



The use of ethnography with discourse analysis in the study of software quality management systems

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ABSTRACT

This paper arises from a project, called SoFEA, which is using social science approaches, specifically Ethnography and Discourse Analysis, to investigate the factors influencing the evolution and adoption of software quality management systems.

Defining quality in any situation is a complex social process. This process not only involves certain quantifiable measures but also the interplay of social and cultural definitions of quality, within a specific context. Lack of quality management can have effects that range from economic disaster to fatality. Ethnographic and Discourse Analysis research can bring to light the working practices and implicit perceptions used by software developers which directly influence their application of the concept of quality to the process of writing software.

Our research is framed as an ethnographic study, intended to allow description of the wider social context/s informing notions of quality. Specific techniques of Discourse Analysis are used to examine the texts, and the spoken and electronic interactions involved. It is the interconnections between the different texts, interactions and social relations that define or delimit such concepts as 'software quality'. This paper explores some of the important aspects of Ethnography and Discourse Analysis and how these can be used to research the processes by which software quality is defined.



THE PROBLEM

Given the increasing reliance upon software by many systems in contemporary industry and society, determining what is 'good quality software' is increasingly important. The implication of software problems in several high-profile system failures has made this problem an imperative rather than an option. These include such well-known examples as TAURUS, London Ambulance and Airbus. Our examination of these cases and of some of the critical literature concerning them (e.g. LAS report [1], Flight International [2]) tends to indicate that poor communications, bad management and a lack of knowledge and information were germane to the problems that occurred.

In the SoFEA paper presented to SQM '93 [3] the case for considering the non-technical factors influencing software quality was made. This outlined the failures of software systems and the various initiatives that had been taken to solve these problems, e.g. those funded by ALVEY and ESPRIT. It was argued that:

While advances have undoubtedly been made, significant software development problems remain. Despite a shift in research and development towards project management, there is an almost exclusive concentration on the likes of estimation techniques, measurement systems and supporting tools. These still represent fundamentally technical solutions.

Whilst technical factors are influential a variety of other factors are also at play. Technical products are created by a culture for consumption within a culture. They do not spring fully realized from a 'master brain'. Decisions have to be made, information gathered and utilized, people managed and innovations nurtured. These factors are often ignored in preference for 'technical fixes', e.g. CASE tools, to the detriment of overall 'quality'. Attention therefore needs to be paid to the non-technical factors involved in software production. Such factors include the business, market and workgroup cultures within which managerial, organizational and programming practices take place. Quality is not simply a 'technical fix' but requires sensitivity to the interplay of managerial and production systems as well as the organizational context in which these are situated.

WHAT IS QUALITY ?

Concepts such as 'quality', and specifically 'software quality', are not abstract, pre-ordained and rigidly defined; they are constructed by the social discourses within which they are situated. In other words, such terms are 'up for grabs'. The following are a selection of some 'officially' given definitions of quality:

By quality we mean meeting expectations and retaining user satisfaction
Margaret Dennis DTI [4]

This is based on the widely accepted 'formal' definition:

The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implicit needs ISO [5]

As pointed out by John Slater [6] this may seem clumsy but is a good definition in that

... it balances the interests of users and suppliers. Generally the short form definitions (e.g. fitness for purpose, conformance to requirements) lose this balance and the quality emphasis moves away from the user.

One Open University course on Project Management identifies five separate views of quality [7]:

The *product-based* definition arises from the study of economics. In this view quality is related to the content of the product, i.e. to the quantity of the ingredients or attributes possessed by the product.

The *user-based* view may be summed up as 'fitness for purpose'.

The *manufacturing-based* approach to quality is summed up in the definition 'conformance to specification'.

The *value-based* approach is a composite of the last two views. It defines quality as providing what the user wants at an acceptable price, and conformance to specification at an acceptable cost.

The *transcendent* view equates quality to innate excellence. ... It is something that is felt rather than measured, recognizable only through experience.

The course goes on to point out that not only do these differing definitions co-exist but that each of them is debatable in itself.

Where definitions themselves are contentious it is all the more important that the processes informing them are made explicit.

We are not making claims for any particular definitions of quality in this paper. Our intention is to leave the term open and to see what the data from our case studies says. As well as differing definitions there are many different interpretations of the concept and we are looking at the conditions for these various constructions. This entails asking who is using which interpretations, when, why, for whom and with what results.

In our preliminary work we have found that quality has been described most frequently in terms of the following phrases:

- "Quality is best fit": this is usually then interpreted either as 'adequacy' or as 'fitness to purpose'. These interpretations

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themselves will vary depending on who decides what 'adequacy' or 'fitness' means and how purpose is determined.

- "Quality describes something that is well-made": analogies are usually drawn here with luxury goods, things that convey quality by virtue of the high quality of their materials and processes. These are the things that are '*reassuringly expensive*' where high cost ensures high guarantees. The purveyor of the 'well made' is looking after the customer by promising an anxiety-free purchase, not necessarily something innovative, but something trustworthy, something that will last.
- "Quality is customer satisfaction": this can be driven by slogans such as "delighting the customer", "going the extra inch for the customer", or by a measure of return business. These are all very different. They are not necessarily contradictory in any sense but perceptions, and hence activities, will be modified depending upon which one is being stressed. "Delighting the customer", for example, is very open – it could mean or involve almost anything. It is not necessarily driven by the customer's view of what would be 'delightful'.

In our preliminary interviews we spoke to 'quality managers' from a variety of concerns. Two specifically mentioned the phrase 'delighting the customer'. Both were highly qualified and experienced quality managers with fairly sophisticated views of what 'quality management' consisted of. However, their views of the phrase 'delighting the customer' were completely different. For one the phrase was typical of meaningless guru-speak and had little to do with actual 'quality management'; for the other it was useful, one aspect of the kinds of things to consider when building a quality management system.

So 'quality' is a chameleon term – it has an array of possible guises that it can put on to fit in with a particular company culture. Perhaps it can be quantified, translated into hard cash value, for example, but these are really the effects that are being measured. 'Quality' isn't an X% increase in market share, although a reputation for, or consumer experience of high quality products may ensure this effect. The interpretations – what 'quality' means for one company, in one market, at one time – are still mutable.

Quantification usually means that the quantified knowledge can be more 'publicly accessible'. Where knowledge is qualitative it is necessarily debatable and amongst people who are used to quantified knowledge this can create problems. Where certainty cannot be guaranteed some prefer to ignore the potential problems arising from this. And so qualitative knowledge tends to have a certain characteristic hiddenness. The quantifiable issues get talked about and noticed, the

more ephemeral issues get ignored, or left to the advertising people. This combination of mutability and hiddenness results in a situation in which people can be unaware of those factors influencing their decisions and actions.

QUALITY IN OPERATION

Various quality initiatives, including standards, codes of best practice and 'quality systems' have proliferated since the mid 1980s. These were outlined in the last SoFEA paper [3].

Quality initiatives are essentially management/organizational responses to the problem of ensuring 'quality'. Despite this fact many of them still focus upon technical aspects and fixes, e.g. metrics, formal methods and so on. As both management responses and in part technical fixes these initiatives represent a complex socio-technical phenomena formed by specific business cultures and practices. In describing them as being formed by particular social practices we are using a very specific definition of the term. Our use of the term 'practice' follows that of Scribner & Cole [8] who stated that:

By a practice we mean a recurrent, goal-directed sequence of activities using a particular technology and particular systems of knowledge ... Whether defined in broad or narrow terms practice always refers to socially developed and patterned ways of using technology and knowledge to accomplish tasks. Conversely, tasks that individuals engage in constitute a social practice when they are directed to socially recognised goals and make use of a shared ethnology and knowledge system.

'Quality systems' and standards can therefore be seen as both defining and being defined by social and organizational activities while at the same time being governed by particular systems of knowledge.

The influence of different knowledge systems is indicated by the difficulty of transposing definitions and interpretations of quality from one sector to another. For example, the problems apparent in transferring the practices developed in defining and maintaining hardware quality to the arena of software quality indicate potential differences in the two systems of knowledge. These differences arise from three main factors.

1. Hardware and software are not comparable products; the plasticity and intangibility of software make conclusive testing impossible. In a BBC Radio 4 broadcast on safety critical systems (19.10.93 *File On Four*) testing of software was described as difficult because software is essentially a piece of text with an enormous number of possible paths through it. Programmers have to be sure that none of those paths will bring users up against something unexpected. Cliff Jones



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(Professor of Computing at Manchester University) stated that, due to size and complexity, all these paths cannot be tested. He also claimed that a fundamental difference between mechanical engineering and software engineering is that in the latter case one small change affects the entire system.

2. Unlike hardware products, whose performance can be measured in terms of specific attributes, many software products are often used to store and manipulate the very systems of knowledge which created them, e.g. CAD/CAM software.
3. Software is often required to fit in not only with the material requirements of running on specific hardware but also to function within a specific organizational (social) setting.

An increasing sensitivity to 'quality' issues has entailed that many at the forefront of the TickIT initiative, for example, see it as the first step in a commitment to a more sophisticated 'quality' enhancing process. The rhetoric is now very much one of "Quality is a journey not a destination" (BDO Consulting [9]). Concomitant with this greater sophistication, and in part evolving from the experience of implementing 'quality initiatives', is the belief that this is a people-based issue rather than a tool or technique based issue. Although this view is not new, it is put forward in Crosby [10]

In dealing with quality we are dealing with a people situation. The entire concept of quality management in this book is oriented towards that thought. People conduct the business of every company, Each individual performs an individual service.

At a recent one day seminar that one of us attended, designed to illustrate and promote the business benefits of TickIT, one of the organisers made the following comment. He was describing the efficacy of working 'back to front' in establishing a Quality Management System (QMS). This entails asking people about the things that have gone wrong in their particular jobs. A QMS is then proffered as a possible way of helping to prevent these particular problems. This is intended to inculcate a sense of 'ownership' since people should then be able to see the QMS as relevant in terms of their own job and working context:

...those steps to implementation of a QMS are very much the same steps you read [about] in all the TQM books about how to get a TQM off the ground. It's the people. I want to make that point because I think its rather important that we end up talking about the people.

In TQM the sense of ownership is inculcated by adopting the Japanese view of the company as a 'family'. This uncovers the notion of collective responsibility, emphasizing perhaps a different aspect of the term

'ownership' than we are familiar with in our culture (for a further discussion see Hovenden [11]).

WHY A SOCIAL SCIENCE APPROACH ?

Given that quality initiatives are framed by social and organizational responses to the problems of quality management, any exploration of the implementation of quality systems requires the detailed study of this social and organizational framework. This argument goes beyond the truism that these activities are performed by groups of people and therefore have a 'social' dimension. The 'framework' determines the boundaries and forms the support. It is the framework that gives any system whatever internal coherence it may hold. Therefore to state that 'quality systems' are framed by social factors implies the strong thesis that they are constructed, held together, given meaning by 'social factors'. The notion of what is 'technical' may also be socially constructed.

Sociological studies of scientific knowledge, e.g. Latour & Woolgar [12], Low & Woolgar [13] have indicated, for example, that claims of objective practice – or the adherence to 'scientific method' – tend not to reflect the work done as it was actually performed. These claims tend to be made retro-actively. The question then is: why are such claims made? Interestingly, Parnas [14] advocated *post hoc* structured descriptions of the software design process, rather than describing what actually happened. This was a pragmatic case that claimed such documentation made maintenance easier. In [13] it was concluded that ascriptions of 'technical' operate almost as a protection. Workers and products described as 'technical' became part of a privileged realm where they could not be deconstructed, i.e. where work, achievements and personnel were not questioned or described in the same ways that the 'non-technical' were. The technical workers also had a significant degree of control over their co-workers due to their privileged knowledge of the future, a future that they had the main options on creating.

Responses to this conclusion are interesting in themselves. If someone were to disagree and argue that ascriptions of 'technical' were correctly regarded as superior because this indicated, for example, adherence to scientific method – truth, correctness and objectivity (higher, more difficult) rather than subjectivity (lower, too easy) – would they simply be totally in thrall to the affective power of such a label? Would they just be less aware of the ways in which they were being socially constructed?



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Are there ways in which we could satisfactorily find out whether all proofs and truths are socially constructed, or, by definition, is this impossible? Do we have to depend solely on argument, debate and reflection? If so are there any problems with this?

These questions are of course relevant to the issues addressed by this project. In an area that is used to working with quantified knowledge the notion that some things may have to be left to argument may be unsatisfactory.

METHODOLOGY

Our approach is to use Ethnography as the macro framework within which we apply Discourse Analysis techniques to specific examples of discourse. We define discourse, after Fairclough [15], as

language as social practice determined by social structures

Since we are still in the early stages of the project we do not yet have any fully analyzed results. In this section we give a brief overview of the approach and methods we are using. It is followed by some examples and an initial statement concerning our preliminary work.

The approach given below differs in some significant senses from that proposed in the earlier paper [3]. The differences arise almost entirely from the adoption of Ethnography as the main approach. This is a highly sophisticated and very broad-based way of working and entails that the researchers analyze themselves with the same degree of open skepticism that they direct toward their collaborators. We have retained the use of Discourse Analysis for the reasons given below, although it is now taking a more directed role.

We have called the people and organizations that formed the basis of our case material 'collaborators' to indicate that this is seen very much as a co-operative enterprise and one that is hopefully mutually beneficial.

Ethnography

This is a term taken from anthropology. Literally it means "writing the culture" and is therefore a very broad-based approach. The idea is not to prejudice the data but to let it speak for itself. Subjects of the ethnographic study are thereby speaking for themselves as far as possible. For example, we make no assumptions about what a 'software quality manager' is. In our interviews we ask our collaborators, who may or may not call themselves by such a title, to describe their jobs;; questions about their daily activities then elicit their perceptions of their function/s.

Obviously the phrase 'as far as possible' has to be used because the ethnographer is still mediating the information. The point of the ethnographic approach is to minimize the effects of this mediation in several ways. Firstly the data collection requires a particular kind of approach. The ethnographer has to negotiate a bipartite position, the two aspects of which (strangeness and participant-observer) could be seen as being in conflict.

Strangeness: All data, the activities of the interlocutors within the study, their language and other discourses, the artefacts they produce and the beliefs and principles they hold have to be regarded as 'strange'. This entails suspending one's commonsense notions and any background knowledge and regarding the phenomena as if for the first time, as if contextless. The context/s of the phenomena then have to be observed in the same way. This is particularly difficult when the ethnographer and her interlocutors share a cultural heritage. The degree of shared background knowledge then is so great that it is probably impossible to suspend it completely. However, the ethnographer has to analyze her own preconceptions as much as possible to at least detail how they may be affecting the analysis. For example, in modern British culture many people may hold a belief that Marks & Spencer have a reputation for high quality products (interestingly we may find it harder to agree on comparable software producers).

Allied to this the ethnographer adopts a position of 'analytic skepticism' wherein the hierarchical relations that exist within the culture are unpicked. For example, within a technical setting it is essential not to take at face value any assertions that a law, a procedure, or a standard are obviously true or the best.

Participant Observation: At the same time the ethnographer is required to live as far as possible, the culture of the organization being studied, to get inside it in order to gain some experiential knowledge. This fulfils two theoretical requirements:

1. The 'strangeness' required to look at the culture with fresh eyes does not become an authoritarian and superior detachment.
2. An epistemological requirement which concerns what can be regarded as legitimate knowledge and how it is to be determined. The position of participant-observer entails that knowledge gained in experiencing the culture from within is somehow richer and more legitimate than simply observed knowledge. As Cooper, Hine, Low & Woolgar [16] state:



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The rationale is that a prolonged period of intense immersion in the culture best enables the ethnographer to experience the world of her subjects, and hence to grasp the significance of their language and actions, for, in our case, the production and consumption of technical artefacts.

Engaging with software developers who are working on real problems, probably under pressure, will reveal more about their attitudes to software quality than talking to them in abstract terms, or talking to their line managers.

Discourse Analysis

Discourse analysis comes in many forms but can be split into two levels or types of activity, neither of which can truly function without the other. The common factor between all the various forms of discourse analysis is the concern with language structures greater than the sentence or the clause.

Before describing these levels we need to define briefly what we mean by the term *text*. This is used by many researchers into language to denote their main form of data, that is, any spoken (and which they therefore make an audio-recording/transcript of) or written (for which they have the printed or written paper copy) interaction. Such a definition makes clear the history of linguistic research where the written text and the written transcript were the main form in which data would be collected. The definition of the term text has widened over time and been given a new meaning in relation to the social study of language (socio-linguistics). For those researching this field the term text has come to denote any form of linguistic interaction that has clearly defined social boundaries, takes place in a specific type of social context and is of a clearly defined type or genre.

The 'deeper' level of discourse analysis is concerned with the linguistic nature of these larger structures. A classic overview of this type of analysis is provided by Brown and Yule [17]. This type of analysis places stress upon the ways in which spoken and written texts are structured, how topics develop and are made coherent and how information is presented, contextualised and referenced. This form of discourse analysis draws upon the fields of psychology and linguistics and often focuses research questions upon the intelligibility and understandings that people gain from reading or hearing a text. This type of analysis would allow us to draw conclusions from the way, for example, notes in a training course on software quality were structured and presented.

The 'higher' level of discourse analysis places emphasis upon the role of social relations, practices and structures in defining spoken and written texts. A recent detailed exposition of this type of practice has been provided by Fairclough [15, 18]. This form of discourse analysis is informed by sociological and linguistic arguments. In many cases the research questions are focused upon the ways in which social meanings and understandings are transmitted through differing texts.

Both forms of discourse analysis are therefore attempts to explain the dynamic processes which allow the creation and interpretation of different texts and utterances.

Using discourse analysis

A model of language where texts encode forms of social relationship is central to the forms of discourse analysis to be used in the study proposed for this project. As was argued above, quality is not simply a material or empirically fixed reality, nor can it be defined and produced through technical fixes, it is part of a larger social process in which both social and technical definitions are formalised and negotiated. The purpose of discourse analysis is to draw out from the text under study those traces and structures which are the products of social relationships in order to bring to light their role in the construction of the text itself.

How then can one engage in this task? Halliday [19] argues that all texts draw upon three aspects of the social and linguistic context in order to provide functioning social meanings. These he describes as the *field*, the *tenor* and the *mode*. The field of a text represents the material or objective elements that are available in a situation to be included in the text itself. An example of the field of a conversation between two programmers might be the details of the project, the programming code under discussion, the hardware and software tools to hand and so forth. The field therefore provides what Halliday describes as the ideational or experiential elements of a text, the knowledge brought by the participants to the interaction. The tenor of a communication provides the social elements of a text. An example of the tenor of a conversation between a manager and a junior programmer would be that of their differing power relationship, the specific social roles assigned to them in the interaction and so on. The tenor of an interaction between the same two people might be quite different if they met at some social event. The tenor therefore defines the types of social relationships and subjective meanings that are encoded within a text.

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The mode of a text is defined by the medium in which it takes place; whether it is a written letter, a spoken conversation, an electronic mail interaction and so forth. This Halliday describes as the textual aspect of a text. It is at this level that the psychological and linguistic aspects of texts and interactions are most prevalent, the ways and forms through which the very clauses, sentences, and other cohesive aspects of text are produced (for a full discussion of written, spoken and computer-mediated textuality see Yates [20, 21]).

The present project is concerned with the processes which inform the evolution and adoption of software quality management systems. There are therefore two main sources of data which the discourse analyst might draw upon in exploring this issue: the spoken, written or electronic interactions between software engineers themselves, and the printed texts e.g. technical manuals, business or academic publications which they draw upon. The first step in conducting discourse analysis consists of the data collection. This data will then form the corpus of texts which will be analysed.

EARLY DATA

One aspect of ethnography which often surprises people new to the area is the analysis of the ethnographer's own thoughts and notes. Through any study of this kind, the ethnographer would keep detailed notes of all activities and impressions gained whilst visiting the cultures under study. The following example is based on a diary excerpt written during initial visits to potential collaborators. The emphasis here is on the element of strangeness (since participant-observation requires a longer immersion in a culture than a couple of hours). All the familiar, even banal, details of the collaborating organizations are regarded as novel and contextless. The analysis indicates the kind of information this approach can yield.

Excerpt from interview diary: organization C

Organization C has many sites in this particular town. Our meeting was scheduled to occur at one of the locations and we were sent a map showing all the sites in advance. This particular site was on an industrial estate and surrounded by branches of many 'big name' companies, some of whom operated in similar markets. The front of the building was imposing and built in a late '70s/early '80s style. There were several flags flying outside including a Queen's Award For Export Achievement. The reception area was spacious and seemed fairly recently refurbished. The company's latest products were displayed next to an area of low comfortable seating. On tables nearby the 'quality' newspapers and the organization's promotional materials were displayed.

Analysis

This initial simple description of one of our collaborators work places yields a surprising amount of information. One of the most notable factors is the way boundaries are set up between the 'public spaces' and the 'official organization spaces'.

Organization C is sited on what could be described as a function-specific road, i.e. it is a road that exists only in the setting of an industrial estate (of which a lot could be said in itself). Despite this there is still a large, landscaped frontage to the building, incorporating an individual driveway.

It could be argued that C simply has a lot of money and so can afford large and imposing premises. But this is not a sufficient explanation. It could also be argued that since C is a strictly commercial enterprise it has to take account of its public image. This is true, in a sense, but these are things we know because of our specific cultural heritage. We need to question what is behind this knowledge.

In our culture distance implies importance. More specifically this refers to distance that is constructed in a particular way, that is when something can be seen but not reached. Buckingham Palace, for example, was designed to be important in a way that Downing Street wasn't, despite the latter's previous occupant moving the public space away. So organization C has a need to appear important. Important to whom? The siting on an industrial estate surrounded by other commercial players suggests that one aspect may be to present a strong image to competitors. The display of sales literature and products in the reception area suggests an image that is also directed at customers.

This sense of distance and boundaries creating an air of importance also extends to the reception area of the organization. In C there is a large reception area, reminiscent of a medium sized hotel, and a large, curving reception desk which reinforces this sense. Here, however, the receptionist is able to disappear through a door to the side and doesn't provide constant availability.

Again, in our culture, 'hiddenness', and hence limited availability, is a characteristic which increases the importance of a person. Checkout workers are highly visible in supermarkets, floor managers less so (a distinction which is heightened by the use of uniforms); bank tellers are visible, bank managers are usually not. In C we had to wait (not long) for the receptionist to appear before we could go through a legitimization process of signing in and being presented with stickers to wear. She was therefore seen to be important enough not to have to be totally



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available to the public, with the additional possibility that she had other, equally important, work to do. We were still confined to the organization's own, set public space however until our collaborator came through some glass doors at the back of reception which lead to the company proper. Now suitably chaperoned we were allowed 'in'.

How does this relate to quality? Already we are building up a picture of 'importance'. But what kind of importance is this? C sets up a series of graded approaches (the estate, the frontage, the driveway, the reception area) that impress on the visitor just where s/he is going and that not everyone is allowed in. As mentioned this is a model that is reminiscent of an hotel, but the echoes of this are also of the large country house. The receptionist is also allowed to be 'important'. The conclusion here is that outward expressions of 'importance' indicate a concern with public image which suggests extroversion and the need for competitiveness. A lack of these expressions could indicate a low profile, introversion and some kind of monopoly market. As we have seen above 'quality' can mean many things but, apart from the transcendent view, it is always relational: "conformance to..."; "fitness for ..." etc. We would expect then that quality issues generally would be more of a concern for an organization that is itself 'relational', i.e. outward looking.

SUMMARY AND CURRENT STATUS

In the early discussions we have attended and participated in there seems to be a general assumption that everyone knows what quality is. However the phrases used and the actions taken belie this consensus. Quality implicitly means different things to different people. These meanings are influenced by the context in which the term is used and this context is formed by a variety of cultures, for example, the project team, line management, senior management and the 'market'.

SoFEA is investigating the non-technical factors which influence the evolution and adoption of software quality management systems using techniques developed in the social sciences. We have taken a social science approach to this question for two main reasons:

1. The notion of quality must be viewed in an organizational and social framework;
2. Qualitative knowledge is mutable and implicit. In such circumstances, people can be unaware of the factors influencing their decisions and actions. With SoFEA we are attempting to make the implicit explicit.

The approach taken draws on two areas of social science research: ethnography and discourse analysis. Ethnography involves the



researcher immersing herself in the culture/s of the collaborators to study their actions and discussions in context. Discourse analysis involves studying and analysing written and spoken texts for evidence of the social and organizational framework which results in their creation.

Data for the analysis is being collected from a number of different sources: from public seminars and discussions, from studies of two specific collaborators, and from public texts on the subject of quality and quality initiatives.

We have conducted the initial interviews. The next stage involves a researcher living in a company for about a week, collecting written and spoken texts, and reference material used by the collaborators in their discussions and opinion-forming. Analysis of these will provide a rich informational resource concerning software quality specifically and software development generally.

REFERENCES

- [1] *Report Of The Inquiry Into The London Ambulance Service*. February 1993 (available from BDO Consulting).
- [2] *Flight International*. 22.12.93 – 4.1.94 p.11.
- [3] Woodman, M., Sharp, H., Hall P. (1993) 'What Is Behind Software Quality Management Systems?' in *Proceedings SQM '93*, pp 225–232.
- [4] Dennis, M. (1991) 'TickIT: The DTI Involvement', *TickIT Certification Initiative: Objectives And Practice*, IEE Digest No: 1991/138, 1/1 – 1/5, 24.4.91.
- [5] ISO 8402 (1986) *Quality Vocabulary*, International Standards Organization.
- [6] Slater, J. (1991) 'TickIT Overview', *TickIT Certification Initiative: Objectives And Practice*, IEE Digest No: 1991/138, 2/1 – 2/13, 24.4.91.
- [7] 'Achieving Quality' (1987) Unit 6, *PMT 605 Project Management*, The Open University.
- [8] Scribner, S. and Cole, M. (1981) *The psychology of literacy*, Harvard University Press.
- [9] BDO Consulting *Quality Matters*, Issue No. 3, June 1993.
- [10] Crosby, P.B. (1979) *Quality Is Free*, McGraw-Hill
- [11] Hovenden, F.M. (1994) 'Family, Health and TQM', Technical Paper. Computing Department, Open University.



572 Software Quality Management

- [12] Latour, B. & Woolgar, S. (1986 [1979]) *Laboratory Life: the construction of scientific facts*, Princeton University Press.
- [13] Low, J. & Woolgar, S. (1993) *Managing The Socio-Technical Divide*, Discussion Paper No. 33, CRICT, Brunel University.
- [14] Parnas, D.L. and Clements, P.C. (1986) A Rational Design Process: How and Why to Fake It, *IEEE Transactions on Software Engineering*, SE-12(2), 251–257.
- [15] Fairclough, N. (1989) *Language and Power*, Longman, London.
- [16] Cooper, G., Hine C., Low J. & Woolgar S., (1993) *Ethnography And Human Computer Interaction*, Discussion Paper No. 39, CRICT, Brunel University.
- [17] Brown, G. and Yule, G. (1983) *Discourse Analysis*, Cambridge University Press
- [18] Fairclough, N. (1992) *Discourse and Social Change*, Polity Press. Cambridge.
- [19] Halliday, M.A.K. (1978) *Language As Social Semiotic: A Social Interpretation of Language and Meaning*, Edward Arnold Ltd.
- [20] Yates, S.J. (1993) 'Speech, Writing and Computer Conferencing: an Analysis' in Mason. R.D. (ed.), *Computer Conferencing: the last word?* Beach Holme, Victoria.
- [21] Yates, S.J. (1993) *The Textuality of Computer-Mediated Communication: Speech, Writing and Genre in CMC Discourse*, Unpublished PhD Thesis, Open University.