Economic Benefits of Free and Open Source Software: An Evaluation for Health Sector

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Abstract

In the present world of information and communication technologies, free and open source software (FOSS) has been drawing more attention in spite of the hegemony of the vendors of the (proprietary) software industry. FOSS provides considerable economic benefits for individuals, firms and economic sectors as well as some other advantages. Main types of these benefits are decreasing total cost of ownership, enhancing security and achieving vendor independence. This paper investigates these benefits laying emphasis on health sector in the light of some cases from the world.

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1. Introduction

FOSS is defined as *"programs whose licenses give users the freedom to run the program for any purpose, to study and modify the program, and to redistribute copies of either the original or modified program without having to pay royalties to previous developers"* (Wheeler, 2003). It simply means that everyone has the right to use, extend, adapt and redistribute the original or modified software. Thoroughly, it refers to four types of freedom for the users of the software:

- The freedom to run the software for any purpose (freedom 0).
- The freedom to study how the program works, and adapt it to your needs (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to improve the program, and release your improvements to the public, so that the whole community benefits (freedom 3). Access to the source code is a precondition for this.

In actual fact, when computer technology arose around 1960's and early 1970's all software were open source and the programmers (hackers) were used to share software in their community freely. However, in the mid-1970s some programmers such as Bill Gates advocated that sharing behaviors of hacker culture were not ethical and software had to be priced as many other private goods and services in the market. In 1976, Gates issued his famous 'An Open Letter to Hobbyists' that he argued proprietary software as saying: *"As the majority of hobbyists must be aware, most of you steal your software. Hardware must be paid for, but software is something to share. Who cares if the people who worked on it get paid?"* Sooner, FOSS applications and the sharing culture of programmers were effected negatively because of this approach (Yang & Wang, 2008: 1044).

In the first half of the 1980s, personal computer (PC) industry was emerged. Then, designing and commercialization of software became a profitable area of business and some software vendors arose in computer industry. When AT&T began to enforce its intellectual property rights over UNIX Operating System in the same years, an opposition led by Richard Stallman began to unite (Boyer & Robert, 2006: 3-4). Then, Stallman initiated GNU Operating System Project in 1983 to provide a free operating system to computer users and founded Free Software Foundation (FSF) in 1985 to hold the rights of GNU Operating System Project and to fund this project (Lee, 2010).

A milestone for GNU Operating System Project is the release of Linux kernel by Finnish hacker Linus Torvalds in 1991. Torvalds and others unified this kernel with the rest of the GNU Operating System, and as a result, GNU/Linux Operating System was born. In 1998, a group of programmers led by Eric Raymond and Bruce Perens accepted FOSS as a business model and founded Open Source Initiative (OSI). Since then, FOSS community has been being drifted apart into two main groups as FSF and OSI.

In 1999, IBM announced its support for GNU/Linux Operating System. Since that time IBM has invested considerable financial, technical, and marketing resources to foster the growth, development, and use of GNU/Linux Operating System, and has made significant contributions to the community on which GNU/Linux relies. Also, many service providers for GNU/Linux have appeared in software industry since then. These developments have contributed to FOSS popularity on Internet and FOSS applications have become more widespread.

Recently, FOSS has been used increasingly in public sector as well as private sector because of its public good nature (Arslan, 2011:34-38). Especially, educational and health applications of FOSS have been gaining much more popularity for a few years. More importantly, it is considered that economic benefits of FOSS are very high in education and health sectors. This paper aims to evaluate economic benefits of FOSS for health sector in particular.

This paper has three sections. The first section analyzes economic benefits of FOSS phenomenon. The second section discusses use of FOSS public good in health sector. Finally, the third section concludes. Thus, the paper aims at stressing the economic potential of FOSS applications in health sector.

2. Economic Benefits of Free and Open Source Software

FOSS applications produce huge economic benefits that apply to society and business in many ways. Just because of this, many large organizations in both public and private sectors have already adopted GNU/Linux Operating System and related software (Varian & Shapiro, 2003:12). These benefits are:

2.1. Decreasing Total Cost of Ownership (TCO)

As is known, TCO is the purchase price of a good or service plus the costs of operation. Lower TCO is the most obvious economic benefit of FOSS largely due to the lack of licensing fees. FOSS also lowers TCO through its better security, ease of administration, cross-platform availability, and etc. (Wong, 2004:7).

GNU/Linux distributions generate high savings by reducing purchasing price as the main cost item of TCO. Titterton (2003) asserts that 70% of business users of FOSS are motivated chiefly by cost savings. A comparison between costs of Microsoft Windows Operating System and GNU/Linux Operating System clearly shows cost advantages of FOSS solutions, as seen in Table 1 below.

Table 1. The Comparison of Purchasing Prices of Proprietary and FOSS Operating Systems

	Microsoft Solution	GNU/Linux Solution*	Savings
Company A: 50 Users	$87,988	$80	$87,908
Company B: 100 Users	$136,734	$80	$136,654
Company C: 250 Users	$282,974	$80	$282,894

*Red Hat
Source: Wong & Sayo (2004:11)

The savings generated from using FOSS solution instead of Microsoft solution actually increases with the number of users. Hence the financial motivation for migrating to FOSS solutions in an organization increase with the number of employee. Due to this fact, many large firms and institutions such as Intel, Amazon, Credit Suisse, Morgan Stanley, and Goldman Sachs have moved to GNU/Linux Operating System as well as many governmental institutions in recent years (Wong, 2004:8).

2.2. Enhancing Security

When compared with proprietary software, FOSS is believed to be less vulnerable because of its open source code. This openness leads to a trust for users regarding security of software. Also, FOSS developers actively ask to check security problems and if it exists, awareness of this security problem and possible solutions become public (Ghosh et al., 2002:7). As a result of this advantage, FOSS users are not obligated to use proprietary and costly Internet security

suites such as Norton, McAfee, Kaspersky, Bitdefender, etc. Table 2 below gives purchasing prices of most popular Internet security suites for individual users.

Table 2. Purchasing Prices of Most Popular Internet Security Suites

Internet Security Suites	Purchasing Prices
Norton Internet Security 2014	$39.49
Kaspersky Internet Security 2014	$25.00
McAfee Internet Security 2014	$15.24
Bitdefender Internet Security 2014	$22.20
Trend Micro Titanium Maximum 2014	$29.99
avast! Internet Security 2014	$49.99
AVG Internet Security 2014	$30.00

Source: www.amazon.com, July 4, 2014

Security concerns have already attracted many public institutions to switch or to consider switching to FOSS applications. Many governmental organizations in France, China, Japan and South Korea accept security concerns as the main reason for their FOSS initiatives (Wong, 2004:9).

2.3. Achieving Vendor Independence

Proprietary software vendors (e.g. Microsoft, Apple) are always tying the users to their software products for a long term. For users, switching to different supplier can usually be a costly and long operation because of vendors' non-universal formats and intellectual property restrictions (e.g. patent rights). Hence proprietary software vendors can easily lock in an organization to use their closed software products only, as noted below.

> *"Consequently one major argument against the implementation of proprietary software in the public sector is the subsequent dependency on proprietary software vendors. Whenever the proprietary standards are established the necessity to 'follow' them is given. Even in an open tender acquisition system, this requirement for compatibility with proprietary standards makes the system biased towards specific software vendors, perpetuating a dependency."* (Ghosh et al., 2002:4)

However, FOSS firms cannot lock in their clients due to the openness of the software code. Openness of the code makes it very easy to reverse-engineer any data format and therefore, buyers of FOSS systems are not bound to stay with their supplier and can easily change their supplier (Wong, 2004:9). Consequently, achieving vendor independence through FOSS systems leads to keep away from high software prices and make an important cost savings for individual users and firms.

2.4. Other Economic Benefits

Reducing imports/conserving foreign exchange reserve is an economic and also a strategic benefit for many countries, especially for developing ones. Almost all proprietary software licenses and related services are imported goods and services for developing and underdeveloped countries and their cost share in these countries' GDPs are very high. These billion dollars of imports for proprietary software worsen balance of payments and therefore

threaten economic stability and development of these countries. Conversely and alternatively, FOSS systems are low cost tools for these countries that are also facing with heavy development problems. To put it Keynesian economics approach, FOSS is truly a multiplier for development (Arslan, 2011:36). Brazil, South Africa, Taiwan and South Korea are countries that are reported to have a motive of reducing imports through FOSS usage (Wong, 2004:5).

Another important economic benefit of FOSS is developing local software capacity. It is asserted that there is a positive correlation between the increase of FOSS developer base and the innovative capacity (software) of an economy. There are three arguments for this as follows (Wong & Sayo, 2004:16):

- Low barriers to entry: FOSS is very easy to get, use and learn from. However, proprietary software has a propensity for restricting the source code through intellectual property rights. FOSS gives developers an opportunity to build on existing software codes.
- FOSS as an excellent training system: Free and open character of FOSS allows students and computer novices to train with software concepts without any cost.
- FOSS as a source of standards: FOSS frequently becomes an effective standard by virtue of its dominance in a particular sector of an industry or a region.

3. An Evaluation for Health Sector

The use of FOSS systems by healthcare providers and organizations has been becoming an important trend today. According to Peter Groen of Open Health News, the number of FOSS systems and applications that currently exist has grown to be substantial and the number of new FOSS health care applications under development is also impressive. He notes that a wide range of FOSS solutions are already in use in health care, generally consisting of technical tools and business applications - Linux, Apache, Open Office (now Libre Office), mySQL, FireFox, and other popular products. Moreover, he also emphasize that there are a large number of health care specific FOSS solutions that have also been developed and are being widely deployed (Groen, 2010).

One of the main reasons for using FOSS in health sector is definitely economic benefit of FOSS. Decreasing total cost of ownership, achieving vendor independence and enhancing security are typical economic benefits of FOSS use in health sector as well as other economic benefits. In a recent survey, technology executives in health sector indicated that their existing proprietary systems (Red Hat, 2012a):

- Were too complex to manage (62%)
- Resulted in higher TCO (58%)
- Created vendor lock-in (35%)
- Lacked flexibility and interoperability (33%)
- Didn’t offer operational and process efficiency (33%)
- Didn’t alleviate security concerns (29%)
- Slowed application delivery (28%)

To recognize economic benefits of FOSS for health sector precisely, main FOSS applications and some case studies for health have to be considered closely.

3.1. Medical Linux Distributions and FOSS Projects

There are so many diverse FOSS applications in the world. These applications ranges from medical Linux operating system distros to a wide variety of FOSS health applications.

3.1.1. Medical Linux Distributions

There are five major medical Linux operating system distributions (http://www.medfloss.org/node/256). These are:

- Debian Med: It is a "custom Debian distribution" with the aim to develop Debian into an operating system that is particularly well fit for the requirements for medical practice and research. The goal of Debian-Med is a complete system for all tasks in medical care, which is built completely on free software.
- Fedora Medical: This project was recently initiated to package medical software for the Fedora linux distribution.
- Linux for Clinics: The goal of Linux for Clinics is to create a free medically themed linux distribution combining the work of Debian-Med with the release schedule and support of Ubuntu. They also have a blog.
- OpenSUSE Medical: OpenSUSE-Medical is a sub-project of the openSUSE free and Linux-based operating system, provided and driven by the Community. In the first OpenSUSE conference in 2009, the Community came up with the idea to make a distribution for doctors and medical personnel.
- Ubuntu-Med: It is a Kubuntu-based operating system customization created to provide a coordinated operating system and collection of available free software packages that are suited to the requirements of medical practices and research.

3.1.2. Medical FOSS Projects

There are 15 categories of medical FOSS projects. These categories have hundreds of projects (http://www.medfloss.org/node/614). These are listed below:

- Clinical Data Management Systems: OpenClinica, php Easy Survey Package, RANDI2, openCDMS, Clinical Study Tracker (CST), ClinStudyWeb, Evidence-based Guideline and Decision Support System (EGADSS).
- Database Management Systems: GT.M, Free D Path.
- Disaster/Disease Management: The 'surveillence' R Package, Real-time Outbreak and Disease Surveillance (RODS), Sahana, TriSano, Zyxware Health Monitoring System, iPath, popHealth, Epigrass, GNU Gluco Control, District Health Information Software 2 (DHIS 2).
- Electronic Health Record: iHRIS Suite, CollaboRhythm, OpenMRS, District Health Information Software 2 (DHIS 2).
- Hospital Management Systems and Electronic Medical Record: GNU Health, GNUmed, CARE2X, Res Medicinae, GastrOS, Community Health Information Tracking System (CHITS), Hospital OS, SQL Clinic, Sinapsis HIS, OpenGPSoC, ClearHealth, Mediboard, MARiS, THIRRA, Cottage Med, Open Hospital, iPath, COMSATS Open Source Healthcare Management System (COS-HMS), Freefeathers EHR Project (FFEHR), phpMedCare, Gestion de cabinet médicaux (GECAMed), Clinical Management System (CMS), HOSxP, SmartExp, vxVista, iRPMS, MedClipse, Endoclinic SPMS (Endoclinic Secure Patient Management System), VistA-EdgePractice Management System, Open Dental, OpenVista CIS, Meta Clinic Management System, Mountain Meadow EMR, Sagui Saúde, EHRflex, ZEPRS, MirrorMed, TurnHos, MEDILIG – Medical Life Guard, OpenEMR, elementalClinic, Episodus, Open Source Clinical Application and Resource (OSCAR), ClinicWeb, FreeMED, Resource and Patient Management System (RPMS), OpenEyes, Tolven

Health Record, openEHR-Gen, Ultimate EMR, OpenClinic, Clinica, WorldVistA, Open TAPAS (The Technology Assisted Practice Application Suite), Medscribbler Community, Clinic Med, Raxa JSS EMR, OpenMRS, FreeMedForms, Elexis Praxisprogramm, AuShadha, DataPall Palliative Care EMR, MedinTux, NOSH ChartingSystem, WebEMS, Patient OS, Eureka, openMEDIS, Clinical Handover Database, Hospital Schedule, Hospital System Osiris (HIS), CARE3G, Proteus, OpenClinic GA, Open ISES (Open Information Systems for Emergency Services), Open Food Order System (OFOS).

- Framework & Toolkit: RANDI2, Zephyr Open, Open Health Tools Model-Driven Health Tools (MDHT), MassChroQ (Mass Chromatogram Quantification), Ruby openEHR, Opereffa, PyEPL (the Python Experiment-Programming Library), Gwyddion, rxncon, The R Project for Statistical Computing, ADDIS, Laika, Computer Assisted Search for Epidemics (CASE), EGADSS (Evidence-based Guideline and Decision Support System), Charrua DICOM Toolkit, OpenHRE, HIEOS, cancer Biomedical Informatics Grid (caBIG), Axial 360, Simulation Open Framework Architecture (SOFA), HL7 Test Harness, ODIN, CTSim, PROSIT Disease Modelling Community, RANDI2, IHE Gazelle Tools, Virtual Medical Training (ViMeT), rxncon, GIMIAS, SimThyr, PyEPL, VTKEdge, MIView, ITK-SNAP, Brainstorm, RT_Image, OpenMEEG, RANDI2, MediPy, AMIDE, Nukak3D, Caret, MITK 3M3, CTSim, ImmunoRatio, Droid Dicom Viewer, InVesalius, MRmap, STIR, Visualization Toolkit (VTK), C# ECG Toolkit, ParaView, 3D Slicer, Vurtigo, rxncon, BioImageXD, JULIDE, Image-Guided Surgery Toolkit (iGStK), DataViewer3D (DV3D), FieldTrip, Medical Imaging Interaction Toolkit (MITK), Voreen, MedicalExplorationToolkit (METK), OpenEEG, EEG-Holter, Virtual Medical Training (ViMeT), dicompyler, PsychoPy, Imebra SDK, MeVisLab, Spectroscopic Image Visualization and Computing (SIVIC), Delft Visualisation and Image Processing Development Environment (DeVIDE).
- Laboratory Information Systems: Bika LIMS, OpenELIS, Screensaver, FreeLIMS, LIMS for proteomics (LIPAGE), OMERO.
- Middleware: DICOM Router, OpenHRE , Grassroots DICOM (GDCM), Axial 360, Model-Driven Health Tools (MDHT), cancer Biomedical Informatics Grid (caBIG), Project HealthDesign Common Platform, DicomBrowser, Bots, Sinapsis-HIS, Net4Care, Chiapas, OpenEMed, epSOS Common Components, Dataserver, OpenPIXPDQ, Laika, OpenXDS, Mergence, IHE open source, Mirth, OpenATNA, REMITT, IHE Gazelle Tools, Open eHealth Integration Platform (IPF), OpenEMPI, HIEOS, O3-XDS, PixelMed Java DICOM Toolkit, CONNECT, FreeSHIM, JCAM Engine, Aurion, OpenIGTLink.
- Picture Archiving and Communication Systems: O3-DPACS, dcm4che, CDMEDIC PACS WEB, Conquest DICOM software, ClearCanvas, OpenSourcePACS, Open Source Picture Archiving and Communication System (OSPACS), Xebra, Dicoogle, Orthanc, MRIdb, DCMTK DICOM Toolkit, MIView, ezDICOM, Mayam, Dicom Widow, O3-RWS, ImageJ, Weasis, Java Light PACS Viewer, MITO - Medical Imaging TOolkit, Kradview, TutatiX, OsiriX Imaging Software, V3D-Viewer, Pgctn, iRad, RT_Image, MITK 3M3, Stratos viewer, Droid Dicom Viewer, AMIDE, Dicoogle, PixelMed Java DICOM Toolkit, Oviyam, Nukak3D, DCM4CHEE Lite Viewer, Ginkgo CADx, Aeskulap, GIMIAS, Spectroscopic Image Visualization and Computing (SIVIC).
- Personal Health Record: Indivo, Tolven Health Record, Mediboard, My Health Portal, Episodus, GNU Gluco Control (ggc), Project HealthDesign Common Platform, iTrust, CollaboRhythm.

- Practice Management Systems: openMolar, Cottage Med, MedClipse, Open Dental, MirrorMed, Mountain Meadow EMR, OpenEMR, CARE3G, WorldVistA, Care2x, openGPSoC, FreeMed, Freemed-YiRC, GNUmed, OpenTAPAS, Res Medicinae, SQL Clinic 4, CyDoc, FreeMedForms, Elexis, AuShadha, MedinTux, NOSH ChartingSystem.
- Public Health Management Systems: iHRIS Suite, ESP, CASE, eMOCHA, iDART, CommCare, RapidSMS, Raxa JSS EMR, Sana.
- Radiology Information Systems: ClearCanvas, MARiS, Xphile.
- Telemedicine Systems: Borboleta, iPath, Xebra, Open Health Assistant, H-Monitor, Sana, OpenTele.
- Miscellaneous: FreeB, Arden2ByteCode, Caisis, MediSnap, FreeDiams, OpenRep FREE, DosIS, Snofyre, WEKA, OpenMedSpel, HL7 Inspector, ch.oddb.org, ctapi-mtk, NUT Nutrition Software, ATOM, tinyHeb, OBsched, Wardware, OpenInfoButton, SPINA Thyr, and etc.

3.2. Some FOSS Case Studies

The healthcare sectors in the world are facing heavy cost pressures that are mostly stem from healthcare reforms and decreasing profits. While improvements in information technology will enable productivity gains and reduce medical errors, the reality remains that healthcare organizations need to achieve their information technology objectives while containing costs. At this point, FOSS systems provide a crucial opportunity to reduce costs and enhance security for both public and private health sectors. Hence, the number of public and private health organizations that using FOSS solutions in the world have been increasing sharply. Some examples are given below:

3.2.1. Jamaican Ministry of Health's Adoption of GNU Health

In 2013, a group mission of GNU Solidario visited Jamaica and inaugurated officially the project of deploying GNU Health within their Public Health Care system. The mission is in the context of the agreement signed between Jamaica Ministry of Health and GNU Solidario, to cooperate in the implementation of GNU Health, the Free Health and Hospital Information System in this country. This step is also a tipping point in health history, granted that Jamaica is the first country to embrace GNU Health nationwide (Falcon, 2013).

3.2.2. Brazilian Ministry of Health's Migration to Red Hat Linux

In 2011, Brazilian Ministry of Health moved its software system to Red Hat Enterprise Linux and JBoss Enterprise Application Platform mainly to ensure total security in the operation of applications. The expected benefits of this migration were an increase in information processing, application performance, security for applications, and the reliability of the Ministry of Health's programs for the general public. With this migration, Ministry of Health also achieved an approximate savings of 80 percent when compared to proprietary software and received enhanced technical support from Red Hat Global Support Services (Red Hat, 2011a).

3.2.3. Aragon Health Services' Migration to Red Hat Linux

Aragon Health Services is a public entity created by the Government of Aragon, Spain, to provide healthcare to its region's citizens. In 2012, in order to improve the performance and organization of its technological infrastructure, the healthcare provider has consolidated its information systems into various datacenters, parts of which have been virtualized using Red

Hat Enterprise Virtualization and are centrally managed through a unified service management system (Red Hat, 2012b).

3.2.4. National Health Service's (NHS) Tendency for FOSS

NHS of England has used a mixed and a competitive software strategy in health services since the beginning of 2000s. FOSS solutions and proprietary software have been used together in NHS in a very competitive manner. However, NHS has started to change its strategy in favor of FOSS since 2013. In 2013, NHS has selected US developer Basho's open source database Riak to underpin its efforts to rebuild its Spine infrastructure. The new project that named Spine2 will replace the existing infrastructure that was implemented as part of the ill-fated NHS National Programme for IT (NPfIT). NPfIT was accused of being the "worst and most expensive contracting fiasco in the history of the public sector". One of the key criticisms of the NPfIT – which was scrapped but cost taxpayers nearly £10bn – was that there should have been an agile development (Shah, 2013).

3.2.5. Hospitals Migrations to FOSS

Since the mid-2000s, many hospitals have been using FOSS systems for their IT infrastructure as well as health-specific FOSS solutions in the European Union. For example, Clermont-Ferrand University Hospital of France, Görlitz Eye Clinic of Germany, Tivoli University Central Hospital and Leuven University Hospital of Belgium, St. Antonius Hospitals and Bosman Psychiatry Clinic of Netherlands have all moved their software solutions to FOSS gradually to cut their proprietary software costs (Demirel, 2009).

In 2008, Beth Israel Deaconess Medical Center of Harvard University chose Red Hat Linux to make core clinical applications stable, secure operating environment and create new disaster-recovery system with higher availability. The center realized $200,000 in annual cost savings, decreased annual downtime from 20 hours to near zero – furthering leading-edge patient care (Red Hat, 2008a).

In 2008, Florida Hospital also moved to Red Hat Linux to design a new disaster-recovery system that would ensure seamless business continuity for the hospital; determine a solution to aid in delivering high-performance, secure, cost-effective systems to ensure optimized patient care; identify a solution to enable internal hosting and support for the growing number of external websites (Red Hat, 2008b).

In 2010, The UCL Institute of Child Health and Great Ormond Street Hospital wanted to replace the disparate server infrastructure on which their joint website was running. The Institute of Child Health decided to introduce a cost-effective solution that could maximize resources, ease management and enhance business continuity. It worked with a solutions provider to implement an IT environment based on Ubuntu Server Edition and OpenVZ virtualization software. As a result, it expects to reduce the number of physical servers it runs from 11 to 4. With a standardized infrastructure in place, the IT team has dramatically simplified maintenance and disaster recovery processes, while making considerable cost savings (Canonical, 2010).

In 2011, MD Anderson Cancer Center started to use Red Hat Linux to cut costs by moving from IBM AIX running on proprietary hardware to a mainstream operating system that could run on commodity x86-based machines. After this migration the center cut costs by 40 percent; improved reliability and stability; streamlined support; increased user satisfaction (Red Hat, 2011b).

Recently, King's College Hospital (KCH) NHS Foundation Trust needed a new middleware platform that would allow over 50 hospital systems to exchange critical patient information

quickly and reliably and hence migrated to Red Hat Linux. After this migration, with timing and budgetary constraints, King's College Hospital reached out to Red Hat partner and implemented an integration hub based on Red Hat JBoss Fuse that offers better reliability, speed, and manageability than its predecessor Red Hat, 2014).

3.2.6. A Brief Note on FOSS Usage in Turkish Health Sector

It can easily be observed that FOSS usage in Turkey is very limited although there has been Pardus Linux Operating System as a national FOSS solution since 2005. Pardus' main focus is office-related work including the use in Turkish government agencies. Despite that, Pardus ships in several languages. Its ease of use and availability free of charge has spawned numerous communities throughout the world (Wikipedia). However, a limited number of government institutions and firms have used Pardus nowadays and none of them is a healthcare organization.

In Turkey, proprietary software vendors and firms dominates health sector (Ceylan, 2014:14-19) and a few software firms are producing FOSS products for hospitals. These products are mostly hospital information management systems and electronic medical record systems. Deha HBYS® of Anasel Software and Information Technologies, ARESHIS® of Kaftan Software, MonoIVR® of Mono Information, Immigration Visa Medical Information System (IVMIS) ®, Medical Data Management and Analysis®, Appointment Management® of Uskur Software and Information Services are major FOSS solutions for health sector in Turkey.

A genuine FOSS system for hospitals in Turkish health sector is HIPOCRAT (Hospital Information Planning, Organization, Coordination, Research and Advanced Technology) of Anadolu University, which was firstly developed in 1991 for Anadolu University Medical Center. HIPOCRAT was rewritten with new technologies in 2002 and enhanced with managerial connections in 2005 (Şenel, 2007:3). Today, HIPOCRAT is being used in many hospitals in Turkey, e.g. Vakif Gureba Hospital, Zeynep Kamil Gynecology Hospital, Orthopedics and Traumatology Department of Istanbul University School of Medicine, Sakarya Public Hospital, Dumlupınar University Hospital (Telçeken:1).

Muğla Association of Public Hospitals has recently declared its support for using FOSS solutions in public hospitals to produce economic benefits. In this regard, the association suggests using Libre Office suite, Joomla CMS, ClearCanvas PACS, Osirix PACS and ClamWin Antivirus software within its tied public hospitals (http://www.muglakhb.gov.tr/index.php/opensource-freesoftwares).

Conclusion

It is very clear that FOSS has large economic benefits – both realized and potential – for health sector. First economic benefit is decreasing TCO and making important cost savings. Second economic benefit is achieving vendor independence, which is also as important as decreasing TCO for cost savings. Another economic benefit is enhancing security. FOSS also serves for reducing imports and developing local capacity/industry especially for developing countries.

When a wide variety of health-specific FOSS solutions considered, health organizations and health sector in general have a great opportunity for cutting software costs as well as providing security and efficiency for their IT systems. Case studies show that economic benefits of FOSS can easily be realized in a short time period. However, a more systematic and resolute approach is needed for increasing FOSS usage in health sector, especially in

public health sector. Additionally, more advertising is required to introduce FOSS solutions to the health sector and also economy as a whole.

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