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65. The Application of an Information Systems Development Methodology in Practice – An Exploratory Study

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Abstract
The use and modification of Information Systems Development Methodologies has continued to be an important issue for research and practice as developers struggle to complete large-scale IS development projects. Whilst there is a widespread belief that the use of an ISDM is appropriate when developing an information system, a considerable body of evidence exists to indicate that few practitioners actually use methodologies as described. Instead, ISDMs are tailored to create a unique instantiation for each project. This study explores the application of ISDMs in a large global IT company. The paper contributes to the understanding of ISDM application in two ways. Firstly, it identifies two steps in the tailoring process: a deliberate tailoring of the methodology prior to the commencement of a project based on developers' perceptions of the project and its context; and ad hoc tailoring to meet the real, unfolding development needs of the project. Secondly, it provides a description of the way in which a large, experienced organization using ISDMs has addressed the shortcomings of ISDMs by the introduction of a "meta-methodology".

Keywords: Information systems development methodologies, modification, tailoring, adaptation, customization

Introduction
The use of an Information Systems Development Methodology (ISDM) is commonly accepted as an appropriate way with which to construct an information system (Fitzgerald 1996; Hardy et al. 1995) with the claimed benefits including the ISDM acting as a mechanism for capturing and recording collective knowledge and experience (Stolterman 1994); providing a common vocabulary for information exchange (Fitzgerald 1998b); improving the process of systems development (including making the process more manageable) (Avison et al. 2003); improving programming productivity; and producing a better quality end product (Riemenschneider et al. 2002).

Whilst there is a widespread belief that the use of an ISDM is appropriate when developing an information system, research shows that few practitioners actually use methodologies as described, instead creating unique instantiations of them for each project (Barrow et al. 2005; Fitzgerald 1998b; Hardy et al. 1995). An extensive search of the literature in the fields of Information Systems, Computer Science, Software Engineering and Methods and Systems Engineering revealed surprisingly few studies of how practitioners apply an ISDM in...
practice. Existing studies have examined students rather than practitioners; have examined the application of the methodology to sample, rather than real problems; or have performed the study in a laboratory rather than in the practitioner’s usual working environment (Wynekoop et al. 1997). Several authors have noted these limitations and have called for research on how methodologies are actually used (Aydin et al. 2005; Vigden et al. 2004).

Consistent with the above, the following research question is posed:

What are the influences that lead to the tailoring of methodologies?

This paper provides an overview of the literature in the field which has led to the construction of an initial conceptual framework. It then outlines a research design for investigating the research question, and the results of an exploratory study. A revised conceptual framework which incorporates these findings is presented and areas for future study future are described.

Background

Defining ISDMs

The distinction between a method and a methodology is one which is often blurred, with some authors expressing the view that an ISDM is founded on an underlying philosophy, and thus is cast at a higher level conceptually than a method (i.e. a method provides a greater level of practical detail), whilst others use the terms interchangeably.

The British Computer Society Information Systems Analysis and Design Working Group has defined an ISDM as a “recommended collection of philosophies, phases, procedures, rules, techniques, tools, documentation, management and training for developers of information systems” (Avison et al. 2003, pg. 528). In this view it is the inclusion of a philosophy which distinguishes a methodology from a method, where the philosophy is the “…underlying theories and assumptions that the authors of the methodology believe in and that have shaped the development of the methodology” (Avison et al. 2003, pg. 528). Several other authors take the view that an ISDM includes a philosophy. Iivari (1996), for instance, states that a methodology is “…based on some ‘philosophical’ view” whilst Wynekoop and Russo (1993) also see it being “…based on a particular philosophy of system development and the target system”.

Whilst a number of authors have commented on the importance of an underlying philosophical basis to an ISDM, it should be recognized that this is not a universally accepted point of view. Hansen et al. (2004), for example, comment that ISDMs are used in a “pragmatic” way by taking an eclectic mix of method fragments and that this undermines the practical effects of the application of the underlying philosophy or the ISDM itself.

Avison and Fitzgerald’s (2003) framework for understanding the underlying philosophy upon which a methodology is based focuses on four factors:

a) Paradigm – Two alternative paradigms are identified which may underpin the philosophical basis of a methodology: the science paradigm with its emphasis on “…reductionism, repeatability and refutation”; and the systems paradigm with an emphasis on understanding “…the whole picture, the emergent properties, and the interrelationships between parts of the whole”;

b) Objectives – A distinction is made between methodologies which aim to simply develop a computerized information system, and methodologies which adopt a broader view including as part of their scope “…manual, procedural, managerial, organizational, educational, or political change”;
c) Domain – This factor refers to the domain of situations which the methodology addresses. This can vary from viewing the task as being to address a specific, often narrowly defined problem, to taking a much broader view in which rather than attempting to solve specific problems an understanding of the organization is first obtained from which a system designed to meet the wider organizational needs can be developed; and

d) Target – This relates to the applicability of the methodology. Some methodologies focus on addressing specific types of problems or environments whilst other methodologies are claimed to be more generic in terms of the problems which they attempt to solve.

Avison and Fitzgerald’s framework also includes additional elements for the purpose of comparing different methodologies. These additional elements include the model used as the principal means of communication for abstracting the important factors in the system and the use of techniques and tools which the ISDM may mandate.

**ISDMs in Use**

The principal rationale for using ISDMs is to improve the likelihood of project success. It has been suggested that they achieve this by improving both the quality of the process and product and that they do this by:

- Improving the process of systems development and the manageability of the development process (Avison et al. 2003; Fitzgerald 1994; 1998b; Russo et al. 2000; Sawyer et al. 1998; Truex et al. 2000; Wynkoop et al. 1993);
- Capturing and recording collective knowledge and experience and providing a common vocabulary with which information and ideas can be exchanged between practitioners (Fitzgerald 1998b; Riemenschneider et al. 2002; Stolterman 1994); and
- Improving the productivity of the programming task and the quality of the end product (Riemenschneider et al. 2002).

Studies of the application of ISDMs in practice have shown that they are generally not used as documented but instead a unique instantiation of the ISDM is created for each project (Barrow et al. 2005; Carroll 2003; Fitzgerald 1998a; 1998b; Hardy et al. 1995). The process by which this unique instantiation is created is referred to throughout this paper as “tailoring”. The reasons cited for departure from the documented form include:

- The rigid application of the ISDM constrains creativity or intuition and limits the possible set of solutions explored, or the rigid application of the ISDM limits opportunism and contingency (Carroll 2003; Fitzgerald 1994; Russo et al. 2000);
- The philosophical basis of the selected ISDM is flawed (Button et al. 1994; Gasson 2003); and
- The ISDM does not reflect the way people actually work (Fitzgerald 1994).

Many of the early studies of the application of ISDMs have been criticized for ‘flaws’ in research design, including the participation of students rather than practitioners; that the ISDM was applied to sample rather than real problems; and that the study was performed in a laboratory rather than in the practitioner’s usual working environment. Consequently there have been calls for studies that are not subject to these limitations (Aydin et al. 2005; Vigden et al. 2004). This paper reports the early stages of a project that is designed to address these criticisms.
Research Design

Initial Conceptual Framework

An initial conceptual framework to represent the tailoring process was developed from several sources including personal experience (such as outcomes from a pair of workshops conducted as part of a preliminary study in 2004 (Barrow et al. 2004; 2005)); a review of the literature; and interviews and preliminary discussions with ISDM experts from different organizations. The initial conceptual framework is shown in Figure 1.

The initial conceptual framework depicts a methodology existing in three states. The Methodology-as-Documented is the “official” documented form of the methodology. It includes a philosophy and other elements as outlined by Avison and Fitzgerald (2003). This Methodology-as-Documented is subjected to a conscious process of tailoring prior to the start of a project to produce the Methodology-as-Anticipated, taking into consideration:

- External environment influences including: legislation; standards; and customer/stakeholder pressure (Fitzgerald 1996; 1998a).
- Organizational issues internal to the development organization including: size of the organization; familiarity with the technology being proposed/employed; and organizational culture with respect to methodology application (Avison et al. 1999; Riemenschneider et al. 2002; Rossi et al. 2004; Truex et al. 2000).
- Project attributes/constraints including: problem space; problem definability; problem complexity; project constraints; nature of the solution – packaged or custom; maturity of the selected technology/product; and project phase/time (Avison et al. 1999; Aydin et al. 2005; Fitzgerald 1998a; Goulielmos 2004; Khushalani et al. 1994; Rossi et al. 2004; Truex et al. 2000; Wynekoop et al. 1993).
- People/roles including: length and breadth of industry experience; formal academic qualifications and industry certifications; personal qualities; and personal perceptions of usefulness and ease of use of methodology or developer commitment to the methodology (Avison et al. 2003; Davis 1989; Fitzgerald 1998a; Riemenschneider et al. 2002; Sawyer et al. 1998).
Analysis of the data generated from personal experience; a preliminary study; a review of the literature; and interviews and preliminary discussions with ISDM experts from different organizations, resulted in the identification of a set of ISDM tailoring influences. Developers respond to these influences to produce a Methodology-as-Anticipated. This is the Methodology-as-Documented tailored to take into account the combination of attributes and influences unique to a specific project and development organization within a particular external environment. The Methodology-as-Anticipated may then be further tailored by ISDM practitioners in an opportunistic or contingent way as they apply it during a project. This results in the production of what Fitzgerald (1998b) refers to as a “unique methodology-in-action”.

Research Design

An in-depth study of a large organization, with lengthy ISDM usage experience, and with a culture of acceptance of ISDMs, was deemed appropriate for the examination of the process by which an ISDM is applied in practice. As the process of ISDM tailoring is one which may cover an extended period (years in the case of a large project), it was necessary to bound the scope of this exploratory study. The scope excludes consideration of the process by which the Methodology-in-Action is generated and focuses instead on the process by which the Methodology-as-Documented is tailored to become the Methodology-as-Anticipated. This process is little understood and rarely examined in the research literature. Field research was undertaken to examine the way in which tailoring of an ISDM to produce a Methodology-as-Anticipated actually occurred. This was achieved by observing real developers in a real-life organizational context, working on real-life projects.

The organization chosen as the focus of an initial study (referred to here as “Sysco”) is a large, global provider of information technology hardware, software and services. It was chosen because it had a well-documented set of methodologies for information systems development, an organizational commitment to its use, and a willingness to provide the researchers with access to the methodologies and to the projects to which they were being applied.

Sysco’s methodology has been iteratively developed as a result of use on thousands of projects of different sizes globally. It consists of a framework which supports a number of what are referred to as “Engagement Families”, each of which consists of sets of Engagement Models which share close relationships within a common area of customer need and which describe how to deliver a project in terms of a work breakdown structure. It is documented as a standard practice (and in fact is part of the Methodology-as-Documented) that when applying Sysco’s methodology, a selected Engagement Model is tailored further at the commencement of a project to suit the particular characteristics of that project.

To develop as rich a picture as possible of the documented influences upon the tailoring of the selected ISDM, a review of all available documentation including work products, roles, technique papers and education and training materials was undertaken.

A previous section of this paper highlighted the view of many authors that the underlying philosophy of the ISDM, whether implicit or explicit, is a critical element to developing an understanding of how that ISDM should be applied. A semi-structured interview schedule was therefore developed, using Avison and Fitzgerald’s framework (2003) as a starting point, in order to clarify the philosophy of Sysco’s methodology at both the framework and
Engagement Levels. The “owner” of Sysco’s methodology in Australia was interviewed. Several sets of supplementary questions were later sent to the methodology “owner” in order to clarify areas of ambiguity.

The conceptual framework was then used to guide the design of a separate semi-structured interview schedule which explored influences upon the tailoring of the methodology. In this case skilled methodology practitioners were chosen as the interviewees, in order to address criticisms that have been levelled at previous studies that have focused on novice, student developers. It remains an open question, and a possible subject for future research, whether influences are substantially different for less skilled developers. Five skilled methodology practitioners were interviewed in the present exploratory study.

These semi-structured interviews were conducted with both the methodology “owner” and with the skilled methodology practitioners to explore poorly-understood aspects of methodologies and their use in commercial contexts. Semi-structured interviews are suited to examining areas of uncertainty (Fontana et al. 2000). Each interview was recorded with the interviewee’s informed consent, all identifying information removed, and the interview transcribed. As the interviews were semi-structured, participants provided unprompted responses as well as answers to questions derived from the conceptual framework. Following the completion of the transcription process, a copy of the transcript was sent to each of the participants who were asked to read and confirm the accuracy of the transcript. Each participant agreed that the transcript represented an accurate account of the interview.

The questions put to the methodology “owner” were analysed using the concepts in the Avison and Fitzgerald framework (2003) whilst each interview with the Sysco skilled methodology practitioners was coded using a manual coding process following the guidelines of Miles and Huberman (1994). No a priori coding scheme was used, with codes emerging from the analysis of the transcript and then compared against the postulated influences upon ISDM tailoring previously identified in the initial conceptual framework (see the discussion in Section 3.1). After all interviews had been initially coded, a superset of codes was developed from the code sets from each interview, and each interview was then re-coded using this superset.

Findings and Discussion

Methodology Philosophy
The purpose of the interview with the “owner” of the Sysco methodology was to uncover the underlying philosophical basis of the methodology at both the framework and Engagement Model level. The responses were analysed using Avison and Fitzgerald’s framework as a guide, and are presented in Table 1.

One interpretation of the responses provided by the ISDM owner is that Sysco’s methodology is in fact a “meta-methodology”, the purpose of which is to provide a common framework with which Engagement Models focused on specific problem domains may be created. It is these Engagement Models which represent what Avison and Fitzgerald (2003) refer to as an ISDM. The Engagement Models are thus already partially tailored, enabling solutions to problems encountered previously on similar projects to be re-used and applied more readily. This is a practical and innovative way to overcome some of the problems encountered when implementing methodologies, and is compatible with Kumar and Welke’s (1992) view that “meta-methods” which can be assembled in response to project factors to quickly and efficiently produce a method should contain “pre-defined and pre-tested components”. At the
commencement of a project, there is further tailoring of the engagement model to suit the characteristics of the particular project - this produces the Methodology-as-Anticipated. This is shown in the revised conceptual framework (see Figure 2) where the Methodology-as-Documented is founded on the meta-methodology.

### Table 1 - Analysis of the philosophy of the Sysco methodology using the framework of Avison and Fitzgerald

<table>
<thead>
<tr>
<th>Avison and Fitzgerald Methodology Philosophy Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paradigm</strong></td>
<td>The Sysco methodology fully supports both the science and system paradigms. Individual engagement models, however, are based on one or the other.</td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
<td>The Sysco methodology is very broad in that it makes no assumptions about the objective other than being the development of a computerized information system. Individual Engagement Models, however, may have specific objectives.</td>
</tr>
<tr>
<td><strong>Domain</strong></td>
<td>The Sysco methodology is agnostic with respect to problem domain; however, individual Engagement Models do take particular positions as to the breadth of the problem domain that they cover, with some models taking a very broad approach, including analysis of the client organization and business drivers, whereas others take a much narrower approach and focus more on the technological aspects, usually according to client requirements.</td>
</tr>
<tr>
<td><strong>Target</strong></td>
<td>The Sysco methodology is general purpose, being applicable to problems ranging from those requiring purely IT solutions to business consulting and operations. Engagement Models are specific to a particular type of problem or environment.</td>
</tr>
</tbody>
</table>

**Influences on Tailoring**

Common themes (Miles et al. 1994) identified by the skilled Sysco methodology practitioners included:

- The perception of their role as essentially being that of problem solver. Several of them, when asked which parts of their job they particularly enjoyed, explicitly identified this: “Oh, problem solving, looking for opportunities to improve….”
- Having their own “formula” or heuristics for methodology application. One interviewee stated “…you’ve got your, your kit bag of work products that you know that you’ve used on multiple occasions that have been successful”, and “…you know the successful formula, somebody has to have a good reason as to why you wouldn’t…” apply it.
- A variety of tailoring processes exist, varying in the degree of formality. The principal reason cited for preferring a less formal approach was the belief that a formal process inhibits the ability to explore all potential options for a solution: “…in the rigid format also if you have so many people in the room, you have to accommodate everybody, and everybody’s not on the same page at any point in time you have to assume”. This is consistent with literature which reports that a rigid application of an ISDM constrains creativity or intuition and limits the possible set of solutions explored, or the rigid application of an ISDM limits opportunism and contingency as outlined earlier (Carroll 2003; Fitzgerald 1994; Russo et al. 2000).

Triggers identified for the initiation of tailoring of the Sysco methodology were:
• Project attributes: the type of problem, whether it requires a custom or packaged solution, and the problem domain were identified as factors for tailoring the selected engagement model (see also Aydin et al. 2005; Goulielmos 2004).

• Client Organization standards – some client organizations have their own methodologies, and deliverables to the client often have to conform to these standards. This may result in a change from the documented form of the selected engagement model, by supplementing the client methodology with a selection of work products from the selected engagement model.

• Skill sets of the personnel involved in the project – different Sysco skilled methodology practitioners had different ways of dealing with this trigger. One interviewee stated that their response to this trigger was to assume the lowest possible skill level for the personnel engaged and to provide as much detail as possible in the work products produced. This also served as a personal strategy to overcome ambiguity. Another respondent stated that if the requisite skills were not available on the project team, “….then you need to recruit people with the capability.”

• Time at which the skilled methodology practitioners are engaged on a project – ideally, they would be engaged at the commencement of a project, however, this is not always the case. In such situations the nature of the tailoring of the selected engagement model would typically result in conducting an “informal” methodology tailoring workshop in conjunction with one or two other key personnel rather than the “formal” documented form (which often involved multiple stakeholders).

• Level of perceived risk associated with a project – where the skilled Sysco methodology practitioner felt that there was a high level of risk (for example the proposed use of an immature technology) they would tailor the documented form of the selected engagement model in a specific way. For example the use of an immature technology resulted in the ISDM practitioner insisting on the inclusion of a “proof of concept” work product.

• The degree of mis-match between the problem and the selected engagement model – one interviewee responded that where they felt that there was a mis-match between the problem and the selected engagement model they would take into consideration what the model said and would then identify the work products that they thought were appropriate for the problem based on their experience. This may include the addition of work products from outside the selected model, deletion of work products from the selected model, or modification to work products.

Several influences on the actual tailoring process were also identified.

• Experience of the methodology practitioner, with breadth of experience being more important than length. This is consistent with the findings of Curtis et al. (1988) who found that one of the key problems in systems development was in understanding the problem and that the key to overcoming this was application of knowledge acquired through experience more so than training.

• Personal qualities of Sysco methodology practitioners – Sysco methodology practitioners believe that “soft skills” such as conflict resolution skills, negotiation skills and people management skills were key to success in the role. As one interviewee put it “You may have the technically best solution to meet those requirements, but if you don’t have that relationship don’t worry about it”. The emphasis is less on fine grained technical detail and more on softer, non-technical skills.

Reflection on the generated themes resulted in the initial conceptual framework being further revised (see Figure 2).
Of the six categories of tailoring influences identified in Figure 2, four had been identified in Figure 1 (shown as unbolded in Figure 2). Of those already identified in Figure 1, one component of one category was explicitly rejected by all interviewees as an influence when they tailor an ISDM. All subjects interviewed stated that whilst external influences would often impact on the way the ISDM was tailored, legislation would have no impact on the way in which they went about tailoring the methodology. Two of the interview subjects highlighted that whilst a legislative requirement may drive the development project in the first place (e.g. changes to taxation, compliance with privacy legislation) legislation itself would not affect the way in which the ISDM was tailored.

However, several of the influences on ISDM modification identified in the revised conceptual framework were supported strongly by the interviews. For instance, external influences such as technological standards and customer/stakeholder pressure (to use a particular technology, approach, or to meet specific time or budgetary constraints) were identified by the interviewees as influences on ISDM tailoring. Similarly, attributes of the project, such as the nature of the problem; the nature of the solution; when the Sysco methodology practitioner was engaged; and the maturity of the technology required or being proposed, were all confirmed as influences on the way the Sysco practitioner would tailor the methodology in practice.

An examination of the influence of the development organization on the process of methodology tailoring will be deferred until the final phase of the study, following an intensive study of the process of ISDM tailoring within the initial development organization (Sysco).

Of particular interest are two new categories of influence on ISDM tailoring emerged from the interviews. The first is client organization standards. A number of interviewees commented on projects where the client organization possessed its own ISDM, and one of the
key tasks was to tailor the Sysco methodology to suit the client organization ISDM. This tailoring can take the form of modification to the content of methodology artifacts and changes to the format of work products produced to conform with those of the client.

Secondly, the level of risk perceived by the Sysco practitioner was also identified as an influence on the tailoring process. For instance, one practitioner’s approach to this was to ensure that all methodology artifacts which may be relevant are included in the Methodology-as-Anticipated. In the opinion of this practitioner, deleting tasks or work products which may have been identified in the Methodology-as-Documented adds a certain element of risk to the project.

Conclusions and Future Work
The study has enabled the development of an understanding of the origins and objectives of a well-documented, widely-used, commercial ISDM, the Sysco methodology. The Sysco methodology has been analysed at several levels, including at the framework or “meta-methodology” level (where it is agnostic in terms of the underlying paradigm, objectives, domain and target). At this level, its purpose is to enable the creation of domain-specific Engagement Models which share a common structure, notation and terminology.

The Sysco methodology has also been analysed at the substantially domain-specific Engagement Model level, where typically a particular stance on each of the four elements of the philosophy referred to earlier is taken. This is one organization’s innovative approach to overcoming the documented problems in applying ISDMs in practice. The provision of an over-arching “meta-methodology” gives Sysco methodology practitioners with a general framework with a common structure, notation and terminologies in order to facilitate information sharing and re-use across its organization. The domain-specific Engagement Models within this framework, then represent forms of the “meta-methodology” already tailored to some extent, to deal with specific types of problems.

The study developed understanding of the way in which experienced practitioners of the Sysco methodology apply it in practice. We found that tailoring of the Sysco methodology occurs in at least three ways. Firstly, there is the tailoring of the generic Sysco methodology framework to produce the various domain specific Engagement Models. Secondly, there is the deliberate tailoring of a selected Engagement Model prior to the commencement of a project. This deliberate tailoring takes into account a variety of influences presented in the revised conceptual framework. Thirdly, there is the “ad hoc” tailoring by developers once engaged on the project. This ad hoc tailoring enables the ISDM to meet the real, unfolding needs of the project and for the ISDM to be tailored to fit project attributes that may not have been known or anticipated at the time of the initial tailoring.

Analysis and reflection on the data has highlighted omissions in the initial conceptual framework and resulted in the construction of a revised conceptual framework which incorporated the insights gained into the process of methodology tailoring during the study, including the importance of the role of the methodology practitioner in the methodology tailoring process, the influences which affect the tailoring process and the form which the tailoring took.

These results are useful because while the use of ISDMs has generally been accepted to be appropriate when constructing an information system, there is recognition that the chosen ISDM must be tailored to suit the unique combination of characteristics which a specific
This tailoring process, however, has not been well understood. This study has added to the understanding of the tailoring process revealing that successful practitioners of this ISDM apply an experience-based personal “formula” for methodology tailoring in which the degree of formality applied to the tailoring process varies. This has implications for the designers of ISDMs since an ISDM which is intended to be tailored in a highly prescriptive way may not be successfully applied.

This study has provided a platform for further study in which the relationship (if any) between the influences on tailoring, the form which the tailoring takes, and the methodology practitioner (especially their personal way of working) will be examined and documented.

This initial study, however, is subject to several limitations. Firstly, it relies on interviews as the primary data collection method, so only post hoc recollections of the tailoring process have been collected. Secondly it examines the process of ISDM tailoring in a single organization (Sysco), although with respect to several different client projects. The first limitation will be addressed in the next stage of the study in which in situ observation of Sysco methodology practitioners tailoring the methodology on several live projects in their usual working environment will be undertaken. The second limitation of this study will be addressed by a subsequent comparative study, examining ISDM tailoring in other large Australian development organizations.

It is clear that ISDM modification is complex and that development of a rich understanding of it will only occur by observing skilled, experienced methodology practitioners as they go about the tailoring process. A more detailed description of the tailoring process (which was not possible to provide in the space constraints of this publication) will be the subject of later publications.

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