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The Overlook of Maintenance Practices in the Digitalization of Railway Maintenance Records

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Abstract. We present an ethnographic study of railway maintenance work, with a focus on digitalized maintenance records. This on-going research is taking place in a small private railway maintenance company in the south of France for two years. We describe the integration of maintenance records in a wide material environment, and the evolution from filling in these records on paper to smartphones. This research brings some nuance on the beneficial effects of the 'digital transformation' in this industry, and shows how the workers compensate for the overlook of their practices in the design of the digital records.

Introduction

Railway maintenance records allow the gathering of information on the status of the infrastructure, which is central for maintenance work. The digitalization of these formerly paper-based records is an on-going process in France, with software companies offering systems that can be used both on personal computer (in offices) and on smartphones (on the field of work). This research focuses on this transition, and its impact on the collective work done by technicians. We have in particular

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discovered that maintenance practices have been overlooked, and by then socio-material constraints of the workers have not be taken into account.

This work is part of a large project funded by the French Public Bank for Innovation, piloted by Vossloh, a leading global rail technology company that sells integrated offers for rail transportation including for instance track fastening systems, concrete ties, switch systems, crossings, so as services associated with the lifecycle of rail tracks. The aim of this major 4-year project is to bring together players in the rail and safety industries and researchers to develop a new-generation, secure remote monitoring system dedicated to rail infrastructures, using a range of devices: Innovative sensors, new-generation concentrators dedicated to local data collection and transmission, a centralized data acquisition system with real-time data processing and analysis, modular user interfaces with key indicators based on usage, maintenance prediction and alarms, and an operator support system for the maintenance on the field.

Our research contributes to this last action and aims at ensuring a practice-centered development of the technology that will be offered to the workers in charge of the maintenance. In this respect, it resonates with questions raised by CSCW researchers about the links between ethnography and design (Blomberg and Karasti, 2013). We have introduced in the project the idea of working with technology probes (Hutchinson et al., 2003 ; Hemmings et al., 2002), as this research and design method "combines the social science goal of gathering information about the use and users of technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to think about new kinds of technology to support their needs and desires" (Hutchinson et al., 2003, p. 18).

In the remaining parts of this paper, we position our work in the literature, present our case study, followed by our preliminary results, before concluding.

Related Work

The question of technical supports for action in the very specific work environment of the maintenance site remains relatively unexplored both in Sociology of work and in CSCW. There is a whole body of knowledge from Science and Technology Studies interested in the question of maintenance and repair (Graham and Thrift, 2007; Orr, 2016; Denis and al., 2016), which in turn stems from reflections on the infrastructures (Star, 2016) that characterize this activity as such. The main thrust of this literature is to move away from the paradigm of innovation and to be interested in every action that allows things to last and contributes to the ordering of the world. However, this body of works shows very little interest in railway maintenance workers as a professional group with its own resources, skills and organizational constraints.

In order to address the question of artifacts which is central in our work and also to the concerns of CSCW, we mobilize the “ecology of artifacts” concept (Bødker and Klokmoose, 2012; Lyle et al., 2020), sometimes referred to as a constellation of technologies (Rosito and al., 2014) or digital assemblages (Sawyer et al. 2014). These concepts are particularly useful for understanding work activity as it happens and for grasping the situated nature of the use of artefacts at work, describing in precise terms the places, temporalities and resources of action. In addition, these concepts offer a dynamic vision of digital tools and their appropriation by workers that can evolve.

Moreover, since its first ethnographic works, CSCW researchers have always been interested in the question of the use of paper and the issues raised by the transition from paper to digital (Schmidt and Bannon, 2013; Ciolfi et al., 2023), with the well-known case of paper flight strips (MacKay, 1999). We can also mention the research in Management Science that examines, from a socio-historical standpoint, the evolution of the coordinative practices of tramway maintenance workers, especially with regard to changes in managerial and organizational processes (Arena and Relieu, 2022). In French sociology of work, two authors have taken an interest in maintenance records, offering an ethnographic study of a department of the French metro company RATP, that explores the "role of the production and circulation of maintenance records as a written aspect of the collective re-ordering process" (Denis and Pontille, 2014, p. 83). Our study extends this work by looking at digitalized records.

Case Study

This case study takes place in a small (around fifty employees) French private railway maintenance company, which was created less than ten years ago. This organization is considered as “innovative” in the railway domain because both the railway infrastructure is recent and the organization is equipped with relatively new maintenance machines (with several inspection wagons) and surveillance technologies (notably in remote monitoring systems and sensors).

This research is based on a set of ethnographic data collected by the first author in the framework of their sociology thesis. The main material comes from in situ observations of maintenance interventions for about eighty hours. It was possible to take numerous notes on a smartphone during the interventions, which mainly took place during the night.

Semi-structured interviews were also conducted; 8 in 2023 and 14 in march 2024: 12 with maintenance technicians, 5 with maintenance workers in a coordination center and 5 with middle management. Three main themes were discussed during the interviews: socioprofessionnal trajectories, work activities and working conditions, and the different ways employees use digital technologies. When possible, the questions were related to on-site situations observed

beforehand, in order to go beyond generic discussions on the supposed benefits or problems offered by digital technologies.

Findings

During our observations, we first realized that there is nothing obvious about the beneficial effects of the 'digital transformation' of maintenance records. Indeed, filling in an online record requires a special effort in a physically restrictive environment exposed to changing weather situations (rain, luminosity...) and where on-site mobility is required. In fact, digital technology plays a marginal role compared to the other tools and technical aids on site. Indeed, there is already a constellation of tools to carry, such as toolboxes, ruler tools or adjustable wrenches, in addition to personal protective equipment (figure 1). Technicians also often have to adopt restrictive positions when they use these tools (figure 2). Paper has not completely disappeared either.



Figure 1. Two pictures depicting non-digital maintenance tools.

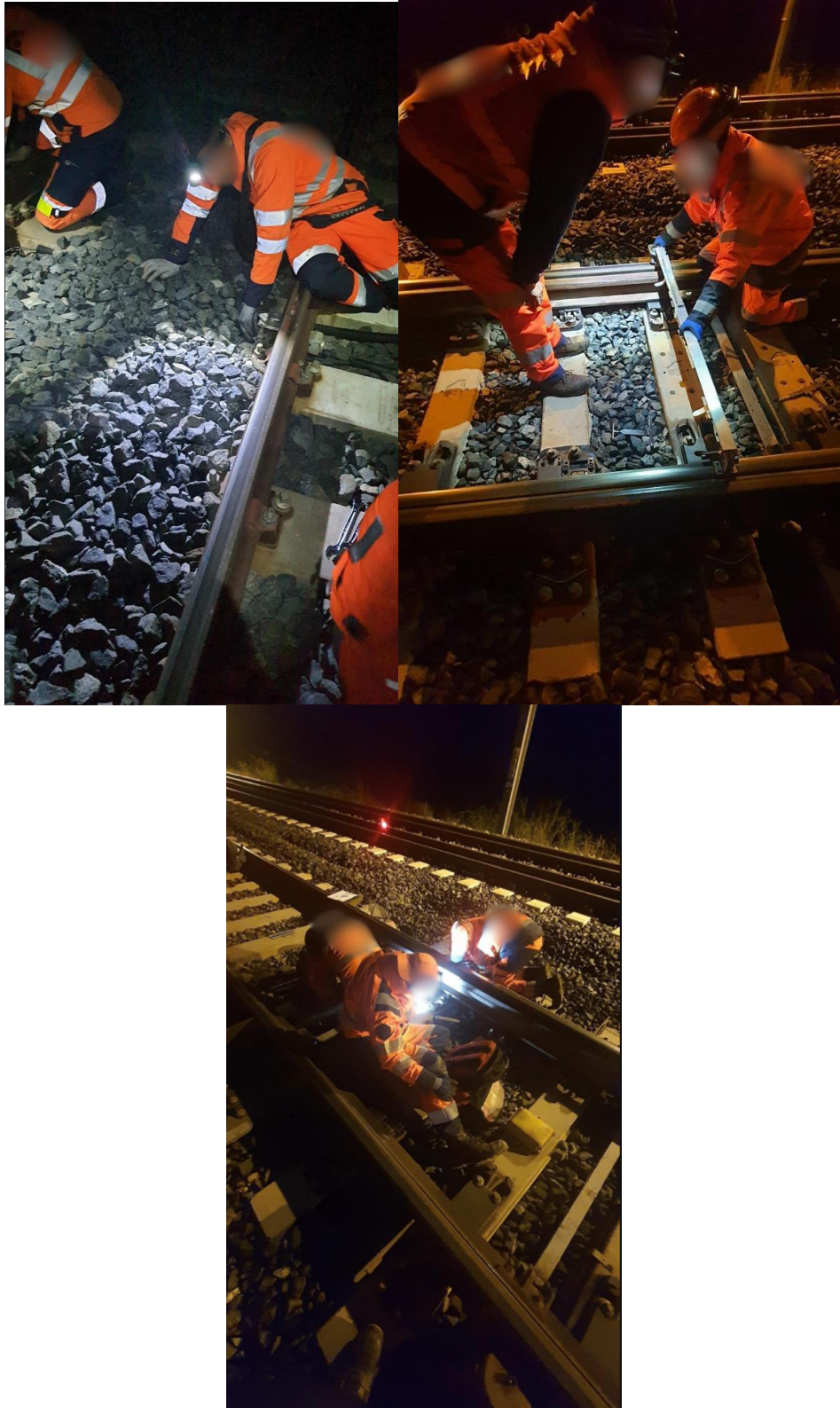


Figure 2. Three pictures of maintenance postures and material environment.

Conclusion

Our contribution is two-fold. First, we offer a recent ethnographic study that gives insight into maintenance work on a French railway site. Then, we situate the use of digital records in an already highly equipped technical environment, illustrating the complexity of this digital transformation that seems to have been overlooked by the railway company

Our preliminary results will be completed thanks to new observations and interviews and the introduction of two technology probes, one aiming at identifying how to offer an easy access to documentation while being involved in a maintenance task on site, and the second one focusing on facilitating the escalation of critical problems on the infrastructure.

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