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# Aspects of an Open Source Software Sustainable Life Cycle

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**Abstract.** In this paper we present a literature overview about OSS sustainability, considering not only financial resources, but also community growth, source code and tools management. Based on these aspects, we define an OSS life cycle that may contribute to OSS projects sustainability.

**Keywords:** OSS Sustainability, OSS Communities, Financial Resources, Software Maintenance

## 1 Introduction

With the popularity of OSS (Open Source Software), governments, universities and other institutions around the world are adopting free platforms aiming to save millions [1, 12].

A natural question that arises when one looks at the increasing use of such software for which you do not pay any fee or license is: how open source projects are supported?

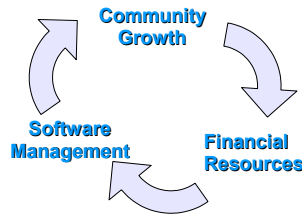
Researches related to OSS sustainability [6, 9, 14] show that the profits come from offering services such as support, consulting and training. In this work, we mean by sustainable the management model that can support the community through various resources. It is not, however, financially maintained by a single company or institution.

We present a study on other aspects, besides financial ones, that are also important for OSS projects sustainability. In the next sections we treat OSS projects sustainability broadly, considering the dynamics involved in a sustainable life cycle.

## 2 An OSS Sustainable Life Cycle

Based on a literature review, we can say that the sustainability of OSS is closely related to three factors – community growth, financial resources and software management, as illustrated in Figure 1.

According to Figure 1, growth and continuity of the community can result more naturally in financial resources that, if well managed, can be reversed in benefits to the community and encourage its growth, feeding the OSS sustainable life cycle.



**Fig. 1.** Sustainable life cycle model for OSS projects.

The proper management of community, software and tools can decrease the financial resources necessary to maintain the project. With management improvements in that subjects, it is possible to minimize tasks and human factors, and to promote a vision of a robust computational development for the community. As a result, it is possible to reduce costs and, consequently, to contribute to the sustainability of OSS communities.

## 2.1 Community Growth

When we talk about OSS communities management, it is natural to think of reasons why communities continue to exist and to grow. Some important factors for the existence and continuity of an OSS community are: interactivity, variety of participants, large number of members, web space that allows interaction, matters of common interest, and cooperation among participants. A basic premise is that people should bring information and share it openly with the group. Another important attribute of a community is the population size. A community becomes more valuable as more members join it [18].

Researches also point out that community growth and development process openness can contribute to software quality and reliability [16, 8, 7]. This statement assumes that the more people are paying attention to the software and interacting with each other, the easier it is to find and to fix its bugs.

Researches also show that the continuity of an OSS community depends on the adoption of the software that it produces [18]. There are several factors for companies or individuals to take the decision to adopt certain free software. These factors include availability of support, size of community, technical attributes of software such as reliability, safety, quality and performance [11, 5]. Software adoption can increase the visibility of the community and generate employment opportunities in bundled services (support, enhancements, upgrades) that can contribute to the community sustainability.

## 2.2 Financial Resources

In most cases, OSS projects profits come from offering services such as support, consulting, training, product maintenance, and development of new software customizations [6, 9, 14]. Free software can still be funded by various segments of society such as government, academia and corporations [3, 4]. In order to receive more direct support from government, the groups associated with OSS often turn to NGOs, foundations and even micro companies [18, 14].

Many OSS economic aspects have been investigated in the literature. Riehle [13] tried to answer one of the main questions in the economic field of OSS projects: How is developers payment determined? Lerner and Tirole [10] discuss questions about economic justification of OSS projects. Shirali-Shahreza [15] discuss various OSS aspects, including economic ones.

## 2.3 Software Management

Factors related to source code structure can greatly contribute to OSS projects sustainability – it can lead to faster changes with less bugs. The code with a modular structure is an incentive for developers to enter and to continue in the project development [2]. Terceiro and colleagues [17] claim that structural complexity increases the cost of maintaining a software project, because the code becomes harder to understand, and consequently more difficult to modify. In OSS projects, this increased effort may represent an additional difficulty for the entry of new developers, and a sustainability problem.

The discontinuity of the development team and the geographically distributed nature of OSS projects make them even more difficult to manage. For issues like these, the need to communicate, interact and socialize using communication tools with computational support is even greater.

In order to coordinate their work, OSS communities members use the Internet with simple and widely available tools. There are two categories of tools used in OSS projects. The first one is related to communication between community members and the second concerns the management of source code.

A challenge to be exploited in this context is to investigate solutions on how to improve integration and communication between OSS tools, such as discussion forum, issue tracking, wiki, among others. The possibilities of using the communication that is made through these tools can reduce, for example, support costs and other activities that require time from the development team.

## 3 Conclusion

This study provided a brief overview, bringing together different aspects which contribute to OSS projects sustainability. With such a study we defined a sustainable life cycle aiming to provide guidance on the creation and maintenance of sustainable OSS development and communities.

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