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Case study of open-source enterprise resource planning implementation in a small business

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Enterprise resource planning (ERP) systems have been recognised as offering great benefit to some organisations, although they are expensive and problematic to implement. The cost and risk make well-developed proprietal systems unaffordable to small businesses. Open-source software (OSS) has become a viable means of producing ERP system products. The question this paper addresses is the feasibility of OSS ERP systems for small businesses. A case is reported involving two efforts to implement freely distributed ERP software products in a small US make-to-order engineering firm. The case emphasises the potential of freely distributed ERP systems, as well as some of the hurdles involved in their implementation. The paper briefly reviews highlights of OSS ERP systems, with the primary focus on reporting the case experiences for efforts to implement ERPLite software and xTuple software. While both systems worked from a technical perspective, both failed due to economic factors. While these economic conditions led to imperfect results, the case demonstrates the feasibility of OSS ERP for small businesses. Both experiences are evaluated in terms of risk dimension.

Keywords: enterprise resource planning systems; open source software; small business; risk factors

1. Introduction

The proprietary enterprise resource planning (ERP) market has seen extensive acquisitions of small software products by large firms, and even acquisition of large ERP vendors by Oracle. The proprietary ERP market however also includes a number of products distributed using the OSS model, such as Compiere, Nexedi’s ERP5 and many others. There are trade-offs in cost and risk.

ERP systems have been recognised as offering great benefit to some organisations, although they are expensive and problematic to implement. The cost and risk make well-developed proprietal systems unaffordable to small businesses. Open-source software (OSS) has become a viable means of producing ERP system products. The question this paper addresses is the feasibility of OSS ERP systems for small businesses.

OSS has become a viable means of software creation. The most commonly understood open-source success is the Linux operating system, used by Dell, Compaq and IBM as well as many other firms. MySQL is an open-source database management system. Sun Microsystems have long viewed OSS as a means to develop

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long-range market strength (Babcock 2009), although this effort was insufficient to avoid short-term takeover by Oracle. Other firms, however, have been able to make OSS work, to include Dell computers (Conry-Murray 2009).

Real competition between proprietal vendor products and OSS include Microsoft’s IIS software vs. OSS Apache in the Web server software market, MySQL vs. traditional database vendors such as Oracle and Microsoft, and Intuit’s Quicken and Microsoft’s Money vs. the OSS GNU Cash (Jaisingh et al. 2008/2009).

OS software may thus become a viable alternative to major ERP vendors with an obvious cost advantage. There are risks, in that one cannot expect the same level of service with OSS as with proprietary alternatives. However, support for many OSS products is available, from such organisations as IBM and Red Hat. Contemporary software selection thus requires considering the trade-offs between OSS and proprietary software. There were over 1000 ongoing ERP projects on SourceForge.net as of 7 May 2009, overlapping with customer relationship management (CRM) and supply chain management (SCM) projects.

Weber (2005) reviewed industry surveys seeking to identify why participants gave their time to open-source endeavours. The underlying philosophy of OSS is to enhance software reliability and quality through independent peer review and rapid evolution of source code. With OSS, developers and users are free to utilise and modify OSS by accessing open code (Jaisingh et al. 2008/2009). OSS projects have become popular since developers and adopters are able to implement OSS easily and give feedback promptly.

The purpose of this paper is to present a case study of a small manufacturing firm in the western United States in their efforts to obtain affordable computing support on a very limited budget. The paper seeks to demonstrate that OSS ERP can be made to work in a small business enterprise. It thus addresses factors involved in implementing OSS ERP in a small business organisation. Factors needed to make them work are analysed. While it is only one case, and resulted in limited success at best, it demonstrates the opportunities OSS ERP offers for small to medium enterprises (SMEs). It also represents some of the trade-offs between cost and risk mentioned above. Section 2 reviews literature related to OSS, open-source ERP and small business ERP. Section 3 includes a case study of the design and adoption of ERP systems. Section 4 includes comparative analysis of alternatives undertaken as a part of that case. Section 5 presents conclusions.

2. Open-source software

Products such as the Web server Apache, the database query engine MySQL and the cash management system GNU Cash have been highly successful (Jaisingh et al. 2008/2009). Hossain and Zhu (2009) attribute OSS development as being faster and more responsive, leading to more robust and secure software.

The underlying philosophy of OSS is to enhance software reliability and quality through independent peer review and rapid evolution of source code. A common misconception is that open source is synonymous with public domain. Unlike software in the public domain, OSS can be copyrighted (Lougee-Heimer 2003). With OSS, developers and users are free to utilise and modify OSS by accessing open code (Jaisingh et al. 2008/2009). OSS projects have become popular since developers and adopters are able to implement OSS easily and give feedback promptly. Kogut and Metiu (2001) reported that OSS project managers control communications between
innovators and users with minimum interference, enabling innovators and to take
the initiative in OSS projects. Some of the motivations for software creator
participation are enjoyment, learning, reputation and community membership
(Lakhani and Wolf 2005).

Open-source technology makes possible cooperative development of information
technology tools, making it possible to use small bits of functionality developed by
others and tested by the market rather than having to develop everything yourself.
Web 2.0 provides a cooperative development environment allowing widespread
participation. Examples include the Wikipedia online encyclopaedia and the
operating system Linux. Open-source products have been developed for financial
applications (Kane and Masters 2009), marketing applications (Fleisher 2008) and
many other fields.

2.1. Open-source ERP

ERP systems have evolved to expansion of functionality, especially in the form of
CRM and supply chain support, to a transformed product often referred to as
enterprise information systems (EIS). Recently, ERP vendors have realised that open-
source software systems (OSS) have robust capabilities, both as a source of content
for vendors and a threat to the proprietary enterprise system market share from
competitors based on OSS development or delivery (Grewal et al. 2006). Open-source
ERP systems are used by firms such as Home Depot, Toyota and Fidelity (Weber
2005). There is a market of open-source ERP products, to include Compiere, and
OpenMFG. There also is a demand for less-expensive systems by many organisations.
Hauge et al. (2006) cited evidence that few SMEs in Eastern Europe have
implemented ERP systems, due to lack of needed financial and human resources.

Olsen and Saetre (2007) reported that in-house development of ERP was feasible
and cost effective due to the availability of modern development tools. Open-source
ERP products can provide similar flexibility, and we would expect that to be at even
lower cost. As ERPs are commonly implemented by organisations, it is hard to
attain competitive advantage through implementation of ERP (Karimi et al. 2007).
Jaisingh et al. (2008/2009) suggested that OSS ERPs can be an answer for
competitive advantages since organisations are able to customise their information
systems by modifying the open software codes. Three potential benefits in using OSS
ERPs are increased adaptability, decreased reliance on a single supplier and reduced
costs (Serrano and Sarriegi 2006).

2.2. ERP support to small to medium sized business

Raymond and Uwizeyemungu (2007) studied 356 small Canadian manufacturers
with respect to their disposition towards ERP adoption. Of the group internally
predisposed towards ERP (140 of the 356), there was a higher level of commercial
dependence on major customers and less networking activity. The second group (40
of 356) was labelled as externally predisposed to adopt ERP and less dependent on
major customers, with a higher propensity for networking, larger and more
decentralised. The third group (156 of 356) was unfavourably disposed towards ERP
and had the highest degree of customer base diversification and lowest levels of
networking. They did less make-to-order (MTO) work and had lower need for
innovation. Overall, the study found that proficiency with computer technology in
manufacturing and need for coordination was a significant factor in ERP adoption among small manufacturers.

Snider et al. (2009) reported another Canadian study of small business ERP adoption, based on five case studies. All five of these companies reported reasons for adopting an ERP to include the need to integrate legacy systems and to obtain scalable solutions to deal with business growth. While the sample size was quite small (three successful and two unsuccessful implementations), differences that stood out were that the successful projects involved smaller internal teams with frequent interactions, had high levels of documentation, used consultants to lead the projects and need external end-user training while the unsuccessful projects in general did not. Table 1 compares strategies in some cases reporting OSS ERP systems. Table 1 is presented as a review of what some open-source ERP systems have used as strategies. It is included as background.

Other case studies have compared OSS ERP systems. Stoilov and Stoilova (2008) itemised functionality of Compiere, TinyERP and OFBiz, highlighting the variety of functionality provided by various systems. Leina et al. (2008) reported a case of Compiere customisation by an SME in China, finding that OSS makes IT affordable for Chinese SMEs by reducing cost across the board, as well as providing transparency,

Table 1. OSS ERP cases.

<table>
<thead>
<tr>
<th>Source</th>
<th>Product</th>
<th>Site</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Compiere</td>
<td><a href="http://www.compiere.org">www.compiere.org</a></td>
<td>SME market leadership through lower cost Use customer and partner development guidance for quality, transparency Documentation proprietary</td>
</tr>
<tr>
<td>A</td>
<td>Erp5</td>
<td><a href="http://www.erp5.org">www.erp5.org</a></td>
<td>Create common knowledge Reduce maintenance costs, control custom developments Nexedi documentation</td>
</tr>
<tr>
<td>A</td>
<td>GNU Enterprise</td>
<td><a href="http://www.gnuenterprise.org">www.gnuenterprise.org</a></td>
<td>To bring freedom to enterprises Voluntary contributions</td>
</tr>
<tr>
<td>A</td>
<td>Open for business</td>
<td><a href="http://www.ofbiz.org">www.ofbiz.org</a></td>
<td>Develop high-quality software – open To lower cost, allow customizations MIT license – non-copyleft Usable in proprietary software</td>
</tr>
<tr>
<td>B</td>
<td>Opentaps</td>
<td><a href="http://www.opentaps.org">www.opentaps.org</a></td>
<td>OSS ERP and CRM based on Apache OFBiz Cost reduction, improved quality Can collaboratively develop</td>
</tr>
<tr>
<td>C</td>
<td>JBoss seam</td>
<td></td>
<td>Unify Java server faces with JavaBeans 3.0 Can export as SOAP Web services</td>
</tr>
<tr>
<td>C</td>
<td>OFBiz</td>
<td></td>
<td>Java EE with Apache OSS SOA to organize reusable services</td>
</tr>
<tr>
<td>D</td>
<td>WebERP</td>
<td><a href="http://www.webERP">www.webERP</a></td>
<td>Financial and accounting for SMEs Free download, MIT license Customizable</td>
</tr>
<tr>
<td>E</td>
<td>xTuple</td>
<td></td>
<td>A free version, plus charge for added functionality Wiki documentation Openly developed add-ons</td>
</tr>
</tbody>
</table>

avoiding vendor lock-in, and providing flexibility in options provided. Baharum et al. (2009) interviewed two Malaysian SMEs about their experience with OSS ERP. The business driver as would be expected was financial benefit, but the ability to customise was also present. Barriers to overcome included database migration, synchronisation of software to company workflow, developing user interfaces and user support, and integration of third-party software.

Overall, our contention is that OSS ERP systems offer affordability to SMEs. As is to be expected, value and cost are inversely related in the long run. But in the present short run, a number of affordable opportunities for SME acquisition of enterprise computing exist.

3. Small business EIS case
Our purpose is to demonstrate the feasibility of OSS ERP for SMEs. Any research method beyond a demonstrative case is not claimed.

Weld Engineering Technology Incorporated (WETI – name changed to protect identity) is a small enterprise that manufactures industrial automated welding systems for several industries. As the client base expanded, the required inventory to service the many unique systems they manufactured expanded as well. Customer service for repair and replacement parts also became a large part of daily operations. Demand for systems increased, the number of engineers grew and the subsequent paper trail exploded.

WETI experienced a major jump in growth starting after the release of a new system that boasted modularity and flexibility. The new system design could serve a wide range of client needs and due to its modular design could be scaled to fit any need. This allowed WETI to be flexible in the size, functionality and ultimately the price that they could offer customers their signature advanced automated system. They could now offer systems to small manufactures or for operations that required less programming power and parameters while still offering a more complete automation experience than any of its competitors. Furthermore, expanding and upgrading systems became much easier for clients who might need to add additional functionality in the future, yet might only need a basic system to start with. No longer would WETI have to engineer new systems from the ground up, in many cases they could alter the mechanical elements already in place and the software and control modules would usually stay the same.

3.1. First round
The firm was a small engineer-to-order (ETO) operation with 30 employees. Practically, every product the company manufactured varied from prior work. Company production increased 500% in the first 2 years and steadily increased at about 20% per year thereafter. This led to a need for greater information system support.

3.1.1. Decision
Early in 2003, it was recognised that the old way of keeping track of sales, parts and documentation was not adequate to keep up with the demand of its customers. The owners wanted a system, but had strict budget constraints.
3.1.2. Planning

A plan to obtain an enterprise system was initiated. Based on the owners’ software engineering backgrounds, the firm used a Linux operating system for its products and thus was suited to OSS.

3.1.3. Information search

They began to explore several information systems, including but not limited to:

- In-house development,
- High-cost vendor software ERP systems
- Low-cost vendor systems
- Off the shelf software such as QuickBooks and Microsoft Office Suite.

In-house development was an option considering the company’s experience in software engineering, but the limiting factor that prevented development was decided to be time and manpower. Several mid-market ERP software providers were considered such as Microsoft Great Plains, Sage software and Infor Visual. However, the price tags for Great Plains and Sage software were in the $60,000–$80,000 range, which the owners considered to be too high.

3.1.4. Screening

After several months of moving through the typical sales routine, proposals were given to WETI and all were rejected. Although several employees were champions for these systems, ultimately the owners felt that at that price it would be worth re-considering in-house development.

3.1.5. Evaluation

Both owners had come from larger companies and had seen some of the ‘horrors’ of vendor ERP implementation. They felt that the high cost was not justified or worth the headache of drastically conforming to a system that would lock them into ongoing support and maintenance costs for the life of the software, as is typical of traditional ERP software vendors.

The employee in charge of finding a software solution examined low-cost ERP systems available at that time. ERPLite, www.ERPLite.com, was selected. The price per user was around $300 at the time, which was drastically lower than the prices offered by the traditional ERP vendors. The software seemed that it would meet many of the requirements needed for their ERP system. ERPLite offered basic inventory tracking and order management functionality to include the following:

- work/purchase/sales orders
- multilevel bills of material
- multiple inventory locations
- multi-user
- customisable (open Microsoft Access source)
Accounting Links: Quickbooks, Peachtree, Simply, Microsoft Small Business Accounting (sync list data: Items, Customers, Vendors).

ERPLite claimed to include materials requirements planning (MRP) software functionality without the need of a complex user interface. ERPLite had the ability to link with Microsoft products to enable use of SQL Server or MySQL as the backend database.

At the price and perceived functionality, the decision to move forward with ERPLite was easy for the owners to accept. The risks seemed very manageable and if the system failed to deliver the loss would be minimal. In mid-2004, three user seats were purchased, with the intent to buy more once the basics were in place and functioning well.

3.1.6. ERPLite experience

The three seats were installed and everything worked well for a couple of months. Testing went smoothly, but regardless some limitations were discovered. One such limitation probably had more to do with the basic limitations of Microsoft Access, rather than the ERPLite software. The processing of work orders for the volume of work that WETI was experiencing not only took a long time to compile but also created an overwhelming paper trail. WETI employees were not accustomed to filling out information of a work order traveller and the management was limited in its ability to properly oversee accurate execution of the new process. This is not a problem limited to WETI or ERPLite, as many companies have undoubtedly run into the same difficulties when in the middle of reengineering a business process.

One of the perceived advantages of ERPLite was the ability to access most of the source code via Visual Basic for Applications (VBA). The system could easily be customised for a more tailored fit to WETI’s needs. Within a few months of installation, there were a few modifications made to help better manage the work order travellers. However, when improvements were made to one part of the system, it uncovered or created problems in other aspects of the integrated systems functionality. The timely processing of work orders was still limited by the method of closing out work orders to properly track manufactured work that had been accomplished.

It is entirely possible that many of these problems were created when the various bill of materials (BOMs) were entered into the database. Due to the limited support purchased by WETI, the entire implementation was done with little interaction from ERPLite staff members or third-party consultants. Support was available over the phone, but often was limited to core software functionality. Best practices for structuring the data for the most optimal performance was left to WETI to decipher and implement. ERPLite is not to blame here, for much of that information can be extremely variable from one company to the next and it is very difficult to control without some hands on knowledge of how a particular company is trying to use the system and how they need to construct their data in a way that it meets everyone needs.

As the ERPLite system was altered to accommodate WETI’s unique problems, it became more difficult for ERPLite staff to provide effective over the phone support, but not due to their lack of effort. Within a year WETI decided to forgo monthly support and decided that it would pay on a per instance basis if further support were
needed. Along with the cancellation of monthly support they no longer would receive bug fixes or patches realise by ERPLite. Within 18 months of installation, the head of the manufacturing staff decided that the work order system was not adequate to keep up with their requirements and they stopped using the official work order system.

While ERPLite did not meet the accounting needs of ETI, it did allow for integration into off-the-shelf accounting software. WETI decided to use QuickBooks as it is accounting software. ERPLite had the ability to link item numbers, customers and vendors, as well as synchronise invoices generated by ERPLite. When manufacturing moved away from using the ERPLite work order system, it created a problem for the accounting department to accurately perform cost accounting per project or per product. In an effort to maintain some control, accounting and manufacturing decided to use a tag system of keeping track of ‘builds’ of products and categories of products.

3.2. Second round

Four years later, the only functional aspects of ERPLite being used were the purchasing module and sales quotes module. Purchasing would use the stored product numbers, its’ preferred supplier and the most recent purchase price to generate purchase orders for suppliers. Historical purchase orders were stored in the database and could be accessed for historical changes in price and or to list a set of purchased products associated with a particular project or product build. Sales would use the system to determine a sales price based on a standard markup of the purchase price. The items could be added to a sales quote and sent via fax or email to a customer. It should be noted that sales quotes were only used for spare and replacement parts only, not for entire contracted systems sales. Purchase orders and sales quotes were generated and then printed to provide accounting with the information necessary to generate a check from accounts payable or an invoice from accounts receivable within QuickBooks. This duplication of effort was common in many areas of WETI’s daily business operations.

3.2.1. Decision

WETI had become accustomed to these various systems and could function without many serious problems a majority of the time. However, there was never full satisfaction with the information system, and WETI sought a functional ERP solution that would meet their requirements.

3.2.2. Planning

WETI’s list of ERP requirements included: BOMs creation and revision tracking, work orders, purchasing/purchase orders, sales order entry, accounting (AR, AP, payroll, etc.), inventory tracking and control, MRP. From this list, only one and half of their needs were being met by one system. What was filling in for the rest was a hodgepodge of QuickBooks, Excel spreadsheets and separate Access databases linked by double or triple entry of information to keep information consistent and concurrent across departments. One can easily imagine why there was still a desire to find a better solution. So the process of ERP selection began again.
3.2.3. Information search

The business case for this round proceeded much as in the first round. This time however those in charge of finding the replacement for ERPLite started with low cost solutions first, looking at programs such as DBA Manufacturing, www.dbamanufacturing.com, and Fishbowl inventory, www.fishbowlinventory.com. The employee in charge of the first round of ERP research was still involved in the second round but others were more involved this time around. These low-cost solutions were tested through free trials and while robust and very functional, there were concerns voiced over some key limitations regarding WETI’s mode of operations.

WETI was an ETO manufacturer. This manufacturing process creates some very unique features when evaluating an ERP system. Many, if not all, of the ERP or materials management systems evaluated in the low-cost market are built for manufacturers that produce standardised products from a standard set of inputs. That type of manufacturing process can benefit greatly from many of these low-cost solutions. However, in an ETO or MTO manufacturing environment, these systems are rarely robust enough to handle the ever increasing, continuous development of unique parts, systems and configurations. The direction of ERP software selection escalated into the mid-market ERP vendor arena.

Over the period of 3 months, several ERP vendors were evaluated including but not limited to

- Sage AccPac,
- Epicor,
- Made2Manage,
- E2 Shop System,
- Exact JobBoss,
- Infor Global’s Visual, M1 by Bowen and Groves (now ECi M1).

3.2.4. Screening

The selection was narrowed to Visual and M1. They both seemed to offer a comprehensive solution for an ETO/MTO manufacturing operation. After another couple of months of demonstrations with various employees of WETI and more importantly with the owners, it was decided that WETI would allow them to offer a quote for a 10-user system with on-site implementation support and training for several end-users. The bids ranged from $18,000 to about $42,000 with approximately an additional $5000–$8000 expense on a dedicated server and SQL database software. Like before, the owners baulked at the price and it was quickly realised on all sides that the owners had no intention of purchasing a system at that point in time. The company had just built a state-of-the-art manufacturing centre and were heavily invested in the development of a new automation product that was over budget and past the hoped for completion time, and this over shadowed any potential gain that would be realised from a purchased ERP system.

3.2.5. Evaluation

The owners could see how a system like those proposed would benefit the company but the financial barrier was very strong for them. Being proponents of Linux, they
suggested that OSS be explored. A quick Google search resulted in finding the software *Openbravo ERP*. Openbravo ERP is a web-based open-source ERP system. The overall interface is easy to use and very capable. After initial testing, it seemed that Openbravo would fill many of WETI’s requirements, but it was difficult for those charged with implementation to get others involved. The testing of the software never made it past a quick demo test of the software and with no actual WETI data involved. While Openbravo seemed fully developed and functional, there was no adoption at WETI for no other reason than poor timing. Many employees were disappointed that the owners had turned down either of the two traditional ERP programs again, and they seemed to believe that OSS would not provide the solution to their needs.

### 3.3. *xTuple*

Information was being entered two or three times into the legacy ‘systems’ that each department had developed, mostly in Excel. After about 3 weeks had passed from the decision to forgo the traditional ERP, the head engineer approached those involved with the ERP selection process and mentioned that his friend in a research and development arm of a major company was using a program called *xTuple* to keep track of procurement, production and costs. They were using *xTuple* in conjunction with their company’s large vendor ERP system to keep track of each project’s inputs and outputs, because the large ERP program was only doing so from a macro view; just keeping track of the overall department’s parts and costs. WETI’s head of engineering and manufacturing was excited about the product and helped others see how it might be a viable solution for the company’s many ERP needs.

*xTuple* is unique as an OSS in that it does offer its’ source code but it has three versions of the software: the Postbooks, the Standard and the Manufacturing editions. The Standard and Manufacturing editions are available through a commercial license. Support services are available for the otherwise free Postbooks edition as published in April 2010 on the company’s website www.xtuple.com.

Monthly pricing was available at a 20% premium, but an annual contract was still required with the first 3 months billed in advance. The Standard or Manufacturing editions were available with a perpetual license paid one per use, with an annual maintenance fee 18% of the purchase price. Maintenance was required for the first year.

Another important benefit that *xTuple* offered WETI was the possibility of moving beyond the free Postbooks edition into the Standard or Manufacturing edition. WETI could implement the free version, get accustomed to it and then add the additional functionality when they were more prepared to utilise it and in a financial position to do so. In addition to upgrading to the full Standard or Manufacturing editions, *xTuple* also offers some functionality in the form of modules, which can be added for a fee.

It should be noted that even though Openbravo may have been as good of a solution for WETI as *xTuple* seemed to be, the only reason that they choose *xTuple* was due to the recommendation given to the head engineer.

As compared to the Traditional ERP software solutions, *xTuple*’s three editions offer very similar functionality. Some of the more advanced functions are only available in the commercial versions, but when comparing the costs to traditional ERP there is a compelling reason to go with the open-source model.
3.3.1. xTuple experience

After a quick overview of the xTuple website, the Postbooks installer was downloaded through sourceforge.net via the xTuple Postbooks project page. In addition to the source code, a SQL database was also needed. All the installation information, including information regarding the SQL database installation, was available on the xTuple website. xTuple was installed with the PostgreSQL database. PostgreSQL is an open-source and free SQL database server.

Installation was easy and in a matter of minutes the software was loaded and functional in the most basic form. There was no data available but the entire system was there to alter and test. Fortunately, there are a few database options to choose from on the Sourceforge Postbooks project page. In addition to the empty database, there is also the Quick Start database, which contains a basic Chart of Accounts and also the Account Assignments required to run a full range of transactions common to most businesses. There was also a demo database containing the accounting data found in the Quick Start database and a set of sample data such as parts, accounting chart of accounts, BOM data, etc. For initial demonstration and testing purposes, the demo database was loaded.

The initial assessment of the Postbooks edition of xTuple only lasted a few days within the two-person team in charge of finding and implementing ERP for WETI. It was found to be very capable and easy to use. In addition to the ERP software, xTuple also offered a free SQL report writer called OpenRPT. This feature provided a very functional tool to query the PostgreSQL database for information and reports such as sales quotes, work orders, purchase orders, inventory reports, accounting information, etc. This additional component was explored further in an effort to modify or create reports that would give manufacturing, accounting, and purchasing data in a form that they were familiar with to lessen implementation pains and also to better mould the ERP program into a product that would closely match the way WETI like to run their company.

After the initial fundamentals test, access to the system was given to the head of engineering, to the inventory control team and to purchasing. A small number of BOM data was imported into the system and the system was tested for interdepartmental functionality. Fake sales orders would be created and the information would pass to manufacturing, inventory and purchasing for further processing. After the individuals would perform their tasks, the fake products would be ‘assembled’ and finally run through the shipping module as complete orders. This all seemed to work well and with very little problems other than the learning curve associated with a new interface.

Meanwhile, a second database was created with just the basic accounting chart of accounts and no manufacturing or parts data. This was done to start preparing for a finalised implementation of the system. As the inventory control team and the head of manufacturing and engineering became more used to the system they began a new naming process for the many products and/or BOMs that WETI manufactured and sold. xTuple was functional enough to allow a wide range of use for categorising and grouping products into families and types based on how it was sold, manufactured or accounted for financially. Importing information was provided for through another OSS product called CSVimp, which allows mapping of comma separated values (CSV), generated from an Excel spreadsheet, into the many relational database tables used by xTuple.
In addition to the BOM data that was being compiled, the inventory team began utilising the location format found in xTuple to organise the many traceable inventory parts into a centralised location by an aisle, shelf, bin structure. This had never been fully realised before due to a lack of an intelligent system that could keep track and maintain inventory levels on over 16,000 parts. ERPLite was not a good fit for this task and the inventory control team quickly abandoned it soon after it was implemented several years earlier. xTuple was able to run inventory reports for the entire number of parts and could do this in a matter of seconds unlike the previous system. Another big advantage of xTuple was found in its search ability. Searching for parts could be done according to several different criteria with no effort. Due to the MS Access implementation of ERPLite, searching for certain data needed to be performed by generating specific queries and it could be tedious and time consuming. The result led to many duplicate parts and inaccurate information on most purchase orders, sales, quotes, work orders, etc.

Interestingly, the owners were never asked for the approval to move ahead with the project. It was presented to them, after the initial weeks of tinkering around, as a free and capable software solution. Naturally, they had no problem with moving forward.

After about a month of this segmented testing, it was decided to go ahead with a more structured implementation of the ERP system. Item master data were added in batches as it was formatted and arranged in a matter that suited the structure of the program and the use requirements of WETI. This went slowly due to the unstructured format that the data were in and because of the lack of information for a large number of items. Most of the parts being added were part of BOMs for products that had never been tracked electronically. Many of those major products and their sub-components needed part numbers and names, which added considerably to the time it took to organise the data into a form that could be used by xTuple. Within a few weeks, there were approximately 750 to 1000 parts out of over 16,000 entered into the PostBooks database.

3.3.2. Implementation setback
After about 4 solid months of data organisation and entry, WETI’s sales were suffering heavily from recession and lay-offs were imminent. Unfortunately, the employee hired to carry out the implementation was let go along with 15% of the employees at WETI. Shortly thereafter, the head of engineering and manufacturing left the company for unknown reasons. The effect was that the two main drivers or champions of the implementation were no longer at WETI and a companywide implementation has not been realised to date. The owners have considered the idea of hiring a third-party consultant to aid in the implementation but no hard decisions have been made.

4. Comparative analysis
The experiences with the two forms of ERP systems used by WETI are evaluated in terms of the six primary risk dimensions in information technology/information system implementation cited by Poba-Nzaou et al. (2008):

- Organisational (personnel, organisational structure)
- Business-related (business process consistency and reliability)
The ERPLite system was found to provide utility in supporting tracking sales orders and purchase orders. However, it created some difficulties for WETI employees to change their workflow. Data had to be entered multiple times. Much of this was due to the limited version of ERPLite purchased (as well as the limited support package purchased). The system purchased provided inventory support, but technologically the system took excessive time to produce too much paper.

The xTuple system proved a better fit. However, it too ultimately failed as a companywide solution, due to economic factors (recession leading to declining sales and lay-offs of system personnel). Table 2 recapitulates this discussion related to the two systems.

The ERPLite experience consisted almost entirely of negative lessons. This was true for all six risk criteria considered, even though the software did perform its function. The xTuple experience attained better results, especially in the

Table 2. Comparison of risk area experiences.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>ERPLite</th>
<th>xTuple</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisational</td>
<td>Workflow changes imposed but little effort was given to data structure which caused multiple problems</td>
<td>Best practices built into the software helped better control data structure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower cost IT staff lay-offs killed project</td>
</tr>
<tr>
<td>Business-related</td>
<td>Customisation of software required to serve WETI needs</td>
<td>Customisation only needed for reports not overall system functionality</td>
</tr>
<tr>
<td></td>
<td>Duplicate entry of some information because of partial integration (accounting)</td>
<td>Much faster inventory processing</td>
</tr>
<tr>
<td></td>
<td>No control over user privileges</td>
<td>Better search capabilities help control duplicate items</td>
</tr>
<tr>
<td></td>
<td>Not well suited for ETO manufacturing</td>
<td>Robust access control for users and groups of users</td>
</tr>
<tr>
<td>Technological</td>
<td>Access database version selected caused problems</td>
<td>Time required to structure system</td>
</tr>
<tr>
<td></td>
<td>Processing took a long time to compile, created excessive paper trail, difficult to close work orders</td>
<td>PostgreSQL was much more powerful and capable of handling thousands of processes quickly</td>
</tr>
<tr>
<td>Entrepreneurial</td>
<td>System provided access to sales quotes but only for service orders, not contracted system orders</td>
<td>Full CRM module built in allowed for lead management, project management, etc.</td>
</tr>
<tr>
<td>Contractual</td>
<td>Limited support package purchased, with corresponding limited service received</td>
<td>Wide variety of options available</td>
</tr>
<tr>
<td>Financial</td>
<td>No financial modules available in the system, third-party accounting software required</td>
<td>Accounting module included was robust but abandoned because of no payroll function</td>
</tr>
</tbody>
</table>
organisational, entrepreneurial, contractual and financial areas. However, this proved insufficient. The IT staff lay-offs that killed the project were not the fault of the xTuple implementation, but rather were due to economic conditions affecting demand for the firm’s products. The accounting module provided by xTuple proved robust, but the lack of payroll function led to its abandonment. The overall lesson we draw is that it is feasible to implement an OSS ERP. These products will vastly lower investment. However, they cannot overcome economic downturns. Certainly more expensive proprietorial ERP systems would have led to early bankruptcy on the part of the firm.

5. Conclusions

Even though not fully utilised, the overall structure of xTuple helped WETI to establish several positive areas for Business Process Re-engineering and also an adoption of several best practices enjoyed by many companies with traditional ERP vendor software. A considerable amount of time and effort was given to generate the master parts list, generate or update BOM data for several hundred products and organise inventory according to the structure found within xTuple.

The open platform also allowed for modification of the functions and reports found in the core software. This allows companies to mould the software around some of the business practices that provide a competitive advantage while also providing the benefits of a fully integrated ERP program and the best practices most ERP software is based on.

5.1. Implications

The case we have reported demonstrates that open-source enterprise systems are an affordable alternative. It also demonstrates some of the difficulties in getting them accepted by small business management. These systems will not have the full functionality of major vendor systems, but there are a wide variety of systems available that can provide small businesses with needed integrated enterprise system functionality at prices enabling financial survival.

Probably on the exact same point, OSS products make ERP accessible to small businesses. It also makes integrated computing support available to small government agencies in the US, the European Union, Brazil and around the world.

5.2. Lesson learned

Overall, open-source ERP software has been proven a capable solution for many businesses throughout the world. While it may not account for a large percentage of market share, there is a demand for such solutions and small business can gain many advantages from the adoption of such software. OSS is not always free (and there are always going to be costs of implementation) but most OSS companies do offer a no-cost version of their software, with an upgrade path when more functionality is needed.

References


