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Robert English

*University of Massachusetts Amherst*

Charles M. Schweik

*University of Massachusetts Amherst*

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## **Identifying Success and Tragedy of FLOSS Commons: A Preliminary Classification of Sourceforge.net Projects**

**Robert English**

*Center for Public Policy and Administration,  
University of Massachusetts,  
Amherst, MA USA  
bobengl@gmail.com*

**Charles M. Schweik**

*Department of Natural Resources Conservation  
and Center for Public Policy and  
Administration, University of Massachusetts,  
Amherst, MA USA  
cschweik@pubpol.umass.edu*

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This version is essentially the same paper as the above, but we have made some slight improvements/adjustments to Tables 1 and 3 in this paper based on feedback and some continued work we have done with the database used in this project.

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# Identifying Success and Tragedy of FLOSS Commons: A Preliminary Classification of Sourceforge.net Projects

(November 1, 2007 Version)

## Abstract

*Free/Libre and Open Source Software (FLOSS) projects are a form of commons where individuals work collectively to produce software that is a public, rather than a private, good. The famous phrase “Tragedy of the Commons” describes a situation where a natural resource commons, such as a pasture, or a water supply, gets depleted because of overuse. The tragedy in FLOSS commons is distinctly different -- it occurs when collective action ceases before a software product is produced or reaches its full potential. This paper builds on previous work about defining success in FLOSS projects by taking a collective action perspective. We first report the results of interviews with FLOSS developers regarding our ideas about success and failure in FLOSS projects. Building on those interviews and previous work, we then describe our criteria for defining success/tragedy in FLOSS commons. Finally, we discuss the results of a preliminary classification of nearly all projects hosted on Sourceforge.net as of August 2006.*

## 1. Introduction

Free/Libre and Open Source Software projects (FLOSS) are recognized as Internet-based commons [1,13,15]. Since 1968, when the famous article “Tragedy of the Commons” by Garrett Hardin was published in the journal *Science*, there has been significant interest in understanding how to manage commons appropriately. Hardin’s work, and much of the work that followed, focused on commons management in the natural environment. And in these commons, the “tragedy” Hardin described was over-harvesting and destruction of the resource, whether it be water, fish stock, forests, or our atmosphere. In FLOSS commons the “tragedy” is different; what developers hope to avoid is project abandonment and a “dead” project. In order for FLOSS projects to avoid tragedy and be successful, the collective action involved (or attempts at collective action in the case of projects with one participant) must be sustained at least until a software product has been produced. Discovering how FLOSS projects sustain collective action to produce useful software may have important implications for improving our understanding of FLOSS software development as well as computer-mediated collective action more generally [14,15].

In recent years, scholars have investigated different approaches to measuring the success and failure of FLOSS projects. For example, studies [2,3,7,11,16] measured FLOSS project “life” or “death” by monitoring project activity measures such as: (1) the release trajectory (e.g., movement from alpha to beta to stable release); (2) changes in version number; (3) changes in lines of code; (4) the number of “commits” or check-ins to a central storage repository, and (5) activity or vitality scores measured on collaborative platforms such as SF and Freshmeat.net. Weiss assessed project popularity using web search engines [17]. And most recently, Crowston, Howison and Annabi reviewed traditional models used to measure information systems success and then adapted them to FLOSS [4]. They collected data from Sourceforge.net (SF) and measured community size, bug-fixing time and the popularity of projects.

In this paper, we are trying to build on these studies by defining success and tragedy of FLOSS commons from the perspective of successful collective action. The section that follows this one describes interviews we conducted with FLOSS developers to get feedback on our ideas about defining success. Next, in the “Success and Tragedy Classification System” section, we define a 6-stage classification system of success and tragedy of

FLOSS commons based on information gained from these interviews, as well as previous literature and our own earlier work studying FLOSS. In the “Operationalizing the Classification System” section, we describe our efforts in building a dataset which combines much of the August 2006 data available from the FLOSSmole project (described below) and data we gathered ourselves through automated data mining of the SF website. This section then describes how we operationalized our proposed success/tragedy classes using this dataset. The “Results” section discusses our preliminary classification of nearly all projects hosted on SF as of August 2006. We conclude the paper with some next steps.

## 2. FLOSS Developer Opinions on Success and Failure

We conducted eight interviews [18] with FLOSS developers between January and May of 2006 to get opinions about the independent variables we thought important to FLOSS project success and to get their thoughts about our definitions of success and tragedy. Because we wanted input from a diversity of projects, we stratified our sampling by the number of developers in the project. We created categories of projects with <5, 5-10, 11-25 and >25 developers and interviewed developers from two projects in each category. Interviews were conducted over the phone, digitally recorded, transcribed and analyzed using Transana 2 (<http://www.transana.org>).

Interviews consisted of about sixty questions and took approximately one hour. Among other things, we asked interviewees how they would define success in a FLOSS project. Interviewees responded with five distinct views. One defined success in terms of the vibrancy of the project’s developer community. Three defined FLOSS success as widely used software. Two others defined success as creating value for users. One developer cited achieving personal goals, and the last interviewee felt his project was successful because it created technology that percolated through other projects even though his project never produced a useful standalone product.

Immediately after asking interviewees about success, we asked how they would define failure in a FLOSS project. Interestingly, all eight developers said that failure had to do with a lack of users and two indicated that a lack of users leads to project abandonment. In a probing question that followed, we asked if defining a failed project as one that was abandoned before producing a release seemed reasonable. Four interviewees flatly agreed, three agreed with reservations and one disagreed. Two of those with reservations raised concerns about the quality of the release. For example, one project might not make its first release until it had a very stable, well functioning application while another project might

release something that was nearly useless. Another interviewee had concerns about how much time could pass before a project was declared abandoned. One developer argued that a project that was abandoned before producing a release could be successful from the developer’s point of view if he had improved his programming skills by participating. The dissenting developer felt that project source code would often be incorporated into other FLOSS projects and would not be a failure even if no release had been made.

So, how do these responses inform working definitions of success and tragedy? Because we view FLOSS projects as efforts in collective action with the goal of producing public good software, defining success in terms of producing a useful software product makes sense, and our interviewees seem to agree. Six of the eight interviewees suggested that success involves producing something useful for users. Since the real tragedy for a FLOSS project involves a failure to sustain collective action to produce, maintain or improve the software, defining failure in terms of project abandonment makes sense, and generally, our interviewees agreed. Treating the first release as a milestone or transition point between what we refer to as the “Initiation Stage” and the project “Growth Stage” [13, 18] emerges logically from this line of thinking. All in all, these interviews supported our initial thinking about project success and tragedy.

## 3. A Success/Tragedy Classification System for FLOSS Commons

After conducting the interviews and considering the results, we developed a six-class system for describing success and tragedy of FLOSS projects across two longitudinal stages of Initiation and Growth (Table 1). In previous work [13, 18] we defined “Initiation” as the start of the project to its first public release, and “Growth” as the period after this release [13, 18].

Therefore, a project is classified as (1) *Success in the Initiation Stage* (SI) when it has produced “a first public release.” This can be easily measured for projects hosted at SF because SF lists all a project’s releases. A project that is successful in the initiation phase automatically becomes an indeterminate project in the growth phase.

Projects are classified as (2) *Tragedy in the Initiation Stage* (TI) when the project is abandoned before producing a first public release. We define abandonment as few forum posts, few emails to email lists, no code commits or few other signs of project activity over a one-year period. Preliminary data we have analyzed from SF indicates that projects in Initiation that have not had a release for a year are generally abandoned (see the discussion of the “test sample” below)

A project is considered a (3) *Success in the Growth Stage* (SG) when it exhibits “three releases of a software product that performs a useful computing task for at least a few users (it has to be downloaded and used).” We decided that the time between the first release and the last release must be at least six months because a “growth stage” implies a meaningful time span. As mentioned above, we can easily measure the number of releases and the time between them since SF tracks this information. Measuring “a useful computing task” is harder and clearly more subjective. Acquiring the number of downloads recorded on project websites is probably the easiest measure, with the assumption that many downloads captures the concept of utility.

A project is considered a (4) *Tragedy in the Growth Stage* (TG) when it appears to be abandoned without having produced three releases or when it produced three releases but failed to produce a useful software product.

We classify a project as (5) *Indeterminate in the Initiation Stage* (II) when it has yet to reveal a first public release but shows significant developer activity.

Finally, projects are assigned (6) *Indeterminate in the Growth Stage* (IG) when they have not produced three releases but show development activity or when they have produced three releases over less than six months.

#### 4. Operationalizing the Classification System

As a first step in operationalizing our definitions for FLOSS success and tragedy, we conducted a random test sample of sixty projects hosted on SF using April 2005 FLOSSmole data [5]. The FLOSSmole project is itself an open source-like project where researchers and others collaborate to collect and analyze data about FLOSS. The data is collected by automated “crawling” or “spidering” of SF and other open source hosting sites. We decided to conduct this test sample from the FLOSSmole database to look for problems with our classification scheme and to get some idea about the number of projects likely to fall within each of the classes. Following the logic used in our FLOSS developer interviews and knowing we wanted to study projects with larger numbers of developers because of their more interesting collective action issues, we stratified by number of developers into categories of <10, 10-25 and >25 developers. We randomly sampled twenty projects from each category for a total of sixty projects. We chose 20 projects because it was a reasonable undertaking given time constraints and because twenty projects per category provided a standard error of plus or minus 22% with 95% probability for a binomial distribution. (Note: Because a project is either successful or failed, and is either in the Initiation or Growth stage, the sample is a binomial distribution for these categories.) For these sixty sampled projects, we manually compiled data on project registration, last release date, number of

downloads, project website URL and forum/email/postings among other data. From this data, we made a judgment about whether the software was “useful” and whether the project was abandoned. We classified the projects as SI, TI, SG or TG (see code definitions in the previous section) based on this information. We found no indeterminate cases in this sample.

Perhaps the most important information we acquired from the test sample is that the vast majority of projects that have not had a release for a year are abandoned. All 27 projects in the sample that (1) had not provided a release in over a year and (2) had less than three releases were abandoned. This finding suggested that we could produce a relatively simple but approximately accurate classification by using a project’s failure to release within a year as a proxy for abandonment.

**Table 1: Six FLOSS success/tragedy classes and their methods of operationalization**

<i>Class/Abbreviation</i>	<i>Definition(D)/Operationalization(O)</i>
Success, Initiation (SI)	D: Developers have produced a first release. O: At least 1 release (Note: all projects in the growth stage are SI)
Tragedy, Initiation (TI)	D: Developers have not produced a first release and the project is abandoned O: 0 releases AND $\geq 1$ year since SF project registration
Success, Growth (SG)	D: Project has achieved three meaningful releases of the software and the software is deemed useful for at least a few users. O: 3 releases AND $\geq 6$ months between releases AND does not meet the download criteria for tragedy below detailed in the TG description below.
Tragedy, Growth (TG)	D: Project appears to be abandoned before producing 3 releases of a useful product or has produced three or more releases in less than 6 months and is abandoned. O: 1 or 2 releases and $\geq 1$ year since the last release at the time of data collection OR $< 11$ downloads during a time period greater than 6 months starting from the date of the first release and ending at the data collection date OR 3 or more releases in less than 6 months and $\geq 1$ year since the last release.
Indeterminate Initiation (II)	D: Project has no public release but has significant developer activity O: 0 releases and $< 1$ year since project registration
Indeterminate Growth (IG)	D: Project has not yet produced three releases but shows development activity

<i>Class/ Abbreviation</i>	<i>Definition(D)/Operationalization(O)</i>
	<p>or has produced 3 releases or more in less than 6 months and it has been less than 1 year since the last release.</p> <p>O: 1 or 2 releases and &lt; 1 year since the last release OR 3 releases and &lt; 6 months between releases and &lt; 1 year since the last release</p>

Naturally, operationalizing the definitions for success and tragedy measures had much to do with the availability of data. We chose to use the August 2006 data spidered from SF because it was the latest data available at the time we did our classification. This data has a total of 119,590 projects, but 235 of these projects are missing essential data leaving 119,355 projects. Although FLOSSmole had much of the data we needed for operationalizing our classification scheme, the data on the number of releases and the dates of the first and last release were not available. Consequently, we spidered that data ourselves between September 24, 2006 and October 16, 2006. Of the 119,355 projects, 8,422 projects had missing data or had been deleted from SF (SF occasionally purges defunct projects) between the August 2006 and the time we collected our data. The result: we have valid data for 110,933 projects. Based on our definitions described earlier, and the added information we gained from the test sample, we undertook a preliminary classification of SF projects as described in Table 1.

## 5. Results

Table 2 provides the number of SF projects classified by the two longitudinal stages: Initiation and Growth. It also reports projects that could not be classified. Table 3 summarizes our results of our preliminary success and tragedy classification of all projects on SF and potential sources of error in our classifications.

We believe that the classification above is informative despite the possibility of classification errors (listed in the third column of Table 3). Potential classification errors stem primarily from two sources:

Source 1 Error- using one year without a release as a proxy for abandonment.

Source 2 Error - using the number of downloads per month as a proxy for the software being useful.

Regarding Source 1 Error, our test sampling indicated with 95% probability that at most 22% of projects with less than 3 releases will turn out not to have had a release within a year and yet not be abandoned thus suggesting an upper bound for many abandonment errors.

As for Source 2 Error, some projects classified as TG may be useful and have met the download criteria for tragedy or, on the other hand, some projects classified as

SG may be useless and have not met download criteria for tragedy. Because our definition of SG is broad (the software performs a useful computing task for some number of users), we don't expect this error to be large. In other words, we expect that the vast majority of SG projects have produced something useful. Only 62 projects were classified as TG because they met the download criteria for Growth Stage tragedy in Table 1.

In terms of improving our classification, abandonment could be more precisely measured by (1) no code "commits" or changes in lines of code in the concurrent versioning system (CVS) or other repository over the course of a year, or (2) little or no activity on developer e-mail lists and forums over the course of a year. Measures to improve our estimation of whether the software is useful could include: (1) a content analysis on utility of the software on data collected from user forums, e-mail archives or even web searches; (2) more carefully constructed download criteria that takes the life of the project and the availability of download data for different time periods into consideration. In addition, some projects make more than one release on a single day, thus bringing the criteria for three releases into question. We have data that will allow us to examine the time between each release and possibly refine the definition of the three release criteria, but this is yet to be done. Moreover, projects with websites not hosted on SF and no file releases or downloads on SF are currently not classified. We hope to address these issues in future work.

**Table 2: Sourceforge.net projects organized by longitudinal stage (as of August 2006)**

<i>Stage</i>	<i># of Projects (% of Total classified)</i>
Initiation Stage	50,662 (47)
Growth Stage	57,085 (53)
Not classified	3,186*
Total classified	107,747
* These are valid projects, but could not be classified because they have 0 releases & downloads on SF but have other websites that may be used for these functions.	

**Table 3: Preliminary classification of all FLOSS projects on Sourceforge.net (as of August 2006)**

<i>Class</i>	<i># of Projects (%of Total)</i>	<i>Possible Classification Errors (other than errors in the SF data)</i>
TI	37,320 (35)	The project is not abandoned but > 1 year old
SG	15,782 (15)	The software is not used in spite of not meeting the download criteria for tragedy

Class	# of Projects (%of Total)	Possible Classification Errors (other than errors in the SF data)
TG	30,592 (28)	The project is not abandoned; OR The project produced useful software even though it met the download criteria for tragedy
II	13,342 (12)	No classification errors (by definition)
IG	10,711 (10)	No classification errors (by definition)
Total	107,747	

Note: SI is not listed because these successes are Growth Stage projects. Including SI would double count.

## 6. Conclusion

Our most immediate task now is to validate the classification described above. We plan to sample a large enough number of projects to empirically establish the accuracy of our classification within a few percent. Our long-term goal is to use this classification as a dependent variable for quantitative models that investigate factors that lead to success and tragedy in FLOSS in the two stages of Initiation and Growth. We expect influential factors to be different in these two stages [13, 18].

Despite the shortcomings of this classification system described in Section 5, we chose to publish preliminary results of our efforts in the spirit of “release early and often” and because defining and classifying success in FLOSS projects is so important to many FLOSS research projects. In the near future, we plan to release the data we collected and our classifications on the FLOSSmole site. We hope that in the tradition of open source collaboration other researchers will build on this work by correcting any perceived “bugs” in our approach and collecting additional data to improve classification accuracy.

## 7. Acknowledgments

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