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## 1 Introduction

This report provides key findings from the FLOSSInclude Context Report (D1.1) and the report on further data from countries without previously available data (D1.3). It is largely based on the results of the previous FLOSSWorld project, but updates and amplifies these findings through additional information gathered specifically for the FLOSSInclude project. Target regions that have been examined for this report are: China, India, South Africa, Brazil, Argentina, Ghana and Cambodia.<sup>1</sup> For Ghana and Cambodia surveys on employers, developers and higher educational institutions have been conducted in order to achieve a degree of information on these countries that is comparable to the information on the other countries that was gathered in FLOSSWORLD.

The purpose of this deliverable is to give an overview of fundamental aspects of FLOSS development, FLOSS communities, FLOSS policies and FLOSS in the public sector and in education in the target regions and to identify for each of these fields problem areas that should be tackled by different actors in order to tap into the full potential of FLOSS for society and economy. This overview includes a number of indicators related to FLOSS software communities and projects.

For this purpose, the FLOSSWORLD project has identified and examined representative parameters, such as publications related to FLOSS, Linux user groups, or FLOSS development communities. These parameters have been gained from studies on

- the SourceForge user database<sup>2</sup>, including information about mail addresses and time zones for registered users, which allows estimating the geographical origin of developers;

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<sup>1</sup> A brief description of these countries is provided in D1.1

<sup>2</sup> This database is provided to researchers by by University of Notre Dame, see details at <http://www.nd.edu/~oss/Data/data.html>

- mailing lists of several large global FLOSS projects, whereby the mail addresses and time zones of messages also allowed determining the origin of developers
- forges found in the target regions, including the analysis of public information about registered users, source code management repositories (CVS and Subversion), release files with source code, and mailing list archives; this information allowed estimating developer and project population in the target regions, the quantity of source code developed, etc.
- the incidence and role of FLOSS skills in the economy and higher education of the target regions; for this purpose surveys of employers, developers and higher education institutions (HEIs) have been carried out, or existing surveys carried out in FLOSSWORLD have been re-examined
- the role of FLOSS in the public sector; for this purpose surveys on local governments have been conducted or, in the case of existing surveys of the FLOSSWORLD project, have been re-examined

Another important source of information that particularly helped to interpret and evaluate the above mentioned data was provided by the regional FLOSSInclude partners. This qualitative background information provided insights in the functioning and difficulties of regional developer communities, employers' opportunities and barriers related to FLOSS, the situation of the educational sector in the target countries of FLOSSInclude, and policies towards or against FLOSS in these regions.

This report is structured as follows:

- The next section (3) gives basic background information on the role of the Internet in each target region (in terms of the share of the number of Internet users in total population) and describes overall characteristics of regional FLOSS communities in the target countries of FLOSSInclude, as far as data and information on this subject is available;

- Section 4 provides insights in the role of FLOSS communities for the skills attainment and the usability of skills learnt in FLOSS communities on the labour market;
- Section 5 examines the role of FLOSS in the public sector of the target countries and, vice versa, the role of the public sector for FLOSS communities and FLOSS businesses
- Section 6 presents the conclusions of this report by identifying the major problem areas in each of the fields (communities, skills, and public sector).

## 2 Characteristics of Regional FLOSS Communities

### 2.1 Approach

In order to evaluate the characteristics of the local FLOSS communities of the FLOSSInclude target regions we build upon studies that were carried out earlier (2005-2007) for the FLOSSWORLD project. In addition, information that can be compared to the outcomes of the FLOSSWORLD studies have been gathered for Ghana and Cambodia by the local consortium partners. Besides technical aspects, such as programming languages and forges that are used in these communities, a key objective of these studies was to identify the geographical origin of developers.

The studies we refer to collected quantitative and qualitative data on

- Collaborative Development Environments (CDE or forges)
- repositories (Code Management Systems)
- mailing lists
- source code releases
- on-line web form surveys
- Internet searches (e.g. in order to obtain representative parameters like publications related to FLOSS, Linux user groups (LUGs), or FLOSS development communities)

The information obtained from these studies has been used to estimate developer and project population in target regions, quantity of source code developed, etc. SourceForge, the largest forge in the world, has been studied as a proxy of the global FLOSS development community, which provides a good contrast for all the regional data:<sup>3</sup> As of 2007, Source-

<sup>3</sup> The detailed methodology and results of this undertaking are presented in Deliverable D1.1 (Context Report) of the FLOSSInclude project. In the current report, we provide only the main findings of D1.1 together with some additional data, mainly the number of Internet users as a reference point for the regional FLOSS community characteristics, from a different angle: While D1.1 describes community characteristics, this report puts more emphasis on the comparison of the regional communities and on the identification of problem areas.

forge represents more than 140,000 projects and over 1.5 million of registered users. Based on these figures, the average size (in terms of community members participating in the project) of a project registered with Sourceforge is roughly 10.7.<sup>4</sup>

The order in which the situation in the target regions is presented and discussed in the following sections follows the discussion in Deliverable D1.1.

It must be emphasised that the validity and reliability of such data is quite weak. First of all, not all forges that exist allowed to analyse the data they contain. Second, those forges that allowed to analyse their data are usually not representative for the FLOSS community as a whole in the target regions. Third, it is very likely that not all of the FLOSS developers and projects in a target region are registered in a forge. Nevertheless, given our broad research activities and the combination of examining public available data and insider expertise our approach represents the best guess that is possible at the moment.

## **2.2 Brazil**

Overall, FLOSSInclude has identified three meaningful forges in Brazil: CodigoLivre (<http://codigolivre.org.br/>), LuaForge (<http://luaforge.net/>), and AgroLivre (<http://repositorio.agrolivre.gov.br/>). Together, these three forges represent 17583 developers and 2389 projects. These figures imply that, on average, each Brazilian FLOSS project that is registered in one of the forges is performed by 7.4 developers, i.e local FLOSS projects in Brazil appear to be much smaller than on average in the worldwide FLOSS community (10.7).

As compared to the 50 million Internet users in Brazil,<sup>5</sup> there are 35.2 FLOSS developers in 100,000 Internet users. As Deliverable D1.1 illus-

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4 See <http://www.nd.edu/~oss/Data/data.html>

5 Source: CIA, World Fact Book, <https://www.cia.gov/library/publications/the-world-factbook/geos/br.html>.

trates, there has been a considerable growth of the Brazilian FLOSS community between 2006/2007 and end of 2008.

Except for LuaForge, none of the forges allowed to gather reliable information on SCM repositories, committers and commits. Information about mailing lists, releases, and lines of code (SLOC) were revealed by none of the three repositories.

All three Brazilian forges use exclusively Portuguese, which suggests that the Portuguese FLOSS community is not very well integrated in the worldwide FLOSS community, where English is the lingua franca.

### **2.3 India**

There is only one forge in India that could have been analysed for the purposes of FLOSSInclude, Sarovar (<http://sarovar.org/>). It represents 3714 developers in 500 projects, which corresponds to an average of 7.4 developers per project, again a significantly smaller value than the one for the global community that can be derived from Sourceforge (10.7).

According to the CIA World Fact Book, there are 80 million Internet users in India, which corresponds to 4.6 FLOSS developers per 100,000 Internet users.

Since Sarovar allowed to run a number of tools to analyse further the communities and the code it is possible to calculate a number of metrics that describe the Indian FLOSS community in more detail:

- Number of SCM repos per FLOSS project 0,33
- Number of Committers per FLOSS projects 0,17
- Number of Commits per FLOSS project 106,92
- Number of Commits per Committer 621,64
- Number of Mailing Lists per FLOSS project 0,07

- Number of Releases per FLOSS project 0,18
- Number of SLOC per FLOSS project 76693
- Number of SLOC per FLOSS developer 20,65
- Number of SLOC per Committer 891,78
- Number of SLOC per Commit 1,43

At the end of this section, these metrics will be compared across the target regions of FLOSSInclude.

## **2.4 China**

For China, only one local forge that allows to collect meaningful data on FLOSS communities exists, OSDN (<http://gforge.osdn.net.cn/>). There are 8380 registered users in 441 projects in OSDN, i.e. there are 19 developers per FLOSS project, on average, which indicates that Chinese FLOSS projects are considerable larger than the global average (10.7). While the project size in terms of project members appears thus comparably large, the incidence of FLOSS community members within Internet users is comparably low. Given the 253 million Internet users specified by the CIA World Fact Book, there are only 3.3 FLOSS developers in 100,000 Internet users.

However, since we could not use any of our analysis tools to dig deeper into the data of OSDN it is impossible to provide more metrics about Chinese FLOSS communities than the ones presented above.

## **2.5 Argentina**

There is one forge in Argentina that allowed to gain a wide range of metrics on Argentinian FLOSS communities, LugFI (<http://gforge.lug.fi.uba.ar/>), which has 189 registered users in 49 projects. This corresponds to an

average project size of 3.9 developers per project, which is significantly smaller than the global average of 10.7 developers per project.

According to the CIA World Fact Book, Argentina has 9.309 million Internet users. Based on this figure, there are only two FLOSS community members in 100,000 Internet users in Argentina.

The following metrics provide a more detailed overview of the Argentinian FLOSS community:

- FLOSS developers per 100,000 Internet users 2,03
- Average number of developers per FLOSS project 3,86
- Number of SCM repos per FLOSS project 0,73
- Number of Committers per FLOSS projects 0,33
- Number of Commits per FLOSS project 94,29
- Number of Commits per Committer 288,75
- Number of Mailing Lists per FLOSS project 0,92
- Number of Releases per FLOSS project 0,35
- Number of SLOC per FLOSS project 1292,84
- Number of SLOC per FLOSS developer 335,18
- Number of SLOC per Committer 3959,31
- Number of SLOC per Commit 13,71

## **2.6 South Africa, Ghana, and Cambodia**

There is only one forge in South Africa, Avoir (<http://gforge2.uwc.ac.za/-index.php>), representing 31 projects but providing no further information on registered users, the code, committers and commits, or mailing lists.

For Ghana and Cambodia, there was no forge identified at all.

## 2.7 Problem Areas

The results presented in the previous section illustrate mainly one thing, that is, FLOSS communities in the target regions of FLOSSInclude usually show a lack of infrastructure and deriving from that a comparably low degree of institutionalisation, as indicated by a lack of forges in which these communities are organised and other tools such as mailing lists that create an environment that enables the community to effectively communicate and to knowledge.

Thus, finding data at all about regional FLOSS communities in the target regions, especially in the low income countries Ghana and Cambodia, is more or less impossible. It is therefore also impossible to make a sound comparison of the regional FLOSS communities that we have targeted, as shown in Table 1, only India and Argentina allowed gathering data at a necessary and comparable level of detail.

	Brazil	India	China	Argentina	South Africa	Ghana	Cambodia
FLOSS developers per 100,000 Internet users	35,17	4,64	3,31	3,86	n.a.	n.a.	n.a.
Average number of developers per FLOSS project	7,36	7,43	19	2,03	n.a.	n.a.	n.a.
Number of SCM repos per FLOSS project	n.a.	0,33	n.a.	0,73	n.a.	n.a.	n.a.
Number of Committers per FLOSS projects	n.a.	0,17	n.a.	0,33	n.a.	n.a.	n.a.
Number of Commits per FLOSS project	n.a.	106,92	n.a.	94,29	n.a.	n.a.	n.a.
Number of Commits per Committer	n.a.	621,64	n.a.	288,75	n.a.	n.a.	n.a.
Number of Mailing Lists per FLOSS project	n.a.	0,07	n.a.	0,92	n.a.	n.a.	n.a.
Number of Releases per FLOSS project	n.a.	0,18	n.a.	0,35	n.a.	n.a.	n.a.
Number of SLOC per FLOSS project	n.a.	76693	n.a.	1292,84	n.a.	n.a.	n.a.
Number of SLOC per FLOSS developer	n.a.	20,65	n.a.	335,18	n.a.	n.a.	n.a.
Number of SLOC per Committer	n.a.	891,78	n.a.	3959,31	n.a.	n.a.	n.a.
Number of SLOC per Commit	n.a.	1,43	n.a.	13,71	n.a.	n.a.	n.a.

*Table 1: Comparison of regional FLOSS communities - and its limits*

However, if we desist from the Chinese case with regard to project size, we observe a tendency in the target regions towards small communities

and small projects. It appears also apparent that the regional communities operate quite isolated from the global FLOSS community, which seems to be (at least partly) caused by language barriers, as Deliverable D1.1 points out.

Given that the major advantages of FLOSS derive from network effects it is obvious that FLOSS communities in the FLOSSInclude target regions face considerable disadvantages, as compared to European or North American (and some Asian) FLOSS communities. Due to these limited network effects, there is also a reduced capacity to create spill-overs, initiate economic dynamics, etc. Thus, in the target regions, societies and economies as a whole do not benefit from FLOSS as they could if the communities would be larger.

## 3 FLOSS as a Learning Environment

### 3.1 Approach

FLOSS has proven that it is not only a viable software development approach, but also a model for the creation of self-learning and self-organizing communities. FLOSS communities therefore provide a virtual learning environment in which both professional software developers and novice users benefit by leveraging their knowledge and information access repertoire. The main characteristics of this learning environment are its openness (everyone can participate) and its flexibility (there are no fixed roles, a learner in one field or communication can become a teacher in another field or communication). It has therefore been argued that FLOSS communities are sort of prototype of Open Participatory Learning Ecosystems (OPLE) that develop together with the advent of Web 2.0 technologies and practices, though acknowledging that many of the learning principles of FLOSS are not newly developed but applied in a new meaningful way.<sup>6</sup>

The purpose of this section is to examine how FLOSS contributes to human capacity building (in the community, in HEIs, and in firms) and how these capacities are valued by FLOSS community members and by employers.

For this purpose, we build upon the skills surveys that were carried out in the FLOSSWORLD project, namely the

- survey of FLOSS developers
- survey of employers (HR managers at businesses)
- survey of universities and institutes of higher education (HEIs)

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<sup>6</sup> See Meiszner, A., R. Glott, and S. K. Sowe: Free / Libre Open Source Software (FLOSS) Communities as an Example of Successful Open Participatory Learning Ecosystems. *UPGRADE*, Vol. IX, issue no. 3, pp. 62-68; June 2008.

For Ghana and Cambodia, these surveys have been conducted in 2008 in the course of the FLOSSInclude project, thereby using the same research instruments (questionnaires) and methodology as in FLOSSWORLD.<sup>7</sup>

The response to the surveys in Argentina, Brazil, China, India and South Africa was sufficient to conduct some statistical analyses. It turned however out that despite very strong efforts of the local partners to find people within the target groups of the survey and to convince them to participate in it, the response from Ghana and Cambodia remained too low for a useful analysis with regard to the purpose of this report (except for the Ghanaian employer survey). The feedback from the community and our local partners on site suggests that the FLOSS communities are too little. This problem is not unique to these two countries, as the research team has encountered similar problems in the FLOSSWORD project.

We will therefore present and discuss the results for these two countries only if it appears useful, and only in absolute numbers but not in percentages.

### **3.2 Composition of Developer Communities**

FLOSSWORLD found that the demographic structure of the developers that participated in the survey differed significantly between the target regions only with regard to gender and the professional structure. China (11%) showed extraordinary large shares of female developers (compared to the average of 6.6%), while in the other countries this share remained within a range from 2% to 6%. All five respondents from Ghana are male, while one of the three Cambodian respondents is female.

The overall share of students within the FLOSSWORLD respondents was 16%. It was particularly low in Argentina (5% and 9%) but comparably large in China (61%). Respondents from Ghana were either employed or retired, which is quite extraordinary with regard to the communities in other countries. All three respondents from Cambodia were employed.

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<sup>7</sup> A detailed methodology of the analysis of capacity building in FLOSS is provided in D31 Track 1 International Report of the FLOSSWORLD project, available online at [www.flossworld.org](http://www.flossworld.org).

Homogeneity, by and large, can however be observed with regard to the age structure. The average age of the respondents was 29.2 years in 2007 (FLOSSWORLD). China's developers were significantly younger, (25.5 years), due to the large share of students. While the Cambodian respondents fit in this pattern, the Ghanaian respondents are supposed to be comparably old, given the fact that there are retired persons within the community. However, due to a coding error the age of the Ghanaian respondents has been recorded in a wrong way. South Africa provides the oldest community, with an average age of 31 years.

The educational structure of the respondents is quite homogeneous, too, which is explained by the fact that FLOSS obviously mainly attracts its members from universities or from professions that require a university degree.

The professions of the community members are very similar across all countries, as software engineers, system administrators, and programmers provide the lion shares of the regional FLOSS communities. Again, the Ghanaian respondents provide an exception from this rule as they all are either consultants or executives.

### ***3.3 FLOSS Capacity Building within the Community***

In this section we compare the views of developers and employers regarding the relative role of informal FLOSS skills and formal educational degrees, e.g. a university degree in computer science.

FLOSS offers its community members a wide variety of activities to perform and to learn, so in the survey the respondents could choose from more than 30 different activities. FLOSSWORLD found a very strong homogeneity across all countries, explained by the fact that in all communities the members prefer to write code or to act politically but don't like to write documentations or to localise texts or software. The FLOSSInclude surveys on Cambodia and Ghana show a similar result.

Overall, employers in the target countries are familiar with FLOSS and its principles, and a large majority of them is active in this field and knows about people with FLOSS skills among their employees. By and large, employers think that FLOSS provides the opportunity to learn a number of skills, of which some, e.g. managerial skills, are often considered to be learnt better than in a formal computer science course at university.

However, the employers' response to this item is too heterogeneous to provide a clear picture of their views. Especially employers from Ghana seem to have some reservations towards FLOSS skills in general.

Like in the other countries that were surveyed by FLOSSWORLD, the majority of the respondents from Gana and Cambodia considers the skills they have learnt in FLOSS as core skills for their professional career. The Cambodian developers also share the view of the respondents from the other countries that proven participation in the FLOSS community can compensate for the lack of formal degrees, like certificates or university degrees. The Ghanaian developers, however, obviously didn't have a clear opinion on this and therefore often did not answer this question.

This view is largely shared by employers, of which most see no difference between a formal degree and informal FLOSS experience. As the FLOSSWORLD survey revealed, Chinese employers even tend to prefer informal experience over a formal degree. While Cambodian employers also tend to make no difference between a formal degree and skills that were attained in an informal way, the Ghanaian employers clearly prefer a formal degree.

Assuming two persons that exhibit an equivalent level of formal qualifications but different experiences - Person A with proven experience developing an important component of a proprietary software product and Person B with proven experience developing an important component of a FLOSS software product of equivalent complexity - a majority of the developers thinks that both are equal. While this is true for the Cambodian respondents, too, the Ghanaian deviate from this overall pattern as a majority of them thinks that Person A is advantaged.

Again, the opinion of employers does not differ from the views of developers, as the share of employers that think that both Persons are equally qualified is as large as the share of those that would prefer Person B (approximately 40% in both cases). Cambodian employers show a strong preference (50%) for Person B, only a minority of 13% prefers Person A. Ghanaian employers follow the overall trend and consider both persons equally qualified.

### ***3.4 FLOSS Capacity Building in the Higher Educational System***

After examining how FLOSS skills are learnt within the community and what value they have for community members and employers we would like to switch the perspective now and ask what role the formal educational sector plays for the attainment of FLOSS skills. We focus thereby on Higher Educational Institutions (HEIs) because FLOSS obviously requires and attracts people with comparably high educational degrees.

Since there was only one respondent to the HEI survey in Cambodia, which is apparently due to a lack of awareness for FLOSS in the educational sector, we limit the discussion of this aspect to the target countries as covered by the FLOSSWORLD surveys and the additional survey in Ghana, which has been replied by 23 HEIs. However, for practical reasons in order to achieve a high response rate the HEI survey carried out in Ghana was much shorter than the original FLOSSWORLD HEI survey, it focussed on the usage and developmeny of FLOSS in Ghanaian HEIs. The reason for this focussing is that the Ghanaian partners were mainly interested in whether or not the Ghanaian HEIs are in line with the global trend.

The FLOSSWORLD survey found that overall the shares of FLOSS use and FLOSS development at universities vary substantially across countries. FLOSS use lies in the range above 60 percent, FLOSS development typically lies in the range below 60 percent. This holds also true for Ghanaian HEIs.

### **3.5 Problem Areas**

Given the high degree of homogeneity that we observe among developers and also among employers – and even between the two groups – it is not easy to identify problem areas. The most important result to highlight here is surely that there is a large share in both groups that thinks that informal FLOSS skills are at least equivalent to formal degrees. Though the reservation must be made that the companies that have participated in the surveys are mostly companies that do not only deal with FLOSS but for whose FLOSS is of strategic importance this result indicates that FLOSS skills seem to open chances at the labour market everywhere, not only in North America and Europe.

However, it must be pointed out that the survey asked for personal experience with and opinions on the value of FLOSS skills, it did not measure how easy or difficult it is in the target regions to learn these skills. With regard to our findings in the previous section, it is to assume that the learning communities in these regions are often comparably small, which is a disadvantage, given the fact that self-organised learning is only effective if there are enough participants to work on different tasks simultaneously, so that the community can acquire a broad variety of expertise that can be d in flexible interactions between the experienced and the less experienced (in one field).

In addition, our local partners pointed out that in many target regions, especially in rural areas, the infrastructure needed to learn FLOSS skills, especially permanent Internet access, is lacking, and that there is also a lack of educational policies addressing FLOSS.

## **4 FLOSS in the Public Sector**

### **4.1 Approach**

This section examines what policies and behaviour governments around the world adopt towards FLOSS, open standards and interoperability. Therefore, it particularly looks at attitudes towards FLOSS and usage of FLOSS and open standards/interoperability in public authorities at various levels in each target region.

The discussion in this section builds upon the findings of the FLOSSWORLD governments survey and a government survey in Ghana that was carried out in 2008, using the original FLOSSWORLD questionnaire in order to secure a high degree of comparability of results.

The questionnaire addressed following aspects:

- FLOSS usage and further potential for FLOSS within the public sector
- Attitudes towards FLOSS
- Improvements for Citizens
- FLOSS policies

The following sections summarise the main findings concerning these subjects in order to identify the main problem areas in the field of FLOSS in the public sector.

### **4.2 FLOSS Usage and FLOSS Potential**

While the FLOSSWORLD government survey found that overall the share of public authorities using FLOSS in the low-and middle income countries examined was 65%, the FLOSSInclude survey in Ghana features a 100% usage among the 18 respondents. This result is not surprising, as the usage of FLOSS has continuously increased worldwide during the last decade, and the variety of FLOSS is meanwhile so large that

hardly any (public or private) institution can avoid using it at all. Therefore, we assume that Ghana rather represents what has meanwhile become the normal case than an exception.

Correspondingly (because the share of users is already very high), the share of public authorities that find it useful to increase the share of FLOSS in their organisation is significantly smaller (56%) in Ghana than on average in the FLOSSWORLD survey (64%).

This suggests that FLOSS has already tapped a considerable portion of the usage potential in the public sector in Ghana. Nevertheless, the fact that more than 50% of the public authorities wish to increase the share of FLOSS in their organisation indicates that there is still enormous potential for the growth of FLOSS in the public sector.

### **4.3 Attitudes towards FLOSS**

Whether or not a government organisation uses FLOSS depends not so much on its actual usefulness and adaptability but on the awareness of the users of a combination of different advantages and disadvantages that can be attributed to FLOSS - regardless of whether or not this attribution is justified.

According to the results of the FLOSSWORLD surveys, there are mainly two positive statements that found support by the majority of the respondents: FLOSS is considered to be easier to use and easier to customise than proprietary software. We have observed strong regional differences in these attitudes. For instance, Argentinian and South African respondents strongly emphasised the pros of FLOSS, whereas respondents from Brazil, and China showed a more careful evaluation of the pros.

While the driving forces can thus be relatively clearly identified, it appears that the fears that may prevent governments from using FLOSS are more diffuse.

Ghanaian public authorities show an ambiguous attitude towards FLOSS. They like FLOSS because it can easily be combined with proprietary software, but at the same time they fear that migrating towards FLOSS is associated with too high a level of training costs..

#### **4.4 Improvements for Citizens**

FLOSS is strongly related to open standards and therefore usually helps to increase interoperability. It also provides a valuable means for fundamental eGovernment objectives, such as ease of access to government services or ease of data exchange between public administrations. In the FLOSSWORLD survey, 84% of all respondents (100% in Brazil) said that citizens should be able to access all governments services regardless of the software platform they use. China, with a share of only 60% supporting this statement, provided a remarkable exception in this regard.

If we look however if and where this opportunity is actually implemented, we found (in FLOSSWORLD) this in only 68% of the respondents' organisations, most pronounced in India (85%) and Brazil(81%), whereas China (53%) showed the lowest degree of implementation in the FLOSSWORLD survey. However, looking at Ghana indicates that this country lags far behind the state of the art otherwise observed in the FLOSSWORLD countries. Only 28% of the Ghanaian public institutions have this opportunity already implemented, although more than 60% support this statement.

The same share supports the statement that public authorities should be able to exchange data with each other independently from the platform they use. Here, the share of institutions that have realised this opportunity is higher than with regard to the accessibility to citizens (41%). In the FLOSSWORLD survey, 88% (but only 52% of the Chinese respondents) said that governments should be able to exchange data with other government organisations independently from the software platform they use. This opinion was most pronounced in Argentina and Brazil. An actual im-

plementation of this opportunity was however reported from only 55% of the respondents, notably in Brazil (72%).

#### **4.5 Problem Areas**

As these results illustrate, FLOSS usage has meanwhile achieved a level that this cannot be considered any longer as a problem area, especially as it seems that this trend is also true for low income countries like Ghana.

This does not imply that public bodies in the target regions are fully aware of FLOSS, but rather that FLOSS has become so pervasive that most computer systems use at least some FLOSS applications. This suggests that usage rates are not a useful metric to gauge awareness of or attitudes towards FLOSS.

But a look at the attitudes shows that still there are fears for FLOSS, especially the fear of high costs aligned with training. Therefore there is still a need for awareness raising and the diffusion of collaboration and cost sharing models within the Ghanaian public sector and between the public sector and the developer community. This could indeed lead to a win-win-situation, since such an approach would also help to increase the number of FLOSS developers in the country, which could result in increased network effects and enhanced economic dynamics.

Another problem area seems to lie in the infrastructure of the public sector, especially when services for citizens are considered. Given its cost-effectiveness, FLOSS could become a very effective means to significantly boost eGovernment services in Ghana.

## 5 Conclusions

The main lesson to be learned from the discussions in this report is that FLOSS has made significant progress in all fields and all regions of the world, but there are still some problems which must be solved in order to help especially low income countries like Ghana and Cambodia, which lag behind middle-income and European and North American countries in many respects, to gain momentum and to catch up.

One of these crucial factors is the structure and dynamics of the FLOSS communities in these countries. They apparently suffer from a lack of infrastructure (forges) and a low degree of institutionalisation. Overall the communities appear too small to initiate sustainable economic dynamics which would fuel also other sectors (especially the educational sector). Finally, measures should be taken in order to overcome the language barriers which isolate these communities from the global FLOSS community.

A consequence of the small size of FLOSS communities in these countries is that they fail to fully perform their function as a cost-effective learning environment. In this field, too, there is a lack of infrastructure to be overcome, especially in rural areas. Affordable Internet access is the most important, but not the only factor in this regard. Infrastructure initiatives should be aligned with training measures that help more and more people to benefit from the opportunities to live, learn, and work provided by FLOSS.

Finally, there are still fears to be overcome, especially regarding training costs. As argued in the previous section, developing and disseminating collaboration and cost sharing models within the Ghanaian public sector and between the public sector and the developer community could be a win-win-strategy in this regard.

The overall aim of political measures to improve the economic and social situation in low income countries by the means of FLOSS should be a multifaceted policy that tackles community initiatives (e.g. platforms for

international collaboration), education, and infrastructural enhancements in both, the educational and the public sector, in parallel.