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Providing e-business capability on a legacy systems platform: a case study from the Knowledge Transfer Partnership scheme

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Abstract. This paper focuses on the how the Knowledge Transfer Partnership scheme has been used to develop and implement a technical strategy to support e-business trading by an SME dealing with the NHS and other public authorities. In this instance, the company (TPG DisableAids) decided against the introduction of new core systems but preferred instead to pursue a strategy of building e-business capabilities on legacy systems that were deficient both technologically and in terms of functional capacity. This resulted in a number of technical and business challenges that were addressed via the KTP project.

Keywords: Knowledge transfer, e-business strategy, legacy systems, systems integration, process change

1 Introduction

1.1 Company Background

TPG DisableAids is a provider of equipment for the elderly and disabled and has grown steadily since 1984 to employ 47 staff today. The company assembles and distributes a wide range of products from primary manufacturers, such as Stannah who make a range of stair lift products. The company currently has an annual turnover of £4.3m (2009/10), with stair lift products generating about one-third of turnover but over 50% of profits.

TPG DisableAids' market can be divided into different segments (NHS, local authorities, district councils, residential & nursing homes, private individuals). Nationwide, this is a multi-billion pound market, which is growing as the age profile of the population increases. Competition comes from some of the national equipment dealers operating in the region (e.g. Stannah Lifts, who are also a supplier to TPG DisableAids) and one or two other smaller locally based companies with less

than 5 staff each. The business opportunity is there to rapidly grow market share, particularly in the new market segments driven by public authority care management, insurance industry home equipment provision, and lifestyle products for the elderly. TPG DisableAids business plan is to double their turnover within 5 years to £8.5m in 2014/15 which is dependent on developing e-business capabilities in line with changes in NHS and public authority procurement practices. It is important that the company have the systems capability to respond to the equipment and service requirements of the NHS and related bodies at short notice as the elderly and disabled leave hospital and return to their homes. The NHS e-procurement initiatives require specific inter-organisational systems integration capabilities which the company has hitherto not had. This alignment is critical to the expansion plans of the company.

1.2 The challenge and opportunity of legacy systems

When packaged software first became widely available in the early 1990s, many companies moved quickly to procure and implement either a range of standalone packages (such as Sage, Manugistics, Peoplesoft) or integrated ERP suites (such as SAP, JD Edwards or Oracle). However, once the real costs and complexities of such projects became apparent, many companies began to look at alternatives that maximized the value of their investment in existing legacy systems. This trend was encouraged by the failure of some of the early ERP projects to deliver expected benefits. As Jeffrey and Morrison (2000) concluded, 'You don't have to go far to bump into lots of evidence that shows how ERP software has not delivered on the promises of vendors.' By the mid-1990s, the data warehouse was perceived by some as constituting an effective alternative strategy to wholesale replacement of old systems, by extracting data from new and legacy systems alike to provide timely aggregated management information, one of the main apparent benefits of new integrated ERP packages.

The data warehouse concept achieved considerable success and was onwards developed to utilize not only relational database technology, but also multi-dimensional spreadsheet type engines (the so called OLAP products – On-Line Analytical Processing) and subject specific mini warehouses often termed 'data marts'. By the late 1990s, however, the emergence of the web and the growth of the concept of information portal provided another possible option that could build on existing legacy systems and yet provide some of the benefits of across the board systems replacement (Wynn, 2000). This saw the emergence of the concept of middleware that could act as an information exchange between legacy systems and packaged software alike, and also provide a link through from in-house systems to the corporate portal or web-site.

1.3 The KTP scheme

The UK KTP scheme attempts to harness the skills, knowledge and experience that exist in the higher education sector and apply them to projects in local industries. As the Work Foundation recently noted 'universities are a valuable source of knowledge and innovation which can benefit.....existing businesses, whilst close linkages with businesses are also very valuable to universities' (Work Foundation, 2010). The KTP scheme has been in operation in one guise or another since the 1970s and the basics of the scheme are as follows:

- The university partners with a local company to deliver a project – typically of two years duration – of direct bottom-line benefit to the company
- The university and company design the project proposal which is then submitted the Technology Strategy Board – a UK Government organisation. If successful the UK Government provide circa 50% of direct costs for projects with small to medium sized enterprises.
- The cost subsidy applies to the salary of a full-time project manager or technical expert (recruited by the company and university together), a supervisor from the University working half a day a week on the project, and associated training, travel, equipment and support costs. The full-time project manager or technical expert (known as the KTP Associate) is recruited onto the University payroll, but works full time in the company.

KTP projects are multi-faceted and provide benefits for all parties. Knowledge transfer is at the heart of these schemes, with the Associate and university supervisor acting as conduits for a range of skills and knowledge that can be brought in to help the company move forward. The university benefits from involvement in real-world project delivery which often produces conference research papers and publications; and the Associate gets the opportunity to play a key role in a high profile company project, supported by a blue-chip training programme.

1.4 Project objectives and outputs

The project objectives were to underpin a transformation of the company from a traditional family business to a highly efficient e-business, operating electronically across its extended supply chain. Failure to enable electronic trading would cause significant damage to the company's ability to tender for upcoming supply contracts (and post sales services) and have a detrimental effect on efficiency. The KTP overarching objective was to optimise business processes and implement new cross-supply chain systems.

Outputs were targeted to include the following:
- Technology infrastructure upgrade to support cross supply chain information exchange.
- Top-level process maps for TPG DisableAids extended supply chain, identifying opportunities for process integration

- New information reporting capabilities providing improved communication and sharing of information in-house and with key clients and suppliers. This was seen as particularly significant in the tracking of large contracts covering several years transactions.
- New e-procurement/order capture capabilities to allow transaction processing with NHS and other key customers.
- New integrated systems incorporating bespoke elements for systems integration and web access.

2 Evolution of the KTP project

2.1 Research Questions

From a research perspective, the key challenge was to determine if a technical strategy based on preserving old legacy systems and using a range of technologies could provide the e-business capabilities the company required to trade electronically with public authority client base. In essence, it was about finding an answer to what Laudon and Guercio Traver (2010) call the 'e-commerce site-building puzzle' (Fig. 1). This requires a systematic consideration of a number of key questions:

1. Could a data warehouse be constructed to extract, aggregate and summarise key performance data from the old Sybiz legacy financial systems?
2. Could an information portal be built that could sit 'on top' of the in-house legacy systems to allow electronic order capture and invoice posting?
3. Could bespoke 'middleware' be used to link these new technology elements together to function alongside the old legacy systems platform?
4. Could business processes be changed to support and exploit the business opportunities afforded by the technology innovation?

2.2 The Technology Challenge

From a technology perspective, the challenge was to understand the company's business processes and IT infrastructure, upgrade IT infrastructure and associated technical strategy to provide a solid platform (middleware) to build new capabilities to reduce cost and exploit new business opportunities. The key new strategic element was the need to develop an electronic trading capability through a web portal linked to the middleware infrastructure which fills a technology gap between the company's old legacy accounting system and new modern technologies possessed by key customers. Key project phases are shown in Fig.2.

To understand TPG DisableAids business needs, it was deemed essential to understand company business processes. This was not a simple task because of a complex and tight relationship between business processes and the company's bespoke

accounting software package (Sybiz Vision). Often software packages are customised or adapted to fulfil the needs and requirements of an organisation, but here company growth has been a very gradual transition that has occurred around their
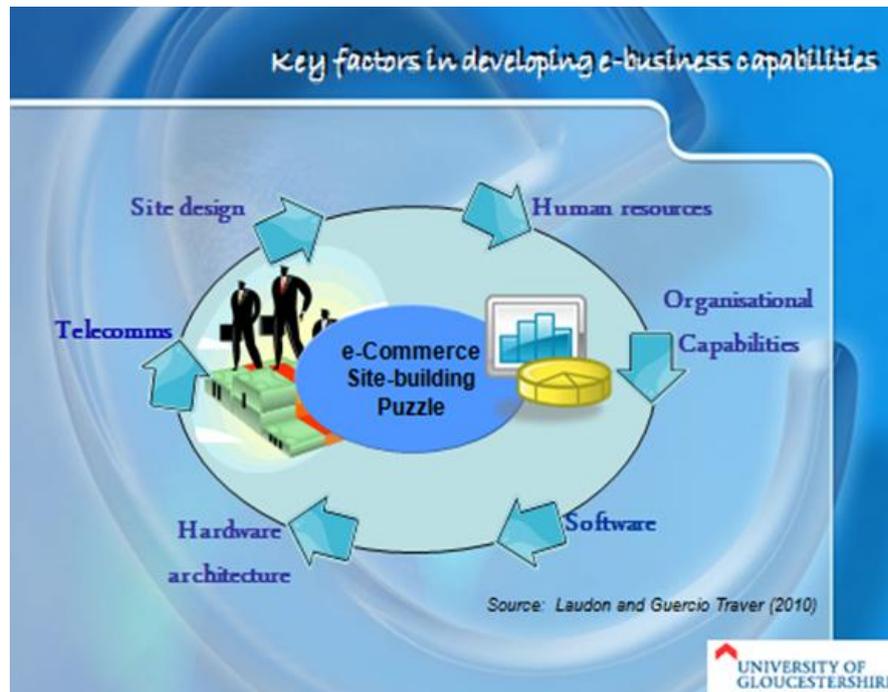

Fig. 1. The e-Commerce site-building puzzle
Source: Laudon and Guercio Traver (2010)

accounting system. This made the task of studying and understanding business processes problematic. It was essential to ascertain possible capabilities and the current restrictions associated with adherence to the limited functionality of the existing accounting system.

2.3 IT infrastructure strategic upgrade

There was a significant technology mismatch between the company's legacy accounting system and the new capabilities developed in modern technologies, so it was essential to upgrade the existing IT infrastructure to provide a solid foundation for those modern technologies. Information security was another concern for future development. Implementing information security controls on existing systems provided a secure environment for future development. A consistent IT strategy was also required to keep all technologies working and upgraded in line with business needs and requirements. TPG DisableAids decided to use open source/freeware

support for in-house development which provides a secure, reliable and a flexible platform to develop in house systems capabilities. Implementing freeware technologies in a live business environment required significant research and knowledge transfer. MySQL Community Server and PostFix Email Server are two examples of secure and reliable open source technologies deployed in the project.

		2008 DEC	2009 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	2010 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
A	Business Process Mapping	█	█	█																						
B	IT Infrastructure Strategy Upgrade			█	█																					
C	IT Infrastructure Upgrade					█	█																			
D	e-Business Requirements							█	█																	
E	Design Middleware Architecture									█	█															
F	Develop Middleware											█	█													
G	Develop Contract Management Portal													█	█	█										
H	Develop e-Business Capabilities																█	█	█	█	█	█	█			
I	Embed new Capabilities and Information Culture																							█	█	
J	Overall Programme Review																									█

Fig.2. The project plan

2.4 Middleware design and development

This phase of the project had the most technological challenges. From design to development and implementation, at every stage, there were unexpected challenges due to the technical and functional shortcomings of the legacy accounting package and its limited integration capabilities.

There were two main phases of middleware development:

1. Development and synchronisation of a middleware database
2. Data synchronisation of the data mart containing contracts information

Converting the information from old file structures in the legacy accounting system to a modern RDBMS (Relational Database Management System) was the biggest challenge. Technology-wise there were only limited options available to convert the flat data files (DBF format) that existed in the legacy accounting system (Sybiz Vision). This challenge was accomplished by using further open source products to

convert DBF files into modern SQL based information. Assuring quality and consistency of the data was another challenge. The overall performance of the above mentioned operations in terms of time was another challenge. Handling these challenges simultaneously amplified the overall difficulty of the task. Integration and well designed architecture were key to accomplishing this complex and critical phase of the project.

A further phase of middleware development centred on extracting data from the middleware database and transforming it into modern database objects which are the basic foundation for any modern software design pattern.
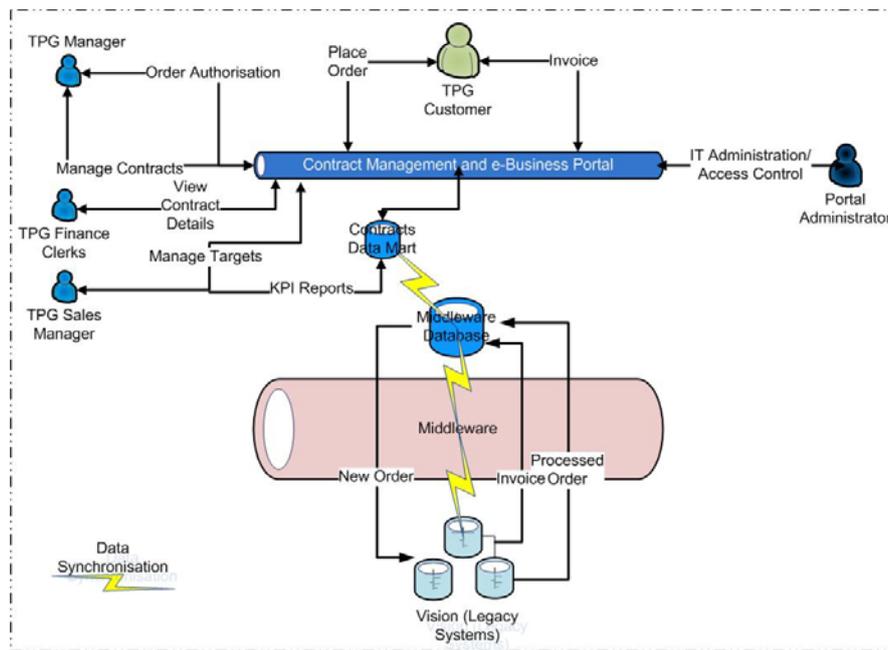

Fig. 3. TPG DisableAids systems architecture

2.5 Portal architecture

This was the critical deliverable from the project from a business perspective and was dependent on the stability and reliability of the middleware synchronisation of the database, data mart and legacy systems (Fig.3). The portal architecture is based on the modern technology (MVC J2EE) design pattern whereas the design of the middleware database is necessarily based on the old legacy accounting systems file structures. To plug the gap between these two technologies, a modern data mart was created. A one-way synchronisation technique was used to extract data from the middleware database and populate the data mart on a regular basis. The main task of this synchronisation is to clean and transform primitive data from the middleware database into the technologically modern data mart objects.

Extracting data from the legacy accounting system to a modern MVC based portal was a collective effort utilising different open source products, freeware utilities and intelligent architecture design/development with tight integration. This allowed the production of capabilities and functionality not possible in the old legacy system.

3 Project Benefits

3.1 Delivery of e-business trading capability

The company is now in a position to trade electronically with key customers including NHS Shared Business Services and local authority organisations responsible for the provision of disabled facilities grants and associated products and services. This may include trading via third party data transfer intermediaries or other similar agencies. Improved efficiencies can be seen throughout the order and sales processing procedures utilising web portal technology, whereby order information is accepted over the web and returned to the customer as an invoice, thus minimising the opportunity for human or machine error. The company's environmental impact has also been improved by removing the need to print paper documents and post to customers.

The introduction and transfer of explicit supply chain management thinking and knowledge has been a significant corporate development that will produce many ancillary benefits. The programme will eventually deliver technological, managerial, philosophical and financial benefits across the company's supply chain and business-to-business relationships. The blurring of inter-organisational boundaries through supply chain management techniques, controls and information flows will enable the companies in the supply chain to compete with the increasing number of large multi-nationals entering the consumer disabled-equipment sector. Demonstrating the practical benefits of electronically enabled supply chain automation technology and in-house knowledge facilitates the future evolution of organisational and business unit specialisation required for planned growth.

3.2 Research findings and Change Indicators

The impact of the overall project can be assessed from a number of perspectives:

Technology application: The key research questions focussed on the possible application of middleware and data warehouse concepts to allow e-trading through a bespoke portal. The project manifestly demonstrated that this was achievable.

Organisational development: Certain company policies and procedures had to be modified, clarified or replaced to adequately support the new company. Business process flow charts were revisited to re-emphasise the role of the process owners, their responsibilities and new activities associated with each process.

Resource commitment: To implement the recommended solutions the company has utilised a number of obsolete servers, thereby extending the value of prior capital investment and reducing budgetary costs for implementation.

Skills Enhancement: The training of in-house workers to use the portal enhances very basic IT skills necessary for clerical work. For many involved, the use of the portal eases the use of ordering portals that are being developed by up-stream supply chain suppliers and manufacturers. Furthermore, the production of accurate financial figures allows staff to reason confidently and develop confidence in software systems. The legacy systems are widely acknowledged, within the company, to have poor data accuracy and misleading reports.

Process change: Creating enthusiasm among staff for new ways of working and the use of modern technology facilitates their expectations and adaptation to future wholesale replacement of legacy systems with modern software and best practice workflow systems. Of major benefit is the plugging of the gap historically surrounding the management of contracts. To date, managerial thinking and outlook and day-to-day management of contracts has been hit and miss, with, in particular, *a priori* adherence to Service Level Agreements with KPI reporting for the customer and in-house managers absent or hard to produce. The philosophical change from fire-fighting contract management to properly managed, KPI/dashboard based operations is the first fundamental shift in decision support and monitoring of operations within the company. Such changes are necessary to ease the cultural shift away from 'finger on the pulse' *ad hoc* decision making pertinent in the small company to the normal repertoire of techniques and tools of the medium sized SME. Finally, as a tool that is utilised by major stakeholders in each department, the portal and associated processes force into sharp focus the team effort viewpoint. In particular, effort in one department produces benefits for another, which forces employees and departmental managers to take a holistic view of effort and benefit.

3.3 Impact on TPG DisableAids' business performance

The actual impacts of the project have been in many areas. In addition to the impacts on company culture discussed above, the project has provided KPIs for contracts to date, reduction in errors in pricing for larger customers and errors during invoicing, and finally, and most importantly, in the day-to-day management of existing contracts and the creation of new contracts pricing structures.

Throughout the project, a number of additional changes have been necessary, which have resulted in (a) more reliable email systems, (b) more accurate and extended documentation and contact searching facilities, (c) increased information security, (d) development of middle-ware to allow future work on data-cleansing, (e) improvements in IT worker conditions, and (f) an increased awareness of the benefits of IT and information reporting. All these changes have directly or indirectly improved business performance across the whole company.

4   Concluding Remarks

The KTP scheme is central to UK government policy for re-invigorating and supporting British industry, not least in this period of economic downturn. It provides direct support of circa £25 million per annum for graduates – normally with several years' business experience - to undertake specific knowledge transfer projects in firms of all sizes, but particularly in SMEs of less than 250 staff (Wynn, 2009). This KTP project brought TPG DisableAids significant technology based business benefit and competitive advantage. As Urwin (2000) has remarked, 'rapidity of response and ability to move quickly is an important advantage which small companies have over their bigger rivals, and the internet enables them to use it to the full'. In addition it has allowed the company to maximise the value of its investment in old legacy systems and to choose the appropriate time in its business cycle to replace them. This case study has illustrated how the scheme can be used to usher in new technologies in an evolutionary manner to support an SME achieve its key business objectives without significant cross-company upheaval.

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