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Picture Perfect? Exploring the use of smartphone photography in a distributed work practice.

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Abstract

Our research extends debates regarding technology use for knowledge sharing through examining how smartphone photography mediates a complex, unpredictable distributed work practice: responding to operational problems within a transport system. We offer a narrative analysis examining how smartphone photography may (partially) bridge physical distance between managers and engineers, and how sharing images establishes 'truths' and provides 'evidence'. We further explore the challenges engineers' face as the demand for images impacts the acceptance of their verbal accounts. We conclude that smartphone photography prompts the negotiation of new narratives of knowledge sharing, narratives which highlight tensions around the role and status of the digital image. With the increasing availability of smartphones at work, and an emerging interest in the visual in organizational studies, this research offers both practical and theoretical insights.

Key Words: Smartphone, distributed work, communication, organizational knowledge

Introduction

Smartphones are ubiquitous (Sorensen, 2010) across social and business contexts (Mazmanian et al., 2006, OfCom, 2011). They differ from previous devices in combining

voice and data within a single, portable handset thus enabling communication via a variety of integrated media. This is predicated to aid effective communication however, the conclusion of existing research is that such technologies are 'Janus-faced' (Arnold, 2003) or paradoxical (Jarvenpaa and Lang, 2005): we both 'love' and 'hate' these devices.

A particular concern is the impact of smartphones on work-load management and work-life balance (Middleton, 2008, Wajcman et al., 2008, Mazmanian, 2009, Allen and Shoard, 2005, Matusik and Mickel, 2011, Bittman et al., 2009). Research is also starting to explore the implications for group processes such as decision making (Dennis et al., 2010) and for knowledge work in general (Wajcman and Rose, 2011).

There has been sustained concern with technology's potential to enable and support knowing (Zammuto et al., 2007, Schultze and Boland, 2000) and optimism that mobile technologies may offer more elegant solutions (Maier and Hadrich, 2007). Indeed, we argue that smartphones have implications for knowledge sharing that are currently poorly understood. This requires investigation to increase our understanding of the relationship between technology and knowledge sharing, and to inform continued organizational use of such devices. Given the potential for smartphones to prompt renegotiation (both individually and collectively) of knowledge practices (Leonardi et al., 2012) this is an important research priority. We address this lacuna via an empirical examination of the use of smartphones within a large engineering firm, Rail Engineering. We examine the complex practice of responding to operational incidents (fixing problems preventing safe and/or effective operation). We focus on the role of smartphone photography in this practice, which entails the capture and sharing of digital images between those in the field and their remote managers.

While smartphone research is a developing area, investigations to date have concentrated on a rather homogeneous sample of managers in financial and service sectors (Pritchard

and Symon, 2011; Symon and Pritchard, 2011). Wajcman and Rose, amongst others, focus on "the office worker of today" (2011: 941) and only a few studies have considered smartphones in non-office settings (e.g. Sorensen and Pica's (2005) research on police and Ferneley and Light's (2008) in the fire service). One contribution of our research is therefore the addition of a new empirical context to this emerging field.

Conceptually, we adopt a practice perspective in examining the way in which work gets done (here, resolving incidents), understanding this as a "set of interconnected activities" (Corradi et al., 2010: 277) alongside related processes of social interaction (Wenger, 2000). Knowledge sharing is thus situated and embedded within and between practices (Bechky, 2003b). Recognising the material within practice has a long tradition (for example; Latour, 1999, 2011; Pickering, 1995), we draw on the theoretical framework of sociomateriality to understand incident resolution. This entails the "recognition that technology is not valuable, meaningful, or consequential by itself; it only becomes so when people actually engage with it in practice" (Feldman and Orlikowski, 2011: 1246). It is the ongoing reuse of the material (the smartphone) which mutually shapes both understandings of the technology itself and the practice within which it becomes enmeshed (Feldman and Orlikowski, 2011; Orlikowski and Scott, 2008).

Our focus on smartphone photography offers a contemporary, material, twist on concern with the codification of knowledge (Kuhn and Jackson, 2008) and interest in visual representations (Bechky, 2003a) within practice studies. Our contribution is therefore to highlight the implications for understandings of knowledge sharing that arise when smartphones are introduced to share digital images within a complex, distributed work practice. We suggest that the advent of smartphone photography is a "contested terrain" (Edwards, 1979), and requires the negotiation of new narratives of knowledge sharing; narratives which highlight tensions around the status of the digital image and the role of the

smartphone itself. Unpacking these narratives generates both conceptual and practical insights on the use of smartphones to share knowledge at work.

Distributed work, knowledge sharing and technological mediation

Work on transport networks has always been distributed by its very nature. Distributed work covers various social and technological contexts and a range of mobile and dispersed work practices (Pyoria, 2003). Definitions of distributed workers include those performing job-related tasks in different locations and, increasingly, whilst moving between them (Axtell et al., 2008). Hislop and Axtell define 'multi-location workers' as those "whose work requires them to travel to and work at a diverse range of locations" (2009: 60), relying on a variety of technologically mediated interactions. Indeed, the increasing prevalence of distributed work is often attributed to technological developments. Bosch-Sijtsema et al. suggest "this trend has been made possible by mobile technologies which have liberated work from being bound to a particular place and time" (2010: 183).

It is increasingly suggested that categorizations of work and working relationships (including the label 'distributed') hide more than they reveal (O'Leary and Mortensen, 2010) and typologies do not further our understanding of workers' experiences (Wageman et al., 2012). There is a tendency to "treat proximity and distance in purely physical terms [which] provides an incomplete view of how people experience it" (Wilson et al., 2008: 980). Wilson et al (2008) emphasise both physical and perceived proximity (defined as an individual affective and cognitive construct). Pertinent here is their suggestion that perceived proximity involves individuals "develop[ing] mental images" of the physically distant (Wilson et al., 2008: 985). Further, Hinds and Mortensen suggest research consider "different dimensions of distributed work and how these dimensions shape team dynamics" (2005: 304) while Wageman et al. (2012: 311) call for "consider[ation of] novel contexts". Our research addresses these calls and goes beyond 'mental images' in examining the role of digital images in distributed work.

A further concern is the challenge of knowledge sharing within distributed practices (Cramton, 2001, Swart et al., 2011, Van Wijk et al., 2008). Foss et al (2010: 457) offer a usefully inclusive definition of knowledge sharing as "the provision or receipt of task information, know how, and feedback on a product or a procedure". However, generic definitions offer limited insight since understandings of such processes (along with distinctions between aspects such as information and know how) are contextually bounded (Bechky, 2003b). Practical challenges impacting knowledge sharing have been suggested to include issues related to different forms of knowledge (such as tacit and explicit, Nonaka and von Krogh, 2009), relationships between actors (such as strong or weak ties, Hansen, 2002) and understanding why knowledge may appear 'sticky' or 'leaky' (Brown and Duguid, 2001, Szulanski, 2000), the differential nature of knowledge capacities (Zahara and George, 2002) and boundaries (Carlile, 2002, O'Mahony and Bechky, 2008). While it is beyond our scope to comprehensively review this literature, we note these authors highlight the importance of the "interconnectedness of knowledge" (Swart et al., 2011: 372) while emphasizing technology as a means of storage and communication to facilitate knowledge sharing (Leonardi and Bailey, 2008).

Our focus on smartphone images offers a different sociomaterial context (Orlikowski and Scott, 2008) from 'static' email communication (Duchenaut and Watts, 2005; Kruger et al., 2005). In offering a range of technical capabilities in a single portable device ('push' email, phone, camera and internet tools) a smartphone offers the potential to combine modes of communication, such as here emailing digital images. Our focus is not the functionality itself but examining how this "technology is continuously developed and temporally stabilized by the way it is used in practice" (Nyberg, 2009: 1183). Thus, deploying a sociomaterial framing (Orlikowski and Scott, 2008), rather than viewing the smartphone as a predefined tool, we examine the understandings of knowledge sharing that emerge and are enacted when employing smartphones. Our focus is therefore on the various situated

understandings of knowledge sharing that are (re)negotiated as smartphones become embedded within the practice of incident response.

This requires us to unpack issues associated with images and the sharing of images. Visual representations have previously been identified as significant boundary objects (Bechky, 2003b, Ewenstein and Whyte, 2009) between practices and as crucial material aspects of communication (Ashcraft et al., 2009). To date, research has particularly focused on drawings and plans, (Bechky, 2003b) suggesting these act as a "bridge between the concrete and the abstract. They are themselves concrete but also represent the abstract thing" (Ewenstein and Whyte, 2009: 14). However, our focus on digital images raises rather different issues. In contrast to drawings and plans, photographs are direct visual representations and often assumed to be realistic. Yet such perceptions of reproduction are flawed (van Dijck, 2008, Guimond, 1991). Munir (2005) observes that, despite the acceptance of manipulation, digital photography remains associated with "preserving" scenes (Runde et al., 2009: 15). However, both the visible and invisible need to be examined rather than assumed (Whyte et al., 2008). For example, the individual taking the photograph is often (though not always) absent from the image. Chance, choice and circumstance influence the production of the image, which is thus a partial, incomplete representation. Along with the research reviewed earlier, this suggests a need for further interrogation of the "relationships between artefacts and the people who produce and consume them" (Leonardi, 2010: 14) when investigating smartphone use in distributed work practices. With this in mind, our overall research question is: *in what ways does the use of smartphone photography mediate knowledge sharing in the (sociomaterial) practice of incident resolution?*

Our empirical context: Rail engineering

'Rail Engineering' (a pseudonym) maintains UK transport infrastructure. It has a large employee base, a head-office in London, offices in other cities, and operational staff spread

across the country. Main offices house senior management teams, project managers and technical specialists. Out in the field, operational engineering staff and their line managers are organised into regions, available 24/7 (via shifts and on call) and respond to incidents. Incidents range from equipment problems and weather-related issues to those requiring the emergency services. There is a dual concern with safety and efficiency, and performance is measured in minutes of disruption (after three minutes financial penalties are incurred). Many management and engineering staff have smartphones, including mobile operations managers (MOMs).

Materiality at Rail Engineering is complex and often unpredictable. The fundamental materiality of the railway (including track, points etc.) is interposed within an incident involving problematic combinations of different objects (for example, livestock on the track) and the involvement of the MOM arriving in his[1] van with his toolkit (including smartphone). This is a practice "where the material conditions are never fully known ex-ante and where the operating of technology used in the work is never fully possible to predict" (Styhre, 2009: 387).

MOMs main role is incident response, working in small teams (under a Local Operations Manager, LOM) in shifts providing 24/7 coverage. MOMs have responsibility for a geographical area and also perform routine tasks (primarily safety checks). MOMs are notified of incidents by a control centre (hereafter, Control) via email accessed via a computer (in their field office) or their smartphone. Control also telephones the MOM to confirm details. Control is the communications hub, liaising with others (including emergency services) as required. The MOM's line manager, the Local Operations Manager (LOM) is involved to update senior managers, particularly if there is significant disruption.

The MOMs' primary role is assessment and, ideally, resolution, thus minimising disruption. They perform temporary fixes and liaise with specialists to resolve underlying faults; working

under strict safety regulations. MOMs often work alone in potentially hazardous circumstances. Control and their LOM contact them to ascertain the nature of the incident, the fix required and timeframe. The ability to share images was a key management rationale for smartphone provision. Previously, MOMs used a digital camera, later downloading and emailing images on return to their field office. Depending on shifts, images might not be shared until hours or days later. Now, via their smartphones, MOMs can email images directly from the scene. However, there are no explicit policies on smartphone photography and therefore at each incident those involved determine the need for, and practicality of taking and sharing, images.

LOMs, remote from the incident, are concerned with the MOMs' performance and minimising service disruption. While MOMs work shifts to ensure 24/7 cover, LOMs operate an on-call system. Most incidents require follow-up investigation which is coordinated by the LOMs, so they also monitor and gather evidence as the incident unfolds. Senior managers require an understanding of incidents across a region as part of performance management. Incident magnitude determines the level of managerial interest but allocating responsibility for incidents to a particular corporate entity (within broader service level agreements) is a key concern since that group may incur financial penalties.

Responding to operational problems encompasses an unpredictable mix of office, mobile and shift work. The practice of incident response is fundamentally distributed yet embedded in specific times and locations i.e. where and when an incident occurs. This usually requires the MOM to undertake physical labour, whatever the weather or time, while being monitored remotely. Manual and managerial work practices are therefore enmeshed in the work of responding to engineering incidents which requires effective knowledge sharing between all those involved.

Methodology and Approach

Our approach was developed with representatives from Rail Engineering who arranged access and assisted in data collection and analysis. We had many meetings with Rail Engineering to understand the structure, work practices and use of smartphones across a variety of functions.

Table 1: Sampling Strategy

Office Managers (OM, n=12)	Local Operations Managers (LOM, n=11)	Mobile Operations Managers (MOM, n=12)
• Professional background • HQ-based • Automatic issue of smartphone because of seniority, mobility and need for availability	• Operations background • Local offices • Automatic issue of smartphone because of mobility and incident response requirement	• Operations/engineering background • Mobile work (rapid response) from field offices • Automatic issue of smartphone because of mobile work and incident response requirement

The research was advertised on the company's intranet and volunteers were sought. In addition, management were asked to recommend participants from different areas. Three researchers (the authors and a Rail Engineering researcher) interviewed 35 participants involved in incident response concerning use of their smartphones (see Table 1) as part of a broader study of smartphone use within the organization. For health and safety reasons, it was not possible to accompany the engineers and directly observe their work. Furthermore, while interviewees showed us images, emails and incident records, we were not permitted to collect or analyse these directly.

Interviews were conducted at central and field offices, enabling the researchers to visit a variety of sites. Both MOMs and LOMs were often located in station buildings or signalling complexes rather than the more traditional office locations of the OMs. When visiting the LOMs and MOMs we were often shown around the site, which on occasion necessitated the

wearing of safety equipment; sometimes we accompanied them as they unloaded their vans or completed their reporting. In addition to the interviews, we were then able to observe some activities associated with incident resolution.

All interviews were semi-structured and encouraged participants to talk about using their smartphones (here, in respect to incident response). Interviews lasted between 45 and 90 minutes, were fully transcribed and entered into NVivo (qualitative data analysis software) for analysis. To facilitate initial sense making, a descriptive coding framework (Richards, 2009) consisting of 20 categories was developed. This was jointly constructed by the interviewers based on initial reviews of the transcripts and subsequently revised during team meetings so that a shared template was produced. Interrogation of the category 'knowledge sharing' prompted our interest in accounts of the use of smartphone photography during incident response. Further examination of these data identified 191 extracts in which smartphone photography featured in stories about incident response. These data were then subject to further iterations of the analysis process to identify narrative accounts of using smartphone photography.

Narrative analysis is well established within organizational studies (Boje, 2001; Gabriel, 2000). Rhodes and Brown (2005: 169) suggest "people in organizations are storytellers ... their stories constitute valid empirical materials". Narrative has long been considered an integral aspect of work itself, as examined in Orr's (1996, 2006) classic work 'Talking about machines' in which stories are key to knowledge sharing. A narrative approach also fits our experiences of interactions with the participants (Herrmann, 2011) as they told stories about incidents and enrolled us in a process of shared sensemaking. It seemed that the event-based nature of incident response lends itself to storytelling, particularly by the MOMs who are often the only individuals to see the process through from beginning to end. Therefore in the analysis that follows, while considering the different perspectives of the various groups involved, it is not surprising that MOM's accounts are pivotal to our analysis.

Adopting a narrative approach offers a different, but no less valid, lens from, say, participant observation. In this context, a narrative approach allows a form of access not otherwise achievable within the local constraints as we can follow the work through to a specific outcome (here, incident response) and explore the role of different characters and tools (here, the smartphone) within the plot (Corbett-Etchevers and Mounoud, 2011).

There are many different forms of narrative analysis which may follow individuals' experiences (sometimes over a lifetime) or adopt a specific focus on events (Andrews et al., 2008). This latter approach formed the basis of our own investigation. We focused on the content themes of these narratives rather than form or performance within the interview (Maitlis, 2012) and worked through 191 extracts to identify commonalities and tensions in the narratives told by different participants. Specifically we identified four narrative themes which enabled us to unpack the different ways smartphone photography mediates knowledge sharing in the (sociomaterial) practice of incident resolution:

- Smartphone photography brings remote groups to the track.
- Sharing images establishes truths and provides evidence.
- Images reduce reliance on MOM's own accounts.
- MOMs use images to (re)assert their knowledge.

Smartphone photography brings remote groups to the track

Accounts of smartphone photography often began with an explanation that sharing images gives office-based staff a better understanding:

> They never see a railway, they're in an office and they've got a phone, for them to be able to see what it is that you can see outside by the click of a button helps them to understand why you're making the decisions you're making and it helps them to understand should they bombard you with phone calls or can they see that you're digging a set of points out from snow or whatever it might be. So we feel it helps them to understand what we're doing a bit better and it helps them to manage the incident a bit better. (LOM11)

Here smartphone photography bridges the distance between front-line and other staff, and can provide a basis for knowledge sharing as remote groups 'see' the challenges the MOMs face. This bridging is specific; Control 'see' the track, the image only works in one direction while MOMs retain ownership of the work itself. Smartphone photography enables management learning as aspects of trackside incidents are made visible, the digital image partially acts as a material substitution for being there. However this account could also be read as subtly critical of remote groups, who remain safely in their offices, but are now able to understand some aspects of 'real work' through the combined agency of the smartphone and the MOMs themselves.

This MOM suggested that remote groups remain protected from the harsh realities of incidents:

> You don't take photos of gory stuff ... I mean there's no real benefit of taking a photo of that anyway really, if you sent that to Control I think they wouldn't like that very much, you know. (MOM4)

Within this story the MOM selects the knowledge to be shared and protects others. Therefore Control's knowledge of the 'reality' of incident response can only ever be partial. Utilising smartphone photography offers only an incomplete replication of some aspects of incident response, and in this narrative the agency rests with the MOM who can act to involve or protect others.

Here, MOMs position themselves as the key actors and employ the smartphone to support this positioning. They are the ones taking and sending the images. This image may allow (partial) access to the track, but access is given (or withheld) by the more knowledgeable individual present at the incident. However, as we explore further below, this positioning is both tentative and contested through alternative narratives.

Sharing images establishes truths and provides evidence

As this MOM explained, smartphone photography becomes directly implicated in knowledge sharing, since it offers a short cut to the previous lengthy phone conversations:

> They get the picture and it helps, it saves writing a thousand words if you can just like 'there you go, that's the problem, that's what's been hit, that's what needs fixing'. (MOM11)

Thus MOMs suggested that they use the smartphone to provide proof and save time (compared to previous lengthy verbal exchanges). In this respect, knowledge sharing has been simplified to a straightforward exchange. Once the image is shared, the MOM can then be left to get on with their 'real' job of repair, work which remains hidden from view.

However, in the management of incident response, smartphone photography is also positioned as a critical material aspect in establishing the causes of incidents. Below, a MOM explained how he uses an image to dispel rumours:

> I was getting all these horror stories about, you know, it's done this, and it's done that' and I'm like 'no it hasn't, I'm standing here looking at it - hang on I'll take a picture and send it to you and you can see what I'm talking about'. So it's very good in that sense ... Control deal with lots of other people so they sometimes get lots of information and they then come to us and say 'we've heard this' ... 'oh no, no, no'. (MOM3)

This MOM employed the smartphone to share the 'material reality' of the incident. Paradoxically, in part because of the wide usage of smartphones across the organization, (mis)information about an incident circulates quickly and responding to rumours takes time. Emailing an image directly from the scene acts as 'proof' and thus is depicted as key to enabling effective knowledge sharing in the broader context of managing incident response.

With the wide use of smartphones, images may also be sent up through the hierarchy and to customers as a means of resolving arguments about the cause of an incident:

> The MOM took a picture of the [equipment] and you could see the contact through the image, and the image was then sent on to [customer organization] 'look, there's nothing wrong with the contact, here's the image' and it stopped the debate dead. (OM10)

Within these narratives the images sent from the track are positioned as the ultimate truth (the knowledge to be shared) to resolve misunderstandings about incidents. The image speaks for itself; it 'stops the debate dead'. Managers here have been given direct 'proof' that is easily shared (and hard to dispute) via smartphones. These become a common tool involved in both management and engineering aspects of the incident resolution practice.

Such management debates are critical as the source of the fault has financial implications:

> It's definitely a sort of insurance policy that makes sure that people are aware and involved. That's probably the biggest thing actually. (OM2)

Smartphone photography intercedes to enable incident resolution, but sharing knowledge is also positioned within broader management processes. While management are concerned with the effective resolution of incidents, they also need to attribute the cause. Although removed from the site of the incident, they can forward images via their own smartphones to ensure that this knowledge (proof) is shared.

Some stories about knowledge sharing went further and included examples of how sharing images provides the basis for shared decision making with others:

> You can take a picture and send it to them, and then they're looking at what you're looking at and you can come to some sort of agreement, an action plan of what to do and what type of incident it is ... basically [I use it] if I'm out and about and I need to ask someone a question. (MOM6)

Again the image is depicted as offering direct access to the incident and here mediates a sense of shared action. The image opens up possibilities for knowledge sharing via the smartphone voice functions. Smartphone photography is positioned as a starting point to knowledge sharing and as enabling people to work together while apart.

The MOMs also explained that they found smartphone photography a useful means of sharing knowledge when they were able to liaise directly with specialist engineers to gain advice about specific aspects of an incident:

> Now if it's outside your remit then you've got to contact [a specialist]... you send him a picture and then he could send you back a 'yes' or 'no' or give you some advice or whatever. (MOM9)

Examples related to the need for MOMs to access specialist advice (for example, about the stability of structures after an impact). In this case, the image is seen as a starting point to the knowledge sharing process.

However at the same time some MOMs expressed concern that the increasing demand for images could end up distracting from their real job of fixing the incident:

> For some reason it takes forever to send it, it takes about 6 minutes to send, so if you're taking a series of pictures it can take time and that's frustrating, you know. (MOM10)

In this case, the smartphone is not performing its role within the knowledge sharing process effectively: 'it' has become materially problematic, and is taking the MOM away from their role of dealing with the incident itself.

Here we see the role of the image established through these narratives as providing proof and direct evidence of the truth of the incident, even when shared by those who are remote from the track. Many narratives suggest that smartphone photography provides a short cut which enables more effective knowledge sharing. However other stories suggest that since the value of the image as evidence has been recognised so MOMs are spending more time taking and sending photographs. Within these stories the smartphone may present a material obstacle to incident response since too much focus on sharing knowledge becomes a distraction rather than an enabling aspect of the practice. Clearly there are tensions here that the MOMs cannot themselves resolve; hence the negotiation and management of these tensions becomes part of their day to day work practice.

Images reduce reliance on MOM's own accounts

Smartphone photography was further held to create tensions about understandings of knowledge. Some MOMs commented that since they could now provide images almost instantly these were increasingly demanded by managers. The image was held to be a replacement for the MOM's personal knowledge and assessment of the incident scene. As such the MOM became potentially less visible within the process and, perhaps, less valued as a source of personal knowledge:

> It's a funny sort of thing because railway knowledge, we would know what we're dealing with ... however they don't always take our word for it, you know. (MOM5)

As images become regarded as the best form of proof, the previous practice of providing a verbal report is less accepted. Smartphone photography (and the smartphones themselves) becomes positioned as central to incident response as this LOM explains:

> So when we go out on an incident and say 'there is a big tree down' and he [senior manager] says 'prove it', they go click, send and the e-mail goes to Control and they can go 'my God look at that'. (LOM9)

As the image has become 'truth' so it is demanded as evidence, even when those present may feel their account is sufficient. A MOM's individual knowledge can be challenged and there is no longer the need to be reliant on their account. Thus the material becomes significant in this narrative, while the MOM is relegated to a supporting role (that of taking the image and emailing it) within knowledge sharing processes.

However, some MOMs have also capitalised on the status of the image as evidence in other aspects of their work, since sharing an image may prompt others to take action:

> The chap in charge of fencing doesn't really like me and my smartphone, because I take a picture and I send it to him and Control and say 'I want this doing'. 'But we haven't got the money'. 'Right, if anybody gets knocked over it's in your hands now', because I've taken it and it's gone and it's brilliant for that. (MOM7)

Here the MOM and the smartphone work together as a sociomaterial whole (me and my smartphone), though the MOM retains the agency within this account of knowledge sharing.

Emailing the image enables him to provide evidence of work to be done, and by sharing that knowledge, he has passed on responsibility for performing the work.

While earlier narrative themes emphasised the benefits of smartphone photography there are risks for the MOMs as they become potentially less visible as a source of knowledge and move to a supporting role. This is not to say that they are not still active on the ground, working to resolve incidents, but within the broader practice this activity may becomes less visible.

MOMs use images to (re)assert their knowledge

Some MOMs constructed narratives of smartphone photography which reassert their role in knowledge sharing. For example they mentioned using images to challenge managers (in Control) and assert their (correct) knowledge of events, as in the example below:

> They say 'it's about 10 metres off the end of the platform' and you end up walking half a mile, and you'll take a picture and you'll say 'look, this is how far I've had to walk', because Control might be on the phone saying 'are you there yet, you're only 5 minutes away' and I'm like 'well look'. (MOM6)

Since the image appears to be accepted as proof within broader narratives of knowledge sharing, the MOMs can now use this to challenge Control's knowledge. In this way, the materiality of the digital image again enables those removed from the location to 'see' the MOM's view of the field (here the distance between the platform and the incident itself).

MOMs' stories further explained how they attempted to balance their role as knowledge providers with having the space and time to do the manual tasks required to resolve the incident. This often requires the MOM to wear protective clothing or work in environments where it is impractical or unsafe to stop and use their smartphone. In the main, MOMs described fitting in smartphone use into 'gaps' around practical tasks. Thus knowledge sharing is positioned as secondary and the smartphone as materially less significant than

other tools:

> You know, if they're saying 'can you get some photographs' you say 'yeah, when I can'. I mean you'd never sort of stop everything just to take a few photographs, you'd do it when you can, that's my attitude, you know. Whilst I'm going about, I don't know, taking statements or whatever ... I'm also getting my smartphone loaded up, talking to people, finding out what's going on and taking pictures, you know ... and then when you get time....and you always do ... 'when are the [contractors] going to be here', 'not for another 20 minutes', we've now got 20 minutes to do what I've got to do. (MOM3)

Thus, despite the importance of the image as evidence, MOMs construct a narrative which places smartphone photography within a broader sequence of tasks within the practice of incident response. Here the MOM once again features as the actor in charge of the material aspects of this process, fitting in taking the images according to their assessment of the work required rather than responding to remote groups' demands.

Below, another MOM positions taking images in direct relation to his own expertise; smartphone photographs are only required when the MOM is not able to use their own knowledge to resolve the incident:

> If we're not an expert on what we're dealing with, you can take a photo of it; send it to our Control who will send it someone who knows a bit more. (MOM5)

In this version it is the MOM who makes the choice regarding whether to employ smartphone photography in knowledge sharing; whether the situation is within their capability or whether additional advice is needed. In this account, the MOM is knowledgeable about the sources of expert support and recognises that it may be possible that emailing an image could be useful in accessing the opinion of someone who 'knows a bit more'.

Other MOMs commented that they could 'fend off' Control and use practical and /or safety issues as the reason for being unable to share images, although this raised concerns regarding the impact on the MOMs' reputation:

> There are [MOMs] that just won't make that effort to show us in a good light, you know ... they'll be standing there chatting ... but they're not feeding the information back and that's what we have to do ... if we don't do that then what are we there for? ... Management then look at the log 'well nothing's coming up' ... 'why is nothing coming up'. So they then ring up Control, 'what's going on?'. (MOM3)

Within this account the MOMs have to be seen to be sharing knowledge so that their work on the incident is made visible to others, this is here positioned as integral to incident response rather than a separate practice. Smartphone photography provides the opportunity to provide this evidence but it is not straightforward as the MOMs also seek to remain key actors in the incident response narrative. Smartphone photography is then a "contested terrain" (Edwards, 1979) within the practice of incident response.

Discussion and Conclusion

Incident response at Rail Engineering is complex and challenging; both for those who work there and, analytically, for us to access and unpack. We therefore used a narrative approach to develop insights into the ways in which the use of smartphone photography mediates knowledge sharing in the (sociomaterial) practice of incident resolution. Smartphone photography has added an additional layer of material complexity to incident resolution. We have examined stories about knowledge sharing, exploring how smartphone photography might bridge the physical distance between managers and engineers, and how sharing images could establish 'truths' and provide 'evidence'. However, we also explore the challenges engineers face as the demand for images reduces acceptance of their own accounts and their re-assertion of their central role in the incident response process.

In this materially complex practice (Styhre, 2009), the smartphone may initially appear as an insignificant device; after all it is not of direct engineering use, the MOM cannot use the smartphone to directly resolve the incident. However, our analysis unpacks the ways in which smartphone photography has prompted the negotiation of new narratives that construct understandings of presence at, and knowledge about, incidents. In being retold

within our research interviews such stories are worked through by the participants and this (may) act to further reconfigure smartphone photography within the practice itself (Feldman and Orlikowski, 2011).

Within some narratives the visual image has become regarded as incontrovertible, the truth made material, yet as Guimond reminds us using the words of the American documentary photographer, Lewis Hine; (talking in 1909) we should be wary of our "unbounded faith in the integrity of the photograph" (1991: 20). The notion of knowledge to be shared is thus both tangible (made material via the shared digital image) and out of reach. Remote groups are offered a means of becoming present at the incident via the digital image, yet this presence may be partial, temporary and contested. We further see changes to management's interpretations of knowledge about incidents and the source of this knowledge. While both a verbal and visual account may be delivered by the MOM using the smartphone, the digital image is preferred as evidence. Whilst some MOMs may seek to resist this narrative, it is also reinforced through their resistance (for example, the MOM who sent an image to prove how far he had to walk to the incident). Narratives thus highlight tensions about understandings of knowledge and how this is shared. These tensions present new challenges which the MOMs must continually (re)negotiate within their day to day experience of the practice of incident response.

Whilst other forms of visual representations have been previously been examined (e.g. Bechky, 2003a, Ewenstein and Whyte, 2009) and visual research is now more widely utilised (Warren, 2005), the use of digital images and specifically smartphone photography within work practices is less well understood. Within our analysis, the positioning of the digital image as 'proof' shapes knowledge sharing practices and their renegotiation between the different groups involved in incident response. The representational capability of the image is both confirmed and disputed in relation to 'capturing' the complexity of incidents. There is the possibility images can save time and avoid misunderstandings, but the MOMs risk

becoming invisible should their role be simply viewed as one of image capture. On the face of it, decision-making about the incident could either be devolved to MOMs or removed entirely from their hands through the use of smartphone photography. However our analysis suggests more complex negotiation around the 'proof' represented by the digital image. The digital image becomes an important boundary object (Bechky, 2003b) in the power relations between MOM and other staff. Thus, complex knowledge sharing processes are continually renegotiated as the different actors incorporate smartphone photography into narratives of responding to incidents.

From the perspective of the distributed work literature, smartphone photography offers the potential to develop understandings of both physical and perceived proximity (Wilson et al., 2008). We suggest this prompts a renegotiation of distance, offering the potential to bring different groups closer or to create space. The key here is *potential*, as we see from the narratives that both outcomes are possible. We suggest proximity is a precarious notion that is subject to ongoing negotiation, both during the sociomaterially mediated interactions that take place while incidents are being resolved and in their subsequent retelling (here, within research interviews). As the digital image is also a partial representation of the physical location, only certain dimensions of distance may be overcome, whilst others may remain intact (the MOMs may be working in the cold and wet, while Control stay warm and dry). Smartphone photography is thus conceptualised as a material intervention that creates a sense of proximity, yet, as we see in the MOMs' accounts, the practice of incident response may be constructed as the 'real' engineering work that continues out of sight.   In this respect we suggest that moving empirical research out of the office enables us to draw attention to temporal and spatial considerations of smartphone use in alternative contexts (Green, 2002).

Thus a simple conclusion that the smartphone will increase a sense of proximity – perhaps an original motivation for their introduction – is more complex than it at first appears. Organizations need to pay more attention to the complex enactment of working practices

and relationships in shaping change outcomes. This may be a particular challenge for distributed work groups, such as those studied here, but organizational exploration of narratives of smartphone use, potentially using the device itself to facilitate such discussion, could offer useful way forward. Moreover, it is clear that the continual (re)embedding within practice means that this should be reviewed on an ongoing basis, as use will evolve over time.

While offering such insights, we recognise that our work has a number of limitations, particularly in terms of the access constraints experienced during the study. We were not able to directly observe incident response or collect images for analysis. However, the narrative perspective allows us instead to focus on the processes of negotiation surrounding smartphone photography (Maitlis, 2012). Future research which enables direct access to the practice of smartphone photography would of course be welcome. Further insights might also be generated by using photo-elicitation techniques (Rose, 2012) within research interviews.

In conclusion, we have examined narratives of smartphone photography as engineers share knowledge in the practice of incident response, positioning this as an exploration of a particular kind of distributed work. We suggest that smartphone photography presents a specific form of sociomaterially complex "contested terrain" (Edwards, 1979). Effectively it shakes the previous foundations of knowledge sharing and requires the renegotiation of notions of 'truth', knowledge and agency by all those involved. Our analysis directly contributes to the understanding of this renegotiation process, highlighting the challenges and risks for different groups. As smartphone usage within organizations seems likely to continue to increase we hope our paper will prompt further interest in, and understanding of, the use of digital images in a range of organizational work practices.

Notes

1. All the MOMs interviewed were male, as was generally the case throughout the organization.

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