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# EXPLORING INFORMATION SYSTEMS IMPLEMENTATION AND INTERNALIZATION USING REPERTORY GRID ANALYSIS

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## Abstract

*The research presented in this paper views the process of implementing information systems as an important locus of discussion and negotiation that affects judgements of information systems and the work they support. Empirical data gathered during a series of experiments conducted before, during and after the implementation of a large-scale distributed information system show how significant and unanticipated issues and concerns emerged during and immediately after implementation, and how these can provide important evaluative feedback to both developers and the user community. The research is significant to the IS community since it demonstrates how significant issues and concerns can be overlooked despite the sophistication of development and evaluation techniques. The research is also of interest to the wider evaluation community since it demonstrates an innovative use of Repertory Grid Analysis (RGA) as a content-free medium for interview, data gathering and analysis.*

## Introduction

The research explores the development, implementation and use of the National Automated Fingerprint Identification System (NAFIS) in the UK. NAFIS serves the 43 police forces of England and Wales, providing support for two processes; the verification of the identity of people arrested by the police; and identifying offenders from the latent finger marks left at crime scenes. The research was prompted by concerns within the police community that the implications of NAFIS were neither widely understood nor their complexity fully appreciated. Although fingerprint work is highly specialised, the findings of this research have broader implications, in particular highlighting the need to acknowledge the increasing variety and particularity of values used to judge the worth of information systems as they become ubiquitous in an ever-widening range of application domains.

The RGA experiments were conducted as part of a wider study of NAFIS carried out by the author and a colleague over a period of three years. The experiments provided deep insight into fingerprint work through their use of RGA as a content-free data-gathering medium, overcoming the limitations of more orthodox techniques whose evaluation criteria are pre-determined. The findings show how the prioritisation of issues and concerns within the fingerprint community did not match those of the systems developers or commissioners.

Smithson and Hirschheim (1998) Pawson and Tilley (1997) and Bawden (1990) conclude that IS evaluation is less mature than evaluation in disciplines such as social policy. An important consequence of this is that the shortcomings of popular techniques such as cost-benefit analysis are less well understood in the IS community. Smithson and Hirschheim (1998) suggest that the increasing functionality and range of applications of information systems exacerbate this lack of understanding: the pace of innovation in information systems functionality and use outstrips the capacity of orthodox techniques to assess their impacts. Much IS evaluation suffers from a 'methodological inertia' (Davis and Beeson, 2000), arising from adherence to familiar evaluation techniques. This problem is characterised by an increasing disenfranchisement of user communities from the evaluation process.

The research reported sought to complement orthodox evaluation techniques, overcoming some of their limitations by engaging the user community in the evaluation process directly. The aim was to gather empirical data about work processes, particularly

changes occurring during and after implementation of the information system. The study focused on the construction and use of language by workers using the system. A particular aim was to avoid the pre-formulation of either assessment criteria or metrics, since both the literature (e.g. Eason, 1988) and experience showed that it was impossible to predict all of the impacts of an information system in advance. In the same way that workarounds are both inevitable and unpredictable, so are the values used to judge their utility.

## **Background**

NAFIS is a large-scale distributed information system due to be rolled out to all 43 police forces in England and Wales by July 2001. The database, located in London, holds the national fingerprint collection of some 50 million fingerprint images. It also holds a database of outstanding (latent) finger marks from crime scenes. NAFIS interfaces directly with the Police National Computer (PNC) which holds descriptive (alphanumeric) data of convicted offenders. Together, the alphanumeric data held on PNC and the corresponding fingerprint images (called 'ten-prints') held on NAFIS comprise the National Criminal Justice Record System (NCJRS).

NAFIS uses Automated Fingerprint Recognition (AFR) algorithms to provide a comprehensive information system supporting two distinct processes (i) the verification of the identity of individuals arrested and (ii) the identification of those responsible for crime. Historically, identity verification (i) has been the responsibility of the National Identification Service (NIS) at New Scotland Yard in London, whereas identification of (latent) marks left at the scene of a crime (ii) has been a local (police force) responsibility. NAFIS bought these processes together: since each process depends on the comparison of fingerprint images, NAFIS removes the need for both national (to support (i) above) and local (to support (ii) above) collections. The devolution of the ten-print verification process to the 43 forces bought with it responsibilities previously held by staff at NIS. Although the ten-print process was familiar to provincial fingerprint officers, its management and resource implications were not familiar to their managers.

A study of NAFIS development, implementation and use in eight police forces was undertaken between January 1999 and December 2000. The study explored the impacts of NAFIS on the process and organisation of fingerprint work in England and Wales (Beeson and Davis, 1999 a-c). Within this wider study of NAFIS, the research reported here adopted a theoretic position developed from the work of Eason (1988), Scarbrough and Corbett (1992) and Walsham (1993) which accommodates the view that the impacts of an IS cannot be wholly known or predicted in advance (Davis, 2001). The implementation phase is seen as an important locus of innovation, as users take the system into operational use. Since the majority of users in this case had no direct involvement in the design and development phases of the NAFIS project, implementation required substantial creative effort on their part in order to operationalise the NAFIS design. The research sought to explore this creative process as changes to work were experienced and discussed within the fingerprint community. Issues and concerns facing the fingerprint workers during and after implementation were specific to their specialised work context, representing what Thomas and Harri-Augstein (1985) call a community of discourse.

Repertory Grid Analysis (RGA) was used to articulate the experience of people in this community without prescribing the parameters or priority of the discussion. The research exploited the capacity of RGA as a content-free data gathering medium that provided structure but without dictating content during conversations with fingerprint staff. This engagement with the fingerprint community allowed the negotiation of shared meaning and the inter-subjectivity of the issues and concerns discussed as NAFIS was brought into use to be explored. During the course of the study, 56 RGA experiments were carried out with 24 participants.

The initial phase of each RGA experiment followed the conventional pattern described by Fransella and Bannister (1971). Each participant was asked, "what tasks are involved in fingerprint identification?" Participants' responses were verbal descriptions of their experience of fingerprint work, which were recorded. These task descriptors included both current manual tasks and tasks supported by NAFIS. Typically, participants named tasks in the sequence of their execution: the completeness of the list was intuitively clear to the participant. When a comprehensive list of tasks had been compiled, they were differentiated by a process called triadic elicitation (see Thomas and Harri-Augstein, 1985 and Davis, 2001 for a full discussion). In this way, the task list provided a series of bi-polar constructs, unique to the participant, capable of differentiating the tasks. The task descriptions provided the column headings and the bi-polar constructs the headings for the two 'poles' of the rows in the repertory grid. Participants then rated each task in turn against the constructs using a 5 point Likert scale. The example in Figure 1 below shows the task descriptors or elements as column headings and the constructs used to differentiate them as labels at the end of each row. The numbers indicate the ratings applied to each of the element and construct combinations.



FOCUS: Tony180599  
 Elements: 16, Constructs: 10, Range: 1 to 5, Context: Impacts of NAFIS

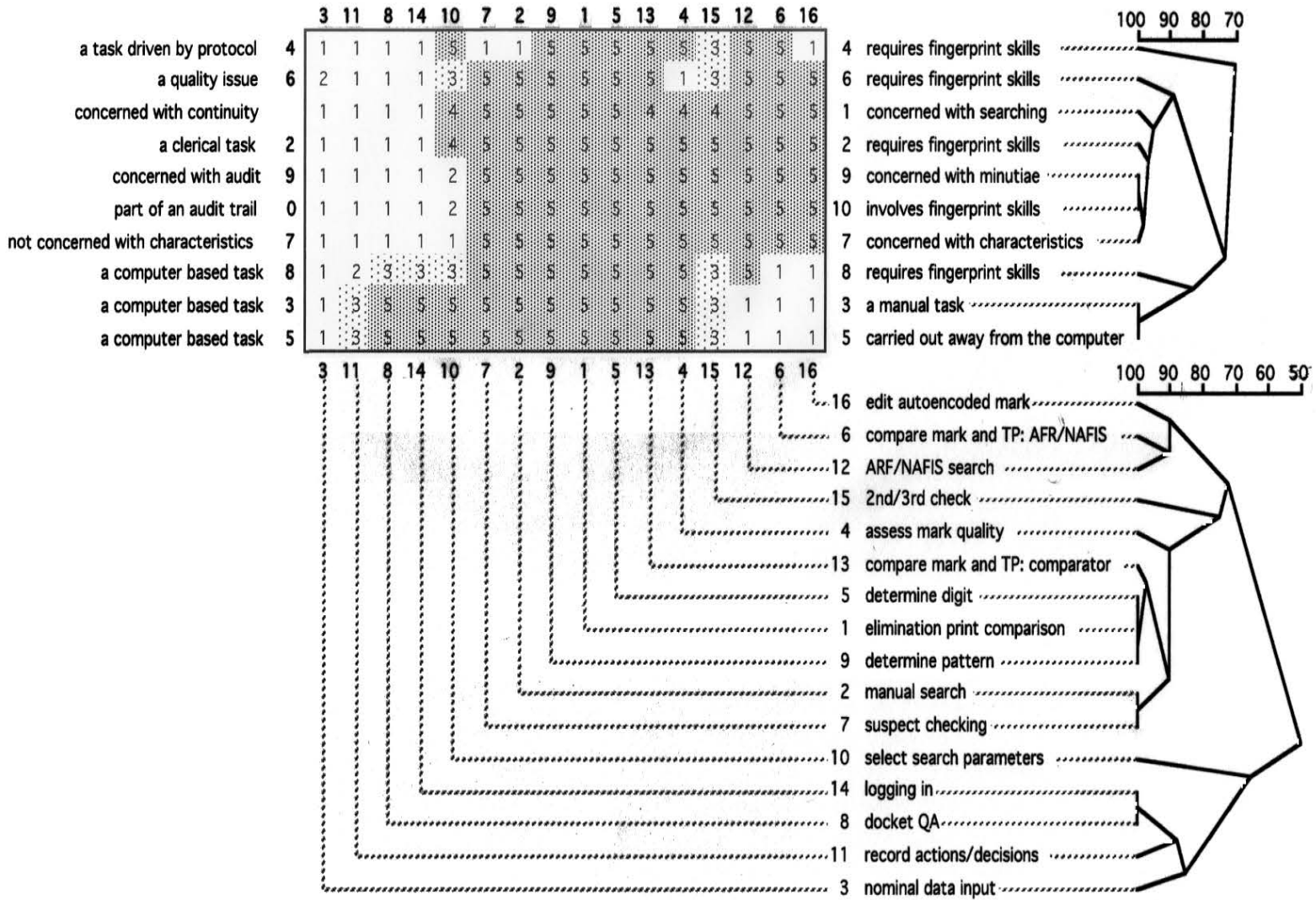


Figure 2. A Spaced-Focused Repertory Grid

No further statistical analysis of these data was carried out. The spaced-focused grid was presented to the participant, who was asked to explain what the clusters meant. This process, called talkback by Thomas and Harri-Augstein (1985), diverges significantly from the conventional statistical analysis of Repertory Grid data used, for instance, by Hunter (1997). This innovative use of the RGA technique in the information systems field fulfilled the research aim of enabling participants to articulate their experience of fingerprint work and the values that they used to judge it.

Each experiment, or conversation, started from scratch with the same question. Most participants took part in 3 experiments during the research. During the talkback phase, the spaced-focused grid was annotated to indicate the meaning attributed to the clusters. Additionally, following the second and third RGA experiments, participants were asked to compare the most recent grid with the previous grid(s). This provided a substantial extension of the talkback protocol proposed by Thomas and Harri-Augstein, enabling change in both working practices and interpretations of those changes to be monitored and discussed as utilisation and understanding of NAFIS increased.

## **Findings**

The longitudinality, albeit modest, of the RGA experiments provided rich insight into fingerprint work: this insight was cumulative, increasing the understanding of participants and researcher over time. The participants were drawn from fingerprint bureaux all over the country: RGA provided a medium that provided methodological cohesion but without pre-determination of evaluation criteria.

The issues, concerns and values that emerged from the RGA data gave rise to a loose typology of 9 themes, each perceived as important by the participants. The nine themes, listed below, represent areas of shared meaning and concern.

1. Macroscopic versus microscopic examination of fingerprints
2. (Fingerprint) Process continuity: inclusion versus exclusion
3. Fingerprint work versus administrative work
4. Automation, autonomy and control
5. Performance, training and trainability
6. Status and competence
7. Exploration, discovery and confirmation
8. Process awareness and integration
9. Nature of output

The findings from the RGA experiments complemented the data gathered through observation and interview in the wider NAFIS study. The validity and relevance of the RGA data manifested in the 9 themes listed above was attested to by their acceptance among the fingerprint community when the research findings were reported locally and nationally. The significance of the findings can be illustrated by an example.

The differentiation of microscopic and macroscopic examination of fingerprint images was both intuitive and clear to the fingerprint community but had not previously been articulated in this way. The differentiation is important. Comparison of the minute detail in two fingerprint images is time consuming and places high demands on both human and AFR resources. For that reason, working practices have evolved that remove the need for unnecessary detailed comparison. For instance, if a (latent) mark found at a crime scene is known to have a loop pattern, suspect ten-prints with other patterns (e.g. arch or whorl) would be excluded from detailed comparison almost instantaneously by the fingerprint expert. Anecdotal evidence gathered during the wider study of NAFIS suggested that such exclusions, based on macroscopic rather than microscopic comparison, accounted for about 40% of all fingerprint comparisons.

The NAFIS design sought to optimise control and auditability of fingerprint comparisons. To this end NAFIS workflow required that all fingerprint comparisons were carried out using NAFIS. The design goal of optimum auditability clearly clashed with highly developed working practice. The articulation of the microscopic-macroscopic construct provided a shared meaning that enabled this impasse to be resolved.

Additionally, the shared meanings enabled issues arising from the devolution of ten-print verification to be addressed. NAFIS presented a generic workflow for ten-print verification which devolved the responsibilities of NIS to each of the 43 forces: it could not 'fit' all of these individual organisations, each with its own structure, history, culture and working practices.

One force faced immediate and serious problems following ten-print devolution: these arose from a lack of understanding of the devolved process in a department outside the fingerprint bureau. Fortunately, at this point in time, the researchers had sufficient understanding of the processes to facilitate a resolution. Managers responsible for both the ten-print verification and crime scene (latent) mark identification processes were brought together in a meeting during which discussion was facilitated by the author. The guidance provided by the author built on the shared meanings articulated by the research and was sufficiently authoritative to enable resolution of the problem within three hours.

The data gathered using RGA were demonstrably relevant and showed that emerging effects of NAFIS implementation and use could be articulated and used to extend the repertoire of judgements used to assess its impact. This is what Patton (1997) calls utilisation focused evaluation.

The research shows how significant issues and concerns emerge as information systems are assimilated into operational use in the work setting, and how such issues and concerns can be underestimated or overlooked by conventional IS development methodologies and evaluation techniques. The implications of the research for IS practitioners are important, since such oversights have clear potential to increase dissatisfaction with the system and reduce the perception of success.

## Implications

This research confirms the validity of the theoretic position adopted, in that IS evaluation must be sufficiently flexible to accommodate unpredicted and unpredictable impacts. The content-free nature of RGA has been exploited to enrich the empirical data gathered during this intensive case study research.

Clearly, the work has limitations. The small sample of participants and the complexity of fingerprint work combine to limit any claim to comprehensive understanding. The speciality of fingerprint work and the context of the wider police and criminal justice communities in England and Wales limit any claim to generalisability. Nevertheless, the work does have significance beyond the fingerprint setting.

The use of RGA to articulate shared meanings of issues, concerns and values supports Weiss' (1990) challenge to the single objective reality that underpins many orthodox evaluation techniques applied to information systems. The capacity for such shared meaning to re-integrate practitioners and managers into the evaluation process has been demonstrated. Further research is planned to explore the extent to which such increased participation in IS evaluation could be achieved in other settings.

The research also has implications for the timing of evaluation. This work suggests that evaluation tends to be seen as one of the later phases of an IS development project. There are two issues here. Firstly, by this time, the IS has typically become perceived as a monolithic entity (revealed by phrases such as "the system" or "the computer"). Such a perception tends to mask the range of effects an IS has across a wide range of organisational departments. Given the increasing process integration made possible by contemporary information systems infrastructures, this is a particularly important line of enquiry to pursue. Secondly, evaluation can become encapsulated as a phase of a development methodology. This can lead to a closed world, whereby the criteria for evaluation are defined by the design goals rather than the work or other social context where the IS will be assimilated into use. This research demonstrates that RGA has the capacity to support an interpretive discourse that complements orthodox, primarily positivist, evaluation techniques by articulating and prioritising issues, concerns and values.

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