

Transforming Procurement in the UK Immigration Directorate

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ABSTRACT

This paper discusses the Procurement Transformation Project of the UK Government's Immigration and Nationality Directorate. The project was designed to change the current procurement processes and to enable the frontline business units to undertake these activities. Through the use of Sveiby's (2001a) Ten Knowledge Strategy Issues a knowledge management strategy was devised and knowledge of the business requirements for goods and services procurement was successfully developed within the stakeholder community. Tangible benefits such as salary savings and improved organisational design were realised. Additionally, intangible benefits of increased staff knowledge, process understanding, and knowledge sharing within the improved social network were also achieved. This paper demonstrates that a practical implementation of knowledge management activities in the supply chain, devolving decision-making to the front-line staff, can make significant procurement savings and improve relationships within the stakeholder community.

Keywords: Knowledge strategy; procurement; supply chain management; innovation; business process transformation.

1.0 INTRODUCTION

This paper describes how knowledge management was established as one of the key elements of success for the Procurement Transformation Project of the UK Government's Immigration and Nationality Directorate (IND).

The Procurement Transformation Project (PTP) was designed to support and empower frontline business units to undertake routine local transactional and operational procurement. The PTP focussed on increasing knowledge and value within the procurement community and its stakeholders, through using Sveiby's (2001) Ten Knowledge Strategy Issues to support the business requirements.

This paper discusses the link between knowledge, innovation and business processes. It looks at Sveiby's work related to Knowledge Strategy and the Knowledge Based approach to organisations; and considers the use of knowledge management in procurement and business processes in the Public Sector and Government, illustrating this with the case of the Procurement Transformation Project.

1.1 Research (and Methods)

This was not a research project per se and so no questions were formulated prior to undertaking the work.

This was commercial consultancy project whereby the academic was presented with archival data by the consultant for analysis. Informal conversations were also conducted to clarify issues, timelines, and understandings.

Whilst an element of grounded theory was utilised in that no preconceptions as to what the data might reveal were formulated and no propositions developed, a full grounded data analysis was not performed. Rather a top level content analysis was performed to in order to classify and theme the data. This permitted the academic to apply different theory to different parts of the data for academic understanding of the process and to ensure that the data was partitioned appropriately. This high level open coding produced some interesting outcomes whereby the consultant commented "I hadn't thought of the project being like that", and additionally permitted sufficient segmentation so that more than one interpretation of the data

could be taken and thus written up as academic papers (see Coakes and Young, 2006; Coakes and Young, 2007 forthcoming).

2.0 KNOWLEDGE, INNOVATION AND BUSINESS PROCESSES

In the section below we consider the link between innovation in business processes and knowledge. Whilst the IND is a public sector body, its role is to provide a service to other UK Government departments and thus, we would argue can be considered in the light of the literature that relates to the service sector.

Prajogo's (2006) article considered the link between innovation and business performance and discussed the existing literature assumptions relating to innovation in service firms. The literature suggests that such innovation is largely technological (Gallouj, 2002). Service firms it is argued are less radical than manufacturing and their emphasis is on continuity rather than newness (Voss et al, 1992). Innovation in such firms is mostly adopted and thus is concentrated on process rather than product (Gallouj, 2002) where such innovations are rapidly implemented but easily copied (Voss et al, 1992) - process innovation is thus a prime area of concern.

2.1 Process Innovation

In the case study discussed below relating to the IND, the major innovation was indeed related to a change in processes - in which a technological innovation was utilised to facilitate a process innovation. According to Popadiuk and Choo (2006) technological innovation relates to the 'knowledge of components, linkages between components, methods, processes and techniques that go into a product or service... (whereas) process innovation is concerned with introducing new elements into an organisation's operations such as input materials, task specifications, work and information flow mechanisms and equipment used to produce a product or render a service' (p303) (see also Afuah, 1998).

Stamm (2003) compares the major differences between incremental and radical innovation through 9 foci. These foci - time frame; development trajectory; idea generation; process; business case; players; development structure; resource requirements; and unit involvement, indicate who should be involved and how the project should be undertaken. In the case described below, the project falls very much into the incremental innovation category as indicated by Table 1.

Incremental innovation is appropriate for business processes in terms of continuous (quality) improvement, where radical organisational change is not required but rather improved support and greater efficiency (within the supply chain).

In addition, there are a number of models of innovation in the literature (for example Abernathy and Clark, 1985; Henderson and Clark, 1990; Tushman et al, 1997; Chandy and Tellis, 1998) which consider both technology and market perspectives in describing the type of innovation and its level of radicalism for the organisation. Technology is considered to impact on the market whereby new technology may produce new markets or market knowledge, or enhance penetration to the existing market and develop existing knowledge. The market of course can also be considered as the client and, in today's environment we can also consider that the market can be the supply-side value-chain. Technical innovation, whether it is radical, incremental, or indeed generational (Tushman et al, 1997), represents a change from existing firm practices and activities and thus requires project management and knowledge management of what is required, when, and

by whom. Innovation it is also argued (Popadiuk and Choo, 2006) depends on knowledge creation and in their paper they juxtapose a number of ideas relating to innovation and the types of knowledge creation that can produce them. In particular, they infer that sharing mental, emotional, and active knowledge can generate ideas to produce value for the organisation, suppliers and customers; and that knowledge based on the value chain produces innovation for both component and architectural elements of the firm. In addition, they pair procedural knowledge with market orientation and change in technology; and whole company knowledge with localised and functional area innovation.

The formal management of organisational knowledge in an organisation requires the organisation to formulate a knowledge strategy and to allocate resources to this end. Localised and functional area innovation, such as process innovation, can be guided through its development phases by answering Sveiby's Ten Strategy questions as discussed below.

2.2 Sveiby and Knowledge Strategy

In 2001(a), Sveiby identified ten issues or questions that should be asked to guide (knowledge) strategy formulation in the firm. These are:

1. How can we improve the transfer of competence between people in our organisation?
2. How can we transfer some of our competence to customers, suppliers and other stakeholders?
3. How can our people learn more from customers, suppliers and other stakeholders?
4. How can we support our customers' conversations with their customers, or host communities?
5. How can we use competence from customers and suppliers to add value to our systems, processes? Services, practices and products?
6. How can our customers and suppliers learn by accessing our systems, processes, services, practices and products?
7. How do we integrate systems, tools, processes and practices effectively internally?
8. How can we convert individually held competence to systems, tools and templates?
9. How can we improve individual's competence by using systems, tools and templates?
10. Strategic Purpose: how can the value of creation capacity of the whole system be maximised?

Sveiby emphasises three major aspects of the firm - customer relationships, internal structure, and employee competence. These elements make up what Sveiby calls 'knowledge capital'. The purpose of Knowledge Management for Sveiby (2001b) concerns how the organization best can nurture, leverage and motivate people to improve and share their Capacity to Act. Indeed, Sveiby says you should regard the organisation as consisting of knowledge, people, and the relationships between people. He proposes a knowledge-based approach to the organisation which recognises the fact that performance excellence does not exclusively mean financial performance. Under a knowledge-based approach the primary objective of actions is to enhance the value of all assets of the organisation by enhancing knowledge flows, generating intangible revenues, reducing intangible costs, and enabling knowledge creating processes (Sveiby 2001c).

If we consider Sveiby's three major aspects of the firm in the light of business processes, and in particular, the supply chain, we can see that process innovation needs to improve employee competence and knowledge, and that an organisational structure that empowers employees is likely to achieve this. It is also evident in the supply chain process that stakeholder relationships (both internal customer and external supplier) are of great importance and must be managed effectively and with understanding of their environments to formulate requirements. Formulating a strategy that develops competences and increases understanding is thus important in any organisation whether Public Sector or not.

3.0 KNOWLEDGE MANAGEMENT IN PROCUREMENT AND BUSINESS PROCESSES FOR GOVERNMENT ORGANISATIONS

Innovation in the public sector has not often been considered as being either radical or frequent. Additionally, it is often thought that innovation comes from the top

and is not initiated by the front-line staff (Borins, 2000). However Borins' study showed this was not the case and many innovators in the public sector had the same entrepreneurial characteristics as those in the private sector and were prepared to be creative, to take risks and break rules and (even) not to be bureaucratic.

In the public sector, Borins' (2000) study showed that the most frequent reason for innovation was internal problems such as procurement (as cited below for our case organisation), but additionally, political initiatives were also high on the reason list for change and innovation with ICT (Information Communication Technology) frequently provided these opportunities.

Procurement in Government organisations is traditionally an area that has been looked at many times for ways to cut costs and to streamline the business processes and workflow to increase efficiency (Hsieh et al, 2002). To support business requirements procurement there needs to be a time-scheduled sequence comprised of the materials and components (Bowersox et al, 2002). ICT has long been involved in ways of stream-lining and numerous systems have been designed to improve the workflow. However, as with so many ICT systems, there has been a steady failure rate. Hsieh et al (2002) attribute these failures to diverse internal cultures (within the business units involved in the process); technical issues relating to the technology and systems; and human-computer interface issues.

Procurement is an essential component of an organisation's supply chain. It connects internal business units with external suppliers and is typically complex with, according to Hsieh et al (ibid) upwards of 15 different processes involved. Associated with these processes are numerous documents and activities and a variety of decision points for action along the supply chain. Many ICT systems pass the procurement decisions to the suppliers and thus organisations are reliant on their suppliers' knowledge and understanding of the business situation rather than using an internal understanding of the situation. This has caused significant problems for some organisations when the suppliers make the wrong decisions (see Soletron Corp as discussed in Engardio, 2001).

Procurement is about connecting up the diverse elements of the supply chain across unit and organisational boundaries and cultures and human understandings of the situation. Thus utilising and sharing knowledge across the procurement process will assist in helping with issues such as determining the optimal mix of order size and suppliers; controlling the timing of ordering and order delivery; managing product quality; and improving the management of cash-flows.

Best practices in utilising knowledge management (to assist in procurement) have been put forward by the APQC¹ (as described in Wimmer, 2005). These include creating a team approach; focusing efforts on business objectives and measuring tangible outcomes; and using a blend of knowledge-sharing approaches that incorporates people, processes, organisation and technology - the classical socio-technical approach. Wimmer also points out that learning cultures are not prevalent in governmental organisations and knowledge management has to be introduced in such a way that it can be seen to provide an immediate benefit. Knowledge management that preserve the organisation's Intellectual Capital she says, will not only cover the initial investment but will also add additional future value. Indeed, knowledge management is so difficult to introduce into public sector organisations that Sinclair (2006) argues it needs to be done by stealth... Sinclair also argues that this could be a result of senior managers' attitudes towards organisational structure and control which emphasises centrality over knowledge flows.

The intention of including knowledge in a procurement supply chain must be to lift the chain management from the 'ad hoc' level (Lockamy & McCormack, 2004) through to a higher level such as (initially) 'linked' but essentially up to 'integrated' and finally 'extended'. An integrated chain is where vendors and suppliers cooperate in the process and collaborative forecasting is performed. The extended chain has supply chain competition, and collaboration is through multi-firm teams with common processes, goals and a broad authority.

Seeley (2002) argues that effective knowledge management comes from connecting knowledge activities to processes that create value. Merely capturing, stockpiling, and transferring knowledge does not automatically lead to organisational performance enhancement (Swan, 2003). Successful processes indeed are (frequently) knowledge enabled (Smith & McKeen, 2004); yet to date this is not well developed in organisations. Successful processes will also link informal tacit knowledge into these activities and will be built within an organisational context and culture that supports (Marchand et al, 2000). An understanding of the context may also improve the process outcomes and execution (El Sawy & Josefek, 2003) and may elucidate the issues surrounding problems and uncertainties in the process.

The case study we describe below shows how the building of knowledge in the Procurement Transformation Project attempted to answer Sveiby's ten questions and also set out to link in this tacit knowledge that was held in the Immigration Service so that it was built into the processes and thus answered Smith and McKeen's current criticisms.

4.0 THE PROCUREMENT TRANSFORMATION PROJECT

Background

This project was carried out between January 2005 and April 2006 for the UK Immigration and Nationality Directorate (IND) within the Home Office.

The Immigration and Nationality Directorate (IND) is part of the Home Office. (Home Office, 2006a). The Home Office is the government department responsible for ensuring that the citizens of the UK "live in a safe, just and tolerant society by putting public protection at the heart" (Home Office, 2006b) of all they do. They are responsible for the police in England and Wales, national security, the justice system and immigration. The strategic objectives of the IND are to:

- Strengthen borders, use tougher checks abroad so that only those with permission can travel to the UK, and ensure that they know who leaves so that they can take action against those who break the rules.
- Make fast track asylum decisions, remove those whose claims fail and integrate those who need protection.
- Ensure and enforce compliance with UK immigration laws, removing the most harmful people first and denying the privileges of Britain to those who arrive illegally.
- Boost Britain's economy by bringing the right skills from around the world, and ensuring that the UK is easy to visit legally. (IND, 2006a)

The IND's work is underpinned by Home Office Aim 6: to manage immigration in the interests of Britain's security, economic growth and social stability. This means that their work includes the following areas:

- Immigration
Considering applications from people who want to come to the UK to work, do business, visit relatives, take a holiday, or settle permanently.
- Nationality
Deciding applications from people who want to become British citizens.
- Asylum
Responsibility for processing all claims for asylum and asylum support made in the United Kingdom
- Border control and entry clearance
Last year, the UK Immigration Officers facilitated the arrival of more than 12 million passengers who were subject to immigration control. British Diplomatic overseas visas staff decide applications from people who need to get permission to enter the UK before they travel.
- Law enforcement
Enforcing and framing the immigration laws. It is their job to deter illegal workers and illegal entrants - Immigration Officers have legal powers to detain and remove them from the country.
- Appeals
They share targets with the Department for Constitutional Affairs, the department with responsibility for the Asylum and Immigration Tribunal (IND, 2006b).

4.1 The PTP

The primary objective of the Procurement Transformation Project was to empower and support the frontline business units to undertake routine local transactional and operational procurement. The core PTP objective emanated from IND strategic business drivers which were to deliver the recommendations of the Government White Papers by Gershon (2004) and Lyons (2004) which related to the utilisation of assets, through releasing resources for the frontline units within the Home Office, and lowering the cost of resources needed to provide public services.

In particular the project set out to:

- Assist the organizational objectives by designing effective corporate governance to enable local procurement;
- Develop suitably trained staff;
- Increase the capacity of the central procurement unit to undertake and sustain

local and operational buying at the frontline and high value strategic procurement at the centre;

- Enhance IND commercial activity by creating a procurement community of practice through knowledge sharing, utilizing the Procurement User Group (PUG) meeting format, commercial development workshops and a web based portal.

The Approach

The project was undertaken in a controlled environment based on a formal project management methodology (Prince II™). A Project Board was appointed to review progress at critical stages and reference to peer sounding boards was used throughout the project as and when needed.

Commencing with formal approval, the project completed a critical analysis of procurement activity and existing procurement skills through a gap analysis of skills, competences, information and technology. A formal Benefit Management tracking process was prepared at the commencement of the project and updated throughout the project. The analysis stage informed the proposed future structure of procurement within the hubs and the potential benefits arising. A review at the conclusion of this stage was undertaken to ensure buy-in of relevant key stakeholders, to consider the benefits and to confirm the continuance of the project.

A knowledge management strategy was developed from the "10 Knowledge Strategy Issues" and the "Knowledge based theory of the Firm" created by Karl-Erik Sveiby (2001).

The KM strategy for the project focused on increasing the knowledge and value within the procurement community and relevant stakeholders, and subsequently the 10 Sveiby strategies were developed to support the business requirements to effectively and efficiently procure goods and services.

As a result of the project analysis, minimal procurement competences and knowledge were identified in "frontline" business units and was identified that a recently implemented ERP system was not delivering its planned efficiencies. The ERP system was a powerful tool but the users were not fully aware of how it could be used and were unaware of its role in the supply chain and the totality of the system. As a result the first phase of the KM implementation focused on 5 of the Sveiby strategies and "individual competence" by:

- Improving the transfer of competence between people in the organization;
- Transferring competences to customers, suppliers and other stakeholders;
- Learning more from customers, suppliers and other stakeholders;
- Converting individually held competence to systems, tools and templates; and
- Improving individual's competence by using systems, tools and templates.

The PTP realities were that, through the use of the Prince II™ formal project management method, Stamm's innovations were all achieved.

5.0 OUTCOME AND BENEFITS

The project delivered both tangible and intangible benefits as the business units were receptive and open towards learning and a consensual style of organisation - these benefits were:

Table 1. Incremental innovation categorisation (as per Stamm)

Focus	Stamm's description	The PTP realities
Time frame	Short-term - 6-24 months	✓
Development trajectory	Step by step. High levels of certainty.	✓
Idea generation	Incremental. Critical events anticipated.	✓
Process	Formal, staged.	✓
Business case	Business case produced initially	✓
Players	Cross-functional team. Clear roles.	✓
Development structure	Cross-functional team within existing business unit.	✓
Resources	Provided within team, standard process.	✓
Operating unit	Involved from beginning.	✓

Tangible

- Management reports for cross business procurement activity were derived from the ERP system;
- Procurement awareness workshops and material were developed and implemented;
- Procurement organizational design was undertaken;
- Buyer job specifications were developed and implemented;
- Salary savings were made as a result of the role scope changes;
- £700,000 plus savings were made through local training which enabled a wider usage of the GPC (Government Procurement Card i.e. a type of internal credit card), and the local decision-making and buying competences developed;
- A benefit tracking document was developed.

Intangible

- Local staff understanding of relationship between system activity and procurement practice was developed;
- An improved relationship with suppliers developed;
- Greater leverage in procurement negotiations occurred;
- An enlarged social network developed for informal sharing of procurement practices;
- There was knowledge sharing for system improvement;
- Enhanced system training was undertaken;
- Supply chain awareness was developed.

6.0 CONCLUSIONS

As John Ruskin said²:

It is unwise to pay too much, but it is worse to pay too little. When you pay too much, you lose a little money. When you pay too little, you sometimes lose everything.

Procurement is about providing the end users of the item procured with what they need, when they need it, and at the best value to the organisation. Procurement is a very complex task that is achieved through matching the multiple supplier offerings, through competition, with the multiple requirements of the purchasing organisation. Procurement has legal, ethical, specification, and supplier appraisal aspects. In all of these there are business processes that need to be undertaken and matched and integrated with each other. In each business process there will be found *sticky* knowledge (Coakes et al, 2004) which is related to tacit knowledge that will need to be considered and transferred. As argued above this sticky knowledge is often not transferred within the supply chain and procurement processes. As can be seen from the description of the work of the IND, their functions and connections within the UK Home Office are multiple and diverse. These multiple functions and activities can only complicate the procurement process. There is a requirement for a varied knowledge base and in-depth knowledge in a variety of fields of expertise.

In this paper therefore, we demonstrate through a case study of a UK project how knowledge within business processes and the supply chain for procurement can be identified, explicated, and made valuable through devolving decisions to those at the frontline of the decision-making process. Through utilising local knowledge, and developing competences and learning, with a change in organisational structure and management style, significant savings in procurement can be made.

REFERENCES

- Abernathy W., & Clark, K.B., (1985) Mapping the winds of creative destruction *Research Policy* 14 pp3-22
- Afuah, A., (1998) *Innovation management: Strategies, implementation, and profits* Oxford University Press: NY
- Borins S., (2000) What border? Public management innovation in the United States and Canada *Journal of Policy Analysis and Management* 19 (1) pp46-74
- Bowersox D.J., Closs D.J., & Cooper M.B., (2002) *Supply Chain Logistics Management* NY: McGraw-Hill
- Chandy R.K., & Tellis, G.J., (1998) Organizing for radical product innovation: The overlooked role of willingness to cannibalize *Journal of Marketing Research* 35 (4) pp474-487

- Coakes E., Bradburn A., & Sugden G., (2004) Managing and Leveraging Knowledge for Organisational Advantage *Knowledge Management Research and Practice* 2 2 pp118-128
- Coakes E and Young N (2006) Procurement Transformation in the Immigration Directorate: the Money Tree Project. *BIOPom 2006* June Westminster
- Coakes E and Young N (2007) "Transformation Procurement in the Immigration Directorate: applying Sveiby" Knowledge Management Challenges and Issues Special Edition *Journal of Knowledge Management Practice*; due Nov
- El Sawy O., & Josefek R. Jr., (2003) Business Process as Nexus of Knowledge *Handbook on Knowledge Management* Vol 1 Berlin: Springer-Verlag pp425-38
- Engardio P., (2001) Why the Supply Chain Broke Down *Business Week* p.41 03/19/2001
- Gallouj F., (2002) Innovation in services and the attendant old and new myths, *Journal of Socio-Economics* 31 (2) pp137-154
- Gershon Review, (2004), Releasing Resources for the Frontline: Independent Review of Public Sector Efficiency UK: *HM Treasury* July
- Henderson R.M., & Clark, K.B., (1990) Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms, *Administrative Science Quarterly* 35 (1) pp9-22
- Home Office, (2006a) <http://www.ind.homeoffice.gov.uk/aboutus/> accessed Sep 2006
- Home Office, (2006b) (<http://www.homeoffice.gov.uk/about-us/> accessed Sep 2006
- Hsieh C-T., Yang H., & Lin B., (2002) Roles of knowledge management in online procurement systems *Industrial Management and Data Systems* 102 (7) pp365-70
- IND, (2006a) (<http://www.ind.homeoffice.gov.uk/aboutus/objectivesandvalues/> accessed Sep 2006
- IND, (2006b) (<http://www.ind.homeoffice.gov.uk/aboutus/whatinddoes> accessed Sep 2006
- Lockamy A., McCormack K., (2004) The Development of a Supply Chain Management Process Maturity Model Using the Concepts of Business Process Orientation *Supply Chain Management* 9 (4) pp272-278
- Lyons Review, (2004), Independent Review of public sector relocation UK: *HM Treasury* July
- Marchand D.W., Kettinger W., & Rollins J., (2000) Information Orientation: People, Technology and the Bottom Line *Sloan Management Review* 41 (4) Summer pp69-80
- Popadiuk S., & Choo C.W., (2006) Innovation and knowledge creation: How are these concepts related? *International Journal of Information Management* 26 (4) Aug pp302-312
- Prajogo D. I., (2006) The Relationship between Innovation and Business Performance - A Comparative Study between Manufacturing and Service Firms, *Knowledge and Process Management* 13 (3) pp218-225
- Seeley C., (2002) Igniting knowledge in your Business Processes *K M Review* 5 (4) Sep/Oct pp12-15
- Sinclair N., (2006) *Stealth KM: Winning knowledge management strategies for the Public Sector* Butterworth Heinemann: Oxford
- Smith H.A., & McKeen J.D., (2004) Developments in Practice XII: Knowledge Enabling Business Processes *CAIS* 13 pp25-38
- Stamm B von., (2003) *Managing innovation, design and creativity* Wiley: London
- Swan J., (2003) Knowledge management in Action? *Handbook on Knowledge Management* Vol 1 Berlin: Springer-Verlag pp271-96
- Sveiby K-E (2001a) A Knowledge Based Theory of the Firm to Guide Strategy Formulation *Journal of Intellectual Capital* 2 (4) retrieved from www.sveiby.com 21 May 2006
- Sveiby (2001b) Knowledge Management – Lessons from the Pioneers <http://www.sveiby.com/Portals/0/articles/KM-lessons.doc> accessed September 2006
- Sveiby (2001c) A Knowledge-based Approach to Performance Excellence <http://www.sveiby.com/Portals/0/articles/kbasedaldrige.htm> accessed Sep 2006
- Tushman M.L., Anderson P.C., & O'Reilly C., (1997) Technological cycles, innovation streams, and ambidextrous organisations: organisational renewal through innovation streams and strategic change. In M.L., Tushman & P. Anderson (eds) *Managing strategic innovation and change: A collection of readings* Oxford University Press: NY

- Voss C., Jonston R., Silvestro R., Fitzgerald L., Brignall T., (1992), Measurement of innovation and design performance in services, *Design Management Journal* 3 (1) pp40-46
- Wimmer S.J., (2005) For Illinois Agency, Knowledge is Power - and Promise *Government Procurement* 13 (4) pp6-10 Aug

ENDNOTES

- ¹ APQC is the American Productivity & Quality Center
- ² 1888 is the approx year

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