2006

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The model of technology appropriation: A lens for understanding systems integration in a Defence context

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Abstract

This paper draws on the model of technology appropriation (MTA) in order to assist in understanding the integration of systems in a Defence context. The MTA describes the process of appropriation through which technology is adopted, adapted and integrated with work practices. As users appropriate a technology they are completing the design process. The contribution of this paper is the application of a model that provides a lens for understanding the process through which the design of a technology is completed by humans embedded in a particular organisational context, and which provides insights into how to improve design practices associated with systems integration.[1]

Keywords

Technology appropriation, Defence, systems integration, information systems, document management, design

INTRODUCTION

Considerable resources are invested in systems designed to improve the productivity of Defence organisations. However, some of these systems are underutilised, misused or avoided altogether and as a consequence they fail to generate the desired improvements in productivity. In order to increase the likelihood of achieving desired performance gains from investments in systems there is a need to better understand the various influences that constrain and enable effective incorporation and use of systems in specific organisational contexts. This understanding will be of increasing importance given the critical role envisaged for many of these systems, particularly information systems (IS), in facilitating the fundamental changes in organisational behaviour associated with such concepts as Network Centric Warfare (Alberts et al. 1999).

Network Centric Warfare (NCW) represents an attempt to position our military forces to effectively adapt to an environment that is dynamic, complex and uncertain (Persson and Fidock 2005). The thesis is that dramatic increases in mission effectiveness can be brought about via improved networking of military force elements, which improves information sharing, thereby enhancing information quality and shared situational awareness, collaboration, sustainability and speed of command and decision making (Network Centric Warfare report to Congress 2001). Information systems, and the information infrastructure and networks upon which they reside, are viewed as a critical component in support of this thesis since they influence the networks that can form, the flow of information, and the types of organisational structures and behaviours that are possible. However, the capacity to change organisational behaviour supported by technological developments is contingent on personnel making productive use of technologies.

There are a number of system integration frameworks that assist defence organisations in addressing the various constraints and enablers of effective incorporation and productive use of systems, and which if followed should guide the design of future systems. Such frameworks as the US Army's Manpower and Personnel Integration (MANPRINT) and the UK Ministry of Defence's Human Factors Integration (HFI) approaches assist in

[1] The views expressed are the authors only and do not represent DSTO or the Department of Defence's official position.

conceptualising and managing the complexities of defence capabilities in order to increase the likelihood that when new systems are introduced they lead to the intended improvements in capability. In the case of MANPRINT, throughout the acquisition process for a particular system systematic consideration should be given to the following domains: manpower, personnel capabilities (cognitive and physical), training, human factors engineering, health hazards, system safety, and soldier survivability (MANPRINT History 2006). These frameworks developed in response to persistent problems being experienced when new systems were put into the hands of personnel, with systems performing well below designed specification (Ibid.). These frameworks focus our attention on considering the integration of humans with technology-based systems during acquisition, since this is a period in the implementation process before the design of a particular system becomes fixed. But at what point does a system's design become fixed?

Engineered systems have certain material or design constraints, such that once 'metal has been poured' the configuration is fixed. However, there is wide acknowledgement that the material constraints of a system do not determine the behaviour of users; instead humans are viewed as both shaping and being shaped by systems (Chae and Poole 2005, DeSanctis and Poole 1994, Orlikowski 1992, Rose and Jones 2005, Walsham 1997). The implication of adopting this position is that the system's design is not stabilised or completed "until realized in action, until integrated into the everyday practices of human actors for whom the designs are a means to an end" (Orlikowski 2002, p.3).

The active role played by human actors in completing design through use, and the implications this has for improving design practices associated with the system and supporting context, is parsimoniously conveyed by the model of technology appropriation (MTA) (Carroll 2004) (see Figure 1). In this model, users are seen as engaging in a process of appropriation whereby they adopt, adapt, and incorporate a technology into their work practices. As users engage in this process they are viewed as completing the design. By highlighting this design through use, the MTA serves as a useful complement to such frameworks as MANPRINT and HFI, because it draws attention to the many influences on effective incorporation and use that follow the acquisition and initial insertion of a technology in a particular context.

In this paper, the MTA is firstly described. By way of background, some of the influences that constrain and enable the effective appropriation of IS in an Australian Defence context are then identified. After describing the context, the MTA is applied to a case study of an electronic document management system (EDMS) deployed into a number of Australian military headquarters. This example will show that the use of technologies by Defence personnel is not pre-ordained by the designers. Instead, these personnel play an active role in interpreting, shaping, and determining how technology comes to be used in practice. This case, together with insights from other IS in the Australian Department of Defence (DoD), will be used to draw some implications for the design and integration of IS. The MTA will be shown to be a useful lens for understanding and shaping the process through which the design of a technology is completed by humans embedded in a particular organisational context.

THE MODEL OF TECHNOLOGY APPROPRIATION

The model of technology appropriation (MTA) was developed by (Carroll et al. 2002) to facilitate building an understanding of the process of appropriation and the influences that act on users' evaluations of technology. This understanding can then help to improve the design and implementation of systems (Carroll 2004). The model describes the process of appropriation through which people adopt, adapt and incorporate technology into their work practices; it describes how users transform technology as it was envisaged by the designer into technology as it is currently used.

The MTA is a generic model of technology appropriation that can be tailored for particular technologies and user cohorts (Carroll 2004). Throughout the process of appropriation various influences shape the attitudes and behaviours of users toward the technology. The types of influences that operate will depend on the nature of the technology, the attributes of the users, and the organisational and environmental context. The attitudes and behaviours are in turn shaped by the evaluations that users make at different times during the appropriation process.

In the model there are three levels of evaluation that correspond to different stages of the appropriation process (Carroll et al. 2002). As can be seen in Figure 1, when first encountering a technology, users are confronted with the technology as intended by its designer, or *technology as designed*. The intention of designers in creating new technologies is for these to assist in solving identified organisational concerns (Hevner et al. 2004). From a military perspective, this translates into the technology addressing identified capability deficiencies. From the users' perspective the technology presents a variety of possibilities for addressing their particular concerns, which may or may not align with those identified by the designer. During their initial exposure to the technology a series of influences shape users' evaluations and decisions whether or not to adopt the technology. In the case of an IS, influences on users might include the graphical user interface, system reliability and performance. The

outcome of this level 1 evaluation is the establishment of certain expectations about what the technology can deliver, which leads to either non-adoption or the user choosing to persist with exploring the technology thereby continuing the appropriation process. In the case where the user chooses not to adopt the technology there may be circumstances that cause them to re-evaluate the technology at some later time (represented by the dashed arrow from Non-adoption to Level 1 in Figure 1) (Carroll 2004).

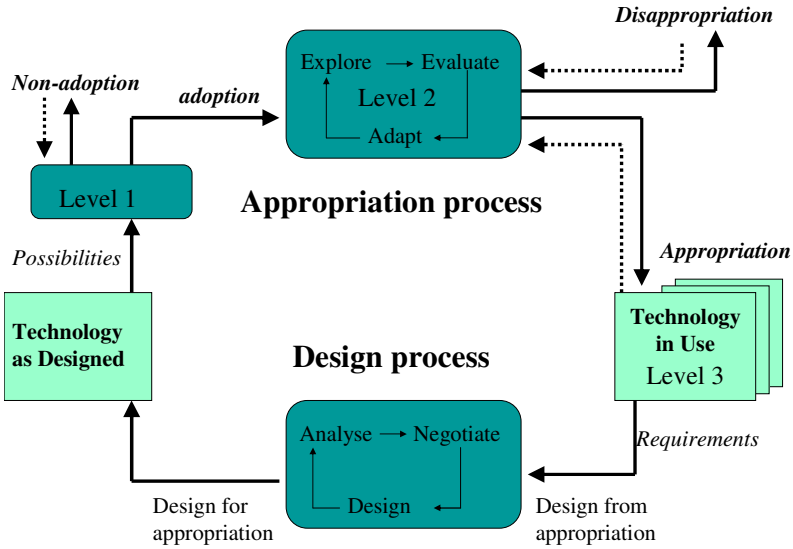

Figure 1: The model of technology appropriation (Carroll 2004, p. 5).

At the next stage of the appropriation process users evaluate the technology more deeply through exploring and using the technology (Level 2 evaluation) (Herszfeld et al. 2003). They come to learn how the technology can support their practices through the provision of particular functionality. As users explore and learn about the technology they also adapt their practices associated with the technology as well as adapting the technology itself. During this adaptation stage there are again a variety of influences that serve to encourage or discourage continued appropriation, for example, the extent to which the technology enhances the users' performance.

In the final stage a state of appropriation is reached, whereby the practices around the use of the technology become routine, and no further adaptations to the technology occur. The technology becomes integrated with work practices, is part of users taken for granted experience of work, and is just another part of the work landscape, referred to as *technology in use* (Carroll 2004). It is at this stage that the design can be said to be fixed, although this may not be permanent (Mendoza et al. 2005). The state of appropriation is maintained as long as users' ongoing evaluation of the *technology in use* continues to reinforce persistent use. These level 3 evaluations are shaped by various influences, for example, the attitudes and behaviours of ones peer group toward the technology or the performance of the technology. However, users' persistent use and ongoing incorporation of the technology with their work practices is subject to modification if their evaluation of the technology changes. If this occurs then users may return to level 2 and the technology could be disappropriated or rejected.

The context within which military forces operate is often complex and dynamic. This means that military forces must adapt to such a context in order to maintain effectiveness. One means of achieving this is through modifying or upgrading existing technologies and associated practices, processes and structures. Alternatively, technologies can be purchased that offer the promise of radically new ways of doing business, such as distributed computing and communications infrastructure. The bottom half of the MTA in Figure 1 captures the need to reflect on the process of appropriation for a given context and technology and use this to inform the design process. In the first instance the understanding generated by such reflection serves as an input into the design process through identifying requirements for future versions of the technology or for new technologies– *design from appropriation*. Users' needs and requirements are articulated as they use a technology to support their work practices (Carroll 2004). Reflection on the process of technology appropriation also highlights that technologies are shaped by users to support their particular needs. For designers this suggests technologies should be *designed for appropriation* by making them more malleable and flexible thereby better supporting the behaviour of users (Carroll 2004, Dourish 2003, Hevner et al. 2004). Furthermore, the insights gained can be used to inform the various design activities and practices associated with the context within which the technology is embedded, such as those undertaken by implementers, system integrators, project managers, local management and users.

The MTA offers potential in helping to understand the integration of technologies in an organisational context like Defence, however, it has to date not been applied to such a context. Therefore, the question to be investigated is:

> *What is the explanatory utility of the MTA when applied to IS in an organisational context such as Defence?*

BACKGROUND

The first-named author undertook three evaluations of command support systems (CSS) in the DoD between 1998 and 2000. Consideration of the results of these evaluations will assist in identifying some of the influences that constrain and enable the effective appropriation of IS in an Australian Defence context, and will therefore provide a broader context for considering the results of the EDMS case. The MTA will also be used to help describe the implications of the various influences on users' evaluations and subsequent appropriation choices for each CSS.

The first system (CSS1) was developed in response to a detailed user requirement prepared in the 1980s but took approximately 10 years before it was finally delivered. This system provided a number of applications that were viewed by users as conceptually sound, however, the Unix based system was slow, had a non-intuitive interface, was difficult to customise to meet different user group needs, had a complex system structure and reliability problems. In terms of the wider context, there were concerns raised about turn-around times for repair of hardware, the training provided, difficulties in deploying the system, and perceptions of too much duplication of existing paper based procedures. Furthermore, because of performance and reliability concerns, voice communications and paper based procedures were used in parallel with the system. Users' evaluations of this system were largely negative and they generally didn't adopt the system nor have opportunities to engage in adaptation primarily because of reliability issues.

The next CSS (CSS2) replaced the one just considered and represented a move toward an iterative acquisition and development approach (Fidock 2002). An evaluation was undertaken a few months after its introduction, focussing on the standard office environment (SOE) (Microsoft (MS) Office and Lotus Notes) and a digital mapping and communications application, the Command Data Network System (CDNS). Whilst the overall quality of this CSS was viewed more favourably by users than CSS1, there were concerns about the reliability of the mapping application, its non-intuitive, or non-MS windows, interface and its lack of maturity in terms of still needing considerable development work to better meet users needs, but it was seen as having potential. The implementation of the system was generally well received, such as the quality of system support and training provided. However, there was a time lag between system training on CDNS and field use such that the benefits of training were reduced. The in-barracks version of the system (the SOE) had led to changes in operating procedures, but these were driven by the system rather than planned and managed. In particular, with the introduction of a reliable e-mail facility a lot of traffic became informal, which had improved information flow, but had led to some information by-passing the normal chain of command. Overall, the evaluation of the SOE and CDNS revealed that more mature applications, combined with users having some prior exposure or familiarity with the system, in this case MS products, led to improved user perceptions of the system and its impact on organisational performance. Viewed from the perspective of the MTA, the SOE was being adapted by users, but not in a planned way. They were engaged in level 2 evaluations and adaptation but a state of appropriation had not been reached. In terms of CDNS, level 2 evaluations had begun to occur but users' evaluations were largely negative suggesting disappropriation would occur. Sometime later CDNS was removed from CSS2 and an alternative tool introduced.

As a result of conducting this evaluation, the evaluators concluded that more needed to be done to support military personnel in integrating systems with their work practices (Fidock 2002). Military personnel were struggling with effectively integrating this CSS with their business practices due to time and resource constraints. Furthermore, there appeared to be little support being provided to personnel to assist with such integration efforts. Considerable support was being provided by those agencies in the DoD responsible for technology implementation through the provision of training, system support and opportunities for users to provide feedback for the design of future iterations. However, these agencies are quite separate from the various military organisations they service. They did not provide support for integration with business practices because they did not see it as part of their remit. This structural separation between IT and business operations appears to have limited the degree of technology integration with work practices.

The third CSS (CSS3) was quite a mature system, having been in use for a number of years and employing mostly well established Commercial-of-the-shelf (COTS) software such as MS Office and Lotus Notes. However, there were some bespoke and specialist applications available. A number of influences on the effective utilisation and integration of this CSS were identified including: having too many sources of information to search and lack of an effective search capability across these multiple sources; limited formal training undertaken on the CSS and

an absence of tailored training; and limited policy and practice guidance on the management and storage of electronic information, with document duplication and email overload being of particular concern. Users also indicated they had limited influence over system development and were ambivalent about the design and flexibility of the system (Fidock 2004). Despite these issues most users perceived the software on CSS3 as being user friendly and reliable, except for a bespoke Common Operating Picture (COP) tool, which was seen to be difficult to use, too immature, unreliable and slow. Users also perceived CSS3 as providing some efficiency gains over the previous system based on telephone, fax and paper based messaging, but users were continuing to maintain their own hardcopy files driven by electronic storage limitations and a lack of information management guidance. This CSS had overall reached a state of appropriation, however, particular applications, such as the COP tool were being used by only a small subset of personnel and then only sporadically. Whilst CSS3 had been appropriated, the effectiveness of this appropriation was questionable given the considerable information processing and management demands being placed on users.

The key influences on effective IS integration within the context of the DoD are summarised in Table 1

System	***Influences***	
	Positive	***Negative***
CSS1	Applications conceptually sound	Slow system
		Non-intuitive interface
		Difficult to customise
		Complex system structure
		Reliability problems
		Hardware repair time
		Training
		Duplication of paper based procedures in design
		Existing and computer based procedures used in parallel
CSS2	Implementation process	Limited integration support
	CDNS	Lack of integration with work practices
	- Had potential	CDNS
	SOE	- Reliability
	- Prior exposure/familiarity with system	- Non-intuitive interface
	- System quality	- Lack of maturity
	- Reliable e-mail facility – improved information flow	- Lag between training and use
		SOE
		- Information bypassing Command chain
CSS3	System design and flexibility (ambivalent)	
	User friendly software	COP tool – not user friendly, immature, unreliable and slow
	System reliability	Too many information sources to search
	Efficiency gains over previous system	Lack of an effective search capability
		Limited formal training and no tailored training
		Limited IM policy and practice guidance
		Electronic storage limitations
		Influence over system development

Table 1: Influences on the appropriation of IS in the DoD

Across all three CSS, system quality issues such as performance, reliability and the intuitiveness of user interfaces were raised (see Table 1). Whilst established or mature COTS tools were generally well received, CSS1, CDNS and the COP tool, were perceived as suffering from system quality problems. These problems together with system immaturity contributed to reduced user acceptance and ineffective usage or rejection of the systems. The implementation process, which includes such things as training and system support, was criticised for CSS1, improved for the second CSS, but was viewed as problematic for CSS3. Across all systems there were concerns raised about integration with work practices. The tentative implications of these findings for implementing IS in the DoD are that mature systems present less concerns in terms of system quality, but that unfamiliar or immature systems present challenges in terms of generating user acceptance and effective utilisation. However, even when the system concerned is mature, a failure to attend to training and integration issues can affect the effectiveness of appropriation.

Conducting these evaluations contributed to a realisation that military personnel were struggling with effectively integrating CSS with their work practices, and that more needed to be done to better understand and facilitate such integration. The theoretical work of Orlikowski (1992, 2000) and Kallinikos (2002) assisted in better understanding the relationship between technology and human agents through such ideas as the *malleability* or

interpretive flexibility of the IT artefact, and *technology-in-practice*, which highlights the importance of understanding what happens during use of a technology in a particular context. However, the MTA captured these ideas but in addition provided a means of understanding how *over time* human agents come to adopt, adapt and then integrate a technology into a particular work context. Furthermore, it facilitated such an understanding in a way that could inform stakeholders involved in supporting system (re)design, implementation and integration. It is for these reasons that the MTA was selected to serve as a model to guide consideration of the findings from the evaluation of future IS.

THE CASE OF AN ELECTRONIC DOCUMENT MANAGEMENT SYSTEM

During the evaluation of CSS3 a number of the issues raised by participants related to information management, such as having too many sources of information to search and lack of an effective search capability across these multiple sources. This situation was perhaps made more frustrating for more senior members of staff because they could recall a time, prior to the widespread use of computers, when the organisation had formal organisational structures and processes in place that largely ensured effective management of records, correspondence and documentation. However, with the introduction of networked computer systems and the capacity to rapidly distribute information, for example, via e-mail, the conduct of business had increasingly come to rely on informal communication and ad hoc processes. The organisation had continued to maintain the formal organisational structures and processes for records management, however, these were not designed to handle the massive increase in the volume and type of information created. Consequently, many personnel were experiencing information overload, corporate memory was being undermined and there were difficulties in satisfying legislative requirements in relation to archiving.

To address deficiencies with information and document management an electronic document management system (EDMS) was initially introduced into three military headquarters (HQ), including the HQ where CSS3 was evaluated. The particular deficiencies the system was designed to address included: correspondence management, scanning of hardcopy documents for later electronic search and retrieval, collaborative document development and version control, electronic document sharing, file management, information sharing and retrieval, document development tools, and web authoring and publishing. In sum, the EDMS was "designed to support the entire document lifecycle of both electronic and physical documents" from creation through to eventual disposal (Fidock and Carroll 2004, p. 4).

Methodology

An evaluation of the EDMS was undertaken toward the end of 2003 in response to a request received from the project office responsible for implementing the system. The evaluation needed to be completed before a key meeting to decide whether to proceed with further rollouts of the system. Due to the narrow time window for data collection, the approach and methods selected were chosen to facilitate efficient data analysis whilst also providing sufficient depth and breadth of coverage. Data to support the evaluation was collected using interviews and questionnaires. In order to collect sufficient data key IS stakeholders in each HQ assisted with conducting the interviews. A total of 30 interviews were conducted with 27 personnel from the three HQs. Fifty five people (22%) also completed the questionnaire. A follow up evaluation of the system was also undertaken in March 2004 which utilised data from 15 interviewees and 32 questionnaire respondents.

The system introduction was staggered across the three HQs. In addition, due to the posting cycle in the DoD, where staff move approximately every two years, staff turnover at each HQ was high. At the time of conducting the evaluation, respondents therefore had access to the EDMS for different periods of time, which provided a snapshot of influences at different stages of the appropriation process. At the time of the primary evaluation in 2003, length of usage ranged from less than a month to just over 12 months.

The first questionnaire used a combination of rating scale questions and space for written comments to assess the implementation of the EDMS against the documented user requirement. In addition, a number of other common IS evaluation criteria were included such as frequency of use, attitude toward computers, usability, demands on users, perceived usefulness, expectation of the future impact of the system and competence (Clegg et al. 1997, Davis 1989, Fidock 2004, Igbaria et al. 1997). The follow-up questionnaire included additional questions to assess document storage and management behaviour and the particular EDMS functions used.

Two types of interviews were conducted. The first type used a semi-structured format to derive background information from seven key stakeholders relating to their roles, measures of success for the project, and influences on the systems implementation. The remaining interviews were conducted using the repertory grid technique, which is an interview approach designed to minimise the influence of researchers when eliciting people's views (Stewart 1997, Tan and Hunter 2002, Whyte and Bytheway 1996). Interviewees were presented with three elements written on cards: 'previous IM [information management] practices', 'IM using EDMS' and 'Ideal IM practices'. Interviewees were asked in what ways two of these elements were like each other and different from

the third. This technique helped to identify features of the EDMS which were meeting users' needs (when respondents paired the EDMS and ideal elements), or needs that weren't being met (when respondents paired previous and ideal in contrast to EDMS, and previous and EDMS in contrast to ideal). Furthermore, the comparisons provided a means of assessing Rogers (1995) idea of relative advantage by exploring the degree to which 'IM using EDMS' was perceived as being better than the IM practices it superseded. In the follow-up evaluation a semi-structured format was also employed to assess people's perceptions of the system's progress, additional influences on implementation and suggestions for improvement.

Results

The MTA was selected because it provided a useful framework to assist with building an understanding of the process of appropriation for the EDMS (refer to Figure 1). Some of the influences that constrained and enabled users' adoption, adaptation and incorporation of the EDMS into their work practices will now be described and are summarised in Table 2.

Stage of appropriation (Evaluation level)	***Influences***	
	Positive	***Negative***
Adoption (level 1)	Positive attitude toward computers	Demanding to use
	Improved ability to share documents	Difficult to learn
	Version control of documents	Unfamiliar and complex interface design
	Formal training	Somewhat unreliable
	Support received from help desk	Slow system response
	On the job training & support from BSOs[1]	Longer process to create new documents
	Appointment of Information Managers	Limited usefulness/reduced job performance
		Inadequate preparation prior to system introduction
Adaptation (level 2)	Improved ability to share documents[2]	Demanding to use
	Version control	Difficult to learn
	Controlling access to documents	Poor interface/system design
	Improved ability to manage e-docs	Somewhat unreliable
	Support from help desk	Slow system response
	On the job training & support from BSOs	Effort required to change work practices
	Guidelines/procedures to support use	Limited usefulness/reduced job performance
	Usefulness/improved job performance	Difficulties sharing information with 'non-EDMS' sites
	Maintenance of Information Managers	
	In-house solution to enable sharing of information with 'non-EDMS' sites	
Integration (level 3)	Stage not reached	

[1] Business Support Officers (BSOs). These personnel were embedded in each of the HQ for a few months following the implementation of the EDMS. They were responsible for providing on the job follow up training and system support for HQ staff.

[2] Underlined text represent factors which had previously been raised in an earlier stage of appropriation.

Table 2: Influences on the appropriation of the EDMS

During users' initial exposure to the EDMS, in the first 1 to 3 months of use (n=14), they evaluated the system as providing good functionality through supporting their ability to share documents and maintain good version control (Persson and Fidock 2005). Users also were largely satisfied with the training and system support provided during implementation. However, there was a perception that the HQs had not adequately prepared or pre-positioned themselves for the introduction of the system, for example, by developing policies to encourage appropriate document management behaviours. Instead such developments occurred in parallel with the system's introduction, generating an additional change burden. Nevertheless, the three HQs had appointed information managers to support the change effort. Concerns were also raised by many of the users about system usability (demanding to use, difficult to learn, unfamiliar and complex interface), reliability, slow system response times, the time taken to set up new document files using the system, and the impact of the system on the ability of users to do their job. Despite these concerns adoption of the system had largely occurred because users did not have much discretion over using at least some aspects of the system. Nevertheless, there was evidence of some users partially adopting the system, through employing workarounds to avoid using certain features of the system. There was also evidence of non-adoption, for example, the executive staff in one of the HQ were not directly using the EDMS. They continued to make hand-written changes to various documents as was the current practice, rather than electronically editing the document stored in EDMS, with support staff ensuring that these edited documents were then scanned into the system. It could be argued that such partial or non-adoption was largely being driven by a poor attitude toward computers in general. To mitigate against such claims users' attitudes were assessed using a scale developed by Clegg et al. (1997). Respondents largely assessed themselves

as having a positive attitude toward computers, which suggests that issues with adoption were not being driven by a negative view of computers in general.

Level 2 evaluations of the EDMS at the adaptation stage of the MTA occurred when users had been exposed to the system for between 4 and 8 months (n=17). Users were engaged in more in-depth evaluations of the system through use and had started to adapt the technology and their work practices. Issues that continued to have a positive influence on users' evaluations and their choices regarding appropriation included perceived improvements in document version control and document sharing, training and system support, and the maintenance of the role of Information Manager in each HQ to help drive process and practice changes. New issues that emerged at this stage included the development of guidelines and procedures to support use, and a belief that the EDMS had improved users ability to manage electronic documents and control access to documents. Also, a greater proportion (41%, 7 of 17 respondents) of users perceived the system as improving their job performance than was the case during the adoption stage (7%, 1 of 14). Nevertheless, there was still a significant proportion (53%, 9 of 17) of users who believed the system was of limited usefulness and was reducing their job performance. Other issues that continued to have a negative influence included system usability, reliability, and responsiveness. New negative issues that emerged at this stage included the effort required by users to change their work practices driven by the system, and difficulties in sharing information with sites that did not have the EDMS installed. To address this later concern, an in-house web-based solution was developed to enable sharing of information with 'non-EDMS' sites. There was no evidence of the system being rejected or disappropriated as a result of level 2 evaluations, however, a number of users were employing workarounds, or minimising their use of the system through not creating documents. Instead they were working on and saving documents on their computer, and only later would they 'create' them in the EDMS shared repository, or they avoided 'creating' them in EDMS altogether. There was also minimal use of the capability to store e-mails using the system, and to support collaborative document development. Partial appropriation can therefore be said to have occurred.

This partial appropriation or under-use of the system by a number of users can be viewed as a form of technology adaptation. The system's designers would perceive such use as being mal-adaptive since the power of the system stemmed from a critical mass of personnel utilising the system to store and manage documents. This partial appropriation was not consistent with the spirit or underlying theory of use embodied in the system (DeSanctis and Poole 1994). However, some users had experienced loss of documents they were working on and many users had been affected by the system being unavailable on occasion, preventing them from accessing certain documents. So from the users' perspective such under-use of the system, and employment of workarounds, was adaptive. Technology adaptation had occurred and so too did adaptation of work practices. The system forced a number of work practice changes on users, for example when creating a document for the first time in MS Word, a dialogue box would open up asking for various meta-data fields to be filled out. Also, many of the practices they had employed previously in relation to such activities as version control, document management and storage, and controlling access had changed as a result of the system's introduction. However, work practices that pre-dated the installation of the EDMS were also being maintained, such as local creation and development of documents. Such behaviour was being driven by concerns about system maturity, and some resentment about being forced to undertake document management activities which previously had been the responsibility of registry staff.

The level 3 integration stage of the MTA was not reached. Even though the system had been in place at two HQs for 9 months and one HQ for 12 months, only 28% (12 of 43) of respondents who provided a date of first use had been using EDMS for 9 months or more, with 30% (14) only having used EDMS for 3 months or less. Therefore many respondents had not had much opportunity to adopt and adapt the technology. There were also ongoing efforts by the information managers to encourage staff to more fully utilise the system's capabilities and to comply with the new information management policies and practices. The system was also undergoing changes, with ongoing efforts to improve reliability, and plans to introduce an improved user interface (design from appropriation – see Figure 1). Neither the system nor associated work practices had stabilised so a state of appropriation had not been reached.

IMPLICATIONS FOR DESIGN AND INTEGRATION OF IS IN THE DOD

Modern information systems like the EDMS often have the potential to substantially impact on the way business is conducted in an organisation. Considerable resources were therefore invested by the project team responsible for this system's implementation on training and system support, both in the form of a telephone help-desk and embedded business support officers who were responsible for providing on the job follow up training and system support for HQ staff. There was also assistance provided with preliminary integration efforts. Users did appreciate the improvements made to some aspects of the document creation process, such as version control, however, they also evaluated the system as suffering from usability and performance problems. Furthermore, given the ad hoc nature of much of the document management going on in these HQs the move to this EDMS

represented a major change in business practices. Of most significance for users, it introduced additional overheads relating to increasing the number of steps involved in creating and modifying documents. These influences led to a system that was only partially appropriated, with a number of users minimising or avoiding use of the system.

Consideration of the positive and negative influences on the appropriation of other IS in the DoD suggests that such partial appropriation should not have been an unexpected outcome, particularly given the apparent immaturity of the EDMS. This is because the evaluations of the other IS suggest that unfamiliar or immature systems present challenges in terms of generating user acceptance and effective utilisation, because they can suffer from system quality issues, such us poor reliability and ease of use. Previous research has also highlight the link between system quality and user acceptance (Davis 1989, Igbaria et al. 1989).

There are four main implications to draw from this finding. First, if cutting edge, or immature systems are to be introduced then considerable effort need to be invested in managing users' perceptions of the system such that their evaluations do not lead to partial appropriation or disappropriation. This is at times undermined by the rhetoric of the IT vendors. As researchers supporting systems integration efforts we therefore need to moderate corporate expectations of the period of time within which improved organisational behaviour will result, and highlight the significant corporate and localised resources required to support effective integration. Successfully integrating systems is a major undertaking, but is made even more challenging if the system has not yet reached maturity.

The second implication is to avoid cutting edge or immature systems until sufficient evidence has accrued to demonstrate the benefits of acquisition. This is not to suggest that Defence should not try to facilitate improvements in its organisational behaviour through investment in modern technologies. It is simply a call to consider how much Defence should absorb the risks associated with immature systems. The use of the MTA represents one way of acquiring evidence about the potential of systems, for example through partial roll-out or pilots, and the likely constraints and enablers of successful appropriation and integration.

Third, regardless of the maturity of a system, the human, technological and organisational context within which it is to be embedded is likely to be unique, as will be the many ways in which users appropriate the system to support their work practices. For example, in the case of the EDMS it was: employed by users who were largely not educated in document management or familiar with the interface, installed on to a network that utilised Lotus Notes for messaging, and which operated in an environment that was much more sensitive than the commercial sector to controlling information access. Furthermore, the process of appropriation through which the EDMS was being integrated was critically dependent on the evaluations made by users during this process, which in this case led to partial appropriation. The users played an active role in interpreting, shaping and determining how the EDMS was to be used. The uniqueness of context and the multiple trajectories followed by users when appropriating systems suggests that resources should be invested in the variety of design activities associated with the system and its integration. The evidence from these DoD IS should serve as a counter to those people who argue that integration challenges and associated costs can be minimised by purchasing COTS or Military-off-the-shelf systems, as users can simply be expected to get on with using the system. A failure to recognise or support the process through which people come to appropriate systems potentially puts at risk the aspirations of system developers and integrators in achieving desirable changes in organisational behaviour.

A fourth implication, which follows from the above, is the need to appreciate that many IS can be flexibly configured and modified by users. There is a sense in which such IS are somewhat supportive of appropriation (designed for appropriation – see Figure 1). By recognising this and understanding that appropriation is normal, those supporting system integration (implementers and management) will be better placed to more effectively guide and shape a process of appropriation that is not simply at the whim of users. There are benefits to be gained from allowing the use of systems to develop in manner that is not prescriptive to the point of stifling creativity. However, a balance needs to be met between providing sufficient procedures to facilitate more efficient utilisation of a system and allowing users enough freedom to generate innovative new ways of using the system to support their work. System integrators have an important role to play in managing this balance, and supporting effective appropriation, informed by a good understanding of the various influences on appropriation in the particular context. The MTA may assist integrators in building this understanding by surfacing the various positive and negative influences on users' evaluations of the technology.

A LENS FOR UNDERSTANDING SYSTEMS INTEGRATION

The contribution of this paper is the application of a model, the MTA, that provides a lens for understanding the process through which the design of a technology is completed by humans embedded in a particular organisational context (Defence). Applying the MTA provides concrete insights into how to improve design and management practices associated with systems integration. By highlighting this 'design through use', the MTA serves as a useful complement to such frameworks as MANPRINT because it draws attention to the many

influences on effective incorporation and use that follow the acquisition and initial insertion of a technology in a particular context. A better understanding of these influences can then be used to inform design and management practices that will shape the appropriation process in ways which support more effective incorporation and use of technologies.

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ACKNOWLEDGEMENTS

We would like to acknowledge the opportunity provided to us by the project office staff to evaluate the EDMS, and to use the data to support this research, and the Defence personnel who participated in the evaluation.

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