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EVALUATING APPLICATION INTEGRATION: AN EXPLORATORY CASE STUDY

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Abstract

Application Integration is a category of integration software resulting in the development of flexible, and maintainable information systems. It is achieved through the incorporation of functionality from a diversity of systems, such as legacy systems and Enterprise Resource Planning. Application integration is a new research area and therefore, scientific research and literature around it is limited. In attempting to enrich AI literature and to support theory building, the authors of this paper present the case study of a multinational group that is adopting an integrated infrastructure based on AI. The organisation been studied, adopted an application integration solution to overcome existing organisational and operating problems. The study presented in this paper, shows that the organisation has changed its business strategy and structure in order to achieve integration. In doing so, it faced resistance from partners and its subsidiaries. In addition, the organisation has to overcome employees' resistance to change and invested a lot of money to educate them and to change their culture. Moreover, the IT infrastructure was restructured to piece together organisation's applications and systems were redesigned or phased out in order to meet integration requirements.

Keywords: Application integration, case study research

Introduction

Application integration remains a problem for organisations, as they consist of diverse systems and lack enterprise architecture. In the past organisations rarely integrated their systems, as there was often a technological gap around integrating incompatible platforms and heterogeneous systems (Puschmann and Alt 2001; Ring and Ward-Dutton 1999; Themistocleous et al. 2001).

In the last few years a new generation of software called Application Integration (AI) is supporting the development of flexible and manageable IT infrastructure by incorporating functionality from disparate applications (Edwards and Newing 2000; Linthicum 1999; Morgenthal and La Forge 2000). Application Integration is defined by (Linthicum 1999) as

> 'unrestricted sharing of information between two or more enterprise applications. A set of technologies that allow the movement and exchange of information between different applications and business processes within and between organisations'

> Linthicum (1999, p.354)

Despite the apparent importance of application integration for organizations, the area remains somewhat under-researched in the literature as AI is in its infancy (Themistocleous et al. 2000; Zahavi 1999). Application integration addresses more effectively the need to integrate both intra and inter-organisational systems by incorporating functionality from disparate applications (Markus 2000; Ruh *et al.* 2000). It combines traditional integration technologies (e.g. database-oriented middleware, interface-based technologies, distributed object technologies etc) with new application integration technologies (e.g. adapters, message brokers) to support the efficient incorporation of information systems. In considering this, application integration results in supporting data, objects/components and processes incorporation. Application integration can efficiently incorporate custom applications, packaged systems and e-business solutions into a flexible a manageable infrastructure (Themistocleous *et al.* 2000).

Sufficient knowledge of AI is important for many reasons, with organizations needing to justify their investments in IS before committing time and money to implementation (Irani and Love 2001). Managers also need to have a better understanding of the impact of application integration on organizational performance (Weill and Broadbent 1998). Such understanding can help an organization better utilize resources and improve its position vis-à-vis its competitors.

This paper approach application integration using a survey within a case study to approach, interpret and develop theory on application integration. The next section describes the research methodology adopted for this research and then, case data are presented and analysed. In addition, possible research topics around AI are highlight based on both research methodology and case data.

Research Methodology

A case study strategy is used for studying a phenomenon, for testing research questions/hypothesis and/or for theory building (Strauss and Corbin 1998). According to Yin (1994), three conditions can be used to separate research strategies such as experiment, survey, case study etc. One of these conditions describes the form of research questions. The research questions of a case study focuses more on *how* and *why.* As a result, the authors propose the following research questions:

> **Research Question 1**. *Why do organisations adopt application integration solutions?*

> **Research Question 2**. *How has application integration impacted the organisation and employees?*

> **Research Question 3**. *What are the costs related to the adoption application integration?*

The case study presented in the next section, is a single exploratory case. The authors conducted this study using interview techniques as the main instrument for data collection. A number of employees of the organisation were interviewed. Interviewees included the members of the technical team responsible for the development of the AI solution (e.g. project manager, internal consultants, developers) and other staff members. The authors of this paper predefined a set of questions that were asked during interviews. In case of variation in answers, researchers arranged a group discussion with interviewees to triangulate the answers and reduce bias.

Case Data

The enterprise been studied is an international organisation operating in the chemical sector in more than 135 countries around the globe, and with more than 100,000 employees. The name of the organisation can not be reported, and therefore the authors of this paper use the term 'XYZ group' to refer to this organisation. The XYZ group is organised into five core businesses including oil, chemicals, gas and power, exploration and production and renewables. A Chief Executive Officer (CEO) heads each core business with broad overall responsibility. The CEOs report to a committee of managing directors made up of the executive directors serving on the boards of the parent companies.

Justification of Application Integration Adoption

Each of XYZ subsidiaries complies with the same set of business principles but operates independently. The service companies provide a range of specialist advice and resources, and the principles ensure that all companies perform to the same high level in the economic, environmental and social domains. Each company has its own Information Technology (IT) infrastructure, which in many cases includes complex, heterogeneous and incompatible systems and clearly presenting an integration challenge. The diversity of Information Systems (IS) causes delays in giving information as applications are not integrated, and a lot of work has to be done manually. For instance, data from one system has to be printed out and then re-entered in a different format to a target system. The reason for this is that the target system has its own data structure and it is based on a different operating system. Other technical problems include:
- Incompatible ERP systems. The organisation has 90 different ERP systems provided mainly by 2 ERP vendors. However, there are many problems in retrieving data from one system that is running for instance on a mainframe and processing them in another ERP system running on different platform or having a different version.
- Difficulties in getting data from legacy as the XYZ group is consisted of 1500 different legacy systems with heterogeneous and incompatible data format.
- Restrictions of existing and ERP systems as they are not able to manipulate all types of data,
- Difficulties in combining middleware to achieve integration as it requires high technical skills and it can not address all integration problems.

In addition, the amount of subsidiaries and/or the diversity of systems involved in serving clients have resulted in no single face to customers. For instance, various types of customers' data are required to support systems with the same functionality. As a result, customers should provide each subsidiary with different types data to fulfil similar processes. Only a few systems require the same data to perform the same functions around the group. In addition, the delays in giving information and no single face to customers have also resulted in low customer satisfaction. The XYZ group has realised that the non-integrated nature of systems costs the organisation more, as the group has to spend a lot of money to support and maintain all these systems. Moreover, the inability of XYZ group to efficiently serve customers has an extra cost as it leads to lose of sales and thus, customers turn to competitors.

The Application Integration Solution

To overcome these problems, the managing board initiated the idea for adopting an application integration solution. After evaluating AI tools the XYZ group decided to develop integrated information systems architecture that supports both intra and inter-organisational business processes. Such architecture will allow XYZ group to do business easier as it will integrate enterprise information and provide better services to customers. These types of benefits are achieved in other application integration case studies such as the case of Tesco supermarkets, British Airways etc (Edwards 2000). In addition, the internal processes will become external through the integration of systems and thus, supporting ebusiness solutions. Likewise, time consuming and manual tasks will be eliminated as the manipulation, reporting and analysis of information will be automatically provided by the integrated systems. As a result, managers will be able to better analyse and monitor all the processes.

Finally the managing board took the decision to adopt an integration project aiming at achieving customer satisfaction and incorporating ebusiness solutions with existing IT infrastructures. XYZ group used Tibco middleware, MQSI from IBM and application integration software (Crossworld) to develop enterprise architecture. As illustrated in figure 1, the architecture is based on an integration hub/bus that pieces together e-procurement (eProc), Customer Relationship Management (CRM), Supply Chain Management (SCM) and Data Warehouse (DW) applications with packaged solutions (SAP, JDE), custom applications (legacy systems) and databases (DB). Based on this architecture, all systems can efficiently exchange the information needed to support or fulfil a business process.

The integration hub receives data from one application and translates and formats it into a compatible format for the target solution. In addition, the integration hub synchronises and routes the data to the appropriate applications. The integration achieved is non-invasive and thus limited (or no) changes to existing applications code are needed. As a result, the integration solution is manageable, flexible and maintainable as the altering of one application does require changes to the code of other solutions that collaborate with it.
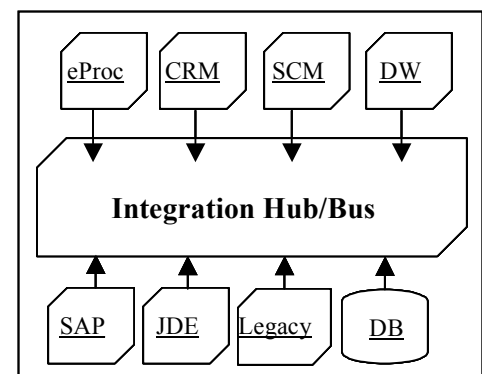

Figure 1. Integration Architecture

Impact of Application Integration

During the implementation phase, a number of problems have arisen regarding application integration. XYZ group has to consider and deal with political issues and the demands of their subsidiaries and take serious decisions. In the past there was a lot of diversity around ERP implementations as XYZ subsidiaries made a strong case for localisation. This individualism is a problem because operating units are now sceptical about integration fearing that they loose autonomy. Although integrated architecture will help both XYZ group and its companies, some of its subsidiaries prefer to have their own solutions and not to share data and processes. In other cases, there is a security scepticism, as subsidiaries hesitate to allow customers and partners to access their applications through ebusiness networks (internet, extranet).

Another problem is related to employees' and partners' resistance to change. Partners do not want to change their way of working and integrate their IT infrastructure. However, some partners will be forced to change, as the majority of their transactions are financially depended or related to XYZ group. Therefore, this category of partners is estimated to adopt application integration solutions too. Apart from external partners, XYZ group has to face its employees' resistance to change. A lot of employees fear that their tasks and duties will be reduced through the integrated systems and therefore, the XYZ group will gradually employ fewer people. Other employees fear that they will lose their power, as their job will be less important to the group. Furthermore, employees with old technical skills fear that will not be able to operate in an integrated environment as, they are short of skills.

At this point, the managing board believed that education would help employees understanding the reasons for adopting integrated solutions and reducing resistance to change. Training will also help employees adapting into the new system, as they will advance

their knowledge and learn how to handle and operate the system. However, the training and the transition to the integrated system will cost a lot of money to the group.

Taxonomy of Application Integration Costs

The total cost for application integration of XYZ group is estimated to more than 150 million UK pounds globally. This cost includes the following:

- The cost of software and hardware for the development of integrated architecture.
- The cost for maintaining the software (e.g. licenses)
- The adoption of an integrated infrastructure, is strongly related with XYZ group's business strategy. The organisation took the decision for integrating both internal and external applications to be more customer driven and to increase its competitive advantages. As a result, the XYZ group has an extra cost for adapting the organisation and its strategies into the new environment which have resulted in radical changes to organisation and business strategies.
- The cost for redesigning and changing the business processes in order to make them more customer driven.
- Development and consultancy costs. These costs are related to the implementation of integration hub as well as with the incorporation of the existing systems with it. Existing systems have been redesigned and changed to be customer driven. In cases that systems could not be changed to meet this requirement are phased out and new applications are developed to replace them.
- High costs relating to ERP implementations because some functionality will come redundant and thus, forcing organisation to run all systems
- The high costs for changing the way people currently work and include organisational changes and training. Part of this cost is related to staff development and allows employees advance their technical skills to operate the systems. In addition, other training costs are related to the adapting of staff in the system (system usage training).

According to Hochstrasser (1992) Irani et al (1997; 1998) costs can be divided into direct and indirect cost factors. Direct costs are financial tangible and are those that can be attributed to the implementation and operation of IT costs. Such costs may include initial hardware and software costs, maintenance costs (e.g. licenses, hardware and software maintenance), system development costs etc. Indirect costs are financially tangible/intangible and non-financial in nature and can be divided into indirect human costs and indirect organisational costs. Indirect human costs can include employee training, employee motivation, management effort and dedication where indirect organisation costs may include business process reengineering, losses in productivity, strains on organisation resources, organisational restructuring etc. Based on this analysis, table 1 illustrates a taxonomy of the costs of XYZ group for adopting an AI solution

Table 1. Taxonomy of Direct and Indirect Costs

Direct Costs	Indirect Human Costs	Indirect Organisational Costs
Hardware costs	Employees training	Business process re-engineering
Software costs	Changing employees culture	Organisational restructuring
Development costs	Management efforts	Covert resistance
Maintenance costs (hardware and software)		Strategy redesign
Consultancy costs		

Conclusions

The value from the use of IT technology comes when companies integrate their applications in a way that efficiently supports business processes. A non-integrated IT infrastructure adds more complexity to organisations and costs more (operational, maintenance, functional, management costs etc). Organisations are increasingly turning to application integration technology to establish an integrated infrastructure by incorporating functionality from disparate applications. Application integration helps organisations gain control on their inter and intra-organisational processes. In doing so, it incorporates various types of systems such as custom, packaged and e-business applications and leads to flexible and maintainable solutions.

To enrich application integration literature and to seek for answers to their research questions, the authors uses a case study to describe issues facing application integration.

XYZ group is an international organisation that uses up to by 90 ERP and 1500 legacy systems to support its business processes. However, the incompatible nature of these systems causes many organisational problems to the group. As a result, the XYZ group adopted application integration to piece together both inter and intra-organisational systems and processes. Based on the analysis of the study the following conclusions can be derived:

- Application integration leads to the incorporation of both inter and intra-organisational systems and processes. Based on application integration XYZ group seeks to develop an integrated IT infrastructure that could piece together functionality from existing custom, ERP and ebusiness systems.
- The cost for the implementation was over 150 million UK pounds and it covers both direct (software, hardware, development of AI solution) and indirect costs (redesign the business processes and strategy, changes to the way people currently work, training, etc). Costs related to the adoption of application integration solution are categorised in direct, indirect human and indirect organisational costs.
- As reported in the case study, XYZ has to overcome a number of problems caused by the introduction of the integrated architecture. These problems include:
  – Politic issues: part of the subsidiaries do not want to lose their autonomy
  – Security scepticism: some subsidiaries fear sharing data and applications over the internet or extranet.
  – Employees and partners resistance to change
  – Conflicts with consultants.

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