

# A Behavioural Approach for the Coordination of Open Source Software Intermediaries

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**Abstract:** An interesting phenomenon in the open source software (OSS) market is the evolution of intermediaries, which provide services to the OSS community. A problem of this business model is the lack of appropriate instruments to dismantle coordination problems inherent to the OSS development model. Therefore, this paper proposes a behavioural approach to coordinate OSS intermediaries. Since OSS intermediaries typically provide internet based services, it is possible to observe actor behaviour by use of technical data acquisition instruments like server logging. Consequently, it seems reasonable to analyse this behavioural data base to derive relevant information to ensure rationality of management. We present exploratory results for the intermediary CampusSource to evaluate the utility of this data source and link them to relevant aspects of diffusion theory. This contribution is based on our results presented in [GBK04].

## 1 Introduction

In 2002, Europe represented 29 % of the global market for information and communication technology (ICT). Within this sector, the software market has only gained marginal importance compared to other segments like hardware or services. In numbers, the software market only amounts to 10 % of the total ICT sector [SL03]. Since software production is the main driver for complementary services and consulting, the whole ICT market lags behind its original potential. A promising approach to stimulate domestic

ICT markets is the promotion and employment of Open Source Software (OSS). OSS has important implications for the European software industry because it provides a basis for system consulting and further software development efforts. Despite of this, the use of open source software in the industry is still at a relatively low level [FBE02]. Reasons for this are the technological, economical and legal barriers inherent in the supply and demand sides of the OSS market. Existing OSS intermediaries seem to be a first step to dismantle these barriers.

## **2 Design of open source intermediaries**

Research on intermediaries is predominantly pushed forward in the domain of electronic markets [MYB87]. Theoretically speaking, the function of intermediaries is to coordinate transaction processes between the supply and demand sides of a market. Within the OSS market, intermediaries have to connect producers to consumers to stimulate adoption behaviour. In order to gain effects of scale, intermediaries cover a specific set of OSS products (product portfolio) and provide services. Typically, some of these services are provided for a fee in order to gain profit. This approach has led to a multitude of OSS business models [Ka03] [HH03], like hardware and software integration, technical support and publications, contract development, consulting and training. Several intermediaries emerged and some of them already disappeared from the OSS market, because they failed to fulfil their financial goals [KEB03][BD01]. A major factor for this shortcoming lies in coordination problems, which emerge from the OSS development model [KLK03]. In order to handle these coordination deficiencies, it is necessary to design controlling instruments which are able to enhance decisions of OSS intermediaries. These instruments should generate relevant information about market-related processes to ensure rationality of management [SWP01]. Since these processes are mediated by portals, it is possible to technically observe interaction behaviour of all involved actors. An efficient means of data acquisition is server logging, which generates a log file containing all elementary interactions of the OSS community with the intermediary's internet portal. Since this is an unobtrusive data acquisition instrument, the behaviour of market actors can be recorded without subject or observer biases.

## **3 Log file data as behavioural basis for market-related processes**

Log files record all activities of a web server on the level of the hypertext transfer protocol (http), such that all interactions of site visitors with the server are continuously recorded by a series of entries [BW99][Be01]. These entries document time-referenced events which correspond to visitor's online behaviour, e. g. requesting specific pages from a web server, downloading software or filling out online forms. In order to examine the informational potential of log files for management support of open source intermediaries, we present analytical results for the OSS intermediary *CampusSource*.

#### 4 Informational benefits of log files – an exploratory study for the OSS intermediary CampusSource

Aim of the intermediary *CampusSource*, which was founded by the Ministry of Science and Research of the Federal State of North Rhine-Westphalia (Germany), is to set up cooperative processes for the development of software systems and modules as well as the creation and operation of an infrastructure for e-learning [Ho04]. The efforts of single university projects are brought together and Open Source platforms as technical requirement of presence- and distance-universities are provided for use and further development [KE03]. The product portfolio of this intermediary consists of 15 e-learning products and is extended in consideration of a severe quality policy. All functions are provided by an internet portal accessible through the URL <http://www.campussource.de/org/>. The data base of this study consists of log files covering all online interactions from 09-01-2001 until 03-31-2003. We used standard software tools to carry out all steps of the analytical process and focused on descriptive statistical analysis. In order to evaluate the reach of the CampusSource website, we analysed the total number of visits in a first step. A visit is defined as a temporal coherent sequence of interactions exerted on the website by a single actor. This key figure shows the contacts of potential adopters with the CampusSource website, but does not evaluate the quality of the contact. Therefore, we used the visit duration as general indicator for the attractiveness of the website and – in particular – of the product portfolio and its associated OSS projects. In the context of diffusion theory, these metrics characterize the communication processes and are therefore relevant to understand adoption behaviour of market participants [TEB83]. Fig. 1 depicts the results for the key figures *visits* and *duration*.

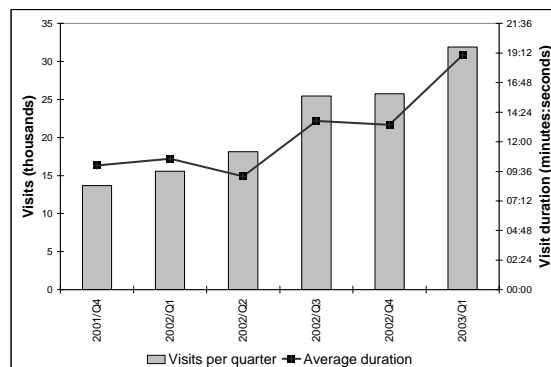


Figure 1: Visits and duration per quarter

It is discernible that there is a significant increase in visits and duration over time. Roughly speaking, both figures have doubled from 2001 to 2003. This result does confirm the increasing overall attractiveness of the CampusSource website. From a strategic point of view, this growth provides the basis for gaining network effects by rapid diffusion and should be measured continuously in order to signal negative trends. Nevertheless, this result tells something about the quantity and duration of contacts (“reach”), but nothing about the characteristics and roles of potential adopters [TEB83].

With regard to the characteristics of log file data, it is possible to analyse the search behaviour of adopters, which qualifies specific aspects of decision processes as conceptual substructures of adoption. First, it is interesting to see *how* users establish contact to the website. This knowledge is essential in order to attract potential OSS adopters via internet channels. Consequently, we analysed which website the user visited *before* he browsed to the CampusSource site. It is notable that more than 75 % of the website visits were established via the google search engine. This “google bias” indicates that the majority of visitors make use of a keyword driven, general purpose search engine to locate the CampusSource website and therefore show explicit, intentional search behaviour. In addition, it is possible to extract the search terms [GBK04], such that textual characterizations of the visitor’s motives exist. An OSS intermediary can utilise this knowledge to personalise information streams, e. g. by use of basic operations like customizing, filtering, annotating or aggregating information about products, services or projects. Finally, this contributes to a higher degree of coordination between user preferences and offerings based on search behaviour. In addition, information about search behaviour may be used on the OSS project level to identify emerging requirements for innovative products.

CampusSource covers a portfolio of 15 e-learning software products, which are provided for download. To support product portfolio management, it is necessary to control the diffusion of the provided products. In order to measure diffusion on the product level, we analysed the download rates of the OSS products. On the individual product level, the download measure is an overall indicator for product diffusion and is therefore relevant for CampusSource’s product policy and for the management of the associated OSS projects. Of course, this measure has to be interpreted carefully because the vast majority of downloads does not imply successful product adoption, which – from a user centered view – at least implies the stages of product commitment, implementation and routinization [TEB83]. Therefore, download figures should be regarded as upper bound of product diffusion and can be used as informational basis to create product-specific services. It is interesting to see that the individual download rates are subject to significant fluctuations over time. As we could notice, these fluctuations heavily depend on individual project activities, e. g. the availability of a new software release. As a consequence, timing of the provision of additional value added services is crucial.

From the view of an OSS intermediary like CampusSource it is also interesting to see that successful product adoption may also lead to a role switching effect: The modification of open source code by an adopter relocates him into the role of a producer, such that sequential and complementary software innovation patterns result [BM00]. In order to perpetuate this innovation cycle, intermediaries should not only focus on stimulating OSS adoption in the sense of unchanged reuse, but also leverage OSS modification.

## 5 Conclusion

This paper briefly explored some informational benefits of behavioural data for the coordination of OSS intermediaries. In order to unleash the utility of this coordinative in-

strument, it is necessary to analyse specific OSS processes in depth. To foster coordination of OSS projects, it will be interesting to identify patterns in feedback behaviour of OSS adopters or contribution patterns of OSS producers. This approach is applicable for intermediaries who provide centralised development services like bug tracking and versioning (e. g. SourceForge or BerliOS). In addition, this will also lead to valuable empirical information for diffusion research activities in the domain of OSS.

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