Western Decision Sciences Institute
Annual Meeting
5-9 Apr, 2016 Las Vegas, NV

Information System Innovation in the Legacy Systems Era[1,2]

Dean Kazi, Department of Operational Sciences, Air Force Institute of Technology, 2950 Hobson Way, Wright-Patterson AFB, OH 45433, 937-255-4486, dipta.kazi.1@us.af.mil
Alan W. Johnson[3], Department of Operational Sciences, Air Force Institute of Technology, 2950 Hobson Way, Wright-Patterson AFB, OH 45433, 937-255-3636, alan.johnson@afit.edu
Matthew A. Douglas, Department of Operational Sciences, Air Force Institute of Technology, 2950 Hobson Way, Wright-Patterson AFB,OH 45433, 937-255-3636, matthew.douglas@afit.edu

ABSTRACT

We evaluate the United States Air Force's (USAF) management of its information system (IS) network with a case study of a supply chain stakeholder. The USAF uses a decentralized approach to develop and manage its IS network and empowers each stakeholders to innovate IS solutions for its local mission. Our case study findings reveal several negative organizational impacts to the USAF's decentralized IS innovation approach; including misaligned organizational and IS strategies, mismatched business and IS processes, poor data quality and unnecessary user complexity. We offer a framework for stakeholders to manage innovation in a way that better addresses local requirements and enterprise-level goals and objectives.

INTRODUCTION

Innovation must be pursued and fielded with an overall objective in mind, align with a strategy, and consider all stakeholders involved. The pursuit of innovation should be balanced with stability and continuity for the organization[1]. In this paper, we address the innovation balance issue using Information System (IS) management as exemplar. We begin this paper with a brief background of the problem. Next, we discuss our case study of a locally developed supply chain IS. Finally, we offer suggestions by which IS managers can plan, design, and implement IS innovations in a way that improves efficiency and effectiveness for all stakeholders.

The USAF employs a decentralized approach to managing its information systems. Decentralized IS management leads stakeholders to create solutions which benefit local missions at the expense of other organizations. This sort of "pocket innovation" separately addresses the needs of each stakeholder and can neglect other supply chain partners. The lack of enterprise-wide IS solutions and poor innovation management has resulted in an expensive, inefficient and ineffective IS network.

In response, the USAF spent over $1 billion between 2004 and 2012 on an Enterprise Resource Planning tool called the Expeditionary Combat Support System (ECSS), before the project was

[1] This research is sponsored by the Air Force Materiel Command's Directorate of Logistics, Depot Operations Division, Wright-Patterson AFB, Ohio.

[2] The views expressed are those of the authors, and do not reflect the official policy or positions of the United States Air Force, Department of Defense, or the U.S. Government.

[3] Corresponding Author.

ultimately cancelled for nonperformance. ECSS was intended to reduce IS complexity in the Air Force supply chain by consolidating over 400 legacy systems used today.[2] The Secondary Item Requirements System D200A and D035A are two examples of IS which have a complicated input and output relationship with over 40 other IS.[3] The ECSS failure may spur further decentralized logistics IS activities, and motivates our research into finding better ways to achieve enterprise goals using decentralized IS management methods.

METHODOLOGY

We conducted a case study of a USAF supply chain stakeholder to evaluate the effectiveness of a locally developed IS innovation designed to improve the depot source of repair (DSOR) decision process and workflow. This organization is responsible for oversight and management of the USAF's $13 billion depot maintenance program. Our case study was conducted over a one-year period. Multiple forms of data were collected, involving documents, interviews, and participant observations. We reviewed a total of 31 documents, to include official Air Force instructions, guidance, and policies. We reviewed a total of 13 archival records and conducted 17 interviews of case study organization members and external stakeholders. We also conducted direct observation of the case study organization for 5-10 hours per week from January 2014 to January 2015. Lastly, we examined seven different supply chain IS in order to assess how the case study organization's locally developed IS interacted with other enterprise and external stakeholder supply chain IS. The case study data were coded and categorized into three topics using a qualitative analytical technique called pattern matching.[4] The three topics--strategic planning, IS design, and diffusion innovation management--follow a framework supported by the available literature.

CASE STUDY EVALUATION

The case study organization had created a DSOR IS which helps it execute its mission. We measured the case study IS effectiveness by evaluating its intended functions. The DSOR IS was designed to enable the organization's mission through the following main functions:

1. Use MS SharePoint to execute standardized workflow process within the supply chain.
2. Allow for joint expansion into other DoD agencies.
3. Generate ad hoc reports to support execution & management of workflow processes.
4. Produce financial reports to help ensure compliance with Title 10 laws.
5. Provide audit trail/documents of decisions for the system's life.

Finding 1: Incomplete Workflow Process. The case study organization has five main tasks. These tasks include validating a depot source of repair request submitted by the programming office, providing support to a depot standup working group, providing oversight of depot repair budgets, providing concurrence of to other services' provisioning process, and generating mandatory Congressional Title 10 financial reports. There are a total of 34 action or information exchange links in these five main tasks. Only nine, or 26%, of the exchanges are captured in the organization's information system. The other tasks and information exchanges are executed or managed outside of its workflow management tool. This finding is in conflict with existing IS design theories. The DSOR IS contributes to user complexity for internal and external

stakeholders based on its workflow process tool analysis.

Finding 2: Organizational & IS Strategies Misaligned. The case study organization has made it a priority to expand its IS for use by its counterpart organizations in the Army, Navy, and Marines. However, the case study analysis identified that the IS is deficient and fails to meet the requirements of the current organization. The case study organization is not currently positioned to reasonably incorporate the workflow processes and existing databases of the other military services. The other services are unlikely to be motivated to adopt the IS if it does not benefit them.[5] Focusing time and effort to make the case study IS a joint system does not coincide with its organizational capabilities or priorities. All effort and resources allocated to the IS project must be focused on addressing the workflow process integration, data quality and interoperability issues.

Finding 3: Business Process Re-engineering Required. The management report function in the case study IS is unreliable due to poor business processes. The case study organization should have identified the requirements and feasibility of any business process re-engineering and requirements in the IS design stage. The organization's business process is depicted in figure 1. The figure shows the action taken by a stakeholder and the IS used to execute the action. The IS used by each stakeholder is shaded gray. Note that an independent IS is a local IS created for the use of that stakeholder.

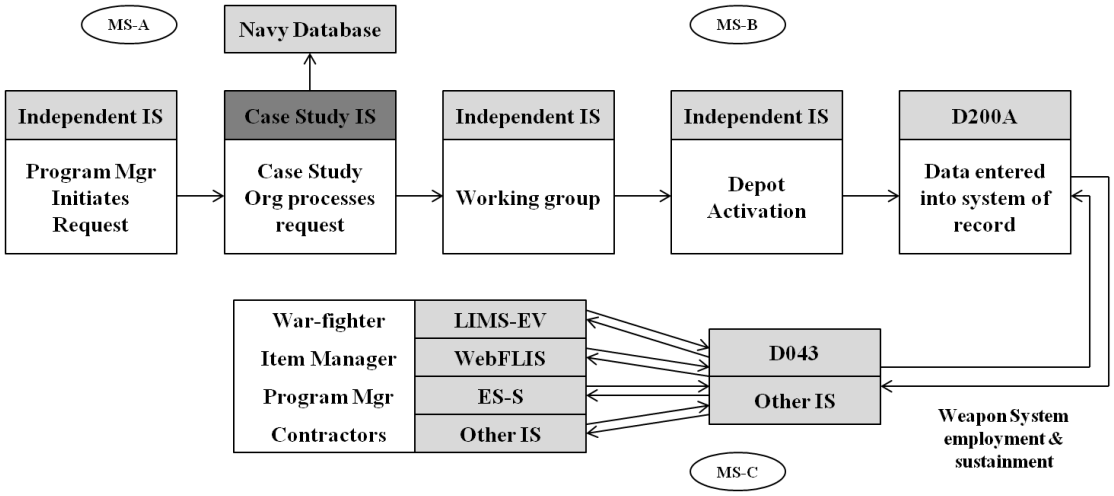

Figure 1. Case study organization business process.

There are two major issues with this particular business process. The first issue is that once the data is entered into the Air Force IS of record (D200A), it does not exchange information with the case study IS (as depicted in Figure 1). The case study IS requires manual updates whenever there are changes in the repair capabilities of parts after they are in the sustainment stage. The lack of data exchange and interoperability may be contributing to the system's poor data quality. Data quality will be explored further in finding 5. The second issue is the unit of measure used to record data. When a request is processed by the case study organization, the pertinent data is stored using the system or subsystem as the unit of analysis. Later on in the business process, the systems and subsystems are decomposed into constituent parts by National Stock Number. This discrepancy presents a significant challenge to maintaining data accuracy, as the case study organization's database does not match the other supply chain stakeholders' databases.

Finding 4: Unreliable Financial Data Reporting. Another measure of data quality is the financial information entered by the case study IS in the initial request from the program office. We learned that initial projections submitted by program managers were seldom accurate in comparison to the actual expenditures. The program office's projected first year expenditures were found to be accurate about 1% of the time between fiscal year 1998 through 2012. This discrepancy is significant and shows the poor reliability of the case study IS financial data. The projected financial data cannot be used for reporting purposes or to make managerial decisions.

The case study organization does not use their local IS to manage financial information and generate its annual report. To generate this report, managers instead gather financial data from 9 other supply chain stakeholders and store this information in an independent database. The discrepancy between the case study organization's business process and their IS design is a contributing factor to the case study IS ineffectiveness.

Finding 5: Poor Data Quality. The poor data quality of the case study IS database fosters an unreliable audit trail for source of repair decisions. As a result, users must search other databases such as LIMS-EV, WebFLIS and even commercial search engines to find source of repair information on parts. This finding is in conflict with existing IS design theories regarding data quality and meeting end-user requirements. Failure to meet end user requirements makes it difficult for the organization to effectively implement an IS.

In order to quantify the data quality of the case study IS database, we compared source of repair data for 43 randomly selected aircraft parts to six other supply chain IS, including ES-S, LIMS-EV, Navy Depository, D043A, WebFLIS and the system of record D200A. The source of repair locations listed in each of the six IS were captured and compared to each other. The case study IS database matched a reliable source (D200A) only 21% of the time. Another key finding is that a third of the parts could not be found in the case study IS. This can be attributed to the part simply not being recorded or that the case study IS does not record source of repair data by national stock number. The source of repair data comparison across six other IS shows the case study IS is both unreliable and incomplete.

In summary, we learned that the organization's IS performed sub-optimally in effectively delivering each of its five intended functions. It also struggled as a workflow process tool, by failing to incorporate the majority of the organization's business processes. In the next section, we provide suggestions for organizations who seek to improve their locally developed IS processes or are planning to develop an IS for their organization.

MANAGERIAL IMPLICATIONS

In the absence of an enterprise technical solution, organizations must rely on effective managerial approaches to innovate effectively. In this section, we provide suggestions on how IS managers can locally develop IS using a three-step strategic planning, IS design, and diffusion innovation management process. Our framework—shown in Figure 2—offers a managerial solution to IS innovation.

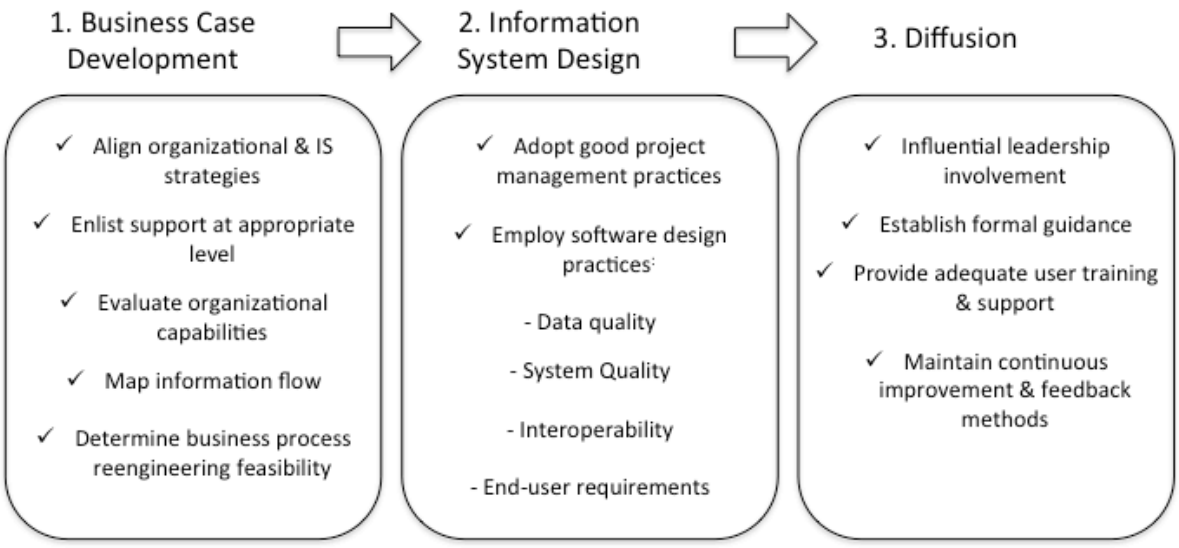

Figure 2: IS Development Framework

First, IS managers should focus on business case design and the strategic functions of IS development. This includes aligning organizational and IS strategies, enlisting support at the appropriate levels, evaluating organizational capabilities, mapping the organization's information flow and evaluating the possibilities of business process reengineering. Second, the IS manager should identify general functions, features and qualities which are desirable in IS design. This involves adopting good project management practices, ensuring data and system quality, interoperability, and satisfying end-user requirements. Finally, some best practices for IS implementation and diffusion includes obtaining influential leadership involvement, establishing formal guidance, providing adequate user training & support, and maintaining continuous improvement and feedback methods.

SUMMARY

A decentralized approach to IS innovation management brings benefits but, in some cases, also creates a complex, cumbersome supply chain IS network. Our IS development and diffusion framework and managerial implications highlight how stakeholders can best develop and diffuse IS innovations that effectively contribute to the enterprise-wide supply chain IS network. Our case study example provides insight into some of the specific issues that result from sub-optimal IS development and diffusion activities. These issues include misalignment of organizational and IS strategies, deficient business and IS processes, poor data quality, and added user/network complexity.

When innovators are considering development and diffusion of a new IS, we suggest stakeholders first evaluate their organizational strategy and capabilities, identify the requirements for an IS, and create a business case to fund IS innovation. Next, they should design an IS using solid project management and software design practices. Finally, IS innovators should employ effective IS diffusion methods to achieve user acceptance and realize the full benefits of their IS investment. These steps will allow the organization to locally develop an IS that not only meets its own mission objectives, but also facilitates mission accomplishment for all IS stakeholders.

REFERENCES

[1] Prince Jr., J. (2014). US Military Innovation: Fostering Creativity in a Culture of Compliance, *Air and Space Power Journal* (October 2014 issue), 132.

[2] Levin, C., and McCain, J. (2014). *The Air Force's Expeditionary Combat Support System (ECSS): A Cautionary Tale on the Need for Business Process Reengineering and Complying with Acquisition Best Practices*. Washington DC: Senate Subcommittee on Investigations, 1-5.

[3] Air Force Materiel Command (2014). D035A, D035B, RAMP and WHSL Module Data Subsystems. *Air Force Materiel Command Manual 23-5 Vol 1*. Wright-Patterson AFB: US Air Force.

[4] Yin, R. (2009). *Case Study Research Design and Methods, Vol 4,* 136-139. Thousand Oaks CA: SAGE Publications.

[5] Hazen, B. (2012). Toward Creating Competitive Advantage with Logistics Information Technology. *International Journal of Physical Distribution & Logistics Management Vol* 42 No. 1, 26.