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Knowledge clusters: Dealing with a multilevel phenomenon

Kieran Conboy
National University of Ireland, kieran.conboy@nuigalway.ie

Thomas Acton
National University of Ireland, thomas.acton@nuigalway.ie

Raija Halonen
National University of Ireland, Galway and University of Oulu, raija.halonen@nuigalway.ie

PRESENTING DATA FOR TEAM-BASED DECISION-MAKING IN AGILE INFORMATION SYSTEMS PROJECTS

Conboy, Kieran, National University of Ireland, Galway, University Road, Galway, Ireland, kieran.conboy@nuigalway.ie

Acton, Thomas, National University of Ireland, Galway, University Road, Galway, Ireland, thomas.acton@nuigalway.ie

Halonen, Raija, National University of Ireland, Galway, University Road, Galway, Ireland, raija.halonen@nuigalway.ie

Abstract

Although there are a number of purported benefits of agile systems development methods over traditional forms, many in the Information Systems Development (ISD) community highlight the difficulties that the dynamic, turbulent nature of agile development environments may present. One prominent difference compared to traditional ISD projects is the emphasised presence of the customer in decision-making. Specifically, project management and decision-making can be significantly more challenging than in projects involving traditional development approaches. This paper describes a research-in-progress, that focuses on decision-making in agile projects, and aims to develop a better understanding of how agile teams present dynamic data to decision makers who may act "on the fly", and in so doing lead to effective, high quality decision-making in agile environments. The goal of the paper with its three case studies is to develop a set of best practices for representing decision-making data in agile ISD projects.

Keywords: Agile IS project, Decision-making, Data presentation.

1 INTRODUCTION

This research captures one of the state-of the-art development methods of today. The last 10 years or so has seen the emergence of a number of information systems development (ISD) methods, which have collectively been labelled as agile. Some of the most popular include eXtreme Programming (XP) (Beck 1999), the Dynamic Systems Development Method (DSDM) (Stapleton 1997), Scrum (Schwaber & Beedle 2002), Crystal (Cockburn 2001), Agile modelling (Ambler 2002), Feature Driven Design (FDD) (Coad et al. 1999), and Lean Software Development (LSD) (Poppendieck 2001), along with variants of each e.g. XP-Lite (Aveling 2004). These methods have been well received by those in ISD and there is strong anecdotal evidence to suggest that awareness and indeed use of these methods is highly prevalent across the community. However, use of these methods has a significant impact on the project's decision-making processes.

Therefore, this research-in-progress paper aims to investigate and develop appropriate methods of data presentation to support high quality decision-making in agile information system projects with the means of qualitative multiple-case design (Benbasat et al. 1987).

In an agile development environment, the project manager's role as a decision-maker is greatly reduced, and is more akin to that of a facilitator or coordinator (Nerur et al. 2005; Alleman 2002; Lindstrom & Jeffries 2004). Further, the development team makes most of the decisions, creating a "pluralist decision-making environment" (Nerur et al. 2005) due to the diverse backgrounds, attitudes, goals, and cognitive dispositions of the team members (Highsmith 2004; Chin 2004; Cockburn & Highsmith 2001). In agile projects, the organisation or team structure is "organic and flexible", as opposed to traditional structures which are "mechanistic, bureaucratic and formalized" (Nerur et al. 2005); the project is completed through a series of iterations, each often as short as a few working days (Fowler & Highsmith 2001; Fitzgerald et al. 2006), resulting in more frequent, short-term decision-making; and software is valued over documentation (Fowler & Highsmith 2001) which was traditionally used as a vital decision aid. Significantly, the customer plays a more continuous and embedded role, and thus is intrinsically involved in most decisions (Griffin 2001; Farell et al. 2002; Beck & Andres 2004; Beck 2000). Moreover, developers are not confined to a specific specialised role and are encouraged to self-organise, interchanging and blending roles (Nerur et al. 2005) and involved in decisions that may fall outside their traditional skill areas.

One could assume that decision-making in an agile environment should be ad hoc, unstructured, and without discipline. Indeed, there is a common misconception that agile methods are centred around improvisation, and care-free deviation from rules and regulations. However, Beck dismisses this stating that agile "is not an excuse for unilateral behaviour" and he views agility versus discipline as a "false dichotomy" (Beck & Boehm 2003). In fact he argues that agility "is only possible through greater discipline on the part of everyone involved". The need for discipline has been stressed by many key texts across a broad range of the agile methods (e.g. Schwaber 1996; Cockburn 2001; Cockburn 2002; Schwaber and Beedle 2002; Beck and Andres 2004).

Next, we present the research objectives of our study. After that, the theoretical background for decision-making in agile IS projects is presented. Then we describe the research approach and the empirical cases of our study.

2 RESEARCH OBJECTIVES

As is often the case with new and emerging phenomena in ISD, agile method practice has led research, with the creation, promotion and dissemination of these methods almost completely due to the efforts of practitioners and consultants. Agile method research has gained momentum in more recent years,

but has been argued that the current body of agile method knowledge suffers from a number of conceptual problems such as a lack of clarity, parsimony, cumulative tradition, and theoretical 'glue'.

One key weakness of agile method research is a lack of focus on how best to present data for decision-making in such an environment, particularly when many contribute to and are involved in the decision process. Indeed decision-making in this context is much different to that associated with traditional systems development, with many additional complexities, uncertainties and hurdles to overcome. There is a need to capture and represent metrics on the progress of the project, for example, estimates and bounds for stage delivery, dependencies and required resources for iterative development, timeline information on next stages, personnel information such as planned vacations, and external factors such as customer availability for development across iterations. Typically these are dynamic data, and are best represented either in tabulated formats with columns and column attributes, or in other aggregate representations such as appropriate graphs and charts. Indeed the latter has been shown to be particularly valuable in decision-making instances and scenarios involving key performance indicators. It follows that the format of presented data can be influential in decision-making scenarios. In agile development the customer plays a more continuous and embedded role, and thus is intrinsically involved in most decisions (Griffin 2001 ; Farell et al. 2002 ; Beck & Andres 2004 ; Beck 2000). This in contrast to more traditional approaches where customers do not get involved in day-to-day operational development; rather their involvement is limited to intermittent events such as prototyping sessions and release meetings.

It follows that data presented to decision makers in agile scenarios needs to be accessible to many people with varying roles and foci: considering the frequency of decisions in these environments together with the team-based approaches to decision-making endemic in agile projects and a need for timely decisions, it would seem sensible that data are presented to all actors in a manner that enables team interactions and facilitates the decision making process. One such manifestation of this may involve a single presentation technique to all involved, perhaps displayed on a computer screen or projection, that is easy to understand, displays interactions between variables, and allows data manipulation during the decision-making process. Such a presentation mechanism would not be solely output-based insofar as offering only data display, but would be pliable in terms of enabling decision-maker interaction with the data. In so doing the presentation mechanism could support the decision-making process.

In this study we seek to investigate decision-making efficacy in agile projects by exploring how best to present dynamic data to decision makers in team-based decision scenarios. The primary focus is in understanding the decision-making strategies in agile project management, supporting high quality decision-making through data presentation. The study will examine the decision strategies involved by project managers and teams in ensuring the success of agile projects in a context with both customer and IS teams consisting of diverse professions as the decision-making can not be studied outside its natural setting (see Benbasat et al. 1987). Furthermore, the study will investigate the appropriateness and value of various data presentation techniques to best support quality decision-making. In so doing, as output the study aims to develop a data presentation model for quality decision-making in agile projects involving the composition, structuration and presentation of relevant data.

The framework (Fig. 1) for the study is as follows:

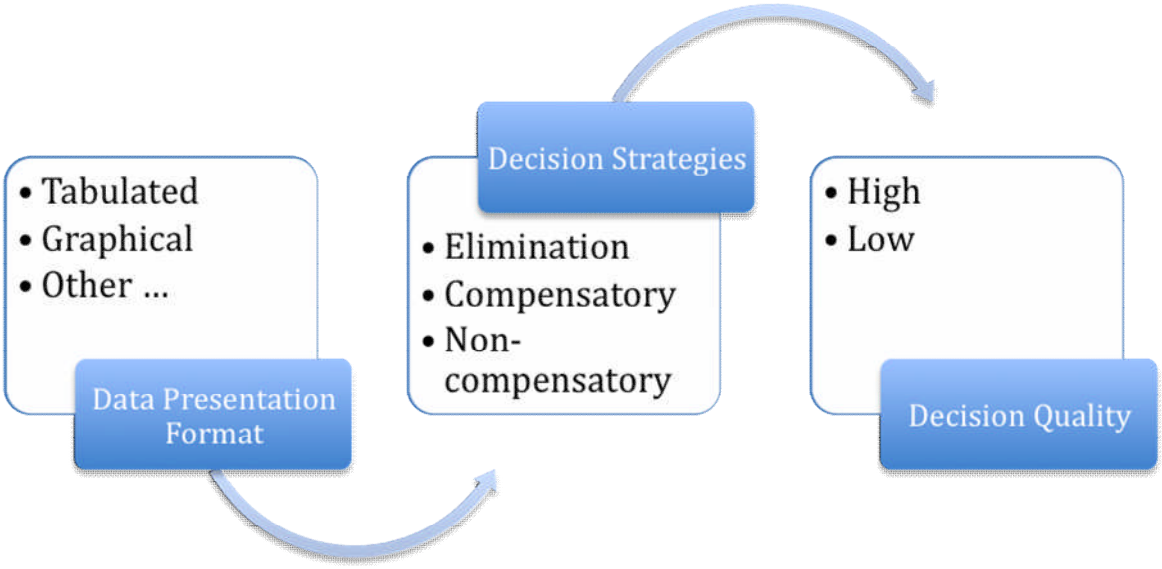

Figure 1. Framework for quality decision/making in agile projects

Commensurate with the IS literature in this regard, we assume that decision makers will employ an effort-accuracy tradeoff in the decision-making process, and seek to reach an optimal decision with least effort. We also assume that the format of the data used in the decision-making process can support particular decision-making strategies: it remains to be seen whether such presentation formats can encourage quality decision-making by promoting superior strategies, but in so doing reduce the effort required for their use, and therefore provide a mechanism whereby decision makers are likely to employ such strategies.

Through an examination of the impact of data presentation on decision strategies used in the decision-making process, the study will provide a best-fit model of data presentation formats best suited to quality decision making in agile project management. Our research objective is thus: To investigate and develop appropriate and effective methods of data presentation to support high quality decision-making in agile information systems project management.

To realise the objective we will explore the decision-making strategies in agile project management, and investigate the effects of various data presentation formats on these strategies. Considering that there is substantial evidence in the literature that decision processes and employed strategies can directly impact decision quality, we strive to investigate decision making in agile development projects from a process perspective, with the aim of that identifying optimal decision strategies and the presentation formats underpinning them, so that decision quality can be maximised.

3 THEORETICAL BACKGROUND

Decision making is the performance of a task, that of making a particular decision (Bahl & Hunt 1984). Project managers and agile teams are faced with decision tasks on a daily and more frequent basis, with the occurrence of such tasks increased in agile development projects as a consequence of rapidly changing requirements, expectations, and their underlying data. Typically these tasks involve choice, with the decision makers presented with large amounts of data, and categories of data describable by various attributes that may influence the value of those data for decision-making. Decision makers in dynamic contexts need to assess various courses of action, various potentially good avenues of resource, or investigate the relativity of one potential decision over others, and make a choice. Such activities are multifaceted, and the process of quality decision-making includes aspects such as decision maker behaviours and strategies, the inherent timeliness of decisions particularly impactful in agile development scenarios, as well as data-related aspects such as data representation.

A decision strategy can be considered as a method (sequence) of operations for searching through a problem space (Payne et al. 1988 ; Todd & Benbasat 1999). Some strategies are better than others, infosar as leading to higher quality decisions. Benbasat and Todd (1996) argue that decision makers have "a series of pre-existing strategies which have been learned and stored in memory", and to formulate a strategy, they make a selection "from a repertoire of pre-existing strategies which may be applied or adapted to the problem at hand." They argue that the determination and application of a particular decision strategy is contingent upon the capabilities of decision makers as well as the characteristics of the problem (that is, the decision-making task) and the availability of decision aids as tools to support particular strategies. However, in choice-based decision-making scenarios, with decision makers choosing from alternatives, the use of particular decision strategies is dynamic, and decision makers are highly adaptive in strategy selection (Payne 1976 ; Kuo et al. 2004 ; Häubl & Trifts 2000). Decision making is the accomplishment of a decision task, where decision influences are assessed and where a decision choice is made. The application of strategies and decision-making approaches can be task-centred, with decision-making behaviours influenced by the nature of the task as well as other factors.

The choice and use of a particular decision strategy, or combination of strategies, is dependent upon many factors. The cognitive ability of the decision maker in conjunction with behavioural characteristics and decision styles can influence strategy selection and can impact decision making. Further, the nature of the decision-making task can lend itself to the employment of particular strategies: the use of accurate but more effortful strategies can arise in tasks where there is an importance attached to the decision outcome, and where decision-making time may be secondary to decision outcome. Also, data presentation formats may influence strategy selection, with particular display formats commensurate moreso with higher quality strategies.

The cognitive ability of decision makers in conjunction with behavioural characteristics and decision styles can influence strategy selection and can impact decision making. Indeed many other person-centric and behavioural factors can be influential in the decision-making process, including self-efficacy, decision and management styles, team skills and others: a more thorough discussion is presented by Moldafsky and Kwon (1994). Decision makers perceive only that information relevant in order to achieve a specific goal within the problem space under consideration (Yadav & Khazanchi 1992). Zmud (1979) argues that whilst information requirements of decision makers are task-dependent as well as influenced by situational and individual characteristics, decision makers too often do not understand their information requirements, and demand too little or too much information. Further, he argues that decision makers are typically unable to make full use of the information provided or available in reaching a decision. Tasks best requiring the implementation of particular decision strategies for their resolution may only be optimally addressed if those strategies are recognisable as appropriate or useful by the decision maker. If decision makers possess the skills, intellect, and confidence to match particular behavioural strategies to particular task scenarios, and have the cognitive abilities required to choose and implement such strategies, then more optimal strategies may be implemented (Kuo et al. 2004 ; Eierman et al. 1995). Further, the nature of the decision-making task can lend itself to the employment of particular strategies: the use of accurate but more effortful strategies can arise in tasks where there is an importance attached to the decision outcome, and where decision-making time may be secondary to decision outcome. Also, data presentation formats may influence strategy selection, with particular display formats commensurate moreso with higher quality strategies.

Studies have shown that modes of presentation of information to decision makers can be extremely influential on task performance (Garrity et al. 2005 ; Benbasat & Dexter 1986 ; 1985 ; Gershon et al. 1998 ; Jarvenpaa 1989 ; Hu et al. 1999 ; Kester et al. 2001 ; Lamberti & Wallace 1990 ; Marsden et al. 2002 ; Montazemi et al. 1996 ; Noyes & Garland 2003 ; Tan & Benbasat 1990). Vessey and Galletta (1991) found that individuals' mental representations of the task space and the processes required to complete the (problem-solving) task were influential in determining the strategies employed in task completion. Literature from behavioural decision theory as well as consumer behaviour support

problem solvers' use of processes and strategies that match the representation of the task (McClintock & Becker 1967 ; Barron 1974 ; Edwards 1961 ; Eierman et al. 1995 ; Gray & Wert-Gray 1999 ; Häubl & Trifts 2000 ; Payne 1982 ; 1976 ; Payne et al. 1988 ; Slovic et al. 1977). Further, there is evidence that individuals employ different decision-making and problem-solving processes and strategies for different types of task. Vessey and Galletta (1991) argue that matching the problem representation directly to the task positively impacts task performance, and that individuals' skills have the greatest impact on performance when there is a close match between task representation and the task itself. Indeed they found that the former was largely unimportant in isolation and that the latter was substantially more important: where task representation alone was matched with the individual skills necessary for task resolution, there were no performance effects. Where individual skills supported the task itself, or both the task and its representation, there was significantly positive performance effects. As such, skill affected task solution rather than the acquisition of information alone. However, in this study the overall performance impact of individual skill-based differences were minimal compared to the effect of a fit between the task representation and the task problem. This study (involving the comparison of alternatives across a number of attributes) found that individuals prefer tabulated information to other representative forms.

It is clear that modes of presentation of information to decision makers can be extremely influential on decision making. Vessey and Galletta's (1991) study involving the comparison of alternatives across a number of attributes found that individuals prefer tabulated information to other representative forms. Indeed Speier and Morris (2003) found that informational display format was influential in affecting decision performance. Further, Jarvenpaa (1989) found that display formats used in a multiattribute choice task were central in influencing decision strategies when the format was matched to the task, and that strategies which minimised the cognitive effort were preferred.

In this study we aim to examine the most appropriate data presentation formats to best support quality decision-making. In examining the usage, employment and selection of particular decision-making strategies, we aim to support decision making in agile projects by mapping presentation format to decision strategies, so as to promote the use of high quality strategies in the decision-making process, and thus positively impact decision quality. The study will examine a number of cases exploring how data are presented; investigate the decision strategies in use; map presentation format to decision process and strategies used; and produce a model for data presentation formats most likely to support and lead to high quality strategies in agile situations, and therefore superior decision-making.

4 RESEARCH METHODOLOGY & CURRENT PROJECT STATUS

To reach understanding of how teams act in agile IS projects; we apply experiental research methodology i.e. an integrated academic-practitioner team approach (Grant et al. 2001). With the methodology we aim to understand the "process behind the actual decisions being taken in the context of the inherent characteristics of entrepreneurs" (p. 66) in the teams of diverse professionals. The study will involve three case studies. Case studies are considered to be a suitable research approach for this study since it is exploratory in nature, with the intention of investigating decision-making in a real-life context (Stake 2000; Yin 2003) and they explore a phenomenon in its natural setting, applies several methods of data collection to gather information from one or a few entities (Benbasat et al. 1987). Empirical data will be collected over a 6 month period from December 2008 to May 2009.

	Project A	Project B	Project C
Team size	8 Ireland, 5 U.S.	24 people (sub-group of 5 using agile) Ireland 5 U.S.	7 Ireland, 6 U.S.
Team composition	1 SVP, 1 VP,1 director, 1 principal engineer, 1 tester 1 directors, 1 project manager, 1 principal engineer, 5 engineers	1 SVP, 1 VP, 1 director, 2 principal engineers 2 directors, 2 project managers, 2 architects, 15 principal engineers, 4 testers	1 VP, 1 project manager, 1 principal engineer, 1 tester, 3 engineers 1 project manager, 1 principal engineer, 1 tester, 3 engineers
Project Duration	1.5 years	7 years (2 years agile sub-group)	1 year
Type of system developed	Exploring new strategic opportunities of cutting edge Web 2.0 technologies	Security system for provision of enterprise wide access control	Suite of tools to monitor SLA adherence across Pennysoft's core application service providers (response times etc) Application for monitoring/tracking system issue resolution
Customer	Internal	Internal	Internal
End Users	General population	Pennysoft staff	Pennysoft staff

Table 1. The Profiles of the Three Cases.

In this research, we will observe the meetings and collect literary material written by the project members. Further, we will collect emails and other notes that are written related to the project. To analyse the collected material, we will use discourse analysis (Potter, 1999) that supports naturally occurring talk and discussions, keeping in mind its context.

In addition, data collection will involve personal face-to-face interviews, a technique well suited to case study data collection, and particularly for exploratory research such as this because it allows expansive discussions which illuminate factors of importance (Yin 2003 ; Oppenheim 1992). The information gathered is likely to be more accurate than information collected by other methods since the interviewer can avoid inaccurate or incomplete answers by explaining the questions to the interviewee (Oppenheim 1992). The questions will be largely open-ended, allowing respondents freedom to convey their experiences and views, and expression of the socially complex contexts that underpin ISD (Yin 2003 ; Oppenheim 1992). The interviews will be conducted in a responsive (Rubin & Rubin 2005 ; Wengraf 2001), or reflexive (Trauth & O'Connor 1991) manner, allowing the researcher to follow up on insights uncovered mid-interview, and adjust the content and schedule of the interview accordingly. In order to aid analysis of the data after the interviews, all will be recorded with each interviewee's consent, and subsequently transcribed, proof-read and annotated by the researcher. In any cases of ambiguity, clarification will be sought from the corresponding interviewee, either via telephone or e-mail. In relation to the interviews, supplementary documentation will also be collected, including project management plans, budgets and budget reports, meeting minutes and relevant e-mail communications.

Alternatively, we will carry out an interview done by questionnaires that will include both closed, semi-structured and open questions. With this choice we will ensure that we will reach also those respondents whose voice might otherwise remain unheard (Stapleton 2008).

Data analysis will use Strauss & Corbin's (1998) open coding and axial coding techniques. Open coding is "the process of breaking down, examining, comparing, conceptualizing, and categorizing data" (Strauss & Corbin 1998). Glaser (1992) argues that codes and categories should emerge from the data, while with Strauss & Corbin's approach (1998) these are selected prior to analysis. The approach adopted in this study is more akin to the latter, where the interview questions and subsequent analysis will be based on Payne's (Payne et al. 1988) decision-making model. This will provide a list of "intellectual bins" or "seed categories" (Miles & Huberman 1999) to structure the data collection and the open coding stage of data analysis.

The second phase of analysis will use axial coding. Axial coding is defined by Strauss and Corbin (1998) as a set of procedures whereby data are put back together in new ways after open coding; whereas open coding fractures the data into categories, axial coding puts the data back together by making connections between the categories and sub-categories. As the data is coded, theoretical questions, hypotheses and code summaries will arise. These will be documented in analytic memos (Miles & Huberman 1999) to aid understanding of the concepts being studied and to refine further data collection. Miles and Huberman (1999 p. 72-74) offer advice on effective analytic memos, and these practices will be followed where possible.

As categories emerge, follow-up interviews will be arranged to elicit further, richer, more focused information. This will be done to confirm, extend, and sharpen the evolving list of categories. As categories become integrated, further data collection will not tend to cause any additional categories to emerge, but rather reinforce those already in existence. At this point, the categories will be deemed to be "theoretically saturated" (Strauss & Corbin 1998), and data collection ended.

Once the decision-making process is documented and analysed, the focus will shift to constructing decision-making scenarios involving underlying data presented in various formats to decision-makers. Revisiting the cases using a think aloud protocol, the study will investigate the impact of data presentation format on the decision-making process, in terms of the decision strategies used to reach decision finality. Using decision strategies as indicators of decision-making quality from a process perspective, the study will construct a model illustrating the relationship between data presentation format and decision-making processes in agile project management.

In all, the case study database will fulfil recommendations by Yin (2003) with its components of case study notes, case study documents, tabular material and a case study narrative.

The Cases

The primary operation of Pennysoft, a large, privately owned U.S. company, (employing 40000) involves the provision of financial services and investment resources. The company has been developing software at its site in Ireland since 1995, and currently employs around 300 people at this Irish site. The software products developed are supplied mainly to internal customers in the U.S. Many projects involve co-ordinating with several teams in the U.S. and India. In many cases, the requirements are generated in the U.S. with software development then taking place in both the U.S. and Ireland. In this study we analyse three systems development project cases within Pennysoft (Table 1).

Table 1 describes the three cases highlighting their differences. By including three cases in our study we will get a good conception of how decision-making is carried out in agile IS projects. As the chosen project teams involve several professions, we will get a conception of preferred data presentation as perceived by the team members. In addition, the team compositions reveal that there

are high-ranked people involved, such as a senior vice president (SVP) and vice presidents (VP) and this situation may influence the decision-making (see Stapleton 2008).

While we aim to examine the most appropriate data presentation formats to best support decision-making, we believe that the three cases offer good insight into real-time decision settings and environments.

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