOS and OpenBRR, the surveyed companies usually use their own set of criteria to test the quality of a OSS product. Many of these criteria are already part of the listed methodologies but the methodologies are not yet well established and known by the industry and their use is still limited.

Aspects that companies consider important when testing OSS vary considerably across companies and the summary described in this paper presents characteristics mentioned by a large percentage of interviewees. The testing process is usually done informally by developers of the company (80%). Testing is also done by the OSS community that is using the product and that reports bugs and proposes new features and improvements. OSS communities are a good short-cut for companies when they need to choose which OSS product to adopt, as communities can provide volunteers

for the testing process. If they need additional test results related to each company's specific requirements, they conduct in-house tests carried on either by a group of specialized developers, by the project manager, or sometimes also by external teams.

Two frequently mentioned characteristics considered important for assessing the quality of OSS are: results of in-house or external tests of the product, and the size of the user community. Both were mentioned by all the participants to the study (as evident from Fig. 2). The number of users that already use a OSS product is an indication of the variability of opinions and comments about the product that can offer insight in aspects of the OSS project. Another important aspect is the type of standards implemented inside the OSS project (73%). This aspect is often related to technologies, programming languages, and frameworks used and supported by projects. Documentation is also considered important by three-fourths of the companies. Satisfaction of user expectations reported on forums and mailing lists by the community of users of the product are considered important by half of the surveyed interviewees. Just half of the interviewees consider important the process followed (either the Rational Unified Process - RUP, a process assessed according to the Capability Maturity Model - CMM, an IT Infrastructure Library - ITIL benchmarked process or others) for the development of the product. Less frequently mentioned aspects are: the availability and use of measures such as bug reports, the size of the components, the certification of the quality of the product by a third-party company, and others. The answers are graphically presented in Fig. 2.

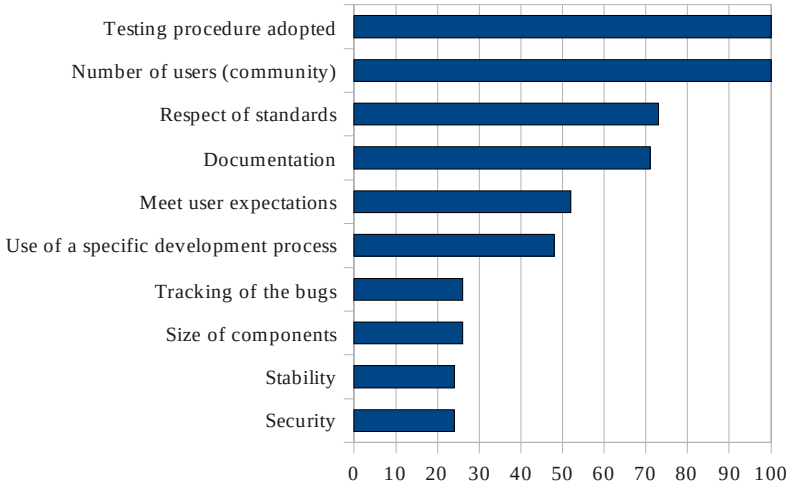

Fig. 2. Criteria for assessing the quality of OSS.

3.2 Aspects related to stakeholders

Roles and responsibilities of people inside companies participating in our research play an important role when considering the adoption and development of OSS.

Surveyed companies use OSS products but in some cases they also develop OSS. There is a correlation between the development of OSS and its usage. Part of the participants only use OSS products, however the interviewees that participate in the development of OSS products usually also use the product. This behaviour was expected and it was reported in previous studies. We have asked how are the OSS projects managed inside the companies and which are the responsibilities related to OSS. For most of the companies, OSS development is only one of their development activities. The majority of companies involved in the survey, is still exploring the OSS development and their current OSS development approach is a mix set of activities typical of a proprietary software development and of OSS development (as the one adopted by OSS communities as Linux Kernel, Apache, and others). The number of developers and the size of OSS communities formed by the companies is still rather small. They are typically composed of up to 100 developers and contributors and only rarely reach 1000 contributors. A limited OSS development approach is evident from the responsibilities that members of the OSS community have. Important decisions and responsibilities are assigned to employees of the company. This way, companies still maintain the leading role and decide the development directions of the OSS project. This way companies lose important advantages that a more democratic OSS development process offers, such as a larger amount of source code contributions, the development based on meritocracy, and better motivation for the involvement in the OSS development process.

As for the roles and responsibilities, also the definition of requirements and implementation of new features is influenced strongly by the business strategy of the companies. After the implementation of critical features that are imposed by architectural and design decisions; key contributors of new features are customers of surveyed companies. More than 80% of interviewees consider more important the suggestions from their regular customers than suggestions coming from the OSS community. Decisions of which features are implemented first are usually taken by the coordinator of the project that is almost always an employee of the company.

3.3 Technology aspects

The technology used inside OSS projects is an aspect that strongly influences the whole OSS project and specially the development process. Interviewees answered in details on questions related to technology related aspects and showed a high interest on these characteristics. We dedicate this subsection to answers of interviewees to some strongly perceived technology aspects.

Surveyed companies use different operating systems for developing OSS; Linux is the most frequently used. Some companies also use the Windows operating system and sometimes Solaris, in addition to Linux. Fig. 3 presents the percentage of use of each operating system.

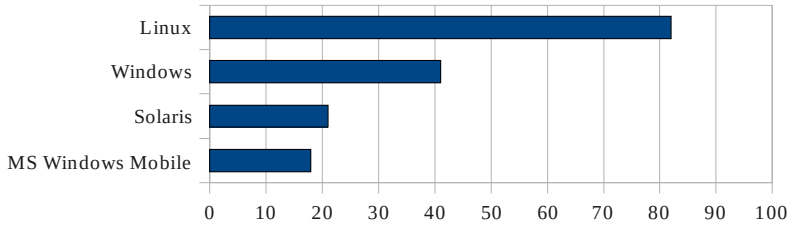

Fig. 3. Operating System used by interviewees.

The most frequently used programming language is Java which is regularly used by all the companies. C++ is the second most frequently used programming language. The surveyed companies use also other languages as: C, Python, PHP, Perl, some proprietary domain languages, JavaScript, MS proposed languages, and others. Languages and technologies usually influence the development methodologies used and also the efficiency of specific development activities. The frequent use of Java and Linux confirmed our expectations related to the language and the platform used by OSS communities. Fig. 4 presents the frequency of the use of programming languages.

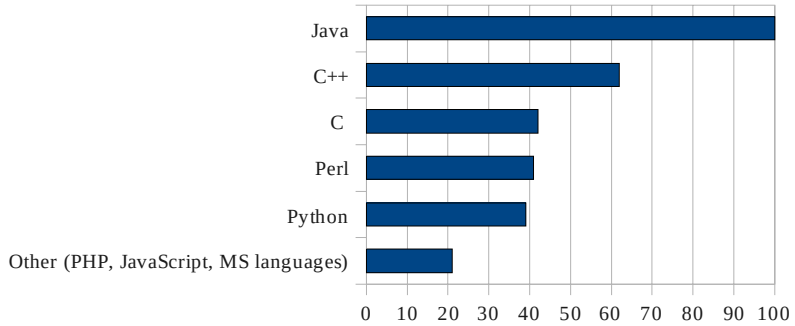

Fig. 4. Programming language used by interviewees.

The surveyed companies that develop OSS, do it incrementally (80%) with small exploration projects, starting with some basic features and releasing the first versions of the product. New features are added later according to new requirements collected first by the customers and then by the community. Such development is similar to the process followed in OSS communities that are not strongly influenced by software companies. The results of the survey also show that in some cases, the core part of the project is entirely developed and implemented inside the company and only then it is disclosed to the community and opened for new suggestions.

Two important aspects of OSS projects that are supported by the surveyed companies are: the use of open standards, and the modularization of the system architecture. From the survey, we could not identify a OSS development strategy that was used by the majority of companies. The methodology usually depends on the type of the company, the OSS project, the technology used, and several other

characteristics.

The large majority of the OSS projects developed by the companies, create and maintain the documentation for the OSS product. More complex and thoroughly developed projects have a diversified documentation for different types of stakeholders, e.g., the user's manual, the developer's manual, and the manual for administration of the OSS product. Since high quality documentation of OSS projects was identified as one of the key trustworthy elements, companies invest a considerable effort to create the documentation of their projects. The documentation is stored in formats types as: readme files, wikis, web pages, user guides, as comments to the source code, and in other forms. Developers are responsible to write the documentation related to their part of the project. Only occasionally the documentation is written by specialized in-house or external groups of experts.

4 Conclusions

The study presented in this paper has confirmed the interest of European software companies in OSS in general and also in the OSS development process. The majority of the surveyed companies are trying to participate on the OSS market starting with small, exploration projects and then incrementally extending them. The majority of companies participating in the survey started mixed proprietary-OSS projects. OSS products developed are free to be used and improved by everybody and the source code is available; the development process, the management responsibilities and evolution of the project are, however, coordinated by the company that started the project. The quality of the OSS development process and the lack of a high quality assessment process, that can be used to measure characteristics of the development process, is one of the main limitation to a wider diffusion of OSS. The key issue is related to the perceived quality of OSS and the trust people have in its development process. The survey was focused on the usage of OSS in the European software industry and the results sheds some light on this growing market.

Interviewees report that companies, that are releasing some of the management and planning aspects of the project to the OSS community, are observing growing contributions from volunteers. Benefits provided by OSS communities allow faster improvement of OSS projects. Interviewees reported a perceivable improvement of the business in companies that have started to use OSS and that have decided to use the OSS development process for some of their projects. The key result of the study was a set of characteristics that are considered important for improving the quality of the OSS development process. The most important one are: the quality of the documentation, the number of the users of the OSS product, and standards implemented by the OSS project. These characteristics were used for the definition of an assessment methodology that is now in the process of validation and refinement.

5 References

[1] Atos Origin, 2009, “Method for Qualification and Selection of Open Source Software (QSOS),” http://www.qsos.org (Last visited: March, 2011).

[2] V.R. Basili, “Software modeling and measurement: The Goal/Question/Metric paradigm,” Technical Report CS-TR-2956, Department of Computer Science, University of Maryland, MD, USA, 1992.

[3] O.R. Burzynski, A.R. Graeml, and Z. Balbinot, “The internationalization of the software market: opportunities and challenges for brazilian companies”, JISTEM J.Inf.Syst. Technol. Manag. (Online). 2010, vol.7, n.3, pp. 499-516.

[4] A. Capiluppi, J. Feller, B. Fitzgerald, S. Hissam, K. Lakhani, G. Robles and W. Scacchi, “First International Workshop on Emerging Trends in FLOSS Research and Development,” *Proc. of* ICSE*companion*, 29th International Conference on Software Engineering (ICSE'07 Companion), 2007, pp. 135-136.

[5] C. DiBona, S. Ockman, and M. Stone, “Open Sources: Voices from the Open Source Revolution.” Sebastopol, CA: O'Reilly, 1999, pg 280.

[6] C.J. Dueñas, H.A. Parada G., F. Cuadrado, M. Santillán and J.L. Ruiz, “Apache and Eclipse: Comparing Open Source Project Incubators,” *IEEE Software*, vol.24, no.6, Nov/Dec, 2007, pp. 90-98.

[7] F.-W. Duijnhouwer, C. Widdows, 2003, “*Capgemini Expert Letter Open Source Maturity Model*,” Capgemini.

[8] G. Goth, “Sprinting toward Open Source Development,” *IEEE Software*, vol.24, no.1, Jan/Feb, 2007, pp. 88-91.

[9] W. Humphrey, 1988, “Characterizing the software process: a maturity framework.” IEEE Software 5 (2), 73–79.

[10] M. Birendra, P. Ashutosh, and R. Srinivasan, "Quality and Profits Under Open Source Versus Closed Source" (2002). ICIS 2002 Proceedings. Paper 32.