Conference proceedings

The inspiring success of Free/Libre/Open Source Software

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Abstract

On the one hand, the typical dilemma between developing an Information System (IS) internally or finding it elsewhere increasingly favors the latter option, with the result that the currently available packaged software applications are gaining substantial ground in the market. On the other hand, Free/Libre/Open Source Software (FLOSS) is becoming an ever-more significant reality in many different software industry segments.

Despite the evident importance of these two underlying trends, change in the software industry seems to have been insufficiently explored in academic literature, and more specifically, longitudinal studies of the trajectory of software industry evolution are lacking. We have conducted a longitudinal study, based on Porter's strategic grouping approach, on the evolution of one specific software industry segment - Content Management Systems (CMS) - paying particular attention to the differences between packaged and FLOSS CMS.

Our research adopts a critical social theory perspective through which the article contributes to the understanding of the role of FLOSS in the software industry, as we show how FLOSS has a positive impact on emancipation of software users and finally on the development of the ecological sustainability and social equity.

Keywords

1 Introduction

The software industry receives billions of dollars from the selective investments of its customers (Boonstra, 2003). On the one hand, the typical dilemma between developing an Information System (IS) internally or finding it elsewhere increasingly favors the latter option, with the result that the currently available 'off-the-shelf' software applications are gaining substantial ground in the market (Adam & Light, 2004; Leebaert, 1995; Pang, 2008; Paulson, Succi et al., 2004; Price Waterhouse, 1998; Quintas, 1994; ReportSURE, 2005; Sawyer, 2000; Succi, Paulson et al., 2001; Voas, 1998, , 2001). On the other hand, Free/Libre/Open Source Software (FLOSS) is becoming an ever-more significant reality in many different software industry segments (Bell, Shegda et al., 2007; Driver, Alvarez et al., 2008; Economides & Katsamakas, 2006; Fitzgerald, 2006; Gutsche, 2005; Succi, Paulson et al., 2001).

Despite the evident importance of these two underlying trends, change in the software industry seems to have been insufficiently explored in academic literature (Fitzgerald, 2006; McGahan, 2004), and more specifically, longitudinal studies of the trajectory of software industry evolution are lacking. We have conducted a longitudinal study, based on Porter's strategic grouping approach (Porter, 1980), on the evolution of one specific software industry segment - Content Management Systems (CMS) - paying particular attention to the differences between packaged and FLOSS CMS.

We chose the CMS segment because it is a dynamic market that has evolved significantly over just a few years. The CMS industry is very young, with the first software only being released in 1998 (Pelz-Sharpe, Ashenden et al., 2002). In industry life-cycle terms (Frankl & Rubik, 2000), its introduction period can be considered as having been completed by 2000 (Pelz-Sharpe, Ashenden et al., 2002). Market research (Wintergreen Research, 2005) estimated a sharp increase in the CMS industry's total revenue: from an estimated worldwide size in 2006 of $3.6 billion, the CMS market is expected to reach $4.2 billion by 2010. Although the introduction period of the CMS segment has passed (Pelz-Sharpe, Ashenden et al., 2002), it is difficult to define precisely which change trajectory the CMS segment is undergoing and the role of FLOSS in this change trajectory.

Our research adopts a critical social theory perspective and it contributes to the understanding of the role of FLOSS in the software industry. We show how FLOSS has a positive impact on emancipation of software users, economic degrowth and, more in general, social equity. The paper begins by giving the theoretical and empirical background to our research. Our research approach is then described, and our results presented and considerations about the power of FLOSS discussed. Finally, conclusions are drawn and avenues for further research are outlined.

2 Theoretical and empirical background

2.1 Critical social theory

Critical social theory is traditionally associated with the thought of the Frankfurt School (or more precisely of the Frankfurt Institute for Social Research), pointing to the possibility of an alternative (to communism and to capitalism) path to social development.

Critical social theory has been initially defined in 1937 by Max Horkheimer in his Traditional and Critical Theory essay (HORKHEIMER, 1972), referring to a social theory oriented towards critiquing and changing society as a whole. Critical social theory covers a variety of theoretical **perspectives** questioning the domination and the injustice of the present status quo originating in the scientism, managerialism, globalism and consumerism. From the beginning, the opposition was against the "traditional theory", i.e. the positivism and the purely observational modes of inquiry. Rather than only describe how things presently are, as traditional theory does, critical theory takes into consideration whether social realities

ought to be. Hence, beyond criticizing, the critical social theorists advocate radical social change for the promotion of justice and emancipation (Kincheloe & McLaren, 2005). They were commonly concerned by the conditions which allowed for social change and the establishment of rational institutions, through dialectic, given that reality was conceived by them inherently composed of contradictions.

Beyond Max Horkheimer, many other theorists gather around these principles such as: Theodor Adorno, Friedrich Pollock, Herbert Marcuse, Jurgen Habermas and also Information systems literature has an extensive tradition of leveraging critical social theory (Brooke, 2002; Elmes, Strong et al., 2005; Hirschheim & Klein, 1994; Klein & Huynh., 2004; Lyytinen & Klein, 1985; Markham, 2005; Porra, 1999; Wilson, 1997). "From the perspective of critical social theorists, information systems are generally perceived as supporting the control and monitoring of human actors and consequently contributing to their oppression" (Hansen, Berente et al., 2009). Fortunately, it is not always the case, as we will see for FLOSS.

2.2   FLOSS, Packaged Software

Free/Libre/Open Source Software (FLOSS) is software the user can use for any purpose, study its source code, adapt it to his needs, and redistribute it - modified or unmodified (Free Software Foundation, 2007). Hence "Free" is a matter of liberty and in particular 4 freedoms must be gathered in order to class a software program as FLOSS:

0. The freedom to run the program, for any purpose.

1. The freedom to study how the program works, and change it to make it do what you wish. (Hence the open source code).

2. The freedom to redistribute copies.

3. The freedom to distribute copies of your modified versions (which is at the origin of FLOSS communities gathering users-developers of FLOSS applications).

At the opposite, Packaged Software is commercially available software, where the user has no free access to the source code and no rights to redistribute. It is typically licensed onto the mass market as a tradable, ready-made, off-the-shelf, pre-built product, whose eventual customization is controlled by the vendor and redistributable only by the vendor.

Between FLOSS and Packaged software, there is a wide range of intermediate solutions with various commercial terms (such as freeware, shareware, or open source software) and heterogeneous software licenses (such as Academic Free License or Microsoft Public License).

2.3   Content Management Systems

This heterogeneousness exists also in the specific Content Management System segment of the software industry. While the name Content Management System is commonly used for commercial purposes, it has no generally recognized definition, so the market offers products under that label that differ significantly, while at the same time software systems with many similar functionalities are commercialized under other labels such as Document Management Systems (DMS) and Knowledge Management Systems (KMS). The following paragraphs provide definitions – substantiated by our literature review – of the key terms in our research area.

Content, defined in general as something that is contained, as in a receptacle (Pickett, 2000), can embrace a wide range of types of information, from simple ASCII-format texts to multimedia objects (AIIM, 2002), regardless of how and where they are published. In our research context, the label refers to the information contained in web sites. Thus, in our context, Content Management (CM) - which has been

generally defined as the process of capturing, codifying, storing and sharing information that is vital to an organization (Bradley, Paul et al., 2006) - relates to the management of web site content, while a Content Management System (CMS) has been defined as 'a software application that allows the creation, collection, management, publication and modification of the content of web sites.' (AIIM, 2002).

These CMS software applications can be Packaged CMS, i.e. commercially produced software packages supporting the management of web site content, FLOSS CMS, i.e. CMS applications respecting the FLOSS principles, or intermediate solutions.
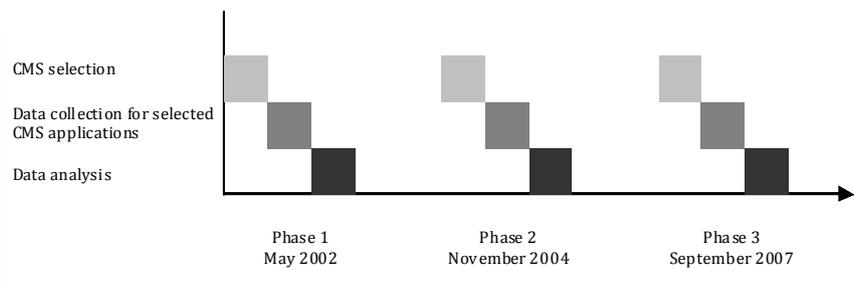
3   Research approach

A longitudinal study is carried out to explore the trajectory of change in the CMS segment and to understand the role of FLOSS in it. Our longitudinal study is first introduced, and the different time phases and associated actions explained. We explain then the Porter's strategic grouping as our research approach to explore the differences and evolution of CMS applications. We next describe the strategic variables used to group the CMS applications: the number of functions available to users, the costs to users and the number of services offered. Finally, we explain the criteria applied to selecting CMS and in collecting and analysing the data.

The first step of the study consisted of identifying the most suitable research method to examine the evolution of CMS applications over time. The research was conducted through a 5 year longitudinal study involving three empirical phases: Phase 1 in May 2002, Phase 2 in November 2004 and Phase 3 in September 2007. Three actions were performed at each phase (see Figure 1):

1. CMS selection: the set of CMS applications was selected;

2. Data collection: empirical up-to-date data was collected for each CMS application of the selected set and for each strategic variable;

3. Data analysis: collected data was analysed to identify the trajectory of change in the CMS segment.

Fig. 1   The timeline and main activities of the longitudinal study

CMS selection

Data collection for selected CMS applications

Data analysis

Phase 1   Phase 2   Phase 3
May 2002   November 2004   September 2007

After reviewing the analysis tools for the IT market (Levy & Powell, 2000; Pollock & Williams, 2008; Porter, 1980; Usoro, 2001), we based our research on Porter's strategic grouping approach (Porter, 1980), which identifies the differences between units of analysis using the most strategic variables. In our case, the units of analysis were the CMS applications, and we identified and measured the most strategic variables at each of the three temporal phases. Using only the most strategic variables makes this approach relatively simple and allows for quicker data collection. However, this simplicity can also be seen as limitation, in that the method can only partially represent the complexity of the segment. Notwithstanding this issue, the validity of Porter's approach has been effectively tested by other authors (Frazier & Howell, 1983; Harrigan, 1980; Hinteruber, 1984; Pigni, Ravarini et al., 2002).

We therefore sought to identify the most strategic variables to describe the CMS segment. As there is no statistical method available to determine key variables, we identified them by reviewing previous

analyses of CMS applications as described in the literature. The available research on the Software Industry and CMS applications (Brooks & Princi, 2001; Cherns, 1993; Gartner, 2001; Jaydip, Kai et al., 2003; Kekre, Krishnan et al., 1995; Kunda & Brooks, 2000; McKeever, 2003; Nakano, 2002; Pelz-Sharpe, Ashenden et al., 2002; Raghunathan, 2000; Reynolds & Kaur, 2000; Robertson, 2002; Sawyer, 2000) suggested the most strategic variables were the number of CMS functions the application offered and its cost. These literature review findings are consistent with McGahan's proposition on the importance of core assets to the software industry (McGahan, 2004), where the number of functions appeared to constitute the added value for which customers were most willing to pay.

Nevertheless, we constantly monitored several dimensions of the CMS market throughout the study, such as the marketing strategies and technologies associated with each CMS application. This market monitoring revealed another variable, one unmentioned in the previous literature, but which emerged as strategic for the CMS segment: the services offered with the CMS application (e.g. training). Over the years of the study our CMS market monitoring allowed us to observe CMS companies re-directing their strategy towards differentiation based on the services offered with the CMS applications. This variable did not appear as strategically relevant in Phases 1 and 2, when numbers of services offered were limited, and were not levered in the CMS marketing strategies. But, subsequent to Phase 2, we observed a shift in the core activities of the CMS editors toward the delivery of services, with the number of offered services increasing and being promoted by specific marketing campaigns. In fact, the growing strategic relevance of the services offered by CMS segment organisations can be seen as evidence of a change in their core activities, and we therefore decided to add the number of offered services as a third strategic variable for our study, and measure it in the final Phase 3.

3.1 The strategic variables

3.1.1 The number of available functions

The available functions of the CMS applications define the range of tasks each application can perform (Jaydip, Kai et al., 2003), which may cover different content management areas such as content creation, digital asset management and publication. To measure this first strategic variable, we studied the different data analysis techniques (such as function points, weighted averages, hierarchical classifications) employed in previous similar research (Kunda & Brooks, 2000). Reviewing the literature showed that the most common method consisted of simply counting the functions an application offered and giving them all equal importance, thus minimizing the subjectivity of the assessment associated with giving a hierarchical weighting to the relevance of different functions. In fact, all the papers noted above employed this simple measurement methodology. Thus a list of functions was developed and applied, and the presence of each function on the list checked by examining each CMS application. Each function was noted with a 'yes' or 'no' to indicate its presence or absence, (Brynjolfsson & Kemerer, 1996), with 'free add on' if the function could be freely integrated into the main application and 'not specified' if we could not be certain of its presence. Functions were regarded as included in a CMS application if they registered a 'yes' or a 'free add on' in our functionality database, and the total count was considered as our proxy of the functional strength or value of the CMS application.

As product features changed or were extended over time, our list of functions was revived and updated, increasing the number of included functions, from 44 in Phase 1 – 2002, 119 in Phase 2 -2004 to 194 in Phase 3 – 2007.

3.1.2 The cost of the CMS application

The second strategic variable in our framework was the cost of the CMS application, which we decided to include based on the CMS taxonomy proposed by the CMS Review portal (skyBuilders Inc., 2004, , 2007) and applied in other studies (CMSWorks Inc, 2004; Ravarini, 2006) and is based on an overall estimate of the cost to an organization of obtain an entry level license for the CMS application. In accordance with the

CMS Review taxonomy, we split the CMS applications into 5 different categories, based on their estimated entry-level license price range in thousand US$: Entreprise (above 175K$), Upper tier (above 100K$), Middle market (above 25K$) Lower priced (less than 25K$) and Gratis (for 0$ CMS). Albeit clearly a proxy of the actual license cost of a CMS application, this taxonomy was considered adequate for the purpose of our research. As the focus of our study was represented by changes in costs over time, and the cost differences between different CMS applications, a more precise cost estimation would have added little significant value to our research.

3.1.3   The number of services offered

The third and final strategic variable was the services offered as complements to the CMS application. As noted above, in monitoring the CMS market over the study period we observed CMS companies re-directing their strategies towards a differentiation based on services offered alongside the CMS applications, and therefore included services offered as our third strategic variable. 22 different services were identified at the third phase of the longitudinal study, including the availability of documentation on the CMS or host application possibilities. As with the data collection for the CMS functions, each service received a 'yes' if the service was offered, 'no' if the service was unavailable, or 'not specified' if we were unsure about its offer, and the variable was measured by the number of 'yes' registrations on our database.

3.2   The longitudinal study

3.2.1   CMS selection

Changes in the software market had a direct impact on the choice of CMS applications analysed during the period of our longitudinal study. At each of its three phases, a new set of CMS applications was selected and added to those used in the previous phase. For the precise purpose of our research, the first criteria used to select a CMS application was the availability of data on the functions and the license price category, as the two key variables in explaining the evolution of the change trajectories in the CMS segment.

At Phase 1, several CMS applications were selected because they figured among the market leaders and had heterogeneous origins in terms of software segments in which they had previously operated. Subsequent to this phase, we observed many other applications entering the CMS market, with numbers of functions offered increasing, prices evolving, and FLOSS CMS applications emerging as an effective alternative to packaged offerings. We therefore decided to develop our Phase 1 work into a longitudinally study by examining the CMS market a second time. We redefined our set of CMS applications for Phase 2 to include a new range of packaged CMS applications, and a set of FLOSS applications, but without losing sight of the need for sample heterogeneity. Our Phase 2 sample emphasized FLOSS applications, as they represented the biggest novelty over Phase 1, and only retained the four most well-known CMS applications from Phase 1 into at Phase 2. At Phase 3, the emergence of some new players onto the CMS market led us again to add more applications into the previous set.

For the purpose of managing our study and its data collection, we opted to choose a set of CMS applications that, as a whole, would best represent the whole field in terms of the range of functions offered and of license costs. We identified three parameters as proxies of such choice: the market share of the application, the achievement of awards and how different the CMS applications were in terms of functions each offered. **Table 1** shows how the list of applications studied grew for each phase, together with the reasons for including each in the sets.

3.2.2   Data collection

Data was collected from primary sources (i.e. directly testing the CMS applications) and secondary sources, such as browsing CMS application web sites, reading paper-based and electronic-based journals, reports and articles (Jaydip, Kai et al., 2003; Kunda & Brooks, 2000), and stored on a database, which also recorded the values relating to the selected strategic variables for each CMS application analysed. Phase 1 data collection took place in May 2002, and Phase 2 collection in November 2004. Market monitoring over the 29 months between these phases revealed the CMS segment to have evolved in function and cost terms sufficiently - in particular, with the rapid appearance of new versions of many existing CMS applications boasting several new functions - to allow us to define significant differences between the two phases.

Table 1
The set of applications in
Phase 1, 2 and 3

CMS application	Reasons for inclusion in set
Retained from Phase 1	
Documentum ECM 4i 4	In 2002, Documentum was an enterprise specialized in Document Management Systems (DMS) and Content Management Systems. Its DMS application evolved over the years into a CMS application. We were interested to see the characteristics of this CMS application which was originally a DMS.
Interwoven TeamSite 5	Interwoven was a company which started up with a CMS application and, in 2002, it was still the only application offered. In 2002 the company held the biggest CMS market share, so we included it for its wide diffusion.
Microsoft CM Server 2001	Microsoft was selected because it is the world's biggest software corporation. hence it has the potential to be a leader also in the CMS segment.
Vignette Content Suite 6	Vignette, like Interwoven, is a company which started up with a CMS application. We included the CMS application as it distinguishes itself through its advanced and celebrated IDE and API technological solutions which seem superior to traditional CGI/vi/Perl Web development solutions.
Added at Phase 2	
Apache Lenya 1.2	FLOSS CMS became a Top Level Project of the Apache Software Foundation, in September 2004 and consequently obtained formal support to become a leading CMS, as the web server Apache leads its industry segment.
Drew Vogel Xaraya 0.9.10	FLOSS CMS which pursued its differentiation from the other FLOSS CMS through an accentuated separation between design and content in order to achieve a more modular and flexible product.
eZ systems eZ Publish 3.x	FLOSS CMS with a good reputation and diffusion in Northern Europe
Ingeniux CMS 4.1	Packaged CMS distinguishing itself from other CMS by means of its XML-architecture.
Mambo 4.5.1	FLOSS CMS which was advertised as one of the easiest CMS to use and supported by a very large development community
MediaSurface Morello 5.0	Packaged CMS developed by a fast growing English company, which became a publicly traded company on the AIM market of the London Stock Exchange, in August 2004.
MMBase 1.7	FLOSS CMS originally created by the Dutch public broadcaster VPRO and particularly suited to multimedia environments.
Obinary ltd. Magnolia CMS 1.1	FLOSS CMS completely developed by a software house which offers free changes. Community Edition and a paying Enterprise Edition, which includes full support provision.
Open Text Corporation Livelink WCM 9.2	Packaged CMS named Trend-Setting Product of 2005 by KMWorld Magazine, in September 2004 and ranked 11th in Business 2.0 Magazine's list of the 100 fastest growing technology companies worldwide, in June 2004.
OpenCMS 5.0	FLOSS CMS developed by a German company, which provides paying services for extra features and services.
Outerthought Daisy 1.1.0	FLOSS CMS supported by the Belgian company Outerthought and the last released among the set, in November 2004.
Roxen CMS 4.0	FLOSS CMS produced several years before by a Swedish company. Even though reputed very sophisticated, the utilization of the Swedish language by the developer community restrained its diffusion abroad until recently where it emerges as a qualified global player.
Tridion CMS 5.0	Packaged CMS developed by a Dutch company and its tight integration with BEA WebLogic E-Business Platform has partially determined its success.
TYPO3 3.7	One of the most diffused FLOSS CMS
Zope & Plone 2.0.4	Plone is a FLOSS CMS closely linked with its Application Server Zope and its database Zope Object Database and therefore considered as an all-in-one. Since the beginning of the project in 1999, it has quickly grown into one of the most popular FLOSS CMS and is considered, by Packt Publishing, as one of the most powerful FLOSS CMS. In 2004, the Plone Foundation was formed to enhance its success even more.
Added at Phase 3	
CoreMedia CMS	Packaged CMS which won different awards, such as Innovation Area Award 2006, Red Herring100 Europe Award 2005, Frost & Sullivan Product Line Strategy Award 2005
Drupal 5.2	FLOSS CMS repeatedly short-listed in the last editions of the PacktPub CMS Awards. It finished second at the Open Source CMS Award in 2006.
Ektron CMS 400.net	Packaged CMS finalist at the Codie Awards of the Software and Information Industry Association for the Content Management Solution category in 2006 and rated as positive by Gartner in 2006
FatWire Content Server	Packaged CMS awarded by Forrester Wave: Web Content Management for External Sites, for the third Quarter 2007 and rated as positive by Gartner in 2006
IdeaFutura FlexCMP	Packaged CMS developed by an Italian company, and particularly suited to public administration.
InfoGlue 2.0	FLOSS CMS initially produced as a custom solution for a Swedish company, which decided to open and free it, obtained a positive appreciation from the public (more than 50.000 downloads).
Jahia ECM Suite 5.0	FLOSS CMS developed by a Swiss company which offers free Community Edition and other paying versions, serving the European market.
Joomla 1.0.13	The most popular FLOSS CMS of the moment, with more than 200.000 downloads between June and September 2007, with the largest active development community (982.000 posts and 129.000 members). It won the Open Source CMS Award 2006 organized by PackPub.
Oracle UCM 10g Rel. 3	Packaged CMS developed by the leader of ERP applications with the advantage of being easily integrated with other Oracle products.
RedDot Solutions CMS 7.5	Packaged CMS named 'Trend-Setting Product of 2006' by KMWorld and largely (by Forrester and InfoWorld) recognized for its ease-of-use.

After Phase 2, our continued regular monitoring the CMS market revealed a slight decrease in the pace of new version releases, and thus Phase 3 data collection was delayed until September 2007, some 34 months after Phase 2. However, our monitoring also revealed that some new CMS applications, either non-existent or extremely marginal in 2004, had emerged as significant players in the market, again offering

new sets of functions. Moreover, while the pace of innovation in packaged CMS applications had slowed, FLOSS CMS applications registered a number of important improvements. Finally, the Phase 3 data collection revealed that CMS organizations had re-directed their strategy towards offering differentiated services, which led us to include services as our third strategic variable, so as to understand the trajectory of changes in the CMS segment more completely.

3.2.3   Data analysis

The collected data on the three measured strategic variables is presented on scatter graphs in the Results section and reported in **Table 2**. The scatter charts position each product as a mark on the chart defined by axes representing two of the three strategic variables, and facilitate the exploration of the relationships between cost category, functions and services. The graphs are complemented by Spearman Correlation coefficients which measure the correlation of two ordinal level variables so that their significance and value can be assessed. This statistical tool gives quantitative support to the qualitative analysis of the CMS applications, based on the strategic grouping approach and reinforcing (as far as the sample size allows) our results and the discussions on the evolutions of CMS applications over time.

Table 2
The version, cost category, function and service (only in Phase 3) values across time

| CMS	Phase 1 - 2002			Phase 2 - 2004			Phase 3 - 2007			
	Version	Cost category	Funct.	Version	Cost category	Funct.	Version	Cost category	Funct.	Servic.
Documentum	ECM 4i 4	middle market	26	WCM 5.2	enterprise	95	EMC 5.3	middle market	182	20
Interwoven	TeamSite 5	middle market	23	TeamSite 6.0	enterprise	90	TeamSite 6.7	middle market	171	19
Vignette	Content Suite 6	middle market	15	V7	enterprise	107	Rel. 7	middle market	161	19
Microsoft	CM Server 2001	Lower priced	14	CM Server 2002 SP1	upper tier	74	SharePoint Server 2007	lower priced	162	20
Open Text Corporation				Livelink WCM 9.2	enterprise	106	Livelink WCM 9.7	lower priced	142	20
TYPO3				3.7	Gratis	84	4.1	Gratis	176	17
Zope & Plone				2.0.4	Gratis	77	3.0	Gratis	181	18
MediaSurface				Morello 5.0	upper tier	75	Morello 5.5	middle market	158	17
OpenCMS				5.0	Gratis	70	7.0.1	Gratis	120	15
eZ systems				eZ Publish 3.x	Gratis	69	eZ Publish 3.8	Gratis	158	17
Tridion				CMS 5.0	upper tier	66	CMS 5.0	middle market	135	21
Mambo				4.5.1	Gratis	65	4.6.1	Gratis	161	16
Apache				Lenya 1.2	Gratis	61	Lenya 1.2	Gratis	108	12
Outerthought				Daisy 1.1.0	Gratis	58	Daisy 2.0	Gratis	103	10
Drew Vogel				Xaraya 0.9.10	Gratis	57	Xaraya 1.1.3	Gratis	154	17
Roxen				CMS 4.0	middle market	56	CMS 4.5	lower priced	128	21
MMBase				1.7	Gratis	53	1.8.4	Gratis	116	12
Ingeniux				CMS 4.1	middle market	51	CMS 5.2	middle market	140	18
Obinary ltd.				Magnolia CMS 1.1	Gratis	33	Magnolia CMS 3.0	Gratis	117	18
Drupal							5.2	Gratis	161	17
IdeaFutura							FlexCMP	lower priced	159	19
Joomla							1.0.13	Gratis	158	17
Jahia							ECM Suite 5.0	Gratis	156	20
FatWire							Content Server	middle market	155	21
Ektron							CMS 400.net	Gratis	154	19
Oracle							UCM 10g Rel. 3	middle market	147	22
RedDot Solutions							CMS 7.5	middle market	135	21
CoreMedia							CMS	lower priced	133	19
InfoGlue							2.0	Gratis	113	12

4   Results

The results of the empirical study follow our data collection timeline: first, three separate pictures of the CMS market at different times are presented, after which the whole data set is used to draw the trajectory of the CMS application change over time.

4.1   Phase 1 - 2002

The first phase illustrates the heterogeneity of the 4 CMS applications we analysed in terms of the functions and costs. The number of available functions varies from 14 to 26, depending on the application, while the cost categories range from lower priced (for Microsoft CM Server 2001) to middle market (for the other three applications in the set). **Fig. 2** represents the scatter chart results, while **Table 2** gives the details.

Fig. 2
The functionality and cost distribution of CMS applications at Phase 1
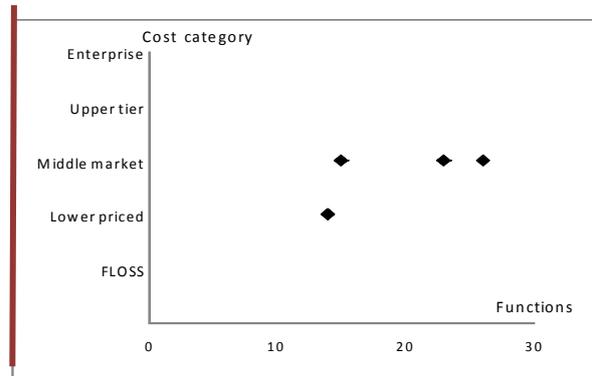
4.2   Phase 2 - 2004

At the second Phase, in terms of functions, the gap between the most and fewest functions offered by applications was 74 functions wide, ranging from 33 functions for Obinary ltd. Magnolia CMS 1.1 to 107 functions for Vignette V7. In cost terms, this phase registered the widest gap, spanning the whole breadth of our cost taxonomy between the Gratis and the Enterprise categories. While the FLOSS applications are free (as in beer), packaged CMS costs are spread among the Middle Market, Upper Tier and Enterprise categories. Generally, at this phase, FLOSS applications are less function-rich than packaged CMS applications, although some (such as TYPO3 3.7, Zope & Plone 2.0.49) offer more functions than some packaged applications. The scatter chart of **Fig. 3** highlights the marginal gap in terms of number of functions between FLOSS and packaged CMS and the wide cost gap between the two (see **Table 2** for details). Nevertheless a general correlation between costs and functions is distinguishable, and is confirmed by the Spearman Correlation coefficient figure of 0.593 significant at 0.01.

Fig. 3
The functionality and cost distribution of CMS applications at Phase 2
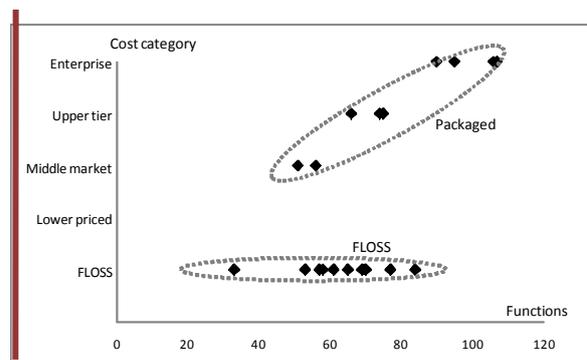
4.3   Phase 3 - 2007

At Phase 3, as far as functions are concerned, a 79 point gap exists between Outerthought Daisy 2.0 (with only 103 functions) and Documentum EMC 5.3 (with 182). Even though the most 'function-poor' application is a FLOSS application and the most function-rich a packaged application, there is no clear overall separation between the two sectors in terms of numbers of functions: many FLOSS CMS offer as many (or more) functions as many packaged CMS. In terms of costs, there are now no CMS applications in the Enterprise and Upper Tier cost categories, so the overall cost span is much reduced, to that between the Gratis category and the Middle Market cost category for some packaged CMS applications. **Fig. 4** shows a clear demarcation between the FLOSS and packaged sectors in cost terms, but the picture is much less clear-cut in terms of functions, with both types regularly distributed all along the Functions axis. This lack of a clear correlation between cost and functions is supported by the lack of significance of the Spearman Correlation coefficient: in Phase 3, the number of available CMS functions appeared to be unrelated to application cost.

Fig. 4
The functionality and cost distribution of CMS applications at Phase 3
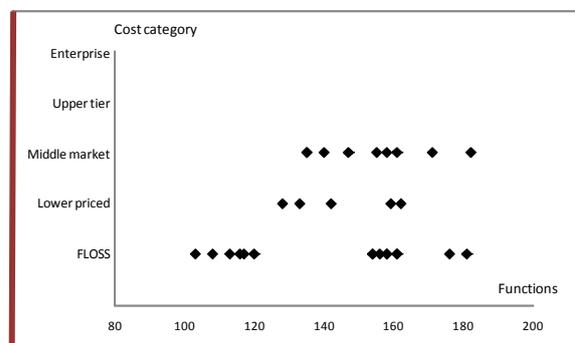
However, when we look at the distribution of services (the variable measured for the first time at Phase 3), we found a correlation between the cost category and the number of services offered. Generally speaking, the more expensive the application, the higher the number of services offered, with the number of services offered by packaged applications being higher than that offered by FLOSS applications (again, see Table 2 in the Appendix for details). A deeper analysis - as depicted in the **Fig. 5** scatter chart - allows two sets of CMS to be identified: set A includes CMS offering many services but dispersed across the three lower cost categories, while set B includes applications offering fewer services (which are also all FLOSS applications). Costs and services are also positively correlated statistically, with a Spearman Correlation coefficient of 0.694, significant at 0.01.
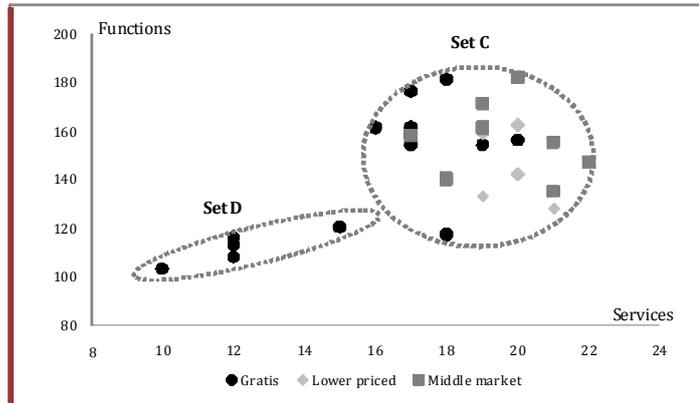
Fig. 5
The cost and service distribution of the set of applications at Phase 3
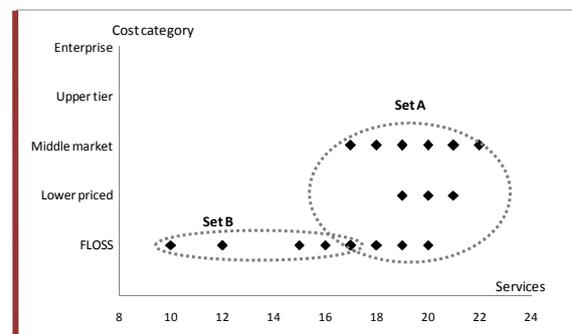
Looking at all three variables together (**Fig. 6**), the data again shows a relationship between functions, cost and services offered, although this time there is no statistical significance. Set C is composed of products offering the most services and functions, and includes all the packaged applications as well as

several FLOSS applications CMS, while, in comparison, set D consists of applications offering the fewest services and functions, which are all FLOSS products.

4.4   Results across the phases

Our data analysis identifies three main changes:

1. The increase in the number of available functions, where the rate of increase was higher for FLOSS CMS than for packaged applications, which contributed to the gap between the numbers of functions offered by packaged and FLOSS applications evening out by 2007;

2. The reverse U-shape evolution of the cost of the applications, which generally rose between Phases 1 and 2, and then decreased between Phases 2 and 3;

3. The emergence of services offered as a new strategic variable in the CMS segment between Phases 2 and 3.

These three changes point to the rising market strength of FLOSS CMS applications. Between 2002 and 2004 packaged CMS developers combined extending available functionality with increasing entry level license costs, with the greater number of functions of packaged CMS applications differentiating their offers from those of the gratis FLOSS applications. However, between 2004 and 2007, the functional extensions of FLOSS CMS flushed away the function-based differentiation between the two types.

The heightened competition among CMS products post 2004, and the increasing difficulties packaged CMS developed had in maintaining function-based differentiation in the market, are also highlighted by two other changes. First, packaged software firms made significant reductions in the entry level license costs for their products. In Phase 2, most packaged applications were in the two most expensive categories in our taxonomy, but by Phase 3, all, except one, had cut their license costs (some very heavily), so by 2007 they all appeared in the lower two cost categories. Second, packaged CMS applications included a much wider range of services as part of their offer and put an accentuated emphasis on this factor in their marketing strategies. Thus differentiation in this market seems to have moved from being function-based to being service-based, and in terms of this strategic variable, the packaged CMS products (or at least some of them) seem to have a significant advantage over most FLOSS applications.

5   Discussions

Our longitudinal data collection highlights the changes of CMS applications in terms of functions, costs and the offer of related services over a six-year period and the role of FLOSS in these changes.

5.1   Functions

In line with previous studies, we have observed a considerable and general increase in application functionality over time (Basili & Boehm, 2001; Latham, 2007; Wilkoff, 2001). At Phase 1, CMS functions tended to be fairly strictly related to content management, but subsequently they expanded to support other management fields such as e-commerce, knowledge management and document management, as predicted in previous research (Howard, 2001; Pelz-Sharpe, Ashenden et al., 2002; Wilkoff, 2001). In this function extension trend, FLOSS CMS made the biggest progress as FLOSS CMS, in the last phase, were able to propose the same functional coverage than Packaged CMS. Hence the commercial discourses insisting on Packaged CMS functionally richer than FLOSS CMS have no more objective rationale as the FLOSS CMS have the same functionalities of Packaged CMS.

Unfortunately it is not always the case in all the segments of the software industry. Hence, we think that, in same cases, this gap should be evened, also through the public intervention when the public administration needs these software applications to deliver its public services. For example, online public services should be accessible through FLOSS applications, and if FLOSS applications are not compliant with the online public services, the public administration should directly invest on those FLOSS applications, developing the missing functionalities, in order to assure a free (as in speech) access to theses online public services.

5.2.   Costs

Concerning financial aspects, the developers of Packaged CMS generally practice frequent new-version releases that often include only several new functions (Adam & Light, 2004). This marketing practice leads to the rapid obsolescence of previous versions and the developers push the existing customers to upgrade their CMS applications, usually expensively charging clients for upgrade (Sawyer, 2000) and activating lock-in (Adam & Light, 2004) policies. As a consequence, the worldwide packaged software license market has been $297 billion in 2008 (Business Software Alliance, 2010) with a annual growth of 8% (IDC, 2010). The growth of the specific segment of CMS application licenses is even more rapid. It is of $635 million worldwide in 2009 and $1.4 billion expected in 2015, which means a 14% annual growth (Market Research.com, 2010).

On the opposite, FLOSS CMS are free-gratis and upgrade and new-version releases are free-gratis too. Moreover, the users of FLOSS CMS do not risk lock-in as the users has the freedom to change it (or to ask any third party to make changes for them) without depending on the choices of the original developer and on its CMS development trajectory. Hence the success of FLOSS applications could lead to an economic degrowth of the software license market.

We have additionally seen that the evolution of packaged CMS costs has followed a parabolic trend. The initial increase in the cost and functions of packaged CMS was in line with a differentiation strategy against the emerging FLOSS CMS applications, which in 2004 were considerably less rich in functionality. But, by 2007, the fact that functionality had subsequently expanded faster in FLOSS than in packaged CMS seems to have led to a decrease in packaged CMS costs (Sawyer, 2000). In fact, it seems unlikely that a packaged application could compete on costs against a FLOSS application (Adam & Light, 2004).

However, in general, in some other segments and/or depending on the use destination, some packaged applications are gratis-free. Hence the choice of the application will not depend on price. Taking the example of the web browser segment of the software industry, most of these applications are gratis-free: Internet Explorer is a free-gratis packaged application while Firefox Mozilla is a FLOSS application. In terms of use destination, for example Microsoft Corporation proposes Visual Studio (an integrated development environment) gratis for students, while it charges non-students, while FLOSS integrated development environments are always gratis whatever the use destination.

The cost differentiation based on use destination is an interesting practice if it would be based on the public interest of the use and controlled by the public itself, rather than based on the private interest of the software developer and controlled by the software developer alone (Ariès, 2007). The cost differentiation could be applied in that sense on any kind of software, packaged or FLOSS. For example, for public education purposes software should be gratis, where as for commercial or private purposes software could be expensive, or even forbidden.

5.3. Services

Packaged CMS developers appear to have chosen a new differentiation strategy against FLOSS CMS, by developing and marketing an increasing range of services to their clients (Adam & Light, 2004; Andersson & Nilsson, 1996), to try to counter, on functions and prices, FLOSS CMS. Even if in the short term this differentiation strategy could be profitable for Packaged CMS developers, as FLOSS CMS is not offering the same wide range of services, it will not in the long term. In fact, while some FLOSS CMS applications contain service elements, freely available and provided by the FLOSS communities themselves, they do not appear as rich or broad as those associated with packaged CMS.

However, the sustainability of this service-based strategy of packaged CMS developers is at risk from, at least, three different strengths of the FLOSS applications. First, if a formal company sponsors the development of FLOSS CMS, it is possible that that company could offer the same full range of services as packaged CMS. Some companies (e.g. Obinary) leading the development of FLOSS CMS have adopted this service strategy, and they are structuring their business model around the offer of services (Fitzgerald, 2006). Second, applications developed by the FLOSS CMS communities may attract the attention of commercial companies who may see a new business opportunity in offering services built over community-developed FLOSS CMS applications (Dahlander & Magnusson, 2008; Fitzgerald, 2006). Third but most revolutionizing one, some very active FLOSS communities (e.g. the Typo3 and Plone communities) have already successfully developed rich offers of services, which seem to match those available from some commercial companies. This third option is the most promising one as it put in practice the gift and counter-gift social relations (Komter, 2007), as each member of the community is provider and receiver of services (Bagozzi & Dholakia, 2006).

5.4 Emancipation

Functional, financial and service aspects are of secondary importance from the critical social theory perspective. The separation between producers and consumers, the domination of producers on the consumers and the consequence alienation of the consumers is typical for packaged software. In general, the packaged software producer releases the packaged software and licenses it to customers who can only consume the packaged software. The customers only consume the packaged software as they cannot reuse it for other purposes, they cannot repair it, they cannot redistribute it and they cannot recycle it. They finally cannot do anything different from what is stated in the license defined by the producer. Prospectively, the consumers depend from the packaged software developers also for the future evolutions of the software. Moreover, in case of bankruptcy of the packaged application developer (not a so rare event in recession periods), all the users will definitively lost the only provider of the packaged application and the only hope for application evolution.

Even if the cost of packaged application decline to zero, the domination and alienation will last. The only way out from it is FLOSS as only FLOSS can assure the freedom of each user to study the software, change it in liberty and redistribute the eventual changes. Even if not all the FLOSS users have the competences to change the software, it's the freedom to do this that makes the difference. Hence and the most important, FLOSS "is about having control over the technology we use in our homes, schools and businesses, where computers work for our individual and communal benefit, not for proprietary software companies or governments who might seek to restrict and monitor us" (Free Software Foundation, 2010).

5.5   Generalizations

This study does not provide direct evidence of generalizability of these results. However, the facts that the growth of FLOSS projects and the trend toward services are generalized phenomena in the software industry (Fitzgerald, 2006; Rai & Sambamurthy, 2006) suggest that these results could be reproduced in other segments. Indeed, similar facts have already been observed in the computer platform segment (West, 2003).

On one hand, Microsoft, and others companies whose packaged applications lead the software market are gradually and cautiously planning and enacting the re-orientation of their business models. They start to distribute open source products, to use open source code in their applications and to authorize licensees to review, modify, redistribute, and sell works with no royalties (Matusow, 2005; Roy, 2003). They are also trying to replicate the open source development process, through globally distributed development, independent peer reviews of code source and reacting to users' experience and input (Fitzgerald, 2006).

Beyond the reactions of the Packaged Software developers, on the other hand, many software users are developing a new consciousness, recognizing the intrinsic advantages of FLOSS. They do not want anymore to be treated as software consumers but they want to gain FLOSS freedoms. Hence FLOSS solutions are increasing in number and in success (Latham & Drakos, 2007) and FLOSS communities are enlarging. This success of FLOSS, in some software segments, adds evidences that concrete alternatives to the dominant paradigm (for-profit and proprietary software) could succeed.

In addition, FLOSS communities (of users and developers) seem to consciously act to change their social and economic circumstances struggling against various forms of social, cultural and political domination. Participating in FLOSS development is not a hobby (Shah, 2006) for all, but the motivations could be multiples (Roberts, Il-Horn et al., 2006) and for some members the motivations are political and ideological (Katherine & Gosain, 2006). FLOSS communities are, hence, very precious social realities where democratic dialectic, rational discourses, responsibility and political debates take place. Moreover, the new consciousness of the FLOSS user will not be confined in the software environment. Some FLOSS users expect to develop the same freedoms, autonomy, peer-to-peer relationships and social equity in the other social realities, fertilizing as a consequence other contexts and stimulating new concrete alternatives, that together could facilitate the establishment of the ecologic sustainability and the social equity (Flipo & Schneider, 2008).

Finally , the FLOSS development should be encouraged at the place of financing packaged software development. Moreover, if public funds are attributed to software development organisations, a clause of the funding contract should impose that the software output should be FLOSS and published under a free software license (like General Public License) as it has been developed with the funds of the community. NASA is doing something similar for its developed software (National Aeronautics and Space Administration, 2010).

6   Conclusion

This paper discusses the trajectory of change in the CMS segment through a six-year longitudinal study of a set of CMS applications that, following the Porter's strategic grouping approach (Porter, 1980), have been measured in terms of available functions, cost and offer of services. There is an increase in the number of functions of CMS applications, a parabolic trend in the cost of packaged CMS applications, and the emergence of services as a new strategic variable. At the same time, competition between packaged and FLOSS CMS applications has led to a shift toward the offer of services.

In addition, this study contributes to the research on the Open Source software transformation

(Fitzgerald, 2006), thanks to its longitudinal approach and the direct comparison of FLOSS and packaged software within a single software segment.

Given the general relevance of the phenomena we have described, similar evolutionary paths may be recognized in other software industry segments, as some empirical evidence has already shown. But speculation as to whether our results hold good for other segments will need further empirical testing. While we will continue to observe the CMS segment, we consider the exploration of some other software industry segments as an interesting research field for developing a better understanding of the raisons of the success of FLOSS CMS and the obstacles to the FLOSS success in other software segments, in order to remove those obstacles. But the most interesting issue will be the development of an understanding of how the success of FLOSS alternative could be generalized outside the software industry.

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