

Exploring the Socio-Technical Dimension of Information System Development: Use Cases and Job Satisfaction

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Abstract

Socio-technical design is an established technique in the information system development repertoire with a strong provenance in the Mumford's work on ETHICS and the participatory design tradition in Scandinavia. Although there has been wide acceptance of the need for socio-technical design in the academic community (for example, socio-technical design has been adopted as a core perspective in the Multiview/WISDM methodology), there is little evidence that practitioners have adopted socio-technical methods. This paper reports from an action research project in which traditional software development methods, in particular the UML (unified modelling language) use case, were combined with a concern for job satisfaction. The outcomes of the intervention are presented together with reflections on the potential dangers and limitations of combining engineering rationality with a socio-technical perspective.

Keywords

Multiview, WISDM, socio-technical, use case, SME, information system development.

1. Introduction

Socio-technical approaches to information system development (ISD) seek to engage the user of the information in genuine participation to achieve an acceptable fit between people and technology rather than forcing one or both to change and adapt to the other. In an invited talk on participatory design Ellen Bravo (1993) argued:

“Leaving out the users isn’t just undemocratic - it has serious consequences for worker health, human rights, job satisfaction, and also for the work process and the bottom line”
(p. 4)

Although we might agree with the principles of socio-technical design, it is difficult to find convincing cases where it has been applied, particularly in commercial situations where there is little trade union power. The failure to adopt a socio-technical approach is all too apparent and manifested in cases such as the London Ambulance Service fiasco (Beynon-Davies, 1999).

This paper reports on an action research project in which the Multiview/WISDM (web information system development methodology) framework (Vidgen, 2002, Vidgen et al., 2002) is used to gain insight into the practical realities of applying socio-technical methods in a commercial setting. The aim of the paper is to explore how unified modelling language (UML) use cases (Booch et al., 1999) and socio-technical methods might be combined in an ISD methodology such as WISDM to give a richer view of business processes. A key constraint on the research is the production of a technique that is sufficiently simple and well structured for the practitioner community to adopt it. This constraint in turn raises the question to what extent the socio-technical perspective might be rendered toothless by engineering rationality and managerialist interests.

2. Socio-Technical approaches to IS Development

Two broad schools of socio-technical design can be identified: ETHICS and the Scandinavian tradition of participative design. Each school is described in overview.

2.1 Ethics

ETHICS (Effective Technical and Human Implementation of Computer-based Systems) is a socio-technical approach to information system design and implementation developed by Enid Mumford (1983, Mumford, 1995). The aim of ETHICS is to foster genuine participation, going beyond users ‘participating’ by providing input to requirements specifications and after-the-event prototype evaluation. In ETHICS users work with technical designers to identify the issue the new information system is to tackle, to set objectives for the new information system, and to redesign work practices and organizational structure so that the socio-technical system as a whole works efficiently and effectively. From a practical perspective, a socio-technical approach should help avoid the problems of ‘the analyst knows best’ and the difficulty for workers to articulate with clarity how they accomplish work.

Achieving genuine participation is not a trivial undertaking and Mumford is realistic about the difficulties involved. There needs to be trust between workers and management; workers have to believe that management’s intentions are good and management believe that workers will work in the interests of the organization. Members of a design group have to be identified - this could be by selection or, more democratically, by election. With genuine participation, the role of the IS designer is altered; rather than playing the role of ‘expert’ the IS professional has to work as a consultant to the design group. Although the manager might decide not to be a permanent member of the design group, so that they do not stifle discussion or overly direct the outcome of the design process, the manager does need to be informed and kept up to date on progress since the manager will still be responsible for approving and overseeing the implementation of any solution the design group suggests.

In addition to the idea of participation is a concern with job satisfaction, which Mumford defines as the goodness of fit between what employees expect and need from work and what they are required to do by the organization. The ETHICS framework for job satisfaction draws on the work of Talcott Parsons, an American sociologist, to give five dimensions of fit: knowledge fit, psychological fit, efficiency fit, task structure fit, and ethical fit. To assess the level of job satisfaction Mumford (1983) created a questionnaire as a practical guide to the assessment of the five fits.

Once the social and business objectives have been identified and matched they need to be ranked, costs and constraints considered, and then the 'best' socio-technical solution selected (Mumford, 1995). The task of assessing the costs and benefits is considerable and even then there is no guarantee that there will be enough information to ensure a successful outcome. There might be some people or groups who will not be happy about the proposed system - indeed there might be situations where the new system is seen as a direct assault on vested interests leading to a power struggle.

2.2 Participative design

The provenance for the socio-technical underpinnings of ETHICS is in the seminal work of the Tavistock Institute of Human Relations in London, which operated from the 1950's onwards. One criticism that can be levelled against a socio-technical approach such as ETHICS is that it can be used to managerialist ends, as a way of persuading workers to accept changes that might otherwise have been rejected in order that the organization can benefit from the increased efficiency that results from user involvement. The ideas promoted by the Tavistock were also taken up in Scandinavia, but with a stronger emphasis on democracy in the workplace. Ehn (1993) defines democracy as freedom from the constraints of the market economy and the power of capital. The desire to accumulate capital is the driver for changes in work practices - the result is intensification of work and the use of new technology (Greenbaum, 1995).

Whereas ETHICS is supported by a documented method, the Scandinavian tradition of participative design tends to have a less formal structure, being guided by a set of principles (Bodker et al., 1993):

- Computer applications should enhance workplace skills rather than degrade them;
- Computer applications are tools that should be designed to be under the control of the people who use them. The computer systems should support flexible work practices - not make them more rigid;
- The introduction of computer applications changes the organization of work. The interplay between computers and work needs to be addressed directly in design.

3. Research design

Action research is a way of building theory and descriptions within the context of practice itself. Theories are tested through intervention in an organizational setting and bear a double burden of testing hypotheses and effecting some desirable change in the situation (Argyris and Schön, 1991). Action research was deemed suitable in this situation because the aim is to build theory (how can a socio-technical perspective be incorporated with traditional systems development methods?) and to make an intervention in a real-world development project.

According to Checkland (1991), the definition of a framework of ideas is important if action research is to be rigorous and have validity - it also helps differentiate action research from consultancy (Baskerville and Wood-Harper, 1996). The framework of ideas adopted here is Multiview/WISDM (Vidgen, 2002, Vidgen et al., 2002). In particular we intend to explore the methods matrix (figure 1) and how the technical rationality of UML use case modelling can be combined with a concern for the quality of worklife. The client organization in which the framework of ideas is tested is Zenith International, a company specialising in consultancy to the food and drinks industry. More specifically, the area of application for the action research is the Research Data Repository (RDR) project, which began in October 2001.

3.1 The framework of ideas: Multiview/WISDM

Multiview/WISDM (web IS development methodology) supports an even-handed approach to IS development, where a broad socio-technical solution is sought. The general framework for WISDM recognizes three interacting elements: the change agents, the situation, and the ISD methods. In this paper we focus on the methods matrix, which categorizes methods (figure 1) in two dimensions: socio (a concern with the organization and individuals) and technical (a concern with the 'things'), and analysis ('what' is required) and design ('how' it will be achieved). Engineering-based approaches to IS development concentrate on the right hand side of the matrix: the generation of a requirements specification and its refinement into a software model. This process might be constituted as stepwise refinement, as in the waterfall lifecycle, or iterative, as in rapid application development. The overtly social left-hand side is often downplayed and even ignored in its entirety, but it is always present whether the developer likes it or not.

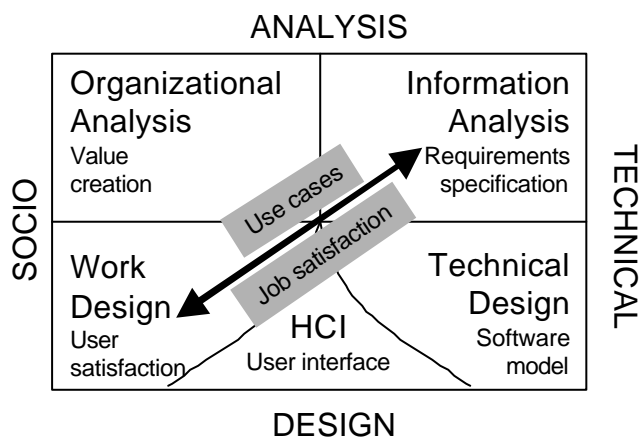


Figure 1: Multiview/WISDM methods matrix, (adapted from (Vidgen et al., 2002))

A core method for the upper right-hand quadrant is the UML (unified modelling language), in which the use case is a fundamental notation for describing business processes from the viewpoint of the user. The aim of this paper is to explore the interplay between the technical rationality of the use case and a softer concern for the quality of work-life. This approach fits well with the ETHICS approach of matching human objectives (job satisfaction) with business efficiency objectives (as described by UML use cases), although it raises questions about how genuine the resulting user participation might be.

The client organization and ISD project

Founded in 1991, Zenith International Ltd is a business consultancy specializing in the food, drinks and packaging industries worldwide. The main business activities are market analysis, strategic advice, technical consulting projects and conference organization. In spring 1998, the strategic aims of Zenith were to create a global presence, to broaden the product range, and to develop complementary skills (e.g., a synergy of market intelligence reports and consultancy). In September 1998 Zenith launched its first Web site, a typical cyber-brochure with limited interaction facilities. The success of the company Web site launched in 1998 gave Zenith the confidence to explore e-commerce and the online delivery of market research content. In October 1999 Zenith built an e-commerce system for selling research data on global drinks consumption (see Vidgen (2002) for a full account).

The global drinks project had e-enabled a single paper-based research report, but there were many more reports that needed to be e-enabled to support internal use and the development of e-commerce. The research data repository (RDR) project would create a single database of research data from which all reports – at any level of data detail – could be generated from the data in the repository and delivered in paper form or on the Web. The RDR project differed from the global drinks e-commerce initiative insofar as it would involve extensive internal business process redesign. The roles and activities of the market researchers would be changed as the cycle of data collection, analysis, and publishing was reengineered.

4. The intervention

4.1 The RDR IS development process

The development approach adopted for the research data repository (RDR) was to use rapid application development to build the system through a series of iterations (Beynon-Davies et al., 2000). The delivery of the RDR was organized around a series of working deliverables that would be evaluated at every stage by the market researchers. The overall RDR project was under the guidance of a steering committee (led by the company chairman) and was championed by the market research director.

To build and encourage user participation, the developer was co-located with the market research staff, allowing the developer to ask questions, observe work practices, and involve researchers in the software prototypes. Formal interviews and workshops were also held to ensure that the user voice was recorded and included. Based on the collected information, UML use cases were applied by the project team for analysing the current business process and for envisioning the future process and proposed RDR application.

4.2 Assessing job satisfaction

From the outset the project was conceived as an initiative that would have a major impact on the work practices in the market research department. An early idea was to conduct pre- and post-implementation surveys based on the generic ETHICS job satisfaction questionnaire (Mumford, 1983, Bancroft, 1992). This survey contains 58 questions organized around the five job satisfaction fits. Approval to administer the questionnaire was sought from the market research director, who in

turn asked the personnel director to review the questionnaire. Both directors found it difficult to see the association between the ETHICS questionnaire, the IS development process, and the working of the RDR project. This is not surprising as the ETHICS job satisfaction questionnaire is a general purpose instrument that has no questions directly concerned with IS or ISD. More interestingly, the personnel director was concerned that the questionnaire was treading on personnel issues and considered that the questions were somewhat naive, were leading, and that more than half were phrased from a negative viewpoint. For example, 'Top management here is too ruthless', 'Senior management is out of touch with the way people feel', and 'There is little opportunity for using initiative'. The directors felt that the ETHICS questionnaire could create or widen any gap between workers and management, undermine the organizational culture, and generate disquiet.

Clearly, the deployment of the ETHICS job satisfaction questionnaire was not perceived as a meaningful intervention in this situation. It is likely that many organizations would feel uncomfortable with the introduction of general human resource issues into ISD, particularly if it is initiated and led by IS personnel. As a result of this concern, the generic ETHICS instrument was abandoned.

Job satisfaction and work processes

A more grounded way of assessing job satisfaction in the specific context of the RDR project would be to attempt to match social objectives with business efficiency and effectiveness objectives (Mumford, 1995). UML use cases were being developed to understand and document the current system in a structured and comprehensible manner (figure 2), while also providing a summary of the project team's knowledge and a platform for hypothesizing about future work organization scenarios.

The use case diagram formed the template for the production of an RDR-specific socio-technical questionnaire (appendix A). For each of the use cases in the diagram a set of five questions was created to record user perceptions:

1. The use case activity is easy to do (individual business process efficacy)
2. The use case activity takes up too much of my time (individual business process efficiency)
3. The use case activity takes up too much of the total process time (business process efficiency)
4. Spending more time on the use case activity would add value to the overall process (business process effectiveness)
5. I enjoy the use case activity (job satisfaction)

The first four questions are inspired by the three E's (efficacy, efficiency, effectiveness) of the soft systems methodology (Checkland & Scholes, 1990), which are used to judge the success of a systemic transformation. Efficacy is concerned with whether the system works, efficiency with using minimum resources (in this context market researcher time is the most precious resource), and effectiveness with meeting the longer term goals (this typically involves looking up to the system at the next level of recursion). Although only the fifth question addresses job satisfaction directly, questions one and two are targeted at the individual and can be expected to give an indication of job satisfaction.

These questions need to be evaluated in context; for example, an 'easy to do' task might be boring for an ambitious employee. Use case activity 5 (figure 2) was excluded from the questionnaire as this activity is only executed by the market research director. Additional questions were added at a

higher level of system recursion (these are the ‘P’ prefix questions in appendix A) to assess business effectiveness in the context of the overall process of market research publication. Finally, an area for respondents to make comments was included on the questionnaire.

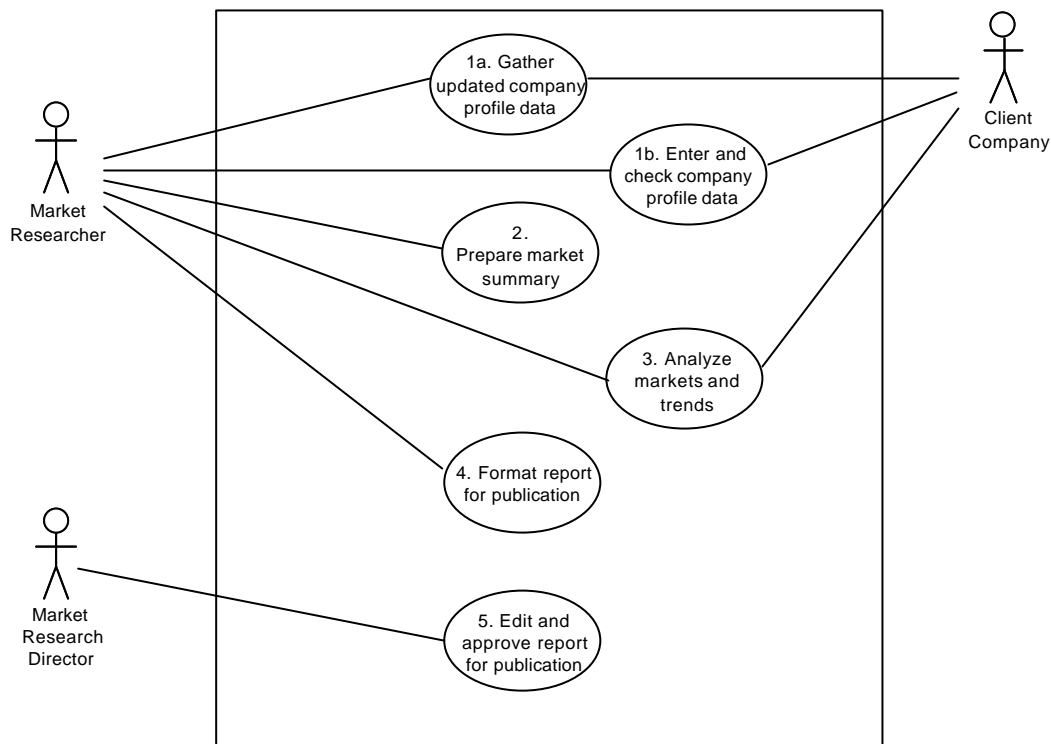


Figure 2: Use case diagram for the current research report production process

5. Results

The questionnaire was administered to the six people involved in report production, giving a 100% response rate. The questionnaire was administered anonymously and the completed forms returned in sealed envelopes to the academic researcher with the undertaking that results would be anonymous and not divulged to the company's management. The questionnaire made it clear to respondents that the intention would be to use the results for academic publication.

Although the number of respondents is not sufficient for hypothesis testing or scale reliability tests, some simple statistical analysis to give an indication of mean scores (central tendency) is useful in making a reading of the results (table 1). The results have been ordered by mean score showing the questions with the highest (nearest to 7) and lowest score (nearest to 1), i.e., in order of the largest absolute difference from the mid-point of the scale (4).

The top five highest/lowest scoring items indicate that: too much of the overall report production process is spent on gathering and checking company profile data (1.3); it is not easy to prepare the report for publication (4.1); spending more time on formatting the report will not add value (4.4); formatting the report is not an enjoyable task (4.5); gathering company profile data takes up too much of an individual researcher's time (1.2). The difficulties of formatting the report were indicated by a comment made on the questionnaire by one respondent:

“the fact that the reports consist of Word/Excel/PowerPoint sections means that page numbering and doing the contents pages at the end is vulnerable to mistakes. The last report I did was made up of Word and Excel docs. Any charts are made in PowerPoint and then copied/pasted in to Word. If any data changes the charts have to be re-done and then re-copied/re-pasted.”

No	Respondent						Analysis	
	A	B	C	D	E	F	mean	mean diff
1.3	6	7	7	7	7	7	6.83	2.83
4.1	3	1	1	1	2	1	1.50	2.50
4.4	1	3	1	1	2	1	1.50	2.50
4.5	1	3	3	1	2	1	1.83	2.17
1.2	3	6	6	7	7	7	6.00	2.00
3.4	6	6	6	6	6	6	6.00	2.00
1.5	-	1	4	1	3	2	2.20	1.80
2.4	4	7	5	6	5	7	5.67	1.67
3.5	6	6	5	7	5	5	5.67	1.67
4.3	5	7	7	7	6	2	5.67	1.67
P4	3	1	2	1	2	5	2.33	1.67
1.1	2	1	4	1	2	5	2.50	1.50
P1	4	7	5	7	6	4	5.50	1.50
1.4	6	2	3	3	1	1	2.67	1.33
P2	5	5	4	5	6	6	5.17	1.17
4.2	1	7	7	7	6	2	5.00	1.00
2.5	4	6	5	5	4	5	4.83	0.83
3.3	5	4	1	6	3	1	3.33	0.67
3.2	5	3	3	6	3	1	3.50	0.50
P3	5	5	-	2	4	6	4.40	0.40
2.1	1	2	6	5	5	3	3.67	0.33
2.3	6	7	2	6	3	1	4.17	0.17
2.2	5	6	2	6	3	1	3.83	0.17
3.1	6	4	5	2	4	3	4.00	0.00

Table 1: Questionnaire results and analysis (task enjoyment activities shaded)

Earlier interviews (conducted as part of the RDR requirements gathering process) with market researchers and the research director had found similar views:

“People seem to spend far too much time formatting”

“One of the major burdens of the report writing process is the use of Excel”

“For the 10-11 years the company has been going, we have produced company profiles in Excel format, we have linked each profile to overview tables and have created charts manually in Powerpoint, because that was the best presentation method at the time. Charts then pasted from Powerpoint, pictures into Word and put it all together using these packages. Obviously, this is extremely time-consuming”

“Everybody within the department ... are just getting extremely bothered ... with this lengthy production process. We spend far too much time getting Excel things to fit, spaces and so on. And it is just not... we need to be able to automatically generate information, getting it in and then interpreting it more effectively and add value on the product”

In terms of task enjoyment, researchers prefer market trend analysis (mean score 5.67) followed by preparation of market summaries (mean 4.83). Researchers are less happy about collecting the data (mean 2.2) and formatting the report (mean 1.83). Unsurprisingly, perhaps, researchers prefer to

work with the data rather than the time-consuming and repetitive tasks of collection (input) and formatting (output). From a systems development perspective, this indicates that effort should be put into streamlining data collection activities and report formatting, leaving the researchers with more time to work on extracting meaning and value from their market research data.

The overall process questions (P1 – P4) indicate that there is strong agreement that the overall process is not satisfactory (P4) and that there are too many non-value adding tasks (P1), but that the process is thorough. There is less agreement on the competitive advantage afforded the company by the process (P3) and indeed one respondent did not complete this with the comment that “don’t know enough about competitors reports to be able to comment”.

Discussion

The administration of the questionnaire has helped the project team to crystallize their thoughts about the development of the RDR and the associated changes in working practices. The simple message from the questionnaire is that market researchers want to be freed from the laborious tasks of data collection and report formatting and supported in the task of adding value to the market research data through being given the time and the tools to summarize, analyze, make forecasts, and write commentaries. From a system development perspective this analysis provides some clear indications of how IT might be deployed to pursue the joint goals of increased job satisfaction and improved business efficiency. In ETHICS terms the project teams can begin to rank the alternatives for RDR development and select the ‘best’ socio-technical solution. However, this approach to integrating socio-technical design into mainstream IS development, such as the unified process (Jacobsen et al., 1999), needs to be considered critically: to what extent is this a genuine participation by users in the development process? Is the technical rationality of UML and the unified software development process likely to take too much precedence over the softer, social aspects of ISD?

With regard to the RDR project, the level of user participation can be characterized as consultative (Land, 1982) rather than the full participation envisaged in the ideals of ETHICS and participative design. From a pragmatic perspective, participation went as far as it could, given the office and work environment of a small company with tight deadlines and busy staff and a strongly entrepreneurial culture characterized by time pressure and a profit motive. Thus, it might be argued that socio-technical design is, at base, antithetical to commercial enterprises and only adopted when it serves managerialist interests, i.e., the ultimate goal of improved business efficiency achieved in part through increased job satisfaction. But, what are the alternatives? To persevere with the quest for full and genuine participation (the ‘warrior’ metaphor for the IS developer) and run the risk of being excluded entirely from the ISD process, or to give up and retrench into an engineering rationality? We argue that any approach that raises a concern for job satisfaction is better than doing nothing, i.e., pragmatism over an unattainable idealism.

This pragmatism extends to mainstream software development. By integrating a concern with job satisfaction into a well accepted process modelling method, the use case, there is an opportunity to influence the way that practitioners go about the redesign of work. Rather than focus on business efficiency outcomes to the exclusion of all else, future work design scenarios might just take account of the interests of those doing the work. The challenge is therefore to first find a way of incorporating a social-technical perspective in mainstream ISD that can be adopted easily by practitioners, such as the use case based questionnaire. The second challenge is to promote and

publicise such an approach so that it becomes diffused and adopted as a standard part of the ISD process.

Summary

The ideal of genuine and full participation is difficult to achieve. Although supporting the idea that job satisfaction is an important aspect of work design, many organizations will shy away from the uncomfortable realities of what this means in practice. The idea of using UML use cases has been presented as a way of matching business efficiency goals with social goals in a method that would be intuitively meaningful and simple to apply by practitioners when thinking about IT-enabled redesigned work practices. Although (Hirschheim and Klein, 1994) have argued that ETHICS is able to accommodate a broad range of efficiency and effectiveness criteria without losing sight of the emancipatory aspects of ISD there is still a significant danger that taking a functionalistic method, such as UML use cases, as the point of departure for a socio-technical investigation might lead to increased emphasis on technical rationality and managerialism. However, the use case approach has proven to be a simple, understandable and practical way of looking at job satisfaction in the context of business process efficiency in an environment characterized by commercial pressures and an ongoing struggle for survival. The questionnaire presented in this paper will be reapplied once the system has evolved into a workable solution and then again once market researchers have used the RDR for a complete report production cycle.

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Appendix A: Job satisfaction survey

		Disagree						Agree
1.1	Gathering and checking company profile data is easy to do	1	2	3	4	5	6	7
1.2	Gathering and checking company profile data takes up too much of my time	1	2	3	4	5	6	7
1.3	Gathering and checking company profile data takes up too much of the total report production time	1	2	3	4	5	6	7
1.4	Spending more time gathering and checking company profile data would add value to the reports	1	2	3	4	5	6	7
1.5	I enjoy gathering and checking company profile data	1	2	3	4	5	6	7
2.1	Preparation of market summaries from company profiles is easy to do	1	2	3	4	5	6	7
2.2	Preparation of market summaries from company profiles takes up too much of my time	1	2	3	4	5	6	7
2.3	Preparation of market summaries from company profiles takes up too much of the total report production time	1	2	3	4	5	6	7
2.4	Spending more time on preparation of market summaries would add value to the reports	1	2	3	4	5	6	7
2.5	I enjoy preparing market summaries from company profiles	1	2	3	4	5	6	7
3.1	Analysis of markets and trends is easy to do	1	2	3	4	5	6	7
3.2	Analysis of markets and trends takes up too much of my time	1	2	3	4	5	6	7
3.3	Analysis of markets and trends takes up too much of the total report production time	1	2	3	4	5	6	7
3.4	Spending more time on analysis of markets and trends would add value to the reports	1	2	3	4	5	6	7
3.5	I enjoy analysing markets and trends	1	2	3	4	5	6	7
4.1	Formatting the report for publication is easy	1	2	3	4	5	6	7
4.2	Formatting the report for publication takes up too much of my time	1	2	3	4	5	6	7
4.3	Formatting the report for publication takes up too much of the total report production time	1	2	3	4	5	6	7
4.4	Spending more time formatting the report for publication would add value to the reports	1	2	3	4	5	6	7
4.5	I enjoy formatting the report for publication	1	2	3	4	5	6	7
P1	Our process of report production involves too many non-value adding tasks	1	2	3	4	5	6	7
P2	Our process of report production is very thorough	1	2	3	4	5	6	7
P3	Our process of report production secures the company a competitive advantage	1	2	3	4	5	6	7
P4	In general, I am satisfied with our process for producing research reports	1	2	3	4	5	6	7