

Information systems 'failure': the case of the London Ambulance Service's Computer Aided Despatch project

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In this paper we use the case of the London Ambulance Service Computer Aided Despatch (LASCAD) project as a cogent example of the nature of information systems failure. Our aims are twofold: to set the LASCAD case in the context of previous case studies of IS failure and to use a web approach to organize the case material and hence assess the importance of two important explanatory frameworks for considering IS failure.

Introduction

In this paper we use the case of the London Ambulance Service Computer Aided Despatch (LASCAD) project as an effective example of the multi-faceted nature of information systems (IS) 'failure'. Our aims are twofold: to set the LASCAD case in the context of previous case studies of IS failure and to use a web approach to organize the case material and hence assess the importance of two important explanatory frameworks for considering IS failure.

Our description of this case is primarily based on a collection of documentary material published during and after the critical events of the 26 and 27 October 1992, particularly the excellent report of the public inquiry (Page *et al.*, 1993). The description has also been shaped by discussion with a limited number of persons involved with the LASCAD project. However, because of the highly contentious and prominent nature of this particular IS project, all such persons wish to remain anonymous.

The structure of the paper is as follows. The next section considers the importance of studying IS failure and describes four contemporary examples of IS failure: two UK cases and two non-UK cases. The following section considers two frameworks that attempt to explain IS failure in terms of the relations between various stakeholders in an IS development project. The subsequent section provides an initial account of the LASCAD project, particularly emphasising the reportage surrounding the events in October 1992. The section following this organizes a discussion of the case study in terms of one of the explanatory frameworks discussed. The penultimate section reconsiders the LASCAD case in the light of the frameworks

and the case material. The final section presents the conclusions of the paper.

Study of IS failure

Information systems failure, or the association with such 'failure', comes close to a form of 'social leprosy' or stigma (Goffman, 1990). People become tarnished by association with information systems projects that are deemed to have failed. This is highly significant in the light of surveys such as that conducted by the US Government's Accounting Agency which in 1979 (US Government Accountancy Office, 1979) found that less than 3% of the software that the US government had paid for was actually being used as delivered. More than half of the software had never been used at all. Gladden (1982) reports in a similar survey that 75% of all system development undertaken was either never completed or the resulting systems were not used. Of this 75%, 25% were never delivered and 47% were delivered but not used.

But IS failures and the study of this phenomenon is not only important because of its apparent frequency. IS failures are also significant because they act as an important resource for validating information systems development practice. The information systems industry is very good at suggesting 'appropriate' tools, techniques, methods and frameworks for constructing information systems (Harel, 1980). It is generally poor at supplying empirical validation for many of its proposals (Galliers, 1992).

In this light, IS failures can act as a significant resource. In other disciplines, the detailed study of 'breakdowns' has proved to be significant in changing established practice. In structural engineering, for

instance, the study of bridge failures has revealed important information leading to the re-design of bridges (Petrowski, 1985). In another context, the idea of studying and even stimulating breakdowns in social interaction has been discussed in the light of revealing significant characteristics of human behaviour (Garfinkel, 1967). It is not surprising to find therefore that work in participatory design of information systems has begun to consider the importance of breakdowns in human-computer interaction (Bodker & Gronbaek, 1991).

Examples of IS failure

The LASCAD project has been one of the most frequently quoted UK examples of information systems failure in recent times. The prominence of this particular case is probably due more to the 'safety-critical' nature of this system and the claim that 20–30 people may have lost their lives as a result of this failure, than the scale of the project. Indeed, in financial terms LASCAD (£1.1–£1.5 million) is dwarfed by other British IS 'failures' such as Wessex Regional Health Authority's RISP project (£63 million) (HMSO, 1993), and the UK Stock Exchange's Taurus settlement system (£75–£300 million) (Waters, 1993).

IS failure is of course not specifically a British malaise. For instance, Oz (1994) takes a similar documentary approach to describing the important case of the Confirm reservation system in the USA (\$125 million). Also, Sauer (1993) comprehensively describes a large Australian government IS project – Mandata (A\$30 million) – that failed during the 1970s.

In this section we examine these four IS projects in more detail. In doing this, our intention is to supply a context for discussing the particular features of the LASCAD case. We particularly devote attention to the two UK projects, both because of their relative recency and their relative lack of coverage in the academic literature to date.

Wessex RISP

In the mid-1980s, RISP (Regional Information Systems Plan) was born at the headquarters of Wessex Regional Health Authority (WRHA) in Winchester, UK. The fundamental idea of the plan was integration across the health region; linking every hospital ward, GP surgery and district nurse between Bath and Southampton (BBC, 1993).

In early 1986, RISP went out to tender. WRHA boasted of its size and financial spending in the tender document and in February 1986 the contract for providing core systems for RISP was awarded to DEC, subject to a further search for a software partner. However, following intervention by the losing consortium of IBM, Arthur Andersen and Technicon Data

Systems (a US software supplier), the final contract was eventually awarded to the IBM consortium in November 1986.

During the development of the project, Wessex's regional treasurer apparently advocated that a team of consultants be employed to consider privatising the authorities computer operations. A consultancy firm was then appointed without tender. The treasurer resigned from the authority, joined the consultancy, and undertook the review. His recommendation was to form a private company called Wessex Integrated Systems (WIS), which was later accepted by WRHA. The ex-treasurer then joined WIS as a director. Later WIS was taken over by services company CFM which was partially owned by ICL.

WIS apparently placed orders and made financial commitments on the authority's behalf, but nobody outside WIS could establish the sums involved. For instance, at the request of WIS, Wessex spent £3.3 million on an IBM 3090 mainframe. The decision was apparently taken by a small number of officers who did not inform WRHA of the acquisition until some months later. The machine subsequently lay unused in its original packaging for 18 months, by which time its value had declined to an estimated £2.3 million.

In 1989 the RISP project began to turn sour. Contracts flowing from the project included the spending of £1.8 million on a hospital information system licensed for two district health authorities which did not want it (Computer Weekly, 1992e). Also, some districts did not want to implement a personnel system which was part of RISP. This too was cancelled at a cost of £1.6 million. A further £806,000 was written off on systems software which was not required and was never introduced.

Problems such as these led to the cancellation of the entire RISP project in 1990 by a new general manager at Wessex. Reasons for the cancellation included the fact that cost had soared beyond expectations, because the project was too technically ambitious, and because it was not wanted by the districts. The auditors were also called in by the general manager to investigate the case.

In May 1993 the House of Commons Public Accounts Committee met to consider the Wessex case (Computing, 1993c). MPs questioned health executives about the conclusions of five district auditors' reports:

- In awarding business to the IBM consortium, Wessex had broken not only its own rules, but also those of the Department of Health, the Treasury and the European Commission.
- The auditors drew attention to the authority's inability to control its own finances – particularly payment of more than £3 million to WIS.
- The general manager at Wessex admitted he had failed to get approval from both the Department of

Health and the Treasury for a £78,000 payoff to Wessex's IT manager who quit her job in October 1992 after two years' service. The IT manager was asked to sign a contract agreeing not to work in the UK National Health Service (NHS) for two years.

The report of the committee voices the following concerns:

- Wessex management contested the findings of external auditors and concealed vital information from the authority and the NHS management executive.
- Wessex placed too much reliance on consultants without controlling them properly.
- A conflict of interest arose between WIS and the authority when the authority appointed a WIS director as regional IS director, despite being a contractor to the authority.
- The RHA allowed an IBM employee on secondment to advise it on buying an IBM mainframe at a cost of £3.3 million. It could have been bought for £1 million less and, by the time it was installed, it was worth £ $\frac{3}{4}$ million.
- Andersen Consulting was awarded a contract to supply the core software which contained no quality provisions and no maximum price.
- MPs pointed to the personal failings of the former RHA chairman and former regional general manager.
- The report claims that it is unsatisfactory that none of the main parties involved in the waste of £20 million has suffered any significant form of disciplinary measure.

Wessex RISP is an important example of information systems failure. Evidence suggests that the project failed because of bad management rather than technical failure (Computing, 1993d). RISP is an example of a project which failed because it lost significant support from members of the Wessex region. There was not enough support for the project to encourage rectification of admittedly serious flaws in areas such as the purchase of equipment and project management.

Taurus settlement system

Taurus (Transfer and Automated Registration of Uncertified Stock) was a project which attempted to build a paperless share trading and dealing system for the London Stock Exchange. The project seems to have arisen from recommendations of a Washington-based think-tank, the Group of 30, which consisted of representatives of some of the world's top financial institutions (Computing, 1993f). The report of the Group of 30 made two main recommendations:

- that the London Stock Exchange automate the movement of paper certificates;
- that it adopt a process of rolling settlement, i.e. a system where share deals are paid for as they are struck.

Since many of the international banks, organizations familiar with the mass-processing of routine financial data, had become owners of the main stockbroking firms in London, great pressure was put on the Exchange to enact a thorough modernisation of the UK settlement system. On the other hand, vested interests such as the large registrars (organizations that issue and transfer paper share certificates on behalf of companies and investors) would be put out of business if share certificates were abandoned. Such interests seem to have fought against the widespread adoption of IT in this area.

The Bank of England set up the Siscott Committee to steer the project. However, it appears that this committee lacked support from the major stakeholders in the project (Waters & Cane, 1993). The Exchange's first plan, Taurus Mark I, was to build a centralised database of shareholdings and electronic records which would replace paper certificates as proof of share ownership. Officially, this plan was rejected fairly quickly on the grounds of cost. Unofficially it appears that the plan folded because of the objections made by some of the major clearing banks (Chapman, 1994). These institutions maintain share registers for listed companies and stood to lose business if the Mark I plan went ahead.

In light of these objections, the committee proposed Taurus Mark II. This proposal amounted to a distributed database of shareholdings; each institutional or private broker would hold a part of the register. Linking the separate parts would be a network, the hub of which would be a sophisticated switching system located in the Stock Exchange.

The Mark II system was meant to work as follows:

- When a bargain was made, the participant making the purchase was meant to update his own share register. He would then send a message to Taurus.
- The participant making the sale would also update his own register and send a message to Taurus.
- Taurus would check that the details sent by the purchaser matched those sent by the seller. If the two tallied, the bargain would be struck and the appropriate company register would be updated.

A project team was appointed and proceeded to buy a £1 million packaged solution from an American supplier. Work commenced on adapting the package to the needs of the London securities market. However, the system was subject to so much customisation that a further £14 million was spent on the software. Not surprisingly, Taurus Mark II suffered a series of delays. Numerous committees were formed, disbanded and reformed, leading to continually changing requirements. The deadline was pushed back a number of times until, in January 1993, participant testing began. Full implementation was scheduled for April 1994. Because the initial results of the testing proved

unsatisfactory, the Stock Exchange's chief executive commissioned two audits of the system, one from Andersen Consulting, the other from Coopers and Lybrand. The verdicts of the two audits were the same: the system was technically too complex and should be scrapped.

On 11 March 1993, the Stock Exchange's chairman issued a statement saying that the chief executive had requested that all development of Taurus be halted. The cost of the development for the Stock Exchange was £75 million. It is estimated that finance houses, bankers and brokers who built bespoke systems to link into Taurus lost much more. Some estimates put the development costs for participants at close to £300 million (Computing, 1993e).

Taurus is a clear example of a system in which the design was fatally flawed, particularly because of its need to bring together a series of diverse and sometimes conflicting interests (Currie, 1994). Also, during the project, communication between the interest groups was inconsistent and irregular, leading to a significant increase in time scales and costs. Indeed, Currie uses the case of Taurus as an example of the divergence between the formal IS planning literature and what she terms the 'adhocracy' of the reality of IS planning.

Confirm reservation system

In 1987 a new potential market caught the attention of the software development arm of American Airlines Corporation, a subsidiary called AMR Information Services (AMRIS): centralised hotel reservations. Over 80% of airline reservations were made using centralised reservation systems like AMR's highly successful Sabre system but, in contrast, as little as 20% of reservations for hotels were made using a centralised reservations system. AMR marketed their idea, which they called Confirm, as a new advanced reservations system that would build on their success with Sabre.

In 1988, a consortium of Hilton Hotels, Marriott Corporation, and Budget Rent-A-Car joined together and subcontracted the development effort for Confirm to AMRIS. This system was intended to be a comprehensive travel industry reservations system combining airline, rental car and hotel information. A new organization, Intrico, was established to run the new system, and the consortium had plans to market the service to other companies. The consortium agreed to pay AMRIS \$55 million to develop the system. The agreement identified two phases for the project: the design phase which was to last 7 months and the implementation phase which was to last 45 months. The deadline for completion was to be the end of June 1992. A paper in the *Harvard Business Review* by Max Hopper (1991), Senior Vice President at American Airlines, is evidence of the high hopes placed on this

particular project. He portrays Confirm as an exemplary instance of the rise in inter-organizational information systems.

On 30 December 1988, AMRIS presented a base design for the system but Marriott claimed the functional specifications were inadequate. In March 1989, AMRIS declared the functional and technical specifications to be complete and tabled a preliminary development plan. However, the plan was unacceptable to the partners in the consortium and so AMRIS spent the next six months revising the plan. In September 1989, AMRIS completed the design phase and circulated a revised development plan. The cost of the project had risen from \$55.7 million to \$72.6 million. This plan was eventually accepted by the partners together with a revised development deadline of July 1992.

The history of the project from this point on resounds with missed deadlines, project slippage and continuous re-planning. Oz (1994) documents the way in which AMRIS executives knew continuously they could not meet schedules but forced AMRIS employees to change their timetables to reflect the new schedules. This appears to have caused much friction between AMRIS employees and their management. Not surprisingly, by summer 1991, about half of the employees assigned to the Confirm project were looking for new positions. In April 1992, AMRIS fired eight top executives and fifteen employees. In July 1992, after three-and-a-half years, and after spending \$125 million on the project, the Intrico consortium disbanded.

Oz (1994) attributes part of the reason for this failure to the technical difficulties experienced in tying together Confirm's central reservation system with its decision support system. Also some of the failure is attributed to bad management practices of the four partners in the Intrico consortium. However Oz attributes most of the reason for this failure to the lack of professional conduct on behalf of the IS development people. He makes particular play of the importance of software professionals being honest about the limitations of the projects they are engaged in and the systems they develop.

Mandata human resources system

Mandata was proposed as an information system designed to automate personnel and establishments record processing for the whole of the Australian public service. The idea was to maintain a central database of such information which would be accessible from every office in every state in Australia via a national network of minicomputers and mainframes. As well as serving pure operational needs, it was also intended to act as a management information service.

The project was initiated in 1970 and is reported as having gone through five major stages (Sauer, 1993). The period to February 1974 was devoted to initiation

activities such as feasibility study, analysis and design. From February 1974 to August 1976 the project concentrated on establishing its organization, developing a technical infrastructure, and developing the application. In August 1976 the original conception of the project was abandoned and replaced by an approach which was expected to deliver shorter term benefits. This phase lasted until June 1980 when it was decided to scale back the project still further. Efforts were made to save the project but it was terminated in April 1981.

The Mandata system was at the forefront of the technology of its time and, not surprisingly, many problems emerged because of the scale of innovation. For instance, numerous communication difficulties occurred between the in-house development staff and external contractors, and difficulties were experienced in interfacing the software from the different development groups. Also, the project team experienced numerous problems in recruiting and keeping suitably experienced staff; the project team appears to have been permanently under-staffed during the entire duration of the project. The management of the project also changed hands a number of times, with some quite pronounced differences in management styles.

The entire project is estimated as having cost \$A30 million and generally left users no better served than before the project started. Indeed, because an operational system was produced and used by some departments for some four years, departments that had abandoned their manual record-keeping were left in a far worse position.

Sauer discusses the reasons for the Mandata failure in terms of his model of development (see 'termination failure' in the subsequent section). This model leads him not to ask the question, why did Mandata fail, but why did a project subject to so many problems continue for so long? He concludes that the project continued for so long because of its ability to rally support from key interest groups. It eventually failed because the project organization manoeuvred itself into a position where it had little influence over its supporters, and the interest groups could see only limited benefits in continuing the project.

Understanding IS failure

Sauer (1993) maintains that the key conclusion to be drawn from the study of cases like the Mandata project is that the idea of IS failure can rarely be understood satisfactorily solely from a technical perspective. This is because a definition of the success or otherwise of a given information system is as much reliant on the social, economic and political setting within which it is constructed as it is on the technical quality of the construction itself. This seems to be supported by

McKenzie's analysis of computer-related accidents reported in the ACM's *Software Engineering Notes*. He found that of the cases reported, 92% involved failures in what McKenzie calls human-computer interaction: 'More computer-related accidental deaths seem to be caused by interactions of technical and cognitive/organisational factors than by technical factors alone' (McKenzie, 1994).

Web explanations of failure

In this light, case histories are a particularly valuable means of helping us understand the complexity of IS development. They are particularly useful in engendering a more realistic view of information systems, replacing the simplistic idealism of textbooks with the hard reality of rich profiles. Benbasat *et al.* (1987) describe case research as being particularly important for those types of problems where research and theory are still at their early, formative stages. They see a key use of case studies in the generation of theory from practice.

Sauer (1993) has argued for the use of case research in what he calls web descriptions of information systems failure; that is, explanations of failure in terms of the complex intertwining of relationships in the context of computing. Web explanations such as this do not offer a simple linear explanation of phenomenon and consequently provide no simple answers to the problem of preventing IS failure.

Defining information systems failure

Since the 1970s, a number of frameworks have been proposed for understanding the concept of IS failure: Lucas (1975), Bignel & Fortune (1984), Lyytinen & Hirschheim (1987) and Sauer (1993). Two of these approaches seem particularly important because of the way in which they relate IS failure to the social and organizational context: Lyytinen and Hirschheim's concept of expectation failure and Sauer's concept of termination failure.

Expectation failure

Lyytinen and Hirschheim (1987), in surveying the literature on IS failure, identify four major categories of failure:

- Correspondence failure. This is the most common form of IS failure discussed in the literature and typically reflects a management perspective. It is based on the idea that design objectives are first specified in detail and an evaluation is conducted of the information system in terms of these objectives. If there is a lack of correspondence between objectives and evaluation, the IS is regarded as a failure.
- Process failure. This type of failure is characterised by unsatisfactory development performance. It usually refers to one of two types of failure: when the

IS development process cannot produce a workable system or when the development process produces an IS but the project runs over budget in terms of cost or time.

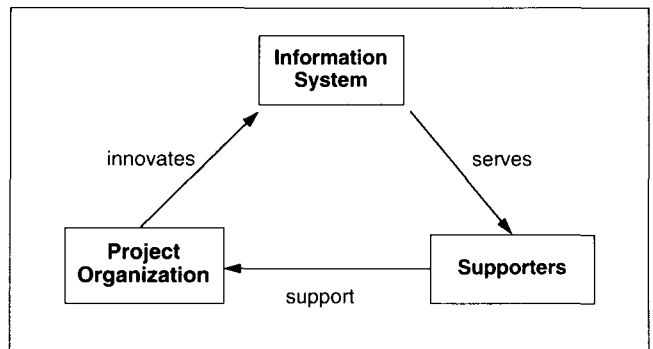
- **Interaction failure.** Here, the emphasis shifts from a mismatch of requirements and system or poor development performance to a consideration of usage of a system. The argument is that if a system is heavily used it constitutes a success; if it is hardly ever used, or there are major problems involved in using a system then it constitutes a failure. Lucas (1975) clearly adheres to this idea of failure.
- **Expectation failure.** Lyytinen and Hirschheim describe this as a superset of the three other types of failure, as it is a more encompassing, politically and pluralistically informed view. They characterise correspondence, process and interaction failure as having one major theme in common: a highly rational image of IS development, which views an IS as mainly a neutral technical artefact (Klein & Hirschheim, 1987). In contrast, they define expectation failure as the inability of an IS to meet a specific stakeholder group's expectations. IS failures signify a gap between some existing situation and a desired situation for members of a particular stakeholder group. Stakeholders are any group of people who share a pool of values that define the desirable features of an IS, and how they should be obtained.

Termination failure

Sauer (1993) has recently criticised the model of Lyytinen and Hirschheim for its plurality. Sauer's model posits a more conservative definition of information systems failure, which suggests that an information system should only be deemed a failure when development or operation ceases, leaving supporters dissatisfied with the extent to which the system has served their interests. This means that a system should not be considered a failure until all interest in progressing an IS project has ceased. This definition of termination failure is hence stricter than Lyytinen and Hirschheim's concept of expectation failure.

Sauer develops a model of IS failure based on exchange relations. He portrays the development of information systems as an innovation process based on three components: the project organization, the information system, and its supporters. Each of these components is arranged in a triangle of dependencies (see Figure 1). The information system depends on the project organization, the project organization depends on its supporters, and the supporters depend on the information system. The information system requires the efforts and expertise of the project organization to sustain it; the project organization is heavily dependent on the provision of support in the form of material resources and help in coping with contingencies;

Environment



Adapted from: Sauer (1993)

Figure 1 Sauer's model of IS development.

supporters require benefits from the information system.

One of the key ways in which Sauer distinguishes termination failure from expectation failure is in terms of the concept of a flaw. Information systems are the product of a process which is open to flaws. Every information system is flawed in some way. However, flaws are different from failures. Flaws may be corrected within any innovation process at a cost, or accepted at a cost. Flaws describe the perception of stakeholders that they face undesired situations which constitute problems to be solved. Examples of flaws are program bugs, hardware performance and organizational changes. Unless there is support available to deal with flaws, they will have the effect of reducing the capacity of an information system to serve its supporters and may result in introducing further flaws into the innovation process. At some stage, the volume of flaws may trigger a decision to remove support and hence to terminate a project.

LASCAD project

In this section we describe elements of computer aided despatch systems, how the LASCAD system was intended to work, the events as reported, and a description of aspects of the aftermath following the IS 'failure'.

Elements of a computer aided despatch system

The major objective of the LASCAD system was to automate many of the human-intensive processes of manual despatch systems associated with ambulance services in the UK. Such a manual system would typically consist of, among others, the following functions (Page *et al.*, 1993):

- **Call taking.** Emergency calls are received by ambulance control. Control assistants write down details of incidents on pre-printed forms. The location of

each incident is identified and the reference co-ordinates recorded on the forms. The forms are then placed on a conveyor belt system which transports all the forms to a central collection point.

- **Resource identification.** Other members of ambulance control collect the forms, review the details on the forms and, on the basis of the information provided, decide which resource allocator should deal with each incident. The resource allocator examines the forms for a particular sector, compares the details against information recorded for each vehicle and decides which resource should be mobilised. The status information on these forms is updated regularly from information received via the radio operator. The resource is recorded on the original form which is passed on to a despatcher.
- **Resource mobilisation.** The despatcher either telephones the nearest ambulance station or passes mobilisation instructions to the radio operator if an ambulance is already mobile.

Many UK ambulance services have now put some form of computerisation in place. Such systems particularly address the call-taking and resource identification functions described above. The major rationale expressed for such computerisation is typically that a number of problems are seen to exist with manual CAD systems. Most such problems relate to the time-consuming and error-prone nature of activities such as: identification of the precise location of an incident, the physical movement of paper forms, and maintaining up-to-date vehicle status information. A CAD system is seen by many within the ambulance service as a means of overcoming many of these problems, and particularly of improving the service to patients. In this light, one particularly contentious area of computerisation being approached by many ambulance services is the incorporation of so-called triage (despatch in terms of medical priority) systems into ambulance command and control.

How LASCAD was intended to work

Figure 2 illustrates the essential features of the system, the basic functionality of the intended LASCAD system being as follows:

- British Telecom (BT) operators would route all 999 calls concerning medical emergencies as a matter of routine to LAS headquarters (HQ) in Waterloo.
- 18 HQ 'receivers' were then expected to record on the system the name, telephone number and address of the caller, and the name, destination address and brief details of the patient.
- This information would then be transmitted over a local area network to an 'allocator'. The system would pinpoint the patient's location on a map display of areas within London.

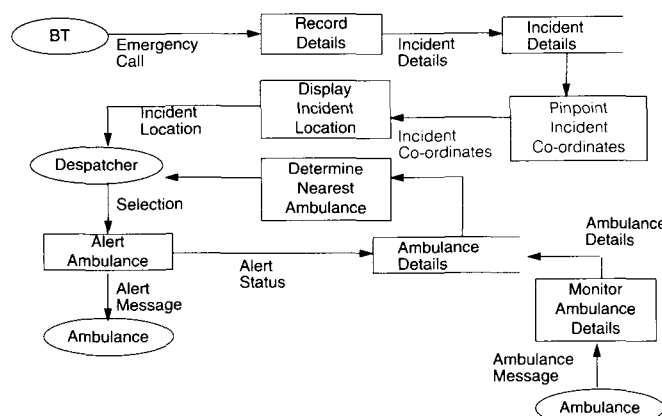


Figure 2 How LASCAD was intended to work.

- The system was expected to monitor continuously the location of every ambulance via radio messages transmitted by each vehicle every 13 seconds. The system would then determine the nearest ambulances to the patient.
- Experienced ambulance despatchers were organized into teams based on three zones (south, north-east and north-west). Ambulance despatchers would be offered details of the three nearest ambulances by the system and the estimated time each would need to reach the scene.
- The despatcher would choose an ambulance and send patient details to a small terminal screen located on the dashboard of the ambulance. The crew would then be expected to confirm that it was on its way.
- If the selected ambulance was in an ambulance depot then the despatch message would be received on the station printer.
- The ambulance crew would always be expected to acknowledge a message. The system would automatically alert HQ of any ambulance where no acknowledgement was made. A follow-up message would then be sent from HQ.
- The system would detect from each vehicle's location messages whether an ambulance was heading in the wrong direction. The system would then alert controllers.
- Further messages would tell HQ when the ambulance crew had arrived, when it was on its way to a hospital and when it was free again.

The LASCAD system was built as an event-based system using a rule-based approach in interaction with a geographical formation system (GIS) (Daily Telegraph, 1992). The system was built by a small Alder-shot-based software house called Systems Options using their own GIS software (WINGS) running under Microsoft Windows (Computer Weekly, 1992a). The GIS communicated with Datatrak's automatic vehicle

tracking system. The system ran on a series of network PCs and file servers supplied by Apricot.

Reported events

The LASCAD project is particularly interesting because of its prominence in the computing and general press. On the night of Monday 26 October 1992, things started to go wrong at the HQ of LAS. It was reported that a flood of 999 calls (some 2900 instead of the usual 2300) apparently swamped operators' screens. It was also claimed that many recorded calls were being wiped off screens. This, in turn, caused a mass of automatic alerts to be generated, indicating that calls to ambulances had not been acknowledged.

Claims were later made in the press that up to 20–30 people may have died as a result of ambulances arriving too late on the scene. Some ambulances were taking over three hours to answer a call while the government's recommended maximum is 17 minutes for inner-city areas (Guardian, 1992). In addition, it was claimed that a reorganization of sector desks over the preceding weekend may have caused loss of local knowledge.

Arguably the LASCAD project was the most visible UK IS failure in recent years and so it is not surprising that it triggered a series of significant responses. In many ways such responses seem reminiscent of a moral panic in information systems work (Cohen, 1980). This particular case seems to have been taken as indicative of a general malaise in software development projects. It has proved particularly effective as a focus for a continuing debate on the professionalisation of information systems work, resonant of the discussion provided by Oz (1994). A number of other projects, such as the failures of the RISP project and the Taurus Stock Exchange system (see above), have also been used as material for this debate.

The LAS chief executive, John Wilby, resigned within a couple of days of the events described above, quoting as his reason the evident lack of confidence in the LAS (Guardian, 1992; Times, 1992). Soon afterwards, a number of Members of Parliament called for a group of IT experts to be set up to investigate IT in the NHS (Computer Weekly, 1992c; Computing, 1992d). The BCS President and Vice President claimed that the breakdown in the LASCAD system could have been avoided if computer people were trained to professional standards. President Roger Johnson stated that: 'The public are entitled to expect that the same professional disciplines apply in IT as in other professions such as medicine and law' (Computer Weekly, 1992d; Computing, 1992e). Under pressure from such sources, the Health Secretary, Virginia Bottomley, announced a public inquiry into the system headed by a senior manager of the South Yorkshire ambulance service. The findings of the inquiry were eventually

published in an 80-page report in February 1993 (London Ambulance Service Inquiry Team 1993), which immediately became headline news in both the computing press (Computing, 1993a) and the national press.

LASCAD and Sauer's exchange framework

In this section we shall use Sauer's model of IS development as a means of organizing key elements of the LASCAD case. This is particularly useful in testing the explanatory power of Sauer's model of exchange relations in the context of the LASCAD project.

Project organization

It has become something of an orthodoxy, or what Harel (1980) calls a folk theorem, to assume that no information systems project can be understood in isolation from its context. As with any project of this nature, the LASCAD system was shaped by the prior history of IS innovation within the organization.

It is interesting that Systems Options, the company supplying the major part of the software for the system, is reported as having had no previous experience of building despatch systems for ambulance services. The company had won the £1.1 million contract for the system in June 1991. However, it appears that the London Ambulance Service had previously scrapped a development by IAL (a BT subsidiary) at a cost of £7.5 million in October 1990. The latter project is reported to have started a year late (in May 1987), and it seems to have been scrapped because of a debate over faulty software. The LAS sought damages from IAL for a faulty despatch module in October 1990 (Computing, 1992c, 1993b).

Also, it appears that Systems Options substantially underbid an established supplier (McDonnell-Douglas) and were put under pressure to complete the system quickly. The managing director of a competing software house wrote various memoranda to LAS management in June and July 1991 describing the project as 'totally and fatally flawed' (Computing, 1992b). Another consultant described LAS's specifications as poor in leaving many areas undefined (Computer Weekly, 1992b).

In January 1992, phases one and two of the project began live trials. In March 1992, phase two of the trials was temporarily suspended following claims, particularly from the trade union NUPE, of fatal delays caused by system errors. In October 1992, phase three was terminated after the two days of reported 'chaos' described above.

A number of the findings of the public inquiry report (Page *et al.*, 1993) directly relate to project organization:

- It was claimed that the LAS chiefs ignored what

amounted to an over-ambitious project timetable. The original procurement document, which was drafted within the guidelines provided by the Regional Health Authority, put price before quality. A report by Andersen Consulting in late 1990, which called for more finance and longer time scales for the project, was suppressed by project managers.

- The LAS board were misled by the project team over the experience of Systems Options and the references supplied by Systems Options were not thoroughly investigated. Also, confusion seems to have arisen over who constituted the main contractor in the project. Systems Options, being an Apricot reseller, appear to have originally believed that Apricot would lead the contract.
- The management of the project was inadequate, the project team failing to use the PRINCE project management method as prescribed for public sector projects.
- The software was incomplete and unstable; in particular, the emergency backup system remained untested. Questions were also raised about the choice of the development tool and the host operating system.
- Training in the use of the system was incomplete and inconsistent.

The information system

It must be understood that LAS is unlike any other ambulance service in the UK. The service receives ten times as many emergency calls as any other ambulance service and it covers a geographical area of just over 600 square miles, handling emergencies for a resident population of 6.8 million people.

Questions were also raised about the complexity of the technical system. A typical ambulance despatch system, like those employed in Surrey, West Yorkshire or Berkshire, merely acts as a repository of details about incidents. Communication between HQ and ambulances is conducted via telephone or voice radio links (Financial Times, 1992b). In the LASCAD system, links between communication, logging and despatching via a GIS were meant to be automated.

It is therefore tempting to adopt a stance of explaining this 'failure' purely in terms of problems of a technical nature. However, the report of the public inquiry (Page *et al.*, 1993) portrays a more complex picture of the so-called technical problems experienced by the LASCAD system than that reported either in the computing or general press. It is interesting that they conclude:

On 26th and 27th October the computer system did not fail in a technical sense. Response times did on occasions become unacceptable, but overall the system did what it had been designed to do. However, much of the design

had fatal flaws that would, and did, cumulatively lead to all of the symptoms of systems failure.

Discussions with a number of people have revealed a range of opinions about this important statement. But if we take this statement at face value, the question of what did happen to the system to cause response times to become unacceptable must be faced.

According to the public inquiry, the system was lightly loaded at start-up on 26 October 1992. Any problems, caused particularly by the communications system (such as ambulance crews pressing wrong buttons, or ambulances being in radio blackspots), could be effectively managed by staff. However, as the number of ambulance incidents increased, the amount of incorrect vehicle information recorded by the system increased. This had a knock-on effect in that the system made incorrect allocations on the basis of the information that it had. For example, multiple vehicles were sent to the same incident, or the closest vehicle was not chosen for despatch. As a consequence, the system had fewer ambulance resources to allocate. The system also placed calls that had not gone through the appropriate protocol on a waiting list and generated exception messages for those incidents for which it had received incorrect status information. Indeed, the number of exception messages appears to have increased to such an extent the staff were not able to clear the queue. It became increasingly difficult for staff to attend to messages that had scrolled off the screen. The increasing size of the queue slowed the system. All this meant that, with fewer resources to allocate, and the problems of dealing with the waiting and exception queues, it took longer to allocate resources to incidents.

At the receiving end, patients became frustrated with the delays to ambulances arriving at incidents. This led to an increase in the number of calls made back to the LAS HQ relating to already recorded incidents. The increased volume of calls, together with a slow system and an insufficient number of call-takers, contributed to significant delays in answering the telephones which, in turn, caused further delays to patients.

At the ambulance end, crews became increasingly frustrated at incorrect allocations. The inquiry (Page *et al.*, 1993) believes that this may have led to an increased number of instances where crews failed to press the right status buttons, or took a different vehicle to an incident than that suggested by the system (New Scientist, 1992b). Crew frustration also appears to have contributed to a greater volume of voice radio traffic. This in turn contributed to the rising radio communications bottleneck, which caused a general slowing down in radio communications which, in turn, fed back into increasing crew frustration.

The system therefore appears to have been in a vicious circle of cause and effect. This vicious circle is illustrated diagrammatically in Figure 3.

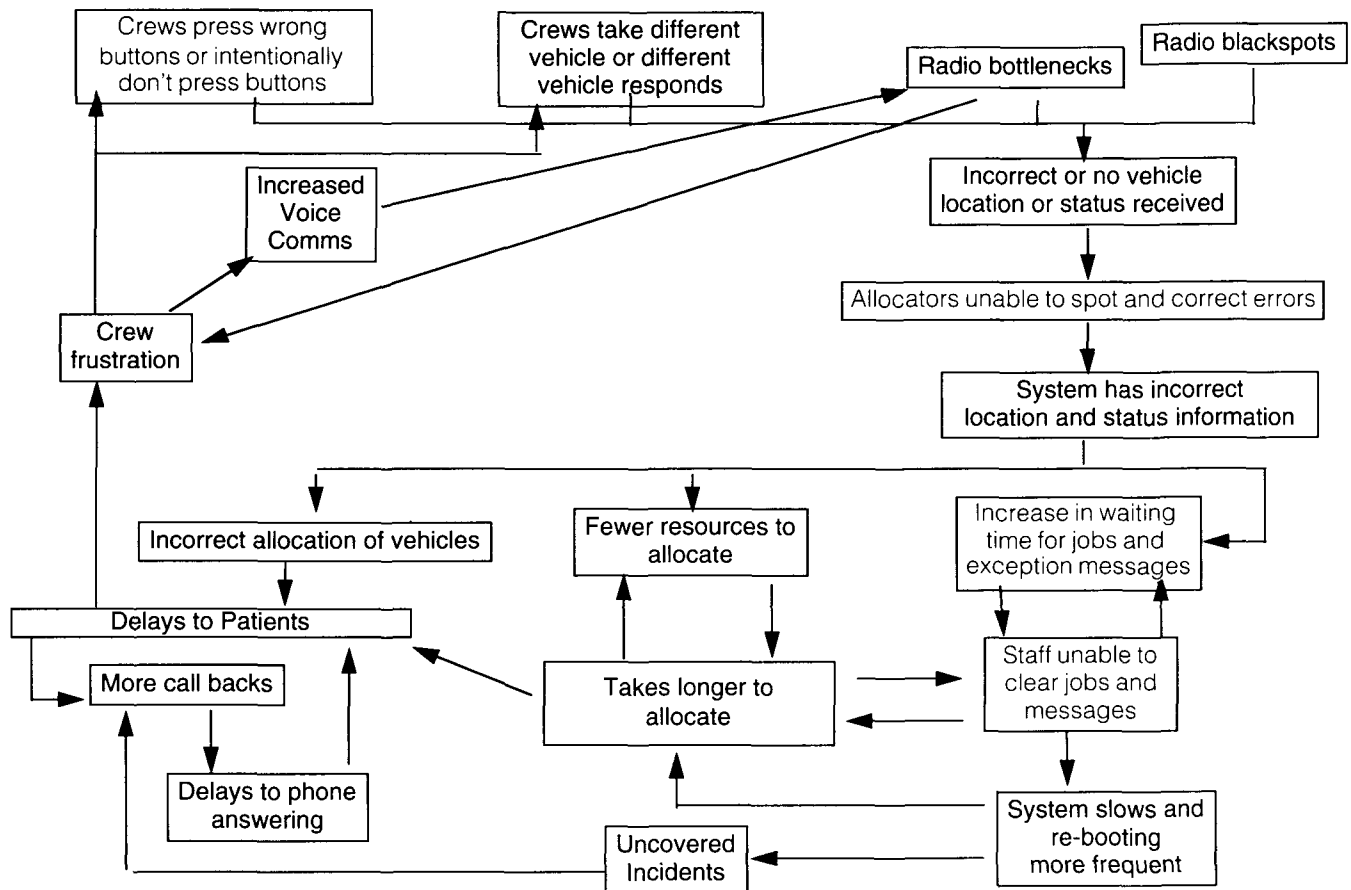


Figure 3 Simplified model of LASCAD failure (after Page *et al.*, 1993).

The supporters

Sauer's use of the term supporter is somewhat ambiguous and in some situations misleading. We prefer the use of the term stakeholder (Land, 1976) in the sense that not all groups with an interest in the development of an information system necessarily support that development. Some stakeholder groups may have a definite negative interest in the success of a given project. There is some evidence of this in the LASCAD case, particularly in the apparent mismatch of perspectives between LAS management and HQ and ambulance staff.

The system has been described as being introduced in an atmosphere of mistrust by staff. There was incomplete 'ownership' of the system by the majority of its users. The many problems experienced with various system components in the preceding months had instilled an atmosphere of mistrust.

Hardware and software suppliers dealing with the London Ambulance Service have spoken of disorganization, low staff morale, friction between management and the workforce, and an atmosphere of hostility towards computing systems. An ambulance crew member is reported as saying, 'whatever system you have,

people have to have confidence in it. We want to go back to the simple system, telephone and radio. Anybody can use it. Crews have confidence in it.' (Financial Times, 1992a). One of the reasons for this low staff morale may be that control room staff were reported as lacking previous experience of using computer systems (New Scientist, 1992a). The trade union NUPE continually complained of the 'macho' style of management at LAS. The Labour Party's health spokesman, David Blunkett, demanded a public inquiry into the system in September 1992, a month before the failure manifested itself, after receiving a report from NUPE (Computing, 1992a).

The environment

Here, the environment of the LASCAD project can be considered in the macro sense of the constraints imposed by the overarching organization of the NHS and in the micro sense in terms of the labour relations history at the LAS.

The political and economic context of the NHS has clearly influenced the current shape of the organization's computing, including most of the information

systems projects conducted within the remit of the organization. Indeed, the LASCAD system is only one example of supposed systems failure within the NHS. As noted above, the Wessex Regional Health Authority's Regional Information Systems Plan is another case in point (HMSO, 1993).

It must be understood that there is no demonstrable and unitary power-structure within the NHS, which is a complex network of autonomous and semi-autonomous groups concerned with health matters (Klein & Scrivens, 1985). Actual delivery of health care is in the hands of powerful clinical professionals who are naturally concerned with preserving their professional autonomy (Leavitt & Wall, 1992).

One consequence of this is that any project carried out in the NHS, such as LASCAD, has to consider the relationships in the network that are affected by the project and the activities that have to be undertaken to enable or encourage those relationships (Checkland & Scholes, 1990). For instance, some of the constraints this enabling network has placed upon information management in the NHS have been discussed in a related paper (Beynon-Davies, 1994).

Computing within the NHS is therefore complicated because no single body has overall responsibility for information technology (IT). IT is exploited and controlled at a number of different levels: region, district, hospital, department, specialty and general practice. Each stakeholder has a different perception of IT: regions and districts tend to emphasise administrative systems, hospitals and GP surgeries emphasise clinical applications, regions emphasise management information and districts emphasise operation systems.

The lack of a clear organization for IT has meant the absence of a clear strategic vision. To build a strategy, there must first be some agreement on objectives and clearly many of the objectives of the various stakeholders are in conflict. This situation is unlikely to change with the recent moves towards a market of providers and purchasers in the NHS.

A great deal of the shape of the LASCAD project was determined by the internal tensions within the NHS. Members of the public inquiry (Page *et al.*, 1993) reflected on some of the stresses and strains that have been placed on the LAS by changes in the NHS over the last few years.

... the result of the initiatives undertaken by management from 1990–1992 did not revitalise management and staff as intended, but actually worsened what was already a climate of mistrust and obstructiveness. It was not a case of management getting the agenda wrong. The size of the programme and the speed and depth of change were simply too aggressive for the circumstances. Management clearly underestimated the difficulties involved in changing the deeply ingrained culture of LAS and misjudged the industrial relations climate so that staff were alienated to the changes rather than brought on board.

It is therefore misleading to portray the management problems of the LAS purely in the context of the two years prior to the events of 1992. Many of the pressures on the LASCAD project can be seen to be the result of a protracted climate of conflict in the ambulance service between management, trade unions and the government of the day. The public inquiry maintained that during the 1980s there was clear evidence that management failed to modernise the service. This was reflected in a lack of investment in the workforce (such as paramedic training and career advancement), the fleet and the estate. By the end of 1990, at the end of a protracted national dispute over pay, the LAS stood in need of major modification and change. During the period between January and April 1991, 53 senior and middle management posts (of the 268 within the LAS) were cut. There appears to have been little consultation with staff over the restructuring and the process caused a great deal of anxiety within the organization.

The public inquiry (Page *et al.*, 1993) cited the 'fear of failure' on the part of management as an important reason for the unstable industrial relations climate within LAS. Changes in structure created a climate in which management were continually under pressure to succeed. This may have put undue pressure on management to ensure that the LASCAD system was implemented on time and within budget. However, it may also have blinded them to some of the fundamental difficulties of the system implementation.

The inquiry team believed that most of the operational management at LAS believed that LASCAD would act as an essential means of overcoming what they saw as outmoded practices. One such practice was the crews themselves or the ambulance stations deciding which resource to mobilise in response to an incident. These practices were to be replaced with what management saw as a system which would decide objectively and impartially the optimum mobilisation of resources.

The inquiry team commented that the management were naive in assuming that the simple introduction of a computer system would automatically result in changes in working practices. Crews and stations, if they wished, could still accommodate older practices by employing strategies such as failing to mobilise, sending a different resource, or failing to acknowledge or failing to report status.

Information systems failure reconsidered

Clearly, it is impossible to point to any single element of the case as being *the* cause of the LASCAD failure. The description demonstrates how the explanation of a particular information systems failure must be multifaceted or web-like in nature. Indeed, the LASCAD project displays many of the features of Perrow's (1984)

concept of a 'normal accident'; that is, an accident which is particularly hard to foresee in detail because it involves failures in several parts of a system which are linked in complex and subtle ways.

It is interesting that there is even some debate about whether the LASCAD case constitutes a failure. The LASCAD project is a clear example of an expectation failure: the system does not appear to have 'failed' in the strict technical sense, but it did fail to meet the expectations of many of the stakeholder groups involved in the project. However, using Sauer's model, the LASCAD project would not be deemed a termination failure; at the time of writing, the LASCAD project organization has been re-structured but has not lost the support of the major stakeholders, the LAS, South West Thames RHA (SWTHA, 1993a, 1993b) and the NHS. It has been reported that the new head of IT at LAS has until August 1997, with a provisional budget of £13.5 million, to deliver a CAD system (Computer Weekly, 1994). The first stage of the work, a system for call-logging, call transfer, address-finding and vehicle location, is reported to have reached completion in April 1995 (Computer Weekly, 1995). In this sense, the 'breakdown' of the LASCAD system on the 26/27 October 1992 would be taken as the result of a number of system flaws that are currently undergoing rectification.

In other words, the triangle of dependencies in this project has not broken down. Although support from stakeholders like LAS HQ staff and ambulance service staff may have been seriously dented by events, support from stakeholders such as LAS management and SWTHA is still there. The project team still has the remit to develop the information system for HQ staff, albeit over a longer time scale. This is perhaps not surprising in the sense that many of the problems that LASCAD was meant to address appear to be still present. For instance, in January 1995 an inquiry into the death of a child in London laid part of the blame on an inexcusable delay by the LAS, apparently caused by a 'failure' in the manual systems at LAS (Guardian, 1995).

LASCAD in relation to other failures

The four cases presented in the second section of this paper make an interesting comparison with the LASCAD case. Some points of contrast are featured below:

1. Unlike LASCAD, all four projects described in the second section are examples of termination failures. It appears that attempts are continuing to computerise security trading on the Stock Exchange but all such projects are at a much reduced level, have taken different directions, and are being undertaken by different project organizations from Taurus. For instance, the CREST project, which seems to

overlap Taurus, has been undertaken by a consortium of major UK banks, not the Stock Exchange. This leads one to reflect on the preoccupation in the literature with termination failures and one might speculate that this might be related to the ease of studying and publishing material on 'dead', as opposed to 'live', projects.

2. The scale of the LASCAD project is smaller than that of the other projects discussed, in terms of expenditure or man-years of effort. While the scale of a failure contributes to its visibility, the high visibility of LASCAD is probably related to its safety-critical nature, the high profile of the LAS and its problems in previous news reporting, and the fact that public funds were spent on this project. The safety-critical factor is significant, as command and control systems for ambulance services do not seem to have been discussed previously in the context of safety-critical systems, at least within the UK. In this sense, the LASCAD project acted as useful fuel for expanding the concept of critical safety to include a larger number of information systems than were previously classified as such.
3. The LASCAD case is useful for the way in which it bridges the idea of IS failure as project failure and the idea of IS failure as use failure. Sauer's analysis of IS failure tends to concentrate on the failure of a development project and the analysis tends to stop at the point at which the system is delivered and used. This may be because most of the well-studied examples of failure were never fully delivered. Taurus and Confirm, for instance, were never actually delivered to users, Mandata and RISP were delivered, but only in small part. Perhaps because of the short development time-scale of the LASCAD project, we get a highly focused view of IS failure which illustrates and confirms many of the findings of the project-centred analysis but also provides important material for researchers with interests in the area of the human/organizational-system interface (such as McKenzie, 1994).

Conclusion

In this paper we have presented a case history of a prominent UK IS project which many people report as a 'failure'. Case histories of this nature are a valuable means of helping us to understand the complexity of IS development (Benbasat *et al.*, 1987). They are particularly useful in engendering a more realistic view of information systems, replacing the simplistic idealism of much of the textbook literature with the complexity and richness of hard reality.

We make no claims that we have provided the definitive account of this particular project. This is resonant of Pinch's (1989) study of the space shuttle

Challenger incident in which he argues that, although technical inquiries search for technical scenarios as causes, it is extremely difficult to come up with a definitive scenario for explaining technical systems failure. Technical experts frequently disagree about the contributing factors to a failure. There appears to be a great deal of 'interpretative flexibility' available to people wishing to explain such failures.

Explanatory frameworks such as Lyytinen and Hirschheim's (1987) and Sauer's (1993) are particularly useful in broadening the notion of technical systems failure and highlighting the political, economic and social nature of information systems failure. Lyytinen and Hirschheim's concept of expectation failure clearly locates the idea of information systems failure in the area of human interpretation and expectations. Sauer's framework is useful in proposing that it is only when relationships between crucial elements of an information systems project break down irretrievably can the project be said to have failed. In this light, it is interesting that Ian Tighe, the new head of IT at LAS is reported as portraying his prescription of success as being:

to recognise the risks, allow people sufficient time to absorb change, and not be lulled into taking the cheapest solution (Computer Weekly, 1995).

McKenzie (1994), in his comprehensive empirical analysis of computer-related accidental death, has some equally interesting comments about the relationship between failure, risk and 'human factors':

To make computer systems safer, we need to address not merely their technical aspects, but also the cognitive and organisational aspects of their 'real-world' application . . . If this does not happen, there is a risk that purely technical efforts to make computer systems safer may fail. Not only are they addressing only part of the problem, but they may conceivably even increase risks, through their effects on beliefs about computer systems.

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