An Empirical Investigation into IS Development Practice in New Zealand

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Abstract

A Web-based survey of 106 large New Zealand organisations was undertaken to gain an understanding of their IS development practices. The survey focussed on the contribution of standard methods and user participation to IS development. Among the findings were that 91% of the respondents used a standard method in the development process in at least some projects undertaken in the last three years. All organisations reported using some level of user participation. The majority of organisations agreed that organisational issues had been more important than technical issues in determining the outcome of the IS development in these projects.

Keywords: Systems development, standard methods, user participation, New Zealand

1. INTRODUCTION

Information systems (IS) development is a central area of interest in the IS field, and has been the subject of academic research for many decades. Despite the attention given to investigating IS development practices and processes, IS projects continue to fail (Beynon-Davies, 1995; Ewusi-Mensah, 1997; Neumann, 1997). In New Zealand, there have been a number of high profile IS failures, including the multi-million dollar abandonment of major projects in the government and health sectors. The negative impacts of such failures include not only the financial cost but the creation of a risk-averse attitude in managers and the alienation of users with regard to future IS initiatives.

IS development projects may fail for many reasons (Oz and Sosik, 2000). More often than not, project failure appears to be due to organisational issues rather than technical problems. These include poor project management, ineffective communication, inadequate financial and human resources, lack of top management support, and the failure of users to accept the developed system. To address these issues, experts have advocated the adoption of practices such as using standard development methods and encouraging the participation of systems users in the development process to improve the likelihood of a satisfactory development outcome. Such practices have been shown to be important because they impact on how the development process unfolds, what costs and resources are required, on how stakeholders in the process interact, and on the final form of the system.

Many IS researchers see the widespread adoption of rigorous and formal methods of development as a way of increasing control over development success (Fitzgerald, 1996). Despite this, empirical studies have found that many developers still do not use a systematic method of IS development (Fitzgerald, 1998; Rahim et al., 1998). Even when standard methods are used, researchers have found that their use in practice differs substantially from the prescribed approach (Fitzgerald, 1997; Wynekoop and Russo, 1995).

The findings of empirical research on user participation in IS development are inconclusive and contradictory. User participation in the process sometimes delivers positive benefits, but not always (Gallivan and Keil, 2003; Kirsch and Beath, 1996; McKeen and Guimaraes, 1997). Furthermore, proponents of user participation in IS development often fail to specify the nature and extent of user participation, or at what point in the development process it occurs. Even when detailed prescriptions for user participation are provided, there is minimal empirical evidence as to their efficacy.

Little is known about the role of standard methods and user participation in IS development within New Zealand organisations. Given their age and restricted nature, prior surveys of New Zealand organisations reveal only limited information (Groves et al., 1999; Urban and Whiddett, 1996). The main focus of this study was to provide a comprehensive and up-to-date assessment of IS development practice in New Zealand organisations. More specific objectives included establishing the nature and extent of both standard method use and user participation in practice, and their perceived contribution to the outcome of the IS development process.

2. RESEARCH METHOD

A survey was used to collect data on IS development practice in New Zealand organisations, including the use of standard methods of development and the participation of users in the development process. While acknowledging the limitations of data collected with this approach, we argue that a survey allowed us to collect descriptive data from a large number of organisations (cf. Fitzgerald, 1998; Kiely and Fitzgerald, 2002). This is consistent with our objective of obtaining a current assessment of IS development practice in New Zealand. The survey forms the preliminary stage of a larger project involving in-depth case study research. The population of interest was public and private sector organisations large enough to require IS beyond standard desktop applications. In order to ensure currency of the results and more accurate recall by survey respondents, the focus was on projects undertaken and completed in the three calendar years prior to the survey implementation.

A questionnaire instrument was developed based on an extensive literature review (e.g. Aladwani, 2002; Barki et al., 1993; Cavaye, 1995; Fitzgerald, 1998; Jiang and Klein, 1999; Yetton et al., 2000; space constraints do not permit a discussion of the antecedents of the questionnaire items). The questionnaire comprised thirty-two questions and was divided into four sections. Section A dealt in general terms with the number and nature of IS development projects undertaken within the organisation over the selected time frame. Respondents were asked to rate the relative importance of a number of factors that might be influential in facilitating IS development. Section B solicited more detailed information about the use of standard methods in IS development within the organisation. Section C dealt with the participation of users within IS development in a similar manner. Section D covered background demographic information about the organisation and the respondent. Key terms were defined for the survey respondents. These are shown in Table 1.

Web-based survey delivery was chosen for this study because of its benefits and because it was believed to be the most appropriate medium to reach the target population. Web-based surveys tend to have a comparatively low cost of implementation, and their response times tend to be shorter. Data from responses can be entered directly into a database for subsequent analysis. In constructing the questionnaire and designing its implementation, Dillman's principles for conducting Web-based surveys were followed (Dillman, 2000).

It was decided to focus on relatively large organisations that were likely to maintain a dedicated IS management function or likely to engage in IS development of the scale envisaged by this research. International studies of IS development practice have tended to focus on large sized enterprises (e.g. Barry and Lang, 2001; Rahim et al., 1998). Large organisations are more likely to have an inherent need for systematisation and computerised integration of business functions, and to utilise up-to-date software innovations and development practices (Fitzgerald, 1998; Wastell and Sewards, 1995). The limited evidence from New Zealand suggests that structured IS development is predominantly found in organisations with more than 500 employees (Urban and Whiddett, 1996), and that organisations with relatively large software development teams tend to have more defined IS development processes (Groves et al., 1999).

Information system (IS)	A computerised system that is used to satisfy the information needs of an organisation. This excludes standard desktop applications.
IS project	A project in which your New Zealand organisation has developed or otherwise acquired an IS for its own use.
IS development	Either the traditional process of IS development (e.g. requirements determination, system design, building, and implementation), or the selection, possible customisation and implementation of packaged software.
Standard method of IS development	A formal or documented approach for directing or guiding the IS development process. A standard method may be commercially or publicly available, or documented within your organisation.
User	An employee of your organisation who interacts with the IS on a day-to-day basis.

Table 1: Definitions of terms used in the survey

A composite list of organisations with 200 or more employees was constructed from organisations listed in either the New Zealand Business Who's Who online (NZ Financial Press Ltd), the New Zealand Management's Top 200 New Zealand companies for 2003 (NZ Management, 2003) or the MIS Magazine Top 100 organisations (MIS Magazine, 2003). Each organisation was classified by business sector and by organisational size to ensure that the frame population for the survey was representative of the New Zealand population of 629 organisations. By surveying the entire frame population, 73% of this target population was involved in the survey, thereby reducing coverage error and making it easier to draw valid inferences from the survey population.

A pilot study involving twenty organisations, from a range of business categories and organisational sizes, was conducted during March 2004. As a consequence of this study, some minor changes to wording within the questionnaire were performed. The main survey was undertaken during April and May 2004. Altogether, the

survey population consisted of 461 New Zealand organisations with 200 or more full-time equivalent employees. An email soliciting participation in the survey was sent to the senior IS manager in each organisation. A total of 113 responses were received, for a response rate of 24%. Seven responses were unusable, leaving 106 usable responses that formed the basis of subsequent data analysis. Table 2 provides background information on the respondents' organisations.

Business category (n=106)		Number of employees (FTEs) (n=106)	
Communications & Media	2%	200 to 499	43%
Construction &		500 to 999	25%
Engineering	8%	1000 to 1999	13%
Education, Health &		2000 or more	19%
Community Services	16%		
Electricity, Gas &		*Size of IS function*	
Water Utilities	3%	*(FTEs) (n=106)*	
Finance, Insurance &		Fewer than 4	23%
Banking	8%	4 to 9	30%
Government & Local		10 to 19	9%
Government	12%	20 to 49	13%
IT, Business, Legal &		50 to 99	16%
Property Services	8%	100 or more	10%
Manufacturing &			
Processing	24%		
Primary Industries	1%		
Tourism, Accommodation &			
Food Services	3%		
Transportation, Logistics & Storage	6%		
Wholesale & Retail Trade	11%		

Table 2: Background information on the respondent organisations

The distribution of respondent organisations by business category and by organisational size compared favourably with the overall target population. The size of the IS function tended to follow the size of the organisation. The majority of the IS functions with fewer than 10 FTEs were located in the 200 to 499 FTEs-sized organisations. Conversely, the largest IS functions were most commonly found in the organisations with 2000 or more FTEs. In the majority of organisations (78%), the IS function was mainly located in one central unit. The IS function was distributed across various organisational units in 12% of organisations and mainly outsourced in 8% of organisations.

3. RESULTS

3.1 Systems development practice

Over half of the survey respondents (58%) said that their organisation had a formal or commonly agreed understanding of successful IS development. Analysis of the descriptive definitions of successful IS development provided by respondents revealed that the three most common elements in definitions were meeting specified project objectives or requirements, delivery within budget, and delivery on time. These traditional measures of success were often associated in individual definitions. By comparison, delivery of business benefits, a more strategic measure of success, and user satisfaction were less frequently represented in the definitions provided by respondents.

The number of IS projects reported by the 106 responding organisations over the three-year time frame ranged from 0 to 230, with an average of 21 projects per organisation. Some 59% of organisations undertook between 1 and 10 projects, while 33% of organisations undertook between 11 and 100 projects. Four percent of organisations undertook more than 100 projects, and only 5% did not undertake any projects. Seventy-two percent of the projects reported cost NZ$100,000 or less, with another 23% costing between NZ$100,001 and NZ$1 million. The 5% of projects costing over NZ$1 million were undertaken by 41% of the organisations, suggesting that these most expensive IS are not the exclusive preserve of the largest organisations.

Table 3 shows the proportion of projects that correspond to specific types of IS development or acquisition. Half of the projects were systems specifically developed for the organisation (bespoke development). The majority of these were developed in-house. The remaining projects involved the purchase of packaged software or applications, of which 62% were customised for or by the organisation. One quarter of all projects were outsourced to another organisation for customisation or development.

Type of development	% projects (n=2218)
Purchase of packaged software or application with little or no customisation	16%
In-house customisation of packaged software or application	12%
Outsourced customisation of packaged software or application	14%
In-house development of information system	39%
Outsourced development of information system	11%
Data missing or unknown	8%

Table 3: Characterisation of projects by type of IS development

Respondents were asked to indicate how important 12 factors drawn from the literature were in *facilitating* IS development in their organisations' projects in the last three years on a 5-point scale from 1=Not important to 5=Very important. Figure 1 shows the relative importance of the 12 factors, ranked by their arithmetic mean. Ten of these factors were ranked very highly in terms of their importance in facilitating development, showing a high degree of consistency with the literature. The highest ranked factor was adequate resources or time, and the lowest was use of external consultants. Of interest is the

high level of importance placed on factors related to users, including user buy-in, effective communication with users, user requirements and management of changes affecting users. By contrast, the use of a standard method was ranked relatively lower in importance, partly reflecting that not all respondents used a standard method in their projects.

All respondents were asked to identify any likely changes in IS development in their organisations in the next three years. Of the 63 respondents who provided comments, 21% indicated that no change was expected. Other respondents indicated likely changes to the amount of IS development and acquisition. For example, 11% anticipated more development in the next three years, often because of the need to replace or integrate legacy systems or to migrate to new architectures. Respondents also commented on likely changes to the mix of in-house development, outsourced development and acquisition of packaged solutions. For example, 13% envisaged an increase in outsourced development. Another common anticipated change mentioned by respondents was an increasing requirement for IS development to meet business needs or benefits. This was referred to in terms such as development being "driven for business benefit", "focus[ed] on business outcomes", "better align[ed] with real business needs", and "more strategically aligned". As one respondent summarised, this reflected a "stronger focus on business processes driving the development of systems, rather than the other way around".

3.2 Standard method use

A standard method of IS development was used for more or less all of the development process in 71% of the projects reported in this study. A further 12% of projects used a standard method for only part of the development process. A standard method was not used in at least 9% of the projects (8% of the data was missing or unknown). The most common reasons given for not using a standard method in a particular project included an informal or ad hoc development approach within the organisation, projects where control was external to the IS department (development was the responsibility of either an external party or the users of the system being developed), and the small or non-critical nature of the project. Of the 100 organisations that undertook projects in the three-year timeframe of the study, 91 (91%) reported using a standard method in at least part of the development process in at least some of their development projects. Of these, 68 organisations reported always using a standard method.

Respondents who had used a standard method in their organisations' development projects were asked to stipulate the most common reason for selecting the standard method(s) used. The two reasons most often reported were institutional, namely organisational policy (26% of 80 respondents) and historical practice in the organisation (18%). Other significantly occurring reasons for selecting a standard method included its fit with the characteristics of the project, developers' familiarity with the method, and ease of use of the method. Of the 80 respondents who indicated the most common origin of the standard method(s) used in their projects, 73% used a method developed in-house. The majority of these (60%) were based on a commercial or published method. Overall, 60% of the 80 respondents used a commercial or published method in some form.

Respondents were asked about the level of detail provided by the standard methods they used. Just over half of 80 responses to this question (57%) indicated that the standard methods they used provided detailed specifications for IS development. A significant proportion of the methods reported (35%) provided only broad guidelines for development. Respondents were also asked to what extent standard methods were used as specified, or were adapted or used in part. Three-quarters of the 72 respondents to this question indicated that standard methods were often or always used as specified. However, 60% also indicated that standard methods were often or always adapted or used in part. This presumably reflects the partial use of a standard method as specified in some projects by some organisations. One respondent provided an illustration of why a standard method might not be used as specified. They commented that sometimes the standard method was "used more at the beginning, and then as we got closer to the deadline we tended to do things quicker and less rigidly".

Respondents who had used a standard method in their organisations' development projects were asked to indicate their agreement with various positive and negative statements about the use of standard methods in the projects undertaken over the three-year period examined in the survey. Each statement was rated on a 5-point Likert-type scale comprising "Strongly disagree" (1), "Disagree" (2), "Neutral" (3), "Agree" (4) and "Strongly agree" (5). Figure 2 shows the relative importance of 12 positive statements drawn from the literature. All of the mean ratings are above the neutral value of 3, implying that these respondents (who had used a standard method to at least some extent) tended to agree with all of the positive statements about the use of standard methods and that they perceived the use of standard methods to be beneficial in their IS development projects.

Three of the top six statements reflect the role of standard methods in facilitating successful development outcomes in the projects reported on in this survey, including meeting user requirements and delivering a high quality system. This suggests that organisations that use standard methods are confident of their benefit in IS development. The respondents also agreed that use of a standard method assisted in requirements definition, project control and communication between developers and users. Overall, respondents were less convinced that using a standard method increased project team productivity or allowed movement of developers between projects.

Figure 3 shows the relative importance of eight negative statements about standard method use drawn from the literature. All of the mean ratings are below the neutral value of 3, implying that respondents tended to disagree with all of these negative statements. This is consistent with the overall beneficial perception of the use of standard methods identified above. What these results suggest is that, although these published limitations may
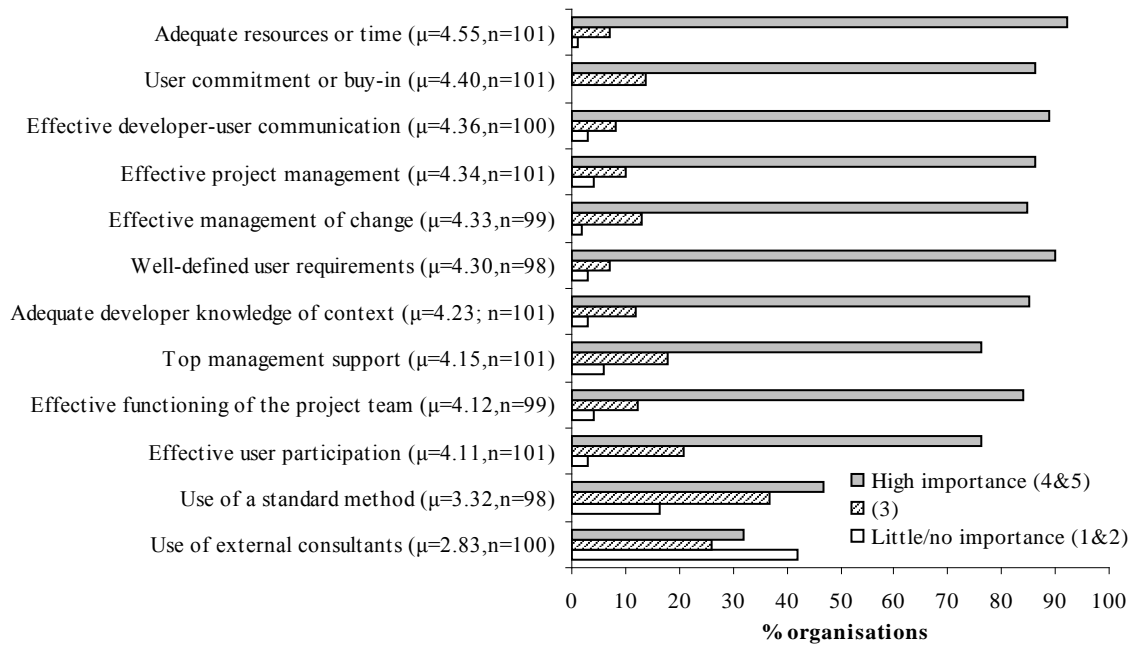
Figure 1: Relative importance of factors facilitating IS development
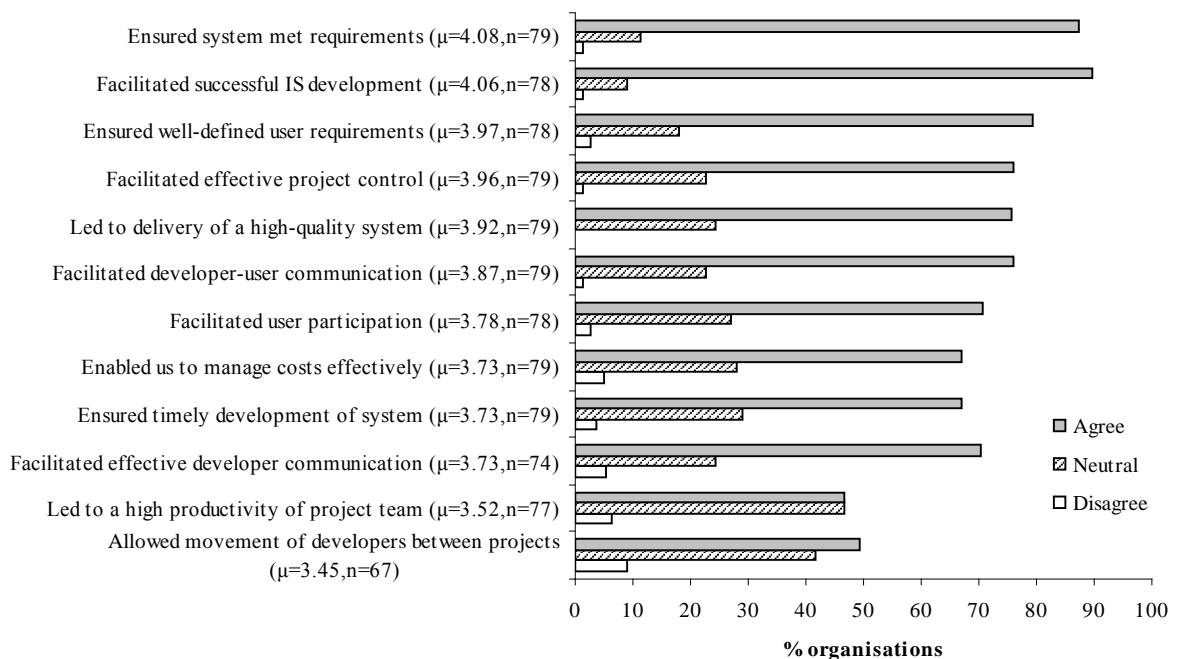

Figure 2: Agreement with positive statements on standard method use

occur on a case by case basis, they are not of sufficient magnitude to adversely influence the respondents' overall perceptions of standard method use. Respondents disagreed most with the statements that suggested standard methods constrained effective user participation and inhibited developers from using their knowledge or experience. Respondents were more evenly distributed in their views on the extent to which the standard methods they used covered the entire development process.

All respondents to the survey were asked to comment on proposed changes to standard method use in their organisations. Of the 67 responses to this question, 30%

indicated that there would be little or no change to current practice in this area. Sixty-nine percent indicated that standard method use would increase in some way in their organisations over the next three years. This included the expected introduction of standard method use in organisations (13%), more frequent use of standard methods (15%), use of a greater variety of types of standard methods (possibly depending on the nature or size of the project) (9%), the continuous improvement or refinement of existing standard methods (18%), and more formalised use of standard methods (sometimes explicitly in order to increase control of aspects of projects) (15%). The comments of two respondents highlighted the

potential influence of different development environments on standard method use. One respondent noted that the use of a standard method was "embedded in the culture" of the organisation. The other respondent noted that because "we typically outsource development, [we] would always look for a structured methodology."

3.3 User participation

Users participated in at least part of the IS development process in the majority of the projects (89%) undertaken in the three-year timeframe of the study. Only 8% of projects had no user participation. The most common reason given for no user participation was that the project was perceived to be of little or no relevance to users, usually because of its technical or infrastructural nature. All organisations had some level of user participation in at least some of their projects, with 76% always having users participate in the development process.

Respondents were asked to stipulate the most common reason for user participation in their organisations' development projects. The reason most often reported was fit with the characteristics of the project (27% of 101 responses). Other important reasons included being a requirement of the standard method of development used (19%), historical practice within the organisation (19%) or organisational policy (12%), and the influence of users (18%). In most organisations (92%), user participation in IS development was typically through user representatives. In only 6% of organisations did all users typically participate in the projects undertaken.

Respondents were asked to indicate how frequently various forms of user participation occurred. The distribution of responses for this question is presented in Figure 4. User participation and levels of responsibility were higher where users were part of the development team or they had full responsibility for development.

Seventy-seven percent of the organisations informally consulted users during the development process on a regular basis (often or always). Between 60%-70% of the organisations regularly involved users in a formal capacity or gave them sign-off responsibility at various stages in development. Users were regularly part of the development team in 40% of the organisations and users regularly had full responsibility for development in 11% of the organisations.

Users most often participated in requirements determination, testing, training, or evaluation, with between 80% and 90% of organisations regularly (often or always) involving users in each of these phases. This is consistent with reported practice where, apart from the elicitation of requirements, users tend to be involved in the latter stages of IS development. Just over half of the organisations regularly involved users in planning (57%) and design (54%). Even fewer organisations (40%) regularly involved users in the installation of IS. As might be expected, only 8% of organisations regularly involved users in the programming for projects.

Respondents were asked to indicate their agreement with various positive and negative statements about user participation in the projects undertaken in their organisations over the three-year period examined in the survey. Each statement was rated on a 5-point Likert-type scale comprising "Strongly disagree" (1), "Disagree" (2), "Neutral" (3), "Agree" (4) and "Strongly agree" (5).

Figure 5 shows the relative importance of 12 positive statements drawn from the literature. All of the mean ratings are above the neutral value of 3, implying that respondents tended to agree with all of the positive statements about user participation and that they perceived user participation to be beneficial in their projects. The top seven statements reflect the role of user participation in facilitating successful development outcomes, including generating user commitment and realistic expectations, meeting user needs, ensuring user satisfaction with and understanding of the system, and producing a high quality system. This suggests that organisations that involve users in IS development are confident in the benefits of doing so. Respondents also tended to agree that user participation facilitated effective communication between developers and users. Respondents were least convinced that user participation avoided unacceptable or unnecessary system features.

Figure 6 shows the relative importance of four negative statements about user participation. All of the mean ratings are below the neutral value of 3, implying that respondents tended to disagree with these statements. Overall, respondents did not consider user participation to be time-consuming or costly, difficult to manage or implement, or overly constraining on the influence of developers in the development process. They disagreed most with the statement suggesting that user participation could actually create user resistance. This is consistent with the relatively strong agreement expressed by respondents in Figure 5 that user participation led to user satisfaction with and commitment to the systems developed in the specified time frame.

All respondents to the survey were asked to comment on proposed changes to user participation in IS development in their organisations. Of the 68 responses to this question, 43% indicated that there would be little or no change to the current level and form of user participation. Two respondents (3%) commented that there would be less user participation in future. One of these specifically commented on the need for the systems developers to have "better veto rights on scope creep". Almost half the respondents (49%) indicated that more user participation in development was expected to occur. Many of these respondents also provided information on envisaged changes to the form of participation.

Analysis of these responses revealed a common theme based around increasing ownership of IS projects by users. Seven respondents (10%) talked about users as increasingly becoming "owners", "drivers" and "leaders" of IS development. The language they used included terms such as "influence" and "empowerment". Three respondents suggested that participation in IS
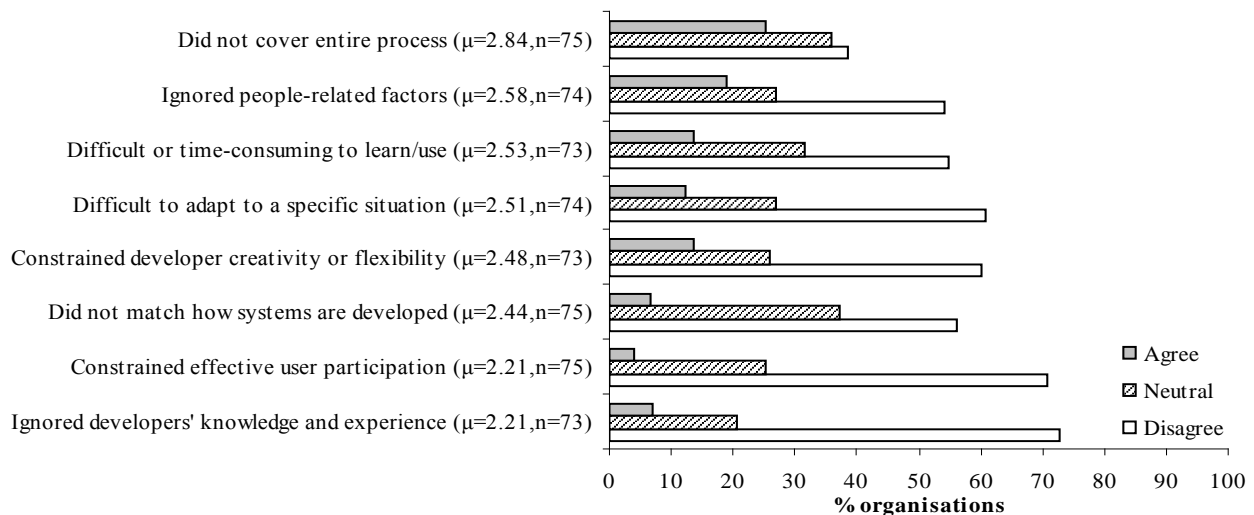
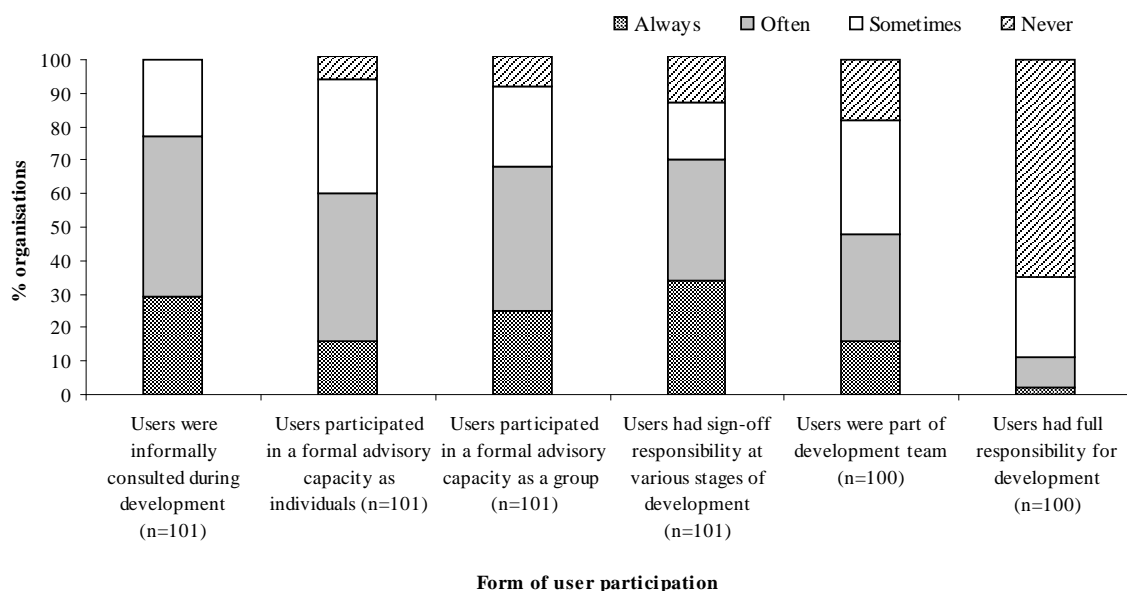**Figure 3**: Agreement with negative statements on standard method use

Figure 4: Occurrence of various forms of user participation

development by users would increase due to the need to access their knowledge base. In one case, "this is because the nature of those projects demands extensive knowledge of detailed facets of the company's operating environment, and it will be necessary for us to tap into that knowledge to gain not only a better functional outcome, but also to encourage ownership at the user level." In another case, it was "critical, given that we don't have an internal IS development team to share and own some of the knowledge". This suggests that if the outsourcing of development increases, users may become more involved in IS development because of a lack of institutional knowledge and memory among external developers.

Two comments that could not be easily categorised in terms of change to user participation practice are worth discussing further. The first reinforces the connection between user participation and successful project outcomes: "It is clear that the projects that had user

participation from the start, [including] management buy-in so that they can release the resource, have been far more successful". This comment also suggests that a major constraint on effective user participation is the lack of time or access to user participants. The second respondent noted that, in his or her organisation, there was a need for "more acceptance by users that it [user participation] is beneficial". This comment highlights the possibility that users may themselves be reluctant to be involved or may be unconvinced of the value of their participation, and that managers and developers should not take the perceived benefits of user participation as self-evident for all stakeholders in the IS development process.

4. SUMMARY AND CONCLUSION

This research has provided valuable insights into the current IS development and acquisition practices of relatively large organisations (200 or more FTEs) in New
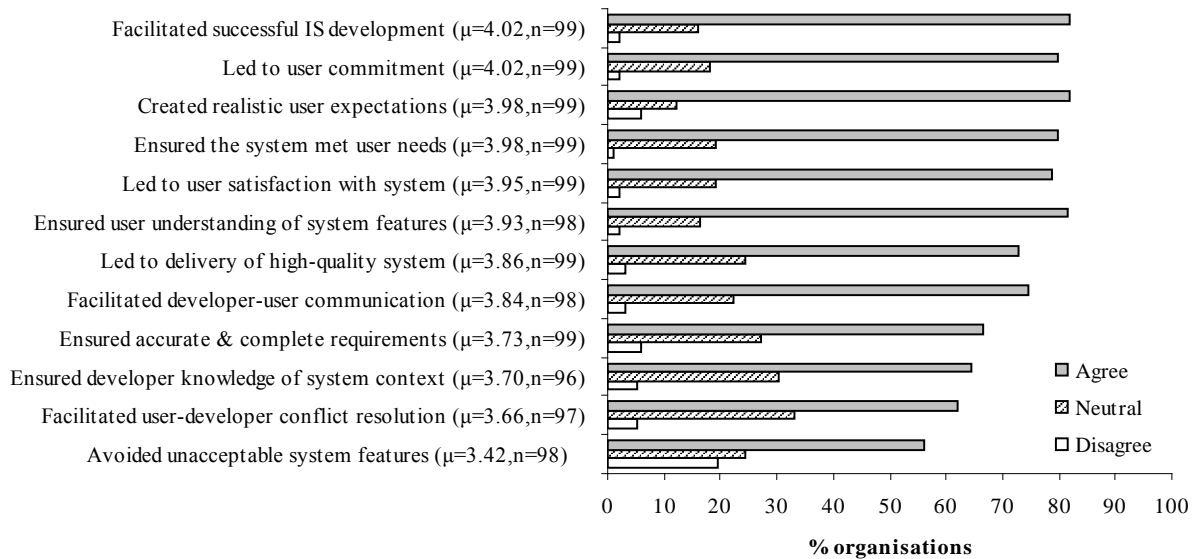
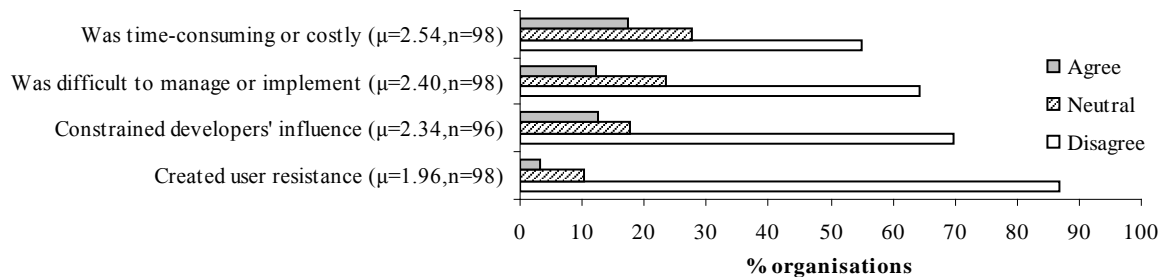**Figure 5**: Agreement with positive statements on user participation

Figure 6: Agreement with negative statements on user participation

Zealand. Over a three year period, organisations undertook between 0 and 230 IS projects – an average of 21 projects per organisation. Large and expensive projects were undertaken by organisations of different sizes, not just the largest organisations. Half of the projects undertaken involved packaged software or applications, the other half involved bespoke development. Factors related to users were regarded as an important influence in IS development. When questioned about the relative importance of organisational or human-related issues and technical issues in determining the outcome of IS development, 72% of respondents agreed that organisational issues were more important.

Ninety-one percent of organisations used a standard method in at least part of the development process of some of their projects. This is consistent with a trend towards increasing use of standard methods in IS development (Fitzgerald, 1998; Kiely and Fitzgerald, 2002). Use of a standard method occurred for various reasons, including organisational policy or historical practice. Methods were usually developed in-house, often from a commercial method. About half of the methods used provided detailed specifications for development. Methods were typically used as specified, but some were adapted or used in part. Users of standard methods generally perceived them to be beneficial. A significant number of organisations planned increasing use of standard methods in some way in the future.

All of the respondent organisations involved users to some extent in their IS project work. The regular participation of users in 60-70% of the responding organisations is consistent with Kiely and Fitzgerald (2002). User participation occurred due to a variety of reasons, including its fit with project characteristics. Generally, user representatives were involved through informal and formal consultation or with sign-off responsibility. They most often participated in requirements definition, testing, training and evaluation. Respondents generally perceived user participation to have been beneficial in their IS development. In future IS development work, most organisations planned on maintaining or increasing their current level of user participation.

The overall conclusion of this study is that standard methods and user participation play an important role in IS development in relatively large New Zealand organisations. However, there appears to be significant variation in how these aspects of IS development are applied. Given this, there is a need for in-depth research on IS development processes to better understand how standard methods and user participation are enacted in practice. Further work will compare these findings with those from similar studies in other countries.

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