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Ordering Networks: Motorways and the Work of Managing Disruption

Abstract

This thesis contributes to a new understanding of the motorway network and its traffic movements as a problem of practical accomplishment. It is based on a detailed ethnomethodological study of incident management in the Highways Agency's motorway control room, which observes the methods operators use to detect, diagnose and clear incidents to accomplish safe and reliable traffic. Its main concern is how millions of vehicles can depend on the motorway network to fulfil obligations for travel when it is constantly compromised by disruption from congestion, road accidents and vehicle breakdowns. It argues that transport geography and new mobilities research have overlooked questions of practical accomplishment; they tend to treat movement as an inevitable demand, producing fixed technical solutions to optimise it, or a self-evident phenomenon, made meaningful only through the intensely human experience of mobility. In response, the frame of practical accomplishment is developed to analyse the ways in which traffic is ongoingly organised through the situated and contingent practices that take place in the control room. The point is that traffic does not move by magic; it has to be planned for, produced and persistently worked at. This is coupled with an understanding of network topology that reconsiders the motorway network as always in process by virtue of the materially heterogeneous relations it keeps, drawing attention to the intensely collaborative nature of work between operators and technology that permits the management of disruption at-a-distance and in

real time. This work is by no means straightforward – the actions of monitoring, detecting, diagnosing and classifying incidents and managing traffic are revealed to be complexly situated and prone to uncertainty, requiring constant ordering work to accomplish them. In conclusion, this thesis argues for the frame of practical accomplishment to be taken seriously, rendering the work of transport networks available for sustained analysis.

Ordering Networks: Motorways and the Work of Managing Disruption

Rachel Joanne Gordon

Thesis submitted for the degree of Doctor in Philosophy

Department of Geography

Durham University

2012

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List of Abbreviations

ACPO	Association of Chief Police Officers
AID	Automated incident detection system
AMI	Advanced motorway indicator
ANPR	Automatic number plate recognition
ATC	Air traffic control
ATM	Active traffic management
AVL	Automatic Vehicle Location
C&C	SunGard Command and Control
CAD	Computer aided dispatch
CCTV	Closed circuit television
CMPG	Central Motorway Police Group
COBS	Control Office Based System
CSCW	Computer supported cooperative work
DDS	Digital display screen
ERA	Emergency refuge area
ERT	Emergency roadside telephone
DETR	Department of the Environment, Transport and the Regions
DfT	Department for Transport
DoT	Department of Transport
DRIVE	Dedicated Road Infrastructures for Vehicle safety in Europe
EDAIU	Enhanced Digital Audio Interface Unit
FTS	Flexible Transport Services

GIS	Geographical information system
HA	Highways Agency
HADECS	Highways Agency Digital Enforcement Camera System
HAIL	Highways Agency Information Line
HAIP	Highways Agency Information Point
HATO	Highways Agency Traffic Officer
HCI	Human-computer interaction
HIOCC	High OCCupancy algorithm
ICCS	Integrated Communications Control System
ICT	Information and communications technology
ISSI	Individual Subscriber Short Identity
ISU	Incident support unit
ITS	Intelligent Transport System
KVM	Keyboard, visual display unit and mouse
MAC	Managing Agent Contractor
MDIS	Midlands Driver Information System
MIDAS	Motorway Incident Detection and Automatic Signalling system
MMI	Man-machine interaction
MS2	Motorway Signal Mark 2
MS3	Motorway Signal Mark 3
MS4	Motorway Signal Mark 4
NCC	Network Control Centre
NHS	National Health Service
NILO	National Incident Liaison Officer

NSPIS	National Strategy for Police Information Systems
NTCC	National Traffic Control Centre
NTIS	National Traffic Information Service
NTOC	National Traffic Operations Centre
PCO	Police Control Office
RAF	Royal Air Force
RCC	Regional Control Centre
RTI	Road Transport Informatics
SCS	Semi Automatic Control System
STMS	Strategic Traffic Management System
TIP	Travel Information Provider
TiS	Traffic Information Services
TJR	Through-junction-running
TLC	Traffic Learning Centre
TOS	Traffic Officer Service
TMU	Traffic monitoring unit
TVBS	TeleVision Base System
VMS	Variable message sign

Statement of Copyright

The copyright of this thesis rests with the author. No quotation from it should be published without the author's prior written consent and information derived from it should be acknowledged.

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Chapter 1

Managing the Motorways: An Introduction

1.1. Motorways, Disruptions and Getting Places: An Introduction

At the heart of this thesis is an interest in the relationship between the phenomenon of disruption, its management and the production of orderly traffic on the motorway. Take congestion, road traffic accidents and broken down vehicles; they are all examples of daily disruptions that compromise the production of safe and reliable motorway traffic – the point is that in spite of these disruptions, millions of vehicles routinely depend on the motorway network to fulfil social and economic obligations for travel. To produce orderly traffic to get people and goods to the places they need to be, at times when they need to be there, the motorway must be planned for and worked at to maintain those traffic flows. Given the unpredictability of the location, duration and severity of disruption, it is therefore necessary for transport spaces and practices to be dedicated to the work of managing and mitigating the effects that disruption has on traffic flow. However, details of this work are routinely missing from transport and mobility research. As this introduction will go on to specify, this is despite the ‘crisis of mobility’ context within which this work plays out (Banister 2002; Button and Hensher 2001; Quinn 1997; Shaw et al. 2008), whereby restricted road building, concern over the environmental costs relating to air and land pollution, and panic about the sustainability of estimated growth in automobile use have resulted in alternative methods being sought that actively manage traffic according to its situated needs.

In response, this thesis aims to reframe movement as a problem of practical accomplishment; a notion which is ethnomethodological in nature (Garfinkel 1967). Ethnomethodology permits the study of the methods participants use to create mutually intelligible local orders to accomplish their work. As such it recognises that orders are not simply given nor should they be expected to occur unproblematically according to rule or procedure; rather they have to be continuously worked at to be accomplished. It is argued that this approach has much to offer the study of the motorway network to further understand how traffic is a locally situated phenomenon which is ongoingly ordered and practically achieved by virtue of active traffic management work. Traffic does not occur as if by magic, if these disruptions are anything to go by, so it is necessary to enter professional transport spaces and observe the practices that help to produce it. This thesis commits to a detailed and sustained ethnomethodological study of the work that takes place inside the Highways Agency motorway control rooms to observe how incident and traffic management occurs in locally complex and situated ways in relation to the challenges it faces. In the case of motorway transport, it does this by showing how the actions of operators and technology contribute to the unfolding circumstances to which they are applied and are constitutive of the ordering of traffic.

The purpose of this introductory chapter is to begin to unpack what is at stake in framing movement as a practical accomplishment. This chapter will start by positioning the thesis alongside existing theories of movement, mobility and transport and introduce the themes that will be taken up in the chapters that

follow. It will also explore the organisational context within which active traffic management emerges and define the role of the Highways Agency now it is a network operator, thus providing a historical overview of motorway management in England. The chapter will end with an outline of the thesis, chapter by chapter, to familiarise the reader with the discussion that follows.

1.2. The Contribution of this Thesis

Broadly speaking, geography has long maintained an interest in questions of mobility and movement, its spaces and its practices (Castles and Miller 1993; Cresswell 2006; Hägerstrand 1967; Haggett and Chorley 1969; Hall and Page 1999; Sheller and Urry 2006; Taaffe and Gauthier 1973; White and Senior 1983). While transport geography is arguably the most obvious and long-standing body of research into geographical forms of movement (Haggett and Chorley 1969; Hoyle and Knowles 1992; Rodrigue et al. 2006), more recently the concept of mobility has been embraced as a principal lens through which human life is experienced; an approach which is often associated with the self-proclaimed new mobilities paradigm (Hannam et al. 2006; Sheller and Urry 2006). These bodies of research produce distinctively different ways of accounting for movement in modern life – one frames movement as an engineering, economic or planning problem, depending on disciplinary affiliations, for which solutions are sought in order to optimise it; and the other always already privileges the phenomenon of mobility as a metaphor for movement, made meaningful by virtue of its cultural significance, with the human figure at its centre. Very few studies originating in these fields, however, take an interest in the primary question of how physical movement is

actually planned for, produced, 'tended to' – to borrow a phrase from Normark (2006) – and overall practically accomplished as it is contingently situated in the register of daily life.

This has real consequences for how movement phenomena have so far been studied and understood, especially those of the transport kind. If they are left to the transport professionals, questions about how traffic movements are produced and shaped according to their situated contingencies are routinely missing from their theories and models. Their propensity to provide solutions that maximise movement through infrastructural building and optimise its time and monetary costs renders these transport networks and its movements indisputable procedural triumphs. The problem with this is that it suppresses an alternative approach that seeks to understand how transport networks are operated, monitored and managed in real time, given that moving traffic inevitably encounters situations that inhibit the kinds of optimal movements transport professionals seek to facilitate. This thesis agrees with Büscher et al. (2009) that there is more to transport than a set of engineered infrastructures and neutral technologies that transports people and goods from one place to another, but the perpetuation of this traditional view works to stifle engagement with core transport matters outside the original transport disciplines. Take the new mobilities paradigm for example; one of its central arguments is that the social sciences have preferred to treat transport as a black box that permits movement, neglecting to explain how the movements of people intersect with social, economic or political life in complexly situated ways (Sheller and Urry 2006). However, its preoccupation with mobility as a primary

condition of what it means to be human often means that the study of empirical movements is not necessary to advance its theoretical ideas. The exclusion of empirical movements means that questions about their practical accomplishment, as well as the study of the spaces and practices that tend to moving traffic, remain ignored. This thesis is therefore positioned in direct response to this doubly inadequate treatment of transport networks and its movements. To study movement as a practical accomplishment signals a break with them and a move towards a new understanding of movement as it is contingently ordered and achieved by studying its situated practices.

Road transport is a case in point. At the end of 2011, there were 34.2 million vehicles licensed to travel on the 245 thousand miles of roadway in Britain (DfT 2011b, 2012c). In fact, during that year these vehicles collectively traversed a massive 303.2 billion vehicle miles, making journeys to fulfil commercial or personal obligations for co-presence (DfT 2012a). These large scale traffic movements depend on the combined efforts of an array of intersecting and interdependent infrastructures, networks and services. This includes the automotive and petroleum industries for the manufacture of motor vehicles and the supply of fuel to power them, the networks of petrol stations, service stations and car parks equipped for refuelling and resting drivers and their vehicles (Green 2004; Normark 2006), the regulatory frameworks and practices that shape and govern automobile movements (Bonham 2006; Dodge and Kitchin 2007; Merriman 2006, 2007), the traffic police (Sørensen and Pica 2005) and parking attendants that enforce these rules (Hagman 2006), the mobilisation of vehicle breakdown and recovery agents

and the teams of structural engineers and contractors that build, maintain and repair road infrastructures (Esbjörnsson 2006; Esbjörnsson and Juhlin 2002; Graham and Thrift 2007; Normark and Esbjörnsson 2004). While these practices actively create the conditions for movement, as well as the resources necessary for their maintenance and repair, road traffic movements are by no means straightforwardly organised into orderly and accomplished flows. This is because they are persistently compromised by congestion, road traffic accidents and obstructions created by broken down vehicles, lost loads and fallen debris, which generate unsafe, unpredictable and unreliable traffic conditions in localised areas. On the strategic road network in England alone, there is an average of 870 incidents per day (Highways Agency 2010b).¹ To deal with this, there must be some other kind of work going on; work that is centred on the real time monitoring and management of disruption to facilitate traffic movements in spite of those instances of disruption.

A telephone call is received by the motorway control room from the police call centre. Jane, one of the operators responsible for call handling today, sits up in her chair and adjusts her headset while she reaches forward to press to take the call. "Hello, Highways Agency." The caller tells Jane that a report has been made by a member of the public regarding debris across the carriageway, around junction 2 on the M69. It is apparently causing traffic to swerve and brake abruptly. Jane opens a New Incident log on the computer screen. In the log, Jane types in the classification code OB [an obstruction], enters the location given by the caller, and selects an IMMEDIATE priority grading for the incident. She issues the log so it is available to other operators in the motorway control room to action a response.

¹ The strategic road network consists of around 4,300 miles of motorway and all-purpose trunk road.

The practical challenge to produce safe and reliable traffic is arguably no more acutely felt than in the context of the strategic road network, given its importance for the transport of people and goods between large urban areas and major transport hubs. While the strategic road network represents only 2% of the total road network in England, it carries just over 33% of all traffic, cutting a striking figure against a general background of road transport use (Highways Agency 2009, 2012a). This results in a higher average traffic flow traversing the strategic network compared with other roads; in 2010, motorways had the highest average traffic flow with 75.6 thousand vehicles for each mile of motorway per day; this is compared to 19.6 thousand vehicles for each mile of major urban road per day (DfT 2011a). Traffic is, of course, not uniformly distributed across the network, meaning that there are some areas more densely occupied than others, especially during peak times, and more prone to disruption than others. This is likely to lead to congestion, where road capacity is reached in high volume traffic, creating traffic conditions characterised by slower speeds, increased stopping and starting and bottlenecks. It obviously compromises the predictability of journey times between two points on the network, which has particular consequences for transport that depends on the timely coordination of arrivals, departures and their complex integration (Cidell 2012; Hesse and Rodrigue 2004). Congestion is set to rise, with drivers across the road network set to incur a loss of 32.3 seconds by 2035 per mile of congested traffic, increasing from 19.2 seconds at 2010 levels (DfT 2012b). This is despite a downward trend in motor traffic volumes since 2007, albeit slight.²

²Motor vehicle traffic has fallen for three consecutive years on the strategic road network (the first time since records began in 1949): a decrease of 1% between 2007 and 2008, 0.9% between 2008 and 2009 and 1.6% between 2009 and 2010 (DfT 2011).

Motorways are also notoriously hazardous environments; research has shown that the accident rate in congested conditions is nearly twice the rate in uncongested conditions (Brownfield et al. 2003). Links are drawn between the unpredictability of traffic movement and queue avoidance strategies in congested conditions that contribute to the increased occurrence of accidents. In 2010, there were 11,372 road traffic accidents reported on the strategic road network resulting in 17,967 casualties. Of these, 1,622 people were seriously injured and 247 killed (Highways Agency Strategic Safety Framework 2011). Any individual involved in a traffic incident is obviously exposed to the dangers of the network – damaged vehicles, leaking fuel, fast-moving traffic – which provides the impetus for quick and effective emergency action (Highways Agency 2002).

Sarah, the traffic management operator, has already begun to search for the debris by using the CCTV (closed circuit television) cameras in the area after listening-in to Jane's telephone conversation, taking place across from her in the control room. Sarah takes each camera in turn – she moves it up and down the carriageway, left and right, zooms in, zooms out. Meanwhile, Martin, the radio dispatcher, has opened the log at his workstation. Glancing at the network map, he sees that the motorway patrol WE12 is located closest to the area of the incident. He transmits a voice message using Airwave radio to request their attendance at the incident. "Whisky Echo 1-2 from Hotel Alpha. New incident message, over. Can I ask you to make towards junction 2, M-6-9? There has been a report of debris across the carriageway. Can I show you Code 2, over?"

The traditional engineering solution to these transport problems has been to build more roads. More roads, it was maintained, create additional capacity that reduce instances of congestion and, in turn, alleviate those traffic conditions that are prone to accidents. However, the impulse to 'predict and provide' new roads has since fallen out of policy favour; the pressure from green campaigners coupled

with the work of analysts show the approach to be logically flawed since it generates an unending cycle of road building— as you build, you release latent demand, and need to build more to meet that demand (DoT 1994; Owens 1995; Goodwin et al. 1991; Shaw and Docherty 2008). It is against this background of mobility in crisis (Shaw, Knowles and Docherty 2008), where a bleak road transport future consisting of increased levels of traffic congestion, the continued production of accidents and other disruptions, capped road building and environmental degradation, that the need for an alternative way of managing the network has been created. In recent years, this alternative way has been found in the approach of network management which aims to ‘make the best use’ of existing roads (DETR 1998b; Quinn 1997). In England, this work is carried out by the Highways Agency, an Executive Agency of the Department for Transport (DfT), which has witnessed a shift in its role from a road builder to a ‘network operator’ to reflect this new policy (DETR 1998a). This means that the Highways Agency is now responsible for traffic management, which spans the work of capital schemes that enhance the capacity of existing roads and real time incident management. Incident management, which is the ongoing work of monitoring and managing incidents on the motorway network, is delegated by the Highways Agency to the Traffic Officer Service (TOS) division. It operates a national network of Regional Control Centres (RCCs) and its own fleet of Highways Agency Traffic Officer (HATO) patrols that are dispatched to incident scenes. By making best use, this approach intends to limit the need to build new roads by adding capacity to already existing infrastructure while mitigating the effects of disruption to help produce safe, timely and reliable traffic movements in contingently and practically situated ways.

About a minute later, Sarah shouts up that she has found the incident on camera. "Camera 2-4-5-8!" There is debris – what looks like pieces of broken pallet – over all three lanes of the carriageway. "Traffic is building up. I'll set signals." With the incident now confirmed by CCTV, Sarah can set speed signals at 30 miles per hour to slow traffic on approach to the debris. Meanwhile, Martin transmits another message by Airwave radio to update the motorway patrol with a more precise location taken from the camera visual. Sarah leans forward and stares intently at the CCTV monitor. She raises her concerns that the traffic is still approaching the incident scene at speed, causing them to brake suddenly. "We've had a couple of close calls," she says. "I'm gonna set more 30s." Martin agrees. "Yeah, the M69 – it's a bit of a speed track, isn't it?"

The excerpt running through this introduction recounts a case of incident management in the motorway control room following a report of debris on the carriageway. It is taken from an extensive period of observational research conducted as part of this thesis in the motorway control room of the West Midlands RCC. This is exactly the ongoing, situated work that has so far been systematically missing from the empirical studies of both transport geography and new mobilities research, which is obviously detrimental to achieving a new understanding of how movement is practically accomplished. The point is that since very little is known about this work of answering telephones, monitoring traffic flows, producing congestion alerts, diagnosing incidents, dispatching patrols, using radio handsets and searching CCTV, it is limiting for broadening such an understanding of how exactly these networks as heterogeneous mixes of people, vehicles, technology and information work together to produce traffic movements in spite of daily disruption (Büscher et al. 2009). To exclude this heterogeneity works to render transport networks as neutral applications of engineered solutions to transport problems and therefore it misses out completely on the situated ways

in which timely movements are produced and coordinated across multiple spaces (the motorway, the control room, the patrol vehicle) and occur in more or less real time.

It may then seem at odds to present an overview of road transport, complete with statistics, when this research is interested in the practical accomplishment of traffic movement. Their juxtaposition is a deliberate move to begin to show how an alternative approach to the practical accomplishment of movement through detailed empirical description is crucial to any comprehension of how real world transport spaces and practices are actively organised and ordered in locally situated ways. This way of breaking with convention by studying phenomena as they are ordered and organised in situ, rather than adhering to traditionally defined theoretical frames and categories of analysis, defines the contribution this thesis makes to research on movement, mobility and transport and, in doing this, draws together two distinct yet complimentary approaches. The first, largely aligned with the work of Law (1992, 1999; Law and Mol 1994, 2001; Law and Urry 2004), offers a relational network topology as a way of understanding how networks are materially heterogeneous and precarious effects that emerge over time and have to be continuously worked at to maintain their stability. It builds on topological thinking that already exists in transport geography, but rather than accepting condensed descriptions of technical toolkits that are applied in relatively fixed and neutral ways to resolve transport problems, this relational network topology draws attention to the creative ways in which people and technologies collaborate in professional transport settings to deal with real time

practical contingencies and generate dynamic spatial and temporal effects. The second is ethnomethodology and its set of principles that are sensitive to the situatedness and practically contingent character of settings which work to challenge grand theories and respecify its contents (Garfinkel 1967). It achieves this by enabling the methods, practices and competencies emerge from the setting itself, witnessable in the actions and interactions of participants in that setting as they work hard to maintain a mutually recognisable order. A practical accomplishment – as informed by these two approaches – refers to the activities involved in maintaining order and not the production of a final result, because any such appearance of an order is ongoingly and precariously situated according to the contingencies of the setting. In the motorway control room then, as illustrated in the excerpt above, this involves a detailed analysis of the interactions between the spaces, practices, people and technology through which traffic flows are monitored and managed and traffic incidents are detected, diagnosed and responded to. The next section takes the opportunity to situate this thesis within the empirical context of motorway management in England in more detail before moving on to provide an outline of the chapters that follow.

1.3. The Highways Agency

“It was very much a knee-jerk reaction to White Friday going back five years or so on the M11 where they had white outs, blanket snow conditions, traffic stuck for hours, close to London, people stuck, and not being able to do anything with it, and the Highways Agency were heavily criticised because they had no response mechanism in place to deal with incidents on the network.” (Keith, East RCC)

White Friday took place on 31st January 2003 on the M11 in Cambridgeshire when heavy snow storms hit the region. Many motorists were stranded for 12 hours in 13 miles of stationary traffic. It was reported that 12 heavy goods vehicles jack-knifed in the carriageway and many motorists abandoned their vehicles on the hard shoulder as they sought respite elsewhere. These obstructions blocked live lanes of the carriageway and hindered emergency responders and gritting vehicles reaching trapped traffic. Like Keith, many members of the TOS name White Friday as a catalyst for the launch of the service. While talk was already underway about transferring some responsibilities from motorway police to the Highways Agency (Quinn 1997, DETR 1998a, 1998b), White Friday provided a highly visible public event that provoked interrogative questions about the government's preparedness for motorway emergencies. The Agency was criticised for its overall unsatisfactory preparation for Winter Maintenance, the ineffective dissemination of traffic and travel information relevant to wintry driving conditions and real time disruption, and its inability to deliver a satisfactory level of emergency response for large numbers of stranded motorists at the scene, such as plans for the provision of food and water, medical attention coordinated with emergency responders and the possible evacuation the scene – if such an event was to happen again. This also raised questions about the adequacy of the daily management of the network in terms of congestion and incident management; after all, it is the everyday processes and practices of management, maintenance and repair that are shown to be instrumental in the recovery from larger scale disruptions (see Graham 2009; Graham and Thrift 2007; Mitchell and Townsend 2005).

1.3.1. From Road Builder to Road Operator

When the Highways Agency was established in 1994, the work of incident management, including the answering of emergency roadside telephones (ERTs), sign and signal setting, motorway patrolling, and real time traffic management was performed exclusively by the police. This has a surprisingly rich and long history dating back to the experiences of policing the very first motorways in the late 1950s and early 1960s (Charlesworth 1984; Bridle and Porter 2002; Drake et al 1969; Merriman 2007; Plowden 1971). The real time management of the motorways was in direct response to the challenges it faced both in terms of generic communications troubles related to the coordination of emergency response over distance and the idiosyncrasies of the motorway network. These challenges included, most notably, the specific networked-form of the motorway (unidirectional flows of traffic, connected by junctions and intersections), the unpredictability of disruption and the difficulty of communicating with drivers for the purpose of incident reporting (in particular before the advent of widespread mobile telephony) and the dissemination of traffic management instructions and information to drivers. These challenges remain pertinent to the demand of real time traffic management today. Taking the matter of its networked configuration first, its elevated intersections, bridges and deep verges make it inaccessible and inescapable by foot and, with fast traffic, creates a dislocating and intimidating environment for anyone who finds themselves stranded on the motorway in need of assistance. Coupled with the fact that access to the motorway is limited to junctions spread intermittingly along it, its configuration compromises the safety of

motorists requiring immediate and emergency response. This saw the development of dedicated police motorway divisions in local forces that were specifically trained and equipped to work on the motorway. The early motorway patrols were mostly to enforce the regulations specified in the Highway Act of 1959 but as the network grew it was necessary to impose strategic use of patrols at busier and more incident-prone areas of the network (Merriman 2007).

The ability for drivers to communicate with the emergency services was tackled with the installation of the very first ERTs by the Post Office in 1959. The fact that drivers were equipped to instantly report emergencies to the police via ERTs, coupled with the patrolling presence of police officers on the motorway, meant that the police were becoming increasingly aware of incidents occurring on the motorway network in more or less real time. The next problem they faced was communicating this information to drivers to warn them about incidents on the network to mitigate further disruption. Secondary incidents and weather-related incidents were proving particularly perilous for motorway drivers at the time who were largely unfamiliar with the faster speeds, road layouts and common hazards associated with motorway driving (Merriman 2007). As early as 1964, research was conducted into the feasibility of providing a remote controlled hazard warning signalling system for installation on the motorway (Bridle and Porter 2002). As the network grew, the ability to detect disruption in its early stages was also desirable. The first trial of inductive loop technology for the creation of an automated incident detection (AID) system took place shortly after in 1965. It sounded an alarm in the police control room in the event of an unexpected gap in traffic. This was matched

with developments in signage – beginning with fixed-text signs on rotating boards or roller prisms that could be operated remotely – and the installation of CCTV beamed back to the police control room. The first fully operational AID system was launched on the M1 in 1989 (Summersgill et al. 1999) – the forerunner to the Motorway Incident Detection and Automatic Signalling (MIDAS) system the Highways Agency operates today. This enabled police to verify automated alerts with visible signs of disruption, describe the location to better direct the motorway police and set signs accordingly to direct traffic.

The first official indication that this real time traffic management work was to be transferred from the police to the Highways Agency can be found in the White Paper *New Deal for Transport: Better for Everyone* (DETR 1998a), along with the restatements contained within the *New Deal for Trunk Roads* (DETR 1998b). As part of its newly defined role, the Highways Agency as the network operator would be expected to “focus on moving people and goods safely and effectively rather than building new roads” in order to “optimise [the] use of network assets” (DETR 1998a, unpaginated). In particular, it sets out to develop its role as a network operator by implementing traffic management to achieve its objectives of reducing congestion and increasing journey time reliability. There is a notable shift in rhetoric from road building to a targeted programme of improvements and better management to “make the best use of the roads we have already” (DETR 1998a, unpaginated). This plays out in a changing transport policy context where the prevailing approach of ‘predict and provide’ was falling out of favour as a suitable approach to take in transport planning and there was a pressing need to explore

alternatives (DoT 1994; Owens 1995; Goodwin et al. 1991; Shaw and Docherty 2008). The predict and provide approach had so far dominated transport planning in England, using traffic forecasts to predict how much unrestrained demand there existed for road transport and advocated the building of new roads to meet that demand (Goodwin et al. 1991; Owens 1995).³ It eventually came unstuck during the 1990s with the new realism movement which criticised its perpetual cycle of road building to the detriment of the environment (especially its contribution to greenhouse gas emissions).⁴

Of course, this was not an entirely new proposition – and at the time of the publication of the *New Deal for Transport*, the Highways Agency had already implemented a series of traffic management trials in England, demonstrating a real interest in the promise of active traffic management (ATM) technologies and techniques to enhance existing road capacity (DoT 1996). The controlled motorway experiment on the M25, for example, was well underway: phase 1 on the M25, junction 10 to junction 15, was implemented in 1995.⁵ Early findings support its positive impact on traffic flow, resulting in a smoother traffic flow, a reduction of

³ Evidenced by the Conservative Government's white paper *Roads for Prosperity* (DoT 1989).

⁴ The new realism favoured demand management, modal shift and environmental sustainability but it was later replaced by the more nuanced rhetoric of pragmatic multimodalism movement to soothe the public's fear of an anti-car policy (Parkhurst and Dudley 2008; Shaw and Docherty 2008). This supported a partial return to road building, mostly in terms of making improvements and adjustments to existing roads to increase capacity. This at least recognised the rootedness of automobility in the practices of everyday social and economic life so much so that modal shift was an unlikely solution to the mobility crisis on the motorways – in the short term anyway (DfT 2003; Lucas and Jones 2009).

⁵ Controlled motorways use ATM technologies and techniques to slow traffic to a steady, uniform speed in order to minimise the risk of breakdown in traffic flow, reducing the number of accidents caused by flow breakdown and thereby helping to achieve journey time reliability. It is an automated procedure that uses real time traffic counts, provided by a network of inductive loops buried in the road surface, to trigger mandatory speed limits on variable message signs in the control area when traffic flow is high. This equalises speeds in all lanes (Rees et al. 2004). It requires constant monitoring by human operators to ensure the swift recovery of any obstacles to traffic flow and safety (such as an accident or vehicle breakdown) and to check the accuracy of sign and signal setting.

stop-start driving, improved journey time reliability and improved lane utilisation (Rees et al. 2004). There was also the Kent Corridor Strategic Traffic Management System (STMS); the first large scale implementation of real time incident detection and traffic management in England, which was fully operational by 1997 (Quinn 1997).⁶ The STMS was very much a forerunner to the RCC as it operates today – operators working in the Police Control Office (PCO) in Maidstone, Kent, would monitor CCTV cameras and set pre-programmed strategic diversion routes, which were automatically displayed on variable message signs (VMS), in response to incidents taking place along the M2/M20 corridor. The real time monitoring enabled operators to consider the appropriateness of diversion routes before pressing to implement in order to improve its effectiveness and driver compliance. It was closely followed by the Midlands Driver Information System (MDIS) (Carden et al. 1999).⁷ The Highways Agency also experimented with a number of real time traffic management initiatives to assess the value of network operations. This included the successful trial of incident support units (ISUs) for the coordination of repair and maintenance duties at incident scenes to speed up clearance times (they remain in operation to date), as well as the Rapid Reaction teams and the Minuteman initiative which involved the proactive patrolling of busy sections of the network to quickly recover broken down vehicles (Brown et al. 2003; Highways Agency 2002).

In 2002, the Highways Agency and the Motorists Forum commissioned the Incident Management Study (Highways Agency 2002) to investigate the challenges

⁶ Launched in 1992 (Quinn 1997).

⁷ Stage 1 was operational in October 1996 and stage 2 by November 1998.

facing multi-agency management of major incidents. One particular concern related to incident clearance times and the detrimental impact long delays were having on traffic in the area surrounding the incident. While traffic management is declared as an already existing priority to the organisations featured in the study, the study actually reveals that it “does not necessarily receive as much early thought as it might do” (Highways Agency 2002, unpaginated). It suggested that the effective implementation of traffic management suffered because there was not an organisation primarily responsible for it. At the time it was the police that held responsibility for traffic management, but it was one responsibility among others, and it simply did not take precedence over other kinds of duties at the scene of the incident. The most obvious examples of this are incidents involving serious or fatal injury and/or alleged offending.

The exact details of how the Highways Agency would be organised to undertake traffic management and what specific tasks it would perform were underdeveloped at this stage, somewhat understandably so. As a result of this, a consultation was commissioned to seriously consider the feasibility of transferring some of the ancillary functions of policing the motorway to a new ‘Traffic Operations Service’ within the Highways Agency. This led to the publication of the *Roles and Responsibilities Review* (Brown et al. 2003). The Review made a series of recommendations in support of the realignment of responsibilities from the police to the Highways Agency; however, it is expressed in terms of the benefits it would bring operational policing, rather than traffic management. Given that much of motorway policing at the time was about emphasising safety, providing assistance,

detering careless driving and attending emergencies, rather than it being solely focused on catching lawbreakers (Ackroyd et al. 1992), the *Review* found it reasonable to suggest that these responsibilities could be effectively transferred to uniformed civilians. The *Review* was written at a time when the allocation of resources to motorway policing was unlikely to be increased, despite predictions that increased traffic volumes would lead to increased congestion and traffic accidents.⁸ If ancillary duties could be shared with the Highways Agency through a network of traffic control centres and with uniformed civilians performing the work, it would relieve the work burden on police and enable them to focus on crime prevention and detection.⁹ By 2004, the Highways Agency's role was recognised as a category two responder in the *Civil Contingencies Act 2004* and given additional emergency planning responsibilities.¹⁰

At the same time the consultation was carried out, the Highways Agency continued to undertake its ATM trials. The availability of new technologies, along with the development of a dedicated operational division trained to deal with real time traffic management techniques, made those trials possible. The phased operation of its Managed Motorways pilot on the M42, between junctions 3A and 7, began in January 2005. Using similar technology to controlled motorways, managed motorways opens the hard shoulder as a live running lane during peak congestion times or capacity-reducing traffic incidents (DfT 2003). It is made

⁸ Brown et al. (2003:3) state that during the years 1997 to 2001, there was a 12% increase in traffic volumes on the strategic road network and at the same time the number of police officers assigned to road policing fell by 12%.

⁹ This civilisation of police functions is also found in the white paper *Policing a New Century* (Home Office 2001), which recognises the time pressures faced by the police and alternative ways to increase capacity.

¹⁰ Managed by its Network Resilience Team, which coordinates the work of regional emergency planning teams.

possible with extensive technology installation at the roadside, which includes continuous CCTV coverage along the operational stretch of motorway, inductive loops to monitor traffic flow, additional lane-specific advanced motorway indicators (AMI) to display mandatory speed limits, the Highways Agency Digital Enforcement Camera System (HADECS) – a radar-based speed detection system mounted on overhead gantries to detect non-complying vehicles, emergency refuge areas (ERAs) to stop safely in an emergency and full motorway lighting to improve visibility. Control room operators work with a Semi Automatic Control System (SCS) to go through comprehensive safety checks before opening the hard shoulder link. The pilot study on the M42 was fully operational by September 2006. It produced favourable results – with reduced congestion, improved journey time predictability and increased motorway capacity at peak times – although average journey times increased slightly, which is attributable to the lower mandatory speed limit when in operation (DfT 2008a, DfT 2008b). To date, Managed Motorway schemes are operating on the M6 from junction 4 to 5 and M6 from junction 8 to 10A and one is currently under construction on the M1 from junction 10 to 13.¹¹

1.3.2. The Launch of the Traffic Officer Service

“It’s what we do, day in day out. We answer emergency calls, we dispatch crews, we set signs, and we tell people what’s going on.” (Paul, West Midlands RCC)

The TOS was officially launched in 2004 as the operational division of the Highways Agency. The TOS is responsible for network operation broadly comprising real time incident management, infrastructural maintenance and traffic information

¹¹ Scheduled to be completed by spring 2013.

dissemination. It has a network of seven RCCs – Quinton in the West Midlands, Godstone in South East England, Newton-le-Willows in North West England, Calder Park in North East England, South Mimms in East England, Avonmouth in South West England and Nottingham in the East Midlands.¹² Each RCC is responsible for the management of its region's strategic road network, although it only performs real time incident and traffic management duties on the motorways. The TOS currently has a workforce of over 1,500 individuals dealing with an average of 870 incidents per day on the motorway network (Highways Agency 2010b). The Highways Agency takes the role of lead responder in all incidents where there is no injury or alleged offence, with the primary aim of managing traffic and congestion with the implementation of real time traffic management (by traffic officers at the scene of the incident or by traffic operators setting signs and signals) and the clearance of incidents.

This work is coordinated from the motorway control room in each RCC. It operates 24 hours a day, organised around the shift patterns of its teams of traffic operators, who work in the control room itself, and on-road traffic officers, otherwise known as HATOs, who patrol the motorway network. In the motorway control room, operators deal with reports of disruption as they are received from members of the public using ERTs,¹³ the emergency services and on-road contractors. Operators also monitor traffic flow alerts generated by the MIDAS

¹² The phased opening of the seven Regional Control Centres: Quinton, West Midlands, Junction 3 of the M5, opened April 2004; Godstone, South East, Junction 6 of the M25, opened August 2005; Newton-le-Willows, North West, Junction 22 to 23 of the M6, opened September 2005; Calder Park, North East, Junction 39 of the M1, opened September 2005; South Mimms, East of England, Junction 23 of the M25, opened October 2005; Avonmouth, South West, Junction 18 of the M5, opened December 2005; and finally Nottingham, East Midlands, Junction 26 of the M1, opened February 2006.

¹³ The TOS does however answer all ERTs, including those located on the trunk road network.

system and use a network of CCTV cameras to actively search for incidents, corroborate existing incident reports and monitor current incidents and traffic flow. It is important to note that the geographical coverage of these technologies is not uniform throughout the network – investment is targeted in areas that are demonstrably prone to congestion or disruptive events. In the event of a disruption on the network, the operators must coordinate an appropriate response to both clear any visible obstruction to traffic and mitigate its effects. From the control room, this largely involves the implementation of real time traffic management and congestion management via sign and signal setting. The motorway is equipped with a range of carriageway and slip road signals, gantry (and lane-specific) signals and VMS. Matrix signals can be set by operators to show speed restrictions, lane closures, lane and motorway diversions, fog warnings and stop aspects. VMS can display legends for motorists to read; they vary in size and what messages they can communicate.¹⁴ The choice of whether to set signs and signals, and which ones to set, is not an arbitrary matter; operators must adhere to the rules set out in the VMS policy document, as jointly stated by the Association of Chief Police Officers (ACPO) and the Highways Agency (ACPO and the Highways Agency 2002, 2007).

In addition, operators work closely with mobile HATO patrols. The fleet of patrol vehicles is distinguishable by its yellow and black livery and flashing red and amber lights. They work from dedicated operational bases located across the motorway network, usually at motorway compounds, and they are known as outstations. There are currently 29 outstations in use (Highways Agency 2012b).

¹⁴ For example, Motorway Signal Mark 2 (MS2) consists of 2 lines of 12 characters as well as a matrix signal. MS3 consists of 3 lines of 18 characters or 3 lines of 14 characters with a matrix indicator. MS4 is a dual colour matrix sign that can display a message, signal aspect and a relevant pictogram.

The HATO patrols divide their time between actively monitoring the motorway according to their assigned patrol route and responding to dispatch requests from control room operators to attend incidents. Under the *Traffic Management Act 2004*, they have legal powers to stop traffic, close lanes and carriageways, direct and divert traffic, place temporary signage, remove debris and remove vehicles from the carriageway or off the motorway. The police retain responsibility at incidents involving serious or fatal injuries and at incidents related to criminal activity. In 2008, the TOS was granted statutory powers to remove vehicles that have been abandoned, broken down or otherwise damaged on the road network.¹⁵ This was passed in the *Removal and Disposal of Vehicles (Traffic Officers) (England) Regulations 2008*.¹⁶ This work was traditionally undertaken by the police. HATOs are limited by what traffic management they can offer at the scene given the limited carrying capacity of their vehicles to transport traffic cones and hard signage, so they can request additional support from the region's Service Providers in operational matters. One of the Service Providers' main responsibilities is the provision of ISUs to assist with traffic management, incident clearance duties and emergency infrastructure repairs. ISUs also perform routine network maintenance, such as litter picking, and repairing defects like potholes.

Distinct from the real time, incident management work of the RCC, but nonetheless inextricably linked to it, is the work of the National Traffic Control

¹⁵ A vehicle can be removed from the motorway network in any case where the vehicle owner is not present (after 2 hours of initial vehicle detection) or otherwise does not have the means to arrange recovery.

¹⁶ This is supported by the National Vehicle Recovery Project which was established by the Highways Agency to assist in the acquisition of statutory powers and the development and delivery of contractual obligations related to vehicle recovery. The contract was subsequently awarded to FMG Support and it went live in July 2009.

Centre (NTCC). The NTCC began operating in November 2003, based in Quinton, Birmingham, and officially opened in March 2006. It followed a £160 million private finance initiative whereby Traffic Information Services (TiS), a subsidiary of Serco Integrated Transport, took responsibility for contract delivery.¹⁷ The NTCC is a key component in the Highways Agency's strategic role to deliver real time traffic information across the entire motorway and trunk road network (Highways Agency 2010a). To do this the NTCC collates confirmed incident and event reports from wide-ranging sources and stakeholders, including motorway control room operators in the RCCs, local highway authorities, emergency services, the Met Office, hauliers, ports and airports, leisure and entertainment venues, and local media. This is combined with traffic flow information from congestion monitoring which is generated by the NTCC's own network of solar-powered traffic monitoring units (TMUs), MIDAS and vehicle tracking enabled by automatic number plate recognition (ANPR) cameras. NTCC operators can also check CCTV feeds to monitor traffic flow. Once the information has been verified, it is disseminated to the public, the media and commercial stakeholders in order to ensure that road users are informed of current traffic conditions. This is achieved through a number of communication mechanisms, including the Highways Agency's Traffic England website and interactive traffic information points located in service stations (known as Highways Agency Information Points (HAIP)) to reach the travelling public and it

¹⁷ The ten-year contract ended in August 2011 and has since been awarded to a new service provider, Network Information Services (NIS); a joint venture between Mouchel and Thales UK. NIS has now taken over the seven-year contract, worth £57 million, to deliver the National Traffic Information Service (NTIS) on behalf of the Highways Agency. The NTCC is now known as the National Traffic Operations Centre (NTOC).

is also sent electronically to a database of registered stakeholders and partners.¹⁸

NTCC operators also have authority to set strategic (network-wide) signage to inform motorists of major incidents, abnormal congestion, upcoming events and diversions, as well as safety campaign messages.

1.4. Outline of the Chapters

All together, the professional transport spaces of the motorway control room and patrol vehicle, the practices of incident detection, traffic management and traffic information dissemination and the collaborative work of traffic operators and technology are expected to produce traffic flow that is reliable, journey times that are predictable and roads that are safer. Chapter 2 begins by investigating the theoretical traditions of transport geography and the new mobilities paradigm to suggest reasons for their systematic neglect of questions that address how movement is practically accomplished, ordered and organised in locally constituted ways. It considers why transport geography and its traditional alignment with professional transportation research has meant that movement is treated as an empirically mappable and measurable phenomenon, abstracted into transport models and traffic forecasts for the purpose of finding solutions for them (Levinson 2003). This approach works to erase any indication of traffic as unpredictable, unmanageable, uncertain or ambiguous, even if this reflects the real-world experience of incident management. In terms of mobilities research, this chapter considers how the broader theoretical project of mobility in the social sciences obscures the value of empirically real movements (Frello 2008; Urry 2000).

¹⁸ During the fieldwork period, traffic information was also disseminated via the Highways Agency's digital radio channel, Traffic Radio. It ceased broadcasting in August 2011.

This is despite one of its main arguments forming a critique of the way in which social science has treated transport as a set of neutral infrastructures, technology and procedures that permit the movement of people without asking how these movements actually take place. This chapter will then consider the consequences of this for the treatment of technology in transport. It is argued that transport technology is routinely left to intelligent transport systems (ITS) research which presents technology as providing relatively fixed solutions to universal transport problems. This means that they tend not to value studies of how transport technology is used in situated ways.

In response, Chapter 3 investigates the suitability of an alternative way of understanding movement that frames it as a problem of practical accomplishment firmly in a transport context. To do this, it develops the concept of the network, which has long been at the heart of both transport geography as a topological metaphor and, more recently, a prominent concept metaphor in the broader social sciences from its engagement with poststructuralist thinking (J. Law 1992, 1999; Law and Mol 1994, 2001; Law and Urry 2004). This draws on actor network theory since it shares with transport geography the study of networks as topological spatial arrangements but builds on its approach by reaffirming the importance of both people and technology in the precarious ordering of heterogeneously rich networks. This chapter is interested in how a networked topology is capable of capturing the complex ways in which information and communications technology (ICT) can draw near spaces that are physically distant and transform temporal understandings of now and next for the prevention and mitigation of the effects of

disruption on traffic. Moving on, the chapter then considers how the concept of the network can be used to reveal the ordering practices of the empirical setting. To help with this, it draws on a number of detailed empirical studies collectively known as centre of coordination studies, originating in the field of computer supported cooperative work (CSCW) (Suchman 1993, 1995). They share with actor network theory a primary interest in how networks maintain their own stability through the local relations they keep, while also committing to ethnomethodology as the study of members' methods as they occur in situated ways to help respecify theories and concepts that have become black boxed. Chapter 4 discusses how ethnomethodology has influenced this thesis, most notably through the frame of practical accomplishment and its core principles of work, indexicality, and reflexivity. It details how ethnomethodology helps to reveal the methods participants use in the practice of creating mutually intelligible orders and why this is important for the study of transport. The chapter then reflects on the practical challenges that were experienced when conducting ethnomethodological observations in the motorway control room, including the difficulty of being a non-expert in a professional setting and how this was managed.

The three empirically-based chapters that follow are oriented around the themes of detecting disruption, diagnosing incidents and rendering incidents available to coordinate incident management work. Chapter 5 deals directly with the paradox at the heart of centres of coordination, which is concerned with how a workplace setting, like the control room, exercises its management responsibilities over a spatially distributed network. The chapter begins by suggesting that the

tendency to understand those settings as primarily coordinative has the potential to eclipse all other activities that are part of the control room's ability to coordinate human activity in the first place. This refers specifically to the work of detection; the work that identifies potential disruptions for the purpose of bringing about a coordinated management response, without which this coordinative work would not happen. In the motorway control room, the character of this is distinctly sociotechnical; operators would not be able to detect disruption over spatial distances and render action at-a-distance without working with telephones, radios, traffic monitoring equipment, CCTV and the like. By reframing this work as collaborative to include both people and technology, the chapter argues that the work of incident management is irreducible to the individual operator or technology. It focuses on the collaborations between traffic operators, MIDAS alerts and CCTV to render the mutual dependencies between social and technical elements visible in the work of detecting disruption over spatial distances. It shows how an account sensitive to the contributions of both people and technology, without privileging the position of one over the other, offers a valuable alternative to those studies in transport geography and new mobilities research that routinely depend on their separation.

Chapter 6 is oriented to the ethnomethodological problem of 'what next?', that is, how do members of a setting make sense of what is currently going on for the purpose of deciding what an appropriate next response would be. This is explored through the work of diagnosing incidents in the motorway control room. This comes at the boundary between detecting disruption, as discussed in Chapter

5, and the enrolment of an incident management response once the disruption has been diagnosed as an incident. To name an incident means that the control room commits to managing it, so operators are understandably cautious about doing this given the substantive uncertainty that surrounds many incident reports and the limited resources at their disposal to simultaneously manage multiple incidents. This chapter is particularly interested in those occasions when the decision to diagnose an incident is further complicated by shifting parameters that define what to do about certain disruptions depending on their local circumstances. This procedural ambiguity is considered through the example of congestion, which is notoriously difficult to diagnose, since it can vary from routine peak hour traffic, slow-moving and stop-start traffic to stationary traffic depending on what measure is used to define it. This chapter considers the ways in which operators visibly draw on a background of normative expectancies in locally relevant ways to make sense of their work trajectories. This helps them to deal with the shifting parameters of action in the control room setting, which are still open to interpretation given their context-sensitivity, and often involve discussion, debate and negotiation between operators to come to a mutually intelligible account of what to do next.

Chapter 7 explores the doubly-situated character of motorway incident management that emerges and extends across multiple spaces and times. This offers an alternative way of thinking about how control room settings work that surpasses the tendency of centre of coordination studies being organised into two categories – those that focus on the coordination of activity between co-located participants in the control room itself, say between call handlers and dispatchers,

and those that attend to the relations between control room personnel and individuals physically located outside the control room. This separation is unhelpful because it misses how the two – the ‘inside’ and ‘outside’ – mix in complexly situated ways. Building on the work of detecting and diagnosing incidents as discussed in the previous two chapters, Chapter 7 analyses what happens next as an operator constructs an incident log. Here the two worlds combine – the maintenance of a local order between colleagues as they participate in delegated yet coordinated incident management work is dependent on and constantly open to reconfiguration by the substantive matter of what is happening on the motorway network – and the management of traffic depends on a mutual understanding of the incident by operators in the control room, which is based on their background of expectancies and orientation to the procedural objectives of its organisation. Taking place at the screen of the incident log, this chapter draws on a number of empirical cases that reveal how operators make sense simultaneously of what is happening on the motorway network and how control room colleagues interpret the incident log to bring about incident management responses that are appropriate and expected. The work of classifying, grading, prioritising and locating the incident when creating the incident log are of particular importance, showing how different types of activity – detecting, diagnosing, and coordinating – across different spaces and times – are contingently managed.

The final chapter draws together the work of motorway incident management, the spaces of the control room and the collaborative practices between operators and technology to summarise the ways in which an

understanding of movement as a practical accomplishment makes a significant contribution to both transport geography and mobilities research. It begins by reflecting on the frame of practical accomplishment and discusses the differences between actor network theory and ethnomethodology that make practical accomplishment a fitting frame for this research. It then moves on to consider the contribution the thesis makes to transport research specifically, including how it helps to break with traditional theories of movement and enter professional transport spaces to observe practices that have been otherwise neglected. It also considers how the motorway control room as a specific kind of control room can offer crucial insights into how control rooms work. This includes the collaborative nature of its work and how it deals with local circumstances of uncertainty in doubly-situated ways. Finally, the chapter points towards the opportunity for further study in both transport research and the motorways.

Chapter 2

Problematizing Movement

2.1. The View from Transport Geography and Mobilities Research

As outlined in the previous chapter, one of the main motivations for this research is to explore the possibility of an alternative frame for movement as a problem of practical accomplishment. This recognises that the very physical act of moving from one place to another is not something which is simply given or expected to occur automatically in an ordered manner. We know this from a number of empirically-rich and ethnomethodologically-informed studies that reveal the most commonplace of everyday movements, including walking, running, driving and playing sport, to be intensely situated accomplishments of social order (Allen-Collinson 2008; Coates 1999; Hester and Francis 2003; Laurier and Philo 2003; Laurier et al. 2008; Lynch 1993; Garfinkel 2002; Ryave and Schenkein 1974). These activities may not be obvious to us as being constitutive of work but they are shown to require their participants to exert real effort so that they are produced and maintained as recognisable, orderly social practices (Sacks 1992). However, the principle ways of theorising movement in a transport context in geography and the social sciences more broadly are insensitive to questions of how movement is produced, maintained and ordered. This then leads to a further neglect of those empirical settings from which movement is produced and managed. For the purposes of this thesis, this includes the professional spaces and practices of active traffic management.

The work of transport geography in particular warrants discussion here. In its pursuit of membership within the transport research arena, transport geography has largely aligned itself with a series of different professional frames that construct it as an engineering, economic or management problem for which solutions are sought (Levinson 2003). Its movements are available as empirically mappable and measurable physical flows of people and goods, which are abstracted into transport models and traffic forecasts and optimised by infrastructure building, the application of technical solutions, traffic management techniques and policy appraisals. Despite the increasing pervasiveness of real time traffic management across the transport modes and over the years (Danforth 1970), it is surprising that the actual situated practices that constitute this work are systematically missing from sustained analysis in the professional literature. They receive only the most cursory of glances in favour of abstract models and technical toolkits to traffic problems. In turn, within the social sciences, there has been a relatively recent trend towards mobility studies as a central part of the self-proclaimed multidisciplinary 'new mobilities paradigm' (Hannam et al. 2006; Sheller and Urry 2006). Interestingly, the new mobilities paradigm depends on a critique of transport research and its narrow treatment of movement as the physical transport of people and goods (Cresswell 2006; Sheller and Urry 2006). It emphasises how movement should be studied for movement's sake, recasting it within the broader theoretical project of mobility as a primary lens through which all facets of human life is experienced. However, only a small number of studies actually take seriously the topic of movement as a product of its own organisation. These studies encompass the inside of the automobile, mobility practices at the roadside and the

activities of driving along the highway and managing information in the traffic control centre to effectively show how the ordinary spaces and practices of automobility can be respecified as topics worthy of study in their own right, rather than taking their order for granted in the first place (Esbjörnsson and Juhlin 2002; Juhlin and Normark 2008; Laurier and Philo 2003; Laurier et al. 2008; Normark 2006; Weilenmann 2003).

The discussion that follows focuses on the selected theories of movement offered by transport geography and the new mobilities paradigm to provide a point of departure for this research. First, this chapter will look more closely at the treatment of movement in transport geography. It should come as no surprise that the way in which transport geography has treated movement is of critical importance to this research given that it is principally concerned with transportation networks such as the roads and motorways. This chapter contends, however, that transport geography maintains a narrow conception of the arrangement and movement of passengers and freight over geographical space and considers why transport geography continues to take this approach. Second, this chapter explores the ways in which movement has been reconceptualised as part of the trend towards mobility studies by teasing out the tendency to make assumptions about the nature of movement and its ontological status as a lens on human experience. In response, this chapter argues that it is not a matter of asking what movement really is, in terms of its essence, or how we know it exists, but it is a case of attending to movement as a situated and practical accomplishment. After all, if we talk about movement mainly as an essential quality of human existence, or

wholly in terms of its empirical attributes, then we run the risk of uncritically accepting its organisation as pre-existing the production of everyday settings and experiences. It makes sense therefore to think about movement as a problem of practical accomplishment to highlight the various ways in which it is actively produced, shaped and regulated in real time to preserve its efficiency and safety.

2.2. “Life on the Road”: Geography and Transport

Perhaps the most obvious and often cited expression of movement that geography has to offer is transport geography (Haggett and Chorley 1969; Hoyle and Knowles 1992; Keeling 2007, 2008, 2009; Rodrigue et al. 2006). Over time, it has been influenced by a diverse range of perspectives, including civil engineering, economics, mathematics and policy and planning, so it is useful to provide a short historical narrative of transport geography to situate its treatment of movement to date. Traditionally within geography, transport is used to refer to the physical movement of passengers and freight over space. In particular, transport geographers are interested in how these movements are mapped onto transport networks, its structures and intersections and how they are iteratively developed in relation to patterns of both economic and social forms of land use. In this context, it deals with the demand for movement as it exists from passengers and freight and the constraints on movement produced by the problems of accessibility, mobility and environmental equity. This also constitutes the practical issue of how to move things from place to place as safely and efficiently as possible and how transport networks can be optimised to handle these movements due to the very simple fact that “people and goods have to get places” (Shaw, Knowles and Docherty 2008:4).

This helps to position transport geography firmly in the professional transportation arena.

Transport geography emerged as a sub-discipline as early as the 1950s in the tradition of the spatial sciences. To be taken seriously as a legitimate scientific programme, transport geographers took it upon themselves to present their research within the parameters of objective science. This meant that transport geographers sought to explain the interaction between transport and various aspects of economic and social life, such as the location of industry and housing, through the application of scientific principles and methods. This was further supported and maintained by the so-called quantitative revolution of the 1960s which championed the use of statistical techniques to measure and predict the patterns it observed (Hall et al. 2006). A lot of this knowledge was presented in the form of abstract theories and models of spatial interaction resulting in the production of generalisable laws that could be replicated irrespective of context. These models certainly had influence in the field of transport planning (Rodrigue et al. 2006). The gravity model, for example, which investigates the relation between two locations (typically the home and the workplace) in terms of trip generation, was used to infer how transport demand is shaped by time, distance and economic cost. The presentation of findings in abstract and aggregated terms cannot capture the heterogeneity of actual lived experience of transport and consequently transport geographers were increasingly criticised as lacking a critical current to their work which led to the neglect of social and political elements in the study of transportation systems (Goetz et al. 2003).

From the 1960s onwards, economic geographers became increasingly intertwined with the endeavours of transport geography to help better understand how to optimise movement to feed into professional transportation research and policy appraisal (Bruzelius 1979; Haggett and Chorley 1969; Stubbs, Tyson and Dalvi 1980; Taaffe and Gauthier 1973; White and Senior 1983). Looking at road movements in particular, they are framed as an economic problem, based on the assumption that the economy generates the need for the movement, as commuters make their way to work, as flows of people go in search of commodities or services and as goods move about in the production and supply chains of commerce. The transport network is considered “an expression of a need to link supply and demand; they are the manifestation of people’s desire to access goods, services and each other” (Shaw, Knowles and Docherty 2008:4). The compulsion to move is an inevitable one, driven by economic activities, and all travellers are treated as rational decision makers whose movements are logically made in order to reduce cost and maximise benefit (Bruzelius 1979; Rimmer 1988; Stubbs, Tyson and Dalvi 1980). This means that it is possible to measure and predict traveller movements based on the assumption that they are constantly seeking out more time-efficient and low-cost ways to move to overcome the friction of distance. These movements are rendered calculable as a ‘derived demand’ – measured by a society’s level of income and rate of economic activity – and then treated “like any other good” (Preston 2001:13). These calculations can then be used to evaluate the cost benefits of proposed infrastructural building schemes, the application of technical solutions and traffic management techniques, which are then fed into the

policies of transport planners. The empirically measurable flows of people and objects then become the key object of its study.

This strong emphasis in professional transportation research comes to shape how movement is conceptualised within transport geography and which movements are deemed legitimate for analysis. One issue with economic appraisals of transport is that its rule-based approach massively underestimates the richness of transport practices and its spaces. The reasons why people move go unquestioned and analysis defaults to an economic appraisal of the utility of transport. As Taaffe and Gauthier (1973:159, original emphasis) explain, the work of the transport geographer is “not so much to determine *why* a particular pattern exists, but to determine what the best possible, or *optimal*, pattern would be according to some stated criteria.” Questions about why movements take the form they do are not asked; this is taken for granted. If we recall Shaw et al. (2008:4) cited above, this is because transport geography accepts that “people and goods *have to get places*” (my emphasis). In this traditional view, the possibility of travelling for travel’s sake is not considered and questions about how people make transport decisions as part of their daily lives, and what they actually do while they are on the move, are eliminated from analysis. The “motorists who simply drive into the country, passengers on cruise liners and ‘railfans’” are described as “the exception” and they are promptly disregarded as interesting phenomena to study (White and Senior 1983:1). This in fact forms the basis of one of the main criticisms that the new mobilities paradigm has of transport geography – that is, transport movements are treated as the physically apparent ‘brute fact’ of human existence

and symptomatic of the modern times we live in (Cresswell 2006), which is “a result of thinking of movement as a cost and as dead time” (Cresswell and Merriman 2011:4). So despite the obvious interest that transport economists have in travel time, their accounts are thoroughly detached from a real time, lived temporality. The consequence of this is that detailed understandings of the daily experiences of transport by people as they move about, schedule and coordinate their activities and deal with the situated practicalities of issues such as accessibility and equity are not addressed. It is the study of transportation as product and not the activities that constitute it, whether these comprise the daily transport movements and experiences of people on the move or the ongoing processes and practices of operational management that maintain it.

The traditional, rather narrow conception of movement that marks the early years of transport geography did not go unnoticed by geographers. As Røe (2000) points out, there were attempts as early as the mid 1970s to challenge the insularity of the discipline’s subject matter. Feminist geography, for example, began at this time to question the dominance of a masculinist perspective in studies of transport through their rejection of the “‘neuter commuter’ assumption” (R. Law 1999:569) by incorporating sociological concepts into its analysis. This led to ‘women and transport’ studies and later ‘gender and transport’ studies in the 1980s and 1990s. One striking consequence of this pluralism in transport geography was the broadening of a number of key concepts which had so far only been used in an explicit spatial or economic sense in conjunction with quantitative methods. For instance, accessibility, equity and safety were increasingly understood in terms of

their social and political significance and seen through the various analytical lenses of gender, race, age, and social and environmental justice (Hine 1996, 2008; R. Law 2002; Preston and Rajé 2007; Rajé 2007; Røe 2000). Hanson's (2003) observation that transport geography had been 'hooked on speed' works well to illustrate its preoccupation with satisfying transport demand for economic gain (by maximising both the speed and the capacity of the transport network to facilitate travel, especially those over long distances with direct and uninterrupted movement) at the expense of understanding how it is intertwined with the reality of daily life. Hanson goes on to comment that "the obsession with speed of movement is the main reason that transportation has tended to be thought of in terms of technology and infrastructure – roads, bridges, buses, trains – rather than in more general terms as an enabling and constraining facet of life, a source of pleasure and exasperation, power and control" (Hanson 2003, unpaginated). The reality that some people experience social and political barriers to movement is routinely overlooked in this narrative of speed and frictionless movement that comes to dominate transport geography; as Hanson (1998) puts it, transport geography has been preoccupied with life 'on the road' at the expense of the lived realities of transport 'off the road.' Such critical accounts of transport tend to emphasise the concept of *mobility*, instead of movement, in order to reframe the issue of movement within political debate. In this context, mobility is considered to represent more than the purely spatial accessibility concerns of civil engineers and planners of early transport geography; instead, it strives to capture the lived temporality of daily mobility needs which are embedded in both the social and political geographies of the everyday. When juxtaposed with traditional transport

research, it shows it to be fixated with the actual journeys facilitated by the transport network, valued for their contribution to economic life and undervalued in terms of their embeddedness in daily life. This means that the opportunities, barriers and constraints to movement, an individual's mobility needs, the work of scheduling and coordinating daily activities around travel and the management of travel time and disruption tend not to be addressed in traditional studies (Bissell 2007, 2009a, 2009b, 2010; Jain and Lyons 2008; Schwanen 2006; Watts 2008; Watts and Urry 2008).

2.2.1. Transport and Technology

The role of ICTs in modern society has captured the interest of many scholars concerned with shifting time-space relations and the effects of ICTs on the spatial and temporal constraints of territorial boundaries and physical distances (Castells 2000). This is evident in the literature on transport and a number of critical transport studies have engaged in the issue of ICTs in the context of spatial interaction and mobility (Banister 2002; Banister and Stead 2004; Jain and Lyons 2008; Janelle 2004; Kwan 2006; Larsen et al. 2006; Schwanen et al. 2006; Schwanen and Kwan 2008; Wagner et al. 2003). Two main approaches to ICTs in transport exist in the literature. The first focuses on the study of ICTs in personal mobility and its effects on the organisation of daily mobility activities. This comprises "the impacts of ICT *on* transport" (Banister and Stead 2004:613), including how ICTs have impacted upon spatial interaction patterns, transport demand and individual travel behaviour, rather than their detailing their use *in* transport operations. The second is concerned with the application of ICT innovations to develop new and

enhance existing approaches to transport and traffic management. These studies are more closely aligned to the traditional concerns of the engineering and managerial perspectives in transport that seek to optimise the capacity, efficiency and safety of transport networks.

In terms of personal mobility, these studies reflect an interest in ICTs and their potential to change the spatial and temporal arrangement of human activities taking place in geography more broadly, which has been applied to the context of transport (Kwan 2002, 2006). In particular, transport geographers have studied the changing dynamics of production, logistics and freight distribution, e-commerce, teleshopping and teleworking in relation to ICT use and transport (Banister and Stead 2004; Rotem-Mindali and Salomon 2007; Wagner et al. 2003). This reflects an understanding that ICTs “reduce, if not subvert, the usual constraints based on distance, spatial contiguity and temporal continuity,” making it of particular interest to transport geographers who remain concerned with the interdependency of transport and the spatio-temporal arrangements of economic activities (Janelle and Gillespie 2004:666). There are typically three categories of analysis that organise ICT use according to their substitutive, generative and modifying effects. Some early studies are characterised by a naive claim that ICTs constitute a simple “substitution of electronic transfers and exchanges for physical transport activities” (Janelle 2004:86) and that the uptake and use of ICTs can occur unproblematically (Geels and Smit 2000). While some uses of ICTs have been shown to replace practices of co-presence previously enabled by transport, the extent to which they have been adopted has not lived up to the exaggerated claims about a paradigmatic

shift to a future led by virtual mobility; instead they often co-exist with previous forms of practice (Haynes 2010). Other studies have focused on the ways in which ICTs have stimulated the gradual emergence of 'complimentary' practices of physical travel (Mokhtarian 2003; Saffo 1993). Haynes (2010), for example, demonstrates that new international business developed through the use of the internet, telephone and email communications actually creates the need to meet clients and partners face-to-face which would not have taken place without ICT use. It is argued that business travel is not done for the sole purpose of conducting meetings, but it is integral to the work of building relationships and showing commitment to new clients that have so far only been supported by technologically-mediated communication. In this sense, physical travel takes on a new significance in relation to other forms of communication enabled by ICTs. To fully understand what these new significances are, studies have embraced empirical case studies to provide examples of actual use.

This has led some researchers to highlight the interdependencies that exist between physical and virtual mobility that result in modification or change to existing practices, rather than the generation of entirely new practices of travel or substituting old for new. Their interest lies in the less obvious and less direct effects of ICTs on daily mobility that emerge gradually over time and often in unanticipated ways (Line et al. 2011). Many of these studies adopt qualitative interviewing and diary methods to provide an insight into the lived temporalities and spatial practices of ICT use. For some, this creates 'hybrid' mobility spaces and practices that transcend the physical and virtual divide, showing how ICTs have

become indispensable to the ways in which we move through and dwell in the physical world (Barton 2011; Frissen 2000; Frith 2012; Haynes 2010; Larsen et al. 2006). In some cases, this hybridity may actually increase the spatial and temporal flexibility of personal travel and thus the opportunities for trip-making, or provide the conditions for different social practices of mobility to be produced (Black 2001, Jain 2006; Kenyon and Lyons 2007; Kwan 2002, 2006; Line et al. 2011; Schwanen et al. 2006; Schwanen and Kwan 2008). This has also been discussed in terms of the opportunities it provides to address issues of social exclusion in transport at a policy level (Keynon et al. 2002; Lyons 2003). While travel demand remains a primary focus, these studies increasingly draw on empirical material to challenge traditional transport concepts and modelling techniques for their detachment from actual personal mobility experiences. This is afforded by the reconsideration of the increasingly spatial and temporal flexibility afforded by the use of ICTs in relation to travel and thus how they bring about changes in what constitutes travel and what happens on a journey. This enables researchers to question the efficacy of existing transport approaches for their ability to account for this resulting complexity in travel behaviour, mode choice, trip frequency and the utility of travel time, which were previously accepted as straightforward categories available for analysis (Jain and Lyons 2008; Lyons and Urry 2005; Lyons, Jain and Holley 2007; Mokhtarian and Salomon 2001).

The second approach comprises the study of the application of ICTs as solutions to the entrenched transport problems of safety, congestion, journey time reliability and vehicle emissions in response to the growing need to make more

efficient use of existing road infrastructure (Branscomb and Keller 1996; Chowdhury and Sadek 2003; Giannopoulos and Gillespie 1993; Hepworth and Ducatel 1992; McQueen, Schuman and Chen 2002; Miles and Chen 2002; Stern et al. 1996). This is the study of ICTs and their use *in* transport. Research into the role of ICTs in transport operations and traffic management and its theoretical modelling, real-world trialling and subsequent implementation has been in existence as early as the 1960s with developments in the United States (Fenton 1980; Roth 1977) and later in Europe with the DRIVE (Dedicated Road Infrastructures for Vehicle safety in Europe) and Promentheus research projects (see Hepworth and Ducatel 1992; Giannopoulos 2004). These developments are not restricted to road transport – Fenton (1980) claims the first use of automatic vehicle identification technology was by the Association of American Railroads to track rolling stock in the mid 1960s. This research fed into the areas of transport telematics and road transport informatics (RTI) which are more commonly known as intelligent transport systems (ITS) today, broadly defined as a toolkit of techniques and solutions that constitute “the integrated application of communications, control and processing technologies to the transportation system” to “save lives, money, energy and the environment” (Miles and Chen 2004:2).

The early 1990s coincided with rapid technological innovation in telecommunications and computing more broadly which helped to make available a set of feasible and increasingly affordable technical solutions proven to address common transport problems (Hepworth and Ducatel 1992; Giannopoulos and Gillespie 1993). As introduced in Chapter 1, this occurred at a time when the

prevailing demand-led approach in transport policy was falling out of favour as analysts began to gradually disentangle the relationship between the provision of roads and economic growth. The 'predict and provide' principle could not satisfy the difference between infrastructural capacity and transport demand (Owens 1995; Goodwin et al. 1991; Shaw and Docherty 2008) so a shift to demand-management to improve safety and journey reliability, reduce congestion and address environmental sustainability issues was supported by the new realism perspective. This is what Shaw et al. (2008) call the 'crisis of mobility' – the panic surrounding the predicted growth of the volume of automobile traffic in the United Kingdom, for example, is well documented during the 1990s (see Banister 2002). The developments in ICTs provided the possibility of applying new techniques to manage demand and to make efficient use of existing capacity. As it was the case for the Highways Agency, road building was not a realistic solution to the transport problems it faced, so attention shifted to the practice of "improvement management" (DETR 1998b:12) in order to 'make the best use' of already existing infrastructural capacity to facilitate movement (Button and Hensher 2001; Parkhurst and Dudley 2008; Quinn 1997).

The application of ICTs encompasses a number of analytically distinguishable approaches, albeit they are often found in combination as ITS toolkits to solve those transport problems listed above. First, ICTs are used to develop new solutions to bring about key changes in how transport networks are operated. In road transport, this includes electronic payments and road pricing (for congestion charging or toll roads, for example, to manage demand), commercial

vehicle operations (for real time fleet tracking and management) and in-vehicle control and driver assistance (for improved vehicle safety). These solutions would not exist without advances in technology development. Second, ICTs are used to enhance existing transport infrastructural capacity by making modifications to infrastructures enabled by the application of technologies and applying traffic control technologies and ATM techniques (which can be automated) to cope with real time demand. In England, the work of the Highways Agency has encompassed the commissioning of a number of capacity enhancement schemes such as managed motorways, through-junction-running (TJR) and controlled motorways. They utilise automated incident and queue detection systems (such as MIDAS) to monitor traffic flow, surveillance technologies including CCTV cameras and ANPR and signs and signals for real time traffic management performed by trained traffic operators working in control room environments. Capacity enhancement now constitutes the Highways Agency's main policy approach to the development of the road network. Third, ICTs are increasingly used to facilitate the dissemination of pre-trip and real time traffic and travel information to drivers and other road users in order to influence their travel behaviour. In particular, it is intended to delegate responsibility to travellers for the planning of their own journeys on a proactive basis based on this information in an attempt to reduce traffic flow at peak times and during major incidents. In this sense, ICTs are increasingly being used to create a critical and personal consciousness among drivers of the economic and environmental consequences of their journeys, thus urging 'us' to think how 'we' as drivers, passengers, hauliers and so on can travel smarter (Cairns et al. 2004).

2.2.2. “Life off the Road”: Where are the Transport Workers?

The study of ICTs and their use *in* transport systems, unlike the qualitative interviewing, diary and case study methods commonly associated with the study of ICT use on personal mobility, tend to form technical toolkits described in relatively neutral terms to be applied indiscriminately of context. The main consequence of this is that the human figure is easily erased from these descriptions and the ways in which they collaborate with technology in practically contingent ways cannot be accounted for. The thesis so far has lacked reference to the practices of transport workers and the spaces within which traffic management work takes place; this is not a deliberate exclusion – accounts of how this kind of work is done and the real time effects it has on traffic movements are missing from sustained analysis in transport research. Many of the early encounters with ICTs in a transport management context are future-oriented opinion pieces that reflect on an entrenched distrust of the reliability of automated traffic management technologies and a concern about the effects that ITS may have on driver complacency (Black 1996, 2001; Haynes 1997; Haynes et al. 2000). This has meant that many transport geographers engaged in ICTs have remained fixed to the context of personal mobility and its effects on travel demand and behaviour. This research certainly has utility in progressing critical thought on entrenched transport concepts and how technologies impact on potential and actual mobility (Kellerman 2012) but it does not take up the opportunity to research ICTs as they are applied in the field of transport operations and traffic management and its effects on the actual organisation of movement. Only a handful of studies exist to offer an insight into

how ITS solutions work in specific cases, including Flexible Transport Services (FTS) in rural areas (Brake and Nelson 2007), congestion management by electronic road pricing (Goh 2002) and real time traffic information and traveller behaviour (Chatterjee and McDonald 2004; Foo and Abdulhai 2006; Formin 2008).

On the one hand, the lack of empirical case studies is attributable to the quantification of transport geography, which looks to map and model the stuff of its study; on the other, it is a case that transport research is very much future-focused, inferring from current practice what it is expected to be like in the future without critically engaging in what this means for the actual lived practice of transport operations. The origins of ITS in transport engineering are maintained through its functionalist approach that focuses on the professional requirements of understanding how structures can enable, facilitate and limit movement in order to achieve its objectives measured by the safety, efficiency and reliability of those movements. Movement which was previously understood exclusively in spatial terms for the physical transportation of people and goods, now becomes framed as a technical problem which is driven by advancements in technology to generate technical solutions. This means that ITS is encountered as an inventory of opaque technical interventions which are abstracted from the practicalities of their use and presented in the form of recommendations for their implementation (Chowdury and Sadek 2003; Hepworth and Ducatel 1992; McQueen et al. 2002; Miles and Chen 2004). The accounts tend to describe in detail the various ICTs, their specifications and capabilities, as if they are fixed and neutral technologies that form neat solutions to transport problems, and rarely are they supplemented with real

empirical cases of their use. This tendency to neutralise technology in transport has been criticised elsewhere, most famously by Winner (1986), for obscuring the interdependencies that exist between humans and technology for shaping and regulating traffic movements.¹⁹

The consequence of this for understanding the role of ICTs in transport is that it makes an analytical distinction between the physical properties of technology (their design, specification, and effects) from the collaborative side of technology interaction (people and technology). Their separation can lead to generalisations about what technology is capable of doing and how people use it as it does not capture the contextual circumstances that generate traffic movements and the real time work that goes into its management. It forgets that these movements are managed in specific places using specific real time traffic management practices that are contingent upon the local conditions within which these movements are produced. In turn, it tends not to recount how these technical solutions have been incrementally developed, tested, trialled and tweaked. Instead, they are presented as a list of tried and tested solutions with positively anticipated and straightforward outcomes on traffic flow. The triumph of technology is exaggerated, which means that any ambiguities in the actual implementation of ITS are overlooked. This is particularly the case with automated management as studies exaggerate the ability of technologies to enable the large-scale automation of real time traffic monitoring over vast spatial transport

¹⁹ Winner's (1986) general argument is that the design of transport infrastructure can be embedded with, and then enact, a politics that facilitates movement in favour of some and not others. His approach avoids determinism by acknowledging that human bias can be designed into systems to be continuously reproduced often without conscious recognition of its sorting effects. The myth that technical solutions are neutral is therefore available for questioning.

networks that human individuals would find practically impossible to achieve unsupported by capture technologies. While this is certainly true in terms of spatial coverage, these technologies are never truly autonomous and the accounts miss out the ways in which the successful implementation of automated management systems is dependent on collaborative work with people. Traffic operators exist to constantly monitor, investigate and on occasion override these automated technologies. Far from replacing human activity, ITS interventions actually work alongside human operators according to the practical contingencies of this or that incident. As Büscher et al. (2009:1) put it, “[t]here is more to intelligent transport systems (ITS) than system ‘intelligence’, transport and technology.” To exclude traffic operators renders these systems as opaque technological triumphs.

In the case of traffic incident management, for example, which is described by Chowdhury and Sadek (2003:67) as a “coordinated and planned approach for restoring traffic to its normal operations after an incident has occurred,” it is presented as a linear process with four distinct stages: incident detection and verification, incident response, incident clearance, and incident recovery (McQueen and McQueen 1999; Chowdhury and Sadek 2003). In those rare instances where traffic operators do appear, their work is understood to be the translation of these stages into a number of sequential tasks – executed in a predictably linear fashion – that can be easily mapped and written into technologies to support their work. This has obvious application in a business context where monitoring and evaluation techniques are increasingly becoming core elements of transport management practice to measure worker efficiency and performance; however, they lend to

narrow and potentially misleading accounts of what kind of work matters in this context. One issue is that the situatedness and occasioned relevance of work practice is too easily dismissed as inconsequential to the real work of technologies in descriptive accounts that are presented as technically streamlined and outcome driven. This erases the constant work of questioning and negotiating with colleagues, checking and investigating reports in collaboration with other technologies, drawing on local knowledge and testing responses from representations in transport research. We know from a number of ethnographic studies conducted in similar diagnostic settings that the work of detecting incidents often depends on the ad hoc practices of human workers to make sense of what this disruption means right now for emergency intervention within a set of context-sensitive parameters for action (Büscher, Goodwin and Mesman 2010). Far from being 'optimal,' some of these interventions need only be 'good enough' in order to clear the incident as quickly as possible and resume a normal state of activity – in whatever way this is defined in context. For example, in the case of the Highways Agency, it may at first appear contradictory that they would choose to close all carriageway lanes to carry out an incident clean-up when the option to keep the carriageway partially open is available. A decision like this is made when it is actually conducive to a speedier clean-up to have the whole carriageway closed because it limits the number of personnel required to monitor and manage passing traffic to protect the safety of road workers who can then help in the clean-up. This situated understanding is missing and results in toolkits of solutions and procedures for their implementation that erase an understanding of how transport networks work in creative and resourceful ways and in real time. Büscher et al. (2009)

propose that social researchers should be encouraged to enter transport settings to observe the work in situ, as well as experiment with technology in scenarios and exercises to inform system design, to produce empirically-rich understandings of phenomena that account for its nuances and unanticipated qualities in practice. However, this is rarely achieved, and the role of the transport worker in these settings remains underplayed.

2.2.3. Transport Geography and its Professional Identity

Transport geography has long come under fire from geographers for its alignment with professional transport research at the expense of developing shared interests with mainstream geography. The discrepancy that exists between the treatment of movement in traditional accounts shaped by civil engineering and transport economists and mainstream geography begins to make sense in the context of transport geography's concerted development of a professional identity. Throughout its history, transport geography has made and sustained a serious commitment to becoming an expert in the transportation field. As a consequence, it has been open to and influenced by the analytical techniques, methods and approaches deemed current by professionals and policy makers to facilitate its own participation in intellectual transport debate (Goetz 2006; Johnston 1998; Vowles 2006). This means that not everyone views transport geography's specialism negatively, by recognising the value that collaborating with researchers in economics, civil engineering and planning can bring to maintaining its relevance in professional transport research. This scholarship should indeed be celebrated for raising the profile of geographers in the fields of transport history – which helps to

trace developments in transport provision and policy in order to contextualise contemporary issues (Black 2003; Bridle and Porter 2002; Charlesworth 1984; Faulks 1965; Schumer 1964; Tolley and Turton 1995), transport policy and planning – which directly addresses current policy debates (Banister 2002; Docherty and Shaw 2008) and political science – which assesses the effects of transport networks on everyday social, economic and environmental life (Vigar 2002), in a competitive and interdisciplinary arena.

The crux of the matter, however, is that transport geography has failed to critically reflect on the philosophical implications of its predisposition to quantification for its knowledge development. Its models and equations have no room for movement to be understood as indeterminate or disruptive, or intensely human, and they fail to capture the complexity of its more-than-human elements in the varied encounters that take place between travellers and infrastructures, technologies and regulatory mechanisms. This is why they are found to be of value in the engineering and planning disciplines as they work to erase any sense of ambiguity or uncertainty in their representation of transport. They are highly structured ways of understanding movement for the practical purposes of professional transport work. The consequence of this is that they perpetuate a single narrative of movement as the physical transport of people and freight that is largely functional and utilitarian – the engineer focuses on structured ways to maximise movement through capacity building for speed, the transport economist seeks to optimise the cost of direct and efficient movement for the rational traveller and the planner wants to know how to develop the accessibility between

the home and the workplace. This legitimates a highly outcome-oriented approach in transport geography, focused on the production of solutions, rather than an understanding of the process, the choices, the decisions and the grey areas of being on the move. Infrastructures are functional and fixed entities and travellers are rational beings. They are treated as products rather than processes of modern daily life. In turn, its reliance on methods of prediction takes away the need to understand real experiences. Those methods qualitative in nature that consult people who travel, or indeed do not or cannot travel, and observe their movements as they occur in situ, are reduced in importance because they do not contribute to model development. As Keeling (2007:219) notes, “[t]ransportation is treated as so obviously fundamental to society that there is no need to explain how or why.”

This is why transport geography is often described as the “last stronghold of positivistic perspectives and quantitative methods” in geography (Røe 2000:99), suggesting that it is out-of-touch with contemporary theories and analytical techniques. In this characterisation, it stands in stark contrast to other sub-disciplines of human geography that have engaged with poststructuralism, which is valued for its progressive and critical analysis of metanarratives and metaphors that continue to shape our understanding of worldly phenomena. This includes movement (Cresswell 2006; Sheller and Urry 2006). For Knowles (1993:7), it is the case that transport geography has not “kept pace” with other branches of the discipline, while openly displaying a “resistance to taking up new perspectives” for others (Røe 2000:99). Furthermore, others have commented on the ‘stifling hold’ that its professional ties have on the future of transport geography. Johnston

(1998) describes the insularity that transport geography suffers by referencing its lack of interdisciplinary dialogue. This is despite the fact that transport geography has worked heavily with the theories and methods of civil engineering and economists; Johnston's point is that it has failed to meaningfully collaborate with them and contribute to shared knowledges.²⁰

For Graham (1999) and Hanson (2003), transport geography has lost its disciplinary centrality which has arguably perpetuated an altogether unhelpful characterisation that places transport on the edge of geography. It is often treated with contempt by its geography cousins, a view captured in Hanson's (2003:469) cutting remark that it is a "quiet... some might say moribund corner of the discipline." This risks disassociating it entirely from mainstream human geography. It is unhelpful not least because the actual existence of a geographical core is entirely questionable (see Johnston 1998) but it also encourages calls that aim to 'rescue transport back into geography' which disregard the professional commitment of its research and, in turn, the value of interdisciplinary approaches for our understanding of transport and movement.²¹ While Goetz et al. (2003:222) admit the "linkages between interdisciplinary specialists have in many cases become stronger than the linkages with other geographers," which can impede collaborative work with mainstream geographers, Hanson (2006:232) urges a critical consciousness of the alternatives: "[t]he transportation aware need to

²⁰ Johnston (1998) challenges publications like the *Journal of Transport Geography* for being almost entirely made up of geographers. The issue of insularity is contested however. Goetz (2006) argues that transport geography has long worked hard to build strong interdisciplinary links. Vowles (2006) argues that the issue of insularity is an unfair characterisation and one that has long been default criticism directed at sub-disciplines that mainstream geography is unfamiliar with.

²¹ It also works to deflect attention away from the fundamental consideration of how movement has been conceptualised across the discipline, not just within transport, which will be discussed later in this chapter in the context of the new mobilities paradigm.

imagine questions, methodologies, and epistemologies beyond those bequeathed to us by economists and civil engineers.”

In fact, there is work of this kind already going on. One area within which we find it is the new mobilities paradigm (Sheller and Urry 2006, Hannam et al. 2006; Shaw and Hesse 2010).²² It is a body of research which is deliberately defined as broadly as possible by its supporters to take in a wide range of perspectives that share a commitment to rethinking movement through the theoretical and empirical lens of mobility. Sharing similar intentions to critical geographers from the 1970s onwards in transport geography, the focus on mobility is intended to dissociate this body of research from traditional transport concerns, but it also involves a critique of the theorisation of movement in the social sciences more broadly – as it is found to engage in the extremes of both sedentarism and deterritorialisation theories. This next section aims to introduce mobilities research in the context of what it offers our understanding of movement. In this context, there have been a number of specific calls for collaborative work between transport geographers and mobility scholars (Cresswell 2010a; Cresswell and Merriman 2011; Hall 2010; Preston and O’Connor 2008; Shaw and Docherty 2008; Shaw and Hesse 2010; Sheller and Urry 2006). They recognise that there is space “to make some previously unlikely connections” (Cresswell 2010:1a), while avoiding the “danger of disconnecting new mobilities work from all the work on forms of mobility that geography has actually

²² ‘New mobilities paradigm’ is a bit clunky and it has scarcely been used since its original publication in Sheller and Urry (2006). In turn, the extent to which the study of mobility is ‘new’ is obviously questionable, given the historical significance of transport geography, migration studies, time-space geography and tourism studies in the discipline (Cresswell 2011; Jensen 2006). Mobilities research is preferred because it captures the diversity of research that shares an interest in all things related to movement.

always been good at" (Cresswell 2010:4b). However, the professional matters of managing, maintaining and operating transport networks are still missing from the research agenda and this chapter goes on to suggest a number of reasons why this might be the case.

2.3. The New Mobilities Paradigm

It is unfair to bestow the narrow treatment of movement solely on the shoulders of transport research given that mainstream geography (and the social sciences more generally) has also neglected its importance as a topic of study in its own right. Sheller and Urry (2006) argue that the social sciences have tended to be 'a-mobile' in their accounts of movement and transport research has largely been 'a-social.' To address this polarisation of perspectives, theorists have turned their attention to mobility as both a theoretical project and an empirical fact to present the world as emergent and processual, while being intensely human and situated through the empirical richness and experience of mobilities (Urry 2000; Hannam et al. 2006; Sheller and Urry 2006; Urry 2007, 2008). The acknowledgement of this provides the theoretical motivation for the new mobilities paradigm; however the fact that this work originates in sociology is particularly significant for the actual framing of the problem of movement through the lens of mobility. In fact, the shifting emphasis from movement to mobility is massively significant for how movement as the act of moving is conceived.

Sheller and Urry (2006) begin from Georg Simmel's observation that the 'will to connection' is an intensely human attribute, visible in the modern world through the activities of arranging, coordinating and scheduling. These activities capture

both the importance of precision in timing activities as well as the need to move through space to connect and coordinate with others which offers a lens on the differentiated experiences of movement as humans engage in and experience the world through mobility. The notion that mobility is a thoroughly human experience is echoed by Cresswell (2006:1) when he urges scholars to turn their attention to mobility; “[y]et study it we must for mobility is central to what it is to be human.” Further Adey (2010:xvii) describes it as the “predominant means by which one engages with the modern world.” Here, mobility is understood as a fundamental part of everyday life and a primary ontological lens through which human life is experienced and our knowledges of the modern world are formed. In effect, mobilities research “starts with the fact of mobility” to ask questions about ontology rather than perpetuating a “point of view that takes certain kinds of fixity and boundedness for granted” (Cresswell 2010a:551, original emphasis). This tends to involve a critique of the theory of sedentarism on the one hand and nomadism on the other (Cresswell 2002, 2006, 2010b; Hannam et al. 2006; Sheller and Urry 2006; Urry 2000). In short, it is argued that key geographical concepts, such as space, place, time and mobility are ingrained with a sedentary metaphysics that conveys a distrust of any form of movement, flexibility or change. Sedentarism “sees mobility through the lens of place, rootedness, spatial order, and belonging. Mobility, in this formulation, is seen as morally and ideologically suspect, a by-product of a world arranged through place and spatial order” (Cresswell 2006:26). This privileges the qualities of human life as stable, bounded and grounded in place and it is suspicious of movement and those whose lives are characterised by movement. At the other extreme, a nomadic metaphysics comes to celebrate the

boundless and emancipatory qualities of movement, which has been criticised by some as verging on a romanticism that ignores the politics of mobility (Kaplan 2006). To overcome this impasse, theorists have turned their attention to core geographical concepts as metaphors of movement; so place, identity and mobility are understood to be differentiated and always in process, rather than relying on essentialist descriptions of them. As a lens on the world then, mobility studies are united by the fact that they “involve engaging with some kind of ‘difference’” rather than adopting the fact of movement as the overcoming of physical distance in the traditional sense of transport (Frello 2008:29).

The ways in which movement has historically been treated in the social sciences have obvious implications for how the empirical matters of movement have been researched. For mobility scholars, movement is largely understood to be an empirical fact that is located, practised and experienced in multiple and interconnecting ways. This recognises that while the world seems to be always on the move, it is actually made up of faster and slower mobilities, immobilities and moorings, which are all available for analysis (Sheller and Urry 2006). There are only faster mobilities due to the existence of slower ones and there are empirically different mobilities that intersect in vastly complex ways. These mobilities range from “the large-scale movements of people, objects, capital and information across the world, as well as the more local processes of daily transportation, movement through public space and the travel of material things within everyday life” (Hannam et al. 2006:1). In terms of transport, for example, it has been traditionally conceived in the social sciences as a collection of functional spaces and practices

reserved for the unproblematic spatial movements of people and things. They are considered to be the kinds of spaces that one would not necessarily choose to go to, other than out of necessity, and they are therefore left to the transport experts. This tendency has been readdressed by theorists associated with mobilities research, resulting in the production of cultural accounts of those less privileged spaces of the roadside and the motorway service station (Green 2004; Merriman 2007; Normark 2006), the embodied practices of driving (Katz 1999; Laurier 2004), and lived accounts of journey-making (Binnie et al. 2007; Bissell 2010; Jain 2009, 2011; Letherby and Reynolds 2009; Vannini 2009). While mobility as a theoretical project and mobility as an empirical fact are distinguished here in an analytical sense, they are almost always found together in the ways in which theorists talk about mobilities; mobilities research understands the world as emergent and processual, and experienced through the empirical richness of mobilities.

2.3.1. Movement and Mobility

On the one hand, it is reasonable to accept that attending to mobility helps mobilities research achieve its objective to rethink the ontological assumptions we make about the world, which results in its differentiation from traditional accounts of movement. On the other hand, there is a risk that movement as the physical act of moving disappears through the lens of mobility as a consequence of the human-centred social science perspective championed by mobilities research. This is because to avoid making the naive claim that modern life is always on the move, mobilities depends on making an analytical distinction between movement and mobility. For the likes of Canzler et al. (2006), Cresswell (2002, 2006) and Frello

(2008), mobility is the experience of movement in context, whereas movement is a homogeneous experience. As Canzler et al. (2006:3) explain, “[m]ovements refer to strictly a geographic dimension. They occur between an origin and one or several destinations, they are identifiable on a map, and are measured according to flow forms.” Movement is what you find represented in abstract transport models and its general theories. For Cresswell (2010b), these models and theories work to remove the human character and experience of mobility from their representations and instead focus on the narrow physicality of the movement of people and goods between spatial locations; they generalise about the nature and experience of movement, equating the status of people and goods. Further Cresswell (2006:3) claims that movement is “the general fact of displacement before the types, strategies, and social implications of that movement are considered” and it is therefore “contentless, apparently natural, and devoid of meaning, history, and ideology.” Movement is “brute fact” (Cresswell 2006:21). In other words, what Cresswell is suggesting is that movement is something that we share with non-humans; it is physical, it is part of the world we live in, but this means that it is not exclusive to humans. Mobility, on the other hand, is what it means to be human. This works to create a distinction between the world in a physical sense and the world as culturally and politically significant as it is experienced only by humans and only through the lens of mobility. The frame of mobility, then, is distinguishable by practice, experience and meaning. Mobility is differentiated, relational and multiple. Mobility is movement made human. Mobility is movement made meaningful.

Some scholars go further to make the distinction between motility and mobility (Flamm and Kaufmann 2006; Kaufmann 2002; Kellerman 2012; Kesselring 2006). Motility, as derived from the biological sciences, refers to the potential to move. It was originally used by Kaufmann (2002) in a mobility context to blur the distinction between the potential to move (motility) and the actual act of moving (mobility) by researching people's motivations for moving in terms of access, needs and competencies. It carries the notion that if we understand people's potential to move, then their actual mobility choices make more sense in context, and the two develop iteratively. While mobility here refers to the actual empirical movements of individuals, it is movement understood in human-centred concerns of motivation, meaning and choice, which is almost always absent from accounts of movement in transport research. In transport research, they tend to be interested in the brute fact of transport, narrowly focusing on the organisation of freight logistics or passenger transport by mode based on spatial interaction, rather than the capacity of people themselves to move, the choices they have and the decisions they make to move or not to move in this way or that way. Again in the example of motility, movement always already has some form of social, cultural or political significance deemed appropriate for study, in the sense that mobility as an act of moving cannot occur without motility, which includes the adoption and appropriation of personal competences, motives and mobility tools in a social setting.

The problem with this, however, is that by starting from mobility as a metaphor of movement, or motility as the potential to move, there is no pressing

need to attend to the phenomenon of movement in its own right. This is because mobility as metaphor does not require the existence of empirically real physical movements to make sense of it because it is always already imbued with cultural significance. This means that there exists a tendency to preclude the phenomenon of movement altogether. Used metaphorically, terms such as emergence, process, change, and so on, imply a movement of kind but do not depend on physical movement in terms of a displacement (Frello 2008). The consequence of this for the study of movement is that it has always already missed the opportunity to ask alternative questions about it, such as questions of how movement is produced as an ongoing practical accomplishment. So what if a different question is asked of it; not in what ways is it meaningful, but how is it actually produced? In other words, if movement is not presumed to exist as a prerequisite for human existence, but rather it is treated as an ongoing accomplishment and its accomplishment questioned, then research can begin to address the issues concerning the situated contingencies of movement *as it moves* as well as the role that structures play in its generation, regulation and accomplishment of its order. Empirical movements do not have to be abstracted from the circumstances of their production; they can be understood through detailed accounting of their continuous production and achievement of orderliness, as they occur, in real time. Rather than assuming that movement takes place in a context already imbued with cultural and ideological significance, an attention to the situatedness of movement can reveal it to be generative of its own contextual significance, whatever that may be, according to its relevance to the setting within which it takes place. That is, the practical accomplishment of movement *on the move*.

A small number of empirical studies exist that focus explicitly on the study of movement as a practically situated accomplishment. These studies are either aligned with the mobilities perspective or they have been influential to the development of mobilities research. Many of them share an interest in ethnomethodology; an invaluable approach for elucidating the precise ways in which social order is accomplished on the move without privileging an analytical lens. One of the earliest of these studies is Ryave and Schenkein's (1974) discussion of the methods that people draw upon when 'doing walking,' either alone or together, to navigate pathways and obstacles. Similarly, Allen-Collinson (2008) has analysed the activity of running together as a practical accomplishment that relies on particular skills and competences to navigate routes and run in close bodily proximity without collision. More specifically within transport, much has been written about the local order of 'driving in traffic' as a product of occasioned social interaction (Garfinkel 2002; Katz 1999; Laurier et al. 2008; Lynch 1993). Instead of trying to explain the observable orderliness of traffic as a result of normative rule-following by drivers, as is typical of traditional sociological reasoning, these studies show that rules are in fact resources that drivers have to persistently make sense of according to the specific activities in which they are engaged in. This is important to show that driving-in-traffic is an ongoing accomplishment and not a case of naïve rule-following. However, given that these studies focus on how traffic is ordered in the practice of driving, the actions of drivers tend to be considered in relative isolation from the road spaces that they move in and the practices that manage traffic from the motorway control room. How these apparently smooth and orderly movements of traffic are part of the wider practical accomplishment of the

motorway network is not addressed. This includes, for example, the work of physically absent traffic operators who identify disruptions and threats to traffic flow, visibly hidden data capture technologies that monitor and attempt to regulate traffic flow through the automation of sign and signalling, and emergency responders at the scene of incidents.

In terms of managing disruption, the volcanic eruption of Eyjafjallajökull, Iceland, in 2010 has produced a number of research papers that address various aspects of the management of disruption in a transport context, dealing with both air and land transport (Birtchnell and Büscher 2011). Although the empirical setting is an international mobility crisis, rather than the daily operation of a transport network, they provide invaluable insights into issues ranging from how transport networks are regulated, monitored and managed to how personal mobility is managed in times of widespread disruption and informational uncertainty (Adey and Anderson 2011; Barton 2011; Guiver and Jain 2011; O'Regan 2011). While a frame of practical accomplishment is not explicitly drawn upon, these studies nevertheless contribute to situated knowledges of mobility and disruption management in action, in ways that are relevant to both transport and mobilities research. Elsewhere, Esbjörnsson and Juhlin (2002) focus on the accomplishment of infrastructure management in the empirical account of mobile road inspectors. The smooth running of motorised traffic is achieved in relation to this work, which they argue often goes unrecognised as worthy of study. Through an account of situated activity they are able to demonstrate how the work of road inspectors does not comprise the simple identification of defects, but rather it involves

ongoing investigative work, sometimes collaborative, in order to assess what the defect is and when and how it can be repaired according to the real time opportunity to stop at the roadside in traffic. Elsewhere, Normark (2006) presents an interesting account of mobility as it is produced through the sociotechnical practice of purchasing fuel and taking breaks in driving at the petrol station. He argues that this work of “tending to” mobility comprises the ongoing maintenance work that helps to accomplish mobility. The petrol station provides a site where the production and negotiation of movement is achieved by the collaborative actions of motorists, forecourt attendants, the act of queuing to make a purchase and the exchange of money. In Normark’s account, movement does not follow a predetermined schedule and he shows how it unfolds in indeterminate ways that must always be made sense of and be made accountable to others because of the ambiguities and tensions that arise due to its local contingencies.

As a theoretical project, mobilities research successfully draws scholars’ attention to the matter of mobility as a fundamental part of everyday life. It highlights the ways in which mobility is differentiated, relational and always in process. However, the tendency for mobilities research to uncritically accept the facticity of movement conceals the opportunity to ask questions of its practical accomplishment in the way that the studies above do. This is because, as it was previously discussed, the mobilities approach privileges mobility as a primary lens through which humans experience the world, as culturally significant, and, as a metaphor of movement, it is not necessary to provide empirically rich accounts of actual acts of moving, of being moved or moving others (although of course some

empirical studies do exist). This is a real problem when we return to the realm of transport studies to ask questions as this research does about the situated organisation of large scale traffic movements and the real time management of transport networks. Mobility as movement made meaningful always already takes these forms and practices of organising for granted and this obscures an understanding of how transport and traffic phenomena work. Therefore in the context of the motorway network, this thesis asks a different question which is concerned with how movement is organised, ordered and accomplished through situated and practical activity. The studies above show how it is possible to consider movement to be an ongoing practical accomplishment of hard work, ethnomethodologically defined – it is the act of navigating paths between other walkers and runners to maintain motion, it is the act of refuelling and resting at the petrol station by forming orderly queues, and it is the act of driving while negotiating the moves of other drivers, roadways and defects as an essential part of the journey. To move is a matter of accomplishing movement and, while it can be considered to be an intensely human experience (indeed the human features are central in those studies), it does not comprise exclusively human descriptions or experiences of mobility. It is important to remember that movements unavoidably depend on collaboration with other things – otherwise pathways and roadways, vehicles and fuel, repair and maintenance workers, inductive loops and CCTV cameras, and operators and control rooms risk being forgotten.

2.4. Conclusion: Movement, Mobility and the Importance of Real Time

This chapter has been concerned with the treatment of movement spanning the annals of transport geography, professional transportation research and most recently the work of mobility scholars. The intention has not been to criticise these bodies of work – they make important contributions to their multidisciplinary fields of study – rather it is an attempt to distinguish this research from them, while acknowledging the ways in which links between them can be drawn. In transport geography, movement is accepted outright as a geographical fact that enables patterns of location to emerge and facilitates economic activity. The resulting empirical movements are analysed in terms of their optimal flow and maximum capacity. This dictates what counts as important matters to study, which amounts to a professional vision that understands traffic through maps, models, simulations and equations, resulting in general theories and abstract technical toolkits and recommendations for implementation. Despite the emphasis on real time in the context of ICT use, transport research overlooks the value of empirical accounts that explore how these movements are managed in practice according to their situated contingency. As a consequence, it neglects a full understanding of the efforts of transport and traffic workers who work with ICTs to achieve various traffic management objectives. In mobilities research, the notion of mobility replaces movement as both a theoretical and conceptual tool for study. This distances mobilities research from previous research on movement, including transport research, which considers movement to be a brute and physical fact. Most surprisingly, despite the fact that mobilities research emphasises the

importance of the multiplicity of mobility spaces, practices and experiences as an empirical reality with an explicit human-centred agenda, the spaces, practices and experiences of transport workers are systematically missing from its accounts in favour of the daily experiences of individual human subjects engaged in personal physical or virtual mobility. In the context of transport, an understanding of how people organise their own mobility is privileged in the new mobilities literature; the spaces and practices of transport are subsequently left to the transport professionals.

The emphasis on notions such as *active* traffic management that occurs in *real time* provides an interesting starting point for an alternative approach to movement as a problem of practical accomplishment. These terms serve to remind us that the technical solutions bound up in the ITS literature are in fact actively used and contingent upon the specific circumstances within which they are practised. They are not simply generalised solutions to generic traffic problems; they are co-constitutive of the shape and regulation of traffic movements as they are required and as movement unfolds. Their use takes place in a gap between optimal and actual traffic conditions that are context sensitive and responded to with an appropriate traffic management response to make best use of existing capacity. This is made ever more interesting given the constant threat of disruption to traffic movements from incidents, congestion and accidents, meaning that practices of *active* traffic management are sensitive to, and in turn help to generate, an emerging context of movement. This is enabled by the flexibility of ICT use to make best use of existing capacity according to the current availability of

resources in an attempt to meet the objectives of traffic management to produce and maintain traffic conditions that are safe, efficient and reliable. The application of ICTs in real time attempts to reshape these traffic movements over distributed and time-critical operations by enabling new and modified forms of communication and coordination over spatial distances with multiple agents, both technical and human. This has the potential to reconfigure how basic relations of time and space are understood in context – ICTs have the capacity to fold and draw near places or events that are occurring at a distance and they are able to make this happen in real time. This is suggestive of one way in which movement is practically accomplished, in the sense that it has to be continuously worked at to be achieved. The next chapter discusses this point further by drawing out the ways in which a relational network topology can transform what transport geographers can do with the concept of network and thereby opening up transport spaces and practices often forgotten about as topics in their own right in contemporary human geography. It also begins to unpack what a situated understanding of traffic management would look like, to alleviate both the tendency towards technological determinism, and the tendency to treat movement as an unproblematic matter of fact. This means that it is necessary to take an interest in how those movements are ordered and made accountable to others in order to address questions related to its practical accomplishment (Garfinkel 1967). This involves moving beyond the disciplines of transport geography and mobilities research to computer science and workplace studies for their empirical studies of actual workplaces and practices.

Chapter 3

Organising Movement

3.1. Rethinking Transport Networks: An Introduction

The aim of this chapter is to explore in more detail how movement as a problem of practical accomplishment can be studied in a conventional transport context – the motorway network. It pushes off from the dissatisfaction expressed in the previous chapter regarding the treatment of movement by both transport geography and mobilities research. It was argued that, on one hand, transport geography has a tendency to present movement as a brute physical fact that requires no further investigation or explanation into its ongoing organisation. The compulsion to move is therefore presumed to be an inevitable and derived demand, with transport researchers taking on the challenge to provide optimised solutions to aid the fulfilment of movement. On the other hand, mobilities research tends to distinguish movement as a brute and empirical fact from movement made meaningful through the concept of mobility. This favours the human experience of movement as it unfolds in a social and cultural context. A consequence of this, and the problem it presents for this research, is the ontological separation of humans and technology in the production of movement. In transport geography, and in particular those studies originating and contributing to civil and transport engineering, it tends to present utilitarian accounts of technical solutions to entrenched transport problems that are general in their descriptions and neutral in their approach. This effectively erases any element of

human collaboration from the performance of the work, despite them being constitutive of the design, development and local operation of it. While mobilities research recognises the importance of everyday materialities for the study of mobility spaces and practices, its human-centred approach means that technology is positioned as secondary to the meanings and experiences attached to those mobility spaces and practices.

Taking this as a departure point, this chapter explores what is at stake if an alternative approach is taken to understand the relations between humans and technology that produce and continually maintain movement with regard to the practical circumstances within which they take place and the inevitable contingencies that arise. To begin, this chapter works alongside a concept that is at the heart of traditional transport geography and professional transport settings – the network. Since its inception, networks have been central to transport geography in its efforts to analyse how transport and its daily movements are spatially organised (Fowler 2006). The idea of a network topology that pervades much of this work understands transport as networks made up of nodes and links to focus on facilitating the connections between places. The history of the network in transport geography is often overshadowed by broader efforts in the social sciences to rethink the world in network terms as part of a relational ontology (Paasi 2011). This risks losing the value of the network *as a network* in a material sense. With this in mind, this chapter highlights the contributions made by one particular area of study – actor network theory – for three main reasons. First, it shares with transport geography the study of networks *as networks* in an attempt

to avoid alienating the professional concerns of transport geography; second, it addresses the separation of humans and technologies in the production of actor networks; third, it values empirically rich studies. Moving on, this chapter then considers how this alternative approach would translate into an empirical study of the motorway control room. To help with this, it draws on a number of detailed empirical studies collectively known as centre of coordination studies (Suchman 1997), originating from the field of computer supported cooperative work (CSCW), which take a primary interest in how networks maintain their own stability through the local relations they keep.

3.2. Networks

Talking about networks is a popular thing to do in geography. In a most general sense, this is understandable given that the network metaphor is inherently spatial (it describes the arrangement of phenomena in space into nodes and edges), it is relational (it depends on the principle of connectivity to create links between nodes to maintain its shape as networked) and it can be used to describe all kinds of phenomena (including computer networks, transport networks, city networks, communications networks and social networks). This way of thinking about the spatial topology of networks has a long history in geography which is often forgotten about in contemporary accounts that promote network thinking (Fowler 2006). From the 1960s transport geographers worked closely with graph theory, an area of mathematics, to develop its primary interest in the spatial analysis of transportation systems. Graph theory supports the description of the spatial organisation of transportation networks into nodes connected by edges, which are

otherwise called links, and the analysis of the spatial relations between nodes (Haggett and Chorley 1969; O’Kelly 1998; Rodrigue et al. 2006; Taaffe and Gauthier 1973). Nodes can be used to represent origins, destinations or important switching points (such as hubs, junctions or interchanges), and the connections between its nodes are the conduits for traffic which can be given properties like flow capacity and speed. It is a flexible approach capable of producing many different types of network topology, at varying levels of abstraction, to represent real-world transport networks by virtue of their spatial arrangement and level of connectivity. The network models they produce vary in theoretical sophistication and empirical complexity depending on their purpose. Some models, for example, depend on distance as a fixed attribute of a link between two nodes (represented as a straight line in Euclidean space), while others calculate network distance which is variable depending on the link capacity, link redundancy, congestion and its susceptibility to accidents (Steenberghen et al. 2010). They are then used by transport geographers to assist in analysing various conditions for movement, including accessibility, network capacity and network efficiency (Rodrigue et al. 2006). More recently, developments in geographical information systems (GIS) have extended the capacity of models to analyse transport in relation to a wide range of geocoded data and increasingly in response to real time data capture (Haynes et al. 2004), which remains faithful to a primary interest in spatial organisation and anchored in space.

This way of understanding network topology is complimentary to the way that the Highways Agency talks about the strategic motorway network. The ways in

which a topology is encountered in this substantive sense can reveal how the motorway network is conceptualised and how network thinking is operationalised to aid the management of the motorways (Levinson and Huang 2010). What is at first striking about the use of network here is that its arrangement into nodes and links forms a hierarchical road network. Compared to web-like road networks that have many-to-many connections, the motorway network only has direct paths leading from origin to destination. They are accessible only by entry and exit slips at junctions to eliminate the need to stop and give way to crossing lanes of traffic. Access to the motorway network is reserved for the exclusive use of motorised vehicular traffic, meaning that pedestrians, bicycles and motorcycles are prohibited. This is designed to create roadways for uniform flows of traffic made up of motorised vehicles only to facilitate movement at higher speeds for more efficient travel at longer distances. This differentiates the properties of links in hierarchical networks by speed and capacity. In this sense, motorways encapsulate what Wootton (2006) describes as 'ways for movement' as distinct from those other classes of road known as 'ways for access' that allow for all forms of movement and connect all sorts of places. As ways for movement, motorways are designed to provide more or less direct connections between places of strategic importance to support obligations for co-presence in modern life. The notion that the motorway network should enable smooth and frictionless movement resonates throughout its history and it is a main motivating factor behind the design of the very first motorway (Drake et al 1969; Charlesworth 1984; Bridle and Porter 2002; Merriman 2005, 2007). This development came as early as 1949 with the Special Roads Act.²³

²³ Although the first motorway – the Preston Bypass – was not opened until December 1958

As a result of its network topology, there are a number of distinct challenges that the motorway network faces. One is accessibility, which is relative to the location of people, goods and services to the motorway network. As the motorway network can only be accessed at a limited number of entry and exit points located at strategic points biased towards the circulation of socioeconomic processes, accessibility is restricted to these locations. This often means that drivers are required to make a journey *to* the motorway using urban and rural roads and this can make a notable contribution to total driving time. Another challenge is network redundancy. Redundancy is at a low level for the motorway network as a result of the low connectivity between nodes. This means that there are very few alternatives to divert traffic in the event of network disruption. While the motorway network is connected to other urban and rural road networks, their topologies are in some ways incompatible because traffic flows cannot be easily diverted from the motorway to other road networks, leading to bottlenecks. This puts additional pressure on critical points in the network, increasing its vulnerability to accidents and congestion. In terms of incident management, this network topology is utilised as a practical resource to assess the appropriateness of this or that traffic management response to an incident by taking into consideration its accessibility and redundancy. Sections of motorway are not independent of others; this means that an incident along one section can have a detrimental impact on another section even if that section is not a continuous link. For example, two discontinuous sections of motorway connected only by an interchange can affect each other if traffic congestion spreads to the junctions connecting them.

Operators have to make decisions based not only on the specific location of the incident but also by incorporating knowledge of the physical layout of the surrounding motorway network, even if it is not directly connected. This is particularly apparent in the event of diverting traffic from the motorway section elsewhere; knowledge of the surrounding motorway and local highway network is crucial for assessing how the decision to divert can affect local links. This at least acknowledges that the motorway network does not exist independently of other networks.

What makes transport geography stand out in its treatment of networks is that it is interested in networks *as networks* that are made up of both nodes and the relations between them that give rise to differentiated spatial topologies (Cidell 2012; Fowler 2006) – which contrasts to other network approaches that tend to privilege the status of phenomena as nodes in a network, as Smith (2003a, 2003b) has argued in the case of world cities research. However, the hold that graph theory has in transport geography can limit what can be done with their network models to further an understanding of how they are produced, maintained and ordered in real time configurations. To begin with, it restricts any conceptualisation of a network beyond its arrangement into the categories of nodes and links. This conceptual linearity neglects the material heterogeneity of networks which cannot be captured in this form of representation and in turn it cannot account for any modification or transformation that occurs along a link resulting from its heterogeneity or emergence in real time. This has obvious implications for thinking about how active traffic management fits into analysis of network traffic if it is

considered to be made up of homogeneous flows over time. The separation of nodes and links may also lead to suggest that agency is located in the nodes, rather than distributed throughout the network, which can create the perception that links are passive conduits affected by nodes (Galloway and Thacker 2007).

Elsewhere in geography, theorists working in a poststructuralist vein have found the network as a topological metaphor particularly important for rethinking the world as emergent and materially heterogeneous, thus tangentially addressing those network qualities omitted in graph theory. However, poststructuralist thought has largely bypassed transport geography, leaving it to pursue its specialism in professional transport research. This is despite the fact that some threads of network thinking are held in common. Actor network theory²⁴ is one particular approach that shares transport geography's commitment to studying the links that make up networks, but creates a different way of thinking relationally that takes seriously the value of heterogeneity in networks as well as their emergence. The following section will draw out a number of connections between transport geography and actor network theory to discuss the ways in which an actor network topology can transform how transport networks are understood to be produced, mobilised and worked at as practical accomplishments.

²⁴ A method for studying networks originating in the social sciences. However, for the purposes of this thesis, actor network theory is not applied as a method. This is because, as a method, actor network theory involves the analysis of the process of network building by describing the associations between all kinds of entities that make up the network. This thesis is interested in the ways in which traffic movements are practically accomplished in contingently situated ways and as such it requires the in depth study of actual traffic management practices through the interactions of participants in the setting of the motorway control room. It is ethnomethodology – an approach distinct to actor network theory – that offers the conceptual tools with which to study interactions in their specific local configurations.

3.2.1. Thinking Topologically

“[O]rganisation is an achievement, a process, a consequence, a set of resistances overcome, a precarious effect.” (Law 1992:390)

Many social theorists have been inspired to think topologically in order to reconsider how space and time are conceptualised in their disciplines. Law and Urry (2004:398), for example, have criticised traditional approaches in social research that create a single version of the world based on an “a Euclidean reality of discrete entities of different sizes contained within discrete and very often homogeneous social spaces.” They argue that this abstract conception of space is coupled with a limited understanding of associated network terms such as connectivity and the relation between proximity and distance whose inherent quality of movement is restricted by the confines imposed by a topographical imagination and its relatively fixed formations. In order to get away from the inclination to think about network as a noun, J. Law (1999) encourages social researchers to think topologically. Topology, a branch of mathematics, realises the possibility of multiple spatial types (Law and Mol 1994). Applied to social theory, it means that the network does not exist as a single spatial type assigned to fixed coordinates locatable in Euclidean space so that it cannot be considered to presuppose the connections or relations that constitutes it. If it is not a frozen framework of points in space then it is a contingently linked set of heterogeneous elements which can at any moment redefine their associations and themselves (Callon 1986a). This means that “what appears to be topographically natural, given in the order of the world, is in fact produced in networks which perform a quite

different kind of spatiality” (Law 1997:5). In this sense, a network topology instantly brings into question traditional assumptions of proximity and distance, presence and absence, and big and small. This is because its spatial form is understood to be recursive and thus constituted by and constitutive of its relations. As J. Law (1999:6-7) explains, “in a network, elements retain their spatial integrity *by virtue of their position in a set of links or relations*. Object integrity, then, is not about a volume within a larger Euclidean volume. It is rather about holding patterns of links stable.” This is a network topology.

One approach that emerges from this way of thinking topologically in the social sciences is actor network theory. Actor network theory originated in the late 1970s and early 1980s as a practical sociological approach to the study of science and technology (STS) and it is widely associated with the work of Michel Callon, Bruno Latour and John Law (see Callon, Law and Rip 1986; Latour 1987, 1996; Latour and Woolgar 1979).²⁵ These studies largely came about as accounts of “science in the making” (Latour 1987:4) to challenge the universal claims of scientific knowledge by tracing how it is actually created in the laboratory. Scientific knowledge, it is argued, is not a fixed and objective world but it is actually achieved by the heterogeneous practices of association, enrolment and translation between humans, technologies, texts, instruments and nature, of which it is an effect. These studies focus particularly on the status of scientific facts as immutable mobiles and how they are stabilised and transported within a heterogeneous network through the relations they perform. These laboratory studies are particularly compelling for an alternative transport geography by virtue of its

²⁵ A history of actor network theory is discussed in Law and Hassard (1999) and Latour (2005).

confidence to enter professional settings to observe practices and attend to the heterogeneous mix of people and materials that are otherwise forgotten about in the presentation of scientific knowledge. While these early studies are faithful to the origins of actor network theory as a sociology of translation, it has since been appropriated in a variety of ways by a number of disciplines – and by the original theorists themselves (see Law and Hassard 1999). Within human geography, for example, actor network theory has played an important role in renewing geographers' interest in the material organisation of everyday settings and reaffirming the importance of nonhumans alongside humans in geographical accounts (Adey 2004; Büscher 2006; Hinchliffe, 1996; Laurier and Philo 2003; Knopp 2004; Schwanen 2008; Thrift 2008; Whatmore 1998). These accounts are not replicas of earlier sociology of translation studies but instead merge the principles of actor networks with Deleuzian thought to produce what some theorists call post-actor network theory (Elovaara 2004; Schwanen 2007). This is suggestive of the possibility to experiment with the approach in other disciplines; after all, J. Law (1999) insists that actor network theory should not be considered to be a prescriptive theoretical approach.

The use of the network concept by actor network theorists can be distinguished from transport geography – despite a shared interest in spatial topology. While transport geography tends to present their findings in the form of network models that appear static and fixed, actor network theory studies the emergent production of networks. Transport geography understands networks as made up of nodes and links in relatively narrowly defined ways; actor network

theory takes an interest in the durability of networks as achieved by their topological multiplicity. Transport geography tends to privilege nodes exerting agency over passive links, leaving what happens from one link to another underanalysed; actor network theory understands networks as relational effects by virtue of the heterogeneous relations they keep.

First of all, while the network models of transport geography omit an appreciation of how networks are created and transformed over time, actor networks only emerge through the situated and contingent practices that constitute them. This means that actor networks are performative and always in process and they unfold through time through more or less predictable interactions (Pickering 1993). As a result of the emergent quality of networks, entities participating in the network only achieve their form and competencies as a consequence of the relations to which they are associated – nothing pre-exists their involvement in the network.²⁶ This works to shift our focus from the event as locatable within specific time and space configurations to the ongoing work of mobilising the network. As Callon (1999:185-6) identifies, the network is “not a network connecting entities which are already there, but a network which configures ontologies. The agents, their dimensions, and what they are and do, all depend on the morphology of the relations in which they are involved.” Any entity we consider an actor is a relational effect; entities do not pre-exist their participation in networks, but emerge through participation as an effect of their

²⁶ This is called the material-semiotic approach, influenced by linguistics. It is the idea that all entities take the form they do and are able to do the things they do as a result of their relation to other entities. In turn, this means that all entities are made accountable with the same explanatory language; any distinctions between things, such as the social or the technical, are relational effects.

relational heterogeneity – they become relevant through their participation under specific situated circumstances. The network can change depending on the configuration of relations performing it and so too can the status of any given entity as they become defined through the alternative relations they keep. Law (1997) reminds us that this means networks are precarious; nothing is given in the natural order of things and there is the ever-present possibility that things could be otherwise.

Accordingly, this is where actor network theory takes an interest in the durability of networks and the fact that they have to be worked at to maintain their stability. This is attributed to its topological multiplicity; the spatial form of the network renders possible the ability to overcome challenges to its stability. As Galloway and Thacker (2007:156) note, “[n]etworks operate through ceaseless connections and disconnections, but at the same time, they continually posit a topology. They are forever incomplete but always take on a shape.” A network, then, is made up of more or less durable connections that hold it together. In those studies closely aligned to the origins of actor network thinking as a sociology of translation, the durability of networks is discussed in the terms of translation. Translation is the process by which network order is continually negotiated and achieved through the alignment of interests. It involves both the enrolment of others’ interest and the management of their behaviour to make their actions more or less stable.²⁷ Where this holds value for the study of the organisation of movement is that it recognises that the durability of networks involves the constant

²⁷ When a quality of durability is achieved, this is referred to as punctualisation. The result is that network now takes on a regular pattern, although it is still precarious (Law 1992).

work of negotiation. A consequence of this is that there is space to analyse the compromises, uncertainties and challenges to durability that the network faces. It is a potential way forward for understanding how the network is ongoingly organised by virtue of its topological multiplicity rather than treating it as homogeneous nodes and flows. This means that we can now ask “how?” questions of it, as Elovaara (2004:48) notes:

“It is not important to look at networks as such to work from the question ‘what’, but instead to start network studying by using the question ‘how’ instead. How are networks ordered in the first place? How is it that some networks seem to be stable? How is it that some actors seem to have power over other actors? How do some networks seem to be large in size? How is it that some networks do not look like networks at all?”

Moving on, and secondly, the network is always materially heterogeneous and anything attributable to the network is understood to be an effect of the relations between human and nonhuman entities (Law 1992). It is its material heterogeneity that makes the network work. This challenges us to rethink the centrality of the role of the human in explanations of networked configurations. The effect of this is to say that a human being is able to achieve the most basic actions because he or she is positioned within a heterogeneous network of things – human, animal, technical, infrastructural and so on. As Law (1992:384) puts it: “[t]he argument is that thinking, acting, writing, loving, earning – all the attributes that we normally ascribe to human beings, are generated in networks that pass through and ramify both within and beyond the body. Hence the term, actor-network – an actor is also, always, a network.” What begins to matter is not the individual human actor per se, but the dispersal of action through a relationally

heterogeneous network, which is at once precarious and continuously made each time anew. Importantly, no characteristics or attributes are pre-assigned to actors. This also works to collapse other categorisations, such as scale, proximity and distance which emerge as relational effects and not pre-given orders dependent on assumptions about level or hierarchy (Strathern 1996).

Third, this leads to a reworking of the concept of agency. It is at once disassociated from the traditional understanding of agency as the capacity of a human being to act intentionally. Agency as decentred from the human subject is understood to be a relational effect, which is therefore not attributable to any individual human or nonhuman entity. It is “[l]iberated from its containment in human entities, it is dispersed through the networks” (Ashmore et al. 1994). Agency is then achieved through the activities of negotiation between human and nonhuman entities. This is often described as the symmetry of actors whereby actor network theory analyses the role of humans and nonhumans as both having the capacity to act as a result of the relations they keep. This is not to suggest that they both have the capacity to act intentionally, but they may be delegated intentions from elsewhere and from actors not readily present (Latour 1992), thus challenging the binary assumption of presence-absence in relation to agency.²⁸ Being an actant²⁹ is “contingent upon its capacity to act, and its capacity to act is dependent on its relations to other actants” (J. Law 1999:93). It is therefore not

²⁸ Distinctions between entities can still be drawn. The way in which an entity is characterised as social or technical, human or nonhuman, actually emerges as a relational effect.

²⁹ ‘Actants’ challenge the tendency to attribute agency to an individual entity, i.e. the human subject.

possible to neither predetermine the characteristics or qualities of a single entity nor assume that entity to be inherently passive.

In contrast to transport geography's network, thinking in terms of the material heterogeneity the network, combined with the principle of symmetry, gives way to an account of the movements of drivers or the work of traffic operators that sounds implausible without the network of technologies, signs and signals, telephones and radios and motorway patrol officers that exists to help them accomplish traffic movements. This brings into focus the question of how exactly the control room is equipped to maintain relations with distributed entities of all kinds across the network, given that the control room exists to monitor, detect and implement solutions to prevent disruption to traffic. This means that there is a further tension to be addressed that has not explicitly featured in this discussion so far. The empirical setting for this research is the motorway control room and it is within this setting that the study of the organisation and situated accomplishment of movement will be focused. The motorway control room takes a very particular networked form of organisation. It is its arrangement as a centre within a wider network that is addressed in the next section.

3.2.2. Action at a Distance: The Motorway Control Room

Motorway traffic is managed by a network that is arranged around a central point of determination, which can be preliminarily identified as the control room itself, which coordinates a wider network made up of dispersed agents – both human and technology. This specific networked form of organisation is crucial to the accomplishment of the work of the centre, given that the control room is

tasked with the management of motorway traffic by monitoring the motorway traffic in real time, detecting incidents, coordinating response and consequently the practical accomplishment of movement itself. At first, this networked form of organisation appears to be at odds with actor network theory given that actor network theory analyses the emergence of networks rather than taking their form for granted. Talk of a centralised control room risks premising a topographical spatial reality comprising a hierarchical centre-periphery formation whereby the centre has control over activities taking place at the periphery and physical distance is mediated by the notion of connectivity. However, actor network theory does not deny the existence of centres, but strives to show how they become centred and maintain themselves as centres as an effect of the distributed relations that constitute the network. Lee and Stenner (1999:83) clarify that “[a]n actor-network clearly does not depend on or belong to a centre, because what passes for a centre is an effect of, and hence depends upon or belongs to the network.” Centres, then, are not predetermined hubs of agency that have responsibility over a wider network; they are only centres as an effect of the relations they keep. This tension of generating and maintaining stability as an effect of the heterogeneity of the network is what keeps them at work. Law (1992:385-386) reminds us that “[s]tructure is not free-standing, like scaffolding on a building-site, but a site of struggle, a relational effect that recursively generates and reproduces itself.” As a ‘site of struggle,’ there is the understanding that at any point the centre can change, but it strives to maintain its function as a centre by the activities of organising, ordering and negotiating.

The network models of transport geography tend not to explore in any depth the relationship between proximity and distance and presence and absence. The fact that actor network theory works with a principle of action at a distance is interesting in this respect. It is its relational topology that renders action at a distance possible – this is because distance becomes a function of the relations between entities. This means that notions such as proximity and distance are not determined by geometric calculations but rather they are relational effects freed from the constraint of the positioning of entities in physical space, such as those depicted on a map. As Law and Mol (1994:649) explain, “[i]n a network space, then, proximity isn’t metric. And ‘here’ and ‘there’ are not objects or attributes that lie inside or outside a set of boundaries. Proximity has, instead, to do with the identity of the semiotic pattern. It is a question of the network elements and the way they hang together.” The effect of making things closer is qualified by a relation to relevance, not by physical distance. Things are not always already connected, but they are connected and disconnected, made closer or pushed away, according to their relevance. Serres (in Serres and Latour 1995:60) attempts to explain it using the example of a handkerchief, which is particularly useful to quote at length here:

“If you take a handkerchief and spread it out in order to iron it, you can see in it certain fixed distances and proximities. If you sketch a circle in one area, you can mark out nearby points and measure far-off distances. Then take the same handkerchief and crumple it, by putting it in your pocket. Two distant points suddenly are close, even superimposed. If, further, you tear it in certain places, two points that were close can become very distant. This science of nearness and rifts is called topology, while the science of stable and well-defined distances is called metrical geometry.”

This gives networks a certain quality of structural plasticity. It helps to think that elements can be made closer through the ability of the network to bend and fold, to make relations and break relations, while still keeping its shape. This is important to bear in mind when considering the significance of other terms related to location. The term 'local,' for example, is often used to describe the emergence of order as occasioned and situated in a given setting. As part of the network, however, anything described as local should be considered to be an effect of its involvement in the broader network of associations. Something like a traffic movement may take place locally, but it is necessarily implicated in a wider heterogeneous network that enables it to occur in the first instance. This is qualified by the concept of agency; the human traffic operator only gains agency locally by participating in the heterogeneous network of incident logs, remote traffic counters, telecommunications and motorway patrol cars. Take them out of this network and they are not able to do very much. This means that the organisation of movement is irreducible to a specific location – the centre or otherwise.

Centres are able to determine the shape and regulate the activities of others from a distance because of their heterogeneity. As Murdoch (1998:36) notes, "it is the mixing of human actions and non-human materials which allows networks to both endure beyond the present and remain stable across space." Objects and technical devices enable human beings to do things they would otherwise be unable to do (Latour 2005). Schwanen (2007:19), for example, reflects on the routinisation of artefacts, such as the mobile telephone, in the coordination of daily

mobility movements, commenting that they are “artefacts that enable humans to act incorporeally at a distance through delegation.” This at once disrupts the tendency to equate physical proximity with the ability to influence the conduct of others. This also collapses the Euclidean distinction between proximity and distance which creates the possibility to think of the ways in which traditional conceptions of space (near and far) and linear time (now and then) is reconfigured through the application of ICTs. The centre is able to manage and regulate the movements of others by delegating certain responsibilities to entities arranged throughout the network without having to be physically present. Schwanen (2007:19) goes on to say that ultimately the “outcome of action at a distance is nevertheless uncertain because of the blankness of the artefacts used to delegate one’s intentions and goals.” What is crucial, then, is that these relations remain stable as agency is dispersed through the network to allow a centre to be seen to dominate its periphery. This stability is maintained by what Law (1994) calls strategies or modes of ordering, Bowker and Star (1999) refer to as classifications and Murdoch (1998) describes as the coexistence of formal prescriptions and continuous negotiations. These formal orders can be considered to be the stuff that holds the network together in occasions of uncertainty or ambiguity. Murdoch’s (1998) characterisation of prescription (ordering) and negotiation (resistance) means that they always exist together to standardise practices over space and time to hold the network together by making activities more or less predictable and steady. The centre does not impose its formalisms but local order emerges through (re)negotiation that is sensitive to the situated and specific circumstances within which orders unfold.

Actor network theory as a method of studying networks, how they emerge and hold together, is adept at revealing the processes of network building that enable networks to maintain their stability. However, the focus on *process* works to the detriment of our understanding of how specific events, such as disruptions, emerge through and become implicated in the practices of ordering networks. Thrift (2008:111) notes that the “troubling impasses and breakthroughs, the trajectories and intensities of events... are too often caught up and neutralised.” This means that actor network theory often stops short of explaining how networks cope with the unexpected and how that potential to be otherwise is mobilised. For Lee and Stenner (1999:99), they argue that some studies of actor networks are positioned “against disorder” – this is because networks are described in terms of the associations they keep and the mechanisms that enable associating to occur without considering how specific events of disorder, disruption or challenge to order are actively managed. The consequence of this for this thesis is that the interactional details of specific moments of associating are routinely missing. This then means that the role of actor network theory is best understood as a conceptual tool that helps this thesis think through how networks function by virtue of their relational heterogeneity – and not as a method of network building.

At this point, it is necessary to make a transition between two distinct yet somewhat complimentary approaches in order to access the missing details of the interactional work of networks. Both actor network theory and ethnomethodology constitute radical breaks with conventional sociological theorising – actor network theory in terms of its sociologies of scientific knowledge and ethnomethodology in

terms of its respecification of taken for granted concepts in everyday sociological theorising (Callon, Law and Rip 1986; Garfinkel 1967; Latour 1987, 1996; Latour and Woolgar 1979). However, it is ethnomethodology – not actor network theory – that provides the analytical means to study specific ordering practices as they unfold in contingent ways. Like Button (1993), Lynch (1993), Suchman (2000) and others in the workplace studies tradition, ethnomethodology has been influential in drawing attention to the ways in which specific practical actions and events maintain the order of phenomena like workplace settings, including control rooms responsible for the management of a network. The next section finds in the field of CSCW and workplace studies a way of analysing the intrinsic tension between prescription and negotiation that animates networks – this includes the ethnomethodological principles of indexicality and reflexivity which will be discussed in greater detail in Chapter 4 – while offering detailed empirical descriptions of its interactions. In particular, it is a body of studies collectively known as centres of coordination (Suchman 1997) that takes a primary interest in how networks maintain their own stability through the local relations they keep specifically within control room settings – helping to make the transition from actor network theory to ethnomethodology as the study of practical action in networks.

3.3. Cooperating, Coordinating and Collaborating: The Work that Makes the Network Work

“The way in which people work is not always apparent. Too often, assumptions are made as to how tasks are performed rather than unearthing the underlying work practices.” (Suchman 1995:56)

Similar in kind to those early laboratory studies of actor network theory, there is a body of research within CSCW and workplace studies that pays particular attention to the qualitatively different practices that draw together and assemble in heterogeneous networks to help maintain their stability across spatio-temporal contexts. Known as centre of coordination studies, they provide a practical orientation to the study of situated action and the specific ordering practices of coordination, collaboration and cooperation that reveal how these settings work. CSCW originated in computer science in the late 1980s; it was a time when computers and technological artefacts were becoming more commonplace in workplace settings. The development of CSCW was closely tied to the field of human-computer interaction (HCI), also within computer science, which sought to understand how humans interact with computers in order to inform system design.³⁰ Bad design, it was maintained, led to ineffective workplace practices, so research into how individuals used technology provided a way forward to better understand how design informed by research could improve workplace efficiency. HCI, however, was largely preoccupied with individualistic cognitive processes and user-centred laboratory experiments (based on the assumption that human activity is governed by rules, scripts and plans) which led to the proliferation of decontextualized design models of workplace operations, thus deemed unhelpful (Bannon 2000; Blythe et al. 2003; Heath et al. 2001; Suchman 1987). In response, CSCW attempted to extend the focus beyond that of the individual to the group and

³⁰ Previously man-machine interaction (MMI). HCI brings together researchers from a range of fields including cognitive psychology, computer sciences and human factors. It is primarily interested in achieving the best 'fit' between the human user, the computer and the task in hand, based on the concepts of usability, functionality and performance (Carroll 2002; Preece, Rogers and Sharp 2002; Te'eni, Carey and Zhang 2007).

from the computer screen to the surrounding social and material setting (Button 1993). It thus shifted the focus from individual cognition to an interest in group work and groupware solutions. Sociological thought was becoming increasingly influential in system design, evident by the focus of the social character of 'cooperative' work and the gradual adoption of ethnographic methods to influence design (Bentley et al. 1992; Button 1993; Heath and Luff 1992a; Luff and Heath 1993; Rogers 1993; Suchman and Trigg 1991). Some of these early studies, however, perpetuated a narrow conception of 'the group' as already assembled (and therefore fixed) and thus assumed that the organisation of group activities was available to formalise and automate (in the case of workflow systems). This neglected the ways in which group work often involves the accomplishment of both distinct yet coordinated work activities performed by individuals as part of the group as well as those more explicitly collaborative in nature (see Abbott and Sarin 1994; Grinter 2000; Grudin 1988; Markus and Connolly 1990; Schmidt and Bannon 1992).

In response to critiques that these early studies were preoccupied with decontextualised accounts of workplaces (whether in reference to the prescriptive role of rules, procedures and plans or the static organisation of group work) and generalised recommendations to system designers, the body of workplace studies provided something of a breakaway (Button 1993; Heath and Luff 2000; Luff, Hindmarsh and Heath 2000; Sharrock and Anderson 1993) – although these approaches are by no means mutually exclusive and often bleed into one another. The developments in CSCW and workplace studies were largely influenced by the

work of Harold Garfinkel and others writing in the ethnomethodological tradition, not least for its highly critical stance towards theory-driven sociological accounts of work that were prevalent at the time.³¹ As Heath and Button (2002) argue, classical sociological concerns such as the division of labour, marginalisation and resistance had so far pervaded theoretical explanations of workplace activity without analysing the *actual work* carried out by individuals. Workplace studies began to treat work as a topic of study in its own right, rather than allowing it to be obscured by grand theories or design assumptions.³² This encouraged more researchers to enter workplace settings to observe workers at work and to produce detailed empirical accounts of work-in-action as it occurs (Berg 1999a, 1999b; Berg and Goorman 1999; Heath and Button 2002; Luff and Heath 2000, 2001; Luff, Hindmarsh and Heath 2000; Schmidt 2000). These studies, often referred to as naturalistic workplace studies in the literature, embraced the classical ethnomethodological concern for observing the practical accomplishment of settings, rather than the blind acceptance that workplaces take the form they do by workers following formal prescriptions. These studies include Suchman's (1987) account of photocopier use in the office environment, Harper (1998) on the use of documents and technologies in the organisation, and Orr (1996) on the work of photocopier repair technicians.

Studying settings *in situ* enabled researchers to commit to the respecification of concepts that have unwittingly become default categories of

³¹ Other approaches have been influential too, including distributed cognition, activity theory, course of action studies and conversation analysis. It is perhaps not surprising that ethnomethodology has steadily featured in workplace studies, given its prominence in Suchman's (1987) *Plans and Situated Actions*.

³² There were already other ethnomethodological studies of workplaces in existence, which developed concurrently but independently of those in system design (see Garfinkel 1967, 1986).

analysis in their discipline of origin in order to make them more meaningful to the actual context of their application. Concepts like 'awareness,' 'alertness,' 'monitoring,' 'plans' and 'the user' are posed as design challenges, regardless of context.³³ Pettersson et al. (2002), for example, in their study of emergency service work in Sweden, strive to show how awareness manifests itself in different forms according to the occasioned nature of its use; the implication being that if systems and technologies are to be effective in workplaces then, firstly, designers need to know the actual situated requirements of those settings and, secondly, technology should not be viewed as a *replacement* for existing working practices but rather it plays a collaborative and contingent role in those practices. This means that workplace studies do not lose sight of the original core concerns of HCI and CSCW, but speak back to system designers with context sensitive recommendations (Plowman et al. 1995).

It is typical of these studies to focus on the practical accomplishment of workplace settings through the concept of 'cooperation' between participants. This is largely understood as a set of "tacit, seen but unnoticed, indigenous resources" (Luff, Hindmarsh and Heath 2000:17) that enable members to "surreptitiously monitor" (Heath and Luff 1992a:26) each other's conduct and systematically offer up notification of changes to their own work. This includes talk in the room, bodily gesture and positioning of gaze and details of how these actions are organised

³³ Many of the early technological interventions in workplaces had disastrous consequences for the integrity of those settings (see Page et al. (1993) and Finkelstein and Dowell (1996) on the failure of a new computer-aided dispatch system for the London Ambulance Service in 1992). As Rawls (2008) argues, technologies and system do fail, and they fail for good reasons. It is not that they are 'resisted' in the place of implementation, or that workers lack the skill or know-how to work with them. Innovations fail because they lack insight into how workplace settings actually work, including the ad hoc sensemaking practices that workers rely upon, and assume that work practices will naturally adjust to system developments.

around technology use (ranging from paper documents like flight strips and railway timetables to surveillance systems and communication technologies). They also share an assumption that the cooperation of human activity within a setting is a prerequisite for any coordinative activity that extends beyond it (Pettersson 2002; Tjora 2004). For example, in Heath and Luff's (1992a) account of the daily operations of the London Underground, the Line Controller must make known to his colleagues any change in the status of a train due to arrive at the station. The Line Controller make changes visible by talking "out loud" to the room or using hand gestures and pointing to screens in order to "render 'private' activities publicly visible" (Heath and Luff 1992a:13). This talk is not necessarily directed at anyone (direct conversation is unlikely given that members of the setting are getting on with their own work activities), but it fulfils the information requirements of colleagues whose actions are sensitive to changes in context, such as the Divisional Information Assistant who provides information to passengers via the public address system.

3.3.1. Studying Control Rooms

It is perhaps not surprising that control rooms have provided rich settings for workplace studies to take place, not least because of their requirements for insightful design. Studies have explored the control rooms for rapid urban transport networks such as the London Underground and the Docklands Light Railway in east London (Heath and Luff 1992a; Heath, Hindmarsh and Luff 1999; Heath, Luff and Svensson 2002; Luff and Heath 2001, 2002; Theureau and Filippi 2000), air traffic control (ATC) and airport operations (Berndtsson and Normark

1999; Goodwin and Goodwin 1996; Harper and Hughes 1993; Nevile 2004; Suchman 1993, 2011), emergency response centres including 999 call-taking (Ikeya 2003; Whalen and Zimmerman 1990; Zimmerman 1992) and resource dispatch (Martin, Bowers and Wastell 1997; Pettersson, Randall and Helgeson 2002; Tjora 2004), newsrooms (Heath and Luff 1992b; Broth 2008, 2009) and trading rooms (Heath et al. 1993). These studies are often grouped together as centre of coordination studies; they move beyond the exclusive analysis of cooperative work within the centre to highlight the role of coordinative activity between physically distributed participants as it takes place within and beyond the physical confines of the centre in order to accomplish workplace order. They tend to follow Lucy Suchman's (1993) influential piece on airport operations and the use of artefacts to coordinate and manage flight departures and arrivals for the accomplishment of workplace order as it extends beyond the spatial confines of the traditionally-conceived workplace setting.

A centre of coordination, Suchman (1993, 1995) argues, is a specific, centralised contact point immersed within a wider network that is responsible for the coordination of distributed resources, usually in response to an unforeseen problem or disruption. The centre provides a setting within which participants are co-located while they perform a set of interdependent, yet relatively distinct, activities. Centre of coordination studies share with actor network theory an orientation to a core paradox that exists between the work done to maintain the stability of the centre (to provide a point of contact to which all kinds of physically distributed participants can orient themselves) and the need to support a range of

sociotechnical relations that give the centre access to situations as they occur and at a distance. This is a very particular kind of networked form of organisation, where the successful coordination of activities is predicated on the flexibility of heterogeneous and multiplicitous relations that enable the timely receipt of information about situations. In this sense, the emphasis is not placed solely on their stability, but also on their flexibility to adapt to uncertain or ambiguous conditions. As Suchman (1995:115) notes:

“Centres of coordination are designed to maintain two contradictory states of affairs. On the one hand, to function as centres requires that they occupy a stable site to which participants distributed in space can orientate, and which at any given moment they know how to find. At the same time, to coordinate a system of widely distributed activities, personnel within the site must somehow have access to the situation of others distant in space and time. A job of technologies in such settings is to resolve this contradiction through the reconfiguration of relevant spatial and temporal relations.”

This paradox is particularly relevant in those cases where co-located participants do not have direct access to or complete knowledge of the situation they are expected to deal with, such as those settings of emergency response – similar in some ways to the motorway control room. Emergency response settings share a number of distinguishable features as a particular kind of centre of coordination: they coordinate response to emergencies over distance and operate in a distributed setting as roles and responsibilities are shared amongst personnel. Their control rooms are typically organised by the core activities of call-taking and the radio dispatch of resources to the scene of incidents. Since these activities often occur in parallel, there is a constant orientation to what others are doing and what others require in order to get their job done, and accordingly cooperative work plays a

significant role. Studies explore a range of topics including the cooperative work between people in the control room, including the accomplishment of 'talk in the room' and other embodied activities (Artman and Waern 1999) and its consequences for system design (Tjora 2004), the coordination involved in emergency call handling, which remains largely influenced by conversation analysis (Ikeya 2003; Whalen and Zimmerman 1990; Zimmerman 1992), the local organisation of work between call handlers and dispatchers when tending to an emergency (Martin and Bowers 1999; Martin et al. 1997; Normark 2002, 2005; Pettersson 2002; Pettersson et al. 2002) and, more recently, the communication between the control room and the spaces of ambulances and police cars as they are dispatched to incidents (Fele 2008; Lundberg and Asplund 2011).

These studies go some way to show how coordination is not a straightforward accomplishment. This is because they share a number of setting-specific qualities that continuously shape their coordinative work (such as being time and safety critical) and the problems they manage (requests for help are by no means standardised; they come in heterogeneous forms with varying degrees of logical consistency and completeness). While these studies remain invaluable in their approach to the study of control room settings for this thesis, it is at this point that this thesis breaks from a typical centre of coordination approach for two reasons. First, the fact that these settings are treated as primarily "centres for the coordination of human activity" (Suchman 1993:113) means that their study tends to be rooted in human interaction which is then understood to be 'enhanced' or 'supported' by technology. This leads to a relatively narrow treatment of

technology, whereby technology provides the communications solutions to the principle problems that Suchman (1993; 1995) sets up, which is one of distance and another of timely coordination between human participants located in disparate positions about the network. Second, these studies tend to perpetuate an unnecessary distinction between internal 'cooperation' and extended 'coordination,' which are analysed in markedly human terms, missing out on how cooperation and coordination may be constituted differently and concurrently across contexts, and how other, qualitatively different kinds of work may go on in these settings.

Returning briefly to actor network theory, its analysis of the relational heterogeneity and symmetry of actors in networks goes some way to help address the centrality of human activity in centre of coordination studies and the unhelpful distinction they make between cooperation and coordination within and beyond the control room. However, it is not simply a case of treating people and technology symmetrically in the same way that actor network theory does because of the assumptions this makes about human capacities to act.³⁴ Actor network theory tends to shy away from the human subject and, consequently, the human subject can appear to be anonymous and the specific relations they keep uncertain (Callon 1999). Of course, the symmetry of actors has great analytical purchase for thinking beyond the individual and the tendency to attribute qualities to the individual before it acts in order to understand the capacity to act as a relational effect. However, the refusal to attribute the human subject any exceptional

³⁴ Actor network theory does not distinguish between the capabilities to act and be acted upon between humans and nonhumans.

competencies is somewhat limiting for this research if it seeks to detail those ordering practices as they emerge as a situated accomplishment. This can be troublesome, as Knopp (2004:127) argues, because its “radically anti-humanist perspective is also at odds with its own awareness of situated knowledges, which, since we are all human, are always and inescapably understood in human terms.”

The creative role of the human subject in the renegotiation of local orders, in particular, is overlooked. For instance, operators must know sufficiently enough about an emergency before they can dispatch a resource to it. This work is more suitably ‘collaborative’ in nature since it depends on the interaction between the operator and say an informant who could be a member of the public who may not be accustomed to the practice of reporting an emergency or an operator and a scene displayed on CCTV. This collaborative work helps to cross the divide between cooperation and coordination and inside the control room and outside in the act of making sense of what counts as an appropriate response in that particular case of emergency. This is the approach that this thesis seeks to advance, which will be discussed further in Chapter 5 – one that is sensitive to the ways in which people and technologies interact collaboratively. Ethnomethodology actually does not assume what an individual can and cannot do before they act in local settings; it views their capabilities and competencies in the specific situations within which they participate (Rawls 2008). One response would be to extend this to seriously consider how technologies feature in the configuration of these situations and, in turn, how they produce certain effects from their collaboration in these settings.

This foregrounds an interest in exactly how the control room deals with the ambivalence and uncertainty that mark events of disruption, owing to the

interdependency of humans and nonhumans to make things happen that would otherwise be a near impossibility.

3.4. Conclusion: Networks, Disruptions and Workplaces

“We will enter facts and machines while they are in the making; we will carry with us no preconceptions of what constitutes knowledge.” (Latour 1987:13)

This chapter set out to find a way forward to the problem of researching the practical accomplishment of movement to form an understanding of how it is organised and ordered in situated ways. Two concerns oriented this chapter: the first was the matter of how the motorway network can be framed in such a way that does not privilege the role of humans or technologies in making movement happen and the second was how the organisation of movement can be understood as an ongoing yet situated practical accomplishment. This chapter began with a discussion of network topology as it is well known to transport geographers and used in a substantive sense by members of the Highways Agency. It was suggested, however, that despite transport geography’s awareness that multiple network topologies exist, and how this has consequences for the relationship between their spatial arrangement and level of connectivity, it is ultimately limited by its categorisation into nodes and links. This differs to actor network theory’s network topology which analyses the material heterogeneity of transport networks beyond that of nodes and links and asks questions of how they are produced, maintained and ordered through the processes of network building. Actor network theory, then, provided an approach that remained sensitive to the topological concerns of transport geography, as well as the study of networks *as networks* in a material

sense, while it opened up analysis to questions of its organisation and practical accomplishment. This is because it treats networks as actively ordered through the associations it maintains between heterogeneous relations and its stability is achieved as an effect of those relations. Asking the question of how exactly is this done is permitted within an actor network theory approach.

In the context of the motorway network, its junctions, interchanges and roadways – its nodes and links – can be extended to include a distributed network of materially heterogeneous entities, ranging from human traffic operators and drivers, rules and regulations, traffic capture devices, roadways, CCTV, signs and signals and emergency responders. The relations they perform constitute who they are and what they can do as participants in the network, which helps to move away from the overtly technical descriptions of automated traffic management technologies or ICT use that pervade transport geography research on the one hand, and other studies more commonly associated with new mobilities research that privilege human experience above all else, on the other hand. The capacity to act is decentred from this or that individual subject and it is instead achieved as a relational effect that disperses throughout the network as a result of configurations of human and nonhuman entities. These relations are accomplishments and because they are not predictably or naturally given, they require continuous effort to maintain their order. They have to be worked at to work – some endure, others change. This has consequences for understanding the relations between proximity and distance, presence and absence and big and small which emerge as relational effects sensitive to local conditions, rather than being predetermined or attributed

natural distinctions. In this sense, the centre and periphery structure that describes the arrangement of many networks, including those made up of nodes and links, is no longer considered to be hierarchical, where control is located within the centre. Instead, they are precarious and practical accomplishments whereby agency is delegated and dispersed through the associations it keeps.

The main consequence of this version of network topology is that it makes possible the study of how a more or less stable centre can maintain access to a spatially dispersed network in order to organise and manage its own practical accomplishment. This is not only a key concern of actor network theory but it has also become a topic of study in its own right within CSCW research and workplace studies. This is why this chapter then moved on to discuss the merits of a particular collection of studies known as centre of coordination studies. Spurred on by the interests of Suchman (1993, 1995), these studies explore the relationship between a centre, such as a control room, and its wider network to overcome the spatial and temporal challenges of coordinating activities between physically dispersed participants. Rather than emphasising the associations between elements like actor network theory does, workplace studies analyses the interactional detail between participants of a setting as they work hard to accomplish workplace order. This is partly a commitment to the respecification of concepts that have become entrenched in their use in a design context by observing the actual situated interaction between people and technologies. They are interested in how co-located participants in the control room maintain a level of mutual intelligibility to enable them to maintain the stability of the centre to provide a point of contact to

which all kinds of physically distributed participants can orient themselves. These studies go some way towards recognising how this work necessarily features technology, because without it they would not be able to access the network from a distance and communicate with participants within it. However, the limitations of this approach come from its privileging of social interaction; the order of the setting is achieved by virtue of the talk, gesture and bodily comportment of humans that takes place within it, which is only ever organised around technology use or mediated by it. Technology's role here is limited to a 'tool' that enables, mediates or supports human interaction; the creative effects that can emerge through its use are underplayed or ignored. In turn, the cooperative and coordinative work they describe is distinctly human, which is accomplished either between co-located participants in the control room setting or between an operator and another participant who is located at a distance. Taking telephone calls of incident reports and checking CCTV are examples of people and technology working jointly to maintain the intelligibility of the setting both across spatial distances and in real time – following current analytical trends in centre of coordination studies, this work would risk being overlooked in favour of social interaction in the form of cooperative and coordinative work. The chapter suggested that a way beyond this was to emphasise the interdependency between people and technologies by attending to the collaborative nature of their work, to overcome the association of cooperation with the work of co-located people working together and coordination with the arrangement of people's activities over space in line with each other.

The value of thinking collaboratively will be discussed in more detail in Chapter 5 by analysing a number of empirical examples from the Highways Agency motorway control room that focus on the interactions between people and technologies in the management of incident response work. For now, the next chapter explores ethnomethodology in more detail as a study of the methods participants of a setting use to maintain an intelligible order for their actions. Ethnomethodology has been particularly influential within workplace studies given its orientation to the social interactions that comprise settings through empirically detailed descriptions of those settings. Chapter 4 discusses how an ethnomethodological approach can further an understanding of how the motorway control room actually works to maintain orderly traffic movements in spite of the constant threat of disruption. Ethnomethodology not only provides the analytical tools with which to put into practice a break from conventional ways of thinking about transport networks but it also shows how empirically rich descriptions of settings can reveal their moment-to-moment accomplishment.

Chapter 4

Researching Movement

4.1. Introducing Ethnomethodology

The aim of this chapter is to consider how the problem of accomplishing movement can be addressed in the empirical setting of the Highways Agency's motorway control room by adopting an ethnomethodological approach. It pushes off from the previous chapter which identified workplace studies as a highly competent analytical approach to work-in-action, given that it is primarily concerned with observing the interactional work that goes on in settings to show how their local orders are precarious practical accomplishments (Button 1993; Crabtree 2001; Luff, Hindmarsh and Heath 2000). It was suggested that this interest in the accomplished orderliness of workplace settings is not unique to workplace studies, but it is in fact indebted to the broader analytical project of ethnomethodology. It is ethnomethodology that inspires a commitment to studying the intricate details of occasioned interaction between participants in a setting, in real time, and develops an interest in how participants make sense of what is going on and what they should do next in the practice of creating mutually intelligible orders. It signals a point of transition between actor network theory and its analysis of the process of network building and ethnomethodology as the study of practical action. This chapter, then, discusses in detail how ethnomethodology provides an orientation to the practical accomplishment of movement and considers the ways in which it is appropriate for a study of road transport.

This necessarily involves a return to the double-inadequacy problem that has been previously discussed in relation to the prevailing treatment of movement in the social sciences. This challenge is made on the grounds that social research has persistently neglected questions about movement as a first order construct, tending to take its practical accomplishment for granted. Although it starts from an understanding of the world in process, new mobilities research has been shown to be predisposed to thinking of movement as a social fact to form a primary lens for the study of authentic human experience. In transport research, its propensity to abstract and generalise about traffic movements embodies an implicit suspicion of those movements deemed to be superfluous, complex, unpredictable or unmanageable. Disruptions, such as congestion or road traffic collisions, remain unremarkable phenomena in their own terms except for their problematisation as threats to the economy of movement, which results in the application of technical solutions into professional transport settings that remain elusive. It is ironic that given traffic moves through space, it is possible that it encounters a range of situational contingencies and has to manage these in the production of its own movement, yet the specific methods that deal with these contingencies are persistently missing from its analysis.

Given that they both preclude the question of practical accomplishment, the problem of movement demands an alternative framing to help respecify it. It is proposed that an alternative can be found in ethnomethodology. The origins of ethnomethodology will be introduced first as a way of understanding how the approach provides an epistemological break to conventional modes of thinking that

many researchers from diverse disciplinary backgrounds have found valuable. As it will be discussed, this does not necessarily mean that the researcher has to commit to following a strict version of the ethnomethodological programme, which is arguably one of its attractions. In this light, a version of ethnomethodology will be outlined here in terms of its key principles and what they offer a study of road transport and its subsequent analysis as part of this research. Most notable are the principles of work, vulgar competency and indexicality which begin to situate an account of the practical accomplishment of movement within the realm of the possible. At the same time, this will provide a space to pause and reflect on the exact meaning of associated terminology, such as work, inquiry, member, indexicality and reflexivity which, while being common to the professional ethnomethodologist's vocabulary, are easily confused with their common sense usage to those unfamiliar with the approach.³⁵

The chapter also details the extensive empirical investigation that was undertaken for this research. Over the course of a year, visits were carried out to each of the seven RCCs in England, comprising control room observations and interviews with operational managers, team managers and operators. Two week-long pilot studies were also conducted in the North East RCC and the East RCC as part of a familiarisation and feasibility exercise in preparation for a sustained period of observation. A five month period of sustained observation was carried out in control room of the West Midlands RCC, totalling 480 hours of observation. This was combined with a month observing traffic operator training in the Traffic

³⁵ Learning the characteristic literary style of ethnomethodology through the research is part of doing ethnomethodology.

Learning Centre (TLC) and three weeks observing the control room in the NTCC. Reflecting on the experience of conducting an ethnomethodological study, this chapter will explore a number of practical issues that arose during the course of the research and discuss the techniques employed to manage them. They include the challenge of observing work in the motorway control room as a non-expert, given that it is a setting that requires a level of professional knowledge to participate within it, and the difficulty experienced in convincing workers of the value of their day-to-day work without them having to default to telling general stories about it. This chapter will account for those experiences.

4.1.1. The Origins of Ethnomethodology

To begin, an insight into the origins of ethnomethodology is a useful way of explaining how the approach provides an epistemological break from traditional sociological modes of thinking and why it has been taken up in other disciplines. Ethnomethodology derives from the investigations and experiments conducted by Harold Garfinkel in the 1950s and 1960s. They are collated in the published works *Studies in Ethnomethodology* (Garfinkel 1967), which is widely regarded as the foundational text of the approach, albeit ethnomethodology is by no means a standardised or procedural research exercise.³⁶ It comprised a radical critique of traditional sociology that sought to break from its preoccupation with classical sociological concerns. Questions of power, the division of labour and patriarchy had become default legitimate frames of study on the grounds that they were deemed to be sociologically interesting. For Garfinkel, and indeed others at the

³⁶ Comprehensive histories of ethnomethodology can be found elsewhere (Flynn 1991; Leiter 1980; Mullins 1973; Sharrock and Anderson 1986).

time, this kind of sociological theorising takes place to the detriment of the analysis of what actually happens in empirical settings because they assume a pre-existing world of structures, rules and norms that govern social interaction.³⁷ The sociologist, then, in his or her quest to produce theories about the social world, works to explain away observable behaviours as expressions of other social forces in action rather than tending to them as topics in their own right (Garfinkel and Wieder 1992).

This has direct implications for the status of social facts. Rather than existing independently as objective and stable facts about the world that are abstracted by sociological methods from a position of privilege, Garfinkel's work strives to show how they are actively produced by people through their ordinary activities as they are made relevant to those people according to the situated circumstances of their production.³⁸ As Pollner (1974:27) explains, "[w]here others might see 'things', 'givens' or 'facts of life', the ethnomethodologist sees (or attempts to see) *process*: the process through which the perceivedly stable features of socially organised environments are continually created and sustained." In this sense, its basic understanding of the world is one that is first and foremost locally constituted. What we can say about the world, only matters in the ways in which it is made relevant to members of a setting in the specific circumstances of it being made relevant. Those structures, rules and norms of traditional sociology become

³⁷ For example, Harvey Sacks, who is best known for his pioneering work on conversation analysis in the 1960s and 1970s (see Silverman 1998).

³⁸ At the very beginning of *Studies* he states that "in contrast to certain versions of Durkheim that teach that the objective reality of social facts is sociology's fundamental principle, the lesson is taken instead, and used as a study policy, that the objective reality of social facts *as* an ongoing accomplishment of the concerted activities of daily life, with the ordinary, artful ways of that accomplishment being by members known, used, and taken for granted, is, for members doing sociology, a fundamental phenomenon" (Garfinkel 1967:vii).

problems of practical accomplishment for Garfinkel; that is, how they appear as stable arrangements is matter of the continuous accomplishment of members' work. This means that ethnomethodology is through and through an empirically focused programme with rigorous attention to the details of its intensely human and situated accomplishment.

For Garfinkel, ethnomethodology was intended to provide a much needed alternative to classical sociological theorising by disrupting the way ordinary practical action was studied and valued. This meant denouncing the construction of general theories, categorical analysis of phenomena and application of standard methods that were inattentive to the situatedness of that phenomenon (Garfinkel 2002). In fact, ethnomethodology does not judge the adequacy of any social theory as a representation of what society is *really like* because it positions itself as indifferent to those concerns. This indifference means that ethnomethodologists tend to eschew questions of their ontological and theoretical commitments and they deny its existence as a methodology as if 'an ethnomethodology' existed. Hilbert (2009) suggests that it is possible to deduce a convincing argument of its ontology from what it strives to show that society is not – it is not governed by structures, rules and norms that exist independently of social interaction and it is cannot be explained away by objective and decontextualised statements that are removed from common sense understandings of what really happens in settings. Musings on the ontological status of ethnomethodology does risk obscuring what ethnomethodology is really about; after all, its indifference is central to maintaining

openness to what counts as legitimate forms of knowledge as they emerge as relevant to the setting under observation.

If it is not a theory or a method, then ethnomethodology is best considered to be a set of principles or attitudes towards research which are by no means rigidly applied (see Flynn 1991 for a generational account of how ethnomethodological principles have been adopted and adapted). These principles persistently orient the researcher to the problem of social order as first and foremost an empirical problem in its situated and occasioned production. They inform the study of the ongoing methods, practices and competencies carried out by members of a particular setting in the production of recognisable and accountable social orders. Broken down into its two principle components, 'ethno' refers to all the members who participate in the setting (which, for the purpose of this research, includes traffic operators, technologies and procedures that are involved in the management of the motorway) and 'method' captures those ongoing practices of sensemaking (which, as it will later become clear, involves the activities of classifying, ordering, investigating, coordinating and so on) (Rawls 2008).³⁹ It therefore provides an analytical approach to understanding the orderly and accomplished nature of settings through the common sense practices and resources with and through which members make sense of what is currently going on, who is doing what and what should be done next. Ethnomethodologists are particularly interested in how members project their sensemaking activities for the very purposes of maintaining order and thus the intelligibility of a setting. As this chapter will go on to specify, the fact that these principles work differently to

³⁹ Also called ethnomethods.

theoretical ideas or conceptual tools means that an understanding of what really happens there can be revealed by observing work-in-action in elaborate detail. Its vocabulary of work, indexicality, inquiry and members' accounts, for example, are analytical tools to help get at these ordinary activities – to respecify entrenched ways of thinking about social phenomena – rather than extracting detail to fit pre-existing categories of analysis. The crucial point is that they do not explain away observable activity like a theoretical framework might do, but it ensures critical attention to, for example, the emergence of order (work), through words, actions and gestures that are uttered in situated circumstances (indexicality), which have to be made sense of (inquiry), through the production of members' accounts and in ways familiar to the setting within which it unfolds (reflexivity). Before these principles are considered in detail to meet the needs of the thesis in order to study movement with the frame practical accomplishment, a short reflection on the consequences of an ethnomethodologically-informed study for the phenomenon of road transport is given.

4.2. Ethnomethodology and the Motorway

“For ethnomethodology, traffic is an example of social order sui generis, a perspicuous instance of Durkheimian “social fact.”” (Lynch 1993:155)

In a similar line of inquiry to that of ethnomethodology, the previous chapters have discussed the conventional ways in which movement has been studied in the social sciences to date. It is sympathetic to established norms of knowledge making in those disciplines, which for transport geography is particularly apparent in the obligations of a professional vision and for mobilities research in

the primacy of the meaningful human subject who is constantly on the move. The consequence of this has been that the ordinary practices that maintain large scale traffic movements, such as the work of control room operators and technology to detect and monitor disruptions and the dispatch of emergency responders to attend incidents and manage traffic at the scene, have remained underanalysed despite their being constitutive of the actual practical accomplishment of movement in their management of threats to order. A focus on the nature of disruption, in particular, can show how it comprises unpredictable and often vague threats to the smooth order of road traffic in precise time-space configurations that must be managed by a set of artful practices that at least attempt to mitigate its effects. Ethnomethodology, then, provides a direct orientation to the problem of the local practical accomplishment of order which has been routinely missed in these studies. Presenting this research through direct observation and actual activity from the setting means that it does not produce generalised, smooth accounts of the work that takes place in a setting but instead it deals with the *real work* that occurs which may involve dealing with uncertainties and ambiguities when working out what to do next.

In response, this research moves into the motorway control rooms of the Highways Agency's TOS.⁴⁰ Gaining access to the Highways Agency was by no means an easy feat. My approach was careful and considered; it was an iterative process of building up an awareness of how the TOS was organised and a matter of getting to know the contents of its key terminology in order to meaningfully secure contacts in and negotiate visits to all RCCs. My first encounter with the TOS was a

⁴⁰ See appendix for the programme of key observations and meetings.

meeting with an on-road operations manager, stationed at a motorway compound in Durham, and a ride-out with a HATO patrol as it attended an incident. The purpose of this was to provide a basic grasp of the TOS in preparation for contacting the control room, but the ride-out also gave me an unrivalled introduction to incident management work and, in particular, the communicative and coordinative work necessary to maintain contact between the control room and those responders dispersed about the network. From there, I obtained a contact for the North East RCC and my first visit was scheduled in October 2009. This was followed by visits to the other six RCCs over the following year.

As a non-expert in the field, I was concerned that my unfamiliarity with the day-to-day life in the control room would present a stumbling block to securing access, so I coupled initial meetings with gatekeepers – the operations managers – with tours of the control room and mini observations of operators at their workstations as ethnographic encounters to maximise my own learning in the setting. At the workstation, the operator would show me how the various systems worked, displayed on multiple screens, and talk about their responsibilities within the control room. As variations on those “format[s] of extrinsic description” that Lynch (1985:10) talks about, these introductory meetings and tours consisted of general talk *about* the work of the control room for me as a visitor. This talk about work was invaluable insofar as it provided a general understanding of the organisation and operation of the TOS, but it ultimately glossed over the actual work that occurs there in situated ways. Following these visits, I secured two week-long pilot studies in the North East RCC and the East RCC, which served primarily as

familiarisation exercises with the real time work of operators and trials of techniques for data capture.⁴¹

The decision to undertake a longer period of observation in the control room came about during the pilot studies to address the need for both breadth and depth in knowledge to understand the significance of practical actions. The unpredictability observed in the occurrence of disruption and incident management work meant that time had to be invested in order to improve the chance of covering a range of activities, including the management of both planned events and unplanned incidents.⁴² This was also influenced by what operators told me about the mundanity of their work; if I wanted to see something happen, I had to spend more time there. In turn, the more time spent in the control room lends a certain luxury of time to pause and consider actions for their ethnomethodological significance. This was particularly important given that this research did not rely on the use of audio-visual recording methods that provide the researcher with the ability to pause, rewind and playback those instances of interaction.⁴³

The West Midlands RCC was selected as the main empirical focus of this research for a period totalling five months of observation. This choice was based

⁴¹ Site choice was somewhat incidental rather than deliberate, since it was dependent upon which RCCs were able to host a visit at that time. The pilot studies involved observation alongside control room operators, mirroring their shift patterns from 6am to 2pm and 2pm to 10pm as the week progressed and they were interwoven with interviews of members of operational staff.

⁴² Planned events are future events on the motorway network that are known about in advance. They include roadworks, the movement of abnormal loads on the network, road closures, maintenance works and public entertainment and sports events. A planned event necessarily entails some sort of disruption to traffic, which includes reduced carriageway capacity (as a result of live lane roadworks) or increased traffic demand (travelling to special events). Unplanned incidents are any instances of disruption to traffic which are unpredictable, such as road traffic collisions, vehicle breakdowns and fallen debris.

⁴³ Audio-visual methods were prohibited in the West Midlands RCC given the proximity of Highway Agency control room operators to police operators representing the Central Motorway Police Group (CMPG) and the likelihood of picking up sensitive police information on a recording device.

on a number of reasons. The West Midlands motorway road network is the third busiest region in England based on vehicle miles (DfT 2011c), so it has the potential of producing more opportunities of disruption for me to observe compared to other regions. At the time, it was also the only control room to have a Managed Motorway scheme, providing a variety of traffic management techniques to observe.⁴⁴ From a pragmatic perspective, the TLC and the NTCC are located in close spatial proximity to the West Midlands RCC, meaning that I could be flexible in arranging visits to them while still committing to sustained observation in the control room of the RCC. The majority of my time was spent observing activities within the live control room, plugged into the telephone and radio transmissions with a headset, with periods of observation typically lasting between 6 and 8 hours.⁴⁵ Start and finish times varied, with observations tending to mirror shift patterns, which ran from 6am to 2pm and 2pm to 10pm.⁴⁶ Approximately 480 hours of observation took place in the West Midlands RCC. I also interweaved a month-long period of operator training at the TLC and a three-week period of observation at the NTCC. Before an account is given of how these observations were recorded and analysed, the sections that immediately follow refer back to the ethnomethodological principles previously mentioned that shape and inform this research to demonstrate how a sense of movement as a practical accomplishment can emerge from the activities of control room operators.

⁴⁴ Managed motorways is an ATM scheme that enables variable speed limits to be applied in real time and the hard shoulder to be opened as a live lane in periods of congested traffic. The first section of motorway to operate managed motorways was junction 3a to 7 on the M42, Birmingham.

⁴⁵ Other opportunities included 'bumping into' visitors to the control room which often sparked conversational encounters that led to new ideas, new leads, invitations to meetings and events.

⁴⁶ Night shift, 10pm to 6am, was not observed.

4.2.1. Ethnomethodology and its Principles: The Significance of Work

“Work is involved in recognising things for what they are, for accomplishing the ordinary facticity of scenes and settings, and it is going on in all forms of practical action.” (Fox 2006:435)

The ethnomethodological principle of work is used in a broad sense to capture the sheer effort that goes into the maintenance of order of everyday settings and social scenes.⁴⁷ Consequently, whenever an ethnomethodologist refers to work, they broadly refer to the accomplishment of *whatever* is done in the setting under study, which in turn can be applied to any situated action *wherever* it takes place, without imposing any prior classification of what counts as legitimate work practice in the first instance. For Sacks (1992: 414), it is the case that

“if you extend the analogy of what you obviously think of as work – as whatever it is that takes analytic, intellectual, emotional energy – then you will be able to see that all sorts of normalised things, for example, personal characteristics and the like, are jobs that are done, that took some kind of effort, training, and so on.”

In effect, the production of everyday scenes is considered to be work because all (social) interactions constituting the scene involve some kind of effort to maintain their intelligibility. This work encompasses whatever people are doing so that the “false starts, interruptions, digressions, and glitches, which are aspects of all activities, are notable features of the phenomena, not so much “noise” to be eliminated in order to reveal sociologically relevant aspects of the data” (Crabtree et al. 2000:673). As previously discussed in Chapter 2, this *whatever* of work

⁴⁷ Similarly, practice is used in a broad sense to highlight the grounded nature of its accomplishment (Büscher et al. 2001; Büscher 2006; Fernaeus et al. 2008; Garfinkel and Sacks 1986).

cannot be adequately captured by flow-charts that represent discrete tasks conducted in a linear fashion, categorised by incident type or by technical specifications that detail solutions to generic transport problems based on traffic flow forecasts. This requires observation of actual practices of doing traffic management through the work of incident management specifically, in the control room, to reveal how the work of operators is made real and accountable in operators' own terms, rather than relying on second-order technical reports about that work.

The principle of work enables the ethnomethodologist to make the crucial point that all phenomena are created and maintained by common sense reasoning as a first order construct; the fact that they may be conceived as an ordinary conversation, an emergency response call or an incident detection emerges as a precarious effect of the locally situated and accomplished sensemaking of its participants.⁴⁸ This is the work that comprises the 'seen but unnoticed' features of everyday life (Garfinkel 1967) – occasioned talk, bodily gestures, glances and so on. They are exclusively members' phenomena and they are common to all settings, regardless of whether they are deemed to be a traditional workplace or not. This is of paramount importance to this research if it is to grasp movement in its ongoing accomplishment; with the principle of work it is possible to study the work of operators as constituted of activities like diagnosing, investigating and dealing with

⁴⁸ For conversation analysts, for example, talk is a practical activity and a topic worthy of study in its own right. They are not interested in the speakers or listeners as participants in the conversation *per se*, or the conversation as a relation between those participants, but rather their analysis focuses on how talk is accomplished through each and every utterance, how those utterances relate to each other and how turns at talk are taken. Talk has a form, but this form is not known in advance –the maintenance of a conversational order, therefore, is a contingent practice. What is actually talked about is of secondary importance; talk is studied as talk itself as an organised phenomenon (Sharrock and Anderson 1986).

interruptions that do not fit models or flow-charts but are nevertheless shown to be legitimate activities of the setting that enable an intelligible order to be maintained.

Therefore, the fact that ethnomethodological studies tend to focus on professional workplace settings should not mislead the reader into thinking that they are only worthy of study because of the expertise we may expect to find there – for this would completely miss out on the value of ethnomethodology as the study of the practical accomplishment of settings through whatever work that members do as common sense competencies. The implication of this for workplace settings, when they come under the attention of the ethnomethodologist, is that any notion of work is freed from its default association with paid employment and the routine completion of a string of tasks according to a prescribed job specification (Barley and Kunda 2001; Boden 1994; Crabtree 2001; Orr 1996; Schegloff 1986). Such normative accounts of workplaces tend to base their descriptions on the organising effects that procedures, plans and rules have on the performance of work – they are deemed to be objectively fixed features of the workplace that successfully order and drive work activity. As Suchman notes (1995:56), [t]he way in which people work is not always apparent. Too often, assumptions are made as to how tasks are performed rather than unearthing the underlying work practices.” This is exemplary of ethnomethodological indifference and its insistence on avoiding formal categories and methods of analysis by refusing to commit to theoretical motivations from the very start. The control room, then, is not interesting because it is a site of paid employment, which would have broader

sociological interest, but it is interesting for the reason that it provides direct access to whatever activities maintain the orderliness of motorway traffic in spite of the threat of disruption. This makes a massive difference to the study of the motorway control room because the work of words, actions and gestures all matter to an understanding of how order is maintained there and how this contributes to the production of orderly traffic movements.

4.2.2. The Problem of Talk and the Importance of Members' Methods and Accounts

"Life at work is a staple in our conversation, but we rarely talk about what we really do in the doing of the job" (Orr 1996:1)

The principle of work explicitly highlights the value of *whatever* happens, *wherever*, for the attention of the ethnomethodologist. Once in the control room, however, the tendency for operators to talk *about* their work quickly became apparent. This is problematic for any ethnomethodologist because it takes the emphasis away from the *whatever* of what an operator does, because the operator selects what aspects of their work they want to talk about and often choose topics they believe the researcher wants to hear (see also Harper 2000). In the motorway control room, operators found it interesting to talk about the mundanity of their work in a most general sense. Adam says that "nothing much interesting happens. We just get on with our job." For Paul, work is "what we do, day in day out. We answer emergency calls, we dispatch crews, we set signs and we tell people what's going on." He adds that "once you've seen a breakdown, you've seen them all." In effect this simplifies the activities they engage in and removes them from their

moment-by-moment accomplishment. This distrust in letting their actions speak for themselves, which is obviously at odds with an ethnomethodological appreciation of work as an ongoing accomplishment, is in fact commonly associated with this kind of study (see also Laurier and Philo 2003; Llewellyn and Spence 2009; Lynch 1985). The impulsion to talk generally about work, typically by highlighting its routine character, and surmising that ‘nothing much interesting happens,’ exists because people find their work uninteresting – it is familiar, somewhat routine, and therefore goes without comment.

Garfinkel (1967) tells us that individuals will always find the practicalities and competencies on which they habitually depend uninteresting exactly because they comprise the ‘seen but unnoticed’ resources of everyday life. In fact, they have little or no awareness of the contextualising character of their actions to make comment anyway (Coulon 1995). This is partly because members assume that anyone participating in the setting has a basic competency to recognise for themselves what is going on (Garfinkel 1967). This is reasonable given that common sense methods are directly observable and available for anyone participating in the setting; they are “for members omnipresent, unproblematic, and commonplace” (Garfinkel 1967:9).⁴⁹ As Hindmarsh and Pilnick (2007:1413) explain in their account of the work of anaesthetists, “participants do not notice the bodies of their colleagues in terms of an arm moving from left to right, or a head turning this way or that — rather they see the offer of help, the beginning of an intubation sequence or whatever.” They are necessary features of settings and as

⁴⁹ This is what Garfinkel means by a member anyway – it is not simply an individual, but an individual who is equipped with the know-how to participate in the setting. This enables them to interact in the setting to achieve mutually intelligibility.

such they are seldom, if ever, notable. Garfinkel (1967:8) goes on to point out that members are not at fault here because they cannot recognise the practical nature of their actions: “[t]o say they are “not interested” in the study of practical actions is not to complain, nor to point to an opportunity they miss, nor is it a disclosure of error, nor is it an ironic comment.” It is the case that their actions are deeply and effortlessly embedded in the accomplishment of everyday settings and so much so that they are taken for granted as constituent features of that setting. It is this apparent ease with which such settings are recognised as being this or that setting, comprising this or that action, without members being explicitly aware of what they are doing to make it happen, is what ethnomethodologists find so extraordinarily interesting about everyday settings.

This is a problem commonly associated with ethnomethodology. A solution lies in the ethnomethodological principle of members’ accounts. When ethnomethodologists refer to members’ methods and accounts, they do not mean members’ descriptions of what they do when they talk generally about ‘life at work’ (Orr 1996). This would remove work from its practical accomplishment. Members’ methods are those directly observable actions that constitute the setting according to the precise circumstances of their use and members’ accounts are formulations of those actions in situated circumstances. Coulon (1995:25-26) explains that:

“Contrary to what is sometimes asserted, ethnomethodologists do not regard actors’ accounts as descriptions of social reality. The analysis of these accounts is only useful for them insofar as it reveals in what way actors permanently reconstruct a fragile and precarious social order to understand each other and to be able to communicate. The property of these descriptions is not to describe the world, but to permanently reveal its constitution.”

This gives rise to an important distinction between general talk-about-work and talk-in-work. Ethnomethodological studies are therefore distinguished by their interest in talk-in-work, whereby talk is understood to be a constitutive part of the setting. Other resources include glances, bodily movements, pauses and hesitations in talk and interaction with objects which are also constitutive of its local order. Studying these resources in-action reveals “what was going on in it *for the participants, in its course*” (Schegloff 1997:174, original emphasis). After all, the practical accomplishment of local order is exclusively a members’ phenomenon insofar as “the ordinary activities we study as analysts have already been situated, by those who produced them” (Llewellyn and Spence 2009:1420). This means that analysis must emerge from their situated use.

In turn, the centrality of members’ accounts means that the researcher cannot occupy a privileged position from which to generalise about what they observe or talk from a theoretically motivated perspective. In the previous chapter, the question “Where are the operators?” was posed. The reason for their systematic absence in professional transport literature was suggested to be related to the institutionalised vision of professional transport researchers and their tendency to account for movement only as long as it fits into flow chart or model representations. In mobilities research, too, the quest to uncover the real meaning of mobility has neglected transport workplaces as legitimate empirical sites for studying movement as accomplished. The notion of members’ accounts then is of course central to Garfinkel’s proposition that ethnomethodology provides an alternative to formalised research procedure in its treatment of members’ accounts

as practical expressions of social reality *in-the-making*. It provides the opportunity to actually enter the worlds other approaches attempt to theorise about and supplement their studies with empirical findings.

4.2.3. Understanding Members' Methods: Learning to be a Traffic Operator

Lucy presses the button to transmit a new radio message. "Hotel Alpha to November-Echo-Two-Four, are you receiving over? New incident, marker post 10 over 1, A-1 Motorway, two vehicle R-T-C, live lane. Can I show you State Five, over?"

Lucy's radio message serves to demonstrate how common sense methods are deeply embedded in the moment-to-moment accomplishment of local order. To understand what Lucy is saying, and to position her talk in the course of doing incident management work, requires an appreciation of call signs, motorway location devices, incident short forms and status codes as well as their meaning according to their occasioned use. While Lucy is talking, she is simultaneously working at the interface of the incident log, using keyboard shortcuts to enter details quickly and to navigate the information it already contains, occasionally glancing at the map screen as it automatically updates the real time position of the patrol car she is liaising with.

Control room operators routinely rely on the use of radio speak ("Hotel Alpha to November Echo Two Four"), incident short forms (such as RTC for road traffic collision), priority grades and status codes, to coordinate this work and ensure intelligibility is achieved not only between their colleagues in close spatial proximity in the control room but also with motorists on the road, HATO patrols and emergency responders. In turn, most of this work happens at the operator's

workstation where they manage multiple computer screens displaying a number of software tools. Although I could tentatively follow interactional exchanges taking place between operators in the control room, listen to radio calls with patrol officers on the motorway, and observe the production of incident logs for sharing information, my ability to understand the relevancies of this or that action was significantly limited given my inadequate appreciation of general incident management talk (as it would be expected, nowhere is this publicly documented) and technical knowledge of the software programmes. This of course can be clarified by questioning or interviewing participants after observing it happen, but this does not emerge from the action itself in real time, and runs the risk of diverting attention away from the course of action as it is now unfolding in order to talk about something else. Understanding short forms and tracing interactions at the screen – such as the purpose of a mouse click or press of a keyboard shortcut – is made more difficult by the fact that they are fleeting phenomena; they come and go quickly as the operator moves on to the next action, which limits the opportunity to ask questions of participants. This means that common sense resources, which operators themselves take for granted, must be at the researcher's disposal.

Getting to grips with members' methods in the control room is complicated by the fact that I am a non-expert in a setting that requires participants to have at least achieved a basic level of professional knowledge. While it is acknowledged that to study ethnomethodology does not require any formal training (after all, it is the study of common sense methods that are common to all settings), the

researcher must have an adequate understanding of the setting under study to enable them to follow its course of action. As Crabtree (2001:2, original emphasis) puts it, ethnomethodology is “after all, a very ordinary craft that anyone may master. Workplace study requires no special methods, no scientific expertise. What it does demand is that the analyst *develop* [sic] *competence in the work under study.*” It is reasonable to accept that there will be some settings that require an understanding of its specialised aspects before a researcher can adequately make sense of what is going on there. Garfinkel and Wieder (1992:182, original emphasis) call this the principle of unique adequacy whereby the ethnomethodologist must achieve at least a level of ‘vulgar competence’ to observe within the setting:

“the requirement that for the analyst to recognise, or identify, or follow the development of, or describe phenomena of order in local production of coherent detail the analyst must be *vulgarly* competent in the local production and reflexively natural accountability of the phenomenon of order he is “studying.” We will replace the abbreviation “studying” with the specific requirement that the analyst be, with others, in a concerted competence of methods with which to recognise, identify, follow, display, and describe phenomena of order in local productions of coherent detail. These methods are uniquely possessed in, and as of, the *object’s* endogenous local production and natural accountability.”

Vulgar competency is wholly necessary if the researcher expects to make sense of such actions and actively deal with the challenge of ambiguity found in all observations by becoming familiar with the possible range of meanings attached to this or that action. Congestion events are a good example of this because there is no straightforward or fixed way of defining it. As Chapter 6 will go on to discuss in detail, attempts to define congestion range from ‘slow but moving’ and ‘stop-start’

to ‘completely screwed’ traffic conditions, which are all open to multiple procedural based readings regarding what to do next. This is further complicated by the fact that individual actors involved in the work of diagnosing congestion – from traffic officers, operators, system-produced abnormal congestion alerts – have different background expectancies and experiences of what counts as congestion in this particular case. Should this event, described as ‘stop-start,’ be diagnosed as an incident requiring incident management intervention? Or is it just typical traffic conditions for the location and time of day? Recalling Coulon’s (1995) insight, even when the meaning of a word, gesture of action is observed in the context within which it emerges, this does not guarantee the removal of ambiguity and a range of potential meanings can still exist. Ethnomethodology helps the researcher to deal with ambiguity because rather than it being symptomatic of an inadequate theoretical framing or insufficient categories of analysis, and therefore a matter for the researcher to resolve the ambiguous matter, it is actually an accepted and expected feature of situated action. Ethnomethodology shows the researcher that it is only by following the course of action that the ambiguity of this or that word, gesture or action makes sense. It is not in the researcher’s job description to remove this ambiguity, but rather to work with it and reveal how it is managed and resolved by participants in the setting. This is why it is important that the researcher becomes a competent member of the setting in order to find the most appropriate way of revealing its common sense methods without imposing an explanation which is external to the setting.⁵⁰

⁵⁰ Some ethnomethodologists insist on doing whatever it takes to render common sense methods visible, especially in everyday settings that are overly familiar to them. Garfinkel’s (1967) breaching

In response, I negotiated access to the TLC⁵¹ and secured the opportunity to take part in the training course for all new control room operator recruits.⁵² Similar to the strategy of “becoming the phenomenon” (Mehan and Wood 1975), more commonly associated with earlier ethnomethodological studies (Livingston 1986; Sudnow 1978), I anticipated that training to be a control room operator would introduce me to the practical know-how required to act like a member of the control room setting. Other studies have found this approach valuable for those very reasons (Martin and O’Neill 2011). I learnt how to create and populate an incident log, set traffic management signs and signals, make and take calls, use the radio, learn keyboard shortcuts, as well as putting into practice the legislative and organisational policies and procedures that give this work its accountable character by practising and performing group-led incident management scenarios. After all, by the very nature that they are members’ accounts, they are produced for recipients who are already familiar with the procedural technical details on the ongoing work. Operator training took place in the mock control room in the TLC. The mock control room is curiously familiar given that the workstations are more or less exact replicas of those in the live control room, but the room itself is stripped of general operator chatter, telephone ringing, radio transmissions and audible

experiments are perhaps the most infamous of these research strategies, while the use of ‘inverted lenses’ and prosthetic limbs to render the familiar strange are less widely documented (Mehan and Wood 1975).

⁵¹ The Traffic Learning Centre (TLC), run by the Highways Agency, provides training for new and existing traffic officers. It is located next to the West Midlands Regional Control Centre in Birmingham, UK. On-road training of traffic officers takes place at the Fire Service College in Moreton-in-Marsh, UK, where the use of a mock motorway is provided.

⁵² I took part in learning the Foundation Course, which is taught over four weeks. The first week is a general introduction to the Highways Agency, covering issues such as the objectives of the Traffic Officer Service, the principles of health and safety and other administrative concerns. The remaining three weeks are dedicated to technology training which takes place in the mock control room. The course concludes with a written and practical examination which all operators must pass before they commence one-to-one coaching in the live control room.

computer alerts. The telephone system and software programmes are disconnected from the national communications network, enabling learners to explore and play with the technologies available to them without the risk of affecting real time incident management. Trainee operators are gradually introduced to work practice, usually by one activity at a time – say making a telephone call, one expert skill at a time– such as hailing a traffic officer patrol using accepted radio prosody, or one software application at a time – for example populating the incident log. Most of this organised learning takes place through group demonstrations of technologies, individual step-by-step exercises and group simulations of incident scenarios. They are then expected to perform tasks that require multitasking, such as simultaneously taking a telephone call, discerning the relevant information and typing to update the incident log. The TLC is not intended to faithfully simulate live incident management work, but rather prepare delegates with basic competencies so that they are able to continue their training in the control room.

The practice of learning is itself a strategy that can reveal the common sense methods of operators – this is the stuff that operators just have to know to get by in the setting.⁵³ First of all, the opportunity to learn removes these activities from the contingency of practice so that they can be studied in relative isolation from the constant orientation to ‘what is next?’ which provokes action in the live control room setting. Therefore as a learner, equipped with a software training manual, there is time to navigate through the various levels of technical detail, exploring the

⁵³ See Hindmarsh and Pilnick (2007) and Martin and O’Neill (2011) for examples of ethnomethodological studies that find instances of learning a practical way of dealing with the invisibility of common sense methods.

array of icons and drop-down menus embedded in software applications that would exhaust the patience of any operator if such explanations were ever insisted upon in the live environment. In turn, it is possible to fathom how the automated ordering and sorting practices embedded in the software work in relation to the actions of the operator. As I developed my technical knowledge of the software programmes through personal use, I removed the need to interrupt operators to ask them to explain what they had just done.

Second, those activities associated with hands-on learning of this kind, such as asking questions, making mistakes and engaging in trial and error, throws the phenomenon of incident management work into sharp relief by providing invaluable interruptions to the common sense understanding taken for granted in the live control room. What does this mean? How do I do that? What should I write here? How should this be prioritised? Why have you done that? Learning is an effective way of revealing the invisibility of common sense methods.⁵⁴ The luxury of time afforded in the mock control room also enables learners to pause at these moments and open up active discussion with others. As a learner, I benefited from unmediated access to the common sense methods that operators draw on to do their work in an intelligible way, which would later become the topic of my study when I returned to the control room, albeit I was performing in a learning environment and not the live control room. I was the one creating incident logs, making radio transmissions, deciding on priorities and classification grades, and

⁵⁴ Of course, the practice of learning is not spatially confined to the mock control room, nor does it only involve new recruits. It is evident in the live control room as new incidents take place, procedures change or actions are questioned or challenged as a way of making sense of them.

finding myself justifying those very actions to my peers.⁵⁵ What also became increasingly significant was the importance of those actions according to their specific circumstances of use; they simply could not be predetermined. Creating an incident log, for example, was never done in exactly the same way each time, the decision to grade an incident depended on a range of contextual information, and the sharing of the information was occasioned by other operators' availability and attentiveness to other incidents taking place. For Garfinkel, this is captured by the principle of indexicality. It is a practical problem that every member has to manage in order to make sense of what this or that action means, right now, for the ensuing action. Indexicality, then, effectively opens up the realm of ordinary practice, as it occurs, to the analysis of the ethnomethodologist.

4.2.4. Analysing Work-in-Action: The Principle of Indexicality

The crux of the matter for ethnomethodologists is to show how this or that utterance, this or that glance, this or that gesture, is demonstrably relevant to the course of action. This involves the analysis of how actions are situated according to the precise circumstances of their delivery and their consequence for the sequential ordering of other actions that make up the setting. This is otherwise referred to as the indexical and reflexive character of actions, which helps ethnomethodologists analyse what each action is doing.

Indexicality refers to the indeterminacy of the meaning of a word, gesture or action when it is separated from the context of their actual production and use.

⁵⁵ This also acted like my initiation in the world of motorway incident management work. Once back in the control room, equipped with this knowledge and experience of practising incident management, operators were less likely to engage in general talk about work because I could understand the technical aspects of what else was going on.

Even when they are understood in context, as Coulon (1995) notes, this does not guarantee the removal of ambiguity in their potential meanings.⁵⁶ They are context bound (Garfinkel and Sacks 1986). In linguistics, indexical expressions are those such as 'I,' 'here,' and 'now,' which refer to a specific individual, place or moment in time. Without a relation to context, they would be meaningless. Making that link to a context to make them meaningful is exactly the 'seen but unnoticed' work that enables members of a setting to create precise meaning and intelligibility through practical action. This can be achieved through a range of sensemaking resources at their disposal, including talk, bodily gesture and interaction with objects. Consequently, this effort is always located, and an action takes on meaning only in relation to the peculiarities of time and space within which it is performed. It is therefore the case that "[t]he demonstrably rational properties of indexical expressions and indexical actions is an ongoing achievement of the organised activities of everyday life" (Garfinkel 1967:34).

For road transport, the principle of the indexical character of actions means that any ethnomethodological study of it must avoid analysing work activity according to predefined categories of tasks or stages in the management of an incident. It therefore speaks to the tendency to consider operator work by the conditions of the flowchart or traffic model in their attempt to rid settings of their indexicality. These flowcharts and models are then subsequently shared in the professional arena and put into practice as technical solutions independent of context. They are abstractions that deliberately detach themselves from situational

⁵⁶ Some ethnomethodologists talk about the 'et cetera clause.' This refers to the fact that individuals engaged in an interaction often tacitly accept the meaning of what is said by treating their descriptions as obvious, even if they are not, and let subsequent actions verify that meaning.

contingencies; they cannot capture the characteristic nature of dealing with this incident compared to the next. The consequence of Garfinkel's ethnomethodological enterprise for road transport then is that instances of incident management work as observed through talk, gesture, interaction at the screen, and so on, have to be considered in relation to the actual circumstances of their delivery. An ethnomethodological perspective is sufficiently equipped to deal with those moments characterised as vague or ambiguous and analyse how they are reflexively tied to an understanding of the setting as part of members' work and how this emerges over the course of action. It therefore helps the thesis to express the practically accomplished and methodical character of incident management work and motorway traffic movements. After all, actions can overlap, change order, and iterate between one form and another; it is about understanding how they occur in practice.

In order to make sense of indexicality, however, ethnomethodologists propose that there must be some kind of interpretive background work going on that makes those indexical activities recognisable as part of the setting. This is the work of reflexivity. Reflexivity refers to the way in which practical reasoning is constituted locally as an ongoing accomplishment, whereby the context of the setting in which actions are performed continually comes back to influence those actions as an iterative and contingent process.⁵⁷ It captures the "practical ways in which people orient to what some practice might consist of, its moral components, identities and asymmetries, in and through the way in which ordinary activities are

⁵⁷ Garfinkel's (1967) use of the term reflexivity should not be confused with reflection or self-consciousness, as is its common meaning in social research, since members of a setting do not think about what they are doing and they are not interested in theorising about their actions.

produced, how people walk, gesture, glance, talk and so on” (Llewellyn and Spence 2009:1421). Reflexivity, then, helps to sustain the methodical quality of settings by enabling members to orient themselves to the setting as *obviously this or that* setting. This is what provides a background of parameters that define acceptable and recognisable conduct and, because members are able to orient themselves to this background, they can determine how their actions are likely to be identified and responded to by other participants of the setting as a legitimate part of its practice.

The result is the iteration between “describing and producing an action, between its comprehension and the expression of this comprehension” (Coulon 1995:23), which constantly enlivens the performance of scenes and thus can only be observed in situ. This goes on in all settings by the very fact that they are all bound by the contingency of practice, from the simplest of conversational exchanges, to the most competent performances (see Sacks, Schegloff and Jefferson 1974; Sudnow 1978). As Fox (2006:431) explains,

“[a] consummate public performance always has the suspense of a tight-rope journey even when its [sic] clear what it aims to do or where it aims to go, as in the case of a pianist playing a well-known piece. Practice does not make perfect. Each new occasion has some of the properties of a first time through.”

Therefore, any reference to the familiar or routine nature of work only emerges as that individual action is performed, as it is oriented to the practice of the setting, because the course of action can never be fully known in advance. This orderliness is ultimately subject to the “inner-temporal course of interpretive work” (Garfinkel

1967:25) and is realised only as a “continuous accomplishment of the actors” (Coulon 1995:16). Therefore each action is always performed each time anew. This requires work effort, which is ad hoc and improvised in response to situational contingencies, and an understanding of this can only emerge through analysis of those work actions through their situated and sequential accomplishment.⁵⁸

4.3. Observing Live Incident Management Work in the Motorway Control Room

It is about “paying to the most commonplace activities of daily life the attention usually accorded extraordinary events.” (Garfinkel 1967:1)

Once in the control room, the next challenge was to capture how the work of incident management is practically accomplished by analysing the relevance of this or that action for the accomplishment of the setting. In particular, I was interested in how disruptions are identified, diagnosed and then allocated resources by attending to the indexical and reflexive character of each action – this includes the relevance of this or that action in the sequential ordering of the course of action under observation and its reflexive properties that make it recognisable as an instance of incident management work.

4.3.1. Knowing What to Follow

The control room is characterised by simultaneously occurring work, given its delegated character. It is typical for two or more operators to be working on the same incident. For example, one operator is responsible for handling any telephone calls for the incident, which may include calls from members of the

⁵⁸ It is important to note that ad hoc considerations are by no means random or messy; they translate one stable and intelligible order into another according to real time circumstances (Lynch 2011).

public who are witnesses to the incident or calls to or from the emergency services to arrange attendance at the incident. One operator is responsible for dispatching HATO patrol cars to the incident scene using the radio. One operator is responsible for traffic management via sign and signal setting. These activities can take place more or less concurrently as operators are oriented to the time-critical nature of their work. This has obvious complications for note-taking – do you follow the actions performed by the operator at the workstation or follow the flow of the incident? This is difficult when you have to make real time judgements about which features of the emerging scene to take note of. In response, I found it necessary to organise my observations through a series of orienting moves – there are three in total – to maintain awareness of the breadth of activities going on there as well as attending to them in analytical detail (see also Suchman and Trigg 1991; Beyer and Holtzblatt 1998).

The first orientation focused on the work of the operator, which comprised sustained periods of observing the work of the call handler, traffic management operator, radio dispatcher and team manager at their individual workstations. They each have their own priorities and characteristic ways of working. This first orientation involved accounting for operator interactions at the screens and with technologies available at the workstation through the activities of reading the incident log, tracking patrol cars using the mapping software, answering ERTs, searching CCTV, and so on, and investigating how these activities were occasioned by the sequential organisation of activity in the control room. Periods of observation were also concentrated on micro bodily movements, such as gestures,

glances and utterances, which were considered in terms of their relevance to the ongoing action of the setting. The second orientation focused on the flow of the incident log, noting the actions through which it came into being, how it was managed, how it moved around the control room and how it was closed. Rather than observing from the static position of the operator at the workstation, I was free to move around the room to physically follow the log as operators created it, clicked on it, discussed it, passed it on and closed it. Analysis was directed at understanding at what points in the course of action do these actions occur, how they follow what has come before, how they shape what comes after and how are they shown to be demonstrably incident management work. These orientations were found to be mutually enhancing of my understanding of incident management work; after all, these activities do not occur independently of each other in the live environment.⁵⁹

My observations were instantly recorded in notebooks as they occurred,⁶⁰ which were subsequently written up after each day's period of observation. This was a practical necessity given the (il)legibility of some notes, especially in times of heightened activity when I attempted to scribble down as much detail about what was going on as possible. Much of what was noted down was messy and often jumped around the page – with arrows and asterisks to add extra details, make

⁵⁹ This doubly-situated character of sensemaking work in the motorway control room is discussed in Chapter 6.

⁶⁰ Not being permitted to record activity was not considered a problem since this research is not interested in ordinary conversation per se, which would require painstakingly detailed transcriptions, common to the tradition of conversation analysis (see for example Heath 1986; Heath and Luff 1992a; Luff, Heath and Sanchez Svensson 2008; Ross and Chiasson 2005; Zimmerman 1992). Even audio-visual methods of recording are subjected to similar limitations as note-taking; they cannot capture everything going on. The positioning of a camera inevitably involves framing issues and the risk that some interactions will be simply unreachable, out of the line of sight.

clarifications or include missing actions, inverted commas to denote speech, capital letters to show messages shared on the incident log and various abbreviations and shorthand forms. In turn, this produced a large quantity of written observations in numerous notebooks. Writing up gave me the opportunity to index observations by type for future reference and provide more detailed analysis of what was going on, as well as tackle any ambiguities or inconsistencies present in the notes themselves – produced by my own omissions of the course of action as I tried to note it as it occurred in real time. The need to supplement these observations with explanatory detail is somewhat attributable to their indexical character; an instance of talk, a gesture, a line of typed text from an incident log is meaningless without an explanation of the situation of its use. Take Figure 4.1, an extract from my field notebook, taken on the 27th April 2010:

11.22 'Another one!' RTC reported Area 9
 Lorry + car, poss h/s, m/p given JS-4a MS.
 Just as we're reading, crew vent out -
 (Can you check for us?) ^{on com} says RO
 JM looks LCN - shades up camera
 no. All 3 lanes ^{knows no. punches in}
 men rad - 'got u on camera, ^{several} ^{involved}
 one sideways', JM closing L3+2
 L3C intense state at (98)
 L2C return to CTC each time
 SET AT... B
 NICC AWARE
 And says NICC. 'we've got a big RTC'
 push through to ~~the~~ desk.
 we've got lane 2+3, from camera 7320.

drops camera on pass

Figure 4.1: An extract from the author's field diary, 26th April 2010

This extract details the actions of the traffic management operator (JM) at 11.22am that morning when he exclaims "Another one!" as a new road traffic collision has been reported. He reads out the pertinent details – the incident has been reported by an Area 9 contractor, it involves a lorry and a car, they are possibly positioned on the hard shoulder and an estimated location has been given. As JM reads through the log, I overhear on the radio that a crew has been dispatched to the location. At this point, the radio dispatch operator turns round to face JM and says "Can you check this for us?" This prompts JM to find the incident

on CCTV – a typical activity for any traffic management operator. He knows the camera numbers in the area from memory, which is shown by the arrow comment, and when he finds the incident, he shouts up the camera number for other operators to hear and then comments “All three lanes.” JM also ‘drops’ the camera feed directly on the radio dispatcher’s screen, also shown by the arrow comment. The radio dispatcher can be heard updating the patrol, “got it on camera, several vehicles involved, one sideways.” JM puts into action the traffic management at the scene, now that he has confirmed the incident is a high priority live lane (as opposed to a hard shoulder incident which would not necessarily require any traffic management intervention). He says out loud “I’m closing lane 3 and 2” and I note a period of concentration where he stares at the sign and signal system (COBS), which he follows by typing in the details of his sign setting as a log entry (L3C, L2C, SET AT ...B, NTCC AWARE). This additional information, provided by my vulgar competency in the setting, reflexively makes sense of these actions which otherwise would appear somewhat obscure, detached observations. This is because ethnomethodology encourages researchers to incrementally learn how to understand what is going on, juxtaposing words, actions, gestures, incident logs, CCTV feeds, screens and incident logs to begin to tease out the ways in which they relate to each other in real time. This is the work that helps operators to account for what is happening for coordinated incident management work to take place to mitigate the effects of disruption on traffic.

4.3.2. Knowing What Each Action is Doing

This work of finding something interesting to say about ordinary activities can seem odd given that they are 'ordinary' and commonplace activities; however, it is part of the ethnomethodological sensitivity to *whatever* occurs in the setting. Indeed Harvey Sacks (1987:56) quite famously said on the topic of researching the ordinary that:

“omnipresence and ready observability need not imply banality, and, therefore, silence. Nor should they only set off a search for exceptions or variation. Rather, we need to see that with some such mundane occurrences we are picking up things which are so overwhelmingly true that if we are to understand that sector of the world, they are something we will have to come to terms with.”

The interestingness of empirical data should not be considered a necessary requirement for their study, so researchers should not shy away from approaching empirical matter that is ordinary and familiar, which includes ordinary talk, bodily gestures, glances and interaction with objects, as they emerge through real time interaction. Sacks (1992:293) goes on to say that:

“in order to find its interestingness we have to find that whatever it is that's interesting about it is what we can say about it. And we can then develop a criteria of interestingness where we're not exploiting kinds of things we 'want to know about' – scandalous topics, gossip, etc.”

This is an obvious expression of Garfinkel's indifference to categories of analysis imposed on social settings as explanatory resources; the provocative act of selecting uninteresting data, then, serves to substantiate practical action as a topic in its own right.

The third orientation, then, is a response to this problem of finding analytic interest in something as commonplace as talking, making a gesture, looking at a screen and typing on a keyboard. It is an orientation to the practice of inquiry. Inquiry provides a resource for thinking about the ways in which members orient to prior and subsequent actions in settings where co-located participants do not have direct access to or complete knowledge of the situation with which they are expected to deal. Ethnomethodologists tend to refer to the work of inquiry as a form of troubleshooting that makes sense of conduct in everyday settings, since members are “continually engaged in having to decide, recognise, persuade, or make evident the rational i.e., the coherent, or consistent, or chosen, or planful, or effective, or methodical, or knowledgeable character of such activities of their inquiries as counting, graphing, interrogation, sampling, recording, reporting, planning, decision-making, and the rest” (Garfinkel 1967:32). In turn, competing versions of the reality of the setting can co-exist, so this work must also achieve a common understanding between members which is accountable and recognisable as practice. In the motorway control room, inquiry provides a resource to think through the work of managing uncertain situations, dealing with gaps in information or considering the trustworthiness and plausibility of information received. It can uncover how choices and decisions are accounted for, how information is assembled, checked, verified, and shared, and how subsequent moves are improvised and made to persuadably cohere (Garfinkel and Sacks 1986). Inquiry manifests itself through the ordinary activities of call taking, talking with colleagues, overhearing the radio transmissions, inputting information into the incident log, and so on.

The following example, taken from field notes and written in a loosely conversational ethnomethodological style, is an ordinary scene (RD is the radio dispatcher and CH is the call handler):

RD opens log.

RD: [Looking at log] Oh this is that breakdown, isn't it?

CH: Yeah.

RD scrolls down log and back up. RD closes log.

Nothing much appears to happen here, but once again it is necessary to explain the indexical quality of these actions. They follow an ERT call taken by the call handler. It is a routine vehicle breakdown, which means that the vehicle is in a safe position on the hard shoulder, with its hazard lights displaying and the two occupants of the vehicle are standing on the grass verge, behind the safety barrier, as advised. The call handler, after taking the driver's details, has arranged for the driver's breakdown recovery service to attend the scene. The occupants of the vehicle are waiting to be recovered and the call handler is monitoring the progress of the incident using CCTV. There is no obvious action for the radio dispatcher to take, given that the incident does not require the attendance of a HATO patrol; however, the radio dispatcher opens the log to have a momentary glance through its contents. As the radio dispatcher opens the log, she says "Oh this is that breakdown, isn't it?" and remains oriented towards the log. She knows that it is a routine breakdown, having overheard the call handler take the emergency call. In this sense, it is an action that appears to be fairly inconsequential to the obvious work of incident management because it is not occasioned by the need to dispatch a patrol to the scene, but with an orientation to the practice of inquiry, it is clear

how it becomes an integral feature of the intelligibility of the setting. The radio dispatcher makes it demonstrably obvious to the call handler that she knows about this incident, makes the effort to check the log, and thus her decision not to inform a HATO patrol of it is reasoned and accounted for by this very action. It also provides a conversational space within which the call handler, if she had any doubts over the choice of the radio dispatcher not to take action, could question her decision.

4.4. Conclusion: An Ethnomethodological Account of Road Transport

“In other words, the careful observation and analysis of the processes used in members’ actions will uncover the processes by which the actors constantly interpret social reality and invent life in a permanent tinkering. Therefore it is crucial to observe how, in a commonsense manner, actors produce and treat information in their exchanges and how they use language as a resource; in short, how they build up a “reasonable” world to be able to live in it.” (Coulon 1995:16-17)

Thinking back to actor network theory as the process of network building, this chapter has demonstrated how ethnomethodology offers a direct response to the problem of the practical accomplishment of movement through the detailed accounting of practical actions. The chapter began by explaining the reasoning behind Garfinkel’s ethnomethodological programme in response to the inadequacies present in sociological thinking at the time. This led to a neglect of ordinary activity as a topic of research in favour of big sociological themes made meaningful by the theoretical insight of the sociologist. A similar argument can be made for the treatment of movement in both transport and mobilities research to date, whereby their ontological positioning and professional research agendas tend

to eclipse questions of the practical accomplishment of movement from serious study. Ethnomethodology does not presume that a social reality pre-exists the activities that constitute it; rather, it understands the world of social reality to be locally constituted. This means that in order to develop knowledges of the world, the ethnomethodologist must observe these practical activities as they unfold according to their situational contingencies. With an interest in process, it is surprising that very few studies have attended to movement in the sense of its ongoing practical accomplishment – something which is continually negotiated as it naturally moves through space and time, managing whatever situational contingencies it encounters along the way.

To make an ethnomethodological account of road transport practically possible, this chapter then set out a number of key principles, or attitudes to research, from the approach. The principles of work, vulgar competency, members' accounts and indexicality were discussed in terms of their relevance for thinking how networks are ordered in local ways and disruptive events are managed through the lens of incident management work. The adequacy of ethnomethodology as an approach to responding to this problem is attributable to its core interest in revealing how phenomena are organised through ordinary sensemaking resources and activities. This brings into focus the epistemological problem of the invisibility of common sense knowledge. It involves a curious kind of iteration between the complex and the banal encompassing the challenge to manage the initial obscurity of settings, of which gaining basic competency is part of that challenge by 'becoming the phenomenon,' while maintaining sensitivity

towards its common sense production at the same time that the phenomenon becomes ever more familiar to you. This was considered alongside a reflection on my experience of training to be a control room operator and my strategies for managing periods of observation in the live control room through a series of orienting moves to its intricate details. An awareness of the relationship between the complex and the banal is wholly necessary to maintain rigour in accounting for its occasioned accomplishment.

Chapter 5

Detecting Disruption: Working with Technology in the Control Room

5.1. Disruption on the Motorway

The motorway control room shares many practical challenges in the accomplishment of its work with a range of settings collectively known as centres of coordination (Suchman 1993, 1997). Originating in the field of CSCW, these studies were introduced in Chapter 3 as a series of exemplary cases of how an ethnomethodological sensibility to the practical accomplishment of settings can reveal the ongoing intelligibility work necessary to maintain social order and manage local contingencies. As their name would suggest, this body of research highlights the coordinative challenges facing people working in *distributed* settings. This includes the work of co-located individuals as they coordinate a series of relatively discrete yet interconnected tasks, say between a call taker and a dispatcher in an emergency response centre (Ikeya 2003, Martin et al. 1997; Tjora 2004), and the work of spatially dispersed individuals as they coordinate their actions with the control room, say between a mobile station supervisor and a control room operator (Heath, Luff and Sanchez Svensson 2002; Luff and Heath 1998; Luff, Heath and Jirotko. 2000). However, while these studies provide rich empirical descriptions of how these settings are equipped to cope with the spatial and temporal challenges facing them, they tend to be predisposed to giving human-centred accounts that depend on an array of social practices and talk. This has

consequences for the treatment of technologies as they are presented as tools that 'enhance' and 'support' social interaction; they become secondary to, albeit implicated in, the practical accomplishment of social intelligibility (Heath and Luff 1992a). This chapter argues that such an approach to the treatment of technologies has generalising tendencies that repress a fuller understanding of the creative and transformative effects that technologies have on the accomplishment of other distributed settings.

This necessarily involves the question of what is at stake if the motorway control room is described in the same vein as other centres of coordination. The focus on *coordination*, as the timely bringing together of elements in space, has the potential to eclipse all other activities that are part of the control room's ability to coordinate work in the first place. This becomes acutely apparent when we enter the motorway control room to observe the work practices that are continuously oriented to the problem of identifying and detecting (potentially) disruptive events. The obvious point to make here is that in order to decide what to do about disruption on the motorway network, operators in the control room must know something about it. This is the *collaborative work* of incident detection, which means that however they assemble a sense of what is happening on the motorway network is irreducible to the individual operator or technology. It is specifically through the work of incident detection that this chapter sets out to reveal the interdependency that exists between control room operators and technology as they work together to deal with the challenge of substantive uncertainty. Making sense of what is happening now on the motorway and making appropriate

subsequent actions for its management is central to maintaining the priorities of the motorway control room for efficient and reliable traffic flow. Exactly how the motorway control room is organised to render instances of disruption available is a particular concern for this chapter.

Accordingly, this chapter presents the motorway control room as an alternative setting within which to break from these accounts organised around coordinative work practice by attending specifically to the work of incident detection. To begin, the chapter opens with a detailed description of the motorway control room. The purpose of this is twofold: it presents the empirical setting to the reader, which thus far has only been introduced in a preliminary sense through the naming of the people, technology and practices found within it, and it sets out to show in what ways the control room differs from other control rooms traditionally associated with the centre of coordination studies, both in terms of its material organisation and the specific operational challenges it faces. For example, compared to other control room settings where the emphasis is placed on the supportive role that communications technologies have in coordinating human conduct, the motorway control room is indebted to a heterogeneous range of sociotechnical relations that actually help to detect disruption in the first instance to enable coordination work to happen. Not only are disruptions reported by telephone and radio exchanges, which are typical of those other control room studies, but operators also work in close collaboration with data capture and visual technologies as part of this incident detection work. This is particularly striking in the case of MIDAS – the Motorway Incident Detection and Automatic Signalling

system. MIDAS, as this chapter will go on to discuss in detail, is a distributed network of traffic sensors that monitor traffic flow and produce alerts observable in the control room when traffic flow falls below a particular threshold. This work would be practically impossible if only human agents were tasked with the continuous real time monitoring of traffic flow across the motorway network; and at the very least for the burden it would place on existing resources. Consequently, this chapter finds in MIDAS an opportunity to render the mutual dependence between social and technical elements visible for the purpose of detecting disruption and actioning an appropriate response, in particular through the effects it has on the spatial and temporal aspects of managing the motorways (both over distance and in real time). In turn, this chapter will consider the role of other technology in the control room, including the network of CCTV cameras located across the motorway network and the various communications technologies used in conjunction. It is possible that technology can be just as much an active participant in the accomplishment of workplace settings as humans can, rather than risking the reduction of their contributions to the status of general tools that simply aid social interaction.

5.2. Centres of Coordination: What is at Stake?

The motorway control room, and the accomplishment of movement more specifically, provides a point of intervention into existing CSCW and workplace studies that think about technology exclusively in terms of how it supports social interaction. Such a move is necessary despite promising calls for a relational understanding of the sociotechnical organisation of workplace orders in workplace

studies itself. In an editorial prefacing a special issue of workplace studies, Heath and Button (2002) begin by saying that workplace studies “are not only concerned with the social organization of work and the workplace, and the relationship between work and organizations, but also with rethinking the distinction between the technical and social” (Heath and Button 2002:158). Thinking that this signals a more radical understanding of the transformative effects of humans and technologies working collaboratively, there is understandable disappointment when the authors follow this with a contradictory statement of analytical intent that implies their refusal to embrace a wholly alternative way of thinking about this relationship. They say workplace studies are ultimately interested in “placing socially organized practice and practicality at the heart of the analytic agenda” (Heath and Button 2002:158). ‘At the heart of the analytic agenda’ always already means that the ways in which they rethink the distinction between the social and technical cannot effectively transcend the divide it creates.

Of course, this should be considered in light of the intellectual origins of these studies and how they frame their problems. The origins of HCI in cognitive psychology and computer science meant that the forceful push towards the social was offered as a corrective to their treatment of technology in workplace settings. Some studies perpetuated a narrow conception of HCI as modelled by the individual sat at a workstation, thus neglecting the ways in which technology use is implicated in social interaction. Others privileged technology as self-sufficient solutions to workplace inefficiencies which were indiscriminately applied, regardless of existing ways of organising work. There was a number of high profile

cases of failing workplace technologies – the introduction of a computer aided dispatch (CAD) system in the London Ambulance Service in 1992 is a classic example (Finkelstein and Dowell 1996; Page et al. 1993) – which brought into sharp relief the inadequacy of current frames of thought for understanding the contextual nature of technology use. In sociology as well, there was a concerted effort to push for analyses of actual instances of work, rather than let its neglect perpetuate through the peddling of broader sociological problems, such as the division of labour or labour relations.

Although the framing of the workplace as a social setting can be considered a practical move devised to advance the design and development of effective technologies for workplaces (Button 1993; Luff, Hindmarsh and Heath 2000), and a respecification of sociological analyses of work (Heath and Button 2002), this major swing to the social has strong theoretical implications for understanding the relationship between the social and the technical that has remained largely overlooked (see Berg 1999a, 1999b for an exception). This is typical of centre of coordination studies. They are primarily concerned with the ways in which technologies 'feature' as tools that 'enhance' or 'support' social interaction in spatially distributed settings (Suchman 1993, 1995, 1997). Much of this research focuses on the communicability of settings that foster mutual awareness and support the "surreptitious monitoring" of each other's conduct (Heath and Luff 1992a:6). As such, they focus on micro-bodily movements, such as glancing, gesturing and the position of gaze, and talk-in-interaction, which is then interwoven with occasioned technology use, such as the shared use of computer screens or

maps to organise practice around. They include Bentley et al. (1992), Goodwin and Goodwin (1996), Harper and Hughes (1993) and Suchman (1997) on the use of flight strips in ATC to organise and mediate distributed activities, and Heath and Luff (1992a), Heath, Luff and Sanchez Svensson (2002) and Luff, Heath and Jirotko (2000) on the use of radio communication and CCTV to coordinate the movements of mobile supervisors in a London Underground station. These studies take an interest in wholly social endeavours – such as how a division of labour is accomplished between co-present colleagues in a control room setting (Artman and Waern 1999; Ikeya 2003, Martin et al. 1997; Tjora 2004; Fele 2008) or how social interaction is achieved at a distance, say between the centre and its spatially distributed colleagues for the coordination of work activities (Bergstrand 2011; Bergstrand and Landgren 2011; Heath, Luff and Sanchez Svensson 2002; Luff and Heath 1998; Landgren 2005, 2006; Luff, Heath and Jirotko 2000; Nevile 2004, 2009).⁶¹

These studies effectively demonstrate how the social aspects of organising workplaces are vitally important, but they risk ignoring the dynamically changing configuration of sociotechnical relations that perform the setting. An understanding of technology in a supportive role is troublesome insofar as it suggests that this interaction would take place anyway, as if they simply enhance already existing methods that humans use to communicate with one another. This

⁶¹ More recently, there have been studies focusing on the coordination work performed by mobile workers actually on the move, such as snow clearance personnel working at the airport and road inspectors, and how communications technologies feature in this work (Bardram and Bossen 2003; Bellotti and Bly 1996; Bertelsen and Bødker 2001; Christensen and Mark 2004; Esbjörnsson 2006; Esbjörnsson and Juhlin 2002; Juhlin and Weilenmann 2001; Kakihara, Sørensen and Wiberg 2005; Laurier 2004; Laurier and Philo 2003; Lundin and Magnusson 2003; Nilsson and Hertzum 2005; Normark and Esbjörnsson 2004). These studies attempt to decentre the centre of coordination to show how the geographical mobility of personnel disperses coordinative activity about the network.

is in part attributable to the influence of ethnomethodology; while it presents settings as situated and locally managed – most notably for the benefit of context-sensitive design and implementation of new technologies – it remains a discursive approach that struggles to treat technology as participants in the organisation of settings in terms equivalent to the social. As Rawls (2008) reminds us, ethnomethodology is not interested in attributing properties to the individual actor, but instead views their capabilities and competencies in the specific situations within which they participate – however the crucial role that technologies play in reconfiguring these competencies needs to be taken seriously. This is perpetuated by the focus on *coordination*, whereby technologies provide the functional means through which distributed settings are socially organised and interaction is accomplished. Here, coordination refers to the conduct of independent activities that are adjusted to and contingent upon the work of others (Heath and Luff 1992a; Heath, Hindmarsh and Luff 1999; Normark 2002; Rogers 1992, 1993).⁶² Distinctions are made between synchronous and asynchronous coordination and coordination at a distance and over distance to manage the timely spatiotemporal configuration of people, technologies and places in order to accomplish different sets of work activities – yet they share an interest in how technologies mediate this distance and support verbal and visual communication. Many of these studies also account for the ways in which people cope using technologies when they provide restricted, fragmented or asymmetrical access to the phenomenon they are coordinating (Heath, Hindmarsh and Luff 1999; Heath, Luff and Sanchez Svensson 2002).

⁶² Coordination and collaboration are preferred terms to cooperation in the literature, since they do not rule out the possibility of conflict occurring (like a default state of ‘cooperation’ does) and therefore include practices of negotiation and discussion in their analysis (Symon et al. 1996).

Examples include radio fallout and image distortion via CCTV feeds, but they maintain a predisposition to the social accomplishment of workplace order in spite of the challenges posed to them by those very technologies – as if technology is at fault for their ordering troubles.

Rather than a focus on coordination, collaboration has the potential to draw attention to the diverse range and intensities of sociotechnical relations in the control room that involve a deeper level of involvement and understanding in order to enable people and technology to work together. The value of collaboration as a frame for this work suggests that the use of technology is not pre-determined, but it is situated, entangled with the context of its production and use. This also means that it is utilised to different ends – detection, monitoring, discussion, etc. The motorway control room differentiates itself from the work of other control centres because it is highly dependent on the ongoing automated and occasioned work of technologies to actually detect and identify potential disruptions and bring them to the attention of control room operators. This means to advance an understanding of how sociotechnical relations – how humans and technology actually working together – render disruptions visible, make vast distances manageable and enable coordination for co-presence, and so on. These relations are paramount to the work that goes on within the control room as well as beyond it – they actually make it possible. This blurs an understanding of the control room as first and foremost socially organised and socially accomplished because the work of humans relies on technology to get it done at all in the way that it currently gets done (this is particularly the case for the motorway network – MIDAS, for example, continuously

monitors traffic flow and automatically produces an alert in the event of abnormal traffic behaviour – how would the control room otherwise be able to provide this kind of continuous monitoring of traffic flow with human associates alone?). The next section introduces the work of the motorway control room, followed by a detailed description of how it is organised. It is equipped to monitor what is going on out there on the motorway and respond appropriately to various manifestations of disruptive activity in order to manage motorway traffic – to minimise further disruption and promote its efficiency. It is a traffic manager, first and foremost – this is what motivates its work.

5.2.1. The Challenges of Motorway Incident Management: What Makes the Motorway Control Room Different?

While the motorway control room shares a number of challenges associated with centre of coordination studies, including its division of labour, the time-critical nature of its work and the constant orientation to coordinating work over geographical distances, this thesis supplements these concerns with the deeply sociotechnical character of the incident detection work that goes on in settings like this. After all, the impetus to coordinate incident response exists in accordance to the identification of disruption on the motorway network, and the way it identifies disruption is closely aligned to the idiosyncratic challenges it faces, rendered manageable by its sociotechnical relations. These problems include, most notably, the dynamic quality of the motorway network. In a literal sense, it is enlivened by the constant movement of traffic. This creates conditions that are susceptible to immediate change. Because of this, the motorway control room is constantly

oriented to the possibility of disruption, which provides the necessary impetus to drive its work. It is the case that disruption can occur anywhere on the network, and at any time of the day or night. Instances of vehicle breakdowns, obstructions, lost loads, congestion, road traffic collisions and extreme weather events can only be loosely prepared for and anticipated in organisationally relevant ways. As one operator comments,

“You can expect the worse and get nothing, and vice versa.”

In turn, the unpredictability of disruption extends to its development. The phenomenon of secondary incidents means that once a disruption is underway, it can create conditions which are prone to successive disruptions, such as bumps and shunts, or congested traffic as an effect of, say, a road traffic collision. This creates an imperative for more or less real time access to current motorway conditions in order to capture disruptions as they occur to minimise further disruption to traffic flow. This means that the work of the control room involves both reactive and proactive work as it seeks to prevent the development of unsafe or congested conditions.

The work of detecting and monitoring disruptions is made tricky because the motorway network is not readily available. Operators are physically removed from the phenomenon they are managing, which means that they rely on their ability to maintain relations with other participants – witnesses, HATOs, capture technologies – to render disruptions available. These challenging circumstances often result in a perpetuation of substantive uncertainty where not all the details of a disruption are known at the outset. As one operator describes it:

“The thing about this job is that you can only go on what you know is actually happening on the motorway.”

In addition, since the control room is organised by geographical region and divided by operator roles and responsibilities, this means that an operator’s access to the network is always already partial. Operators acknowledge this as part of the local organisation of their work; it is not necessary for them to know the details of everything currently taking place in their surroundings, but it does shape the ways in which they collaborate with other associates.⁶³ One operator, for example, comments on the operational consequences of being a call handler and absorbed in taking vehicle breakdown calls, for appreciating what else is doing on in the control room and beyond on the network,

“You’re quite often out of the loop of things that are happening. You’ll hear things on the radio that we know nothing about because we’re generally just dealing with breakdowns. We work very much on a need to know basis.”

Operators need to know what is occurring on the network in order to make any assessment of disruption and the subsequent dispatch of assistance. Unlike other control rooms typical of the centre of coordination tradition, the motorway control room does not deal exclusively with reports of disruptions made by telephone and radio communications or rely on CCTV feeds; it also deals with capture technologies that actively monitor traffic flow and generate alerts when traffic falls below a threshold. This is in part attributable to the topographical networked-form of the motorway. The motorway network is spatially vast and made up of sprawling

⁶³ Also called the egological orientation to work (Anderson et al. 1989; Hughes et al. 2011) to capture how individuals working within a distributed setting understand how their activities are interdependent with those of others also working within the division of labour.

roadways and intermittently spaced junctions and interchanges, with few entry and exit points. It is therefore practically impossible for HATOs to cover it all and monitor it all in anticipation of disruption, so capture technologies like MIDAS help to provide a form of instantaneous access to the scene – although it does not offer comprehensive coverage. In turn, verbal reports from drivers and other witnesses at the scene often need corroborating or clarifying to help operators make sense of them. This means that activities of detecting disruption tend to be juxtaposed – scanning CCTV, monitoring CCTV, checking MIDAS alerts, reading the incident log, glancing and checking-in with colleagues, and so on – in order to achieve an understanding of what is going on.

Operators can do very little in isolation from the technologies they work with and, accordingly, collaboration is a particularly fitting frame for the work that goes on in the motorway control room, and given the challenges it faces. Therefore, to deal with the partial, spatially distributed and operationally delegated nature of its work, human operators cannot work alone, but work intensely in collaboration with technologies to bring about network effects which would otherwise be impossible. With this in mind, the next section introduces the reader to the empirical setting of the motorway control room. On one hand, it provides a fairly perfunctory description of the control room, but on the other, it begins to tease out the ways in which this is a thoroughly sociotechnical setting, whereby technologies are deeply involved in the organisation and accomplishment of the motorway control room setting. After all, if we consider the human operator as only being able to do the work they do because of their participation within a

heterogeneous network of things, then their collaboration in the network provides a frame to explore the transformative effects that transcend their individual capabilities.

5.2.2. The West Midlands Motorway Control Room as a Collaborative Setting

As it has been previously noted, the Highways Agency operates a network of seven RCCs. Each RCC is responsible for a relatively circumscribed area of motorway network. Each centre has its own control room which exists to manage motorway traffic and to minimise the disruptive effects of both planned and unplanned events on the network under its jurisdiction. Its very existence is dependent on the ever-present possibility of disruption to motorway traffic, so the control room is constantly oriented to its wider spatial network, through various data capture and communicative techniques that enable it to render disruptions available and enact some kind of appropriate response. The control rooms are distinctly familiar – the furniture and equipment is standard across them all, albeit there are some local differences in their arrangement according to room size and shape. As the main setting for the empirical research is the West Midlands RCC, the following description is based exclusively on the organisation of the West Midlands' motorway control room as it was observed at the time. Figure 5.1 offers a schematic overview of the West Midlands motorway control room, which depicts the relative location of each operator workstation, the operator role ascribed to each workstation and their orientation to the front of the control room.

Access to the motorway control room is gained through the swipe-card entry door, which is shown to the right of Figure 5.1. Once you enter at the back of

the control room, immediately in front of you are three rows of individual operator workstations. They are arranged with an amphitheatre-like curvature, slightly spaced apart yet close enough so that operators can comfortably talk to each other and see each other by turning their heads. All workstations face towards the digital display screen (DDS). This is a large wall-mounted collection of smaller screens that operators can manipulate to display a range of visual outputs, including television feeds, CCTV images, graphical representations of readings from the region's anemometers,⁶⁴ and a digital motorway network map. The DDS can be viewed at any point in the control room, given its centrality and absolute size. Its use is flexible, not only in terms of content, but the position and size of feeds can be changed by any operator using a dedicated control panel at their computer. In the West Midlands, the DDS would typically be divided between the Managed Motorways digital map and rolling CCTV feeds, a large motorway network map for the whole of the West Midlands motorway network (which depicts MIDAS activations, designated by small yellow Qs, and live sign and signal setting), one 24-hour news channel television feed and numerous CCTV images which were selected by operators, usually relating to the incidents currently being monitored or managed.

⁶⁴ A wind speed detector, placed in notoriously windy locations, such as elevated sections or bridges. High wind speeds pose particular dangers to high-sided vehicles.

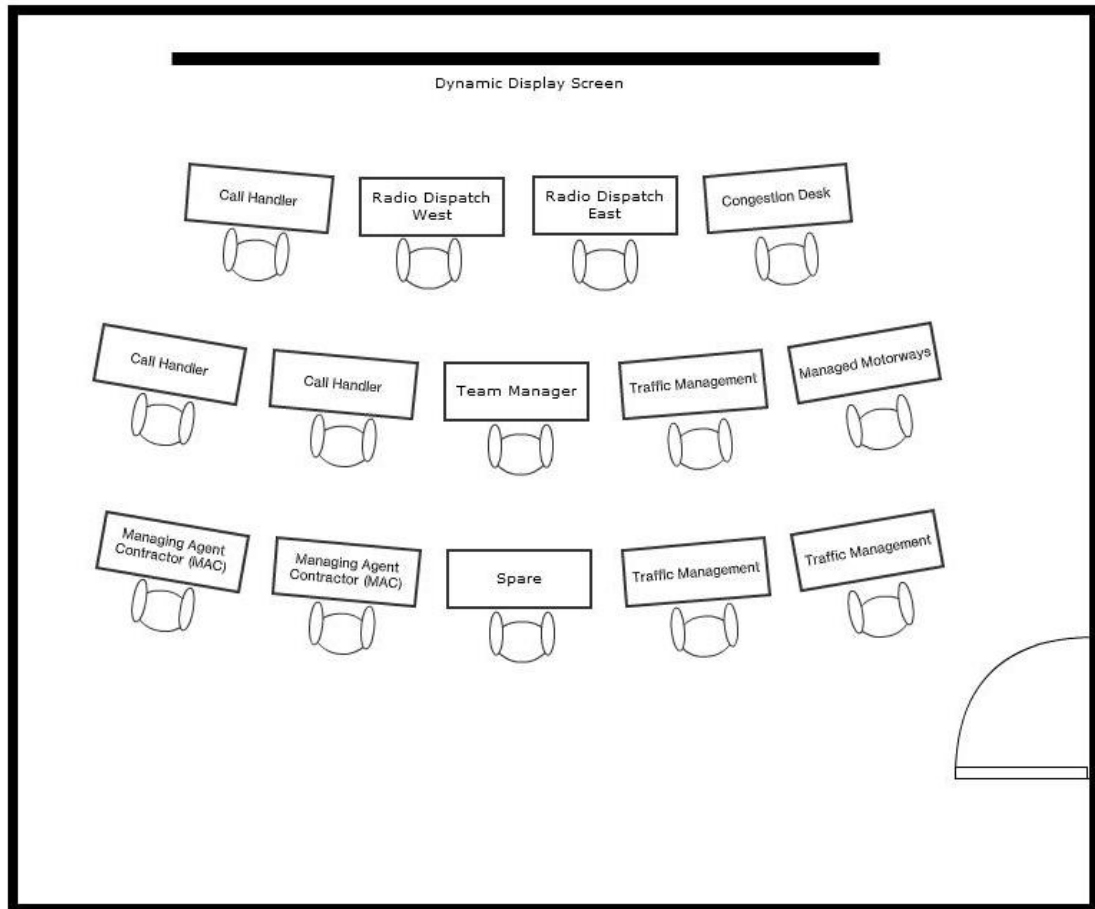


Figure 5.1: A schematic overview of the West Midlands Motorway Control Room

At the same time, this incident management work is delegated among co-located control room operators who are given specific roles and responsibilities. The consequence of this is that for any one incident report it is likely that two or more operators are working on it simultaneously (or their actions are carried out in quick succession) in order to investigate what is going on and how to respond, and to coordinate that response with spatially distributed emergency responders. These actions are by no means wholly separate or distinct – making sense of what is going on in the room, for example the monitoring of a colleague (such as the action of one operator listening in to a conversational exchange between two other

operators), can reveal details of an incident taking place on the motorway network (which in turn may prompt the operator to take action). Each workstation is allocated an operator function – from call handling and radio dispatch to traffic management. From shift to shift, this seldom changes, and results in a predictable form of organisation given to the operation of the control room.⁶⁵ Operators are assigned roles for the duration of their shift and they sit at the assigned workstation. Call handlers are responsible for answering all incoming calls and ERT calls from members of the public. With the exception of night shift, there are usually three operators performing call handling duties. Incoming calls are received from a wide ranging number of colleagues and stakeholders, including other motorway control rooms, HATOs, police, fire and ambulance call centres, on-road contractors and Highways Agency Information Line (HAIL)⁶⁶ operators. Call handlers are also responsible for making appropriate outgoing calls to meet the requirements of incident management, such as summoning the emergency services to the scene of an incident, or calling a breakdown company to arrange recovery on behalf of a member of the public.

To help distribute the work effectively between two radio dispatch operators, the West Midlands control room divides its motorway network into East and West regions. Again with the exception of the night shift, there are always two radio dispatch operators on shift, one responsible for the East region, and another

⁶⁵ There are striking differences in the organisation of operator functions between control rooms. Some control rooms prefer to organise operators in ‘pods’ consisting of a call taker, a radio dispatcher and a traffic management operator for particular sections of the network (say East and West or North and South). This is meant to enable operators to coordinate their respective responsibilities more closely between themselves.

⁶⁶ They pass on reports made by members of the public to the HAIL, which was its name at the time of research, contactable on a 0845 telephone number.

for the West. The radio dispatchers deal exclusively with the HATOs on patrol using Airwave Radio.⁶⁷ Radio has long been a feature of emergency services work (Ackroyd et al. 1992; Bunker 1988), and for the management of transport networks for that matter (Danforth 1970), where instantaneous communication with mobile associates is critical for the passage of messages and delegation of response (Sørensen and Pica 2005). For motorway incident management, it is particularly important for enabling communication between control room operators and HATOs as they patrol the motorway network, looking for and attending incidents.⁶⁸ Radio dispatchers are also expected to manage HATOs by tracking their approximate movements about the motorway network and updating their current status (for example, on patrol, on route to an incident, at an incident scene or on a rest break). Each traffic officer carries a radio handset, identifiable by their unique Individual Subscriber Short Identity (ISSI) number, and they subscribe to a shared talkgroup – East or West depending on their patrol route for that shift.⁶⁹ All verbal communication made over the talkgroup is hearable to each other operator and traffic officer subscribed to that talkgroup. This enables HATOs to listen to communication between all patrols and the control room, providing the

⁶⁷ Airwave is an encrypted, restricted access radio network for voice and data communications which is used primarily by the emergency services in communication with other category 1 and 2 responders (as defined in the Civil Contingencies Act 2004).

⁶⁸ HATOs also have mobile telephones that can be used to contact the control room, but only for passing non-urgent information. All other information – that is, urgent and timely information pertaining to an incident – must be passed on the radio (primarily because all operators and all HATOs (including the team manager and the operations manager) can ‘listen-in’ to the radio, therefore giving them the opportunity to supervise what the patrols are doing, and to question, query or advise on any current radio message).

⁶⁹ Each RCC is allocated 9 talkgroups, of which two are typically used for daily operations (East and West) and the remainder are used as incident channels. If an ongoing incident requires a dedicated radio talkgroup, which often occurs in the event of a serious incident or a special event, participants will be requested to connect to one of the other incident channels.

opportunity to shout up to offer information or to take a job, if they are located closer to the incident scene for example.

While the work of call handlers and radio dispatchers can be compared to the generic challenges facing similar emergency call centre settings, such as the handling of reports from members of the public and coordinating the dispatch of emergency resources to the scene of the incident while constantly oriented to the problem of time-criticality, the motorway control room also involves the work of active traffic management. Traffic management operators deal with the work of sign and signal setting as it is appropriate for incidents and incident-related congestion, they continually monitor traffic conditions to anticipate instances of congestion using CCTV, they liaise with roadworks contractors as they carry out work on the network and they communicate with police patrols whenever they use Airwave Radio. This means that traffic management operators tend to monitor Airwave radio – not only in anticipation of police use but also to listen to updates given by HATO patrols for the purpose of timely traffic management. When congested conditions are expected, say during a Friday afternoon, an operator is allocated to the Congestion Desk. This operator is tasked with implementing local signage to inform drivers of congested conditions, tracking and tracing the length of all congested parts of the network, and providing the team manager with regular reports on these cases of congestion. In addition, the Managed Motorways operator is specifically responsible for those parts of the network that are operating the Managed Motorways scheme. They are trained to open and close hard

shoulder running, when appropriate, and this involves a number of time-consuming procedural checks.

Some of these responsibilities are strictly held to account by organisational rules. A call handler, for example, must only make and take calls, and ERT calls must be prioritised over every other type of call. A radio dispatcher must always be available to take or make transmissions on the radio. This means that they must never take or make a telephone call or be engaged in any other incident management activity (e.g. sign and signal setting) that would distract them or delay them from this priority. At other times, these distinctions drawn between operator roles are somewhat discretionary depending on the specific local conditions. There is flexibility in operator roles according to welfare breaks or in the absence of colleagues and during particularly busy periods of control room activity. Here operators often talk about 'helping out' colleagues who are identified as having to deal with a particularly heavy workload. Figure 5.1 also shows that there is one team manager per shift who is situated more or less in the middle of the room to supervise the activities of the operators. Team managers designate operator roles, oversee the management of incidents and make decisions related to any escalated incidents. They also hold additional responsibilities for the training and welfare needs of their team.

Given that photography was prohibited in the live control room, the photograph in Figure 5.2 was taken in the mock control room at the TLC to provide an example of what a replica workstation looks like. The only missing detail from the workstation is a CCTV monitor.⁷⁰ The pervasiveness of screens is striking at the workstation and it is crucial to how motorway incident management work is done.

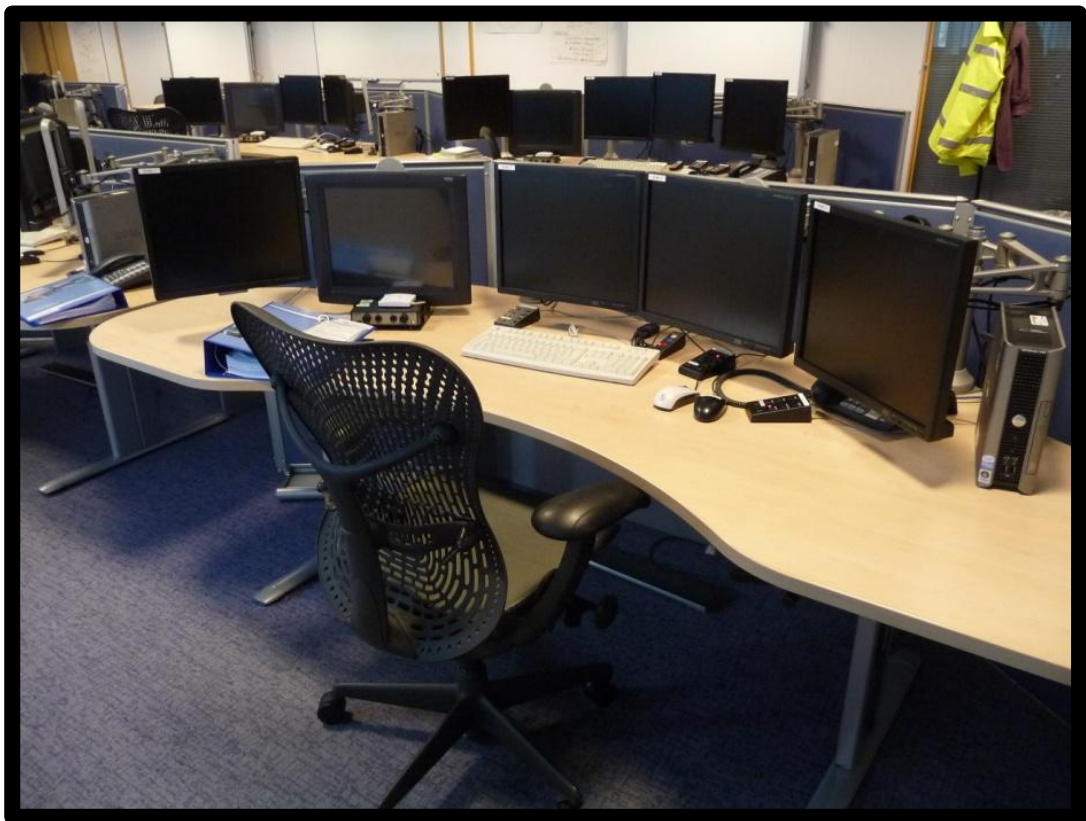


Figure 5.2: A photograph of an operator's workstation, taken in the Traffic Learning Centre

Each workstation has up to five screens, a keyboard, two mice, a personal CCTV monitor and a number of KVM switches.⁷¹ Although operators can select what is

⁷⁰ CCTV monitors were not provided by the TLC to avoid any disruption caused to camera work in the live control room if trainee operators were to inadvertently take control of cameras they were using to search for or monitor incidents.

⁷¹ KVM is an abbreviation for keyboard, visual display unit and mouse. It is a hardware device that enables the operator using a single computer to select which screen the keyboard and mouse interact with. The KVM project, otherwise known as SKRIBE, was introduced to reduce the number

displayed on each of their screens and move these selections around, with the exception the Integrated Communications Control System (ICCS), they tend to follow a standard pattern of arrangement at the workstation. From left to right, the first screen is usually reserved for the SunGard GIS Mapping application. It provides operators with a navigable network map that has various levels of zooming, photographic layers and map layers to give additional information for incident management purposes (such as the location of marker posts, CCTV cameras, signs and signals and diversion routes). Incidents are also shown on the map by icons depicting their priority and current status. The Automatic Vehicle Location (AVL) provides GIS with a means to track the location of HATO patrols. This information is updated at one-minute intervals. Moving to the right, the next screen is ICCS. This is a touch-screen based application that enables operators to make and take telephone calls and operate the Airwave radio. As Figure 5.2 shows, under the ICCS terminal there is an Enhanced Digital Audio Interface Unit (EDAIU) where the operator can plug their headset into the transmitted communications. Under the desk – and just about visible on Figure 5.2 – there is a foot pedal which is used by the operator to press-to-talk on Airwave.

Usually occupying a central position on the workstation, the next screen displays SunGard Command and Control (C&C). C&C is used by operators to log incidents and make updates, coordinate their own activities with those of others, given that responsibilities are delegated between operators, and manage the status and allocation of resources to incidents. Hence it is vitally important that all

of keyboards, mice and screens at an operator's workstation. It allows operators to select what software appears on which screen and manipulate the use of the keyboard and mouse in accordance to their selections.

operators have simultaneous access to C&C and, in turn, C&C is able to dynamically update itself whenever an operator adds or changes any of the information contained within it. The Control Office Based System (COBS) is displayed on the next screen. Operators use COBS for three primary functions – to set signs and signals on the motorway, to monitor MIDAS alerts and activations and to take ERT calls.⁷² These activities are precision-based, not least for their safety-critical nature. Diverting traffic into the path of a live lane obstruction has obvious safety implications, so it is paramount that operators set signs and signals with accuracy to avoid the wrong signs and signals being set in the wrong locations. A notable feature of COBS, then, is the provision of a schematic network map that shows the location of each motorway device (sign, signal, ERT and MIDAS loop) and CCTV camera with the according geographic address. The geographic address of a device is made up of the motorway name (for example, the M42), followed by a four-digit number (the motorway identifier plus the marker post)⁷³ and a letter to denote the carriageway or slip road location (for example, A from Alpha carriageway, B for Bravo carriageway). The resulting geographic address would look like M42/6354A. This enables operators to precisely locate motorway devices on the motorway network. In turn, MIDAS activations are displayed on COBS.⁷⁴ These are shown by a yellow Q on the overview map level, a yellow M on the intermediate map level, and a lane-specific yellow Q on the detailed map level. Lane-specific readings can help operators to pinpoint the location of a possible live-lane obstruction, such as a

⁷² Since this research was undertaken, ERT calls are now managed through ICCS.

⁷³ For example, the motorway identifier for the M42 is 6100. This figure is added to the marker post (the distance from the start of the motorway) to give a unique geographic address.

⁷⁴ MIDAS coverage is not consistent across the network and it reflects the Highways Agency's priorities in investment in areas which are demonstrably prone to congestion or disruptive events.

broken down vehicle, if the traffic is queuing in a single lane only. The final screen provides operators with access to the TeleVision Base System (TVBS). This comprises a network map that displays all CCTV camera feeds, totalling over 1,500 CCTV Highways Agency owned cameras on the strategic road network (Humphrey and Jennings 2010) – albeit they are unevenly distributed across the seven operational regions.⁷⁵ These cameras can be selected by an operator using a keypad to be displayed on the CCTV monitor on the operator's workstation.

Stepping away from the individual operator workstation, it is useful to note the other associates present in the control room. There are a number of desks allocated to operators representing the Managing Agent Contractor (MAC) for the region. MACs are responsible for the management of the motorway network under contract, which variably includes routine and cyclical maintenance (assistance at incidents, infrastructural repair, winter maintenance, cleaning and debris removal) and scheme management (assisting in the planning, design and construction of new schemes). The MAC operators in the control room manage the tasks allocated to their mobile road workers and often coordinate their activities with the requirements of live incidents in the control room, including the dispatch of ISUs to incident scenes. Paper logs are passed between control room operators and MAC operators as they do not have access to each other's incident logging systems or any other means of electronic communication between them. Behind these workstations, there are two additional rows of desks allocated to officers from the

⁷⁵ Interestingly, the East RCC boasts 384 cameras and the West Midlands RCC has 315 plus a further 267 fixed cameras on the Managed Motorway network. The North East RCC has 169 cameras, the North West has 195 cameras, the East Midlands has 67 cameras, the South East has 272 cameras and the South West has 127 cameras (Humphrey and Jennings 2010:2).

Central Motorway Police Group (CMPG).⁷⁶ It is from this space that they coordinate police response to activities taking place on the motorway and trunk road network, including answering emergency telephone calls, managing radio dispatch and liaising with their main radio control room at Perry Barr. This provides the opportunity for control room operators to liaise face-to-face with CMPG when it is necessary to have their input in incident management decisions.⁷⁷ This next section presents a number of empirical examples from the day-to-day work of the motorway control room to highlight how these sociotechnical relations produce a range of creative and transformative practices that work through the challenge of substantive uncertainty. It is a matter of paying attention to their circumstances of action and their positioning within sequential organisation of control room work, rather than prescribing their properties that suggest rigidity.

5.3. The Work of Detecting Disruption

It is an obvious statement to make, but a necessary one nevertheless, that in order for traffic to be managed, and the activities of operators to be coordinated, the motorway control room must have access to disruption. This is all part of the work of incident detection which can be thought of as a collection of related sociotechnical practices that are orchestrated in locally specific ways to reveal disruption occurring on the motorway network in more or less real time. The word 'detection' can be misleading, however, if it is taken to mean a definite and

⁷⁶ In the West Midlands control room, CMPG is located directly behind the Highways Agency's operators, at the back of the room.

⁷⁷ Not all control rooms work alongside operational police officers. Some control rooms have a dedicated police liaison officer; otherwise they rely on communication via telephone or electronic interfacing with C&C.

unambiguous act of discovering disruption. Incident detection is by no means a discrete moment in time whereby technology provides operators with a direct and unlimited access to the world outside the control room to detect an incident and subsequently bring about a response. As Tjora (2004:140) has warned, there exists in the literature “a danger of romanticising the human capability of a ‘peripheral participation’ or an ‘overall attention’ with the use of existing technologies.”

Instead, this next section focuses on the activities of detecting disruption; together, operators and technologies create organisationally relevant accounts of disruption available in the control room. Disruption is not firmly determined, and not all disruptions are easily identifiable. As such they often require the ongoing work of monitoring and investigating. Indeed, there are multiple kinds of detection work and the work of detecting can be multiplicitous in itself. The examples that follow deal explicitly with the work of detecting disruption and the ways in which operators are equipped to investigate reports they receive through the heterogeneous relations they keep. Knowing exactly what to do with this information, such as deciding what intervention is required, if any, will be discussed in Chapter 6.

5.3.1. Working with MIDAS and CCTV

MIDAS presents an interesting case that brings into check the role of technology – not as an autonomous device but as a collaborative partner. MIDAS was first introduced as an automated queue protection system designed to slow traffic, reducing braking on approach to a queue and over-accelerating between queues, giving drivers the experience of a smooth journey (Rees et al 2004).

MIDAS consists of pairs of induction loops embedded in the road surface of each lane of the carriageway at approximately 500 metre intervals and they are used to detect slow moving, queuing or stationary traffic.⁷⁸ The loops are bundles of wire that produce an electrical current when a metal object, such as a vehicle, passes over them. MIDAS continually 'monitors' the traffic conditions by processing the electrical readings given by the inductive loops. This monitoring work is specifically directed by the algorithm HIOCC (which is an abbreviation of High OCCupancy) which detects slow-moving or queuing traffic. HIOCC produces a queue alert when it detects several consecutive seconds of high detection occupancy on its loops. When a vehicle passes over the loop, the loop is said to be occluded or occupied. The output from each detector is scanned at one-tenth-of-a-second intervals to determine whether the detector is occupied or not. For each second, the detector is assigned a value between 0 and 10 (which represents 0 to 100% occupancy) and this is called the instantaneous occupancy. If 100% occupancy has been reached and it lasts for as long as the pre-determined threshold (typically two seconds) then an alert will be produced.

MIDAS then automatically processes the alert to determine the most appropriate signs and signals to display. It sets upstream advisory speed signals of 40mph and 60mph which are matched with information signs reading QUEUE AHEAD or QUEUE CAUTION. Parameters control the behaviour of the algorithm,

⁷⁸ The inductive loops are used calculate the number and type of vehicle by measuring the vehicle's length as its passes over the sensors and the average speed vehicles are travelling by measuring the time taken to travel between one sensor to the next. Loops are also found on the hard shoulder but these are not generally activated (Olds 2010). It is also interesting to note that MIDAS will not work everywhere on the network. For example, sections of elevated motorways have various metals embedded within them which interfere with MIDAS loops, resulting in the Agency trialling alternative incident detection systems such as radar, fibre optic detectors and infrared detection.

including signal on and off times, a smoothing constant and flow/speed alert thresholds (Collins et al. 1979; Collins 1983; Rees et al. 2004), to prevent the quick changing of signs and signals that may confuse drivers.⁷⁹ As soon as an alert is produced, it is automatically displayed on the COBS map in the control room, in the form of a yellow Q on the overview map level, a yellow M on the intermediate map level and a lane-specific yellow Q on the detailed map level,⁸⁰ and this provides a visual representation of what MIDAS calculates to be queuing or stationary traffic. While MIDAS is used for automatically setting signs depending on its algorithmic calculations of queuing traffic, it is also integral to the ongoing work of monitoring the motorway network and detecting disruption that takes place in the control room. This is because MIDAS cannot differentiate between a queue as a case of congestion and a queue as secondary to a road traffic collision or live lane vehicle breakdown which is slowing or blocking traffic flow. Therefore, if an operator works with a MIDAS alert, it could potentially reveal a case of disruption that requires additional intervention – say in the dispatch of a HATO patrol – through further investigative work.

Example 1: Hang on, what's going on there?

Lawrence sits back in his chair. He looks around the control room and glances up at the DDS. He notices that a few yellow Qs have appeared on the network map. He pulls in his chair and leans forward to his workstation. He takes the mouse, turns to COBS, and double clicks to zoom in on the

⁷⁹ Once a queue alert is registered, it will stay visible on the network for a minimum of 4 minutes. In addition, a minimum off time can be selected between MIDAS settings. Say the off time is 3 minutes, if there is another alert in less than 3 minutes after the last setting was cleared, the new alert will not be displayed on network until the full 3 minutes have past (if it is still active).

⁸⁰ On the detailed map level in COBS, operators can access lane-specific MIDAS readings as indicated by the following symbols: / for no queue, Q for queue detection, and F for loop fault. For a 3-lane section of carriageway with a queue alert in lane 1, COBS would show: Q//.

corresponding part of the network map. "What's happened there?" he mumbles to himself. MIDAS is displaying /Q/. "Has anyone else seen this MIDAS? Junction 3, M6," he shouts up in the room. He quickly turns to CCTV, punches in the camera number on the keypad, and swings the camera to point at the area of network identified by the MIDAS alert. Lawrence turns to me. "That rings alarm bells, that's not normal congestion, just in lane 2. The usual congestion suspects, well, we know about them, but if a Q pops up for somewhere else then you go "Hang on, what's going on there?" and you take a closer look."

So far in Example 1, it has been a particularly uneventful shift in terms of incidents to manage, with the exception of a few routine vehicle breakdowns. Lawrence is sat back in his chair, just looking around the room. When his gaze shifts to the DDS, he notices a number of yellow MIDAS Q alerts have been activated along a stretch of the motorway. To take a closer look, he turns to the COBS screen at his workstation and double clicks to zoom to the location of the MIDAS alert. At this level of detail, Lawrence is able to observe that MIDAS is displaying /Q/. This means that the system has identified a queue or stationary traffic in lane 2 of a three-lane carriageway. This is an unusual form of alert, which is likely to have been triggered by an obstruction located in the middle of the carriageway, causing traffic to slow down or stop on approach to it. Despite a lack of substantive detail surrounding what exactly is occurring at this location, Lawrence recognises the likeliness of this alert revealing an actual case of disruption which is something other than congestion. Slow moving or stationary traffic in lane 2 could be attributable to a road traffic collision, a broken down vehicle or fallen debris – all of which are live lane and therefore safety-critical incidents. Not all MIDAS alerts will lead to the detection of disruption – but in certain cases, it is more likely given the specific circumstances within which they are produced. So

here, the fact that one of the MIDAS alerts produced displays /Q/ 'rings alarm bells' for Lawrence. It is 'not normal congestion' since congestion always involves all live lanes of the carriageway reaching capacity. This is compared with the 'usual congestion suspects,' which Junction 3 on the M6 at this time of day and day of the week is not one. This set of circumstances prompts Lawrence into further investigation, working with the MIDAS alert; his subsequent actions include calling on his colleagues to ask whether they know anything about this case or not, to which there is no audible response, and then he begins to search CCTV. What Lawrence chooses not to do is check through the list of current live incident logs, which is typical for operators to do to avoid duplicating effort. This could be attributable to the fact that there have been very few incidents to manage during this shift so far, so an incident on the M6 would have come to his attention sooner, or the time pressure perceived by Lawrence for the potential severity of this incident spurs him to quickly address the lack of substantive detail surrounding it.

This example begins to show that detection work is by no means a clear-cut or straightforward action, because a disruption is not immediately identified at the point of producing an automated alert. It is in fact part of a wider process of detecting, brought about by the operator's participation within a network of heterogeneous relations between other operators, MIDAS alerts and CCTV cameras. This is largely because the MIDAS alert can only provide an insight into network conditions that are potentially disruptive, based on its calculation of traffic flow, and therefore it lacks substantive detail. The potential disruption it has identified is ambiguously defined – it could be a case of congestion or queuing

resulting from a road traffic collision or live lane obstruction. It could also be a false detection.⁸¹ The ambiguity of a MIDAS alert in Example 1, however, is minimised given its specific arrangement of /Q/. Lawrence displays an awareness of the likelihood of this MIDAS alert actually leading to an incident other than congestion, such as a live lane obstruction, and this is consequential for his subsequent actions. While a lack of information exists as to why the alert has been produced, at the very least MIDAS alerts provide operators with one vital piece of information – its location. The location provided by MIDAS is pinpointed to a marker post – the smallest denomination possible – which helps operators work with other technology to corroborate the report. In Example 1, Lawrence is able to quickly select the camera feed matching the location of the MIDAS alert and turn the camera to face the precise location. It is often very difficult to ascertain the location of a report of disruption from other sources. Reports from members of the public are notoriously difficult to locate because of a general lack of awareness they have of where they are on the motorway network. This has obvious consequences for the effectiveness with which incident response can be implemented – for example, the rules for sign and signal setting are limited in cases where a location cannot be verified and the dispatch of a HATO patrol can be compromised when a location is unknown.

The next example focuses on a series of radio transmissions made by the motorway police patrol Yankee Golf on Airwave. A member of the public has

⁸¹ On occasion, the algorithmic calculations of MIDAS can be tricked into thinking there is queuing traffic when there is not. One of the most common occurrences of this is attributable to slow moving vehicles, such as a heavy goods vehicle, going uphill, whereby the slower speed of these vehicles, combined with their length, occludes the inductive loops for a longer duration. Translating this occlusion as queuing or stationary traffic, the queue alert is then triggered. Technical malfunctions are also possible.

reported a road traffic collision but cannot provide a location. Yankee Golf requests the help of the motorway control room to further pinpoint its location.

Example 2: We need a better location than that!

“Yankee Golf to Hotel Alpha, over.”

Jane, the traffic management operator quickly responds, “Yankee Golf, from Hotel Alpha. Pass your message, over.”

Yankee Golf explains that there has been a road traffic collision, possibly over both lanes 2 and 3, reported by a member of the public. No one is believed to have been injured. One vehicle has apparently lost a wheel.

They give the location as “somewhere between junction 3a and 16. That’s all we’ve got, over.”

They request that a HATO attends the scene to give assistance.

Jane types the information provided into a new incident log.

She ends the radio transmission, telling Yankee Golf that she will investigate the report and update them in due course.

Jane turns to me. “We need a better location than that!” she exclaims. “I’ll just check MIDAS.” At this, she leans forward to COBS and double clicks to zoom in at junction 3a. She uses the mouse to drag the network map and scan along the motorway. “There.” She points to the COBS screen. “There – it’s showing QQQ... it must be there.”

In Example 2, a motorway police patrol officer, using call sign Yankee Golf, calls over the hailing channel on Airwave radio to communicate with the motorway control room. The police officer informs Jane that there has been a road traffic collision and they request the assistance of a HATO patrol at the scene. Although the police officer is able to give the operator some substantive detail about the disruption, such as it has occurred in the live lane, it is believed to be non-injury and a wheel has apparently been lost, these details are by no means said with any certainty and they have not been so far confirmed by an authoritative source (such as a police eyewitness or a CCTV feed). This is further obscured by the impressively vague

location – the police could only give a very rough estimation of the incident's location as 'somewhere between junction 3a and 16.' The uncertainty surrounding where the disruption is actually taking place poses a significant impediment to the efficiency of incident response. In the control room, signs and signals cannot be set until the report is confirmed and the speed with which a HATO can be dispatched to the scene is compromised because there is no way of knowing at this point which HATO is closest to the scene. In this case, the radio dispatcher goes on to send a HATO nearest to junction 3a to perform a sweep along the length of the reported section. The effects of this uncertainty are not exclusive to the Highways Agency's experience of it; Yankee Golf is already on its way to this part of the network to begin searching for it, but it could be located anyway along this long stretch of motorway. A more pinpointed location would enable Yankee Golf to take advantage of any shortcuts available to arrive at the scene of an incident more quickly.

After Jane records the details in a new incident log, she leans towards COBS. Here she uses the network map to find junction 3a and then begins to drag the map along the route of the M6 to check if there have been any MIDAS activations. Within minutes, Jane finds a location where MIDAS has been triggered and it is likely to be at the location of this road traffic collision. This is because it shows queuing across all three lanes of the carriageway; QQQ. While the incident was reported as occurring in lanes 2 and 3, the displaced traffic from these obstructed lanes is likely to cause congestion in the free-flowing lane. Rather than a MIDAS alert premising the investigation of a disruption, in this example Jane uses it to

substantiate a report already received from a member of the public. Jane could have used CCTV, but MIDAS provides the opportunity to pinpoint the location of such a disruption that is expected to have a detrimental effect on traffic flow and, therefore, likely to have triggered MIDAS. MIDAS, then, proves particularly valuable for identifying the location of disruption where it is otherwise lacking in such detail. This is then consequential for the incident management activities that follow it. Jane is able to update Yankee Golf with a marker post location likely to be that of the reported traffic collision; this also applies to the radio dispatcher who can reconsider the appropriateness of dispatching this or that HATO to the scene according to which one is closest.

Not all reported disruptions result in a traffic management response being implemented, such as a HATO dispatched to the scene or signs and signals set. In the next example, an operator spots a MIDAS alert and uses CCTV to identify what is going on in the area. As it turns out, the CCTV feed shows queuing traffic and the operators decides that traffic management is presently not required; this then premises a particular kind of occasioned monitoring work (Tolmie and Rouncefield 2011).

Example 3: I'll keep an eye on it

Andy is looking at COBS. He points to a number of yellow Qs that have appeared on the map, "Right, MIDAS has kicked in. Let's see if we know anything about this." He turns to C&C and takes hold of the mouse. He mumbles the location to himself, "M6... junction 2... Bravo," as he leans forward towards the C&C screen and scrolls up and down through the live incident logs. He glances back to COBS and then returns to the C&C screen. "Hmm, we've got nothing." After a short pause, he turns to the CCTV monitor on this workstation and punches in the camera number – 2-1-2-8-7.

“So... that’s a CCTV camera close to it... there we can see...” Andy takes the joystick and moves the camera around, zooms in, zooms out, and uses his finger to trace the traffic flow. “I’ll keep an eye on it.”

In this example, the traffic management operator, Andy, is scrolling through the COBS map when he finds a number of consecutive MIDAS activations. In response, he turns to C&C and scrolls through the live logs to find out whether a disruption has already been reported in this area. An already reported disruption may begin to offer an explanation as to why a queue or stationary traffic has been detected and, in turn, it avoids duplicating effort if he was to continue his investigations only to find that a report has been received from elsewhere. No incidents have been reported in the area, so he next turns to his CCTV monitor. From memory, Andy punches in a camera number close to the location of MIDAS. When he says “there we can see...,” it is as if he expects to see something more notable than he does. He continues to trace his finger against the traffic flow, drawing that which is in the distance to the forefront of his attention, but there is nothing revealing about the scene that suggests another type of incident is underway. It is a case of slow moving traffic and nothing else. A verdict of no further action required is determined by Andy – except he will continue to monitor the scene for any developments. The kind of work that Andy does in this example to ‘keep an eye’ on the traffic conditions by observing the scene on CCTV is extensively referred to as monitoring work in the CSCW and workplace literature. However, it is often used in a most general sense in the literature to refer to a background activity that goes on between human colleagues as they ‘oversee’ or ‘overhear’ the conduct of others around them (Rogers 1993). This misses out on how monitoring work can take

place in occasioned and specific ways. In the motorway control room, monitoring work can be considered to be inextricably linked to detection work in focused ways, as operators keep watch over a part of the network deemed to be a case of borderline disruption. Monitoring work in this sense is particularly important for showing how detection is an ongoing process that can often stretch over time without any actual traffic management intervention taking place. In the case of Andy's work, the MIDAS alert premises his monitoring work at a network location displaying disruptive traffic flow characteristics (slow moving or stationary traffic); he identifies a CCTV feed at the location of the alert, decides that the traffic conditions as observed require no intervention at present, but is aware that conditions can quickly change in the motorway environment. His decision to continue to monitor this particular scene is directed, occasioned and ultimately has a purpose – it will either lead to the detection of a disruption needing some kind of intervention or the traffic congestion will dissipate thus requiring no intervention.

While this particular MIDAS alert did not lead to the detection of a disruption, it is nevertheless integral to the ongoing work of detecting disruption that goes on in the control room. Indeed, MIDAS is insufficient on its own to bring about any appropriate incident management response. This is because an assessment of what counts as an appropriate response is by no means reducible to a quantitative measurement of traffic flow. Each alert produced by MIDAS needs to be situated and juxtaposed with other sociotechnical relations to address the substantive uncertainty that characterises each individual attempt at detection. It will therefore always require investigative work to confirm that a disruption actually

exists. Given the spatial extent of the motorway network, the value of MIDAS for incident detection lies in its ability to pinpoint potential areas for traffic management intervention. While MIDAS continuously monitors the network for congestion and automatically produces alerts visible to the operator on the COBS network map, CCTV cameras make available what is happening on the motorway in the form of real time, moving visual feeds once the operator has selected to view them. The occasions where operators work with CCTV tend to be more revelatory of the substantive details of the disruption. This next example shows an operator working with CCTV to investigate a report made by a member of the public. It reveals how sometimes unexpected details can be uncovered through further investigation to significantly help incident management along.

Example 4: Let's have a look

Anne is sitting at the traffic management desk today. A new log appears in the C&C window displayed on screen. "What have we got here?" The log reads that a member of the public has reported tyre debris straddling the hard shoulder and lane 1, around junction 2, M42. The report was originally reported to the police and they have passed it to the motorway control room. "Right, tyre debris – let's have a look." Anne turns to the CCTV monitor and enters a camera number from memory. She takes control of the camera. She moves it to the right, then to the left. "There's nothing obvious." She selects the next camera. She zooms in on the top of the screen. "Look – a lorry's stopped over on the hard shoulder... so it must have had a blowout."

A report from a member of the public has been passed on to the motorway control room by the police. It is a report of tyre debris across the hard should and lane 1 and it is causing vehicles to pull out into the middle lane of traffic. The location given is only an approximate one – 'around junction 2.' Anne decides to

check CCTV to help corroborate the report before any signs or signals can be set to warn traffic on approach to the scene. The first CCTV camera Anne selects shows “nothing obvious” – traffic is moving steadily, with no evidence of debris in the carriageway, or swerving vehicles. When viewing the next camera, she zooms in on a lorry positioned on the hard shoulder downstream from the location of the reported tyre debris. She makes the connection between this lorry, pulled over presumably in an emergency, and the reported tyre debris, given that it is not uncommon for tyre blow-outs to occur from large vehicles and leave behind debris on the carriageway. Anne’s investigative work is consequential for her colleagues in the control room; the radio dispatcher can advise the HATO to stop with the lorry, once then have swept the carriageway for debris. Again, a report of disruption premises Anne’s engagement with CCTV. Just like monitoring work, CCTV use is by no means a ‘generalised monitoring’ performed by the lone operator, watching a bank of images, waiting in anticipation for something to happen (Heath and Luff 1999; Heath, Luff and Sanchez Svensson 2002; Luff, Heath and Jirotko 2000; Neyland 2006; Norris, Moran and Armstrong 1998; Norris and Armstrong 1999). It is uncommon for operators to engage in proactive searching of CCTV in the motorway control room because of their vast number. Rather it is focused and shaped by organisational priority and relevance.

Example 5: Maybe it’s just a shadow

A police operator informs the control room that several emergency telephone calls have been received from members of the public reporting a pedestrian on the motorway, walking somewhere between junction 4 to 7 on the M6. The police operator asks for the assistance of the control room by checking CCTV in the area. Lawrence, listening-in on the conversation the

call handler is having with the police operator, begins to search CCTV. He starts at junction 4. Pans to the left, pans to the right, zooms in. Next camera. Pans to the left, pans to the right, zooms in. Next camera. He leans in closer to the CCTV monitor and traces what he sees with his finger. "I think I see something there." There is a pause. He zooms in. "Oh maybe, maybe not... maybe it's just a shadow."

This final example observes Lawrence checking CCTV in response to a request from the police. Several sightings of a pedestrian on the motorway have been reported. Pedestrians are prohibited from using the motorway network and any incident involving them is considered a serious breach of safety. By listening in, Lawrence has picked up the basic details of the incident, including its location. He immediately turns to his CCTV monitor and begins to thoroughly check the camera feeds, panning left, then right, and zooming in. Here the CCTV cameras provide the control room with a means of visually accessing the motorway network, as it was the case in previous examples, bringing in distant locations under the scrutiny of the operator's eye and finger for the purpose of investigating a reported incident. It would make little sense to an operator to use MIDAS for this; only in emergency circumstances would it be likely that a pedestrian would affect traffic flow to the point where MIDAS is triggered. Oriented to the problem of the pedestrian, coupled with the time-criticality of the incident, Lawrence thinks he has spotted a figure, but after a second look he is not sure. The judgement of whether this is a 'just a shadow' of a roadside post or the single figure of the pedestrian is ambiguous. The significance of this is that even when CCTV is used in detection work, it does not necessarily permit the straightforward identification of disruption. Whatever the CCTV screen presents to the operator, it does so with the potential to distort what

is actually occurring at the scene (Heath, Hindmarsh and Luff 1999; Neyland 2004, 2006; Sørensen and Pica 2005). It is not guaranteed to faithfully replicate the richness of being there at the scene, thereby giving rise to different degrees of ambiguity. This often depends on the context within which engagement with CCTV occurs; the possibility of a pedestrian on the motorway is a safety-critical one, so Lawrence displays a real readiness to spot the pedestrian, which arguably obscures what is actually observed. Lawrence's dilemma of whether this is a person or not could be further complicated by overgrown trees, inclement weather conditions, birds and insects; these are all factors that can impair vision on CCTV. The situated use of CCTV during the day (sun glare) and night (headlights vs. motorway lighting) can also pose their own hindrances to observing motorway conditions. This is not to mention gaps in coverage and blind spots that evade capture by CCTV. This example of CCTV use shows that far from simply enabling or supporting human interaction, sometimes these collaborations require additional work. Incidents are not simply discovered – or discoverable – and presented to operators in a ready to action form. Like Lawrence, operators have to work with the technology; leaning in, scanning the picture, zooming in, pointing and tracing. This is why they are always experienced as part of a process of detecting, juxtaposing and further questioning. This is why Lawrence pauses and takes another look.

5.4. Conclusion: Working Collaboratively

The main motivation of this chapter was to investigate what is at stake for an understanding of how control rooms work when coordination is taken as the primary lens of study. That is, it privileges the understanding of technology as

supporting human conduct over space, thus neglecting other ways in which relations between humans and technology give rise to ways that transform the capabilities of operators by virtue of the *collaborative* relations they keep. A detailed description was provided of the motorway control room; the main empirical setting for this research. It sought to show how the work of motorway incident management is transformed through the various collaborations between operators and technology. There are traditional communicative technologies present in the control room, including telephone and Airwave radio, which are used to connect spatially dispersed individuals and coordinate response work with HATOs. This work, however, is inextricably intertwined with other engagements with technology – checking CCTV, investigating MIDAS alerts and creating and updating incident logs. These transform the capabilities of operators, providing visual access to the motorway network, pinpointing potential locations of disruption for further investigative work and delegating information between themselves. The notion that the motorway control room presents a collaborative sociotechnical setting was then specifically explored through the work of detecting disruption.

The examples of operators working with MIDAS begin to unpick the assumption that technology is only used as part of the coordination work that connects human participants performing independent activities across space. While MIDAS can play a role in coordination, insofar as it can help pinpoint the location of disruptions to aid the dispatch of emergency responders to the scene, it is also critical to the ability of the control room to actually detect and investigate incidents

from a distance in a time-critical fashion. The receipt of a MIDAS alert in the control room is then more than a simplified act of detection; it is a part of an emergent and often complex process whereby operators investigate it, discuss and negotiate it, juxtapose it with incident logs and CCTV images, draw on local knowledge, and so on, in order to make sense of it according to their organisational responsibilities. It can actually create a need for coordination. Each MIDAS alert is then entangled in the context of its production – location, time of day, already reported disruptions in the area. This is why Lawrence was convinced that investigating the /Q/ alert would reveal a live lane obstruction of some kind, maybe a road traffic collision or a broken down vehicle, and why Andy concluded that the Qs he identified were just a case of regular congestion that did not presently require a traffic management intervention. In terms of CCTV use, it is most often engaged with to investigate and corroborate other reports of disruption. The use of technology is not pre-determined, but it is situated, entangled with the context of its production and use. In turn, the ways in which it presents the network to the operator can actually change how operators make sense of what they observe. It is not predictable given the context within which it is observed, as it was the case with Lawrence and the ambiguity surrounding whether what he could see what a person or 'just a shadow.' This means that even the most unassuming of activities, such as looking again, are part of the emergent process of detecting incidents that deal with the practical contingencies of collaborating with technologies.

The motorway control room is therefore presented as an exemplary case of collaborative activity between operators and technology. It is differentiated from

other control rooms typical of the CSCW and workplace studies literature because its dependence on the ongoing automated and occasioned work of technology to help operators work out what is actually occurring on the motorway network when the network is not readily present. However, the practical accomplishment of incident management work is certainly not exclusively a human or technical accomplishment; it depends on the network of relations within which members are able to act, thereby rendering the network manageable both in (more or less) real time and over spatial distances. This is largely because the methods that comprise the control room's work involve collaborative effort to make sense of elements of uncertainty and ambiguity that arise during their course of action. Once a disruption has been detected, a decision regarding what action should be done next has to be made in order to accomplish smooth and reliable traffic movement. This is the focus of the next chapter, which discusses how a disruption is rendered available for its delegated management in the control room. In particular, it addresses the phenomenon of procedural ambiguity in the case of congestion where it is not always obvious what should be done to help movement along.

Chapter 6

Diagnosing Disruption, Incidents and Events

6.1. From Disruption to an Incident: An Introduction

The previous chapter explored the difficulties that exist in the work of detecting disruption taking place in the motorway control room. These difficulties arise from the sociotechnical mix of relations that make up the motorway control room and the work they perform to cope with the challenges of physical distance and the uncertainty in deciding whether or not this is a legitimate case of disruption. This is because there is no stable link between the receipt of an incident report and the dispatch of a resource to the incident scene – sometimes operators deal with vague threats, incongruous or incomplete reports, and ghost incidents. This means that operators must engage in some kind of investigative work to make sense of the report and deliberate its relevance for the purposes of incident management. The consequence of this is that operators do not simply ‘discover’ what is occurring on the network but they actively create a version of what is going on in relation to the exact circumstances of its emergence to help them make a decision about whether or not an incident management response is required. Sometimes these decisions are collaboratively constructed, opening up to the possibility of discussion, disagreement and debate among operators. After all, the TOS has finite resources with which to detect incidents and implement response, so choices have to be made, when all available information is considered, as to which

disruptions pose a real threat to the integrity of the motorway network and have to be acted upon. At other times, the decision to respond is a fairly trivial matter.

The ethnomethodological principle of indexicality is important here. Even when the meaning of a word, gesture or action is understood in context, it does not guarantee the removal of ambiguity and a range of potential meanings can still exist (Coulon 1995). It is only by following the next action that this ambiguity, tied to the indexicality of this or that word, gesture or action, is managed and resolved to maintain an intelligible order. To help with the analysis of this, some scholars find the notion of sensemaking particularly useful for explaining the relation between local circumstances, their articulation and subsequent action. As Weick et al. (2005:409) describe it, “[s]ensemaking involves turning circumstances into a situation that is comprehended explicitly in words and that serves as a springboard into action.” The process of sensemaking, and the sensemaking resources members draw upon, provide a framework or set of background expectancies that shifts according to the situated occasion of its use and shapes and reinforces the activities of the setting (Gephart 1993; Marcon and Gopal 2008; Weick 1995). This forms an ethnomethodological interest in how work is done “*somehow*” (Garfinkel 1967:10) which recognises that sensemaking activity takes place in contexts whereby the foundations for making sense of what is happening and knowing what to do next (what is expected, what should happen, what forms an appropriate response) are by no means obviously evident but rather are open to procedural deliberation and debate.

While Chapter 5 explored the ways in which substantive uncertainty is experienced by operators engaged in the work of detecting disruption, this chapter investigates the notion that settings like the motorway control room require practical sensemaking resources to help its members deal with the ambiguity associated with diagnosing disruption. This chapter is then specifically interested in, firstly, questions of how operators make sense of what is happening on the motorway network by collaboratively producing a version of what the network should be like and, secondly, exploring how the relation between this version of the network and the type of disruption taking place is consequential to the diagnostic work and incident management response that follows. This recognises that diagnosing disruption is not such a definite, straightforward action as one might imagine at first. This is because operators are dealing with a constantly changing set of parameters that determine what qualifies as a legitimate disruption and what counts as an appropriate response in its specific context. This can lead to procedural ambiguity, whereby operators manage competing and incongruous accounts of what is happening now and what should happen next, which then requires repair by engaging in further investigative work. This will be explored through a number of empirical encounters, including the diagnosis of a vehicle breakdown and two separate congestion events in the RCC and the NTCC. Congestion is notoriously difficult to define because some parts of the motorway network routinely reach flow capacity during peak times (meaning that some congestion events are accepted as the normal state of the network at that time and in that location) and other parts are particularly sensitive to change meaning that a diagnosis of congestion can quickly become redundant as traffic dissipates. It is the

operator's duty to define when these times are and to work out whether the congestion being observed is characteristic of the network residing at normal traffic levels or a legitimate case of congestion requiring traffic management intervention. In these cases, operators routinely call upon a situated understanding of what the motorway network *should be like* in order to help them make their diagnosis of a legitimate case of disruption and any subsequent calls to action. The chapter will explore how any version of what the motorway network should be like exists as an average or normal type (that accepts local traffic conditions as a state of normality and recognises that there are limits to optimising traffic, using real time traffic management techniques, especially when it reaches flow capacity) rather than an ideal type (to optimise traffic movement) in response to local circumstances that challenge the real time practical accomplishment of traffic movement.

6.2. Diagnosing Disruption

There is a growing body of literature, commonly grouped together as ethnographies of diagnostic work, that explores diagnostic activity in a wide range of professional and everyday contexts that have otherwise been neglected as topics of study in their own right or been stifled by entrenched assumptions in their originating disciplines (see Büscher, Goodwin and Mesman 2010). This literature is of great interest here because of its grasp of diagnosis as an inherently tentative, sometimes recursive, process, which most of us engage in daily in our professional or everyday lives. These ethnographies attend to medical settings in which health conditions are diagnosed (Byrne 2010; Goodwin 2010), emergency response management (Büscher and Mogensen 2007; Büscher, Kristensen and Mogensen

2009) and troubleshooting in (everyday and characteristically complex) technological settings for the purpose of repair, maintenance and design work (Firth and Emmison 2010; O'Neill 2010; Orr 1996; Sanne 2010; Watts-Perotti and Woods 2009). The research on emergency response in this context (Büscher 2007; Büscher, Kristensen and Mogensen 2007, 2009; Büscher and Mogensen 2007; Harrald and Jefferson 2007; Kyng and Kristensen 2007; Kyng, Nielsen and Kristensen 2006; Kristensen, Kyng and Palen 2006) is an obvious starting point, but most of these studies strive to inform system design for managing large-scale and time-critical emergency events. Those that delve into day-to-day operations of diagnostic work in the emergency services tend to focus solely on the discursive aspects of emergency call taking (Firth and Emmison 2010; Ikeya 2003; Paoletti 2009) in the conversation analysis tradition (following earlier studies by Whalen and Zimmerman 1990; Zimmerman 1992). Accordingly, human collaboration tends to remain as the primary focus of these accounts. Further, much of this work remains faithful to traditional CSCW concerns of the design of future technologies that *support* diagnostic work (Castellani et al. 2009; Paoletti 2009), including those that experiment with prototypes of technical devices (see Büscher and Mogensen 2007; Büscher, Kristensen and Mogensen 2007, 2009), although they do explicitly challenge the assumptions that plague traditional CSCW studies.⁸²

⁸² Researchers are sensitised to the real-world context and practical application of technology (Büscher 2007, Büscher, Kristensen and Mogensen 2007; Kulyk, van der Veer and van Dijk 2008; Harrald and Jefferson 2007) as a way of challenging those familiar critiques of CSCW: the first questions its ability to design adequate support systems when little is known about the specific requirements for awareness in the workplace setting (given the legacy of context-free concepts of 'awareness,' 'support' and 'diagnosis' pervading CSCW research) and the second challenges the pervasiveness of an individualistic and cognitive frame of reference that neglects to understand the collaborative nature of diagnostic work.

This compulsion to study diagnostic work in this way is largely indebted to ethnomethodology and it builds upon existing workplace studies that are interested in the context-specific nature of sensemaking work through which problems are identified, categorised, and an appropriate response is considered (Luff, Heath and Jirotko 2000, Orr 1996, Muller 1999). These studies take seriously the entangled and locally managed practice that actually produces a diagnosis. They show that it is not necessarily the case that diagnosis is the application of rote procedure to local circumstances to produce an unequivocal, definitive diagnosis, which then predictably leads to an appropriate next action. This is because diagnosis is always performed in relation to a set of real circumstances, the minutiae of which can never be fully exhausted in written procedure. This means that diagnosing a problem is often performed iteratively and concurrently with the techniques of investigating, intervening and responding (Büscher, O'Neill and Rooksby 2009; Alby and Zucchermaglio 2006, 2009). Diagnostic activity is often tentative and testing and sometimes diagnoses need only be "sufficient enough" to get the action moving (Büscher, Goodwin and Mesman 2010).⁸³ As suggested in the previous chapter, many diagnostic settings are characterised by substantive uncertainty (lack of information), which is tied to the experience of procedural ambiguity (having more than one possible next action). This compromises the ability of a member of the setting to know with any definitive sense what to do next. Accordingly, diagnosis is not a straightforward or linear act of following procedure by rote, but it is a core part of the ongoing sensemaking work of a setting. Many of these studies

⁸³ There are indeed occasions where a 'definite diagnosis' is prohibited in professional settings. For example, see Pooler (2010) for an account of nurses managing calls from patients to NHS Direct, in which they must avoid making any official diagnosis since they are not institutionally sanctioned to do so.

draw attention to the ways in which this work is collaborative in nature, taking place between two or more associates, in order to make sense of the observable conditions or provide supplementary information. This works to respecify the all-knowing, rational figure of the 'expert' that often features in CSCW studies to show instead how diagnosis is a mutually intelligible and combined effort, relative to a set of real circumstances (Büscher, Goodwin and Mesman 2010).⁸⁴

These studies also show that this sensemaking work is not just dependent on the receipt of new information or a new experience relating to a specific incident or event. It is also dependent on professional knowledge and past experiences about the setting that form a set of 'background expectancies' (Heath and Luff 1999; Heath, Hindmarsh and Luff 1999; Suchman 1997). These expectancies form a normative framework that enables members to build accounts that are relevant to the setting within which they are constituted. What is important to note is that this framework and the activities it shapes are generated simultaneously and reflexively, meaning that there is no rigid normative structure that dominates all activities. Julian Orr's (1996) ethnography of photocopier repair technicians is a case in point. Technicians need to know general technical aspects about how photocopiers work, their common faults and how to fix them. What runs implicitly through Orr's discussion is the idea that any general understanding of what counts as a state of working order is inextricably linked to the machine's specific context of use. This is because, as Orr tells us, not every machine is

⁸⁴ Accounting for expertise is often separated into human experts on the one hand (which is typical of professional settings like medical consultations, where the expertise is located in the heads of individuals) and technical experts on the other (where expertise resides in a diagnostic database or similar which is then searchable by a human operator).

identical, not even those of the same model. Machines are, in fact, distinguishable by their history of use (heavy usage machines are expected to experience more problems of wear and tear compared to idle machines which are likely to be poorly maintained and dirty), their history of repair (some machines may experience recurrent problems that affect their overall performance; other machines may be modified by newer or specially engineered versions of spare parts meaning that two machines of the same model might be working, in essence, with different parts, and thus compromise any sense of an operational standard), their age (whether they operate quietly or noisily as standard or have good quality copy or not), their idiosyncrasies or “perversities” (Orr 1996:14), and so on. It makes no sense to talk about a “textbook case” as there are machines that work competently and as expected, and there are others that are “chronically troublesome” (Orr 1996:16). Therefore the very foundations for understanding whether this diagnosis is appropriate or this repair is satisfactory, and deciding the point at which the machine resumes a state of working order, is constantly changing, depending on technician’s reflexive construction of ‘what is typical’ for this or that machine. The play off between a generic understanding of what conditions should be like and the specificities of this or that problem and its solution is made each time anew, forming a critically creative and contingent process of diagnostic sensemaking work.

These ethnographies of diagnostic work make obvious intersections with the work of motorway incident management and in particular with the situated efforts of operators as they attempt to diagnose disruption and become entangled in the work of ordering, classifying, prioritising, assessing, investigating, intervening,

probing and determining an appropriate response. Thinking about diagnosis in this way has the potential to remedy the neglect of situated practices of diagnosing incidents as it occurs in motorway incident management, even if the term “diagnosis” is never used explicitly by members in the motorway control room.⁸⁵ These studies effectively show how the offer of a diagnosis is always tentative and open to challenge given the possibility of the receipt of new information and the collaborative nature of its creation. They also demonstrate how a normative framework helps members understand what should be happening and what should be done next. However, they underplay the twofold complexity of sensemaking – its doubling-up – where members of a setting not only have to work out what is going on this and each time anew but also what this means for choosing an appropriate next action according to what their colleagues are doing, given the delegated character of incident management work. This chapter seeks to advance this understanding by examining the relationship that exists between the phenomenon of substantive uncertainty and procedural ambiguity in the motorway control room, which in turn expresses the relationship between indexicality and reflexivity in a more traditional ethnomethodological sense. The empirical examples that follow pay particular attention to the point of intervention whereby a report of disruption becomes something to action through the work of diagnosing it as an incident. The point at which an incident is declared, however provisional this diagnosis may turn out to be, can reveal the sensemaking work that mediates

⁸⁵ The fact that operators do not talk about ‘diagnosing’ or providing a ‘diagnosis’ is considered to be unproblematic for this research (see also Firth and Emmison 2010 on call takers talking about ‘problems’ rather than ‘diagnosis’ in response to callers’ needs for technical troubleshooting). It is the analytical insight offered from the body of literature of diagnostic activity that is of relevance here, which includes the activities of investigating, probing, debating, and so on, and not just a sole interest in the product, the ‘diagnosis.’

the twofold inadequacy problem of substantive uncertainty and procedural ambiguity that characterise motorway incident management work.

6.3. Diagnosing Incidents in the Motorway Control Room

The point at which an incident is declared reveals the point at which the disruption so far observed is rendered problematic for the orderly practical accomplishment of motorway traffic and therefore it is made available to action. The Highways Agency defines an incident as an unplanned event on the motorway network, which is not part of the usual operation of the motorway, and constitutes a potential or actual interruption to the smooth, reliable and safe operation of the motorway. An incident can range from a broken down vehicle on the hard shoulder and debris littering the live lanes of the carriageway, to an infrastructural fault or a road traffic collision. The incident may appear to be somewhat trivial or incidental to the operation of the motorway, as a kind of minor interruption with no longer lasting effect, but nevertheless its detection is critical to the smooth operation of the network. The act of naming this or that disruption as an incident is a significant part of the diagnostic process. It should not be mistaken as an offer of a definite diagnosis, but rather it is a provisional attempt by operators to stabilise a disruption in order to render it available for further action in the control room. It is, however, a definitive act insofar as the operator commits the control room to the investigation, resourcing and resolution of the incident. This means that however provisional the diagnosis of an incident is, it is sufficient enough to enrol operators into investigative action and justify that action, even if it turns out that the incident is a 'no trace' or that there is 'no (further) intervention' required subsequent to

that investigation. Often this investigative work takes the form of the dispatch of a traffic officer to the scene of the incident. This not only goes some way to satisfying the substantive uncertainty that may surround an incident but it is also critical to dealing with the procedural ambiguity of choosing which, if any, incident management techniques to implement. The information gathered from the patrol is then used to inform any further response taken, such as notifying the police, summoning vehicle recovery, or setting signs and signals.

The type of disruption that takes place is somewhat consequential to the diagnostic activity that follows in the motorway control room. This is because there are some incidents that are harder to diagnose than others. This is significant because it changes the point at which an incident is named and the subsequent form that diagnostic activity takes to consider an appropriate response. In the most routine cases, diagnosing an incident is a fairly straightforward and indisputable matter – there is a report of a broken down, there is an obstruction in the carriageway, and so on. These are incidents that are understood in familiar terms and therefore they are instantly recognisable as problematic to the practical accomplishment of movement. The specific details of the incident may be missing at this stage, but they are still treated as incidents and instantly rendered actionable, until they are confirmed by a trusted source.⁸⁶ Operators are aware of what information they need, where to find it and how to get it, in order to repair

⁸⁶ Unconfirmed incidents are those that have not been reported by a trusted source. They are typically those made by the general public, via ERTs or emergency 999 calls, or MIDAS detections that require further investigation. Confirmed incidents are those initially reported, or later confirmed, by 'eye-witness' reports from HATOs, on-road workers, contractors and technicians, emergency services personnel, and control room operators (incidents confirmed on CCTV). Confirmed incidents are also made by off-duty Agency personnel who are driving on the motorway. Incidents must be confirmed before any traffic management is implemented.

the absence or tentative nature of the details about that disruption. Example 1, the case of a broken down vehicle, illustrates well what might at first appear as an odd characterisation of an incident familiar to and expected by the operator yet obscured by substantive uncertainty.

6.3.1. Diagnosing Incidents in Cases of Procedural Certainty

Example 1: Investigating a broken down vehicle

“November Echo 2-3, to Hotel Alpha, over.”

A radio transmission is received in the control room from one of the HATO patrols – November Echo 2-3. They are currently out on motorway patrol. Lucy, the radio dispatch operator, replies. “November Echo 2-3, from Hotel Alpha, go ahead, over.”

“There’s a broken down vehicle on the hard shoulder on the alpha, between junctions 46 and 47, on the M1. It looks like the driver is still in the vehicle. We’re going to turn around at the next junction, over.”

“November 2-3, that’s received. I’ll show you Code 5, over.”

Lucy types the information into a new incident log.

Lucy then turns to me. “We used to watch people on camera and think ‘oh they’ve broken down, they’ll be alright, don’t worry about it’ and then we had guidance through saying if you see a car on the hard shoulder, it’s not guaranteed to be broken down. You don’t know if the driver is having a heart attack, there might be something going on, so we need to get someone there just to check what’s happening.”

In this example, a HATO patrol observes a broken down vehicle on the alpha carriageway. The HATO is currently travelling on the opposite carriageway, the bravo carriageway, and they have decided to turn at the next junction to investigate the incident. It is identified as a familiar incident on the motorway network, what looks like a hard shoulder vehicle breakdown, worthy of reporting to the control room in its own right. However, it appears that the driver is still seated in the vehicle. The HATO has already decided to act and they will turn around at the next

junction to investigate. The operator takes this as an organisationally relevant and provisional diagnosis of an incident and creates an incident log on C&C. From this moment, it is clear to both the HATO patrol and the radio dispatch operator that this incident is recognisable as one that requires prompt investigation. This is because, given their familiarity with incidents like this, their common problems and solutions that form a normative background of expectancy, there is a possibility that there is a more serious incident occurring. As Lucy explains, the observation of the driver still seated in the vehicle could be indicative of a more serious incident whereby the driver has suddenly taken ill and been forced to stop (in the case of a medical emergency). The substantive uncertainty in this case is managed by its procedural certainty – it is an incident which is ‘sufficient enough’ in terms of the substantive detail known (Büscher, Goodwin and Mesman 2010) while being familiar enough to warrant further investigation. This is because, based on their background expectancies, the few substantive details they have of the incident are enough to shape its management as a potentially serious incident given the complications that could arise. The decision to act becomes a rather trivial matter because it is almost always a procedural certainty.

6.3.2. Diagnosing Incidents in Cases of Procedural Ambiguity

There are cases, however, where the parameters for action are much less clear to define and a preliminary diagnosis of an incident difficult to commit to because of the obligation this then creates for the control room to respond to it. They are usually instances of disruption that take place ‘off-network’ and therefore beyond the Highways Agency’s strategic road network. In these cases, requests are

made by police or a local highway authority asking for the assistance of the Agency at an incident scene beyond the motorway network. The Agency is not obliged to assist, so the decision is made on a case by case basis by the control room operators. This is usually judged on the severity of the off-network event, its requirements for traffic management assistance and any comprehension of how it may impact the motorway network itself (a threat to the motorway network would necessitate assistance). This diagnosis is, of course, pending the receipt of appropriate and sufficiently detailed information and, given that the diagnostic tools usually used by operators do not cover off-network (CCTV, MIDAS, etc.), the operator has to deal with a significant level of substantive uncertainty and moderate procedural ambiguity. It is understandable that operators are cautious about committing to an incident, no matter how provisional that initial diagnosis is, before reasonable sense has been made of it. Such an account is reflexively constructed with an appeal to the background expectancies that operators have developed from professional knowledge and past experiences, in light of any details of the disruption as it has so far been reported. This may include the consideration of what constitutes typical and expected network conditions for the time of day and day of the week and what obligations the control room is currently under (how many incidents are being managed, how many resources are available, where are they, do they require welfare breaks?). This is understandable given the fact that if they commit to resourcing an off-network incident, the HATO then comes under police direction, which compromises the Highways Agency's ability to command its patrols to attend incidents on its own network. This means that the point at which an incident is declared in these cases typically comes after some carefully

considered deliberation which is indebted to the situated use of operators' background expectancies.

At other times, operators have to deal with significant procedural ambiguity resulting from competing versions of what should be done when dealing with multiple methods of diagnosing from both human colleagues and technical collaborators. Compared to the case of the vehicle breakdown, in which the decision to diagnose it as an incident was rather trivial given that an incident management response was already underway, instances of congestion are much more difficult to diagnose. This is because the parameters for defining what counts as congested conditions are locally defined and dependent on sensemaking activity that compares an understanding of what is typical and what is actually being observed. It is at this point that reflexive background expectancies become significant in order to make sense of the observed conditions. Example 2 explores how this reflexivity shapes the diagnostic activity that takes place by shaping a situated understanding of the parameters for defining congestion in each case, which is then highly consequential to the incident management work that follows.

6.3.2.1. A Case of Congestion in the Motorway Control Room

Example 2: "Is it stop-start or is it just busy?"

It is Thursday afternoon on the Congestion Desk. The operator has been transferred a call from a traffic officer who is currently on patrol around junction 11 of the M6. He reports that there is "pretty bad congestion round here" and because he cannot identify any other incidents in the area that would be contributing to the congestion, such as a road traffic collision or live lane vehicle breakdown, he concludes that "it must just be the volume of traffic." With this he requests that the operator sets congestion signs for it

to warn other drivers. The operator asks "Is it stop-start or is it just busy?" The traffic officer describes the traffic conditions as "well, it's moving but it's still really congested."

The operator turns towards the CCTV interface. She asks the traffic officer to confirm, "Around junction 11, M6 did you say? And are you going northbound or southbound?" She selects the nearest CCTV camera, zooms in, and moves it around. After a short pause she says, "Oh right, I see. Leave it with me and I'll see what I can do for you," and ends the call. She then turns to a traffic management colleague sitting behind her and says, "What do you think of junction 11? Do you think it's congested?" She explains that a traffic officer has requested congestion signs to be set and that she is not sure that the scene is actually congested. Her colleague finds the location on CCTV and gives his verdict, "No I don't think that's congested either, it's moving isn't it?" He adds "And anyway, we're talking about Thursday afternoon here, it's always busy around there." The operator agrees and she declares "Yeah I'm not signing for it then."

Slippery and often erratic, at one moment congestion can appear to take hold of the network, and the next it can suddenly dissipate. This means that congestion is notoriously difficult to define consistently and consequently there is often a notable degree of discrepancy, discussion and negotiation in its management. Here, the control room operator is dealing with a report of non-recurrent congestion, which is, by its very nature, unfamiliar and unexpected. Non-recurrent congestion is often a consequence of another incident or event (such as a road traffic collision or intrusive live lane roadworks, for example) or otherwise it is an unspecified, and unattributable increase in traffic demand which pushes the carriageway to reach its flow capacity. Recurrent congestion, on the other hand, comprises a fairly predictable and routine situation in which traffic demand exceeds normal capacity, such as commuter peak periods. Generally, operators will not intervene in cases of recurrent congestion or conditions that are likely to be short-

lived, given that it is accepted that excessive or unnecessary signage on the motorway network diminishes its impact and often leads to complaints from disgruntled drivers (Foo and Abdulhai 2006). In the case of peak traffic anyway, it is accepted that drivers will expect congested traffic conditions and therefore it is not necessary to sign for it. The acceptability of responding and its anticipated effectiveness for managing traffic are both critical to the diagnosis of congestion incidents – an operator will not take responsibility for a congestion incident if traffic management intervention is unlikely to ameliorate traffic flow.

In the example above, the operator is positioned at the Congestion Desk and she has been allocated the responsibility of identifying, tracking and tracing congestion, intervening where appropriate by setting traffic management signs and recording all observations and interactions in an incident log. She receives a call from a traffic officer on patrol who reports traffic flow disruption on the network and attributes it to congestion. The purpose of the call is to incite a response whereby the operator will set congestion signs on the motorway network – which is the standard traffic management response to congestion. The operator understands that to accept a report of congestion as an incident is to make a commitment to managing that incident until it is deemed resolved. This involves implementing congestion signage and monitoring traffic conditions. This is a commitment not to be taken lightly, as it is evident in the diagnostic probing and questioning that the operator engages in, in order to ascertain whether this report really counts as congestion. This is because congestion is difficult to define in the very first instance, given that the parameters for its diagnosis are contingent upon a

range of locally situated circumstances, and secondly, this means that it is difficult to track, trace and monitor congestion, blurring the parameters of effective incident management work. It is paramount that signs and signals are appropriate and accurate to reflect network conditions as they are observed. This is for both motorists' safety and to help maintain the Highways Agency's reputation (and trustworthiness) as a traffic information provider. In this respect, congestion must be continually monitored, tracked and traced, so that operators are able to change congestion signage to reflect real time, observable conditions. This is made difficult in locations that are not adequately equipped with CCTV to enable operators to monitor the extent of congested conditions for themselves; in turn MIDAS alerts are not wholly reliable as congestion trackers, and, traffic officer patrols can only provide a snapshot view of the network from their ground position (and, in turn, there is always a risk that patrols will become trapped in congested conditions if they go to investigate and therefore they will be unable to respond to other incident call-outs). This is a challenging incident for an operator to take responsibility for and therefore one that is not taken without further investigation and deliberation.

A diagnosis of congestion is provisionally offered by the traffic officer in the very act of initiating the telephone call to the operator. It is provisional since it is subjected to questioning and re-evaluation by the operator. This is part of the operator's work to determine whether the congestion poses a real threat to the integrity of the network before committing to a response. This is critical in such a case where the report is vague and there is remarkable incongruity in the language

used to describe the observable conditions as the example unfolds. The operator quizzes the traffic officer to further explicate whether the traffic conditions he is observing can be characterised as “stop-start” or “just busy” – the implication being that stop-start conditions are considered to be a legitimate case of congestion, whereas “just busy” is not. The question “is it stop-start or is it just busy?” then serves to press the traffic officer to describe the traffic conditions in more specific terms as appropriate to the phenomenon of congestion, as it is understood by the operator.⁸⁷ The traffic officer’s response surrenders to the fact that the traffic conditions he is attempting to diagnose are not characteristically “stop-start,” but he is still adamant that a traffic management response is needed when he argues that “it’s *still* really congested” (my emphasis). The operator then finds the location on CCTV, presumably to help her form a mutually recognised account of the traffic conditions by visually accessing the scene, building on the traffic officer’s description. However, she makes no comment on the conditions she observes on screen and her response is vague and non-committal, “Leave it with me and I’ll see what I can do for you.” It at least serves to create an alternative space within which to diagnose the incident that escapes the obligation to give the traffic officer the definite response for which he appears to be searching. Compared to the unquestioned acceptance of the vehicle breakdown as an incident necessitating incident management, the form of congestion means that operators and their associates are always already working with a phenomenon that is inherently unpredictable, transformable and unfamiliar in its situated context. The form that

⁸⁷ Such terms have been qualified in transport research. Rees et al. (2004) describe congestion as “stop-start” driving conditions, where some vehicles temporarily come to a halt or move at a very low speed. This contrasts to “smoother” driving conditions, which describes a more balanced distribution of vehicles across all live lanes.

traffic congestion takes gives its diagnostic work the quality of procedural ambiguity, which is resolvable through the kind of verbal questioning and visual investigative work that the operator engages in at the Congestion Desk.

This is the point at which she asks her colleague for another opinion by requesting that they observe the traffic conditions on CCTV. The response she receives from her colleague is “it’s moving isn’t it?” which denies its diagnosis as an incident of congestion and supports her hesitancy to commit. The discussion then explicitly invokes a situated and mutually constructed understanding of their background expectancies to create a normative account of what the network should be like. This is made according to what would normally be expected to occur at this time of day and at this location. The reflexive work involved here constructs a comparative account between normal traffic conditions (which is always shaped by the local situation within which it is invoked) and the specific traffic conditions as observed or reported. The response “no I don’t think that’s congested, it’s moving isn’t it?” invokes a general understanding of traffic conditions deemed acceptable, because at least the traffic is moving. The operators then appeal to the situated specifics of this case of congestion – it is a Thursday afternoon, which is widely regarded as the “new Friday” according to motorway control room operators, given the recent upsurge in busy traffic conditions which are usually characteristic of the weekend get-away on a Friday – and it is taking place on the busy M6 motorway. The operator concludes that “it’s always busy around there,” implying that no intervention is necessary. This appeal to background expectancies is used as a common sense resource of the network

conditions under scrutiny and it comes at a decisive point in the proceedings of diagnosing the congestion report. In effect, the report of congestion is not an unusual enough deviation from normal network conditions; it is never named or logged as an incident in the control room and the operators do not attempt to manage the traffic by sign setting. It is only in this context of procedural ambiguity that operators can rationalise a verdict of 'no response required' by denying the relevance of a disruption to the practical accomplishment of traffic movement and therefore prevent or reject its escalation to an incident.

What this example strives to show is that operators are dealing with a constantly changing context that has direct operational consequences for what counts as relevant to their work. The context within which diagnostic work is carried out is constantly shifting or, in other words, the parameters that define an incident are by no means straightforwardly set in advance, but only dynamically made sense of and collaboratively produced in the moment. This sensemaking work, which is carried out reflexively in an appeal to background expectancies, recognises there is a disruption based on a general, but locally relevant understanding of what counts as normal network conditions, while it also attempts to diagnose this or that disruption according to its situated specifics by constructing a comparative narrative between the two. Operators doing diagnostic work need to continuously (re)consider and (re)evaluate the operational consequences of naming an incident with each reported disruption. This is because there is no rote procedure to follow (for example, congestion is not definitively defined) but instead there are shifting degrees of substantive uncertainty and procedural ambiguity that

have to be managed in locally contingent ways (there are competing diagnoses and parameters for action that are always locally defined).

6.4. Diagnosing Network Events in the National Traffic Control Centre

The diagnostic work which constitutes motorway incident management also takes place beyond the control rooms of the RCC and into the space of the control room at the NTCC. In the NTCC, the operators' background expectancies also emerge as a significant sensemaking resource in the diagnosis of 'network events' – note, not incidents – as they are deemed relevant to the work of traffic information dissemination. The RCC and NTCC work closely together to share incidents but they perform fundamentally different roles within the Agency in terms of real time response to traffic conditions. The primary role of the RCC is the work of detecting, verifying and responding to unplanned incidents at the scene, 'on the ground.' The RCC has a duty to investigate unconfirmed reports, in whatever form they take, in order to identify possible threats and minimise their detrimental effects on traffic flow and safety by implementing an appropriate response. The NTCC, however, is not an incident responder, but a traffic information provider. Rather than dealing with all kinds of reports of disruption, the NTCC only begins from the point at which a disruption is escalated to an incident in the RCC. The NTCC operators then judge whether these incidents qualify as network events.

Incidents come to the attention of NTCC operators by the generation of system alerts which are triggered each time a RCC operator sets a sign or signal on their regional motorway network. The implementation of a traffic management response through sign and signal setting is indicative of an incident taking place and

the NTCC operator is provided with information of the network location and details of what signage has been set (e.g. accident, animal, debris or obstruction).

Abnormal congestion alerts are also created by the NTCC system by comparing current journey time along a predefined network link to a historical journey time profile (which is typically calculated over 6 weeks). When journey time falls below a threshold, it causes an alert to be produced. In addition to this, verbal reports of incidents are received directly from RCC operators, the police and other traffic information providers. Not all the incidents reported to the NTCC are relevant to their work, so in order to diagnose a network event, the NTCC operators must adhere to four main criteria. First, an incident must directly disrupt traffic flow. This means that network events are usually live-lane incidents that reduce carriageway capacity or slow traffic speed. Second, an incident must be expected to – or have already exceeded – a duration of 15 minutes. Third, the network event must be corroborated by a trusted source, such as a RCC operator or verified by the NTCC operator using CCTV. Finally, if it is a congestion event, an abnormal congestion alert must be produced by the system matching the location identified. The logic behind these rules is that the traffic information produced must be consistent in order to maintain the Highway Agency's reputation as a trusted and effective traffic information provider. Andy, a NTCC operator, describes most incidents as "blips in the traffic flow" that are largely irrelevant for the work of defining network events because they only impose a slight disruption on traffic in localised areas of the motorway network. The view is held that if information on all incidents, regardless of their duration or effect on traffic, were disseminated to the travelling public, then the quality and effectiveness of traffic information would be devalued.

Accordingly, the parameters within which a NTCC operator can diagnose a network event are much more rigidly defined in comparison to the sensemaking work involved in diagnosing incidents by RCC operators. This has the potential to alter how diagnoses are accounted for and justified in the NTCC compared to the RCC, based on the relationship that emerges between background expectancies, which are reflexively produced in a local context, and the criteria that serves to standardise network events.

In the case of verbal reporting to the NTCC, some RCC operators lack an appreciation of what incidents qualify as relevant to the wider context of traffic information dissemination. As a result, all kinds of live lane incidents, regardless of whether they are confirmed incidents or not, or their expected or current duration, are reported. This, in effect, requires NTCC operators to perform an initial stage of filtering, sorting and analysing incidents based on a general understanding of what incidents are likely to become network events. For example, NTCC operators are generally hesitant about upgrading a report of a live lane vehicle breakdown to a system event because it is very often the case that once an Agency patrol arrives on scene, they will utilise their ability to tow vehicles off of the carriageway and on to the hard shoulder, meaning that any direct interruption to traffic is short-lived. On the other hand, incidents like a HGV breakdown on the hard shoulder, which at first may appear to be an insignificant occurrence causing minimal disruption to live lane traffic can become complicated as soon as any repair work required involves an offside tyre change – in order to actually move the HGV off the motorway network. This means that lane 1 of the carriageway must be temporarily closed to give

protection to the mechanic performing the tyre change from the live lane traffic, given the proximity of large HGVs to the boundary line between the hard shoulder and the live lane. This usually interrupts traffic flow for longer than 15 minutes. Against such background expectancies, these incidents are logged at the Travel Information Provider (TIP) desk as a TIP event. This effectively classes the incident as a 'tip-off' which acknowledges its status as an incident that has the potential to become a network event once it has been confirmed. TIP events are monitored by the TIP Desk for this purpose.

6.4.1. Dealing with Procedure: A Case of a Congestion Event

This next example focuses explicitly on the generation of an abnormal congestion event in the NTCC control room and how operators make sense of it to ensure an appropriate next action. The parameters for diagnosing and responding to a congestion event are limited by the production of an abnormal congestion alert which is at once markedly different to how the RCC diagnose congestion based on human observation. While each abnormal congestion alert must be verified by a human operator using observations provided by CCTV, and this can create discrepancy in defining what exactly constitutes congestion, it is ultimately limited to the parameters already defined in the organisation's procedure.

Example 3: "It's completely screwed – look at it"

It is Friday afternoon, I sit with Adam on the Unplanned Events desk. He is monitoring the abnormal congestion alerts and one has been triggered for junction 11 to 10a on the M6 roadworks section. As with any abnormal congestion alert, it must be confirmed by CCTV so Adam opens the CCTV viewer and proceeds to find the relevant section of motorway on camera. He scrolls through the camera and comments that the congestion is actually

as far as junction 8. He says "I don't want to set 11 to 10a because 11 to 8 it's congested, it's completely screwed – look at it."

What is immediately striking about this example is that the work of the NTCC operator is heavily shaped and informed by a specific diagnostic tool, the abnormal congestion alert. Motorway traffic conditions are continuously captured by NTCC traffic TMUs, using inductive loops, and supplemented with MIDAS data. This is based on a database which defines every network link in terms of its characteristics, including cross-section, gradient, junction types and speed limit, from which an overall theoretical capacity is determined. This is overlain with traffic data on flows, speeds, journey times, planned and unplanned events and weather conditions over a six week period to create a historic traffic profile, which is deemed sensitive to the typical traffic conditions for that link. To calculate an abnormal congestion alert, the system takes into account the situated context of the network link in question and compares current conditions to the historic profile. The threshold for an abnormal congestion event is set between 5 to 7 minutes above the historic profiled journey time for the link and the delay has to last for two time stamps (lasting 5 minutes each) to trigger an alert. The alert has always already been produced under the system parameters for defining congestion – although at this stage it is still open to challenge from the operator who must corroborate the occurrence of congestion using CCTV.

In this example, the system has identified junction 11 to 10a as displaying abnormal congestion, which constitutes a provisional diagnosis of network conditions as congested. Each abnormal congestion alert must be verified by the

operator before it can become a network event; like the RCC, the creation of a network event commits the NTCC control room to the management of it by sign and signal setting. The operator then diligently checks CCTV in the area. This is in part to compensate for technical malfunctions or miscalculations that the equipment can, on occasion, make, leading to the erroneous production of a congestion alert. The operator will tend to interrogate the alert to ascertain whether it is an accurate reflection of what is observable on the motorway network (is it a technical malfunction, is it just a slow-moving vehicle or is it an actual case of congestion?), what should be done next and what is appropriate to do next. At once, Adam considers the congested traffic conditions he observes on CCTV to be at odds with the abnormal congestion alert produced by the system. The abnormal congestion alert has been triggered for junction 11 to 10a, but Adam observes the congested conditions as they stretch extensively from junction 11 to 8 as he cycles through the CCTV feeds on his monitor. For Adam, these observable conditions are not just “congested” but “completely screwed” as he implores his colleagues to take a look.

The sensemaking work that Adam engages in here is similar to that of RCC operators as they narrate an account that compares a general sense of what traffic conditions are expected to be like and what is currently observable. This helps operators to work through any incongruity that may occur between the provisional diagnosis provided by technical devices and what is observed by human operators. Adam calls on a situated understanding of what the motorway network *should be like* in order to help him make a diagnosis of a legitimate case of congestion. He

explains that this particular section of the M6 motorway is undergoing live lane roadworks which has reduced the normal capacity of the carriageway. As such, this location is recognised by the operator as a troublesome hotspot for congestion, so he cannot understand why the system has only produced an alert for junction 11 to 10a when its effects are much more widespread. This is an appeal to a local context which takes into consideration the effect that live lane roadworks has on traffic. Accordingly, Adam is reluctant to set congestion signs that are inconsistent with conditions visible on CCTV (and inconsistent with the conditions experienced by drivers on the road). His tentative admission “I don’t want to” is firstly suggestive of his distrust of the abnormal congestion alert and secondly revealing of the real possibility that he will surrender to the rule of defining congestion events in the NTCC that states only verified abnormal congestion can be set on signage (meaning that he will sign for congestion between junction 11 and 10a, and not junction 11 to 8).

At this point, there is a lively debate between Adam and his colleagues as he wrestles with the discrepancy between what he can see on camera and the motorway links that the abnormal congestion alert has identified as having characteristics of abnormal congestion. The team leader, supported by another operator, forcefully suggests that Adam just sets congestion signs between junction 11 and 10a, because, after all, it is the section of motorway that has been detected as congested by the abnormal congestion alert. The team leader then states that “the system is telling you that that part is routine [10a to 8] and 11 to 10a is abnormal, so you should set signs for it.”

Speaking out loud, thereby drawing the attention of colleagues, is a way of ‘sounding off’ his discrepancy with the system alert. Adam’s actions are a way of making sense of and testing the plausibility of his maverick diagnosis, while calling

on collaborative input from his colleagues in the control room. This is illustrative of the fact that there can be no concrete, definite diagnosis, but an incrementally produced diagnosis, open to discussion and challenge – contrary to any assumption that rules are indiscriminately applied and followed. By narrating his version of what is occurring based on a set of background expectancies sensitive to the local circumstances under observation, which leads Adam to argue that the traffic conditions he is observing are untypical and warrant signage in their own right, he is effectively “pushing the facts around” (Orr 1996:126) to help him come to a reasoned and mutually corroborated diagnosis. This is made possible because the abnormal congestion alert is always subject to corroboration – it is not uncritically accepted as a confirmed case of congestion – and therefore there already exists a context within which a competing diagnosis is permitted.

However, the operator is restricted with what he can actually do with his diagnosis. If an operator identifies congested traffic conditions, no congestion event can be created without the corroboration of an exactly matching abnormal congestion alert. This is actually contractually imposed by the Highways Agency as a way to standardise traffic information dissemination for congestion and to monitor the NTCC’s performance as a private service provider working on their behalf. Service points are incurred if they are shown to break the terms of their contract, so there is little incentive to defy the calculative mechanisms without a strong rationale. This is evident in the response and subsequent advice received from the team manager, indicating that his discrepancy is irrelevant in this case, given the restrictions imposed by organisational procedure for setting congestion

signage. At this point, however, Adam ignores this instruction and instead looks for more supporting evidence:

Adam scrolls through the network map which displays all the signs currently set on the motorway, including those set independently by the RCC. He says that the RCC has already set signs saying M6 JCT 11 – 9 CONGESTION so if he was to set congestion signs for junctions 11 to 10a, they would conflict with those set by the RCC. He says “So I’m not going to set them, unless I set 11 to 9 to cover the RCC signs.” The team manager opposes this decision outright, “Our system says this, so we have to do this,” making the final assertion that, “if you need a good reason why you should set it like that, if we were to receive a complaint, the first thing we’ll ask you is why you didn’t follow the system alert in the first place.” Adam then reluctantly sets the congestion signage M6 JCT 11 – 10A CONGESTION.

Here Adam notes that the RCC has already set local congestion signs for junction 11 to 9. If he follows the abnormal congestion alert and signs for junction 11 to 10a, the messages displayed to motorists would be obviously inconsistent. He argues that the abnormal congestion alert should be amended to fit the RCC congestion signage – the parameters of which have been defined by an operator and not a calculation. This shows that despite its contextual production as a case of abnormal congestion by the system, the indexicality of the congestion alert does not guarantee the removal of ambiguity in its definition and diagnosis. Its resolution is helped along by the reflexive nature of sensemaking that takes place in the setting, by iteratively drawing on the operator’s background expectancies of what the network should be like in this or that local case. But ultimately in this case, the opportunity to debate the diagnosis and implement traffic management based on background expectancies is limited by the contractual obligations the NTCC operators must adhere to in an extensively audited workplace setting. The

procedural certainty in this case deals with any ambiguity arising from the nature of the phenomenon under management whose definition often eludes consensus.

6.5. Conclusion: Making Sense of Disruption, Incidents and Events

A key orienting problem of ethnomethodology is how exactly members go about getting their work done. This question is particularly significant in the motorway control room where the work of diagnosing disruption is complicated by substantive uncertainty, shifting parameters to action depending on context that produce different degrees of procedural ambiguity and the discrepancy and debate generated by heterogeneous sociotechnical configurations for diagnosing. This means that there must be some kind of flexible sensemaking resource that helps operators to cope with, and repair, these challenges to the order of settings, *somehow*. This is more than a simple case of recognising the situatedness of this or that disruption as consequential to the process of diagnosis. It is dependent on a set of normative expectancies that operators draw on in locally relevant ways to make sense of what should be happening, what is happening now and what needs to be done about it, to deal with the shifting parameters of action that determine what counts as an incident or event in the very first instance. This work forms a general frame of reference that captures what is typically conceived to be acceptable motorway network conditions, according to the occasion of its use. It is situated because there is no permanent standard form to the motorway network. Some parts of the network are busier than others, and recurrently congested, some are more hazardous, and thus prone to disruption, and traffic behaviour itself changes throughout the day, week and month. These situated characteristics shift

the parameters for judging whether a disruption actually matters to the objectives of incident management and if the control room should commit to its resolution. This is actively constructed through a comparative narrative between a general, yet carefully situated, understanding of the network at large (what it should be like, what its common problems are, what our responsibilities are as incident managers), which is tailored to its context of use (this particular part of the motorway network), to a specific account of what is happening now (this or that specific disruption as observed).

Diagnostic practices and resources are necessarily situated to keep up with the nature of the disruption it attempts to make sense of and resolve and the configuration of collaborative activity involved in the diagnosis. On occasions when disruption takes on a familiar form, it is more or less obvious to an operator that an incident has occurred and a response is required. The background expectancies are useful insofar as they prompt operators to ask questions of the disruption to expose anything beyond its familiar form that may be further detrimental to the safety or flow of traffic. In the case of the vehicle breakdown, the driver still seated in the vehicle raises suspicions of a possible medical emergency. As it turned out, on investigation by the patrol, the driver was consulting his road map. He was promptly reprimanded for his behaviour and advised to quickly resume his journey. The example demonstrates how background expectancies can highlight circumstances which appear to be 'other than routine' and thus form part of the probing and investigative dimensions of diagnostic work. In times of procedural ambiguity, as it was evident in the case of congestion, there is no obvious sense as

to what kind of diagnosis should be made and what response should follow. In the case of congestion in the RCC, we hear the operator reflexively making sense of the incident when he says "*we're talking about Thursday afternoon here, it's always busy around there.*" This develops relevance for the particulars of the case that helps to make sense of the procedural ambiguity surrounding what to do with it, thus enabling the operator to make equivalencies and build comparability. The diagnosis is tentative – because congestion can change – and a commitment to monitoring and managing congestion is therefore not taken without serious consideration of the consequentiality of that decision for traffic management.

Diagnosing incidents or events is a multi-faceted process. Any account of the incident is incrementally put together by multiple associates and sources; it is locally managed and transformable at any moment. Diagnosis is not always smooth or mutually agreed upon, but it does have to be plausible and justified within the parameters of action that defines the setting. In the RCC, diagnoses often only have to be 'sufficient enough' to elicit a management response (especially in the context of time-critical incidents). This creates a diagnostic context where any offer of a diagnosis is always provisional and open to challenge, depending on the different understanding of what the network should be like. This is about "pushing the facts around" (Orr 1996:126), sounding out diagnoses and potential responses. However, in the NTCC, events must ultimately meet a number of criteria which restricts operator ruling on diagnosis. Calculation tends to take precedence here, at least in the case of abnormal congestion alerts. This diagnostic context is characterised by the collaborative nature of the setting and the fact that operators

rely on their ability to build and maintain meaningful relationships with multiple associates (on-road patrol officers, CCTV feeds, control room colleagues, and MIDAS alerts or abnormal congestion alerts) to help give them some kind of access to conditions as they appear on the ground. The sociotechnical nature of diagnostic relations can create hindrances to collaborative work including technical difficulties (which can foster distrust of automated alerts), communication difficulties (such as different and competing vocabularies for describing congestion) and incompatibilities in the way different organisational contexts define similar phenomena (different frames of reference regarding what matters as incidents or events between the RCC and NTCC).

This is further complicated by contradictory parameters for action, as it is particularly evident between the RCC and NTCC contexts. Although they perform fundamentally different roles within the Highways Agency, the diagnosis they offer for the 'same' congestion event can be strikingly different. This comes down to the different frames of reference embedded in the specific diagnostic tools utilised in each setting (some based on operator experience, others on calculation) and the accounts that emerge for their justification. In the NTCC, for example, the diagnosis of congestion events must be done in strict correlation with abnormal congestion alerts as produced by the system. Although background expectancies help Adam to make meaningful the conditions he observes, the discrepancy between his observations, the abnormal congestion alert and even the signs set by the RCC, is ultimately denied interest by the team manager. While the abnormal congestion alert as a diagnostic tool makes sense insofar as it helps operators cope with the

changeable nature of motorway network conditions by offering to standardise it through calculation, it does not remove ambiguity in its definition. There is scope to dispute the alert, but the obligation to comply with the calculative rule limits operators to setting congestion signage only when an alert has been created, no matter how convincing the case is to act otherwise, which may lead to incompatible and conflicting sign setting on the motorway. The next chapter returns to the control room in the RCC to explore how a practically relevant version of the incident is rendered actionable through the work of creating an incident log. This will pay particular attention to how operators cope with substantive uncertainty and procedural ambiguity through the activities of classifying, grading and prioritising incidents. In effect, this work enables operators to make choices about what the incident is and how it should be managed which is then shared for the purposes of delegated incident response work. This captures the point at which the disruption diagnosed as an incident is transformed into an actionable, real time incident management response.

Chapter 7

Creating the Incident Log

7.1. The Next Step: Logging an Incident

This chapter aims to advance an understanding of how sensemaking emerges and extends across multiple spaces and times by observing activity in the motorway control room. Similar to other centres of coordination, this doubling effect emerges from the range of practices that exist to cope with the spatial and temporal challenges these settings face. First, the work of a centre of coordination is typically organised over physical distance and it is managed by co-located participants in a control room setting. Second, the relations they keep within and between these spaces have a critical temporal element to them; knowing what is happening now, as well as being able to decide what should happen next, is of critical importance to achieving coordination, whether this has a real time requirement or not. However, this doubling-up of sensemaking across its spatio-temporal arrangements is largely neglected in centre of coordination studies. A possible explanation for this is that these studies tend to fall into one of two research areas that always already separate centres of coordination into two worlds – the work inside the control room and the work beyond it. They either focus on the coordination of activity between co-located participants in the control room itself, say between radio dispatchers and mobile patrols, or they attend to the coordinative work that exists between control room personnel and individuals physically located outside the control room, such as call handlers and callers. This

separation is unhelpful in that it misses out on an understanding of how the two mix in complexly situated ways. This is the challenge of this chapter, which is to investigate how motorway incident management work is achieved by virtue of this doubly-situated sensemaking work.

So far, Chapter 5 has dealt with the challenge of spatial distance, between the motorway control room and the wider motorway network, which is transformed through the sociotechnical relations it keeps, to bring physically distant network spaces closer and render disruption available for detection. Chapter 6 revealed the temporal challenges of incident management, making a critical link between what is happening now and the pressure of procedural ambiguity when deciding what the next action should be, against a background of shifting and situated expectancies. The fact of the matter is that these two worlds do not function independently of each other. One – the maintenance of a local order between colleagues as they participate in delegated yet coordinated incident management work is dependent on and constantly open to reconfiguration by what is known about what is happening on the motorway network. Two – the practical accomplishment of traffic depends on a mutual understanding of the incident by operators in the control room, which is based on background expectancies and their orientation to the objectives and priorities of the organisation. To analyse its doubly-situated character, this chapter focuses on a detailed empirical analysis of the work that occurs at the incident logging screen. This is where the activities that take place between the control room and the wider network (the making and taking of telephone calls and radio transmissions, the MIDAS activations, the pan

and tilts of the CCTV cameras, the production of abnormal congestion alerts, the setting of signs and signals) and between co-located participants (the listening-in to calls, the gesturing at the computer screen, the requests for help and the discussions, negotiations and deliberations of operators) are mixed in the interactional achievement of constructing the incident log. It draws together the findings from Chapters 5 and 6 in that incident management work is complicated by both substantive uncertainty and procedural ambiguity, which has the potential to make coordinative and collaborative work activities in spatially distributed and time-critical settings somewhat troublesome. These uncertainties and ambiguities have to be contingently managed by operators as they construct the log – after all, they need to create a version of what is happening in order to get the work moving in the control room – shifting from the sensemaking practice of “pushing the facts around” (Orr 1996:126) to the work of classifying, grading, prioritising and locating the incident by committing to the information requests of the standardised incident log. This chapter analyses how this works get done. It shows how the doubly-situated sensemaking work is an interactional achievement rooted at the screen of the incident log, helping to treat different types of activity together and link different spaces and times to produce a case of the incident that is good enough for incident management work to continue.

7.2. Why Classification Work Matters

Working out what to do next is a general ethnomethodological problem which is encountered in all kinds of everyday and professional settings and, most evidently, within those where we find ourselves confronted with an unfamiliar or

unexpected series of events. To make sense of these encounters, ethnomethodologists argue that members engage in a number of specific sensemaking practices that include the work of noticing, bracketing and extracting cues and assigning categories or types to an observable set of real circumstances (Garfinkel 1969, 1974; McKinney 1969; Weick 1995; Weick et al. 2005). This is of particular interest to ethnomethodologists because it is through such activities that members produce recognisable and accountable orders of the setting within which they act. Most commonly found in CSCW and workplace studies are accounts of how this sensemaking work produces orders that are observable to us in the form of classifications, codes and types, embedded in written documents, databases, records and logs, or realised in verbal testimonials and verdicts of setting (Bowers and Martin 2000; Castellani et al. 2009; Cromdal et al. 2008; Garfinkel 1967; Hartswood et al. 2003; Komter 2006; Martin et al. 2007; Simone and Sarini 2001). It is precisely this work of classification, broadly defined as the practices of arranging, ordering, making equivalent, and so on, through the observable selections of types, categories and classes, rather than the act of specifically (and narrowly) assigning classes, which is of utmost interest to this chapter. Reflecting on Chapters 5 and 6, this classification work may take place during times of substantive uncertainty or procedural ambiguity, as well as other times that are considered 'just routine' (Randall and Roucefield 2011).

It is worth explaining how this chapter accounts for the relationship between diagnostic and classification work, most notably in professional settings. Previously, diagnosis has been discussed as a particular practice of sensemaking-in-

action which involves working out an appropriate solution or response to a problem. This working out is practically experienced as tentative, sometimes recursive, and largely collaborative, as members of a setting incrementally produce diagnoses as they engage in activities of questioning, investigating and interrogating to further pinpoint the nature of the problem. This means that diagnoses need only be “sufficient enough” in order to grasp a sense of a situation, commence investigations and form retrospective accounts of what happened (Büscher, Goodwin and Mesman 2010). This is in part captured by the sensemaking work of operators as they engage with context-sensitive accounts of background expectancies, which help operators draw comparisons between observable phenomena and normative expectations of what should count as an incident. Ultimately, this sensemaking work becomes intertwined with the more ‘formal’ classification schemes that are embedded in computer systems, databases, records and other material forms related to fulfilling an organisational requirement to account for and audit activity as it occurs. This is not to suggest that formal classifications seek to control other sensemaking activity; this is because all work is of a situated and ad hoc nature and therefore not driven by any sort of formalism (Bardram 1997; Suchman 1987; Symon et al. 1996). An order emerges from their negotiations.

It comes as no surprise that an interest in classification has driven research in the areas of CSCW and workplace studies, given that technology is one of the primary ways through which classifications become embedded in settings through information infrastructures. Early CSCW studies, however, treated classification

schemes as idealisations of work practices that designers could embed in systems for the purpose of managing workplaces, especially those configured by physically distributed, yet coordinated, work activities (for example, see Abbott and Sarin 1994).⁸⁸ They relied on the assumption that work practices could easily be replaced by automated, simplified routines, based on formalisms of work, oblivious to the practical reality that sociotechnical interaction involved negotiation, translation, collaboration and judgement in classification work, impossible to fully replicate by automation (Bowers et al. 1995; Ehrlich and Cash 1999). Further, some studies perpetuated an understanding that the observable 'work-arounds' or improvisations that operators employed to manage classification work were symptomatic of inadequate systems, missing out on the opportunity to analyse how these work-arounds actually played a significant role in how members of a setting make sense of and negotiate their actions within routine parameters of activity (Suchman 1987). Like diagnosis, the term classification seems to have little patience for the sensemaking work that goes into its selection, implementation and contingent activity. This is evident in the professional accounts of traffic management in the transport engineering literature. The very purpose of their models and flowcharts is to present an abstracted version of work from any contextual uncertainty or ambiguity. As Bowker and Star (1999) have argued, this does not just happen in professional context, but classification schemes of all kinds have become a pervasive form of organising and ordering the modern world.

⁸⁸ Some of this work comes under the umbrella of "workflow systems," which firstly represents work through formalisms constitutive of basic categories (artefacts, human roles, activities, tasks) and a prescribed order of tasks, and secondly suggests ways to automate and standardise work activities for the purpose of enhancing efficiency, productivity and accountability through these formalisms (Grinter 2000).

Classifications, types and grades come to stand in for a specific incident, event or phenomenon and subsequently take on the appearance of fixed and indisputable realities. The problem lies in the fact that we barely acknowledge their existence or the consequences they have for how we make sense of and understand the world around us. In response, Bowker and Star (1999) are interested in how classifications come into being by unpacking the invisible work that goes into their construction and routine use. While this focuses more on the 'before' and 'after' of classification schemes, it has inspired a number of studies of classification-in-action, as it is found to be practically relevant for the purpose of the setting within which it takes place.

In CSCW and workplace studies, for example, research has focused on the ways in which classification schemes affect the structure and process of sociotechnical interactions and how they become interwoven in, and consequential to, the form and patterning of work practices (Bowers and Martin 2000; Ehrlich and Cash 1999; Martin et al. 2007; Martin and Rouncefield 2003; Muller 1999). This is, in other words, the work that makes classification schemes work. They show that there is actually an interesting interplay between the general (classification schemes) and the situated (observable phenomena) that helps to move the activity along. However, the way in which the organic quality of sensemaking becomes intertwined with formal classifications schemes and their material manifestations in professional settings, which is so often consequential to diagnostic work (particularly when diagnostic work is coordinated among spatially distributed agents), is disappointingly forgotten about in ethnographies of diagnostic activity.

For example in Orr's (1996) study of photocopier repair technicians, the account stops before we find out how diagnostic activity is translated in call-out records and service histories, which are presumably kept for auditing and accounting purposes, and Paoletti's (2009) study of emergency service calls misses the opportunity to show us how verbal communication between the operator and caller is interweaved with (and co-constitutive of) classification work at the incident logging screen to enable other colleagues to do their work. There are, of course, studies that attend to the practical accomplishment of records and logs, although they tend to be more focused on either the occasioned nature of talk in the conversation analysis tradition or the support of distributed, coordinated activity in a single scene or setting, rather than paying attention to the ways in which classification work intersects with and mixes in multiple spaces and times (Benson 1993; Berg 1999a, 1999b; Hartswood et al. 2003; Heath and Luff 2000; Komter 2006; Symon et al. 1996).

The next section of this chapter details the importance of the work of logging an incident. It is extremely difficult to ignore these more formal classification practices in the motorway control room, given the pervasiveness of the electronic incident log in the coordination of incident management activity, the troubles that operators encounter when choosing mandatory classifications comprising the incident log and how classificatory talk pervades the naturally occurring talk of the control room operators – in previous chapters, this is evidenced by talk about incident type codes, status codes, priority grades and locations, which was encountered throughout the empirical materials. For

operators, incident logging is a necessary part of their work. It meets both organisational requirements for accountability, given that its work is time and safety-critical (taking ERT calls and setting signs and signals are both highly accountable activities) – the details of which would be impossible for a human administrator to record independently of the logging system (Ehrlich and Cash 1999) – and the need to facilitate delegated work between spatially distributed operators by electronically sharing information. But from an ethnomethodological viewpoint, there is something more interesting going on here. The methods operators use to make sense of the doubly-situated character of incident management work, mixing different spaces and times within and beyond the control room, can be observed at the incident log. This takes place through the activities that create, construct, add to, amend, issue, open, close and otherwise negotiate the incident log.

7.3. The Incident Log

Each time an operator diagnoses a reported disruption as an incident requiring some sort of further investigation or intervention, a new incident log must be created to render it available to the operators performing delegated responsibilities in the control room setting by virtue of its virtual mobility. The incident log is an electronic record that can be shared between operators logged on to the incident logging software, C&C, at their individual workstations.⁸⁹ It has a

⁸⁹ Previously Vivista Command and Control. The software was developed under the National Strategy for Police Information Systems (NSPIS) for police use and it is still in use by police forces across England. When the Highways Agency took over motorway incident management from the police, they continued to use the C&C software. Although C&C was not commissioned by the Highways Agency, it has undergone development work to customise the application to meet the specification of motorway working under the TOS. For example, call origins, incident type codes,

standard format, comprising two main components. One is a set of mandatory fields that must be completed by an operator before the incident log can be issued on the system. The mandatory fields are: Call Origin (the source of the incident report), Type Code (the type of incident), Grade (the requirement for attendance by a HATO on patrol, which is ranked from Immediate, Prompt, Routine, Deferred to Non-Attendance) and Location. The other is a system message log which provides a time-stamped audit trail for all log activity, which is automatically generated by the system to record details such as which operator opens, closes, clicks through or amends the log as identifiable by their unique collar number. It also enables operators to enter free-text messages to add information or activity updates. The incident log therefore helps operators to order and organise incidents and their details, it helps to track who has done what, what is currently being done and what needs to be done next, and it acts as a repository for fragments of information deemed relevant to the incident. The form of the incident log does not change, it remains as standard, and only the information contained within it is made relevant to the type of incident at hand.

It is specifically this work of organising and ordering incidents according to type, grade and location which is defined broadly as classification work in the motorway control room. To help readers grasp how this work of constructing the incident log gets done in its initial stages, the first empirical example provides a fairly typical exchange between a call handler and a motorist using an ERT to report his broken down vehicle. It is what operators would call a routine breakdown; the

and carriageway proformas have all been designed into the system to meet its organisational needs. It continues to be incrementally developed through consultation with the Command and Control User Group.

vehicle is located on the hard shoulder, its hazard lights are switched on, the location is not deemed dangerous (for example, it is not an elevated section of the motorway) and the caller does not require any welfare assistance. While the majority of this work takes place at the C&C screen, the example also refers to the operator's use of the COBS – the interactive network map that operators use to answer and locate ERT calls. This first example serves to show how classification work *gets things moving* in the control room by anticipating what kind of information is relevant to foster intelligibility of the incident within the control room, prompting operators to seek out information and then move on to the next action. After all, the mandatory fields must be completed before the incident can be issued; that is, before the incident is rendered available for all other operators to enable the commencement of coordinated incident management work.

This obligation to record certain incident details, however, becomes problematic when common sense understandings of disruption do not fit well with the classificatory structures of the incident log. The second example, reflecting on the perils of winter maintenance, highlights how procedural ambiguity is dealt with at the incident log, spurred on by the ever-present time pressure to issue the incident log, which results in classification work that *needs only to be good enough* for the practical purpose at hand. Here, there is particular concern from the operator that his colleagues will be able to make sense of what is happening on the motorway network and consequently put into action the selections he makes at the incident log. In this case, it is all about determining how best to classify and grade the incident for the purpose of ordering and prioritising incident response work

among colleagues. This occurs at the point of transforming an understanding of what is happening at a distance, in a timely fashion, into the log within the control room. The third and fourth examples explore how the imposed, formal structure of the incident log can sometimes make it difficult for operators to classify according to local relevancies, especially in cases where there is a notable degree of substantive uncertainty. This makes it troublesome for operators to make obvious selections in the construction of the incident log. The assumptions embedded in classification schemes about how diagnostic activity works can then *become unstuck and require additional work to fix them*. All in all, these examples work to demonstrate the practical realities of classification work at the boundaries of inside and outside, now and next, in the production of mutual intelligibility to accomplish orderly traffic movements.

7.3.1. Classifications are Designed to Get Things Moving

Example 1: Answering an emergency roadside telephone call

An ERT call is received in the control room. At the first ring, the operator turns immediately to COBS (he was previously scrolling through the list of incidents on C&C), he takes the mouse, and clicks the telephone icon to accept the call. There is a slight pause while the call connects. The operator adjusts his headset and hunches forward slightly. The call connects and there is interference on the line; a mixture of crackling and whooshing sounds. The operator says, loudly, "Hello Highways Agency. Have you broken down?" The caller replies "Yes, yes I have." He asks "Is your vehicle on the hard shoulder?" The caller replies "Yes." The operator then turns to the C&C screen and presses F2 to create a New Incident while he says "Just bear with me sir, I need to take a few details from you."

The operator first clicks in the Type Code field and types "BH." "And have you got your hazard lights on?" The caller replies "Yes." The operator then clicks on the Call Origin drop down box and selects GENERAL PUBLIC – ERT. He

selects NON-ATTENDANCE from the Grade drop down box. He then asks “Can you read out the number on the side of this telephone box please?” The caller slowly reads out “T-6-2-0-3-A” while the operator types it into the Location field. “And that puts you between junction 2 and 3 on the M42, right?”

The operator then tells the caller that the safest place for him to wait for breakdown recovery is out of his vehicle and on the grass verge, well away from the carriageway. As he does this, he types “SAG – HAZ ON” in the Source Supplied field.⁹⁰ The operator types 1EDE in the Control Area field. He then clicks the ISSUE button to issue the log. The log is now live on the C&C system.

In this example, the operator answers an emergency call made by a member of the public who is using an ERT, located somewhere on the motorway network. As most ERT calls are made to report vehicle breakdowns, the operator immediately orients the opening of the call to this organisationally-relevant, and largely expected, type of incident, by posing the question: *“Have you broken down?”* Giving the time-criticality of emergency calls, the classification of incidents by type is a primary means of communicating with the caller to arrive at a mutually recognised version of what is happening on the motorway network which is quick, to the point, and relevant to the activity that goes on in the control room. The operator then swiftly seeks additional detail about the incident by asking: *“Is your vehicle on the hard shoulder?”* It is this work, routinely executed, that enables the operator to quickly confirm that this ERT call is indeed a report of a vehicle breakdown and he presses F2 on his keyboard to create a New Incident window at the C&C screen. The first mandatory field that the operator selects is the Type Code. The operator has already specified what type of incident this is through the

⁹⁰ Shorthand for Safety Advice Given – Hazard Warning Lights On.

diagnostic work he carried out at the very beginning of the call. He straightforwardly types in BH, inputted from memory. This is the type code for a broken down vehicle (B) combined with its general location on the hard shoulder lane (H). The type code is selected from a predefined, fixed list of incidents that are expected to occur on the motorway network.⁹¹ As a classification scheme in the broadest sense, it exists to help operators define an incident according to predefined categories or types that organise information deemed to be relevant to the setting (Bowker and Star 1999; Dourish 2000).⁹² The type code works well as an example of one of the most basic ethnomethodological principles of common sense understanding in action, where it is typical for us to think in terms of the general and the familiar, rather than the unique or the idiosyncratic, especially when we first attempt to make sense of conditions as they immediately appear to us (Garfinkel 1967; McKinney 1969; Sacks 1992; Spiggle and Sanders 1984). This is what Garfinkel (1967:78) calls the documentary method, where a specific observation (this vehicle breakdown, taking place on the hard shoulder at this location, involving that person) becomes linked with a more general form (an incident type). The general form helps to clarify the relevance of the particular to the purpose at hand (which in this case is working out what to do next) and in turn

⁹¹ There are 21 incidents included in the list: Animal on Network, Abandoned Vehicle, Abnormal Load, Breakdown – in the live lane, Breakdown – hard shoulder, Congestion, Event (off network), Fire, Found Property, Emergency Assistance Required, Other Incident, Obstruction, Observation – infrastructure problem, Observation – police/VOSA intelligence, Oncoming Vehicle, Pedestrian on Network, Roadworks, Use of Hard Shoulder (not breakdown), Traffic Collision, Weather Condition Reported and Duplicate. Note that some of these incidents are not explicitly relevant to the work of motorway incident response; this is the legacy of C&C as a police incident logging system.

⁹² It makes sense to talk of operators working with types rather than classes. A class tends to constitute a list of mutually exclusive phenomena which are distinguished at the same, typically low, level of generality (McKinney 1969). A type, on the other hand, is distinguishable by a combination of its features to enable a more relational understanding of phenomena. In the control room, operators tend to work with 'types' of incidents, because they exist at varying levels of generality, depending on their form.

the particular distinguishes itself from the general in order to inform an appropriate response (this is a routine hard shoulder breakdown). As it is evident in this case, the work at the incident log spans the positioning of the call handler, as a participant within the control room, with the responsibility of providing appropriate and relevant information for the coordination of incident management work, but also between the call handler and the caller as they jointly produce a version of events relevant to each other's needs. This means that the incident log is far from a simple repository of information because the operator works hard to intersubjectively create the incident log with the help of the caller.

The type code is sufficiently general, while remaining practically relevant for the prioritisation of this incident, according to its threat to traffic safety and flow. Any incident in the live lane poses a direct threat to the safety and flow of motorway traffic and it must be removed as quickly as possible (and if feasible, traffic management must be implemented to warn passing traffic). As this incident has been identified as taking place on the hard shoulder, coupled with the absence of any obvious indication that the caller is in need of welfare assistance from a HATO patrol – only assistance from the operator to arrange breakdown recovery from a third party provider – the operator manually downgrades the incident from ROUTINE to NON-ATTENDANCE. There are, of course, exceptions when an incident with the type code BH would be manually upgraded by the operator to a prompt or immediate priority grading from a routine grading. Vehicle breakdowns involving individuals deemed vulnerable (for example, children and the elderly) or those located in dangerous positions on the motorway network (for example, elevated

sections) would be upgraded. This has a direct consequence for the form of response made; a HATO would be expected to attend a prompt priority graded incident and must attend an immediate priority graded incident. For the purposes of the operator's colleagues in the control room, the non-attendance grade signals that there is no requirement for a HATO patrol to be dispatched. Next, the operator must complete the remaining mandatory fields, which are highlighted in yellow on the incident log. The Call Origin field requires the operator to select the best description of the source of the incident report from a predefined list displayed in the drop down menu.⁹³ It is generally a straightforward choice, GENERAL PUBLIC – ERT, and in this case it is made without hesitation or the need for further deliberation. The call origin matters to the response work that follows because it is directly related to the trustworthiness of the incident report, and therefore whether it is treated as a confirmed or unconfirmed incident.⁹⁴ Reports of vehicle breakdowns are more or less the exception to this rule; it is treated as an equivalent to an emergency 999 call and thus generally accepted as it is reported, without the need to substantiate any claims made with another source as it is the case with other incidents reported by members of the public. After that, the operator swiftly types in the geographical address for the ERT into the Location field

⁹³ This list contains: Admin; Ambulance; Automated Detection; CCTV; Emergency Radio; Fire; General Public – ERT; General Public – Other; HA Contractor; HAIL; HA Task Incident; NTCC; Other On Road Service Provider; Police; and Traffic Officer – Routine.

⁹⁴ If the report has been received from a trusted source, such as a HATO, an emergency services personnel or a road worker, then it is a confirmed incident and, consequently, control room operators are permitted to implement intrusive traffic management measures – that is, they can set signs and signals that (re)direct the flow traffic without any need for further investigation of the incident report. An unconfirmed report from a member of the public, for example, must be corroborated with a different source, such as a CCTV observation or a traffic officer is sent to the incident scene. Intervention, in the form of the dispatch of a patrol, is part of the diagnostic activity of the control room, but intrusive traffic management measures are not permitted at this stage.

which is then checked against the gazetteer.⁹⁵ Given the importance of an accurate location to enable a swift and efficient response, the operator reads back the location to the caller for confirmation. The operator then fulfils his obligation to give safety advice to the caller and this is noted in the Source Supplied field (a clunky name, which does not make much sense in the context of Highways Agency use, but it is a remnant of its origins as a police-based system). This field is now used as a free-text repository to record any incident details before the incident has been issued (and therefore before the free message log is made available for use).

Before the incident log can be issued, and therefore made available to all operators logged into the C&C system for the purpose of coordinating an incident management response, the operator must select a Control Area. Control areas organise incident logs by geographical region and operator function (call handling, radio dispatch, traffic management, team manager). Operators select which control areas to subscribe to depending on their role because it is not necessary for all operators to view all live incidents; this effectively filters incidents to display only the ones that are deemed relevant to their role. This has an obvious advantage during busier times and avoids overcrowding the incident logging screen with all the live incident logs. In the example, the operator selects 1EDE. This means that the incident will be shared amongst all call handlers (E) and radio dispatchers (D), working in the East (E) region of the network. The operator has made the decision that it is not relevant to traffic management because the incident is not in the live

⁹⁵ T denotes an ERT, 6203 identifies the specific ERT, and A tells us that it is located on the Alpha carriageway. The operator enters this location into the gazetteer and the system automatically updates the Location field to read "T6203A, J2/3, M42, CMPG." This tells us that the incident is located at ERT number 6203 on the Alpha carriageway between junction 2 and 3 on the M42. CMPG is the police control area it is also located in. The operator then reads this location to the caller to confirm that the correct location has been recorded in the log.

lane (and thus it does not require traffic management intervention) – so, in effect, this particular incident is excluded from the traffic management operator’s incident logging screen. Once the operator presses the ISSUE button, the incident log is now available to all operators subscribed to the 1EDE Control Area. It will appear highlighted in RED in the Incident Queue until the ACKNOWLEDGED button is pressed by an operator who takes on responsibility for the next action. It is expected that any operator picking up this incident log will know what needs to be done next, because the classification work involved in its construction has used familiar types, grades and locations that helps to foster mutual intelligibility, to get the action moving. This is not to suggest that operators will share the *same* understanding of an incident, but they will at least be able to understand what has gone on and what needs to be done next according to routine organisational responsibilities (as in the old ethnomethodological principle of reciprocity of perspective (Garfinkel 1967; Leiter 1980)).

This version of the incident is incrementally developed over the course of the call through the selection of a number of classifications – a type code, priority grade, location, call origin and control area – that require the operator to make selections that best match the incident being reported by the caller. Classification work, as it is evident here, is something that operators must do, but it also works to move the work along nicely. In this sense, the different classifications together form a kind of “scaffold,” to borrow a term from Simone and Sarini (2001:36), which is designed to support and sustain sensemaking work while a reasonable and plausible account is constructed. It encourages the operator to be selective in the

incident details they seek in questioning. The points at which the choices are actually made, by choosing this type and not that type, this grade and not that grade, are particularly invaluable for illuminating how the specific circumstances of a disruption are made sense of in terms of how it is best communicated to co-located participants in the control room to bring about an appropriate incident management response. This can be described as a “springboard into action” (Weick et al. 2005:409) (although this action could be anything from further deliberation to moving on to a distinct subsequent action).⁹⁶ It helps to organise initial observations and make equivalencies between the specific and the general to make sense of any substantive uncertainties or procedural ambiguities that may exist. This is directly related to the characteristics of the setting; it is a time-pressured environment and this means that a plausible account is prioritised over any attempt to ensure its accuracy (Alby and Zucchermaglio 2009). In an audited environment, the operator must issue the log as quickly as possible to enable coordinated response work to begin to take shape. As Simone and Sarini (2011:36) go on to say, scaffolds “are not designed to last for a long period: their main value is to help the work progress.” This is quite apparent in the work of the motorway control room, particularly with the swiftness that the operator completes the mandatory fields, knowing that these classifications do not have to stick if the incident develops in an unanticipated or unexpected fashion, or if incident details become revealed at some later time. Weick et al. (2005), for example, attribute this to the fact that

⁹⁶ Classification schemes, of sorts, are also described as interpretive schemes” (Gephart 1993) and “frameworks” used to organise observations (Starbuck and Milliken 1988). They do not capture the role of sensemaking-in-action as perhaps Weick et al. (2005) strive to do, since they suggest that classification work is the straightforward placement of cues into frameworks for subsequent interpretation – which risks perpetuating the idea that sensemaking and acting are distinct activities (see Thomas, Clark and Gioia 1993).

action is always marginally ahead of attempts to make sense of it, which means that attempts to classify can always become unstuck during subsequent activity.

Therefore it is understandable that classifications may only be sufficiently plausible in order to get the work moving, but ultimately subject to change. Classification work is then not an end in itself, but emerges jointly with other diagnostic activity that attempts to make sense of what is going on out there as well as what is going on in here.

7.3.2. Classifications Sometimes Need Only Be 'Good Enough'

As classification work helps to move the work along, the operator begins to commit to a certain version of the incident as it is observable, right now, provisionally defined by the mandatory selections generated at the incident log. However, not all common sense understandings of an incident are straightforwardly translated into classifications like the previous example. This is a source of procedural ambiguity which manifests itself through operator hesitancy when attempting to make comparable those common sense ways of describing or grading an incident and selecting a classification to match it, bearing in mind the kind of version of the incident the operator intends to create in order to bring about an expected incident response from his or her colleagues in the control room. On those occasions where there is a discrepancy regarding how adequate a classification is, they work to reveal that classifications can be incomplete. Sometimes, they just do not fit. Given the time pressures imposed on operators then, classifications sometimes need only be 'good enough' (Bowker and Star 1999). Being 'good enough' encapsulates a slippage point between what is

observed and the classification schemes put in place to manage the work. This is what Garfinkel (1967) calls 'normal troubles.' They are not unexpected troubles and members of a setting usually have common ways of dealing with them.

Example 2: The troubles of winter maintenance

Gareth receives a call from a traffic officer. He reports a "pretty big pothole" on the M6 between junctions 30 and 31 in lane 1, suggesting that "it's going to cause someone some damage if it doesn't get fixed." Gareth creates a New Incident. He selects TRAFFIC OFFICER – ROUTINE from the Call Origin. He clicks to view a list of the Type Codes, hovers over a few selections, before choosing OTHER INCIDENT. He types POTHOLE LANE 3 in the Type Description, notes the Location, and updates the Grade to IMMEDIATE.

"What with all the bad weather, it's all the potholes that come up, but they're not really relevant to any of the Type Codes. I mean, you could say it's Roadworks, you could say it's Infrastructure Problem, but both of them are Non-Attendance Grade so we don't attend them at all. So there are times when it's not quite relevant to what you've got to deal with. So what I've put down here is Incident Other, which is a Routine grade, and just changed it to an Immediate, because it sounds like a pretty big one."

In this example, Gareth takes a call from a traffic officer, currently on patrol, who has just driven past a "pretty big pothole" on the M6. During the conversation, the traffic officer asks for repair work to be organised. Pothole repairs require a HATO at scene to perform a rolling road block to temporarily stop traffic in the live lane while a road contractor carries out the repair. Potholes constitute a prevalent problem on the motorway network and they appear more frequently during the winter months when temperatures are low (water gets into cracks in the road surface, it expands in cold temperatures, puts pressure on and weakens the crack even further). Potholes can cause damage to vehicles and thus pose a serious safety risk to moving traffic at high speeds (they often lead to

compensation claims being made to the Highways Agency). Gareth creates a New Incident on the C&C system, selects TRAFFIC OFFICER – ROUTINE from the Call Origin field, but then hesitates (albeit only ever so briefly) about the Type Code selection. Despite their rate of occurrence, there is no type code that directly relates to the disruption as observed and commonly described. So to help him make his selection, and to cope with this ambiguity, he views the options available to him from a computerised list of type codes – the more unfamiliar ones are not available to the operator from memory.

Thinking back to the work at the C&C screen, the type code is the most explicit offer of a classification scheme contained within the incident log. The operator has to make a selection from 21 different types of incident, as listed by the system, which corresponds to the incident as observed or reported. This is not to say that there can only ever be 21 different types of incident that take place on the motorway network. This is because classification schemes are rarely, if ever, deemed complete representations of observable phenomena and therefore able to account for each and every local contingency (Bowker and Star 1999). This means that classifying incidents inevitably involves the work of finding the ‘best fit’ from a previously selected list of possible choices, depending on the information available to the operator. While type codes serve to delimit the way in which incidents are recognised (to help prioritise and enrol response), they must remain sufficiently generic to cover any particular incident that occurs. They simulate a sense of completeness with the work of the “Incident Other” category; a catch-all or residual category that is infinitely large so that it can stand in for any incident that evades

classification. This is why classifications are sometimes just good enough because they cannot be anything else; they are ultimately generated from incomplete lists of phenomena that rely on 'invisible work' to make them work (Bowker and Star 1999; Martin et al. 2007) – this is the practical activity that surrounds their selection as both relevant and plausible to the specific circumstances within which it unfolds. The selection of this or that type code can therefore be a source of procedural ambiguity for the operator, since there is no obvious next move.

Since there is no type code explicitly related to the trouble of potholes, Gareth deliberates whether to choose Roadworks, Infrastructure Problem, or Incident Other. Each selection has implications for how they are understood by other operators for the purposes of coordinated incident management work. As Gareth says, if he was to choose Roadworks or Infrastructure Problem, any operator, at a glance, would deem the incident as not requiring immediate attendance by a HATO patrol. The consequences of selecting this or that type code is then considered and worked around to make it as close to eliciting the response that the operator wants. Gareth selects INCIDENT OTHER and then performs a number of workarounds that make best use of the flexibility contained within the incident log in order to make known the specific requirements of the incident. This is the space of slippage between what is occurring on the network and how it is defined in the log for the purpose of bringing about a response in the control room and, in this case, operators expect to do additional work to make explicit what they mean by their selections. So Gareth types in the Type Description field POTHOLE LANE 3 which will be instantly made available to any operator reading the log, in an

attempt to specify what form this Incident Other is taking. He also manually updates the Grade to IMMEDIATE. All this tinkering with the incident log demonstrates the operator's practical competency to work with the structures of the C&C system in order to make his selections visible which would otherwise be obscured behind the classification of type code if left without further specification. It also means that the operator is actively anticipating its future use or future interpretation by other operators and makes amends for any potential source of discrepancy (Komter 2006).

While classification work is shown to be beneficial by providing a familiar structure to collect and record information and to get the action moving, the experience of dealing with procedural ambiguity at the incident log can occupy precious response time while it is negotiated, deliberated and further investigated. These workarounds may appear as inadequacies associated with classification work, but they are typically experienced by operators as normal troubles that are dealt with routinely, as evident in the way that Gareth has worked through this incident. So for the sake of practical relevance, and for getting things moving, neat classifications are compromised for workarounds of its formal structures, which only really make sense as they unfold in situated activity. Garfinkel and Bittner (1967) call these 'good organisational reasons' for 'bad records.' They argue that there are always good reasons for working around formal classification schemes and forms and these reasons are necessarily local and dependent on contingencies of practice.

7.3.3. Classification Work Can Become Unstuck and Require Additional Work to Fix

In addition to experiencing procedural uncertainty (not knowing how best to classify an incident, what to do with the information to hand, or what to do next), operators also have to cope with substantive uncertainty relating to incident reports lacking in detail. In constructing the incident log, the information may not be readily available to the operator to make an informed classification. For example, in the case of a MIDAS alert, it only suggests a disruption in traffic, so it is necessary for the operator to engage in additional investigative work to establish an incident type, priority grade and location for the disruption. In other cases, the operator may have to deal with inconsistent or competing incident reports and have to decide what is the most plausible version of events. This is, of course, part of their routine work; after all, operators do not have direct access to the disruption and rely on techniques of questioning, searching, visualising, investigating and corroborating to further specify what is going on and what needs to be done next. Details of the incident may also change during the initial diagnostic process, given the dynamism of motorway network incidents, which further complicates attempts to standardise incidents in the log. It is often the case that the dispatch of a HATO is required to plug gaps in missing information and help operators diagnose and classify an incident. However, a HATO can only be dispatched once an incident log has been created. The pressure to dispatch a HATO may lead to compromises being made to the internal integrity of the incident log; that is, there is discrepancy between formalised classification work and common sense understandings entered

elsewhere in the log. Classification schemes do not cope well with internal inconsistency or incongruity, whereas common sense understandings are tolerant of the heterogeneity and complexity of everyday encounters (Bittner 1963).

This section now turns to those encounters where operators deal with substantive uncertainty at the incident log. This means to explore the various configurations an encounter takes, from the form of disruption (broken down vehicle, road traffic collision, congestion, and so on), how it is reported (telephone, digital message, CCTV visual, MIDAS calculated alert), to who it is reported by (member of the public, traffic officer, emergency responder).⁹⁷ Suchman (2007) talks about how different configurations of people, artefacts and technical devices make available different possibilities for action, and thus different ways of dealing with uncertainty, in practically relevant ways. It is not a simple case of erasing uncertainty by engaging in classificatory work; rather, uncertainty is harnessed in ways that manage expectations, foster critique, and justify actions. To ignore how uncertainty is managed in situated and specific ways, would mean to blindly accept that the work of constructing the incident log is merely information processing, whereby a human operator acts as a straightforward intermediary between the disruption and its system-driven classification.

⁹⁷ This is more varied than in other contexts of classification work (for example customer service work in a call centre, see Martin et al. (2007), where interaction is consistently mediated between the operator and the customer by telephone and between the operator and the customer's electronic record held on the customer management database). Operators in the motorway control room work through a variety of interactional encounters which always already change the parameters for making choices according to a varying level of uncertainty and opportunity to cope with that uncertainty through further investigation.

Example 3: Vague locations

Phil answers a call from a HAIL operator. HAIL has received a report of debris in the carriageway, near Plymouth, from a member of the public. Phil informs the operator that he has telephoned through to the wrong RCC; this is the West Midlands, not the South West, but he will deal with the incident anyway and send the log to them.

“So, OK, just bear with me,” says Phil as he presses F2 to create a New Incident. He selects HAIL from the Call Origin field and types OB in the Type Code field. “So what is the debris?” The HAIL operator replies that there is a ladder in the carriageway, “It must have dropped off the back of a lorry or something.” “What location do you have?” The HAIL operator says “It’s next to the Sainbury’s roundabout, just when you go over the flyover going out of Plymouth, in the direction of Exeter.” Phil mumbles “So that must be in a South West direction, coming out of Plymouth to get to Exeter.” The HAIL operator says he is confused about the location as he does not know the area very well and adds “I just can’t get my head around it.”

Phil moves to the GIS mapping screen and finds Plymouth. He says “So I’m guessing it’s going to be on the Bravo if the informant was travelling to Exeter out of Plymouth.” He clicks to zoom in on the GIS map; it is slow to load. “So we’re looking for a roundabout around here.” He zooms even further into the centre of Plymouth. “But there’s no way of knowing if there’s a Sainbury’s supermarket here.” After a short pause, Phil exclaims “Oh yes there is!” and promptly opens a web browser. In the search engine he types SAINSBURYS PLYMOUTH. He finds a map of the area and types various locations in the Location field in an attempt to find a match, NORTH CROSS ROUNDABOUT and COBOURG STREET but none of them are recognised as a location contained within the gazetteer.

Eventually he sighs, “Oh I’ll just stick this in for now” and types SWRCC, which is a default location for the RCC. This means that all the mandatory fields have been completed and the log can be issued. He promptly adds a free-text message to the log. It reads INFORMANT GAVE LOCATION SAINSBURYS RBT/PLYMOUTH HEADING TO EXETER. FROM INTERNET – SAINSBURYS STORE IN PLYMOUTH IS ON THE A374 OFF A386 NEAR UNIVERSITY OF PLYMOUTH. He then adds POSSIBLY ARMADA WAY.

In this example, Phil takes a call from an operator at HAIL.⁹⁸ The HAIL operator passes on a report taken from a member of the public about debris found in the live lane of carriageway, near Plymouth. The HAIL operator should have contacted the South West RCC (SWRCC) to report this incident, but instead has called the West Midlands RCC (WMRCC). Phil is aware of this but takes the report anyway, which is typical for this kind of misrouted call because incident logs can easily be shared between regions, using C&C. Phil immediately goes about generating an incident log by pressing F2 for a New Incident and begins to make selections of the mandatory fields. The process becomes unstuck when he is prompted to input a Location. He is ultimately reliant on collaborating with the caller to help him generate a plausible location that is, crucially, in an intelligible format that matches the gazetteer. The location has been reported in common sense terms that are relevant to the informant (*“next to the Sainbury’s roundabout, just when you go over the flyover going out of Plymouth”*), rather than in the form of a geographical address that is recognised by the gazetteer (marker post, carriageway identifier (alpha or bravo), junction, and motorway). Phil is unfamiliar with this part of the motorway network and therefore struggles to translate the informant’s rather informal location description into something more meaningful for incident response (see Cromdal et al. 2008 on location reporting in emergency calls).

On the whole, telephone calls are more suited to occasioned investigative work to help operators overcome any substantive uncertainty, compared to say a

⁹⁸ HAIL deals with enquiries and complaints from the general public relating to the motorway network.

visual feed or MIDAS alert that almost always require corroboration from other sources before a detailed account of the incident can emerge. This is because a telephone call, constituting the direct communication between the operator and the caller, provides the opportunity for further questioning. However, once Phil goes about pressing for a more specific location, it soon becomes clear that the HAIL operator cannot elaborate on the information he has passed on from the original informant. He tries alternative routes of questioning, but ultimately the HAIL operator “*just can’t get his head around it.*” In this case, Phil must work within the possibilities that this interaction affords. It is not possible to speak to the informant directly (the HAIL operator did not note down the informant’s contact details to pass on), so this prompts him to use an entirely different source of information. At this point, Phil performs a web search for a more or less specific location (Sainsbury’s in Plymouth) even though it is likely to produce multiple results (it is likely that there is more than one Sainsbury’s store in Plymouth). This leads to several attempts, at the incident log, to input a recognised location, but each time the gazetteer does not find a match. His attempts of *NORTH CROSS ROUNDABOUT* and *COBOURG STREET* are simply too locally specific (therefore not part of the motorway network) for the gazetteer to find a match.

Location is particularly important for incident management work, for obvious reasons, since the control room needs to know where an incident is located in order to dispatch resources to it for an efficient response. An accurate location is, of course, ideal, but in this case, Phil negotiates a plausible location in order to make the incident available to issue. After all, Phil is resigned to the fact that an

accurate location is unobtainable at this moment without assistance from a HATO that can actively go searching for the debris. It is therefore quite striking the extent to which the location field is intolerant of the practical realities of incident management. Some informants simply do not know where they are on the motorway network,⁹⁹ never mind being expected to provide a location that fits the form of a geographical address as it is recognised by the gazetteer. What is relevant to the system is entirely different to the common sense descriptions given by informants. In turn, some incidents are simply not faithful to static locations (as it is evident in the case of congestion, for example, which expands and contracts, in its spatial extent), yet it still demands a static location. The log cannot cope with flow events and their roaming locations. Phil is mindful of the pressure to issue the log, so in response to the location problem he “sticks in” a default location, which acts as a last resort. This default location, which is the address of the South West RCC, is frankly meaningless to the work of dispatching resources to the scene. However, once the log is issued, Phil is then able to add free-text messages to further elaborate on the difficulties he is experiencing in finding a location that matches the gazetteer. It will be evident to other operators that investigative work has been carried out from Phil’s reference to the additional source, “FROM INTERNET,” and he offers directions to the location of the debris, albeit they are still riddled with substantive uncertainty, in the expression of “POSSIBLY ARMADA WAY.”

⁹⁹ Driver Location Signs were first introduced in 2003 as a measure to increase motorists’ awareness of their location on the motorway network. They are large blue motorway signs positioned at approximately 500 metre intervals along the carriageway. They display location information as displayed on marker posts (distance from the start of the motorway, measured in 100 metre intervals, a carriageway identifier (Alpha or Bravo carriageway), and the motorway identifier (for example, the M42).

These difficulties in defining locations are not isolated to incident reports received by members of the public. They can also occur between operators in response to an incident log and the classifications that have been selected by other operators who were responsible for creating the log in the first instance. This is where the activities taking place between the operator and the wider network in identifying and diagnosing an incident (whether they are mediated by a member of the public, a MIDAS alert or a CCTV feed) and between co-located participants as they engage with the incident log in trying to make sense of its classifications as relevant to them are revealed. This next example introduces the role of the team manager who oversees the work that takes place in the control room. One of the responsibilities of the team manager is to check through live incident logs. This is largely to ensure that operators are giving sufficiently detailed accounts of what is going on, who is doing what and why, as well as to assess whether an appropriate response is being given by other operators in their interpretation of the log and its classifications.

Example 4: Location discrepancy

The team manager quite abruptly shouts up in the control room “There’s a broken down vehicle on the chevrons. Why on earth is this a routine if it’s on the chevrons?” Becky opens the log he is referring to. The vehicle breakdown has been given the Type Code BH – BROKEN DOWN VEHICLE – HARD SHOULDER and it has a ROUTINE grade.

In response, Becky says, “It’s well on the chevrons, and it’s not like it’s causing any disruption to the passing traffic – look,” as she points to the CCTV feed. The team manager replies “I’m not happy about this. Get a patrol sent out to it and tow it off.”

In this example, the team manager has found a discrepancy in the location recorded for the broken down vehicle in relation to the live carriageway. Chevron road markings are used at entry and exit slips of the motorway where traffic travelling in the same direction begins to join or part. Traffic must not enter the area, except in an emergency, because it is precariously positioned between moving traffic on the slip and main carriageway. The type code currently describes the incident as a vehicle breakdown on the hard shoulder (BH) with a routine grade. A routine grade means that the HATO, responsible for the area of the network where this incident is taking place, will be made aware of it and asked to attend only if they are passing it on their routine patrol route. If the HATO attends the incident scene, it is expected that they will conduct a welfare check with the driver and any passengers belonging to the vehicle and, if there is no cause for concern, the HATO will leave the scene in anticipation of the arrival of the breakdown company. In such a case, it is highly unlikely that the patrol will tow a routine vehicle breakdown off the motorway network. This is only done if the vehicle is considered to be located in a dangerous position.

A debate then ensues between the team manager and the operator regarding how the incident has been classified in the log: its location, its grade, and therefore the response it needs. The real discrepancy lies in the relative location of the incident to the live carriageway. Its position "*well on the chevrons*" is liminal; it is neither on the hard shoulder nor in the live lane, and thus it cannot be easily translated into the classifications embedded within the C&C system. This is because the type codes available for classifying vehicle breakdowns can only be

described as hard shoulder or live lane. There is no option for ‘well on the chevrons.’ The operator justifies her classification by suggesting that the vehicle is relatively safe because it is not causing any visible disruption to the motorway traffic as observed on CCTV; the significance of this being that the vehicle is “well” out of the way of live traffic. The classification, then, is intolerant of in-between locations, despite its practical relevance to how incidents are made meaningful and an appropriate response is actioned. There is no straightforward way of appropriately classifying the incident for the response that the team manager desires. The team manager calls for a HATO to be dispatched in order to tow the vehicle to a safer place on the motorway network. Becky makes a compromise for this discrepancy and upgrades the incident to PROMPT. The team manager can ultimately sway and take control of any classification work already done. Substantive discrepancies, then, do not fit easily with attempts to classify and standardise incidents. This can lead to further ambiguity amongst operators as to what next action is most appropriate. This was addressed by the team manager after viewing the location on CCTV which he considered to be precarious in nature and in need of attendance by a HATO. These troubles can further complicate incident management work; sometimes by prematurely downgrading an incident response without interrogating the consequences of its classification further, or by leading to future repair work that is required to make amends for incompatible typologies or priority grading.

Classification work in the motorway control room takes different forms. As the examples have shown, this can give rise to multiple problems associated with

classification that require different ways of dealing with them. In the case of winter maintenance, it is not clear which type code will provide the best classification fit in order to generate the kind of response that Gareth wants – an immediate dispatch of a HATO to the scene of the pothole. He decided not to choose Infrastructure Problem or Roadworks, even though they are arguably the closest descriptions to the actual incident in question, because they incur a Non-Attendance priority grade. Instead, Gareth chose Incident Other – a catch-all classification – and performed a number of workarounds with the form of the incident log to make it clear to his colleagues what next actions were appropriate ones. This included upgrading the log to an Immediate grade and specifying the location of the incident as live lane. For Phil, the incident location he received from the informant did not fit the classification form of the incident log. Phil tried various ways of describing the location in a form that the gazetteer would recognise, but his failure to match one significantly delayed the point at which the incident log was available to issue to other operators in the control room. In the end, Phil chose a temporary location, defaulting to the RCC address. To explain his choice to other operators reading the log, Phil used the Source Supplied field to provide context and entries in the main incident log body text to describe the location, ‘POSSIBLY ARMADA WAY.’ While the initial activity of creating an incident log is a collaborative one – the operator engages with the caller, MIDAS alerts, CCTV feed, classifications, and so on, to produce a mutually intelligible account of what is going on – rarely it is done in collaboration with another operator in the control room. This means that once the incident log is issued, it is open to the scrutiny of others. In the final example, the team manager disagreed with the priority grade of the incident, based on the

ambiguous location of the vehicle in question – do chevrons count as hard shoulder or live lane? The incompatibility of the operator and team manager’s definition of its location created some discussion in the room, leading to the upgrading of the incident. These examples serve to show that these workarounds and negotiations situated at the screen of the incident log are critical to this work to make sense of the doubly-situated character of incident management work that spans the sensemaking of co-located participants inside the control room and the translation of what is occurring on the motorway into an actionable incident log. They deal with different forms of ambiguity – type code, priority, location – which are often inextricably linked to the way in which operators make sense of their next appropriate actions. Classifications therefore help the work along, but they also require hard work to make them work.

7.4. Conclusion: Classification Work as In-Between

“The only good classification is a living classification.” (Bowker and Star 1999:326)

This chapter has shifted the focus of diagnostic work as characterised by “pushing the facts around” (Orr 1996:126) to the more formal classification work that takes place in the construction of the incident log. Classification work is arguably an important part of diagnostic activity in that they utilise similar sensemaking techniques that work to manage what is observed: by turning the unique into the general, the complex into the simple, and the ambiguous into a next action (Garfinkel 1969; McKinney 1969; Spiggle and Sanders 1984). It matters to accounts of diagnostic activity since it shapes, and is shaped by, the situated activity that enlivens diagnostic setting. The incident log then takes on a number of

roles in the motorway control room. First of all, it orders and organises information about an incident according to a set of mandatory fields. These selections are recognised and automatically put into an order by the C&C system in the Incident Queue. Incidents are ordered by their priority. Second, the formal form of the incident log provides a familiar account of the incident to help develop mutually intelligible readings of the incident between operators, and it includes comparable features to help coordinated work and the prioritisation of incidents for dispatching resources. Third, it enables operators to track and monitor who has done what and what is currently being done in the form of the free-message log. This is intended to help operators make judgements regarding what needs to be done next as the process of coordinated incident management unfolds. Fourth, it forms a repository for fragments of information pertaining to the incident that may be useful to other operators (or at least, require recording for auditing purposes).

More specifically within the motorway control room, classification is revealed to be a mixture of work that is simultaneously in-between the control room and the wider motorway network, mediated by informants of all kinds, and in-between co-located participants as they create mutually intelligible accounts of an incident for the purpose of making normative judgements about what should be done next for the primary purpose of coordinating incident management work. The points at which classification work is done are revelatory of the doubly-situated character of this work, giving some structure and guidance to help to move the activity along to deal with any substantive uncertainty or procedural ambiguity that may arise when dealing with disruption. This is particularly important at the point

of transition from distinctly informal and ad hoc sensemaking practices (does this disruption *matter* to the control room?) by drawing on context-sensitive background expectancies, to their translation into formal classification of types, grades and locations that maintain practical relevancies to incident management work. Operators are obliged to construct a version of the incident to help to engender mutually intelligible accounts of what has happened, who is doing what, and what needs to be done next, and to account for their actions. This version of events is still an ongoing practical accomplishment because it is always open to change, given the character of the motorway network, constantly on the move. What comes next can always modify the meaning or relevance of what has come before. Therefore, committing to a version of the incident at the incident logging screen does not mean that the provisional nature of diagnosing incidents is erased. Rather, it is where diagnostic activity continues to be played out by generating orders, comparing and making equivalent, using workarounds, and coordinating activity to get the job done.

However, since classification schemes are never entirely complete (Bowker and Star 1999), operators can encounter varying degrees of procedural ambiguity when it comes to acting on their selection. Knowing what to do with an incident, how to classify and grade it, and the consequences this has for its management, are not always straightforwardly evident. In turn, classification work becomes further complicated, or unstuck, when attempts are made to deal with this ambiguity. The log, and the way it demands information to be recorded in a certain format, is highly intolerant of the practical realities of incident reporting and the situated

forms that incidents take. Largely, these normal troubles arise because classification work is collaborative, and operators have to deal with different frames of reference when translating an incident report into an incident log. Members of the public in particular have different common sense understandings of what counts. Locations given in common sense descriptions, such as “*next to...*” or “*just when you go over the flyover...*” are simply not recognised by the formal structure of the log. Furthermore, those dynamic incidents that move, intensify, or dissipate, including congestion, cannot be easily accounted for by location. Operators can experience such hesitations and others at the incident logging screen due to these slippages between common sense and formal descriptions of incidents and ways of communicating them to colleagues to bring about an anticipated response. Because of this slippage, it is sometimes necessary that operators engage in extra sensemaking work or workarounds to make classifications work for their purposes. The role of the operator is not that of a mere intermediary between the incident being reported and the C&C system, like a carrier of information from source to repository. Operators actively and practically engage in sensemaking to cope with the local circumstances of each and every case, in order to translate it, intelligibly, with the system. This ‘invisible work,’ as it is often referred to (Bowker and Star 1999; Martin et al. 2007), is what really drives classification work. They become normal troubles and they are routinely dealt with. The work of the TOS serves to show that it is not necessary to be able to predict each and plan for every potential incident in order to provide adequate incident management. Rather, it is a matter of providing routinised practices of incident detection and response that can cope with the practical contingencies of motorway network disruption. The construction

and management of the incident log is exemplary of this. It copes with the complexly and doubly-situated character of sensemaking work, to sustain incident management work that produces accomplished traffic movements, albeit while managing hesitations and inconsistencies of its own. The incident log is not a naturally occurring, indisputable or stand-alone representation of what is going on out there on the motorway; it is created by the organisational demands and situated relevancies of motorway incident management, with varying degrees of accuracy, plausibility and accountability. Classifications, ultimately, have to be worked at to be made relevant.

Chapter 8

Conclusions

8.1. Introduction

“Whenever work is observed in detail, one is caught up in admiration for the accomplishment with which it is achieved, and the infinite subtlety with which activities are accommodated to their settings and connected together.” (Büscher et al. 2001:9)

This conclusion chapter focuses on the ways in which a lens of practical accomplishment has contributed to a new understanding of how the motorway network works and traffic movements are achieved. It does this by assembling the various approaches that have come to influence this thesis, including transport geography, new mobilities literature, actor network theory and ethnomethodology, to reflect on how they have helped to generate a differentiated style of researching movement through the professional transport practices and work spaces responsible for its management. This chapter finishes by discussing the implications this approach has for transport related research and suggests future research topics.

8.2. Researching Movement as a Practical Accomplishment

From the beginning, this research has been concerned with the challenge of reframing movement as a problem of practical accomplishment. It has been a matter of exploring how this reframing can contribute to a new way of understanding movement as it is produced and ongoingly organised through the

study of its situated and contingent practices; this means that movement is not considered to be a pre-given order, but one that has to be constantly worked at to be achieved. This has been inextricably linked to the empirical context of motorway transport, which arguably provides a rich and complex setting within which to explore the significance of practical accomplishment for making sense of how transport networks actually work. In this sense, transport networks are no longer considered to be neutral and fixed technologies that support the physical movement of people and goods, but instead they are shown to operate in complexly situated ways to produce reliable and safe movements in spite of the disruption they habitually encounter.

The line of argument here is that while millions of vehicles traverse the motorway network each day to transport people and goods in order to fulfil a range of social and economic obligations, their movements are constantly undermined by the threat and actual occurrence of disruption in its various forms. Given the 'crisis of mobility' context within which this plays out in the United Kingdom – restricted road building, heightened concern over environmental issues relating to air and land pollution, and panic about the predicted growth of automobile traffic for the sustainability of the motorway network (Banister 2002; Button and Hensher 2001; Quinn 1997; Shaw et al. 2008), it has been necessary to shift the role of the Highways Agency from a road builder to a network operator to ensure the provision of safe, reliable and efficient road transport is achieved. One of the most striking developments in the Highways Agency's work in this context has been the introduction of the TOS. With its network of RCCs, the TOS is dedicated to the real

time monitoring and managing of traffic, with incident detection, incident management and the dissemination of traffic information constituting primary concerns. The fact that this work is critical to the production of safe and reliable traffic has significant implications for how we think about movement in transport networks. This is because movement can be no longer considered a self-evident or inevitable phenomenon; it is planned for, produced and constantly worked at. This generates an emerging context for the achievement of empirically-real transport movements within which this research is situated.

This thesis has argued that this emerging context can be revealed and rendered available for detailed analysis by the frame of practical accomplishment. Introduced first and foremost as a problem to be researched, the frame of practical accomplishment has enabled a number of analytical moves to be made that draw attention to the ways in which local orders have to be continuously worked upon to be achieved (see Garfinkel 1967). The focus on practice in the broadest sense develops a critical interest in how movement is actually done and how its orders are achieved; in other words, it studies what this work means in practice. In the context of the motorway control room, ordering practices take place in rather ordinary ways, from talking to colleagues to entering classification codes into the incident log, and they reveal how members make sense of the setting to maintain its order according to its common sense rules. Furthermore, the emphasis placed on accomplishing practice means that the order of a setting has to be worked at; it does not simply exist or occur unproblematically. This is invaluable for studying practical action in the motorway control room because it highlights the ways in

which disruption threatens to compromise the order of traffic movements and how this is managed in ways that are contingent upon the actions of others – especially those not immediately or visibly present at the roadside where these traffic movements are physically realised. This framing recognises that order is not a result of passive rule-following ‘on the road’ – or in the control room for that matter – but that it is reflexively situated according to the specific circumstances of its production as part of the motorway network. In the motorway control room specifically, the consequence of this is that it promotes the detailed empirical analysis of whatever goes on in the setting to help operators deal with the complexity of producing movements across multiple spaces and times.

The influence of ethnomethodology here is obvious– as the study of practical action in the production of intelligible social orders, it is concerned with questions of how order is achieved by providing detailed accounts of social interaction – particularly in workplace settings (Button 1993; Crabtree 2001; Garfinkel 1969; Luff et al. 2000). However, ethnomethodology was not the only approach to influence the analysis in the thesis; it was also shaped by actor network theory. While similarities can be drawn between ethnomethodology and actor network theory in terms of their breaking with conventional sociological theorising to research how social order is produced through detailed empirical study (Garfinkel 1967; Law and Hassard 1999; Latour 2005), it is important to acknowledge that they are altogether different approaches and they have their own consequences for the analysis of phenomena under their study. This thesis argued that it was both necessary and possible to work with the two approaches,

although this unavoidably involved making some significant decisions about how they would work together to best address the problem of movement.

The contribution from actor network theory in this research is probably best considered to be conceptual. First, it offered an understanding of network topology with which it was possible to develop a more flexible account of the motorway transport network compared to traditional descriptions found in transport geography. This thesis argued that transport geography's descriptions of networks have been limited to the legacy of graph theory since they are equipped only to analyse the spatial relations of networks by nodes and links. The consequence of this is that nodes are often privileged as sites of activity, and therefore agency, meaning that descriptions based on this assumption cannot account for any transformation that occurs along a link (Galloway and Thacker 2007). If we consider what has the potential to occur along a link – moving traffic, congestion, accidents, vehicle breakdowns, emergency response, maintenance, resting and refuelling –they are otherwise lost unless an alternative conceptualisation of the network is adopted to deal with its complex and real time movements. Traffic as presented in models and equations is therefore abstracted from all the practices that go into its ongoing production. It was therefore necessary to engage more broadly with scholars associated with actor network theory as well as research within human geography on topological multiplicity (Law 1992, 1999; Law and Mol 1994; Law and Urry 2002). Most importantly, this included ideas on heterogeneous multiplicity, action at a distance and the symmetry of actors involved in the production of networks. This helped to affirm the importance of both people and

technology in the organisation of networks and to show how their relations can produce topologically differentiated network forms with multiple spatial and temporal effects. Second, it provided a valuable link between transport geography and ethnomethodologically inspired centre of coordination studies to help rethink the role of technology. This had a crucial role to play in overcoming ethnomethodology's preference for narrowly conceptualising the role of technology as a supporting tool in social interaction. This is especially pertinent in the case of centre of coordination studies; the thesis argued that they risked perpetuating an understanding of control rooms and similar settings as authentically human where technology only exists to enhance or support the coordination between spatially distributed personnel. Instead, actor network theory highlights the reciprocal relationship that exists between people and technology in terms of how competencies and specific roles are created and shared between them in order to get the work done.

Accordingly, while actor network theory provided conceptual insight into how topological thinking could develop an understanding of how transport networks work further to that of transport geography, it was not applied as a material-semiotic approach. If it was applied as a material-semiotic approach, this would be actor network theory as a method. As a method, actor network theory constitutes a way of describing the process of network building by tracing the associations between all kinds of elements that make up the network, including the strategies they use, to show how they maintain their stability over multiple spaces and times (Callon, Law and Rip 1986; Latour 1987, 1996). So if actor network

theory was applied to the context of motorway incident management then it would be expected to include analysis of the associations between the motorway, drivers and their vehicles, signs and signals, data capture technology, transport planners and civil engineers, the motorway control room, other emergency responders, vehicle breakdown companies and so on. Instead, this research chose to focus on only part of the network – the motorway control room; a method that understands how the whole network hangs together was therefore not appropriate if an in depth analysis of interactions of part of the network was required. This is found in the detailed analysis offered by ethnomethodology.

The difference between actor network theory, as the study of the process of network building, and ethnomethodology, as the study of practical action, is of paramount importance here, and their contrasting treatment of what constitutes work effectively summarises the reasons why ethnomethodology provided the main analytical drive for this research, and not actor network theory. In the case of actor network theory, its primary interest in describing how networks are formed and how their relations are tied together to produce more or less durable formations means that its understanding of the work that makes networks work is about the process of network building – otherwise known as the sociology of translation. This is captured by the mechanisms of problematisation, interressement, enrolment and mobilisation of allies, which perform the work of defining and delegating roles in a network as well as locking their relations together to make stronger and more durable networks (Callon 1986b). The point is that while actor network theory is equipped to reveal how myriad elements hold

together to form a network whole, the specificities of how this work plays out according to specific events are not attended to in as much detail as the mechanisms of network building. Ethnomethodology, on the other hand, describes the actual interactions that constitute the very processes of network building that actor network theory seeks to describe. The idea that actor network theory tends to privilege the language of process over work and association over interaction has been addressed elsewhere by the workplace studies literature (Button 1993; Suchman 2000). According to Button (1993), while actor network theory is well positioned to discuss the mechanisms that build and hold together actor networks, what is missing from their accounts is detail of the actual associating – which for Button encompasses the embodied interactional work of practical action. The focus on process works to smooth over the accounting of specific events or practical actions. This means that while actants are defined only in terms of their relations to other actants that make up the network; the form or character of those relations is not something explicitly explored by actor network theory.

Ethnomethodology's idea of work pays attention to its indexical and reflexive character which means that it is focused on the specific actions and events that maintain the order of phenomena under study, rather than descriptions of its processes. Work in an ethnomethodological context encompasses whatever is done in the setting under study given that all practical actions require some kind of effort to maintain their intelligibility because of their indexical character. This means that it offers rich descriptions of interactions between members of a setting, including the details of gesture, talk and touch. This detail then provides an

understanding of members' situated actions and knowledges according to the specific circumstances of their production; after all, the principle of indexicality means that action only makes sense in the context within which it is produced. In the motorway control room, the consequence of this for understanding how orderly movement is generated is focused on the work of investigating reports, searching CCTV, setting signs and signals and coordinating HATO response as it occurs in locally constituted ways and in members' terms rather than descriptions of the relations that exist between different participants in the network. This permits the study of actions and events for their ambiguous and uncertain qualities, revealing the possible alternatives available to members as they choose their next appropriate action and render that action accountable through the production of context. As such, this is deemed suitable for the study of settings like the motorway control room that deal directly with the matters of maintaining order.

8.2.1. The Practical Accomplishment of Transport

One of the main arguments carried through this research has been the contribution that the study of movement as a problem of practical accomplishment can make to a new understanding of how transport networks work. Since transport studies are concerned with the production of physical movement, the reframing of movement as a practical accomplishment is consequential to the contribution that this research is able to make in rethinking how transport networks are analysed. This contribution can be summarised as follows.

Breaking with traditional theories of movement

First, the frame of practical accomplishment offered a way of breaking with traditional theories of movement in transport geography and new mobilities research. The thesis argued that, in transport geography, any question that asks why or how movement takes place in the way that it does tends to be routinely explained away by the phenomenon of transport demand. Transport demand is taken for granted in modern society, based on the fact that “people and goods *have* to get places” (Shaw et al. 2008:4, my emphasis). The consequence of this is that, as Keeling (2007:219) notes, “[t]ransportation is treated as so obviously fundamental to society that there is no need to explain how or why.” Instead, transport geography focuses its attention on the optimisation of traffic outputs in response to derived demand, which largely reflects its alignment with professional transportation research in the fields of engineering and economics. Questions addressing the practical accomplishment of movement – that is, how exactly it is done in situated ways – are therefore eclipsed. The thesis was also concerned with the treatment of movement in the context of new mobilities research, especially in light of recent calls to develop connections between transport geography and mobilities research (Cresswell 2010a; Cresswell and Merriman 2011; Hall 2010; Preston and O’Connor 2008; Shaw and Docherty 2008; Shaw and Hesse 2010; Sheller and Urry 2006). The study of movement in mobilities research was shown to be framed as an intensely human endeavour with a focus on how humans engage in and experience the world through the lens of mobility (Sheller and Urry 2006). Mobility scholars use this positioning to avoid the extremes of sedentarism

and nomadism present in the social sciences and to distinguish itself from the 'brute fact' of movement in transportation studies (Cresswell 2006). However, since movement is always already made meaningful by virtue of its human character in the theoretical project of mobility, the study of mobility does not necessarily require empirically real movements to validate its theoretical position. This is significant for the treatment of transport. Despite Sheller and Urry's (2006) criticism that social science contributes to the black boxing of transport as a set of neutral infrastructures and technologies, applied in relatively fixed ways, the stuff of transport – its infrastructures, interchanges, vehicles, rules and regulations, management operations, and workers – are still largely missing from study. It appeared that although scholars have identified limitations in the study of movement, they are yet to engage with an approach that provides enough theoretical and methodological distance from traditional assumptions about the nature of movement in order to make a difference to how transport networks are researched and understood. This break was provided by the frame of practical accomplishment. To consider movement as planned for and worked at in situated ways opens it up to questions about how its order is achieved, rather than taking it for granted.

Entering professional transport spaces and practices

Second, the frame of practical accomplishment helped to justify the study of professional transport spaces and its practices in order to break with those traditional theories and address their systematic neglect. The motorway control room presents an exemplary case of this – it is routinely ignored as a topic worthy

of sustained analysis in existing transport and mobilities research, yet it is central to the development of an understanding of movement as a practical accomplishment because of its role in the active management of traffic. By entering the motorway control room to observe the practices that are organised within it, this helps to disrupt the default association of professional transportation matters with transport studies and thus makes it available for ethnomethodological study. This is particularly helpful in the context of ICT use *in* transport. Both transport and mobilities research have engaged in the study of physical and virtual mobility, and the interdependencies between them, in the context of personal transport and travel; however, the thesis argued that the empirical-richness that features in many of these studies has not been replicated in the study of ICTs *on* transport. This is surprising given the reliance of active traffic management techniques on ICTs to deal with the operational challenges of managing vast spatial networks in real time and in relation to the broader programme of ITS. The opportunity to research the dynamic and situated spatial and temporal effects that result from this work is routinely ignored in professional transportation literature. Instead, they provide neutral technical descriptions to direct and instruct their use in transport settings, forming toolkits of applications irrespective of context. Therefore, thinking differently about how transport networks work through a topological metaphor has the potential to reveal the spatial and temporal effects that networks have in maintaining their orders. One of the consequences of this is that traditional conceptions of here and there, now and then, presence and absence, are reworked by virtue of the heterogeneous relations that make up the network. ICTs play a significant part in this, enabling real time monitoring and management of

motorway traffic movements within a spatially distributed network manifested through the various collaborations that take place between people and technology. The emphasis placed on *active* traffic management is then necessary to highlight the constant work that goes on to maintain traffic movements in spite of disruption in situated ways; otherwise, the ability to render distant places visible in the control room and act in real time remains implicit in descriptions of active traffic management practices.

Studying the work that makes networks work

Third, the frame of practical accomplishment enabled the detailed empirical analysis of actual traffic management practices to address the question of how exactly they are contingently ordered to produce reliable and safe traffic movements. Accordingly, the research has argued that it is necessary to treat the ordering practices of members in the motorway control room synonymously with the accomplishment of safe and reliable traffic movements on the motorway network. This recognises the role that the motorway control room plays in the monitoring of traffic and coordination of incident management to mitigate the effects that disruption has on traffic flow. After all, the phenomenon of traffic is by definition the movement of vehicles and as it moves it encounters changing spatio-temporal contexts. This creates conditions for movement that are open to incidents that are unpredictable in type, location, spatial extent and severity. This produces an impetus for the active management of traffic within the motorway control room which can respond to disruption as it develops. It does this by recording and investigating reports, sending instructions to drivers via signs and

signals, dispatching HATO patrols, checking CCTV and responding to MIDAS alerts. So by observing the practical actions that constitute the work of incident management, it offers one way of understanding how traffic is produced according to the situated circumstances of its production, by *whatever* is done and *wherever* it takes place. The motorway control room then presents a setting within which its practices are fundamental to the production of orderly traffic. It is made even more interesting because it is strikingly different to the more familiar ethnomethodological studies of traffic that focus on drivers in their cars (Garfinkel 2002; Katz 1999; Laurier 2001; Lynch 1993).

8.3. The Work that Makes the Network Work

Ethnomethodology's insistence on studying the indexical and reflexive qualities of practical action has proved invaluable for revealing the complexities that operators have to manage when detecting, diagnosing and responding to incidents. This contributes to a new understanding of how transport networks work made possible through the situated interactions and knowledges that constitute the setting. It has been argued that the work of the motorway control room does not follow the trajectory of a linear process of detection, then diagnosis, then response (as it is often represented in transport research), but it emerges in specific ways according to the situated context of the movements it seeks to manage. This following section draws out three main research themes that relate to the ways in which the network is equipped to manage disruption and maintain order – collaborative working, managing uncertainty and doubly-situated sensemaking. Reflecting on these themes, and moving beyond the motorway

control room, this section ends by considering what value this approach has for studying other transport networks.

Collaborative Working

This thesis has observed a serious absence of research on control rooms in transport geography and related transport research. One of the reasons offered for this was the continued dominance of engineering, economics and planning perspectives in transport and their requirements for optimal solutions to entrenched transport problems, meaning that questions of how and why transport networks worked in the way they do were overlooked. It argued that despite the fact that incident management is a legitimate topic of study in the ITS literature, the actual activities that take place within the spaces of transport control rooms are largely tangential to the technical developments it discusses. Transport control rooms are otherwise left to human factors and ergonomics researchers (for example, see Heaton et al. 2008 on the ergonomic design of the Highways Agency motorway control room) or CSCW and workplace studies in the computer science tradition (Berndtsson and Normark 1999; Goodwin and Goodwin 1996; Harper and Hughes 1993; Heath and Luff 1992a; Heath, Hindmarsh and Luff 1999; Heath, Luff and Svensson 2002; Luff and Heath 2001, 2002; Nevile 2004; Suchman 1993, 2011; Theureau and Filippi 2000). Here, still, there is emphasis on a particular kind of work going on in control rooms – the work of coordination. While coordination effectively captures the challenges of working in spatially distributed settings, especially over physical distances, it was deemed insufficiently equipped to capture other kinds of work that are not obviously coordinative but contribute to

coordination nonetheless. In short, the overwhelming emphasis on coordination meant that other work was neglected.

It was argued that the importance of other kinds of work – other than the purely coordinative – was paramount in the case of the motorway control room because of the other kinds of network challenges it faces. It is not just a case of coordinating response over physical distances; for example, the very nature of managing a phenomenon like traffic which is constantly moving means that the capability to monitor, track and investigate signs of disruption in more or less real time and influence the behaviour of drivers is critical to the achievement of network order and thus the safe and reliable flow of traffic. A significant priority of this research therefore was to explore the *collaborative nature* of practical action in the motorway control room. To talk of collaboration then was a deliberate move to open up the human-centredness of centre of coordination studies to understand how people are only capable of doing what they do because they act within heterogeneous collections of artefacts and technologies. Operators would not be able to engage in certain activities if they acted independently of technology. For coordination to occur, operators need access to network events to make any assessment of disruption and the subsequent dispatch of assistance. This relies on intensive collaboration between people and technology to render the network visible in the control room, which would otherwise not be possible if the individual operator was acting independently of technology. Collaboration is then an attempt to analyse the reciprocity that exists between people and technology and the different capabilities the specific configurations create when they interact.

The work of detection is particularly striking in that regard. As discussed in Chapter 5, detection is by no means a straightforward action of identifying a self-evident incident; instead, it involves the extended work of investigating reports of disruption and combining investigations, which may include verbal communication with informants, CCTV and MIDAS work, web-based research, discussions with colleagues, the narration of past experiences and background knowledge and the dispatch of HATO patrols. While incident detection is typically depicted as the unproblematic identification of an incident in the ITS literature (McQueen and McQueen 1999; Chowdhury and Sadek 2003), this chapter showed how a study of practical action in the motorway control room reveals it to be an iterative process of checking, questioning, researching, looking, and so on which by no means leads to the inevitable discovery of an incident. One of the ways in which the local difficulties of detecting disruption was discussed was through the concept of substantive uncertainty. Substantive uncertainty occurs when information received about a reported disruption is insufficient or inadequate. There may be details missing from the report or if multiple reports have been received the details may be contradictory. It is a valuable concept for thinking through how order is not simply pre-given but has to be practically worked through by participants in the setting. This is because information about what is happening on the motorway network is required by operators to necessarily influence their next actions. If this information is missing then it affects the legitimacy and effectiveness of a traffic management response.

Dealing with Uncertainty

This leads us to discuss the complexly situated relationship that emerges between the different degrees of substantive uncertainty and procedural certainty experienced in the motorway control room; they are inextricably linked to the local circumstances of their production and, as such, operators experience different intensities of substantive uncertainty and procedural ambiguity and various combinations of the two. When substantive uncertainty is high, say a MIDAS alert has been triggered and no corroborating evidence can be found to determine whether this is a detection of an incident or not (such as CCTV coverage), then it usually follows with strong procedural certainty. It is necessary for an operator to request the dispatch of a HATO for the purpose of investigating the disruption. The role of the HATO is not initially one of responding to a confirmed incident, but investigating a report of disruption that is currently insufficiently substantiated to bring about any other form of traffic management response (such as sign and signal setting); this also involves the work eliminating disruptions that pose minimal threat to traffic movement or are shown to have been misreported or since dissipated. There are also instances when substantive uncertainty is low and procedural certainty is high because operators have sufficient information to make decisions on prioritising and responding to incidents. The routine vehicle breakdowns that operators deal with are examples of this; the information provided by talking to drivers involved in breakdown incidents tend to provide sufficient information to make an informed decision for the type of response required.

When substantive uncertainty is low – that is when sufficient details are known about a reported disruption, the resulting incident management response is not necessarily straightforwardly certain. This is particularly evident in the case of congestion which was discussed in Chapter 6. Even with convincing patterns of MIDAS alerts or abnormal congestion alerts (depending on the specific control room setting), eye-witness reports and CCTV feeds, it can be difficult for operators to decide to commit to the management of such an incident. This is partly due to the difficulty in measuring congestion in the first place; there are multiple ways of describing it (stop-start, stationary, slow but moving) and different verification methods in the different control room settings (visual feeds, abnormal congestion alerts, eye-witness accounts) that produce competing and sometimes ambiguous accounts of current traffic conditions. In turn, operators are hesitant to name a congestion incident because of the demand it makes on resources, particularly in terms of operator time. The consequence of this procedural ambiguity resulting from substantiated reports of disruption means that operators often engage in discussion with colleagues, ‘sounding off’ their diagnoses by justifying their decisions according to background expectancies. It was also shown that operators have to deal with the challenge of unpredictable and unanticipated outcomes when making choices about responding and prioritising of incidents. Congestion effectively captures the challenge presented by the unpredictability of motorway traffic and the unexpected manner in which incidents can develop. The conditions for congestion can change, from increases in intensity to its complete dispersal. To cope with this, it is evident that the capability of monitoring traffic afforded by CCTV and MIDAS is invaluable for operators to maintain visibility of the motorway

network and assess the effectiveness of any traffic management intervention. The crucial point is that monitoring and investigative work do not stop once a response has been implemented; monitoring work continues for signs of change. In turn, operators cannot fully anticipate what effect their response will have on traffic given the unpredictable conditions within which their decisions take place. The indeterminacy of traffic management interventions such as sign and signal setting on driver behaviour is particularly challenging and one that requires continuous monitoring work. This is pertinent given the safety critical nature of incident management in that it attempts to influence the behaviour of drivers.

Situating ordering work in the network

This thesis also made a contribution to the way in which ethnomethodological studies understand the relationship between a centre (such as the control room) and its spatially distributed network for maintaining order. The idea of the *doubly-situated* character of ordering work recognises how operators make sense of what is going on simultaneously in the spaces of the motorway control room and the motorway network to accomplish their work. While this builds on the ethnomethodological principles of indexicality and reflexivity, the emphasis on the doubly-situated character of sensemaking develops an understanding of ordering practices *simultaneously* across space and time, which presents sensemaking as far more complicated as it is suggested in existing ethnomethodological accounts in similar distributed settings. This doubly-situated character of sensemaking work is a feature of the motorway control room by virtue of its spatially distributed character *and* the unpredictability of traffic as inherently

on the move. It is therefore necessary that actions are made intelligible simultaneously across the spaces of the control room and its network to keep up with any changes in the status of the control room or the status of traffic. We observe this with the motorway network in those cases where traffic incidents change – congestion, for example, can increase in severity or dissipate quickly, so operators need to be constantly aware of this to ensure that any incident management response is timely and plausible – and in the control room, colleagues are engaged in other incidents simultaneously, adding information, dispatching patrols and so on, which can change their capacity to act. This doubly-situated sensemaking work is highly consequential to the action that follows – it is not simply a case that an operator attempts to make sense of an incident according to background expectancies of what matters and what should happen in the setting, but they are also constantly oriented to what these background expectancies mean in the situated circumstances of the motorway network and the control room.

The thesis argued that this doubly-situated sensemaking work was observable at the screen of the incident log and in particular through the work of classification as discussed in Chapter 7. The intervening point at which an operator chooses to create an incident log – and the subsequent work of choosing type codes, priority grades and locations – occurs between the motorway network (in whatever way it has been rendered visible to the operator) and its reception by other operators that must coordinate an appropriate incident management response. This means that at the same time it connects the spaces of the motorway network and control room by providing a repository of information

about the incident formulated in a recognisable and intelligible way and it observes a critical temporal order that orients operators to completing classification work in order to move the work along. Due to the different degrees of substantive uncertainty and procedural ambiguity that operators experience across spatial and temporal dimensions, classification selections only have to be good enough and they sometimes involve additional work to make the reasons behind selections available to colleagues. In cases of substantive uncertainty, operators may experience difficulties in finding a classification to match the type of incident it has been tentatively described as or matching a location to the gazetteer. With examples of procedural ambiguity, the action of choosing a type code and a priority grade hinder the intelligibility of the log to bring about the coordination of an appropriate response. Not all classifications are self-evident, and operators work with classifications that are sometimes only 'good enough' in order to get work moving.

8.4. Further Research

The relationship between the phenomenon of transport movement and the professional spaces and practices that plan, produce and manage it is important for the study of the practical accomplishment of movement if it is to be extended into other transport contexts beyond the motorway control room. The unpredictable and dynamic character of empirically-real transport movements, whether they are motorway traffic, train travel or marine transportation, and the fact that they tend to occur over vast spatial distances, brings into sharp relief the planning, monitoring and managing work that is required to maintain the production of safe and reliable

movements. Thinking differently about movement in terms of its practically accomplished orders provides the necessary analytical resources to interrogate how other transport networks manage movement in real time, given that as traffic moves, it encounters changing spatio-temporal circumstances that have the potential of compromising its order. The practical actions required to deal with issues of substantive uncertainty (given the complex relationship between visibility and spatial distance in the management of transport networks) and procedural ambiguity (which is related to the unfamiliarity of some incidents and the difficulties experienced in prioritising certain response activities over others when their outcomes may be unclear) offer interesting topics for future transport research that are capable of investigating the local configurations of traffic management. This contrasts with the treatment of physical movements as the inevitable expression of modern society dependent on travel to get places as it is enabled by fixed technology and optimised solutions. In turn, there is potential to further develop links between social science and transport geography by making connections with network topology and ethnomethodology. A number of studies already exist that explore the idea of movement as a practical accomplishment (Graham and Thrift 2007; Juhlin and Normark 2008; Laurier and Philo 2003; Laurier et al. 2008; Normark 2006; Weilenmann 2003); however, only a handful of them enter professional transport spaces to deal with professional practices in transport planning or management (Cidell 2012; Esbjörnsson and Juhlin 2002; Esbjörnsson 2006; Weilenmann 2003). The importance of extending study into these spaces and observing these practices is to reclaim the value of empirical movements for the richly complex circumstances of their production.

In terms of the motorway network specifically, there were some aspects of the day to day management of the motorways that were beyond the scope of this research. Given that this thesis has focused on the practical accomplishment of movement, there is a distinct lack of actual physical movements in it. Located within the control room, traffic movements have been experienced indirectly as they are produced in incident logs, described over radio transmissions and displayed on CCTV feeds. This has been necessary given the primary concern was to observe professional transport spaces and how their practices contribute to the accomplishment of safe and reliable traffic movements; however, it does not intend to underestimate the overall importance of being on the move and the value it can add to a study like this one. For incident management purposes, the ability for HATOs to move is critical to their ability to detect disruption, investigate reports of disruption on behalf of the control room, access knowledge at the incident scene, and make material changes to local traffic flow by performing rolling road blocks or implementing static traffic management. It is an integral part of incident management work. One way to supplement this research would be to shadow the work of the HATOs on patrol. The work of mapping patrol routes, scheduling in breaks, interpreting radio calls from the control room and diagnosing and prioritising incidents as they are encountered comprise a selection of activities that would be potentially revealing of the doubly-situated character of sensemaking work beyond the spatial confines of the motorway control room. There already exists a number of studies in the ethnomethodological tradition that follow mobile workers to explore how being on the move gives rise to characteristically different practices to accomplish their work orders – and therefore, highlight the value of

such an approach (Esbjörnsson and Juhlin 2002; Juhlin and Normark 2008; Laurier 2003; Laurier and Philo 2003; Laurier et al. 2008; Normark 2006; Weilenmann 2003). Further research would investigate how mutually intelligible accounts of incidents, and the normative expectancies of the motorway network on which they depend, are fostered between control room operators and traffic officers on the move. This would pay particular attention to how the activities of detecting, diagnosing and responding emerge and how they are characterised on the move. After all, incident management work does not *start from* the control room, but it is enrolled through the relations that constitute it according to the practical contingencies they encounter. To accompany traffic officers during their network patrols would therefore be one way to foreground real movements that are critical to the success of incident management work and adding to our understanding of the practical accomplishment of traffic. Another would be to research the practical actions of drivers as they encounter traffic management in situated ways as they accomplish their personal travel. This would pay attention to the ways in which drivers make sense of traffic management interventions, including live sign and signal setting, traffic information dissemination and the presence of HATOs. Questions relating to how it influences traffic behaviour, if at all, would supplement the work of operators as they make decisions about what signs and signals to set and monitor the movements of traffic in relation to the interventions they make. This would help to reinforce the relationship between the ordering practices that take place in the control room and the real time practical actions of drivers on the motorway network. In turn, it would offer a way of opening up existing ethnomethodological accounts of driving that do not go beyond the immediate

space of the driving seat to take into account other methods of accomplishing safe and reliable movements that go on elsewhere (Garfinkel 2002; Lynch 1993).

Finally, in relation to mobilities research, one of the main contributions this thesis makes to future research is to assert and demonstrate the value of an ethnomethodological approach to mobility, not least for the opportunity it provides for supplementing the theoretical project of mobility with empirically-real movements. The characteristically detailed empirical accounting of ethnomethodology, with its emphasis on either live observations or the thorough analysis of live recordings of actual practical actions *as they occur*, is arguably well suited to the study of mobile phenomena. This is because, as it has been previously noted, mobile phenomena encounter changing circumstances and conditions as they move. By coupling this with the concept of the network, these movements are no longer abstracted from the situated context of their production. Not only do we consider drivers in their cars, but drivers, cars, MIDAS loops, signs and signals, traffic information, HATO patrols, infrastructural and maintenance work, congestion, accidents, and so on, in relation to drivers in their cars. In this sense, an ethnomethodological approach offers a genuine analytical frame to further the self-proclaimed interest mobilities researchers have in the multiplicity of mobility spaces, practices and experiences (Sheller and Urry 2006). It makes available the professional spaces, practices and daily operations of transport for analysis, including those of managing disruption, maintaining traffic flow, monitoring congestion and disseminating traffic information, which transport networks constantly deal with, and therefore how they intertwine with the experiences of

personal physical or virtual mobility, of which mobilities research is so proficient in its accounting.

Appendix

Key meetings and observations

Date	Description	Location
13 th August 2009	Meeting with Greg Morrison, On-Road Operations Manager	Carville Outstation, Motorway Maintenance Compound, A1(M) Junction 62
	Ride-out to an incident with HATO	A1(M)
20 th October 2009	Day visit, including meeting with Janey Love, Operations Manager, tour of control room, demonstration of workstation and short period of observation with team manager in control room	North East RCC, Wakefield
4 th to 6 th December 2009	8 hour control room observations (pilot)	North East RCC, Wakefield
11 th December 2009	Day visit, including meeting with Keith Davies, Technology Lead, tour of control room and demonstration of traffic management software	East RCC, South Mimms
	Visit to the MAC Knowledge Management Centre	NCC, South Mimms
14 th to 15 th December 2009	8 hour control room observations (pilot)	North East RCC, Wakefield
14 th January 2010	Meeting with Paul Trow, Highways Agency	NTCC, Birmingham
	Meeting with Matt Kirby, Deputy Control Room Manager, Serco	

Date	Description	Location
14 th January 2010	Demonstration of NTCC control room workstation	NTCC, Birmingham
21 st January 2010	Meeting with Sue Risdale, Operations Manager	South West RCC, Avonmouth
	Observation in control room with team manager and traffic management operator	
27 th January 2010	Meeting with Ray Coyle, Operations Manager	East Midlands RCC, Nottingham
	Observation in control room with radio dispatcher	
8 th February 2010	Interview with Nigel Allsopp, Data Analyst	East Regional Intelligence Unit, Bedford
11 th February 2010	Meeting with Simon Foxall, Operations Manager	West Midlands RCC, Birmingham
	Observation in control room and demonstration of Managed Motorways	
	Meeting with Matt Kirby to discuss research access to the NTCC	NTCC, Birmingham
22 nd to 26 th February 2010	8 hour control room observations (pilot)	East RCC, South Mimms
	Ride-out with HATO for late shift	
18 th March 2010	Meeting with Dave Cronin, Operations Manager	North West RCC, Warrington
	Observation in control room	

Date	Description	Location
6 th April to 26 th August 2010	Sustained period of control room observations	West Midlands RCC, Birmingham
8 th April 2010	Interview with Karen Lowe, Lead Trainer	TLC, Birmingham
12 th May 2010	Interview with Bernard Walton, Traffic Officer Service Procedures Team	Highways Agency, Leeds
13 th May 2010	Interview with Joe Karama, Consultant for Traffic Incident Management Team	Atkins, Birmingham
14 th May 2010	Attendance at MAC critical incident cold debrief	The A-one+ Sandiacre Operational Depot, near Nottingham
17 th May to 11 th June 2010	4 weeks observation and participatory learning for Control Room Operator Foundation Course	TLC, Birmingham
18 th May 2010	Interview with Frank Bird, Planned Events Coordinator	West Midlands RCC, Birmingham
21 st May 2010	Interview with Chris Caine, Contingency Planner	West Midlands RCC, Birmingham
25 th May 2010	Cosford Air Show Briefing	West Midlands RCC, Birmingham
2 nd June 2010	Cosford Emergency Planning Seminar	RAF Cosford
13 th June 2010	Observation of Silver Control for Cosford Air Show	West Midlands RCC, Birmingham
7 th July to 23 rd July 2010	Observation in National Traffic Control Centre control room	NTCC, Birmingham

Date	Description	Location
7 th July to 23 rd July 2010	Visit to Highways Agency Information Line (HAIL) call centre	NTCC, Birmingham
	Interview with Sarah, VMS Specialist	
	Interview with NILO	
	Interview with Pete Bates, Traffic Radio	
9 th August 2010	V Festival briefing	West Midlands RCC, Birmingham
20 th August 2010	Observation of Silver Control for V Festival 12 hour shift	West Midlands RCC, Birmingham
24 th August 2010	Day visit, including meeting with Dominic McLeman and control room observation	South East RCC, Godstone
26 th August 2010	V Festival debrief	West Midlands RCC, Birmingham

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