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Toward a Dynamic Theory of Open Online Collaboration Communities

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TOWARD A DYNAMIC THEORY OF OPEN ONLINE COLLABORATION COMMUNITIES

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Abstract

This paper reports a research in progress aimed at building an integrated theoretical framework for studying 'open online collaboration communities'. A dynamic feedback modeling and simulation approach is suggested for exploring and articulating a preliminary theoretical framework, which will be useful in analyzing policy options for improving the performance of a range of open online collaboration communities.

Keywords: Online collaboration, online communities, open source, system dynamics, dynamic feedback simulation

Introduction

This paper reports a research in progress aimed at building an integrated theoretical framework for studying 'open online collaboration communities'. We define open online collaboration communities (OOCCs) as a special type of online communities that are formed by loosely connected groups of people, who use the Internet as a medium for carrying out collaborative projects for producing and improving a wide range of stand-alone information products, such as software, and courseware. The theoretical framework is articulated as a dynamic feedback simulation model, which is intended to represent the phenomena related to OOCCs in terms of both structure and behavior.

Research Motivation and Contribution

There are two motivations for this research. First of all, a greater portion of the body of research on online communities tend to approach the issue in a 'wholesale' fashion, without discriminating between different types of online communities, although the literature now has classification schemes (see for example (Lazar and Preece 1998)), and taxonomies (see for example (Hagel and Armstrong 1997; Stanoevska-Slabeva and Schmid 2001)) for online communities. This study defines 'open online collaboration communities' a special type of online community, places it within the overall population of online communities based on existing taxonomies, and develops a theoretical framework for studying that specific type of online community.

The second research motivation is based on the observation that existing models and theories for explaining phenomena related to online communities focus on specific, limited portions of the overall system. However, phenomena related to online communities involve several different aspects that mutually affect each other such as social, economic, and technological aspects. This study is based on an integrated approach which addresses these several aspects in relation to each other, thus developing a system-wide theoretical framework for studying OOCCs.

Open Online Collaboration Communities

We define 'open online collaboration communities' as online communities that are formed by loosely connected groups of people, who use the Internet as a medium for carrying out collaborative projects for producing and improving a wide range of stand-alone information products, such as software, and courseware. We use two taxonomies that exist in the literature for placing OOCCs

within the overall population of online communities. First is Hagel and Armstrong's classification, which classifies online communities based on the needs of the community members (Hagel and Armstrong 1997). OOCCs fit in the definition of communities of transaction, based on Hagel and Armstrong's classification. The other classification we use was suggested by Stanoevska-Slabeva and Schmid (2001). From Stanoevska-Slabeva and Schmid's classification's standpoint, OOCCs fall in the design communities sub-class within the task-and-goal-oriented class (Stanoevska-Slabeva and Schmid 2001). Due to limited space, readers are referred to related work about the details of these classifications.

A prominent example of OOCCs are open source software development communities. Open source software development communities are groups of loosely connected programmers, who use the Internet as a medium for collaboratively developing, improving, and disseminating software (O'Reilly 1999). Only a small fraction of those programmers gain direct tangible benefits in return to their contributions. The majority are motivated by indirect or intangible benefits (Raymond 2001). Despite the lack of monetary motivation factors, Open Source software movement gave way to the production of high quality free software that can compete with leading proprietary software, as in the example of the Linux operating system (Diker and Scholl 2001).

Research Design and Methodology

The study is based on modeling a dynamic feedback simulation model (or a system dynamics model, as it is alternatively called) for articulating a theoretical framework for studying OOCCs. The model represents a generic open source software development community, as an example for OOCCs.

System dynamics methodology is widely used to analyze complex, large-scale, non-linear, partially qualitative dynamic socio-economic systems. System dynamics "assumes direct causal relationships between variables that form the system being analyzed, and interdependence of causal factors through feedback loops. Almost every system includes a number of both negative and positive feedback loops [that consist of several variables], which interact and operate simultaneously" (Diker and Scholl 2001). System dynamics models are represented by structure diagrams, which show the causal relationships in the form of directed arrows connecting the cause variable to the dependent variable. A set of mathematical equations, which demonstrate the algebraic relationships among the variables, accompany these diagrams (Diker and Scholl 2001).

The model represents causal relationships between different elements that drive dynamic behavior of an open source software development community. The main elements that constitute the model, and the overall causal relationships between them are shown in Figure 1. This figure can be regarded as a bird's-eye-view of the model.

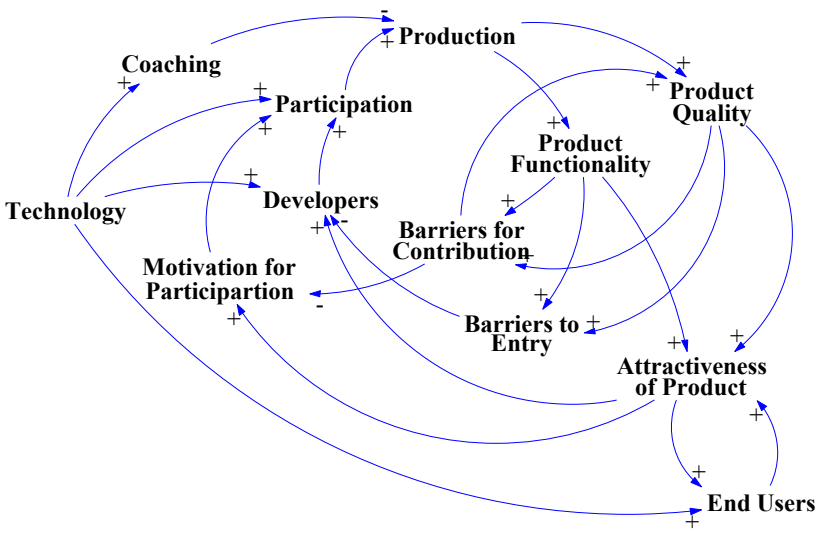

Figure 1. High Level Structure of the OSSD Model

Literature Review

The OSSD model is based on implications derived from parallels drawn between literature on theoretical approaches to the study of online communities, and literature on practices in open source software development communities. Technical components of the model is based on literature on software project management, with an emphasis on system dynamics models of software development projects.

Several theoretical approaches were suggested for studying online communities, such as gift economies, public goods, social informatics, and social networks. Some of these approaches were deemed useful for the purposes of developing the model in question, while others were not useful in providing implication which would guide the development of the model.

One theoretical approach suggested for studying online communities that is particularly relevant to this study is the concept of gift economies (Barbrook 1998; Ghosh 1998; Kollock 1999; Bays and Mowbray 2001). Raymond suggest gift economies as a viable theoretical approach to the study of open source software development, as well (Raymond 2001). Gift economies are based on gift exchange as opposed to commodity exchange (Gregory 1982; Bell 1991; Carrier 1991). Gift exchange takes place between parties who have an existing relationship, or are aiming to build an ongoing relationship (Bell 1991; Carrier 1991). Furthermore, a gift is not necessarily reciprocated by the giving of a 'counter-gift' right away (Bourdieu 1997). However, the giving of a gift generally implies an unstated expectation of reciprocation at an indefinite time on the part of the giver (Carrier 1991). An important implication of the concept of gift economies with respect to the open source software development model is that a relatively larger community would motivate contributors to a greater extent, since the probability of generalized reciprocation increases as the number of contributors in the community increases.

The concept of public goods is another theoretical framework suggested for explaining phenomena related to online communities (Kollock 1999; Millen 2000; Wasko and Teigland 2002). Several authors have suggested public goods as an approach for studying open source software development, as well (Hawkins 2001; Bessen 2002). Public goods differ from private goods in two ways. First, public goods are "non-excludable"; that is, it would be too hard or too costly to exclude the non-payers from benefiting from a public good. Second, the consumption of public goods is on "non-rival" basis; that is, the consumption of a public good by an individual does not hinder other individuals' consumption of the same good (Cowen 1993). Since it is infeasible to exclude non-payers from benefiting form public goods, it is also not feasible to charge for their use (Cowen 1993). This brings about the problem of lack of interest towards producing and distributing public goods. Kollock outlines the possible motivation factors for participation in the production of public goods within the context of online communities as such: expectation of generalized reciprocation, building reputation, gaining a feeling of self-efficacy, and altruism (1999). These motivation factors together bring about certain implications with would guide the development of the model:

1) Larger contributor population may decrease motivation.
2) Larger user population may increase motivation.
3) Visibility would motivate contributors more.
4) Feedback channels may increase motivation

Several authors approach to the study of online communities from a perspective which is interchangeably called "social informatics" or "social impacts" (Turoff and Hiltz 1982; Hiltz 1986; Preece 2000). Social informatics research focuses on the social impacts of information systems (Preece 2000). The basic argument of the social informatics approach is that the design and use of information systems have an impact on the social processes that govern the context in which the said information systems operate. Furthermore, information systems, together with social processes have an impact on the social structures and relationships. Based on these premises, several authors argue that while designing an information system, the effects on the social processes, structures and relationship should be taken into account, and the information system should be designed as a part of the social process it will be "embedded in" (Turoff 1997; Preece 2000). Several authors approached the open source software development from the same perspective (Fogel and Bar 2001; Raymond 2001). The implications of these approaches for the model in question are:

1) Low barriers to entry to the community and contribution would increase participation.
2) Accessibility and usability of end-products may increase user population.

The Open Source Software Development (OSSD) Model

The OSSD model is still in the development stage. As an example, Figure 2 portrays a section of the model which represents the developer population, production, product functionality, and motivations related to joining and leaving the community. Here developers participate in production and add new functionality to the software product. We assume that a given software product has a more or less determined upper limit in terms of potential product functionality. As the achieved functionality approaches to that limit, attractiveness of product for developers decreases. We base this relationship on Raymond's arguments that a developer joins an open source software project in order to "homestead" a certain portion of the software. By developing the "homesteaded" portion of the software the developer builds reputation and self-efficacy sentiments (Raymond 2001). When the achieved functionality approaches the functionality limit, the project does not offer many portions to homestead, and this decreases the attractiveness of the project. This also accelerates the rate of 'leaving developers'. As the project approaches the end, more developers leave the project, leaving a smaller number of developers for maintenance purposes.

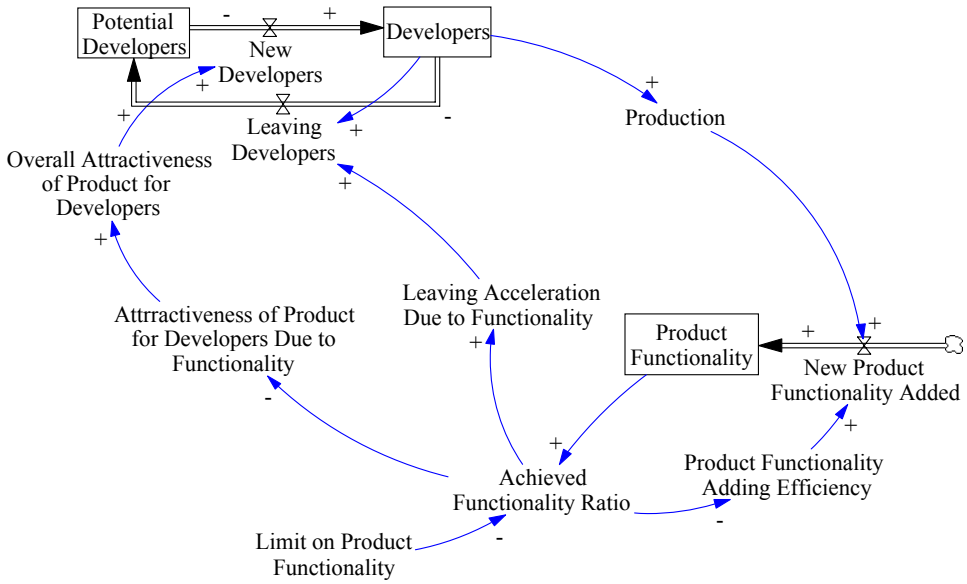

Figure 2. Developers Section of the OSSD Model

A sample run of the model at the current stage is portrayed in Figure 3. Here, the number of developers increase as the project unfolds, and reaches its peak level as the project 'saturates' in terms of product functionality. As the achieved product functionality is reached more and more developers leave the project, leaving a smaller number of developers for maintenance purposes.

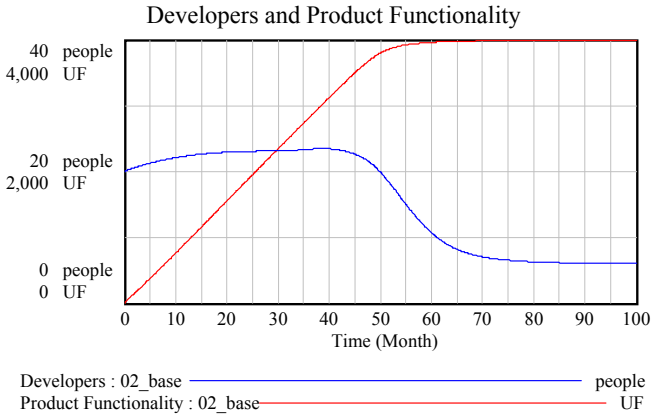

Figure 3. Sample Behavior of the Developers Section of the OSSD Model

Next Steps

As mentioned above the OSSD model is still in the development stage. As the model approaches to the final stages of development, it will be tested for validation using standard structural and behavioral tests defined within the limits of dynamic feedback simulation (system dynamics) methodology. When a certain level of confidence for the model is built based on these standard tests, the model will be re-articulated as a generic model so that it can be tested for its applicability to a wider range of open online collaboration communities.

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