Dependability and Responsibility: The Ladbroke Grove Rail Inquiry

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ABSTRACT
Construcing and maintaining safe and dependable systems in complex inter-organisational settings such as the UK rail network is a wicked problem that demands significant organisational effort. When disasters like the Ladbroke Grove Rail Crash occur the subsequent scrutiny of organisational operations undertaken in the Inquiry into the tragedy offers us an opportunity to understand these operations that we might not usually have. This paper takes the materials of the Inquiry as a means for examining the manner in which the social and technical systems implicated in the disaster were organisationally configured and managed. As such this article can be considered as a condensed report on the Inquiry which focuses on explicating the organisational context of disaster from a holistic systems perspective. The courtroom reconstruction of the prior organisational circumstances, by the parties to the proceedings, provides a display of some of the working relations that embody the dependability practices across parts of the organisations. This provides a view of the way organisations, in an on-going manner, work on dependability, in-and-through existing organisational structures and practices. In this case we can see that problems regarding the signal implicated in the tragedy were organisationally recognised and subsequent ameliorative actions were being undertaken, except, with the benefit of hindsight, they were not taken quickly enough or were not the ‘right’ actions. The lesson learned is that dependable design always needs to have a strong focus on the inter-operation of organisational units, social as well as technical, as misalignments in schedules, practices, procedures and standards between organisational groupings can be as threatening to a system as technical incompatibilities. Finally, we consider how notions of responsibility may be pertinent to thinking about dependability given the preceding analysis.

1. INTRODUCTION

“If these were individual accidents, the discovery of unsafe acts immediately prior to the bad outcome would probably be the end of the story. Indeed, it is only within the last 20 years or so that the identification of proximal active failures would not have closed the book on the investigation of a major accident. Limiting responsibility to erring front-line individuals suited both the investigators and the individuals concerned – to say nothing of the lawyers who continue to have problems with establishing causal links between top-level decisions and specific events. Today, neither investigators nor responsible organizations are likely to end their search for the causes of organizational accidents with the mere identification of ‘sharp-end’ human failures. Such unsafe acts are now seen more as consequences than as principal causes.” (Reason 1997, p10)

In this quotation from “Managing the Risks of Organizational Accidents”, Reason (1997) succinctly sums up the major change in approach to considering organizational safety and the investigation of accidents that has occurred in the last 20 or so years. This change is a product of, and reflected in, changing societal attitudes towards the determination and apportionment of responsibility and blame for major accidents and is indicated in the increasing number of public inquiries. While it may not yet be the case (described by Box (1983)) that such accidents are viewed as: "the rational choices of high-ranking employees, acting in the corporation's interests, to intend directly to violate the criminal law or governmental regulations, or to be indifferent to the outcome of their action or inaction, even though it might result in human lives obliterated, bodies mangled." - there is a discernible change in public perception. Consequently, while there may be organizational preferences to limit responsibility for failure to front-line personnel ("blame the pilot, the operator, the driver") as a means of protecting senior management and organization in general from being implicated, accident investigators and the public are unlikely to take such a narrow view. Our interest in safety and the assignment of responsibility - that often occur in circumstances of accidents - arises as part of a much wider concern with issues of systems dependability. As Reason concedes legally establishing the causal connection between organizational operation or higher level management decision making and organizational
accidents is problematic. However, he is clear that this will not exempt organizations from more wide-ranging scrutiny and that responsible organizations need to take the notion of accidents as organizational rather than individual phenomena seriously if they are to operate in a dependable fashion.

This change in approach described by Reason serves as a useful background with which to understand the proceedings of the Ladbroke Grove Rail Inquiry which took place in the months of May and December 2000 in the UK following a tragic rail crash that took place near London’s Paddington station the year before. The basic details of the accident are as follows. On the fifth of October 1999 at Ladbroke Grove a catastrophic crash occurred between two trains resulting in the deaths of both drivers and 29 passengers and the injury of approximately 414 persons. The trains involved in the crash were owned by two private companies - Thames Trains and Great Western Trains. The Thames Train was driving away from Paddington, while the Great Western was travelling towards Paddington. The Thames train passed a signal that was reading ‘stop’ (signal passed at danger (SPAD)), and indeed sped up into the path of the Great Western. It is this action that has been described in the Inquiry into the tragedy as the “immediate cause of the accident”.

‘Immediate cause’ is a telling phrase. It is used in the inquiry by the Crown’s Counsel (i.e. representing the State) as a starting point to investigate the other more remote potential causes of the tragedy. We can see that the forum of a public inquiry reflects Reason’s comments on changes of approach to accident investigation. The status of the proceedings as an Inquiry (rather than e.g. a criminal trial) removes the legal requirement to prove a causal connection between actions (or inaction) – individual or corporate, proximal or more distal – and the tragedy itself. Instead, the business of the inquiry is to investigate, in a wide-ranging fashion, any aspects of the workings of the railways potentially connected to, and therefore implicated in the event. As stated by Mr Hendy (acting solicitor on behalf of the families of victims):

"The evidence will show that a multitude of failings together brought about this crash. Probably every one of them was foreseeable and avoidable. Our clients want each of them exposed and remedied for the future. In the course of the enquiry failings will be demonstrated which it will be argued were not causative of the collision. Our clients are naturally concerned to find out which factors were causative and which were not. But they are much more concerned that every factor exposed in this Inquiry which might lead to an accident in the future will be remedied than in any abstruse debate about whether particular factor was or was not a causative of this crash." (2,5,23)

Hence, the notion of organizational accidents is a very useful one with which to characterise the business of the inquiry. The approach of the Crown’s Counsel and of the solicitors representing victims and victims’ families is to attempt to trace organizational liabilities as far as possible – across different people, procedures, organizations and organizational levels. On this basis the scrutiny most directly falls on two companies – Thames Trains, the owners of the train whose driver (Driver Hodder) committed the SPAD and Railtrack, the company responsible for the maintenance and running of the rail infrastructure, including signals, tracks and so forth. Thames Trains are implicated and scrutinised as the employers of Driver Hodder and as owners of the train. As employers, their procedures of selection, training and support are questioned. As owners of the train their level of technical safety measures is questioned. Railtrack is questioned on the design and maintenance of the infrastructure, particularly signal design, placing, maintenance and evaluation and the attendant procedures for dealing with these. Interestingly, both companies are also scrutinised on what may be thought of as organisational ethos - were their priorities profit or safety, how were these attended to, was the balance right? Crucially, ethos is seen as something that has a real organisational manifestation in the day to day running of the organisations, in the decisions, procedures and practices.

2. RESPONSIBILITY AND DEPENDABILITY

Our intention is to use the Ladbroke Grove Inquiry to think sociologically about issues of responsibility and dependability. Our interest is in using one occasion when the articulation of responsibility is legally required, in order to explicate some details of the how and when of more general articulations of organisational responsibility. The questions we are interested in are: What occasions the organisational articulation, consideration and review of responsibility? How, in what form, - documents, standards, rulings - does responsibility get articulated? How is responsibility allotted and distributed or delegated? How are agreements reached about responsibility? When can a duty of responsibility be said to have been responsibly discharged?
The purpose of this paper is to examine these notions of responsibility through considering the organizational context of disaster as it is laid out in the Inquiry into the Ladbroke Grove rail disaster. We are examining the materials that the Inquiry generated as expressions of practical organisational reasoning. As such these materials provide displays of the ways in which safety, dependability, responsibility and related issues are oriented to in the context and course of day to day organisational work. These activities include the ways in which such issues are ‘managed’ through the day-to-day enactment of the working division of labour, in which they are brought and kept under review, in which identifiable problems are ‘programmed’ into the organisation’s order of tasks and are progressed and supervised into implementation and so forth.

Part of our idea is to further the ‘socialisation’ of ‘technology’ by using the notion of socio-technical system in a way which treats it as a thoroughly ‘social’ matter, rather than as a composite of two distinct orders of elements, one ‘technical’ or ‘material’ and the other ‘social’. We are, thus, interested in the ‘technology’ purely and entirely as an organisational phenomenon – this does not in any way deny the ‘technical’ composition of the ‘object’ (such as a fixed gantry) but points to the way in which each and every feature of that object is intelligible relative to one or more organisational processes. These include acquisition processes and replacement and upgrade cycles, in-house research services, engineering construction and maintenance operations, standardised monitoring and reporting practices, practical and formal risk estimation calculi, demarcation and integration of organisational tasks and processes, processes of external review and response. A main aspect of the way in which the ‘object’ is intelligible in different ways relative to different processes is the manner in which it is understood in terms of how work tasks concerned with the object should be composed, distributed and prioritised according to both formal requirements and in situ convention. Thus, the problem of SPADS was, prior to the Ladbroke incident, a known-about and in-hand problem, under research and review subject to the co-ordination of a committee’s meeting cycles, and under upgrading through the adoption of measures to provide appropriate run-offs and the like, but within a strategy of reducing rather than eliminating risk. The Ladbroke gantry’s visibility problems was locally notorious as a source of trouble for drivers, but of a containable kind, that was recurrently and safely managed by them, in light of the fact that the gantry itself was contained within the rigidities of both the engineering, business and service requirements prevailing on the sites i.e. the location of the signal was optimal within the constraints of the existing hardware configuration – no other place could be found that would resolve the visibility problem without reconstruction of the gantry system as a whole. That there was risk associated with this was recognised, but the risk was treated as one that could be lived with pending the normal cycles of railway reconstruction. This meant that an adequate design solution to the problem at this stage was through an accretion of engineering additions rather than undertaking the preparation for and scheduling of large scale and potentially disruptive reconstruction work. Such a decision was influenced by considerations over how access to a busy railway station approach could be regulated while minimalizing the interim consequences for the provision of services and achieving an acceptable response from the clients; the network managers and rail passengers.

The system in place on the railways to ensure operation (and necessarily with a strong emphasis on safe operation) was one that comprised a complex of what may be described as technological, human, and social, organizational and inter-organisational components. One can consider that when dependability is dealt with in such a complex setting it is managed by an allocation of responsibility to these components such that all have their roles in providing for the overall dependability of the system by completing individual operations dependably. The ‘overall’ safety situation is a balancing between the distribution of safety operations and regulations to independent and autonomous individuals with the partial integration of this distribution within co-ordinated, co-ordinating and centralising operations. For instance, while technical systems need to operate safely and reliably, providing the correct information and not breaking down, workers need to ensure they follow the correct procedures in the required manner and management must install the correct procedures and guidelines and instal a safe organisational culture that ensures both a generalised but spontaneous attentiveness to safety matters and an entitlement to prioritise and (within the organisation) publicise these with immunity to disciplinary or ‘political’ consequences. Of course, it is the very distribution of responsibility and the complex web of dependability measures – spread across components that interact in many ways – that creates problems for the dependability of the overall system. Gaining and maintaining a comprehensive, overall, coherent view on the system is – organisationally speaking – another (assortment of) task(s) within the existing organisational arrangements and culture, and may therefore be very difficult to achieve, and even when components in isolation do operate dependably there is
difficulty in considering and managing the interactions between them from a dependability perspective (particularly when unpredicted interactions occur). We shall return to this later but firstly it is useful to consider the specialized treatment of dependability that has traditionally existed in computer science.

2.1. Dependability: Technical and Socio-Technical Concerns

Within the computer science literature dependability has traditionally, and unsurprisingly, had a technical focus. Concerns have focused on the safe and reliable etc. operation of the technical systems that perform as subsystems in a wider system of work. Of course, such matters are of crucial concern to systems designers and computer scientists, since technical failures have been implicated in a number of organizational accidents (see for example Therac-25, Nasa, London Ambulance etc) where the faulty operation and output of technical computer-based systems have resulted in tragedy. Undoubtedly the work of computer scientists has produced significant understandings of technical dependability problems. This, in turn, has lead to the provision of methods of programming and approaches to design aimed at limiting sources of technical undependability, for example through, fault prediction the use of formal approaches to producing high quality programs (cf. Dijkstra) and through the development of ‘software fault tolerance’ (Randell, 2000). There are, however, other concerns, not so much with the value of these approaches in themselves, but instead with how the products of these approaches to system dependability are viewed by others, particularly management, in the organizations they are developed. One concern is that measures like formal methods and software fault tolerance may produce technically dependable systems that become undependable in use. As Brian Randell, states in his Turing Lecture of 2000:

“... all aspects of how a system is designed, implemented and deployed can have an effect on its dependability” (Randell, 2000)

Building on this idea that system implementation and deployment are implicated in dependability it is crucial to acknowledge that any technical system is only a part of a wider-environment, a larger system. To quote Randell again:

“Dependability is defined as that property of a computer system such that reliance can justifiably be placed on the service it delivers. (The service delivered by a system is its behaviour as it is perceptible by its user(s); a user is another system (human or physical) which interacts with the former.)” (Randell, 2000)

For Randell and colleagues dependability focuses on technical systems, although, there is a clear acknowledgement that this involves the very human and social (and non-perfect) activities linked to the design, development and implementation of computer systems and that faults do occur right the way through this process. Furthermore, technical systems are only a part of wider systems of work. However, for them their concerns end with ensuring that the service delivered by the system is dependably perceptible to the systems’ users. More recently, however, researchers and practitioners in systems design have been concerned to take a more holistic approach to design, a socio-technical approach, one in which technical systems are seen as inextricably linked to the wider social and organisational systems in which they are embedded.

One strand of research that has been important in emphasising the need to consider technical systems in use as part of wider socio-technical systems when considering dependability are ethnographic field studies of safety-critical settings (e.g. air traffic control, [Hughes et al. 1992]; ambulance control, [Martin et al. 1997]; healthcare provision, [Clarke et al. 2002]). These studies have been keen to point out that systems involved in such settings must be thought of as thoroughly socio-technical i.e. people are undoubtedly critical to ensuring the safe operation of the system. It is people who input information into the systems, operate them, interpret them, make decisions based on (but not dictated by) them, override them, discount their significance and so on. The relations between those parties, furthermore, need to be understood as involving the practical ‘management’ of the activity of organisational units and of the relations between these. That is, between one organisation and another, between different parts of the same organisation, between different roles and responsibilities in the division of labour, to name but the most prominent. These ethnographic studies explicate the details of how socio-technical systems operate dependably in practice. In what may be thought of as a complimentary approach several researchers have, through the analysis of various accidents, sought to produce theoretical accounts of the reasons for organizational accidents. Subsequently these accounts are used to suggest means by which organizations can assess and manage risks to dependability in complex systems (for
example Reason, 1997; Sagan, 1993; Perrow, 1984, Law, 2000). In this paper, we consider the proceedings of the Ladbroke Grove Rail Inquiry by paying close attention to the proceedings as they unfolded as shown in the manuscripts of the inquiry. Our further analysis is also informed by the ethnomethodological programme of sociology (see Garfinkel, 1967), the ethnographic studies of safety critical work described above and the work of Reason (1997). Together, these materials and sources provide a way through which we can analyse Ladbroke Grove as a case study to focus on the issues of dependability from a socio-technical systems perspective.

3. DEFENCES AGAINST ACCIDENTS AT LABDROKE GROVE

Reason (1997) provides a framework for thinking about the different defences that organizations employ to guard against accidents. He suggests that they can usefully be categorised according to their function and whether they are achieved through hard or soft applications. In thinking about function he points out that different defences operate in different ways. For example, some are meant to serve proactively to ensure workers are aware of hazards and operate equipment safely, while others serve to provide warnings of possible danger, halt a dangerous situation or minimise the aftermath of an accident. These can be thought of as ‘defences-in-depth’ – successive layers of protection such that if the first fails the next layer should provide the defence against the situation escalating. The distinction between hard and soft defensive applications resides in whether they are technical in nature or involve paper and people. Hard defences include physical barriers, alarms, keys and protective equipment. Soft defences comprise rules and procedures, standards, legislation, training supervision and front-line operators.

When considering the case of Ladbroke Grove we can see that a multitude of different types of defences are relevant to the tragedy. In terms of soft defences legislation governs the operating of the railways, standards exist on operation, equipment, training and so forth and the companies employ rules and procedures aimed at safe operation. Hard defences consist of alarm and warning systems, run-ons, and other emergency devices. In the following sections we will examine the layers of defences as they came into play on the day as the accident developed.

Signals and sequences of signals: Clearly a core defence against accidents is the signalling system itself. Not only should the signal in question (SN109) have clearly shown stop but the series of signals leading up to SN109 should have indicated to the driver that a stop signal was imminent. Given that the driver (Driver Hodder) had been trained properly and had the relevant experience by the time SN109 was reached he should have been slowing.

Advanced Warning System: The advanced warning system is triggered by the train going over a magnetic device placed in between the rails. When a train approaches a red signal a visual warning appears in the cab along with a warning alarm. See figure 2 (below). The AWS should have sounded just before Driver Hodder reached SN109 thus alerting him to the SPAD, an allowing him to make an emergency stop. However in the inquiry there is some ambiguity as to whether the AWS sounded as there were potential technical faults where it was attached to the track.
**Track Run-On:** The railway system is designed such that areas of run-on are built into the system so that drivers have time to stop their trains before they move into the potential path of another train if they realise or are warned that they have committed a SPAD. SN109 had a 700 yard run-on before the point of collision.

**Signal Control Centre:** The Integrated Electronic Control Centre (IECC) at Slough oversees the signalling, monitoring the operation of the railways in the Paddington area with the ability to intervene if required. They can contact trains or change signals subsequent to a SPAD. Unfortunately in this case they could not react in time to stop the collision. The signal man in charge did not react for 20 seconds. If he had reacted sooner the extent of the accident might have been less. However, since SPADs were to some extent ‘normal’ and were invariably corrected by drivers, it took the signalman in charge 20 seconds to realise that Driver Hodder was not aware of the SPAD and taking ameliorative action.

**The Crash: Tracing the Organisational Causes**
In the case of the Ladbroke Grove disaster the “immediate” cause of the accident can be thought of as a failure in the interface between social and technical aspects of the system. We may firstly (as the Inquiry does), sensibly discount the possibilities that the driver of the Thames Train clearly saw the red stop signal and deliberately and maliciously drove past it, or that he was (somehow) distracted from his principal responsibilities at the time. However, then the Inquiry is confronted with the possibility that the key feature that contributed to the collision was a problem with either the visibility of the signal, it could not be seen, could not be seen clearly, or was displaying the wrong information. This immediately begins to expand the remit of the Inquiry into the practices and procedures enacted in and supporting signal design, placing and testing. Furthermore the focus is placed on the on-going review, reporting and evaluation of signals and SPADs. As conceived of by Reason we can see that the immediate cause of the accident is an *active failure* by at the sharp end by Driver Hodder. However, the inquiry chooses to look deeper to see whether there were *latent conditions* concerning organisational operation which lay behind the organisational accident making it a tragedy waiting to happen.

**4. WORKADAY AND CATASTROPHIC FAILURES**
This study is one which focuses on failure identification and remedy that inevitably seems to stem from studies of failure leading to catastrophe. This research often comes after-the-fact, where specific failures are identified, focused on, pulled apart and reified. Undoubtedly they can be shown to have
caused the disaster and what also can often be easily identified in such cases are the procedures or technologies that could have stopped such a tragedy. Often, such an after-the-fact analysis [sic] simplifies the safety case as it makes it clear where the system has failed. In a complex organisation, involving socio-technical systems there may be multiple minor failures on a day-by-day basis. Indeed, organisations and those working within them are often abundantly aware of this. Not only is this shown in the workarounds, ‘usual rituals’ and so forth but in the working groups, standards, committees, procedural documents, check-lists etc. which are convened and employed to deal with such issues. For instance, Clarke and colleagues provide an exposition of just such day-today ‘failures’ and attendant procedures to deal with them in UK, National Health Service settings (Clarke et al. 2002). This point is well-taken, but our study is not meant to be of the kind that these comments criticise for depending too much upon benefit-of-hindsight. Our reflections on the opening statements into the Ladbroke Grove inquiry are intended, rather, as complementary to their examination of workaday ‘failures’ in other environments such those described by Clarke et al. (2002), in hospital settings.

In other words, it is not our purpose to attempt, from the materials provided in the opening statements to that inquiry, to determine what the cause of the disaster was. We consider, rather, the ways in which the management and operation of safety systems is exhibited in the Counsel’s presentations as an environment within which day to day issues are managed. Indeed, we readily acknowledge the perspective of Reason (1997) who suggests that evidence of routine failures of minor consequence and near misses (such as the prevalence of regular non-catastrophic SPADs) may indicate deeper, latent conditions within the organization that may have provoked a variety of organizational accidents given due time. It is for this reason that we are interested in the organizational background surrounding the active failure that occurred. This, of course, is also the concern for the inquiry, making the transcripts of the proceedings ideal material with which to examine this.

5. INQUIRY: OPENING STATEMENTS & ANALYSIS
We don’t want to suggest a hard and fast distinction between ‘workday failures’ and ‘catastrophic’ ones, for – very much as in the Ladbroke Grove case – the one may be transformed into the other. A critical difference in their status is in the public character that the latter characteristically acquires. The ‘mundane’ failures of the hospital ward are ones that are characteristically contained by and contained within the local organisation, whilst the catastrophic failures fall under review by a much wider range of people. The determination of failure, its causes, consequences, and the adequacy of management is accomplished by ‘interested parties’, and the number and kind of these may make a difference to the standards that are set for the presentation of failure. It is a perspicuous situation in which a retrospective examination of responsibilities is made; who was responsible for which activities related to the accident, did they carry out these responsibilities in a responsible fashion, or were they negligent? In this case, the inquiry into the railway collision acquires part of its character as a result of its being one-in-a-series. There have recently been other railway collisions, and these can be treated as a basis for identifying a general safety problem in the organisation of the railways. It is, therefore, a matter of contestation between the various parties – through their legal representatives – as to whether this occurrence is to be treated as a one-off or as a symptom of widespread organisational problems in the management of safety.

5.1 Scoping The Inquiry
This latter assumption licenses some parties to propose that the inquiry should not confine itself to inquiry into the incident per se, nor merely into matters proximate to the causation of the incident, however widely they may range, but should avail itself of the opportunity to inquiry into any or all matters of safety management on the railways that might suggest that these are less than adequate or pursued with less than total dedication. Compare the following statements from Mr. Hendy (as previously quoted), representing the Ladbroke Grove Solicitor’s Group which is acting on behalf of the families of the victims:

"The evidence will show that a multitude of failings together brought about this crash. Probably every one of them was foreseeable and avoidable. Our clients want each of them exposed and remedied for the future. In the course of the enquiry failings will be demonstrated which it will be argued were not causative of the collision. Our clients are naturally concerned to find out which factors were causative and which were not. But they are much more concerned that every factor exposed in this Inquiry which might lead to an accident in the future will be remedied than in any abtruse debate about whether particular factor was or was not a causative of this crash. “ (2,5,23)
The QC suggests that the crash was caused by a complex set of failings rather than a single, simple one, proposing that the problems to be addressed will be organizational in character. Inquiry should not be simply to establish causative factors or a chain of causation but to reveal all failings with respect to railway safety more generally. This raises the issue as to whether those to blame will own up to their faults.

"Anyone who bears the slightest responsibility for this crash should be clear that their words to this Inquiry will be subject to the most intense scrutiny by our clients. In particular, whether at the back of the hall or at home reading the transcripts on the Internet, our clients will be observing intently to see whether those who made mistakes and errors will own up to them and are sincerely committed to preventing their recurrence." (2,6,13)

The public character of the inquiry involves some parties – we suggest – not in testing whether railway safety management has satisfied the safety standards that it sought to pursue, but whether it was following the right standards. The inquiry involves attempts to set a new standard. The setting of the inquiry is one in which many of the proprieties of organisational dealings may be scrutinised and overruled. The extent and manner in which the conduct of affairs within an organisation are some-of-anyone-else’s-business, may be legitimately inquired into. The question of whether one part of an organisation can actually make those in another part of it do things are all – in the workaday setting - subject to organisational protocols but in this setting parties are required to make public whatever it is that the inquiry wants to know. Detailing actions as having been taken in line with current procedures will not necessarily suffice as standing for instances of bone fide ‘good’ or ‘safe’ practice. They cannot be legitimised by the fact that this is the correct way to do things, in current system operation. Instead the inquiry is likely to require the provision of a rationale, of ‘good reasons’ for Doing things that way and, in the absence of these reasons current procedures and practice may well be deemed faulty.

5.2 Safety Strategies
The retrospective character of the inquiry is strongly shaped by the fact that a catastrophe with fatalities has occurred, and it is this which gives a differential perspective on the safety practices that have occurred. Insofar as the causation of the accident is not simply due to human error – driver failure – then the existing safety practices stand as demonstrably inadequate – they have failed to prevent a catastrophe, and the question which is therefore to be put to them is whether things could have been done – that were not done – that would have prevented the catastrophe. This is a very different orientation to that with which aspects of existing safety management were oriented, which was not toward the ensuring that this kind of incident did not take place, but, rather, of counting on it not actually happening as it would require such a wayward string of contingencies to bring it about. From the point of view of the existing safety practices, such an incident was an unlikely occurrence, and was one that was, therefore, to be dealt with by a risk bearing strategy. Safety measures were directed toward minimising the likelihood of any such incident rather than toward eliminating its possibility entirely.

The railway organisations were presented with the question: were there things which could have been done that would have prevented the accident? Whether or not anything could have been done depends importantly upon whether these are things that could have been done regardless of the railway companies’ safety practices, or whether they could have been done in terms of its risk bearing strategies. Assuredly there were things that could conceivably have been done in terms of introducing new technologies or in terms of reconstructing the railway approach and signalling in the vicinity of Paddington station that would have prevented this occurrence, but these were not – in the real time environment of existing safety management practices, something that could have been done.

The effect of the public inquiry and its retrospective review is to highlight the contrast between what seemed – at the time – like reasonable practice and what, now, in retrospect and in these circumstances, looks bad.

Thus, one of the possibilities for preventing a collision at a signal passed at danger would have been the installation of automatic train protection (ATP), a system that automatically halts a train that has passed a danger signal. But could this system have been installed? That could – technically – have been done, but was organisationally impractical. The system was expensive in the sense that, in terms of the estimation of risk and the likely effect of the installation, the calculated cost of the system relative to the number of lives saved was high, and was therefore not worth undertaking in relation to the use of
available resources. Similarly, the railway approach and signalling in the vicinity of Paddington could have been extensively reconstructed but this would have involved what, precisely, the companies might wish to avoid, namely the considerable disruption of railway traffic into the station. As this was something which would no doubt have earned them the animosity of the public and the newspapers.

In the context of the inquiry, with all its attendant circumstances, however, these responses can be viewed as an engagement in distasteful practices. For example, making monetary calculations of the value of human lives, and of being more concerned with maintaining the movement of traffic than with the protection of passenger safety. What we have described above as the ‘risk bearing’ strategy was so described to suggest that the existing safety practices involved living with the risk of a collision, and the objective of those practices was to reduce, not to eliminate, that risk. Measures, as we will see, were taken to reduce, even to minimise, the risk of collision as a result of SPADs, to render such an occurrence highly unlikely, and possible only as an outcome of a thoroughly contingent sequence of exigencies. Thus, it was possible that collision could occur but should not do so – short of a series of demonic contingencies

A pivotal consideration for the inquiry, and on which we will concentrate throughout the remainder of the paper, is the situation with respect to SPADs in general, and with respect to the signal SN109 located on the approach to Paddington, the one passed when showing danger in the lead up to the collision. SPADs are a recurrent safety problem.

5.3 Managing The Problem Of SPADs: Railtrack’s Perspective

Prior to this recent collision, SPADs had been, may we suggest, what Harold Garfinkel would term a ‘normal trouble.’ They are a ‘trouble’ in the sense that they should not occur. They are a ‘trouble’ to the extent that measures have been taken to inhibit their occurrences, but they are also a ‘trouble’ in the sense that even though measures are taken to prevent them nonetheless they will continue to occur. SPADs had been identified as a general problem (as they still are to this day!), not merely as things that had occurred and would continue to do so, but as things that were occurring too frequently. The problem had thus become that of reducing the rate of their occurrence, a task to be addressed given the understandings of the conditions that precipitated SPADs. This was to be achieved by the reconstruction of organisational policy and practice, not merely by local engineering adjustments to situations that were known to be SPAD black spots. And it was with respect to that task - the reduction in the rate of SPADs - that action had been taken by Railtrack and, in their estimation, success achieved: the rate was down and continuing to fall. However, Railtrack acknowledged that SPAD’s were not a one-off problem, but a much more extensive concern. Its legal representative was, further, willing publicly to acknowledge that there have been deficiencies in the Company’s own practice, and the account responds to the suggestion that safety was not a sufficient priority within the organisation. In terms of the statement from Railtrack’s representative:

“This is the first opportunity for Railtrack publicly to acknowledge deficiencies on its part which it has discovered in its investigation into this disaster……the task is made more difficult by the complexity and length of background to the collision….it is appropriate to highlight now what we presently believe to be the most relevant areas of self-criticism”

Thus, whilst Railtrack had taken the problem of SPADs seriously and had set up a number of groups to tackle the problem this had itself been a problem insofar as, in retrospect, the relation between the different groups had been ‘diffuse’ and the management of their relations had not been such as to ensure that adequately rigorous engineering inquiries had been made. Three methodological inadequacies are identified: the lack of a root cause analysis, the failure to make a ‘SPAD mitigation study’ and ‘the making of less than adequate risk assessments: ‘Whether or not the various assessments of what could be done at SN109 could properly be called risk assessments we doubt’ A different approach should have been taken – ‘A holistic approach to the problem of multiply SPADed signals was necessary, treating GK/RT0078(a signal design standard) as a minimum’ and there had been those who said so at the time but there had been no unanimity on this, and this approach had not been adopted because it had not seemed necessary since (a) it was assumed that the problem of SPAD’s was largely understood: ‘SPADs were generally seen as driver problems and once a driver's mistake was acknowledged this may have been accepted without’ further inquiry, and hence, presumably, no real need for a root cause investigation and (b) if the problem was driver error, then this had already been provided against since there were ‘run ons’ provided at SPAD prone signals and ‘there was, in the case of SN109 particularly, a 700 yard run on before a point of collision and therefore was the opportunity
for drivers to bring their trains to a halt even if travelling at line speed and always assuming that they had full line knowledge, appropriate experience and training.’

These organizational failings do not, however, entail that the state of the infrastructure, for which Railtrack has the responsibility, was a contributory factor in the collision. Neither does the fact that the organizational presumption - that SPADs are essentially driver errors - might have been inappropriate, rule out the possibility that it was the driver’s mistake in this case. Thus, ‘Whether the state of the infrastructure, be it the line or the signals or the signaling controls, played any part in causing or permitting Driver Hodder to pass a gantry on which all signals were at danger, including 109, we do not yet know’. Though, Railtrack now accepted that there were technical problems with SN109:

‘We do know that there was a misalignment of a rail in the vicinity of the AWS (automated warning system – this was meant to sound a buzzer in the driver’s cab if a SPAD occurred) magnet approaching SN109. We also know that the signals on gantry 8 were not aligned in the manner required by GK/RT0037’.

However, there remains a question of whether Railtrack is to be held responsible for these failings since ‘it employed and employs reputable experts to maintain the track and signaling’. But although it may be that these technical problems are due to failings of those ‘reputable experts’ – ‘although this is the explanation’ - it may be that responsibility for them nonetheless reverts to Railtrack itself – ‘it is Railtrack’s infrastructure.’

5.4 Dealing With SPADs Around Paddington And At SN109: Multiple Perspectives

Mr Owen (State representative Counsel for the Inquiry) had provided a history of SPADs at signal SN109. He reported on the build up of SPADs at the signal over a long period of time and the subsequent reporting of these and the actions or lack of action on the part of Railtrack to deal with these. This suggests, for example, that although it was known to have been a problem, Railtrack were slow in responding and placed more importance on maintaining high capacity of traffic movement over a safer configuration (including infrastructure and schedules). There had been an acknowledged problem with signals in the approach to Paddington, especially signal SN109. For example, their Operations and Safety Director wrote to Railtrack on a number of occasions complaining that:

“It is clear from all the SPADs in the Paddington area that there is a serious problem with drivers misreading signals. This has been known for some time and very little action has been taken by Railtrack to date.”

The location of one of the signals was recognised to be problematic, being something that was (potentially) hard to see in the approach to the station owing to circumstances like its location in the midst of a complex tangle of overhead constructions, the state of the light, and so on. This was recognised to be a problem requiring special attention and the signal design team from Railtrack had ‘visited the site on a number of occasions’ due the complexity of the scheme to re-site that signal. However, the (re-)siting of the signal had not been undertaken in (official) consultation with the body that reviews safety arrangements, HMRI (Her Majesty’s Rail Inspectorate). The signal had been in operation for eighteen months before there was such an inspection, and this recognised that the location of the signal was a trouble.

In fact, the problem status had been specified in a report on a previous crash, where the number of signals on the gantries in the approach to Paddington, their raised location, their placement relative to curves in the line, and the high line speed where all specified. This meant, according to another report, that the signal is difficult to read because it is placed on a corner and is partially obscured such that ‘the signals appear and disappear every few seconds.’ An HSE (Health and Safety Executive) report had also complained that the signal was partially obscured by overhead lines, that a nearby bridge could produce dazzle, and that the signal was ‘susceptible to swamping from bright sunlight’. The official HMRI inspection had, further, found that the signal was placed in a configuration that ‘was highly unusual, if not unique; and it is appears to have been acknowledged that it did not comply with the existing signalling standards’. However, the HMRI report had found that the visibility of the signal on approach was ‘borderline acceptable’ and had recommended a reduction in the line speed at the approach.
This means discounting the possibility of driver error, or, at least, of driver error alone. Driver Hodder had precipitated the collision in that he had failed to halt at a signal that instructed him to do so, and had consequently continued on until his train traversed the railway line occupied by an oncoming service. It is that this driver was apparently behaving normally prior to taking over the train, left no traces of any suicidal inclinations, and was a competent, experienced and well trained driver (which last point does not rule out the possibility of asking whether he was well enough trained). Therefore, though this was the driver who made the error, the explanation of that error putatively does not lie with the driver, but in the organisational background, in the ways in which the system had been prepared to manage occasions of this kind.

If we look at Railtrack’s representative’s response to the suggestion we find that this consists of the admission of failures, but of minor and mitigated ones. Railtrack’s defence is not that there were not failures but that these do no manifest a generalised problem in the responsible management of safety matters. There was an admission that whilst some actions had been carried through, they had not been carried out as well as they should have been, but that this was a matter already being attended to, and where efforts were being made to improve the situation. There were two admitted but ‘slight’ problems with the infrastructure, but these were carried out by subcontractors. Railtrack is endorsed by organisations mandated to oversee their safety practice, both by an Inquiry which stated that the subcontractors’ failings did not impugn Railtrack, and by an HSE report denying that commercial interests had outweighed safety.

Railtrack accepted an HSE criticism suggesting that the situation at Ladbroke grove was “complex”, but denied that it presented drivers with a situation which was too complex for them to handle effectively on approach. It is not as if the drivers are unprepared for the approach to this signal, it should be one which they should know was in the offing from the well known landmarks indicating its imminence. An experienced driver should have been trained/should have learned that SN109 was a problematic signal, that there had been previous SPADs:

"Any driver driving out of Paddington should know that the gantry lies just beyond Goldbourne Bridge at the locations of SN105, which being lower, is visible over a considerable distance. He or she should be looking for the signal. It does not suddenly appear without warning or without prior knowledge. SN109 should be known to all drivers driving out of Paddington as a multi SPADed signal….etc…..It is not so complex it cannot be taught, learnt, tested and applied." (2,46,6)

It would not, either, have been a matter of mistaking a danger signal for another signal, since all the signals visible there were at red. The establishment of the likelihood of a mistaken sighting of the signal had been placed in the hands of other (safety) organisations:

"Phantom images of a proceed aspect or aspects in lieu of a red aspect at 109 were not to be seen in the almost identical conditions of the following morning by the HMRI expert Mr Wilkins…Nor was the red light swamped into invisibility ….by the sunshine..." and "In the opinion of experts retained by the HSE was adequately showing red."

Thus, the driver should have known that the signal enjoined him to stop the train, and ‘all contextual indications should have led him to believe that this was so’. Railtrack did acknowledge that there was an issue of the way in which the problem of SPADs was identified, which was primarily as a problem of driver error, and therefore, as one which was to be resolved by reducing the likelihood of driver error, by such methods as training and fail safe mechanisms that operated in the event of driver error (such as the 700 yard run on at Paddington, which gave opportunity for safe recovery of such errors.) This was the same kind of understanding which resulted in the critical 20 second delay in the reaction of a signalman to the incident. As with the case of potential conflicts in air traffic control (Harper and Hughes, 1991) seasoned practitioners see no need to respond to instances of these since they may legitimately be expected to resolve themselves through the continuance of routine. Similarly, the signalman recognised that a SPAD had occurred, but anticipated that it would be corrected for by the driver, without need for action from the signalman himself. It was only after waiting to see the expected adjustment to occur, and after it had failed to materialise – the twenty second delay – that the signalman took what had then become belated action.

Evidence had been presented by other Counsel than Railtrack’s to demonstrate that the signal was problematic. Railtrack’s signal design team had “visited the site on a number of occasions” due to the
complexity of the problem in any scheme to re-site the signal. The signal was placed on a configuration that “was highly unusual, if not unique; and it appears to have been acknowledged that it did not comply with the existing signaling standards”. A previous report into a crash at Royal Oak in which the question “Why do drivers mistake signals at Paddington?” provided four reasons, namely the amount of signals on the gantries, the raised height of them, their placement on curves and the high line speed. A further report stated that SN109 is difficult to read because it is placed on a corner and is partially obscured such that “The effect of this is that signals appear and disappear every few seconds as the train approaches them”. Furthermore, the legality of the signal shape and its position are questioned before “4 further deficiencies” highlighted in a HSE (Health and Safety Executive) report are stated. These are; it was partially obscured by overhead lines, a nearby bridge could produce dazzle, it was “susceptible to swamping from bright sunlight” and its shape was “unusual (possibly unique)”. The scheme had been approved by HMRI, although an official inspection was not carried out until 18 months after the signal had been sited. HMRI had found that the visibility of the signal on approach was borderline acceptable and consequently the maximum line speed was reduced. Although it was known to have been a problem Railtrack were slow in responding and placed more importance on maintaining high capacity of traffic movement over a more safe configuration (including infrastructure and schedules).

A number of different ‘working groups’ were set up to deal with the problems in this area, however it also shows that there were a number of disputes between different groups and individuals as to what were the best remedies. Furthermore, it highlights that representatives of the train operators, particularly from First Great Western, had serious worries about the situation that did not appear to be acted upon. For example, their Operations and Safety Director wrote to Railtrack on a number of occasions with requests such like:

“It is clear from all the SPADs in the Paddington area that there is a serious problem with drivers misreading signals. This has been known for some time and very little action has been taken by Railtrack to date”

And the Counsel’s summarising complaint is:

“...what is unquestionably the case is that the bodies that I have identified generated a considerable quantity of paper. What is less clear is how effective they were at identifying problems and rectifying them.”

6. DISCUSSION
In the preceding sections we attempt to bring forth organisational matters as placed forward and discussed in the opening statements to the Ladbroke Grove Inquiry. The reader can hopefully begin to see the miasma of issues that arise in dealing with and managing safety in such complex intra-organisational settings. We are not dealing with a situation where the work of satisfying a safety case involves following a simple set of agreed upon rules and procedures, enacted through the day-to-day activities of the organisation. Quite apart from the fact that procedures have to be put into practice in day-to-day operations on the shop floor, we can see that rules and procedures themselves, their applicability, their timescales and so forth are topics of dispute within and across the organisations involved. We are dealing with the issues of reconciliation and coordination (of types of activity and the timing of action), raised by the studies of work and technology but on a grander scale in complex distributed settings. In the following sections we wish to draw out a number of issues for safety critical research before returning to discuss how and in what manner issues of responsibility are pertinent to the design, implementation and on-going assessment of organizational systems.

6.1 The Scope Of The Problem
What is clear is that defining the scope of a problem in such a complex setting is no easy business. What should be taken into account as relating to a problem, how matters should be dealt with, whether solutions are good enough are all matters for discussion and negotiation and prioritisation.

Railtrack acknowledged that the approach at Paddington, and SN109 was a problem, and concurred in the HSE attribution that the approach presented a complex situation. The Paddington approach and SN109 in particular were recognised to be a problem, though it was a problem that was being worked by the signal design team and by a series of ‘working groups’. The siting of the signal was acknowledged to be less than optimal, but appears to have presented a difficult problem, insofar as its
sub-optimal siting was due to the problem of finding an unproblematically adequate siting amongst the bridges, gantries and other signals in the vicinity. No ready solution as to how to reposition SN109 was to hand, and therefore other measures were instituted to diminish the risk of being unable to read or of misreading SN109, such as the reduction of approach speed. The existing siting, further, had the approval of the supervisory safety organizations, the sub-optimality of the location being rated ‘borderline acceptable’ by the health and safety executive and Railtrack’s representative insisted that:

"Railtrack believes that the track and signal layout complied with all the main design criteria of the time and also note that this is also the view of the Head of HSE's Technical Division." (2,51,15)

Though an acknowledged problem and one which is under attention, it is presented by Railtrack as a problem which is adequately dealt with, pending improved solution. The problems with the existing arrangements are residual rather than critical, and the compensatory measures taken such that even were the problems of visibility to be realised, they should not have resulted in a collision. If drivers knew what they were doing, they should be attuned to the difficulties and risks, and drivers should have known what they were doing.

6.2 Dynamic Environmental Contingencies
A particular problem in settings such as the rail industry is that safety cases need to be constructed and reconstructed in the light of a situation where the environmental contingencies impacting on the situation dynamically change over time.

The claim to have ‘complied with all the main design criteria at the time’ can run against the fact that the criteria can shift. In the Inquiry efforts are apparently being made to invoke a set of standards, against which those the organisation(s) were working to will be found inadequate. It might even be that these demands are contradictory, that Railtrack’s concern to maintain traffic movement in the area, had that been subordinated to safety criteria, would have earned them public condemnation. Indeed the same people who are now, in the light of the accident, condemning them for failing to prioritise safety over traffic movements would then have condemned them for failing to deliver a good level of service provision. Unanimity, consistency and constancy amongst the authorities and audiences for the organisation’s performance are not necessarily to be assumed in respect of safety standards, and certainly not independently of the circumstances in which they are to be applied.

6.3 Prioritisation And Pacing Of Response To Problems
Another clear problem is that there is not necessarily a congruence in understanding between organisations or parts of organisation with respect to whether and in what ways a problem should be prioritised. The problem of SPADs and of the approach to Paddington are, presumably, some problems amongst the many that are being routinely worked within Railtrack’s organisation, and decisions must be made about how pressing any one of those problems might be, and to what extent finding a solution to that problem must pre-empt work on other problems or be merely included as one amongst many problems in a heavy workload. Railtrack’s appraisal of the formal notification that there was a problem was compatible with their treatment of the problem as one to resolve through their routine organisational methods, one which could partially be resolved through indirect address – reducing train speeds, raising driver awareness, re-organising train schedules – whilst the issue of SN109 and the architecture of the approach could be worked through in accord with whatever procedures routinely provided the process of review, analysis, design and implementation for redesign. The construal of the input from the HMRI and HSE seems to have been that the problem certainly existed, but that it could be lived with in the medium term. It might also have proved that this was a problem that could not be optimally resolved in terms of the ‘givens’ provided by the existing architecture of the gantries, line layout, bridge placement and signal location, and that any short-term practicable solution would necessarily involve trade-offs amongst the requirements for a fully satisfactory solution – i.e. methods to prepare drivers for the situation compensating for the fact that the signal did not have the ready and unproblematic visibility that was desirable. The ‘givens’ that we mention – the relevant features of the approach to Paddington – are not, of course, immutable, for changes can, of course, be made to the architecture and layout, but the kind of extensive, expensive and disruptive operations involved in such a redesign are likely to be outside of the remit of the kind of groups involved in the signal redesign. Practically, then, their decision space would be delimited by the need to keep within budgets, avoid major and ramifying engineering re-arrangements and to keep the traffic moving.
6.4 The Achievement Of An Agreed Solution

The identification of acceptable solutions is often a matter of achieving sufficient consensus amongst various parties. The complaints about Railtrack’s generation of more paper than action suggests that the diversity of bodies – a series of working groups – and difference of opinions within and between these manifest difficulties in arriving at an agreed decision amongst those entitled to a say in it. From the point of view of those arranging a series of meetings, and meetings at which there are failures to figure out candidate solutions to problems, or to generate proposals that can gain agreement it may seem like adequate progression of a standing trouble, known to be hard to resolve. This can particularly be the case when the situation at issue, whilst being recognised as sub-optimal, has nonetheless been endorsed as adequate, albeit minimally so, by supervising organisations. There may simply not be any straightforward or speedy manner in which to solve the problem and gain sufficient or appropriate consensus on the solution within the operating routines, the distribution of powers, and the existing burden of workloads within the organisation. In settings like this the problematic of scheduling and agreement, and of assessing priorities therefore needs to be taken into account when organising work and dealing with issues of safety design and implementation.

6.5 The Administrator’s Problem (to borrow a phrase from Harold Garfinkel)

With respect to organisational matters, the question is, will whatever measures are taken to solve a problem have been worth it? The risk bearing strategy and the determination of the value of possible solutions with respect to expense, inconvenience, and payoff were partly dealt with in terms of cost/benefit appraisal. A more effective driver warning system was considered for installation but rejected because the cost of the general installation, relative to the small number of SPADs and the low likelihood of them resulting in collisions, and the lower costs of the methods taken. The administrator is required to figure out, in advance, risks relative to expenditure. An ‘advanced train protection system (ATP)’ was assessed in this way, relative to considerations of ‘cost per life saved’ and in comparison with the likely safety benefits of other expenditures of the same money. Such decisions, even when aided with sophisticated analytical tools will always be a question of judgement which can be savagely criticised after the fact, as in the case of Ladbroke Grove, where it was found to be a manifestation of (effectively) putting commercial considerations before safety.

6.6 Follow Up And Enforcement

The extent to which within organisations there is autonomy and discretion in determining what the force of requirements and requests originating in other organisations or other parts of the same organisation actually is, is something of an open question. As is the capacity of supervisory and co-operating organisations to follow up on progress and chase on their requests and requirements. There are matters of inter- and intra-organisational diplomacy involved, with respect to whose business it is to deal with matters, what entitlement people have to a response, the frequency with which a request can be reiterated without further degrading the issue it is in respect of. These matters can all impact the safety of a system however, organisationally, they are always up for negotiation within the situated ways of doing things - writing memo's, making phone calls attending meetings and so forth.

7. CONCLUSION: RESPONSIBILITY

The dependability of the railways, the responsibility for its safe working, as a complex socio-technical system, relies on various complex interactions between organizations, social groups, people, and technologies. In order to ensure safe operation these components are integrated in different ways in complex systems. Responsibility for dependability is distributed across these complex systems such that individual components all have their role, their part to play. Drivers should drive defensively, know what to look out for, know their routes and the placement of signals, follow the rules and procedures, and the developing set of signals, and respond correctly to warning lights and bells. Technology should be designed, built, deployed, tested and assessed according to the correct standards and guidelines. Employers should have the right balance of safety over profit, should have correct rules and procedures and the means to determine these are being followed, should have the means for making problems visible and expediting solutions and so forth. Ideally these different components fit together to form an articulated structure of responsibilities – a coherent whole through which all safety aspects are catered for in a systematic manner and delegated to individual components, with correct and timely reviews and evaluations carried out. In reality the case may be rather different.

What should be clear from the Ladbroke Grove disaster, the inquiry into it and the materials presented and analysed in this paper is that they generate important issues for the design of safety critical
systems, and for consideration by systems design researchers and practitioners. The first point to make is that we are dealing with a situation that is incredibly complex. The context is inter and intra-organisational, involving many different companies and interested parties, different technologies, practices, procedures, rules, standards, committees, experts and so on. A narrow view of safety that focuses only on technology or even a socio-technical perspective that focuses on human-technology interaction in situ simply does not capture the organisational features that are important in selecting, implementing, maintaining, testing, supervising and reviewing, then reconfiguring and upgrading technologies and systems. Looking at the ways in which failures are constituted through organisational practice, are categorized, sized, scoped and evaluated, how they allocated to parties responsible for problem solving, how closely and in what ways the activities of those involved in the problem solving are integrated. We have mentioned the way in which the SPADs problem was categorized as (primarily) one of driver error, how the fact that there were measures already taken had made the SPAD problem one of residual risk, and as one that was being handled with sufficient urgency (in intra-organisational terms) by being progressed through regular re-design procedures, and that was being handled by an array of measures addressed to the problem as it was understood. We have also mentioned the organisational constraints on the design space, and of timescale, resource, and the propagation of consequences as prominent in determining delimiting the design space and determining what was practicable with respect to the specific – and perhaps within the design-space – intractable matter of SN109.

Matters of coordination and cooperation are shown to have been of great importance in the Ladbroke Grove situation, including: (a) those involving the responsiveness (or lack of it) of one organization to the requirements and demands of another, (b) problems in articulating the procedures and responsibilities of different organizations with diversified practices so that they dovetail, (c) in controlling the activity of problem solving when this has been distributed across a number of groups, (d) in interpreting the action implications and effecting the implementation of recommendations from independent supervisory bodies, and (e) in dependence on and trust in the competence of sub-contracted experts. And, of course, there are those problems with which the parties attempting to regulate the safety situation with respect to SPADs and in respect of SN109 must contend, that of finding ways of building an enforceable design of technological infrastructure and of the workday practice that employs it in such ways that engagement with safe practices can be (routinely) implemented and sustained.

### 7.1 Comparing Responsibilities

There are two ways in which responsibility is most pertinent to the issue of organisational system design, implementation and evaluation. The first is in the somewhat intractable problem of balancing the responsibility for safety and dependability with other organisational responsibilities such as meeting performance criteria and operating within set timescales and budgets. In the case of Ladbroke Grove we see a situation where after the event we can state clearly that responsibility for safety was wrongly given lesser priority than responsibility for performance and expenditure. Preferred solutions for the problems of SPADs were to punish and re-train responsible drivers, to provide extra information for drivers as a whole, to adjust minor, or isolated parts of the signalling system and to reduce line speeds on problematic areas of the network. Measures were undoubtedly taken which were intended to add to the safety of the system however there was a clear bias against taking measures that would have a more serious affect on performance or cost a lot of money. For this reason the idea that the approach to SN109 or Paddington in general would need to be extensively redesigned was rejected as were ideas that you might close routes on SPADed signals immediately, or that ATP (automatic train protection) should be compulsory on all trains.

It is easy to see the reasons for an organisational preference for seeking solutions to safety problems that affect organisational operations the least however here this also affected the way in which the problem was scoped. For example, as well as dealing with and informing drivers, Railtrack might have considered that they needed to change a whole series of procedures. For example, since it is well reported that front line staff invariably admit personal responsibility over other factors (Reason 1997) it might have been sensible to always examine these other factors in SPAD reports. Secondly they could have made it policy to close SPADed parts of the line until the SPAD committee could have made a formal assessment. Thirdly, they might have had ways of enforcing the SPAD committee to come to a unanimous position on, for example, signal redesign rather than allowing it to falter on with no decisions made. Furthermore, Railtrack could have ensured that SPADed signals would only be reopened with no re-design to the infrastructure in cases where there was overwhelming evidence that
this was not at fault in the SPAD. In the case of the Ladbroke Grove disaster we can see that while the measures that were taken were sensible given the prevalence of SPADs in the area, we can equally see that given the evidence for problems with signal visibility there were good organizational reasons for expediting signal redesign that were ignored.

In the case of Britain’s railways one of the outcomes of the Ladbroke Grove Rail Inquiry was to provoke the Governments decision to abolish Railtrack as a private company and to bring the responsibility for the railway infrastructure back into public ownership as Network Rail. As such profit is no longer a responsibility that must be satisfied alongside safety with the clear suggestion that limiting competing responsibilities is important if safety operation is to be achieved. However, it should be noted that responsibilities will always compete as performance, in terms of train times and throughput, still must be weighed up against safety considerations.

### 7.2 Delegating and Enforcing Responsibilities

A subsequent rail disaster at Potter’s Bar occurred in which the private company called Jarvis, sub-contracted to deal with the maintenance of the tracks, was implicated in the tragedy that again resulted in deaths. This time the disaster happened as a train derailed coming in to Potter’s Bar station, colliding with the platform. This time the cause of the crash was traced to missing pins in a recently replaced section of rail which came loose as the trains went over them, causing the derailment. Again in the aftermath of the crash Jarvis were blamed for their lack of safety prioritisation and again, a subsequent action the Government undertook was to bring track maintenance back into public ownership. The interesting feature of this is it brings us to consider the second issue related to responsibility that is pertinent for issues of organisational system implementation, design and evaluation; that of delegation and enforcement.

It is clear that responsibility for safe system operation must be delegated. As already described, tasks integral to safe, dependable operation are allocated across technical, human, social and organizational components of the system. For example, the safe operation of the railways depends on Automatic Warning Systems in trains operating properly, drivers driving with due care, line managers promoting a safety culture and SPAD committees operating as envisaged. At each step of delegation, the one delegating must be satisfied that those below him or her have the means to take on the safety responsibility that their position entails. Obviously in the complex environment of the railways this forms a very complicated structure of responsibilities. This means that the extent that senior management can gain access to and understand how responsibilities are being discharged down the line is rather limited. Conversely those at the lower end of the organisation may have more difficulty seeing how their responsibilities interact with others across the organisation. When separate or sub-contracted organisations are involved in discharging responsibilities that are inextricably linked to those of the central organization the situation is complicated as control is lessened. Indeed, one of the main reasons for bringing maintenance back under the auspices of Network Rail following Potter’s Bar was to allow better control.

However, although this discussion has been characterised in terms of responsibility thus far, it is worth considering whether part of the problem may lie in the fact that responsibility is not as prescient a concept in the design of organizational systems as it might be. Occasions such as training for a new job are ones in which people are told of their responsibilities. Responsibilities are laid down in procedures and standards. However, we may question how prescient the notion of responsibility is when people are carrying out their day to day work. It may be more accurate to say that they are simply doing their jobs, carrying out familiar tasks in the usual manner, getting things done under a series of pressures. Things may slip, actions may not have the same orientation to responsibilities for safety that they should have, and some errors are inevitable (Reason, 1997). It is one thing to account for actions as having been carried out in line with procedures, it is another to have acted responsibly both to ones own work and the way it is implicated in others work. Clearly, in delegating work there is a need to see how different responsibilities relate and interact and form a structure to gain an overall understanding of the safety of the system. However, this cannot be ensured simply through careful task allocation. There is a need to constantly monitor how, on the ground, tasks are being carried out. This suggests that there is a need to separate the responsibility for the safety of a task being carried out from those doing it, as familiarity, repetitiveness, and other contingencies may lead to bad practices and mistakes. There is a need to constantly promote a safety culture and safe practices but also to supervise that this is indeed what is happening, and this requires the job of supervision to be a separate position from the task itself. Secondly, given our previous discussion, there is a need to allow those doing the monitoring freedom
from competing responsibilities and a means of enforcement. Those holding these positions should have full and singular responsibility for ensuring the safe working of those they are monitoring.

Ideally such a system would promote safer system operation but it must be acknowledged that gaining an overall, systematic understanding of organizational system structure is one very thorny task, while achieving a separation of safety responsibilities from other organizational contingencies is another. However, endorsing the views of Reason (1997) it appears that safety culture must come from the top and permeate the organization. Safety should be promoted as an important strand of organizational work and allowed to work apart from other organisational contingencies while at the same time providing the base for monitoring and evaluating those other activities. Hopefully such measures would aid in the avoidance of tragedies such as the Ladbroke Grove Disaster.

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