Open-source software in an occupational health application: the case of Heales Medical Ltd.

Francis Tiangco[a], Alison Stockwell[b], John Sapsford[b], Austen Rainer[b], Eamonn Swanton [a]

[a]Heales Medical Ltd
27 Bridge Street
Hitchin
Hertfordshire
SG5 2DF
UK
<fptiangco@yahoo.com>

[b]Software Development Services
University of Hertfordshire
College Lane Campus
Hatfield
Hertfordshire AL10 9AB
UK
<j.sapsford@herts.ac.uk>

Abstract – **In this paper, we provide a case study of a small company, Heales Medical Ltd., that has chosen to use open-source software to develop an online integrated patient management system. We use this case study to examine some preconceptions of open-source technology in the light our experiences of open source in the Heales project. We identify costs and cost savings as being the primary business considerations, and identify software purchase and licensing as key advantages for open-source. We then look at development issues including software evaluation, implementation and programming, and identify these as more costly for open-source, in terms of time and effort expended. We also look at issues to do with open source licensing, which our initial investigations suggest is confusing and requires further analysis. Overall, the ability to modify the source code is regarded as a key benefit of open-source software, but in a business environment like Heales, this is of little importance.**

I. INTRODUCTION

In this paper, we provide a case study of a small company, Heales Medical Ltd. (Heales), that has chosen to use open-source software to develop an online integrated patient management system. Heales specialise in the provision of occupational health services to client organisations in the public and private sector. The new system is intended for use by Heales own staff and those of their clients. Heales are working with the University of Hertfordshire's Software Development Services unit to develop this system. The project is funded by a Knowledge Transfer Partnership (KTP) grant, provided by the UK's Department of Trade and Industry (DTI).

II. THE MOTIVATION FOR A NEW SYSTEM

At the start of the project Heales had three separate commercially-available systems and one system that had been developed in-house. These were not integrated with each other and ran under Microsoft Windows with no internet or wide-area network access for off-site users. These packages are summarised in Table 1.

Goldmine and Harris ran on separate PCs at Heales' head office, and OHSSYS and Cohort were located at the offices of different clients. This presented significant issues with data consistency and integration, and a strategy needed to be adopted with regard to new and prospective clients. Furthermore, the projected licencing costs to support the expanding business using packaged software were considerable. (Costs for Microsoft Office® licensing were estimated to be £5,400; An alternative proprietary Occupational Health system would have a licensing cost of £5,300 for each user at Heales as well as for any users at client locations. In addition there would be maintenance costs of £2,500.) There was also the possibility that prospective clients would already be using alternative software products which would present difficult data integration problems. There would also be overheads such as communication and travel costs accompanying implementation, support and upgrades.

TABLE 1 PRODUCTS USED IN HEALES MEDICAL LTD.'S EXISTING SOFTWARE SYSTEM

Product	Comments
Goldmine ™	A contact management application that includes features such as calendar, addresses, document management, timesheets and counselling information. The system provides the ability to link any kind of information to a specific contact.
OHSSYS ™	A medical records management systems used by some of Heales' clients.
Cohort ™	A medical records management systems used by some of Heales' clients.
Harris ™	A system built by Heales Medical Ltd. to provide additional functionality for managing and tracking open cases.

As the same time as these developments, there was an unexpected increase in the amount of new business, and this forced the development of an interim system. The Harris system was significantly enhanced to encompass internet technology and a commercially viable relational database. This entailed the use of some open-source software (MySQL®) and was effective as a pilot study for demonstrating the commercial value and key features of the replacement system that was under development. The pilot study also enabled more accurate planning for a more ambitious integrated system.

Clearly, there were significant commercial reasons for developing a new system and imperatives included enhanced functionality, centralised support and maintenance, and low costs. The decision was made that the new system would be web-based, allowing clients to access the system via any standard web browser. With this new client/server architecture, all updates could be managed centrally, and there would be significant cost savings in licensing. In addition the decision was made to

use open-source technologies wherever feasible. This was a management decision rather than a technical decision and the primary reason given for this was anticipated financial savings in terms of licensing costs.

III. AN OVERVIEW OF THE SYSTEM BEING DEVELOPED

The system being developed is an online database accessible via any standard browser, subject to security and authentication. The system is designed around the Model-View-Controller approach, whereby the underlying data is separated from its presentation.

The online system being developed by Heales Medical is intended to:

- Manage employee medical records and related administrative information. This information is then made available to respective employees, their client organisations and the appropriate staff within Heales Medical. This has raised issues related to security, confidentiality and authentication, which the project team have to address. These issues are not unique to open-source technology and are shared with other organisations developing software in the medical sector.
- Provide case management entailing a history of particular medical problems experienced by employees within companies, and a record of consultations and interventions. Each medical practitioner will have their own caseload of client companies and employees for whom they are responsible.
- Provide a diary management service for all Heales Medical staff, which also serves as a timesheet system.

- Support performance management information. This entails analysis of existing data such as timesheets and case outcome monitoring.

The system comprises a number of Java classes and a number of JavaServer Pages (JSP). Table 2 provides a summary of classes developed in the system. Classes have been organised into three types. Table 3 provides a summary of the JSP pages.

IV. GENERAL EVALUATION OF OPEN-SOURCE TECHNOLOGIES

We begin by briefly considering some of the 'conventional wisdom' about open-source and non-open-source 'solutions'. Much of this 'wisdom' appears to be subjective and contested. We then go on to consider our experiences with open-source in this project.

A. Academic interest

The University of Hertfordshire has an academic interest in open-source technology. The University recently hosted a public debate between representatives from Sun and Microsoft about their alternative technologies, and will be hosting a similar debate specifically about open-source software in the near future. The University is also engaged in other open-source projects within business partnerships and through its involvement with on-line education projects. The relative merits and demerits of open-source are a matter of debate amongst academic staff. This project provides an opportunity to test perceived advantages and disadvantages of open-source software against practical experiences within the context of a 'greenfield' development project.

TABLE 2 SUMMARY OF TYPES OF JAVA CLASSES DEVELOPED IN THE SYSTEM

Class type	Description (purpose of type)	Count
Action	Classes containing methods for pre-processing forms.	6
Data access	Classes containing methods for querying and updating the database	12
Data transfer objects	Classes for encapsulating data to aid data transfer to JSP / HTML pages. Generally, there is one data transfer object per database table.	36

TABLE 3 SUMMARY OF THE JSP PAGES DEVELOPED IN THE SYSTEM

Area of functionality	Count of JSPs
User and application administration	33
Calendar	7
Medical cases	23
Human Resources	21
Website navigation	3
Document scanning	11
Document templates	8

In order to establish an appropriate set of criteria to measure against the project, the team prepared a set of perceived advantages and disadvantages for open-source software. These were derived from several sources (see [1]) and are summarised below:

Main perceived advantages of open-source software:

- Lower or no cost of acquisition
- Ease of acquisition
- Availability for evaluation e.g. by Internet download
- Low or no licensing fees for developers and users
- No upgrade costs
- Ability to customise the source
- Cross-platform portability
- Low cost of distribution across multiple users

Main perceived disadvantages were:

- Complexity of development and user-environment set-up
- Application complexity
- Lack of help-desk support
- User training costs
- Amount of development time required
- Incompatibility between different components
- Lack of backwards compatibility of new releases

An objective for this study is to compare these perceptions against actual experience during the Heales project development.

B. Developing the system

Availability of software for evaluation was highlighted as an advantage for open-source in our survey, but in practise, the plethora of available potential solutions made evaluation very time-consuming. The main sources for open-source software for this project were the SourceForge.net and freshmeat.net portals. The developer found that there was so much open-source software available that it took a considerable amount of effort to identify appropriate software and to evaluate it ([2] and [3] both provide and indication of the quantity of projects on SourceForge.net). In addition, it was difficult to assess the quality of the software and in practise it was found that a lot of open-source software was of poor quality ([2] and [4] both provide insights on the quality and quantity of information open source projects at SourceForge.net).

To balance this there is a lot of software written in proprietary languages too, such as Visual Basic®, and these are also freely available on the Internet. There is little apparent quality control for these types of software and again, there is a concern about the quality of this software.

In some cases, with open-source, freeware and proprietary software, versioning history is supplied, so it is possible to judge which software is being used and is more mature. Similarly, where there is only one developer working on a project/system, then this suggests that the software is likely to be of lower quality and little used by others. From our experience with this project, SourceForge.net has the better quality software, although freshmeat.net has a very active developer group.

There are distributors of integrated open-source software and our opinion is that these distributions tend to provide better quality when they are endorsed by recognised orgnisations such as Mandrake, RedHat and Suse.

A lot of software that is freely available is freeware rather than open-source. The primary distinction is that open-source software should have the source code available for inspection and modification, whereas freeware only implies no cost. From Heales' management point of view, this distinction is of little importance because cost is the primary criterion.

Within the Heales project, no significant requirement to modify the source of any code used was identified, so from Heale's perspective this feature is not a significant advantage for open-source, even though it was seen as a major benefit in our survey. A bigger issue is that some of the software is only free during development; for example in order to run Linux on the live server, Heales will have to pay a licensing fee.

There are other issues surrounding licensing. There does seem to be a lack of consistency in licensing agreements and little guidance available on how to interpret the open-source licences; for example when source should be returned to the open-source community and when it doesn't need to be. This situation can become more complicated when an organisation chooses to integrate several open-source tools where each tool has a separate and different open-source license.

Recent publicity about litigation in cases where it is claimed that code has been illegally used and propagated (e.g. [5]) has created the concern that at any time a code-writer could claim retrospective compensation for code that was inadvertently used against its licence, and this might include embedded code acquired under the understanding that it was freeware or open-source. Similarly, it is feared that stricter copyright laws that exist in the USA and Japan and which are proposed in the EU, will make it easier for any code originator to make retrospective claims.

Heales experience was that a considerable amount of time, and more than planned, was spent evaluating open-source software and then configuring it. This included some time developing scripts for additional functionality. For example, evaluating whether to develop the Java web application using a framework or non-framework approach took approximately a month (both calendar and man-month effort). The evaluation of the application server, database, IDE etc. took approximately 6 weeks. Configuring these systems took approximately 3 weeks. Overall, significant effort was required.

C. The users

Additional user training has been a hidden cost. This is because many of the users are used to Microsoft Office and have had to adapt to Open Office. There are adjustment issues because the users expect the same functionality. There are also interoperability issues with regard to document transfer and in some cases the formatting of documents has been lost in transfer, especially where tables are used in the document. This issue is not unique to open-source, and can occur with incompatible older versions of Microsoft Office.

Some users have formed the perception that open-source

tools are inferior and are only being used to cut costs. For example, if a document gets corrupted, their first impulse is to blame open-source. User training and complexity of setting up the user environment was identified as a disadvantage for open-source in our survey.

D. Costs, savings, and company profits

From the business management point of view, costs and cost savings were a primary consideration, and it was expected that open-source software would be far less costly than commercial alternatives. This opinion was reflected in our survey, where costs of software acquisition, licensing and upgrades were all cited as key advantages for open-source.

In practise it is true that considerable savings have been made with respect to software costs and licensing fees. Some of these cost-savings have to be offset against additional time and effort that has been spent on:

- evaluating the technologies available, both with open-source and proprietary systems; and
- on installing the technologies and ensuring they integrate with each other.

As an example, from a technical point of view, Oracle was the preferred proprietary database system, but the decision was made to use PostgresSQL because it was free. In this instance, savings in licence fees amounted to approximately £50k initial outlay plus £5k per annum support. At the same time, PostgresSQL does not provide all of the required functionality, so some additional development effort was expended writing scripts to provide this.

It is also true to say that there are situations where savings can be made with respect to commercial software. For example, educational institutions can sometimes get discounts or concessionary software. Anecdotal evidence suggests that these discounts are more generous for higher education than for primary or secondary education, in the UK. Similarly, some software development licences, for example Microsoft Office Developer, allow for free unlimited redistributable run-time licences for developed software, and any web-accessed system or in-house development is likely to be cheaper to license than a purchased wide-area networked application.

These savings have to be offset against developer time, and in practise our developer found the technologies difficult and the skills time-consuming to acquire. Some of the technologies are new or in a state of change, and there is little appropriate up-to-date training available and no help-desk support. This means that the developer had to rely primarily on the Internet for skills acquisition and support, and this was of variable quality and usefulness. Another concern is lack of confidence in long-term support for open-source tools.

Overall, the project has required considerable commitment and self-reliance on the part of the developer, over and above that which we have experienced with non open-source developments of a similar size. It could be argued that there is always a steep learning curve accompanying software development in an unfamiliar technological environment however within this project it is considered that this was greater because of the technologies used. This corroborates expectations from our survey, where complexity of setting up the development

environment, lack of help desk support and the amount of development time required to program were all perceived as disadvantages for open-source.

As part of the application process for the KTP grant, Heales estimated the increases in expected company profit (before tax) as a result of the proposed KTP. The estimates are given in Table 4. Note that increase in profits is primarily through increased sales, partly due to a considerably better system and also throughout a reduced cost to the client (as there are no license fees passed onto the client).

TABLE 4 ESTIMATED INCREASE IN PROFITS FROM NEW SYSTEM

Year	Estimate (£k)
During development of system	41
During 1st year after project	131
During 2nd year	297
During 3rd year	546
Total	1015

Results from the interim system have indicated:

- Since the beginning of 2004 Heales have increased turnover from £1m to just over £2m. This was achieved through the addition of seven main new contracts over and above an existing 10. The operating profit from the increase in business is estimated at £100,000 p.a.

- The actual increase in profit over the last three years (to end of May 2004) has been from £33,219 to £103,676, an increase of 212%. This does not take into account 6 months of revenue for 2004.

- Current accounts show turnover to end of February 2005 at £1.432m and operating profit at £194,000 an increase over 2004 of 87% (but that is only 3/4 of the year).

- An estimation for the whole of 2005 is for turnover of £1.9m and a profit of £258,000, an increase of approximately 149%.

V. CONCLUSIONS

In this case study we look at preconceptions about open-source technology, refine these using a preliminary survey and compare them to our experiences during the development of a business application.

We identify costs as being the primary consideration from a business point of view, and identify low cost software purchase and licensing as key advantages for open-source. We then looked at development time including software evaluation, implementation and programming and identify these as more costly for open-source in terms of time and effort expended.

We also looked at issues to do with licensing, which our

initial investigations suggest is confusing and requires further analysis. The ability to modify the source is regarded as a key benefit of open-source software, but in a business environment like Heales', this is of little importance.

ACKNOWLEDGEMENTS

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