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OSS Adoption: Who is Leading and Why?

Daniel Nepelski and Sushmita Swaminathan

It is no secret that open source software (OSS) is gaining ground, yet the drivers for OSS adoption still seem rather unclear. This report aims to compare various industries within select countries in the EU and tries to explain their OSS adoption patterns. The results indicate that companies in Poland, the Czech Republic and Hungary are leading OSS adopters. Further, it was found that company adoption of OSS is largely dependent on in-house IT development and expertise. The focus on internal development and capacities is often characteristic of larger firms, which is corroborated by our findings. Finally, the analysis showed that companies tend to OSS, the higher their requirements for open standards and interoperability.

JEL classification: L86, O33, O52, D21
Keywords: Open source software; Adoption: Internal IT capacity, User Innovation

Why Open Source Software?

Open Source Software (OSS) is defined as those software programs whose licenses give users the freedom to run the program for any purpose, to study and to modify the program and to redistribute copies of either the original or modified program.[1] Linux, Apache and Mozilla represent some of the more well known OSS offerings. Such software is *not* monetarily free instead, it allows consumers control over their product to modify and maintain according to their specific requirements. This is in contrast to proprietary alternatives where consumers are dependent on the supplier for all developments and improvements having

1 No royalties to the developers have to be paid. Compare Renner, T. et al. (2005) Open Source Software – Einsatzpotentiale und Wirtschaftlichkeit. Studie, Fraunhofer-Institut für Arbeitswirtschaft und Organization IOA, Competence Center Electronic Business Pp. 12 www.e-business.iao.fraunhofer.de/docs/fhg_oss-studie.pdf, 03.08.2006 Wheeler, A. D., (2005) Why Open Source Software/Free Software (OSS/FS, FLOSS or FOSS?) http://www.dwheeler.com/oss_fs_why.html 03.08.2006

no access to the source code. The varying proprietary standards do not always allow for interoperability and tend to lock-in consumers in to a particular standard. From an individual firm or industry perspective, the turn towards these applications comes from individual requirements for flexibility, reliability, security and cost considerations[2]. The loss in proprietary market share, according to David Wheeler[3], is most likely due to the re-occurring security problems that were associated with it.

However, despite the obvious growth attributed to OSS, proprietary alternatives are still dominant in the software market. A major disadvantage of OSS comes from the uncertainty with regard to further development, lack of support services, ill-functioning applications and a lack of know-how.[4] This has been countered to some extent by the use of OSS along with proprietary software. In fact many companies try OSS by first using it as a complement and then as a substitute if it suits their purpose. The following sections explore the data and main findings in greater detail followed by the conclusion.

Country and Industry Differences in OSS Adoption

For the purpose of the current study, data from the recent *e-Business Market W@tch* survey on the adoption of OSS applications is used. The *e-Business Market W@tch* monitors and analyses related developments and their impacts on different sectors of the European economy.[5] It collects data on the use of ICT and e-business in European enterprises by means of representative surveys. The e-Business Survey 2006 had a scope of 14,081 telephone interviews with decision-makers in enterprises from 29 countries, including the 25 EU Member States, EEA and Candidate Countries.[6]

As in 2005, the survey considered only companies that used computers. Thus, the highest level of the population was the set of all computer-using enterprises which were active within the national territory of one of the 29 countries covered, and which had their primary business activity in one of the 10 sectors specified on the basis of NACE Rev. 1.1.[7]

According to the recent *e-Business W@tch* survey, OSS diffusion across EU countries is still in its early phase. Our data shows only 9% of all companies use OS operating systems and 7% use OS database applications. Even OS internet browsers are lagging behind Microsoft's IE. At present, only 15% of the surveyed companies use browsers such as Mozilla, Opera or Firefox. However, according to other sources, the use of OS browsers is steadily increasing and the market share dynamics indicate that internet users show a great degree of flexibility and do not seem to be concerned about switching costs when a superior browser is released.[8]

There are considerable differences in terms of OSS adoption between EU countries (see Exhibit 1). Particularly striking is the finding that Poland, the Czech Republic and Hungary are the most extensive users of OSS. Germany has the most advanced OSS users among the old EU member states. In other Western European countries OSS still plays a marginal role and does not present a serious challenge to proprietary solutions yet.

The results reveal interesting patterns of OSS adoption rates between industries as well (see Exhibit 1): The Hospital Activities sector emerges as an OSS adoption leader. The adoption rates are slightly higher than in traditionally ICT-savvy industries such as Telecommunication Services, ICT Manufacturing and Consumer Electronics. The high rates of OSS usage in the Hospital Activities sector can be explained by cost pressures across the sector resulting from the spiralling costs of health care systems to the inability to afford ICT systems at current prices.[9]

The differences in OSS adoption rates between industries can partially be explained by the overall

2 Weber, S., (2004) The Success of Open Source, Harvard University Press, Cambridge, Massachusetts.

3 Wheeler, A. D., (2005) Why Open Source Software/Free Software (OSS/FS, FLOSS or FOSS?) http://www.dwheeler.com/oss_fs_why.html 03.08.2006

4 Compare Renner, T. et al. (2005) Open Source Software – Einsatzpotentiale und Wirtschaftlichkeit. Studie, Fraunhofer-Institut für Arbeitswirtschaft und Organization IOA, Competence Center Electronic Business Pp. 69 www.e-business.iao.fraunhofer.de/docs/fhg_oss-studie.pdf, 03.08.06

5 http://www.ebusiness-watch.org/

6 The EEA (European Economic Area) includes, in addition to EU Member States, Iceland, Liechtenstein and Norway. Candidate Countries, which are candidates for accession into the EU, are (as of May 2006) Bulgaria, Croatia, Romania and Turkey.

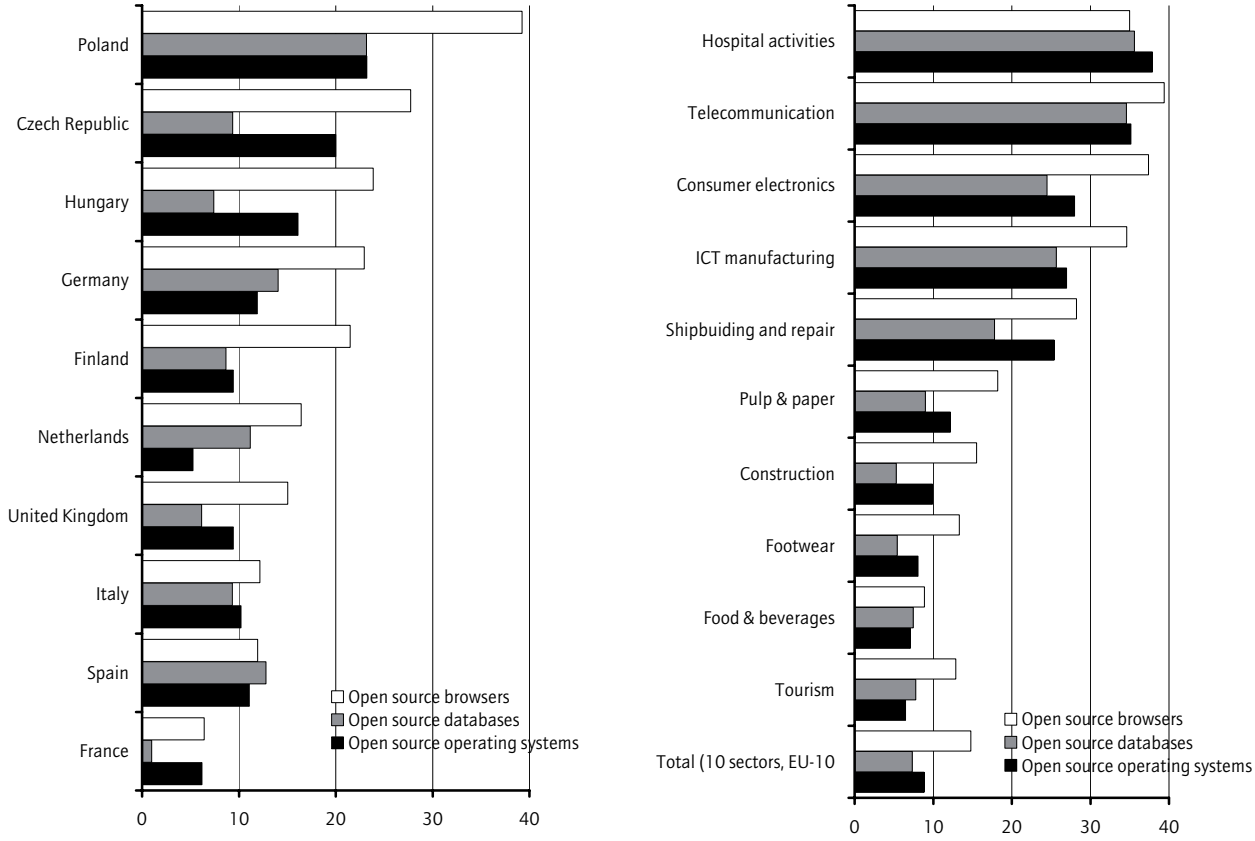
7 Surveyed industries include: Food and Beverages, Footwear, Pulp, Paper and Paper Products, ICT manufacturing, Consumer Electronics, Shipbuilding and Repair, Construction, Tourism, Telecommunication Services, Hospital Activities.

8 See Weiss, T. R. Firefox use growing around the world. www.techworld.com 13.07.2006 In Germany FireFox users constitute 39% of total users.

9 See David, S. (2005) „F/OSS opportunities in the health care sector"; in: Karaganis, J./Latham, R. (2005) „The Politics of Open Source Adoption", Social Science Research Council Version 1.0 May 2005, pp. 84-91.

Exhibit 1

Adoption (in %) of open source applications across countries and industries



Source: *e-Business Market W@tch*

ICT-intensity across the presented sectors.[10] For example, the high adoption levels in Telecommunication, ICT Manufacturing and Consumer Electronics industries reflect the high rates of ICT usage in these industries. The high adoption rates of OSS in ICT-savvy industries might indicate that OSS offers superior performance and features, compared to proprietary solutions. This has been confirmed by existing studies on the reasons for OSS adoption.[11] At the other extreme are industries with less complex value chains and production processes, such as Tourism, Food and Beverages and Pulp and Paper, which traditionally trail behind in ICT usage also do not exhibit high OSS usage patterns.

Product characteristics of OSS additionally tend to greatly drive its adoption : First, flexibility, the ease in modifying and integrating additional modules to an OSS application meets the sector's needs for internet-based services and modular ICT systems that should run on various platforms and devices can be accessed by a number of people. Second, better access protection in OSS guarantees a high level of accountability and transparency while simultaneously maintaining privacy. Third, open standards avoid the risk of being locked-in to a particular software vendor, an issue particularly important when considering a highly fragmented market of proprietary applications. Finally, the high degree of public and government agencies involvement which favours the emergence of open, vendor-independent and secure standards, further contribute to OSS adoption.

10 See The European e-Business Report 2004 edition, p. 10.

11 See Use of Open Source Software in Firms and Public Institutions. Evidence from Germany, Sweden and UK. FLOSS Final Report – Part 1. Berlecon, Berlin, 2002.

Box

An ordered logit model was used to estimate the following linear equation:

$$y_i = \alpha + \beta X_i + \varepsilon_i$$

where y_i takes the value of 0, 1, 2 or 3 depending on how many out of the three OS applications a firm uses. X_i is a set of firm characteristics and β is a set of parameters. An error term, ε_i, controls for unobserved effects and is assumed to be independent from the explanatory variables. It must be, however, noted that we cannot control for unobserved heterogeneity, i.e. the dependent variable might be influenced by other factors for which no data is available.

The table below shows the share of companies ordered with respect to the number of OS applications used.

Company Use of OSS Applications

y	Number of observations	% of total
0	4010	55
1	1537	21
2	871	12
3	819	11
Total	7237	100

Source: *e-Business Market W@tch*

Industries exhibiting the highest rates of OSS use are characterised by high concentration levels, capital intensity and a large (average) company size.[12] Large company sizes allow them to spread the high cost of ICT applications and benefit from the resulting economies of scale. Companies operating in these industries have to deal with complex processes and large data volumes and ICT systems enable them to automate routine and labour intensive tasks and organize activities more efficiently. By experimenting with OSS firms have an opportunity to find innovative ways to deal with firm specific problems. Alternatively, firms in the Tourism or Construction sectors are populated by small firms operating in highly competitive environments.

The results cast some light on the substitution effects of OSS over proprietary software. Contrary to common beliefs, cost savings are not the key driver of OSS usage: Superior stability, and access control are ranked as the most important criteria for OSS adoption decisions. Thus, high complexity of operations, huge information volumes, the need for flexibility and security call for solutions that in many cases are not provided by proprietary software vendors.

Analysis

Two regressions were estimated in order to test the relationship between internal ICT competencies and OSS adoption (see Box). In the first model, only variables accounting for country, industry and size effects were included. All variables used in the first model were dummy variables. The second model was extended by the inclusion of variables controlling for in-house ICT capabilities, i.e. in-house IT specialists, IT training to employees, e-learning use and the firm's IT expenditures compared to its total expenditures. Two additional variables, the share of employees with a college degree and those involved in R&D activities, control for further skill effects. Furthermore, to account for the importance of standards and interoperability in a firm's operations and their effects on OSS adoption, four additional dummy variables were included: the importance of interoperability for internal and external operations, for products and services and the importance of standards for ICT investment decisions. The dependent variable, OSS adoption intensity is based on answers to the question regarding the number of OSS applications used by companies.

The type one model supports the previous (see Exhibit 1) findings suggesting that country and industry effects are important determinants of OSS adoption (see Table 1). First, the results of the first model confirm that the country of origin has an effect on the adoption of OSS. Country effects are strongest for companies from Poland, Hungary and the Czech Republic. Second, industry effects are equally important. Companies from ICT-savvy industries such as Telecommunication, Consumer Electronics and ICT manufacturing industries are particularly likely to deploy OSS. Third, the likelihood of OSS adoption increases with firm size. As larger companies spend, on average, more on software, they might reap greater benefits from licence savings, compared to small firms. [13]

12 A positive correlation between firm size and the likelihood of OSS adoption is reported in the subsequent analysis.

13 Larger companies spend on average more on software in absolute terms, because the share of ICT expenditures negatively correlated with firm size.

The second model confirms the initial assumption that internal IT expertise is an important prerequisite for OSS adoption. The analysis reveals that there a positive correlation between the size and intensity of IT capacities and the likelihood of OSS adoption. Furthermore, offering e-learning programmes to employees, the share of employees with a college degree, employees involved in R&D and the share of ICT in company's expenditures are also positively correlated with OSS usage intensity as well. Thus, these results indicate that ICT competencies and skill effects play an important role in OSS diffusion, similar to ICT adoption in general.

Not surprisingly, the effects of internal ICT expertise on the OSS adoption likelihood is particularly strong for large companies. In general, only larger firms might be able to benefit from OSS because they can afford to develop internal IT expertise. Such internal development may not be financially feasible for smaller firms. In other words, scale effects creates barriers to OSS adoption for SMEs.

The analysis further yields some important results with respect to standard and interoperability issues as well. In particular, companies emphasising the importance of internal and external operability of ICT systems tend to be more advanced users of OSS. Similarly, firms stating that standards are important for their ICT investments are also more likely to be OSS users. These results stress the need for open and vendor-independent standards of ICT applications and confirm that OSS applications give companies an opportunity to achieve flexibility and interoperability, not available with proprietary solutions. This requirement by advanced OSS users has led to OSS moving from simply a complement to actually substituting proprietary alternatives.

Conclusion

This report has shown Poland, the Czech Republic and Hungary to be leading OSS adopters. The analysis highlighted that the main prerequisite to benefit from OSS comes from in-house IT expertise.

This has three important implications: First, intensive users of OSS are able to benefit from superior product characteristics, such as flexibility, better access protection and stability, unavailable to proprietary software users. Second, being actively involved in software development and customization they create invaluable expertise enabling them to extract the maximum benefits and resulting comparative ad-

Table 1

Drivers of OSS Adoption

Ordered Logit Model

	Y=OSS adoption intensity			
	Model 1		Model 2	
	Coefficient	P>|z|	Coefficient	P>|z|
Czech Republic	0,5044	0	0,5825	0,001
Germany	0,4300	0,001	0,5266	0,003
Sweden	0,0181	0,893	-0,1924	0,327
France	-0,1458	0,267	-0,1089	0,553
Italy	-0,3068	0,023	-0,5426	0,005
Hungary	0,5687	0	0,6269	0,001
Poland	1,1804	0	0,8718	0
Finland	0,5167	0	0,2561	0,152
UK	-0,2036	0,121	-0,1602	0,394
Food	-0,3292	0,003	-0,2529	0,09
Footwear	-0,1502	0,21	-0,0192	0,906
Pulp and paper	0,1225	0,235	0,0913	0,523
ICT manufacturing	1,2026	0	0,7417	0
Consumer electronics	0,9663	0	0,7811	0
Shipbuilding	0,0618	0,79	0,1881	0,534
Construction	-0,2457	0,025	-0,1347	0,369
Telecommunication	1,9216	0	1,3312	0
Hospital activities	0,8250	0	0,5531	0,002
10-49 employees	0,2738	0	0,1607	0,051
50-249 employees	0,8684	0	0,7194	0
>250 employees	1,2973	0	0,6731	0
IT specialist			0,7336	0
IT training			0,1187	0,181
e-learning			0,3003	0
IT Budget			0,0154	0
Internal interoperability			0,1996	0,044
External interoperability			0,1547	0,089
Interoperability for products			0,1416	0,126
Importance of standards			0,3950	0
% of employees with higher degree			0,0057	0
% of employees in R&D			0,0172	0
_cut1	1,3243		1,9134	
_cut2	2,4648		3,1998	
_cut3	3,4543		4,3262	
Model diagnostics				
Number of observations	6972		4159	
LR chi2(31)	1359,42		1298,85	
Prob > chi2	0		0	
Pseudo R2	0,0849		0,1395	
Log likelihood	-7327,7898		-4005,1041	

Source: Own estimations

vantages from their OSS applications. This expertise comes from the contact existing between the in-house IT experts and the OSS community which indirectly contributes to internal IT development. As a result, these companies might be more successful in finding innovative applications of ICT in their operations. Third, it is observed that this kind of development and the resulting adoption of OSS is more often seen in large firms who are able to take advantage of scale effects.

Though it may still be lagging behind proprietary alternatives, OSS prevents companies from being locked-in to a particular software vendor and, consequently, contributes to the emergence of open standards and boosts interoperability of IT systems.