

A FRAMEWORK FOR REDESIGNING INFORMATION SYSTEMS DEVELOPMENT METHODOLOGIES TO ENHANCE GLOBAL INFORMATION INFRASTRUCTURE

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Abstract –

Information Systems Development Methodologies (ISDMs) are central to the information systems development process, directing and focusing the work of IS practitioners and project leaders. Given the espoused importance of ISDMs, there is surprisingly little evidence of rigorous, industry-based research into practice-in-use or into the development of methodology adaptation guidelines for practitioners. In this article, we develop a framework for future research, intended to stimulate and guide investigations into an ISDM that is used globally. Building upon a review of existing IS literature on ISDM usage, a fresh research direction is proposed, adopting a socio-technical perspective with an emphasis on process-oriented research. The paper suggests that individuals and the work context are important factors affecting the use of ISDMs by IS practitioners. These factors are incorporated into the framework through the combination of the process of technology appropriation with a practice-oriented approach. The paper fills a gap in the literature by proposing an in-depth, multi-method, investigation of the practices adopted by a leading global IT company, collecting a large pool of data and with analysis underpinned by a strong conceptual framework. The paper argues the importance of studies of the method adaptation process involving real projects and real developers working on real problems.

Keywords: Information Systems Development Methodologies, Process-Oriented Research, Technology Appropriation.

1 INTRODUCTION

The ways that information system development methods or methodologies (ISDMs) are employed is a topic of significant research attention within information systems (IS). There have been many suggested designs of new ISDMs such as MultiView2, Euromethod and Extreme Programming (see Avison and Fitzgerald 2003), some evaluation of these designs and a few evaluations of commercial ISDM use in the field. Given the rapid developments in technology, increases in the size and complexity of IS projects and changing practices in the business world, there is a need for a fresh look at ISDM use. This article contributes to the topic in two ways: it presents a conceptual framework for

investigating and improving ISDMs and it describes the design of a research project examining how a proprietary, or commercial, methodology is used in practice.

The difficulties inherent in constructing large-scale information systems in a timely way to meet business and user needs are widely recognised. As technologies, tools and developers' skills have changed, the scale and scope of IS development projects has grown. As a result, despite many human and technological improvements there are continuing failures of IS development projects globally (Baccarini, Salm & Love 2004). The role of ISDMs in these increasingly ambitious development projects, undertaken to construct complex inter-organizational information infrastructures, is not well understood. What we do know is that partial ISDM use is common with widespread adaptation of methodologies in use. There are many reports that ISDMs are adapted in use but little detailed examination of how and why this occurs.

This paper focuses on ISDM adaptation in order to provide the foundation for creating and validating improvements to ISDMs and associated management practices that are necessary for effective ISDM use. It presents a conceptual framework that will enable IS practitioners and global organisations to more effectively develop information systems, thereby enhancing their information infrastructures. The framework incorporates three complementary perspectives: a technology appropriation approach with a focus on process-oriented research (Carroll 2004); a practice-oriented approach to systems development (Orlikowski 2000); and a socio-technical approach with a focus on people and context (Kling et al. 2005).

This framework is used to derive a multi-method research design that investigates ISDM use in practice. The framework is being applied in a collaborative project being undertaken in conjunction with a leading global hardware and software vendor (hereafter known as the *technology partner*). The project aims to firstly, investigate how the sets of tools, techniques and procedures that make up ISDMs are *actually* employed in practice; secondly, to harness understanding of adaptations to ISDMs to design and evaluate enhancements to a commercial ISDM; and thirdly, to design and evaluate improvements to the management practices around the use of ISDMs.

2 BACKGROUND

An ISDM has three key characteristics (Avison & Fitzgerald 2003:20): it breaks the IS development process into phases and sub-phases; it provides tools, techniques and procedures to assist developers in their work; and it is underpinned by a philosophy that presents a coherent view of the aspects of systems development needed for successful project completion. ISDMs have been proposed as a means of addressing many of the well-documented difficulties in developing information systems. ISDM usage is important for successful project outcomes. For example, the match of an ISDM with a project has been identified as the single most important IS project risk factor (Tiwana & Keil 2004) and the ISDMs used on IS projects is one of the most significant causes of failure (Lindstrom & Jeffries 2004; Standing 2000).

Research to date indicates that ISDMs are rarely used as prescribed but rather they tend to be changed or adapted during the course of projects (Baskerville & Stage 2001; Carroll 2003; Fitzgerald 1997), where adaptation may involve omitting, changing or adding tasks. This adaptation during the use of a methodology is important to both the effectiveness of the ISDMs and the success of the IS projects for which they are used (Barrow et al. 2005; Fitzgerald 1997). While the reasons for choosing an ISDM have been well researched (for example, Avison & Fitzgerald 2003), the adaptation of ISDMs has been the subject of much less research. There has been little research investigating *how and why* a methodology is adapted.

There have been several proposed explanations for adaptation of ISDMs including lack of understanding of the IS development process in general (Fitzgerald 1997) or the requirements of a specific project (Carroll 2003). As this adaptation occurs over time, it can be researched using the recent concept of technology appropriation describing the process through which users adapt, and

adapt to, a technology over time (Carroll et al. 2002). Considering an ISDM as a technology facilitates understanding of the influences and effects of ISDM appropriation. It also enables the redesign of ISDMs, associated management practices, supporting education and relevant standards.

This research addresses a major information systems development problem through asking and answering the question ‘*how can understanding of the appropriation of ISDMs be applied to improve the outcomes of large IS projects?*’ This will be achieved through the combination of a technology partner’s strategic focus on improving the outcomes of large IS projects and the expertise of the researchers related to technology appropriation and ISDMs.

The recent dominance of commercial ISDMs has been noted but, as yet, commercial ISDMs have not been extensively researched despite calls for industry-based research (Aydin et al. 2005). This research will focus on a commercial or proprietary ISDM that is used extensively around the world.. The ISDM has been iteratively developed by one of the largest information technology companies in the world and has been successfully used on thousands of projects of different sizes globally. Using the model of Avison & Fitzgerald (2003), the chosen methodology does not mandate particular tools and techniques, yet its scope covers the entire systems lifecycle for many different types of systems, clients, and environments. The focus of our data gathering will be ISDM usage by IS practitioners in real projects. The following sections present the conceptual framework that underpins this ‘fresh look’ at ISDM use, followed by a detailed description of the research design.

3 CONCEPTUAL FRAMEWORK

3.1 Innovation & Technology Appropriation

An ISDM is a form of technological innovation in that commercial ISDMs are recently developed and are used as tools to develop systems (Fleck & Howells 2001). Fundamental to the notion of *innovation* is the element of change initiated in the material and/or social world as part of a process often involving the alteration of relationships and prior ways of doing things (Rogers 1995). These dual concepts of *innovation* and *technology* provide elements of a conceptual framework from which the adaptation problem can be better understood. A technological innovation - such as a ISDM - is designed, developed and presented ready for sale or use; this is *Technology as Designed* (Carroll et al. 2002). Over time, the technology is evaluated, explored and adapted to meet users’ needs; this is *Technology in Use*. This process of moving from *Technology as Designed* to *Technology in Use* is technology appropriation, which is “*the way that users evaluate and adopt, adapt and integrate a technology into their everyday practices*” (Carroll et al. 2002).

This research will use technology appropriation as a lens to study ISDM adaptation. This process of appropriation involves moving through three levels, reflecting users’ growing familiarity with the technology: Level 1: Deciding to adopt or reject a *Technology as Designed*, based on expectations formed during users’ first encounters with a technology such as in a training session or at a vendor’s presentation. Level 2: Exploring a *Technology as Designed*. A technology is used in different contexts to undertake different activities. Users may select and adapt some attributes of the technology to more closely meet their needs and also adapt their practices to the technology’s affordances and constraints. They may also decide to reject the technology. Level 3: long-term experience of a technology, called *Technology in Use*. Appropriating a technology is not a one-off decision but is conditional on ongoing reinforcement. Changes in users’ needs or introduction of a technology that satisfies their needs more completely may lead to rejection of a previously appropriated technology.

The Model of Technology Appropriation (MTA) represents the above process. The model, shown in Figure 1, can be populated with influences on users’ decisions at each level for different technological innovations (Carroll et al. 2002). Existing theories such as Diffusion of Innovation (Rogers 1995) explain level 1 influences; however, the MTA provides the means to capture and explore level 2 and 3 influences thereby contributing to IS theory. The influences on the adoption of a technology (the

decision to select or purchase) are quite different to those that encourage users to adapt and adapt to the innovation (Level 2) or to integrate it into their everyday practices (Level 3).

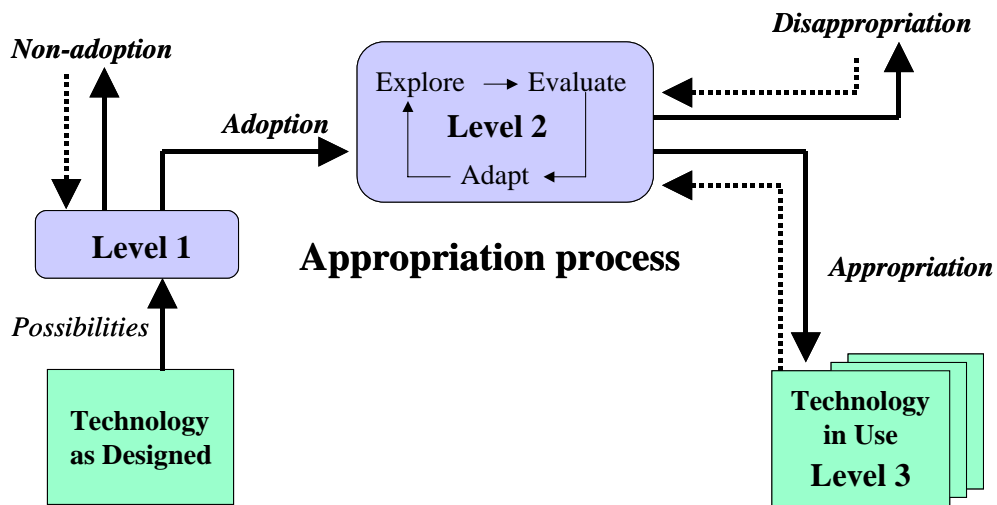


Figure 1. The Model of Technology Appropriation (MTA)

The MTA also captures the practical outcomes of understanding technology appropriation in order to improve subsequent projects (Carroll, 2004). As users actually use a technology they adapt that technology and their usage to more closely meet their needs. These *Technologies in Use* represent users' completion of design. Understanding these changes in the *Technology as Designed* together with the influences on users' actions at Levels 1, 2 and 3 enable designers to determine users' needs more accurately and thereby refine or redesign the technology to meet these needs. Further, understanding of the different influences on users' decisions at the different levels enables the application of more timely and appropriate training and management strategies and thus more effective use of the technology overall.

3.1.1 Appropriation of ISDMs

Viewing the adaptation of ISDMs as an example of technology appropriation will develop understanding of the changing dynamics of ISDM use. To date, there is little research that examines the transformation of a commercial *Methodology as Designed* into a *Methodology in Use* (exploratory studies include Aydin et al. 2005, Barrow et al. 2005, Backlund 2004, and Fitzgerald et al. 2003). IS practitioners adapt ISDMs according to the characteristics of a development situation (Carroll 2003; Khushalani et al. 1994). This research examines ISDMs as technological innovations that will be adopted, adapted and integrated into everyday practices. It enables us to investigate *when* adaptation occurs in systems development, *what* aspects of the ISDM are adapted, *how* and *why* adaptations are made, and *who* in the project team performs these adaptations. Understanding the influences upon ISDM appropriation at each level will enable the design and evaluation of improvements to the ISDM and management practices around ISDM use in the small. The technology partner will then apply the outcomes to improve ISDM redesign and support management practices globally.

3.1.2 Extending the Model of Technology Appropriation (MTA)

Our research will extend the MTA by applying it to ISDM use as shown in Figure 2. As described above, the MTA explicitly provides for the resulting knowledge to be harnessed and applied to

improve subsequent projects (Carroll 2004). Application of the MTA will facilitate development of improvements around ISDM use, while our theory focus on ISDM adaptation and use places our research within an international network of scholars actively researching the topic of methodology enactment.

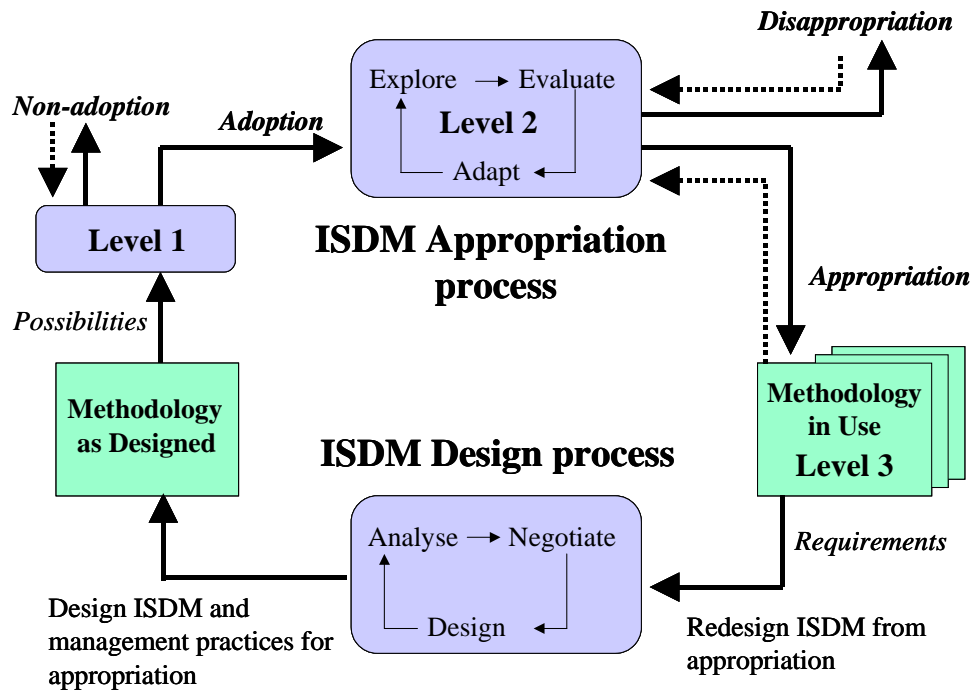


Figure 2. An Extension of the MTA by applying it to an ISDM.

3.2 A Socio-Technical Perspective

The *process* of ISDM adaptation will be studied from a socio-technical perspective (Baskerville & Stage 2001) with a focus on people and the ISDM context. Developers' intentions and actions in using and adapting an ISDM will be tracked over time using a range of research methods. A fundamental assumption underpinning the project is the view that ISDMs are more than just technical artefacts but are social institutions that exert their own types of agency, and that ISDMs also interact with human agency in the systems development process (Rowlands 2006). In this role, it is argued, that ISDMs and people can best be examined through socio-technical perspectives, but more importantly the technical components of the methodology cannot be fully understood separately from the social and organisational context in which they exist. According to a socio-technical perspective, people's individual autonomy (their agency) and their behaviours are shaped by the social norms, institutional forces, and the social and physical structures that surround them. This approach reflects what Orlikowski & Iacono (2001) identify as the 'ensemble view' of technology where ICTs such as ISDMs are components of a more complex socio-technical ensemble that include people, work practices, and institutional and cultural factors.

This is strengthened by applying a practice-oriented approach to systems development, as proposed by Orlikowski (2000). According to Orlikowski (2000) applying a practice lens to study technology use in organisations focuses attention on what people actually do with particular technologies in their ongoing and situated activity. Practice-oriented approaches are consistent with socio-technical views yet provide three major additional insights to understand the ISDM appropriation process. The first is that the efficiency of a work process depends not only of the rules (embedded in the ISDM) but also on the

individual workers' capabilities to deal with contingencies, sometimes in spite of the rules. The second is that ICTs do not have predefined structures of their own, but can only be described in terms of a local practice as it is instantiated in practice. Additionally, a practice perspective offers a way to link macro- and micro-levels of analysis (Luna-Reyes et al. 2005). That is, 'practice lens' directs attention to how a macro-phenomena are constituted by micro-interactions, and how these micro-interactions, in turn, are shaped by macro-influences and affects.

4 APPROACH & RESEARCH METHODS

Our research is investigating '*How can understanding of the appropriation of ISDMs be applied to improve the outcomes of large IS projects?*'

4.1 A Focus on Process-Oriented Research

The prevailing approach to understanding "adaptation and use" in IS research to date has neglected the messy and complex way people work and live, and the dynamics by which institutional processes and structures shape ISDM use. In studying the dynamic phenomena of the adaptation of the ISDM we address these dynamics by applying an *a priori* model – the Model of Technology Appropriation – and then seeks to refine and extend the model by using event histories, interviews and direct observations of developers in action applying and adapting an ISDM. The form of data collected will therefore consist largely of data concerning what happened, and who did what, when, and why – that is, events, activities and choices over time. This accords with Langley's view that data are eclectic, reflecting both process (events) and variance (influences or effects) theories (Langley, 1999). The MTA accommodates both: the process of moving from Technology as Designed to Technology in Use, as well as the ability to insert influences on users' activities at each level. In attempting to gain theoretical understanding of the dynamism and complexity of the data collected, the MTA will guide data analysis. Analytic strategies such as narratives, visual representations and temporal bracketing will be used (see Langley, 1999). The MTA will then be refined and populated with the influences on ISDM appropriation in this particular organizational context.

4.2 Research Design

A commercial ISDM has been chosen for this research because of their prevalence within the IT market, the value to the technology partner and access to their expertise and projects. A combination of qualitative in-depth case studies, and quasi-experimental workshops will be used to examine ISDM use and then identify detailed issues related to ISDM adaptation. The findings and recommendations from the data gathering will be evaluated in a series of industry workshops. The research will be undertaken in three stages:

- Stage 1 examines the technology partner's expectations of ISDM use (Level 1 of the MTA). Given that we are viewing ISDMs as part of a human-technology ensemble, this will involve investigation of the expectations of developers, project managers, senior managers and strategists in order to understand the diversity and scope of expectations of ISDMs and perceptions of the likely benefits and drawbacks of their use in the company.
- Stage 2 studies the technology partner's experiences of ISDM use (Levels 2 & 3 of the MTA). This will examine the ways in which the ISDM is used, how it is adapted and how the people interacting with the ISDM adapt to the ISDM. This will be achieved by a longitudinal study of two types of ISDM use: within the one project, and a series of snapshots of how the ISDM is used within the same phase of multiple projects. Our focus here is on developers' *actions*, so we will collect data on what developers say they do, observe developers' actions in applying and adapting ISDMs and the rationale for observed actions. This will be achieved using interviews prior to ISDM use; observations of use; interviews after the observations; and a review of project documentation.

Analysis of the one project will enable detailed tailoring of the MTA to reflect the research findings. The snapshots of multiple projects will involve 'between case' analysis, and so greater emphasis will be placed on comparing influences on appropriation between different sets of developers in different locations. This will further extend our understanding of Levels 2 & 3 of ISDM appropriation by developers.

- In Stage 3, the research outcomes are harnessed to refine the design of the ISDM; this redesign will be tested in small group experiments. A revised process for adapting the ISDM during a project will be designed and evaluated at workshops involving developers and the researchers, resulting in guidelines on the adaptation of ISDMs. Revised management practices (relating to training and change management) will also be designed. These outcomes will be jointly evaluated by the researchers and representatives of the technology partner and fed back to the partner to improve their development practices. The refined MTA developed in the research will be validated by a focus group of experienced IS developers.

The focus in our research design on multiple sites, projects and phases of actual ISDM use both increases the transferability of our research in different environments and provides additional validation of the findings and results from the project. Also, any differences between locations, projects and phases will be identified, and the ISDM enhancements and supporting material developed in the third stage will reflect these important differences.

This combination of actual industry-based research, alignment with the technology partner's strategic objectives and their strong involvement, and the research capabilities of the academic team will result in outcomes of value to global industry and academia. These include improvements in the quality of information systems and global information infrastructures, through the development of improved ISDMs, and a deeper understanding of technology appropriation as a research perspective.

5 CONCLUSION

Information Systems Development Methodologies (ISDMs) are central to the IS development process, directing and focusing the work of IT practitioners and project leaders. Given the espoused importance of ISDMs, however, we have observed that there is surprisingly little evidence of rigorous, industry-based research into practice-in-use or into the development of methodology adaptation guidelines for practitioners. Building upon a review of existing IS literature on ISDM usage, we have proposed a fresh research direction. In this paper, we have developed a framework for future research, intended to stimulate and guide investigations into ISDMs. The framework is based on the importance of understanding the *process* of ISDM adaptation and use. It incorporates three complementary concepts: technology appropriation, a socio-technical perspective and a practice-oriented approach.

The framework provides the conceptual underpinning of a research design that uses an innovative combination of intensive research methods, case studies and quasi-experimental workshops to develop understanding of ISDM use in practice. This in-depth, multi-method investigation of our technology partner's use of an ISDM will provide both researchers and industry with sound, empirically grounded understanding of ISDM adaptation and use. This will form the basis for improvements to the design of both ISDMs themselves as well as the management practices that support their deployment in industry. Reports on the evolving research will be reported progressively in future papers.

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