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Integrating diverse ERP systems: a case study

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Abstract

Enterprise resource planning (ERP) went through many development cycles since its beginning in the 1970s until it established itself as a backbone of most major enterprises in the world. In spite of its countless advantages, most ERP implementations require heavy customisation to achieve their proclaimed advantages. This paper represents an endeavour to investigate, through a case study, the feasibility of minimising the heavy customisation required by most ERP implementations by selecting the best modules from each vendor and integrating them using enterprise application integration technologies, to form one (integrated) system. In doing so, the paper provides a description of a way to implement a suggested integrated solution, as well as a discussion of how minimising customisation enables enterprises to upgrade their ERP software effortlessly and cost-effectively.

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1. Introduction

An enterprise resource planning (ERP) system is an attempt to create an integrated product that manages the majority of operations in a company. It is defined by Scott (2002) as: "a suite of integrated corporate wide software applications that drives manufacturing, financial, distribution, HR, and other business functions in a real time environment". In the past, organisations used separate applications to automate these business functions. What is different about ERP systems, is that they integrate across functions to create a single, unified system, rather than a group of separate, insular applications.

ERP software is the backbone of many big enterprises in the world today. The purpose of ERP is to provide organisations with a single-point solution, thus integrating all the core back office business activities such as: inventory, logistics, finance and human resources (HR), into one system. Having a single integrated system increases the organisation's efficiency by eliminating many redundant activities that might be required to keep different systems synchronised and this leads to great reductions in the operating costs. Despite some problems such as: long implementation periods and mass customisations required, ERP is "a necessity" for organisations to survive in today's competitive market. Following advice from Business Consultation Groups and ERP vendors, organisations try not to mix the components of different ERP products to avoid integration difficulties. The implication of following this strategy is that, enterprises are tied to a single ERP vendor who might influence and dictate its prices and technologies. In addition, a bigger disadvantage is losing a vast amount of supplementary benefits that might be provided by the other ERP vendors/products, which are not considered in the first place. As an example, suppose that a company realises that SAP ERP would better suit its requirement in most areas except for HR in which another product, such as Oracle, may be superior. At present, the company will most probably choose to sacrifice the important area of HR and select SAP for all its modules, including HR, therefore, losing all the additional functionality provided by the other vendor. As such, the company would then have to be engaged in lots of costly mass customisation for the SAP HR module to comply with its requirements. Recently, academic and business studies (Irvin, 2001; Steadman, 2000; Themistocleous *et al.*, 2001a, b) have concluded that ERP vendors were not able to satisfy the Information Systems (IS) requirements of their clients. As such, companies are now looking for



solutions to fill in the gaps left by their preferred ERP products.

2. Problems with ERP systems

There are many problems associated with ERP solutions. For a start, the word “Enterprise” in ERP refers only to the back office, hardly the whole enterprise. Nonetheless, ERP is still big enough to force lots of companies to do things very differently and that can prove difficult for large organisations as sometimes, it may require a radical change in their business processes (Lee, 2002). As reported by Mc Vittie (2001), anyone who has attempted to change business procedures even slightly knows that this is “painful”. This is in accordance with published literature on this area such as Davenport (1998) and Sumner (1999) who support that ERP customisations is a difficult task. Therefore, in deciding for an ERP solution, organisations must first determine if their traditional business practices would be able to fit within a standard ERP package.

Then, there is the issue of data accuracy. Forget how robust a given system can be; if the data that go into the ERP system is not accurate or immediately accessible, the whole system becomes suspect. The catalyst for an ERP system may be a company’s need to survive, but the success of ERP is predicated on the simple concept of collecting accurate, timely data. In the absence of reliable data, ERP is deficient at best, a failure at worst (Scott, 2002). On the other hand, some enterprise applications make life so difficult by complicating even the simpler of processes. For instance, a simple data collection task in an enterprise software application may require from three to eight screens for the user/administrator to fill-in a few relevant fields of data.

Finally, like all other IS projects, ERP implementations have a high risk of failure and may drift. According to the Conference Board survey results, reported by CMP (2001), approximately 40 percent of participants failed to achieve their business goals after having implemented ERP projects for at least 12 months. The report mentions that the most difficult support tasks were: incorporating business process changes, upgrading software products, supporting gap solutions, and adding new functionality. It must be noted that 20 percent of the survey participants decided to terminate their ERP projects entirely.

While most ERP vendors offer various forms of support for enterprise business needs, some are more successful in one area over another (Mc Vittie, 2001). Several vendors are better at

providing solutions for financial processes rather than for the manufacturing ones. The authors therefore encourage a simple question: “Why do not we select the best tools from each vendor and integrate them into a single system?” Easier said than done, the answer was rather confusing until recently; but with the advent of enterprise application integration (EAI) tools, it is now possible to provide a sophisticated and feasible solution. In this paper, the authors argue that there are many benefits to be realised from the integration of ERP components and they provide an example of integrating the modules of two ERP different systems.

3. The need to mix ERP components

Generic enterprise systems solutions are fading from the scene. The rush to spread ERP systems to more organisations is driven by the prospect base. Executives in industries say that generic products require longer implementations, more workarounds, and increase the complication of add-on solutions (Ramanathan, 2000). There is little doubt that vendors of collaborative enterprise suites, have to address the market on multiple fronts to satisfy all different needs. According to Mann (2002), a CIO at a leading UK organisation says: “We looked at a number of ERP solutions and they just didn’t fit our aviation; what we do is very different from manufacturing; it’s a lot more variable and complex. The manufacturing-based ERP solutions don’t have the flexibility to tie all our business processes together”.

To properly balance and align real-world business processes with ERP functionality, executives and ERP teams have to engage in an important process known as “Gap Analysis”. Gap Analysis is critical not only to determine the overall ERP implementation strategy, but also to pinpoint the integration requirements for the ERP system. The exercise forces thorough inspection of the processes used to collect and move mission critical company data to an ERP system. Gap Analysis is defined by Scott (2002) as the evaluation of the functions provided by the system, compared to the operational processes necessary to run the business. The area, where software does not cover functions and operational process requirements is known as the “gap”. The gap requires executives and ERP teams to proactively take a few crucial steps:

- (1) examine a business process to match an ERP function;
- (2) enhance the business process to meet the needs of the desired ERP system outcome;

- (3) employ integration software to bridge the gap; and
- (4) determine if it is necessary to add a custom bolt-on applications for a critical function that the ERP system does not address.

While ERP software was designed to standardise a range of business processes, each installation typically required extensive customisation to reflect a company's unique procedures and situation (Marti, 2000). So, customisation and adding bolt-on applications to an ERP is a very widespread practice. According to a survey performed by Callahan (2002), when asked how their ERP solution perform, before adding any bolt-ons, or enhancements, nearly 77 percent felt that their system was average or below average. This is also in accordance with previous literature on this area (Themistocleous *et al.*, 2001b). An interesting side note is that 31 percent of the survey respondents said that they use more than one ERP application. When questioned about this in more detail, the answer seems logical: mergers and acquisitions were a major cause. Fifty percent of the companies responding to the study indicated their IT teams accept the concept of adding bolt-on applications to make up for the shortfalls of the ERP application. The *gaps* in the ERP systems are being addressed primarily through outsourcing bolt-on modules from third party vendors.

The above four steps described by Scott (2002) and the bolt-on concept by Callahan (2002) are the industry practice to-date. In this research paper, steps three and four above are both utilised by taking the relevant parts of a certain ERP system and patch the gaps with modules from different ERPs instead of mass customization or costly bolt-on applications. An EAI solution is used to integrate the different ingredients together. The concept which the authors introduce with this case study might not be totally new in the industry, but this research provides an opportunity to investigate the feasibility of this option in a scientific manner.

4. Case study and data collection methods

The case organisation, which will be referred to by the fictitious name of S-Tel, is a leading telecommunication company in the Middle East. It formally commenced operations in July 1981 to provide and maintain telecommunications services in the region. Over the ensuing 20 years, S-Tel has built up a well-deserved reputation as a regional telecommunications hub in the Middle East. Today its vision is far more ambitious, dictated not only by the dramatic growth of technology, but by

other equally potent factors such as globalisation and deregulation which are the main challenges to be faced. S-Tel's aim is to be a world-class company providing integrated solutions as part of a customer-focused strategy. The scope of its business today covers the areas of voice and data transmission, fixed and mobile telephony and content and delivery.

The purpose of introducing this case study was to define a problem area and recommend a solution. In doing so, several data collection methods were used; mainly interviews, observations and document sampling. The interviews were of semi-structured nature and they were the main source of information. They were conducted with the project manager and the team members responsible for analysing and implementing the system as well as the support staff who were stakeholders in the project. The team consisted of IS specialists and super users from different function areas. The observations were recorded by spending some time watching the project activities in different project stages, especially during the initial ones. The authors were also given access to the project shared drive, which utilises a knowledge management repository shared among team members and contained most of the project documentation. Samples of some documents were taken and used as supporting material for this research. The data and facts included in this paper were obtained using the above methods.

4.1 Problem definition

The IS department at S-Tel is responsible of investigating and providing solutions that satisfies all the departments and supports future needs. In order to catch-up with technology, S-Tel started to replace most of its legacy systems with new off-the-shelf software packages. The legacy back office systems consisted of more than 20 loosely integrated systems. Some of the applications had not been developed proficiently, lacking proper documentation, hence making them hard or even impossible to control, maintain and support. Data integrity, consistency and security were not guaranteed. In addition many of the systems were stand-alone (e.g. not integrated); thus, a lot of work was wasted for data re-entry.

Therefore, S-Tel decided to start a project to replace all these systems with a single "best-of-breed" integrated solution. The primary project objective was to provide a fully integrated back office solution to enable the company to improve its processes, support the business more efficiently and effectively and to produce timely and accurate information relevant to the competitive business environment.

The most notable critical success factors of this project were:

- (1) *Centralised database.* The new systems should provide a central database for all information with proper control and validation of all data elements. This should eliminate duplicate and redundant data maintained at different levels thereby ensuring data integrity and quality.
- (2) *Manipulation.* All information should be accessible for end users to manipulate and report based on different security levels to different authorised personnel.
- (3) *Real time access.* Real time access to relevant business information is vital for decision-making. The systems should enable users to generate the required information easily and on a timely basis.
- (4) *Automate business functions.* The system should, where possible, automate business functions and workflow so that human intervention is reduced.
- (5) *Paperless environment.* The system should support a paperless environment.
- (6) *Avoid customisation.* The IS strategy was to avoid customisation as much as possible in order to ease future upgrades to the new versions of the software.

After a thorough investigation of the market, supported by many site visits, the IS department along with the business owners reached the decision that the SAP R/3 suited their back office activities including: manufacturing, planning, finance and logistics. However, it did not suit HR, an area with the greatest number of problems in the back office legacy systems. The mismatch was mainly due to the functional gaps in SAP and other requirements such as:

- HR had urgent problems that needed to be resolved as soon as possible. The SAP implementation would normally take between three and five years. Meanwhile, a solution for the HR was required in 12 months
- SAP R/3 did not offer bilingual support. The HR department requires support for the local language as it is the primary one used for most HR reports and letters.
- The HR department needed a thin-client configuration which would support remote access to their systems which was not offered by SAP R/3 at that time.
- The payroll module was very complex and it was a common feeling that SAP would not satisfy S-Tel's ever-changing needs because of the rigid nature of SAP.

The IS department had three choices

- (1) customise SAP R/3;
- (2) add bolt-on applications; or

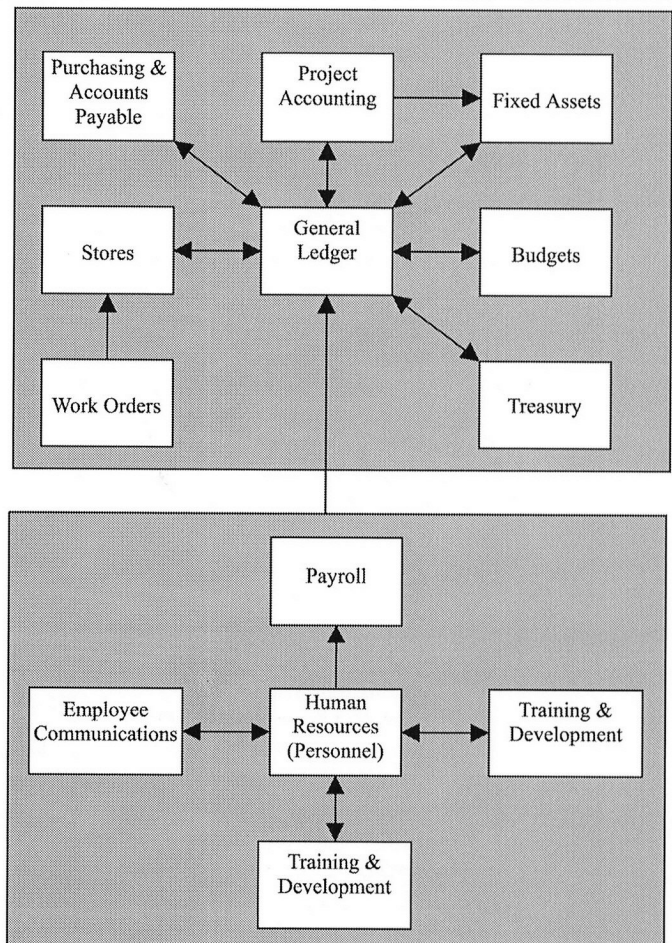
- (3) implement the HR module of Oracle applications ERP integrated with SAP R/3.

The latter (option) was the most feasible in terms of cost and functionality. Therefore, the HRMS module was selected from Oracle applications for its flexibility to suit all HR and Payroll function areas. Figure 1 shows the back office activities at S-Tel. The function areas in the upper shaded box represent all back office activities except HR and payroll, which are represented by the lower box. The entire activities in the lower box can be replaced by one process in the ERP structure.

4.2 HR applications

HR applications such as payroll, personnel and applicant tracking systems are extremely hot in today's ERP market. Organisations are realising that, their employees represent their most valuable assets, and they are investing (more than ever) in systems to help them provide better support to their employees. Companies are also looking for creative ways to examine and evaluate their businesses. As a result, management reporting functions with a

Figure 1 The back-office activities at S-Tel



focus on areas such as hiring trends and turnover analysis, are taking on greater importance in the process of managing large organisations. In addition, government reporting requirements continue to evolve. It is difficult for ERP vendors to keep up with these changes and even when they can, it is a burden for customers to regularly install and configure software updates. Vendors are increasingly looking to provide their customers with the ability to do ad hoc analysis and custom reporting against their HR data so that corporations can be more flexible and responsive to their changing reporting needs. However, providing complex report-writing tools to run against sophisticated ERP data models is not an ideal solution. These tools require an in-depth understanding of the underlying data model, which a typical HR analyst will not possess. As a result, many companies use their MIS organisations as a channel for creating new reports. This can work quite well, but in organisations, where MIS is resource-constrained, this often leads to bottlenecks. Once again, companies are looking to ERP and database vendors to address these challenges in a turn-key fashion. Oracle is one of the few ERP vendors who designed its HR module in such a flexible way that the end users have the ability not only to use the system; but also to develop their own reports and configure some parts of the system, such as payroll elements, by themselves.

4.3 S-Tel IS steering guidelines constraints

Any S-Tel project that is undertaken by the IS department has to follow certain steering guidelines in order to get a proper balance of all variables in the project such as: cost, quality and time. The guidelines identified by the technical working group are:

- *Leverage existing investment in IT.* S-Tel requires the new technology architecture to utilise the existing investment in IT. Accordingly, the new technical infrastructure for the HRMS solution should seek to build on the existing IT hardware components and organisational skills.
- *Industry-standard and proven architecture.* S-Tel requires the new technology architecture to be based on leading and mature technologies in the areas of hardware, system software, databases and business applications.
- *Shared and centralised application services.* S-Tel has a strategic direction to deploy a shared and centralised application service model. The model aims to reduce the IT support overhead and increase information sharing by using the Web and Internet technologies. System users should be able to access business applications through an Internet browser without the need

to install further software on their client workstations.

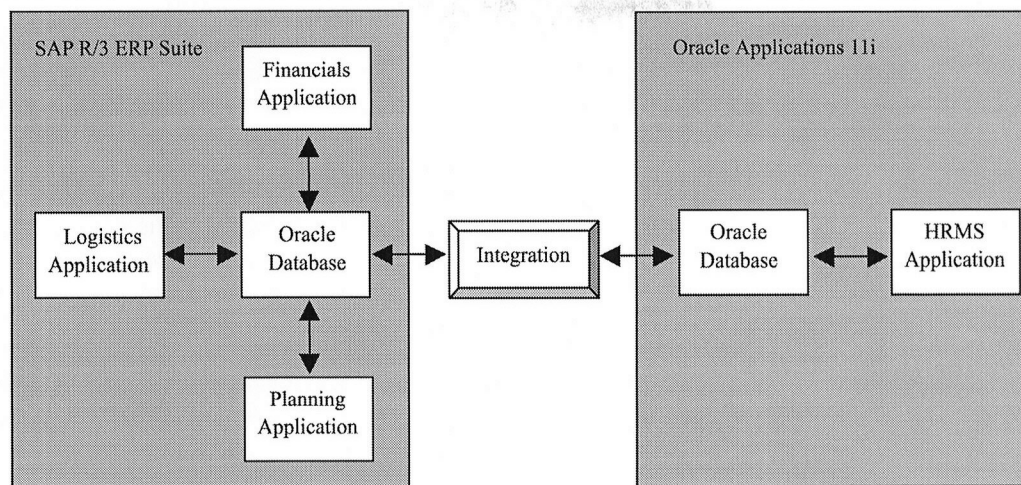
- *Adequate system performance.* S-Tel has strict quality requirements in terms of the new HRMS solution response time, availability and recoverability. These requirements are intended to ensure that key system users have an acceptable and adequate level of service.
- *Integration with existing applications.* S-Tel requires the new technology architecture to be based on open standards, which facilitates the future integration with existing applications. This includes back office applications (e.g. financial system), workgroup software (e.g. Lotus notes) and external systems (e.g. banks).
- *Good balance of architecture characteristics.* S-Tel requires the new technology architecture to provide a good balance of the standard characteristics of performance, scalability, availability, maintainability and cost-effectiveness. S-Tel had set the priorities below for the selection of its future technology architecture. The set priorities were primarily driven by the nature of the HRMS solution being a back office, non-mission critical, administrative system and were identified after a careful discussion between S-Tel's technical working group with one of the authors' attendance (Table I).

4.4 The recommended solution

As mentioned above, S-Tel took the decision to implement Oracle HRMS within a SAP R/3 ERP suite. The basic components of R/3 were found sufficient to cover all the function areas shown in Figure 2; these were logistics, financials and planning. On the other hand, Oracle HRMS module was used to replace all HR, payroll and

Table I S-Tel IS steering guidelines priorities

Selection priority	Rationale
First priority: cost effectiveness	Since the HRMS solution is a back office administrative system, hardware investment need to be tightly controlled and clearly justified
Second priority: maintainability	Low maintenance and support cost is a key driver behind the centralised shared services model targeted by S-Tel
Third priority: performance	Since the HRMS solution is a back office administrative system, there will be no compelling need for superior performance
Fourth priority: availability	Since the HRMS solution is a back office administrative system, system failure will have low impact on S-Tel's business continuity and service delivery capabilities
Fifth priority: scalability	The initial configuration of the system will consider S-Tel's operational requirements for the coming five years

Figure 2 The recommended solution

training activities. Figure 2 shows the final product, with all the different components.

The two shaded boxes represent SAP and Oracle systems. The clear boundaries that separate all modules make the diagram look very simple; however, the underlying architecture is very complex. Some of these modules are composed of more than a dozen subsystems. Although both SAP R/3 and Oracle applications are based on Oracle database, it proved necessary to keep them separate and link them using an integration tool. This was judged as the best way to make the architecture flexible. Using EAI technologies with separate databases provides an infrastructure to add and subtract modules very easily.

Furthermore, it helps combining or separating the platforms. The design enables S-Tel to implement the two systems separately and link them afterwards upon completion and proved essential as the critical HR functions (implemented using Oracle HRMS) needed to be ready within 12 months after project initiation. On the other hand, implementation of the SAP modules started at the same time but will require at least three years to go live. Therefore, Oracle would be linked to the legacy back office systems during the SAP implementation; that should not be a problem once the link is established as it is easy to switch between different systems. However it could cause a problem if the company decides to change its chart of account, which is very unusual in well-established enterprises.

4.5 Selecting integration technologies

S-Tel chose to acquire and implement a proven, highly functional and scalable solution to augment its enterprise integration strategy. Any integration solution purchased by S-Tel should help meet the short- and long-term goals of integrating all systems

into the enterprise and help improve organisational performance. In order to select an EAI tool, S-Tel considered a list of vendors against a fixed set of criteria. An original long list of seven integration-tools vendors was compiled. This long list was reduced to three by an initial evaluation exercise. The three short-listed vendors were: IBM, TIBCO and Microsoft. Several criteria were identified as critical for S-Tel's requirements and each vendor was evaluated against them, in an attempt to ensure that the final selection process will not be flawed because of inconsistent data. At the end of this process, S-Tel decided to go for IBM's MQSeries because it had the greatest score overall.

4.6 Building the integration link

Building the integration link between Oracle HRMS and SAP GL required three main steps: extract data from Oracle HRMS and SAP GL, build adapter for both systems to enable data being passed, format the data based on the adapter and upload data into the two systems. More than 80 percent of the effort was spent on building the adapters. The adapters were used to interface the integration tool with the variety of applications on differing platforms. The interfaces convert the native data formats and procedures of the applications into a common structure that is then utilised by the integration technologies provided by the vendor. The architectural theme is that, the functions that are common to all integrations (networking, queuing, security, etc.) need to be built only once. The custom coding part of the job was reduced to just providing the interfaces. Meanwhile, EAI vendors offer a selection of previously built adapters for most of the popular applications likely to be found in an enterprise. If an adaptor is available, the job will consist primarily of implementing particular data

structures and business logic peculiar to the enterprise, often with GUI based tools that require no detailed programming. On the other hand, if no adaptor exists one will have to be developed as part of the integration effort. The vendors have prototypes, templates and established procedures for how these developments can be accomplished, and hence the risks in general are not something to become alarmed about. But these efforts do take time and are likely to contribute significantly to the duration of the project.

Fortunately, IBM's MQSeries integrator provides adapters for Oracle applications and SAP R/3. This reduced the need to extract of Journal entries from Oracle payroll and passing it to the Oracle's adapter which (in the future) uploaded into SAP using SAP's adapter. There will be no extract from SAP to Oracle because the interface is one way only. Integration can be synchronous or asynchronous. Synchronous integration between systems requires all system to be online at the time of communication. However, it is difficult to make all systems synchronised at all times; and thus, it is preferable to use asynchronous integration. MQSeries is an asynchronous integration tool; and this means that the integrated systems need not be online at the time of communication. Figure 3 shows the way MQSeries passes the messages between Oracle and SAP in S-Tel's implementation.

MQSeries simply gets the message from Oracle and stores it in a messaging server; which in turn passes it to SAP. Since there is no message passed from SAP to Oracle, the communication will be one way in that case. MQSeries messages consist of a header and a body. The header works as a controller to identify the applications being communicated. The body is simply the data to be passed; and in this context it is the general ledger interface details. The general ledger interface aims to reflect the financial impact of the human resource transactions to S-Tel's financial system by means of "Journal Vouchers". Oracle HRMS application has built-in features to calculate payroll costing and generate "Journal Vouchers" to be used by the enterprise financial application. A custom-built program based on PL/SQL and other programming languages, if necessary, will be used to extract the data from Oracle payroll. The script should perform the following tasks:

- Read payroll costing data and journal vouchers from Oracle HRMS tables.
- Process the costing information as per S-Tel's functional requirements.
- Develop corresponding journal vouchers for later entry into S-Tel's financial system (e.g. SAP GL).
- Validate the developed journal vouchers by means of checksums and totals.
- At the end, the script should store developed journal vouchers in a text file or table.
- The interface should also have a "Replay" mechanism in order to re-generate the journal vouchers upon system crash.

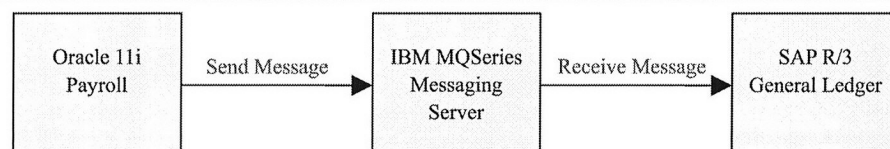
The main fields of a journal entry include: transaction date, profit centre, natural account code, product code, project code, description, debit amount and credit amount.

4.7 Activating and using the link

In order to make the link usable, the following procedure should be followed by the Payroll Administrator or the Super User. Processes 1-4 are standard and provided by Oracle for every implementation. They can be executed from submit processes and report form.

- Run the payroll process to distribute the payroll elements to the staff.
- Run message report and make sure that no errors exist. Otherwise, fix the problems and re-run the payroll process.
- Run the pre-payment process to distribute the amounts to the different payment methods defined in the system.
- Run the costing process to generate the Journal entries.
- Run GL Interface from the same form as the above processes. However, this process is a custom-made process to create the Journal entries on a Unix text file based on the format required by the Integration adapter.
- The Oracle's adapter of MQSeries will automatically capture this file and move it to the SAP adapter which in turn copy it to the SAP files.
- The SAP GL administrator should run a process to post these Journal entries to the general ledger.

Figure 3 Asynchronous communication with MQSeries



5. Summary and concluding remarks

The research represented an attempt to investigate the feasibility of mixing the components of different vendors when implementing an ERP solution for an organisation. ERP went through many development cycles since its beginning in the 1970s until it established itself as the backbone of most enterprises in the world. In spite of its countless advantages, ERP packages have many problems and the word "Enterprise" does not reflect the whole organisation; it barely represents the back office processes. Besides, the heavy customisation required by ERP packages to suit the companies' special needs, it is very expensive, time consuming and causes future upgrades to be a nightmare. Therefore, many companies are seeking a solution to avoid customisation and make ERP implementations and upgrades straight forward. This later statement has led the authors to investigate whether organisations follow a best of breed approach and integrate their ERP modules.

In order to prove that mixing and integrating the components of different ERP vendors is feasible, the case study of S-Tel was used to demonstrate and verify the concept. Using semi-structured interviews, observations and document sampling, the problem of S-Tel was analysed and defined; and was used to illustrate the ideas throughout the research. Proving this concept on a big variety of ERP components with different vendors is a very difficult task. It is much easier to consider integrating one module of an ERP to the whole suite of another ERP. S-Tel's problem was suitable for this investigation because it complied with this criterion and allowed us the opportunity to investigate the feasibility of integrating the HRMS module of Oracle applications to the SAP ERP suite.

The recommended solution to S-Tel's problem was to integrate Oracle HRMS with SAP using a integration software. Oracle HRMS provides S-Tel's HR department with all the functional requirements and a range of additional benefits as well; covering all functional gaps in the SAP standard HR module. Finally, the recommended solution was proved to be feasible to implement and cost-effective. In its attempt to piece together these systems, S-Tel used EAI solutions.

The EAI technology is increasingly used by most of the major organisations in the world. Establishing a flexible and maintainable EAI infrastructure, enables the company to easily integrate different systems. S-Tel selected its integration vendor after a long feasibility study and applying a set of criteria identified very carefully. Using S-Tel selected EAI tool, which was IBM's MQSeries, the integration link between Oracle and SAP was identified and built. The success of this

process proved the overall success of the concept of mixing the components of different ERP vendors.

Overall, this investigative piece of research has achieved its objectives, and mixing the components of different ERP vendors has proved to be feasible in terms of the concept and practice. The paper also demonstrated that this concept is now feasible with the use of EAI tools. The case study, illustrated that it can be done in practice by analysing S-Tel's problem, recommending a solution and defining all the variables that might be faced during the implementation and the integration phase of the project.

This research was an attempt to correct a misunderstanding that some researchers and business consultants have about the feasibility of mixing the components of two or more ERP's. The success of this attempt should encourage enterprises not to be tied to a single vendor forcing its applications and dictating the solutions. In fact, by doing so, they will be able to gain maximum functionality and with equal or probably less cost. The increasing use of EAI nowadays, provides a rich media to give life to this idea and prove it as a new discipline for EAI.

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