



Splintered structures and workers without a workplace: How should safety science address the fragmentation of organizations?

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ABSTRACT

Organizational fragmentation presents a challenge to prominent safety perspectives hinged upon the traditional concept of the organization. The continuing disjunction in the workplace has reached new heights in the recent phenomenon of platform-mediated work (PMW), where workers engage in on-demand labor mediated by platforms. In this paper, the explanatory power of some influential organizational perspectives in safety science is explored in relation to PMW.

Neoteric business models combined with platform technology introduce alterations in accountability, goal conflicts, and social relations. These changes necessitate adjustments in our perspectives to address the safety challenges of a fissured, contemporary work-life.

This qualitative study based on interviews with 37 delivery platform workers and managers in the Nordic region and observations of two online courier communities reveals features that diverge from traditional work settings. Sociotechnical systems thinking is applied in examining goal conflicts arising from work contexts where the traditional employer-employee relationships are becoming transformed into two-sided marketplaces for clients and platform workers selling labor. The long tradition for addressing culture in safety science is then considered in analyzing its applicability to PMW. Finally, we reflect on how the safety research community can address the fragmentation of the organization.

1. Introduction

In many sectors, the nature and organization of work are rapidly changing. In particular, recent decades have witnessed a phenomenon denoted by Weil (2014) as the *fissured workplace*. Organizational fragmentation involves an increasing tendency for companies to focus on core activities and outsource specialized work to subcontractors, third parties, and independent contractors. This development has gone hand in hand with pervasive digitalization and new coordinative technologies. For safety science as a research field, understanding risk and safety depends on the ability of theory, methods, and models to be applicable for new ways of organizing work.

Growing evidence on the negative health and safety effects of non-standard work arrangements links these arrangements to higher accident and injury rates, hazard exposures, adverse consequences to physical and mental health, and income unpredictability (Quinlan, 2015). Some factors contributing to the increase in accidents include

inadequacies in training and safety management, psychosocial risks, lack of bargaining power, and low social affinity (Anyfantis & Boustras, 2020).

The fragmentation of the organization has taken a new turn in the emerging platform economy, where digital platforms owned by large companies are matching and mediating work by software applications (apps) to individuals selling labor (Fleming et al., 2019). An estimated 2% of the European labor force has platform-mediated work (PMW) as a primary source of income (Pesole et al., 2018), and the number of workers selling labor through digital platforms is rising (Eurofound, 2018). PMW represents a wide spectrum of work ranging from high-skilled, professional services (e.g., programming and graphics design) to highly 'taskified' activities (e.g., answering online surveys, delivery, and cleaning) (see Huws et al. (2017) and Schmidt (2017) for an overview). A common feature is that platform companies profit from the transactions mediated through their digital platforms between the worker and the customer. The workers are generally self-employed, and

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the platform owner has no responsibility for their working environment - or at least they rarely formally accept such responsibility.

The problem formulation guiding this paper is: How well-suited are influential organizational safety theories for explaining safety challenges in platform-mediated work, and what theoretical adaptations could be fruitful for this type of work organization? Specifically, we will focus on STS and safety culture strands of research. We will argue that PMW partly repeals the organization as the context of work and that theoretical development and adaptation to new work arrangements are needed. By way of a qualitative study involving interviews of 37 platform workers and company managers and observations of their online communities, our paper will discuss organizational safety perspectives in relation to platform work.

We have chosen to explore the explanatory power of two important theoretical perspectives in safety research when faced with PMW: 1) sociotechnical systems thinking (STS) and 2) safety culture. These strands of research were selected because of their *prolonged and wide application* in safety science and their *inclusion of work context* in their propositions, which is highly relevant when discussing PMW. STS has greatly impacted safety research (Leveson, 2017; Sheridan, 2017; Waterson et al., 2017) and highlighted the importance of the organization's environment, including technology development, regulations, and laws (Carayon et al., 2015; Pasmore et al., 2019; Winby & Mohrman, 2018). System safety from a multi-level perspective (Rasmussen, 1997) has been adopted to underscore the social and organizational factors in complex processes in system design (Leveson, 2004). In like manner, the concept of safety culture has endured as a distinct field of research with a high and steady stream of publications since the 1980s, embracing different industries and sectors (Le Coze, 2019). Despite the lack of consensus in its definition, safety culture and cultural approaches continue to be intertwined with organizational structures in the literature (Antonsen, 2009b; Schulman, 2020). Safety culture's link to the notion of the organization poses the question of what happens when the organization is subject to extreme fragmentation, as we will argue is the case of PMW.

In the following, we will present some developmental trends that challenge the traditional concept of the organization and describe some hallmarks of platform-mediated work. Then we will turn to the implications of PMW, particularly the idea of conflicting goals in STS and limitations in safety culture applications in this new context of work. Finally, we provide some reflections on how the safety research community can address the fragmentation of the organization.

1.1. The fragmenting organization

The essence of an *organization*, in one sense, is that it is a system of division of labor and coordination (see e.g., Mintzberg, 1983). Organizational maps outline formal systems consisting of functional entities and mechanisms for coordination and control as a rational machine designed to achieve a purpose. Real-life organizations, however, are also social arenas where workers interact with organizational cultures, shared histories, and values. They are also arenas for power struggles, sub-groups, and the emergence of communities of practice (Lave & Wenger, 1991) among workers with common interests and work situations.

There are several strands of research within safety science that can broadly be seen as organizational approaches to safety in the sense that they address organizational qualities as sources of accidents or as qualities that strengthen safety. In the quest to improve safety, an organization's management toolkit often consists of an arsenal of interventions related to safety culture, compliance, protective measures, or working conditions at the sharp end.

With the increasing reliance on subcontracting and outsourcing and a movement from monolithic organizations with in-house activities to more network-based forms of organizing, safety research has addressed concerns regarding coordination challenges and principal-agent

dilemmas (see Eisenhardt, 1989; Almklov et al., 2014) as well as goal alignment and efficiency/safety trade-offs (see e.g., Almklov & Antonsen 2010; Kongsvik et al., 2012).

Platform-mediated work is a step further in this development since it is a technologically mediated form of outsourcing to single individuals contributing to the company's core production. For PMW, the organization as a formal structure and social arena surrounding the worker is no longer present. Essentially and functionally, the workers are still connected to an organization, but only through the App's coordination and control mechanisms. Distinguishing between a functional/structural understanding of an organization as a formal system and a sociological notion of the organization can contribute to understanding PMW and its consequences. Whereas the formal functions of the organization, the coordination, and payment of work are inscribed in the algorithms, the organization as a social institution and an arena for social interaction with colleagues and managers is more or less absent. This also means that the organizational 'toolbox' for achieving safety through organizational efforts is different.

1.2. Platform-mediated work

Food delivery companies with neither food nor delivery employees exemplify an era of digital connectivity where global enterprises can be built with nothing but code (Goodwin, 2015). Equipped with Big Data, powerful algorithms, and cloud computing abilities, platform companies aiming for market domination can easily surpass the transformative power exhibited by factory owners during the industrial revolution (Kenney & Zysman, 2016). Digital platforms are refashioning work into gigs, tasks, and favors (De Stefano, 2016); disrupting businesses by lowering entry barriers and changing value creation and capture; and capitalizing on regulatory grey areas by subscribing to the mantra 'Don't ask permission; ask forgiveness' (Kenney & Zysman, 2016, p. 67).

Contingent work arrangements facilitated by platforms can contribute to isolation, job insecurity and income unpredictability for workers, and lack of workplace and social protection traditionally covered by standard employment relations (Cherry & Aloisi, 2016; Tran & Sokas, 2017). An overrepresentation of young individuals furthers the risk of accidents associated with contingent work in PMW (Bajwa et al., 2018; Eurofound, 2018; Huws et al., 2017). Moreover, platform control features such as piece-rate compensation, performance ratings, internal ranking systems, and gamification elements encourage long work hours and intensify work performance (Griesbach et al., 2019). Research on drivers and cyclists revealed workers experiencing impairment due to fatigue and pressure to cut corners, further highlighting the safety implications of PMW (Christie & Ward, 2019).

Two important characteristics necessitate a further investigation of PMW's impact on our understanding of safety in contemporary work. First, platforms structure themselves into 'lean platforms' that 'hyper-outsource' everything from workers to maintenance, training, and capital (Selznick, 2014). The business model excludes workers from employee rights and basic social protections like unemployment benefits in many countries (De Stefano, 2016) and social exchange, learning, and solidarity that a shared workplace offers (Graham et al., 2017). Therefore, the standard binary relationship between the employer and employee is transformed into a triad between the customer, the platform, and the worker – creating ambiguity in how it fits into existing regulations (Eurofound, 2018).

Second, platforms contribute to the 'unbundling of work' where work activities are disaggregated into tasks and distributed to workers who perform their work in isolation (Bajwa et al., 2018). PMW may exclude workers from the protection of health and safety standards; further, platforms exercise a great degree of control through 'Click-through' agreements that protect the enterprise from potential liabilities and justify 'algorithmic management' strategies (Lee et al., 2015).

The externalization of risks, the individualized organizing of work, and the highly controlled labor raise questions on how safety is

prioritized and valued. Furthermore, the combined attributes of PMW challenge safety science perspectives hinged upon the organization. The following section will introduce the two theoretical strands for exploration and discuss their appropriateness to PMW.

1.3. Goal conflicts at the sharp end

Sociotechnical systems thinking facilitates a multi-level perspective (left in Fig. 1) to elucidate complex processes and interdependencies that influence work at the sharp end where humans increasingly interact with technology (Carayon et al., 2015; Leveson, 2004). The higher the level, the greater degrees of freedom (design, decisions, and time horizons) and uncertainties in foreseeing local contingencies at the lower levels (Rasmussen, 1997). Worker latitude is constrained by the local work situation resulting from decisions at the upper levels. In PMW, an independent contractor generally exists outside the platform organization and its risk management system. Hence, the simple hierarchical structure represented in the figure becomes a more elaborate structure in PMW, consisting of individual workers linked to the platform organization through a digital platform while individually responsible for the risk management of their legal entity/sole proprietorship.

STS thinking emphasizes the importance of organizations' external environments in examining work-life. Environmental pressures such as market conditions and changes in technology can impact risk management strategies (Rasmussen, 1997). Recent developments include diverse stakeholder interests, temporary organizational memberships (Carayon et al., 2015; Pasmore et al., 2019), and customers as part of the work system (Winby & Mohrman, 2018). We further this development by underscoring the significance of independent workers loosely tied to the organization in the platform ecosystem. Consistent with Cross and Swarts' (2021) view, we challenge assumptions in safety management and research to include those existing around the organization's periphery.

In discussing the trend towards fragmentation and conflicting goals at the sharp end in PMW, we take Rasmussen's (1997) migration model (right in Fig. 1) as a starting point in analyzing tensions between safety and other organizational goals. The model exhibits how individuals and organizations strive to achieve safety while working towards other organizational goals such as economic viability and acceptable workload (Hollnagel, 2017; Hu et al., 2020). It illustrates the adaptive navigation occurring within the 'space of possibilities.' Rasmussen (1997) refers to local work adaptations individuals or groups make in order to

balance various goals while at the same time ensuring safe operations. In a dynamic working environment, the model's key assumption is to make boundaries visible and provide ample space for local adjustments while remaining within the safety limits (Moorkamp et al., 2014; Rasmussen, 1997). Introducing counter gradients such as training, safety regulations, and safety measures implemented in the workplace provides an error margin that serves as a buffer for workers who perform close to the 'fringes of the usual, accepted practice' (Rasmussen, 1997, p. 379).

The risk management strategies inherent in the models rely heavily on organizational activities such as safety campaigns or several methods from the safety management toolbox to prevent injuries and accidents. This includes using data from reporting systems that provide insight into past accidents.

How does this model apply to PMW? We propose that in PMW, additional individual boundaries emerge and need to be considered as these may be incongruent to organizational goals. Since the independent contractor status in PMW places the worker outside the organization's safety management system, the error margin created using the organizational safety toolbox may be absent. Thus, other goals may dominate as the worker navigates the local work situation. Furthermore, the platform interests may be at odds with worker goals when market domination is part of the business strategy – an oversupply of service providers benefits both the platform and the customers while workers risk lower profitability (Degryse, 2016; Muller, 2019).

Since independent contractors are responsible for providing their equipment, maintenance, and other responsibilities as their own company, the quest for platform domination and other features of PMW may significantly impact safe work performance at the sharp end. We propose a migration model that includes additional conflicts for independent workers to understand safety in the context of splintered work structures. Further, we call for a broader view of sociotechnical systems to include independent workers and other stakeholders outside the organization but still part of a wider ecosystem.

1.4. Safety culture

The interest in cultural issues in safety science can be ascribed to the search for new approaches for safety improvements in working life. Safety culture's appeal seems to lie on the assumption that a good safety culture values and prioritizes safety relative to other goals (Dahl & Kongsvik, 2018; Neal et al., 2000) and is reflected in positive safety performance and results. This assumption explains the broad range of

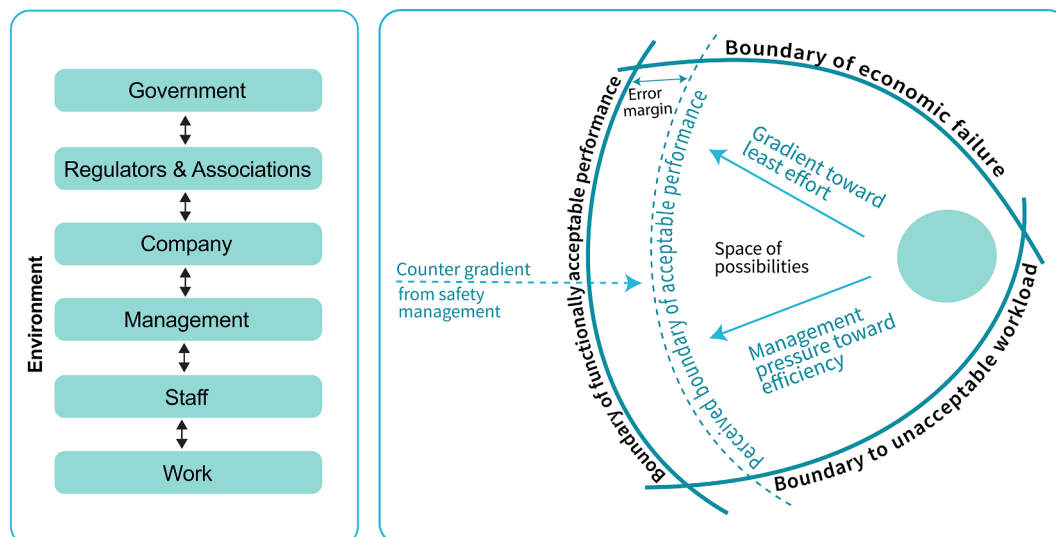


Fig. 1. Sociotechnical systems thinking (left) illustrates the interaction between the various levels and the environment. The migration model (right) demonstrates the space of possibilities and gradients toward the boundary of acceptable performance (adapted from Rasmussen, 1997).

research related to how safety culture can be assessed and described in organizations, the relation between culture, safety performance and results, and how safety culture can be improved. Done almost entirely in working life and industrial contexts and framed within a traditional understanding of the organization, definitions of safety culture/climate (Guldenmund, 2000) and questionnaires for safety climate use the terms ‘employees,’ ‘managers,’ and ‘leaders.’

In many instances, the analysis of safety culture has been informed by a three-level conceptualization of the concept (Bisbey et al., 2021; Guldenmund, 2000; Schein, 1985). 1.) *Norms and artifacts* are tangible and observable reflections of what is prioritized in a work community, 2.) *Values* are less tangible but might be expressed and be reachable for research. Safety climate research might be considered on this level, as it sets out to reveal attitudes and perceptions in a work community, usually by means of questionnaire surveys. 3.) *Basic assumptions* relate to subconscious and tacit ideas but still guide actions and intentions. These are less available for research, but participant observation over long periods is one approach applied.

A distinction is made between a functionalist and interpretive view on culture (Glendon and Stanton, 2000). Functionalist perspectives see culture as something that can be managed or even manipulated top-down by management and a means to an end that can serve certain strategic goals. Interpretive perspectives view culture as an emergent, complex, bottom-up phenomenon involving the development of commonly owned identities and beliefs (Fig. 2). The safety culture models that have been developed have mostly been within the functionalist perspective, exemplified in Hudson’s (2007) cultural ladder and Reason’s (1997) model on engineering a safety culture.

‘Being your own boss’ is a recruiting slogan used by platform owners. It illustrates that management in the traditional sense does not exist for platform workers. Instead, platform and app algorithms perform much of the work management. We thus propose that in the context of platform-mediated work where workers generally perform tasks distributed, coordinated, and controlled by the digital technology (App) in isolation, the applicability of functionalist/management approaches to safety culture is significantly reduced.

The interaction among workers is also a foundation for safety culture and how it is conceptualized. A definition by Kongsvik et al. (2018) is an illustrative example. Based on Bang (2011), safety culture is defined as ‘the shared safety-related values, norms and perceptions of reality that develop in an organization when its members interact with each other and the surroundings’ (Kongsvik et al., 2018, 222, our translation). Hence, sharing something in common can only be accomplished by some form of interaction (Boudreau & Newman, 1993). When organizational members interact over a period of time, patterns of relationships might develop and form social structures. Interactions are also prerequisites for developing common worldviews, norms, and values. Simply put, and based on safety science literature, safety culture emerges in people interacting in a traditional workplace.

PMW has been characterized as hyper-outsourced and individualized. To a large extent, workers are not employed but contracted as sole proprietors. We propose that individualization reduces the opportunities

for interaction between the workers, and as a consequence, the possibility for cultural development will also be reduced.

Thus, we will discuss how safety culture might apply as a concept in PMW, where the employee-employer relationship is diminishing, and the level of interaction is reduced.

2. Method

2.1. Study design

Since research on the emerging phenomenon of platform-mediated work is still limited in safety science, an explorative research design was adopted in this study. We conducted semi-structured interviews with couriers from two food delivery platforms in the Nordic region (hereafter DP1 and DP2) using a qualitative method. DP1 is a digital platform composed of two types of couriers – employees and freelancers (self-employed and through a third-party provider). DP2 is solely composed of courier partners (freelancers). The interviews occurred between February and September 2020. Due to the COVID-19 pandemic, some interviews were conducted online through Zoom or Teams. This shift, however, allowed for a more familiar setting since scheduling was adapted to the time and place (at home) that was most convenient for the participants. A flexible scheduling approach was taken to avoid potential negative consequences for work performance and interruption of company services. The individual interviews were supplemented with observations of two worker-only online communities. Observation captures informal interactions and adds depth to the study.

2.2. Data collection

The empirical data (see Fig. 3 for an overview) consists of 37 semi-structured interviews and observations from two online communities. The interview participants consisted of DP1 managers and employees, DP1 freelancers through a third party, DP2 managers and freelancers, and freelancers working on both platforms.

The initial contact with potential interviewees applied various approaches such as contact information from platform websites, social media, face-to-face inquiry near restaurant clusters, snowballing (Birnacki & Waldorf, 1981), and availing of platform services. The recruitment and subsequent interviews followed the guidelines of the Norwegian Center for Research Data (NSD). Upon explicit consent, the interviews were audio-recorded and converted into transcripts. Since the interviews aimed to collect data for a set of publications covering various facets of PMW, the interview guide included open-ended questions that ensured coverage of several issues: (1) individual background (e.g., when they started with PMW, other income-generating activities, education, immigrant/non-immigrant background, union membership, contract type, motivation for joining the platform), (2) platform company (e.g., recruitment, organization, and company characteristics), (3) courier work experience (e.g., work process, incentives, technology), (4) working conditions (e.g., safety, responsibilities, communication, social support) and (5) regulations (e.g., rights and social protection).

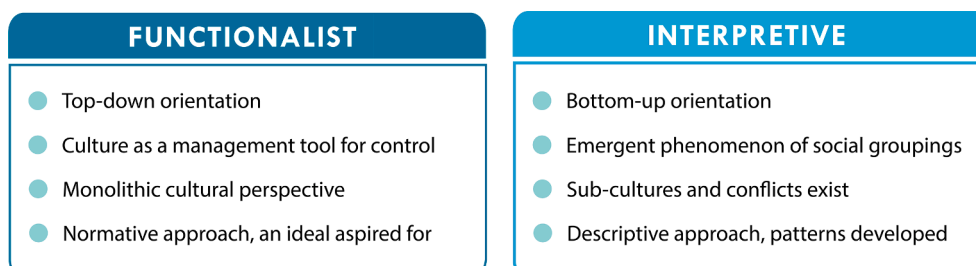


Fig. 2. Functionalist and interpretive perspectives on organizational culture (Glendon & Stanton, 2000).

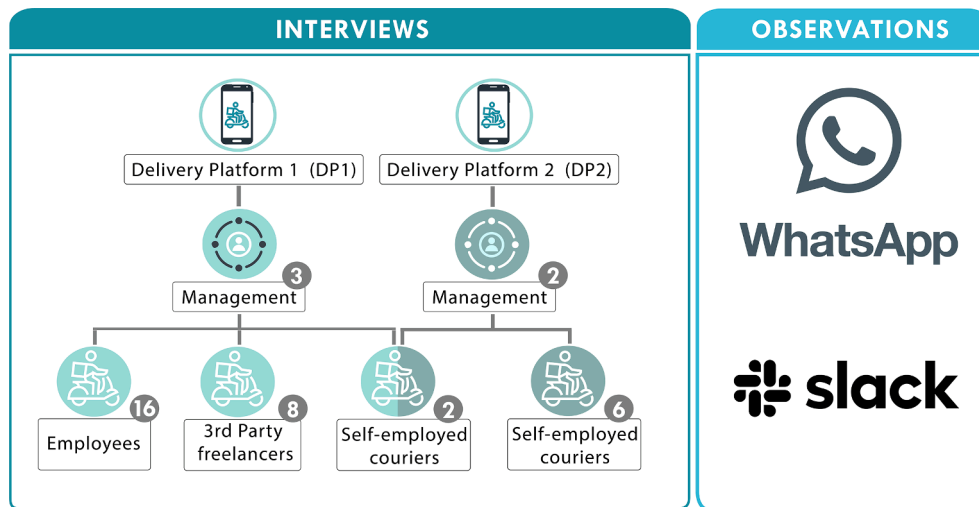


Fig. 3. Data collection - interviews and observations.

Data collection focused on how goals in PMW are aligned and whether there is incongruency between the platform and the worker. How are the workers organized, and how is safety ensured? Are there ways to monitor performance, and are incentives and sanctions present? How do technology and organization influence their work performance?

In exploring how safety culture relates to PMW, the patterns of social interaction and information exchange were explored through interviews which probed into issues such as platform communication with workers, face-to-face and digital opportunities for interaction between workers, and collective problem-solving.

The semi-structured interviews enabled the interviewees to pursue an idea of interest or elaborate on issues emerging in the interview. The interviews lasted from 45 to 75 min. Practical considerations, sufficient data to cover the topics, and saturation determined the participants' adequate number (Tjora, 2019).

An online ethnographic method, *netnography* or digital anthropology (Horst & Miller, 2012; Kozinets, 2010), was used to study the couriers' social interaction and online behavior. Digital traces from online social interaction (e.g., photos, illustrations, text, emoticons, and links to videos and news articles) provide invaluable insight into platform-mediated work and social relations that are otherwise difficult to observe among geographically dispersed couriers. Netnography provides access to vast data; however, collecting information from non-verbal communication may be subject to misinterpretation, and participants may not represent the entire group (Kausel & Hackett, 2015).

Data collection for the observations occurred following community discourse and consent. The online observations of two DP1 communities, one in Slack and another in WhatsApp, occurred from June to August 2020. DP2 couriers have an inactive WhatsApp group, so the possibility of observing the community was not pursued. Observation data included thick descriptions of member interaction and online content screenshots (with explicit consent). The researchers' interaction with the community was limited to keep the interactions as natural as possible. The community members were provided information regarding the study and contact information.

Couriers were encouraged to participate in the interview with a gift card. Potential sources of bias include selecting participants based on accessibility and communication using a second language. The small amount of the gift card may also have discouraged some full-time low-wage workers from participating.

Platform companies are known for keeping information about their technology and algorithms guarded closely (Degryse, 2016; Muller, 2019). While DP1 managers agreed to be interviewed on several occasions through a videoconference, DP2 data from the managers were

limited to text format received through email.

2.3. Data analysis

The data analysis used the computer-assisted qualitative data analysis software NVivo to identify patterns relevant to studying the nature and organization of work in platform-mediated delivery work. The use of technology and potential hazards and constraints faced by the workers received special focus.

The data coding involved two coding cycles (Saldaña, 2016). The iterative process strongly links the empirical data with our interpretation. In the first cycle, *in vivo* coding was performed, resulting in 1,945 codes. The codes were then categorically themed into 52 categories that describe patterns observed, such as general topics and ideas that emerge in the data (Saldaña, 2016). The categories included features of the platform technology (e.g., difficulties in shift grabbing), distinct features of PMW (e.g., performance-based staffing), and worker experiences (e.g., difficulties of being self-employed, freelancing as a choice). The second cycle of the coding involved further categorization according to similarities in their themes. The nine concepts (standardized services, performance pressures, ratings and ranking systems, scheduled shifts and changing conditions, individual investments, risk factors of delivery work, constricted communication, creating communities, and workers without a workplace) were further coded into three main themes: relegated responsibility, algorithmic authority, and solitary service.

In analyzing the goals, a specific focus was directed at how PMW provides and constrains financial opportunities, impacts workload and safety. For instance, we looked into how performance and scheduling systems relate to workers' ability to determine their schedules and income. While in determining social aspects of PMW, the analysis focused on their perceptions of management communications, how the platform ensures their safety, whether or not they feel pressured to deliver quickly and how the online community addresses technical issues and other concerns.

The results from the data analysis were compared to the results from the observations. Consolidating results from the interviews, available documents, and online observations improve validity through methodological triangulation (Yin, 2010).

3. Results

The three main themes represent particular aspects of PMW that deviate from conventional work organizations and processes that may have implications for the selected safety science perspectives. First, an

overview of the two delivery platforms is presented, followed by the three categories from our data analysis.

3.1. Overview of food delivery

The two food delivery platforms (DP1 and DP2) offer a low threshold for entry into the labor market. Many couriers are young (i.e., 20–35 years old) male students with little or no previous work experience. Managers from both platforms confirmed that the turnover rate is high, with DP2 emphasizing that the term turnover is unsuitable since the word is associated with employees. Our data indicates two main types of couriers. The first group consists of individuals who perform courier work as an additional income source and usually work a few hours a week. The second group consists of individuals having difficulties finding work due to lack of language proficiency, low educational background, or personal issues. These tend to work more than the former.

DP1 applies a hybrid model consisting of part-time employees (a minimum of 10 h) with open-ended contracts and freelancers who establish themselves as independent contractors or employees of a third-party company. According to DP1 management, they have employee safety representatives and regular meetings with shop stewards (union representatives). DP1 management mentioned that they have a reporting system for employees, and although they encourage reporting, underreporting is a problem. DP1 management initially planned to have only employees, but competition and flexibility pressures necessitated the recruitment of freelancers.

Other players operate at significantly lower costs because, among other things, they do not have the same health and safety requirements and employer responsibilities. All [...] subsequently, we operate at a greater cost due to the operational split. (DP1_Management1)

Company communication primarily occurs through emails and the Delivery App's chat function with courier support (dispatch). The couriers established an unofficial Slack workspace dedicated to couriers (freelancers and employees). Also, they have informal groups in WhatsApp for couriers in their respective cities.

DP2 couriers are independent contractors, and as a result of the service agreement between DP2 and the courier partner, the Employment Contracts Act and other employment legislation (e.g., Annual Holidays Act) do not apply. Both platforms have recently contracted professional occupational health services, but these services are limited to their in-house employees, not the freelance couriers. DP2 pays for accident insurance for the freelance couriers, while DP1 does not cover this for their freelancers. Managers from both platforms emphasize that freelance couriers are otherwise responsible for all other insurances (e.g., statutory pension, social security insurance, liability insurance). Both companies do not include freelance couriers in their safety management system, and management underscores freelancers' responsibility for the risks associated with independent contractor activities.

3.2. Relegated responsibility - transferring risks to the individual

Relegated responsibility refers to the transfer of responsibility traditionally held by the organization to ensure safe operations to the worker. This section illuminates the consignment of responsibility to the individual. In PMW, financial gains for the platform do not necessarily coincide with profitability for the individual. The safety management toolbox is also restricted to the core organization in PMW. Those operating at the outskirts of the organization are left to their own devices in determining financial gains from PMW, workload, and safety.

3.2.1. Individual investments

Regardless of the working agreement, employees and independent contractors alike must individually provide their mode of transportation

(bike, moped, or car) and communication equipment (smartphone and mobile subscription). Avid cyclists were positive about using their bikes, stating that theirs are presumably better than the platform would provide. However, many bike couriers find maintenance costly, especially new couriers with little experience performing the maintenance themselves. Although the collective bargaining agreement (CBA) of DP1 employees includes additional payment for equipment maintenance, not everyone is convinced it is enough to cover actual costs.

Because of the CBA, we receive compensation for a certain amount per order, and it is, to be honest, a joke. It may cover brake pads for that month. If you are lucky, it covers brake pads. (DP1-W13)

Although many use equipment they owned before joining the platform, some have bought a car after getting the job at DP2. Moreover, it is reasonable to assume that freelance car drivers incur a higher cost since they also pay for fuel, parking during pickup and delivery, toll, vehicle insurance, and potential parking and speeding tickets.

3.2.2. Risk factors of delivery work

DP1 and DP2 managers identified several risk factors in courier work: (1) theft of the vehicle, primarily bikes, (2) traffic-related injuries, (3) damage to one's own or others' vehicle or property, and (4) courier safety in meeting customers and restaurant staff. During the COVID-19 pandemic, virus infection also emerged as a highly relevant risk. While many cyclists acknowledged a few scratches and near misses, online community posts revealed more serious injuries like broken ribs. An interviewee explained:

Those of us who worked long for [DP1], I hardly know anyone who has not broken one thing or another. I myself have almost been run over by a truck. My bike was destroyed, and I missed death by the skin of my teeth. There are many stories ... So far, no one has lost their life or has incurred lasting injuries, but I think it is just a matter of time. (DP1-W17)

Workers described delivery work as physically demanding, especially for bicycle couriers. Despite awareness of personal injury and accident risks, many young workers indicate a higher preoccupation with income. The interviews revealed that many immigrants with PMW as their main income engage in courier work for 40–60 h a week. Some added having an additional job on the side, such as cleaning. Several interviewees registered seeing other couriers without helmets or badly maintained bicycles. For instance, a young freelancer (DP1-FL4) said, 'Health and safety is not my cup of tea,' while also admitting to a 'crazy' biking style.

The interviews indicate underreporting, which may be due to their belief in personal responsibility and a general acceptance of courier work risks. Piece rate payment may also discourage reporting, as an employee indicates, 'If you stop and report, you earn less money.' A few DP2 drivers have experienced traffic incidents that did not result in personal injury but resulted in car damage. Due to concerns about its impact on contract renewal, some do not report such incidents. Although both platforms have a reporting system, they underscore that independent couriers are responsible for their safety. Individual responsibility is reflected by the lack of requirements from both platforms for independent contractors to wear helmets during delivery.

3.3. Algorithmic authority – Algorithms and performance pressures

The theme *algorithmic authority* points to the performance pressures introduced by the control mechanisms embedded in the technology that is easily reconfigured to add or remove features that affect the local conditions in PMW. The pressure to work efficiently in an ever-changing context constrained by standardized instructions can push the individual closer to the safety boundary.

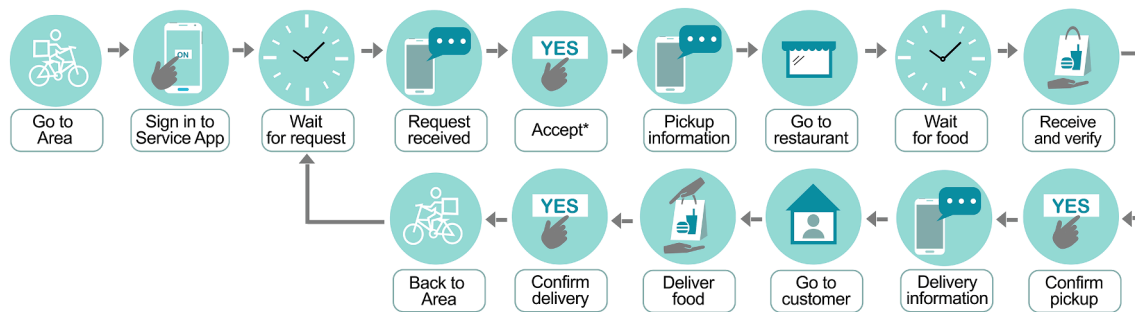


Fig. 4. Work process in food delivery.

3.3.1. Information imbalance and standardized services

Our empirical data also revealed information asymmetry, worker surveillance, and performance evaluation systems that scholars have identified with algorithmic management in PMW. The delivery process is illustrated in Fig. 4.

There is consensus on the App's centrality in organizing the work process, with workers often instructed by dispatchers to 'follow the App.' The work processes embedded within the technology result in highly standardized work, with workers describing the job as 'easy' in cognitive load. Also, many couriers appreciated the freedom of not having a supervisor. In this job, they perceive themselves as their 'own boss'.

While customers can see the courier movement on a map in the Customer App, couriers receive piecemeal information regarding their task. DP1 freelancers receive more information than employed couriers and can decline requests. Employees are obligated to perform the delivery they receive. The decline function has been a cause of resentment for some, saying it leads to inefficiencies when the job is potentially rerouted to a courier located farther from the pickup location. To discourage requests from being declined, updates on the App dished out 15-minute sanctions (inability to receive requests) for consecutive rejections, which also impacted their performance ranking.

DP2 has a customer rating system and system for measuring performance, although more detailed information regarding these systems and their use was not disclosed. DP1 only has an internal ranking system based on completed orders per working hours, late login, etc. Some employees noted that the evaluation system inaccurately reflected performance as delays can be due to many factors such as slow restaurants or uphill biking difficulties. Although DP1 employees officially cannot decline deliveries, some who receive extremely long-distance deliveries contact dispatch to reroute the delivery to a car. However, the delivery may end up with another cycling employee due to car unavailability. Some do not bother asking dispatch, worried it would further delay food delivery. Others performed the long delivery out of respect for other colleagues. Still, another employee with an IT background said that accepting the delivery is troublesome as this will teach the platform's artificial intelligence (AI) that it is all right to distribute long-distance deliveries to cyclists.

The couriers do not have insight into the distribution of orders among available couriers. While some assume it is the courier closest to the restaurant, others believe proximity is only one factor among many:

I feel like they are a bit discriminating ... we were four or five [DP1] workers [freelancers], and there was [an employee] sitting with us in the same circle, and it was a really good sunny day, and we were waiting for like one and a half hours without any delivery. So it is like one and a half hours completely wasted, and during that time, I noticed that [the employee] got three deliveries. (DP1-FL1)

3.3.2. Scheduled shifts and changing conditions

Advanced scheduling allows flexibility for workers and gives the

company control over courier availability. Shifts or working hours up for grabs are released two weeks in advance for both platforms. DP1 employees receive their designated contractual hours the same day and 'grab' extra shifts. Additional shifts are occasionally listed on 'Shift swap' or when demand requires more workers on short notice. Many indicated that advanced shift scheduling could be stressful as shifts may disappear quickly.

Later online observations revealed DP1 management's introduction of performance-based staffing (PBS), which tied shift availability to courier performance. Interestingly, there was little resistance from the workers when PBS was introduced, which was explained by the management as follows:

It is a just system that automatically rewards good employees and makes leadership aware of improvement potentials. [...] It has given all cyclists a more predictable shift that is better than the previous system. [...] It reduces the need to have several employees in an office and reduces our costs. (DP1-Management1)

However, one of the employees of DP1 divulged that one colleague suffering from anxiety attacks was close to having a 'nervous breakdown.' In Slack, the shop stewards backed management decisions arguing that PBS would reduce tardiness and no-shows among the employees and decrease freelancers from declining too many times. A shop steward assured the employees that they would examine if the changes negatively affected shift availabilities and earnings.

Like DP1, DP2 releases available hours two weeks in advance. Couriers that manage to grab published shifts receive compensation if no orders are received during their pre-scheduled shifts. In addition, DP2 couriers can also log on anytime, similar to Uber drivers. However, they do not receive any compensation for zero deliveries during these hours. Like the DP1 couriers, many indicate shift schedules as a source of stress.

Later interviews with DP2 freelancers revealed that compensated shifts were greatly reduced to a few hours early morning and very late shifts with low demand. Freelancers from both platforms also indicated that incentives for reaching a certain number of deliveries per week were removed. When asked about the changing conditions on shift release and incentives, the consequences of income unpredictability vary among individual couriers. For DP1 employees, a quiet shift means less additional payment per order but a guaranteed hourly wage. Freelancers who relied heavily on PMW as primary income expressed dissatisfaction with the changes but understood the fluctuating demands. One DP2 driver explained that the reduced number of compensated shifts was perhaps due to courier abuse by pre-scheduling hours, staying at home, and letting the App reroute requests while still receiving compensation.

3.3.3. Performance pressure

The App has a countdown timer showing the estimated delivery time. The majority of the interviewees explained that they view delivery time as a guide. DP1 managers emphasized that although speed is a factor in performing efficiently, they consciously do not include speed in

their KPIs or communication with workers.

Speed seems to be a higher risk factor for freelancers paid per delivery. Among employees, the pressure to deliver fast was more evident among newcomers than seasoned couriers who have learned to pace themselves. The piece-rate system appears to have a higher impact on speed than the estimated time displayed on the App.

Yes, one feels that, but I see it as more of a guide saying that you should be able to do this [within the estimated time], in a way. I do not feel pressure in that sense. The only thing is that I don't get paid unless I deliver. So, if it is very busy and it is Friday night, and there are many orders, it pays for me to cycle fast to deliver an extra order within the hour. (DP1-FL7)

Many have experienced late deliveries to customers without any direct penalties. In many cases, food preparation is a significant bottleneck in the delivery process. Although not directly sanctioned, their statistics reflect decreased performance through fewer completed orders per number of working hours.

A DP1 employee also underscored the conflicting objectives in their work, saying that the prioritization of safety is communicated during recruitment, in push messages regarding extreme weather conditions, and in meetings with shop stewards and safety representatives. However, receiving emails containing their recent performance reminds them of the need for efficient delivery and indirect pressure to increase speed.

3.4. Solitary service – Social relations in food delivery

The third and final theme, *solitary service*, features the isolated worker in PMW. The individualized work structure acts as a stumbling block to forming social relations, worker protection achieved through collective voice, and potential benefits offered by safety culture.

3.4.1. Workers without a workplace

DP1 and DP2 do not have a place for workers to rest in most of the cities they operate. Still, the couriers highlighted the importance of having a common place to gather and partake in social exchange. An employee voiced this need by saying:

We don't have anything in terms of physical space ... On days like today, it is not a problem, but if you have a public holiday in winter, the shopping centers are shut, and then there is nowhere to shelter. Obviously, the company always wants to get their starting levels at the right levels, at least two orders an hour, and then there is no need for shelter in their eyes. (DP1-W10)

For the DP2 drivers interviewed, the car is the workplace. DP2 drivers in one city mentioned that they were mostly adult immigrants from developing countries. Their inadequate education and language proficiency make landing a permanent job difficult.

3.4.2. Constricted communication

During a shift, the couriers' main communication line is through a live chat with a dispatcher, while face-to-face encounters with fellow couriers are highly sporadic. For the DP1 hybrid model, shop stewards and employee safety representatives communicate information from their meetings through Slack and occasionally through email. DP1 employees and freelancers alike found it strange not to have a phone number to call headquarters.

Many couriers criticized poor management communication. Two employees from different cities referred to the lack of information as 'Mushroom management – keep them in the dark and feed them bullshit.' This lack of information was apparent upon learning that PBS was already implemented in another city. The increased delivery distance and the PBS implementation ignited an online feud between shop stewards and dissatisfied employees who believed that the company

intended to pressure employees to choose freelancing due to its advantages.

3.4.3. Creating communities

The DP1 Slack community members include employees and freelancers who work for various reasons. Some members are full-time freelancers of both delivery platforms. Through Slack, couriers learn about company differences, such as incentives and support (e.g., financial support and personal protective equipment) to couriers during the pandemic. The DP1 WhatsApp group is another site for expressing frustrations, sharing information, and asking for help (e.g., to borrow a spare bike). These two external platforms were used for unofficially swapping shifts, which was especially helpful when the App swapping function was down. It also helped gather phone screenshots to document distance changes and App issues, such as the paid break becoming an unpaid break. The Slack community also had channels for social events and informally reporting accidents to safety representatives.

Members also post information about places they need to be extra mindful of, like newly asphalted roads and bike theft areas. Also, they use Slack to gather bulk orders and propose issues that shop stewards can raise during the next meeting with management. Unlike DP1 couriers, the DP2 WhatsApp city group is inactive. A courier explained the inactivity:

We had one. We wrote on our WhatsApp group that if we all at the same time quit on DP2 and we went to the office, and we asked them for more pay, then maybe they would help. Because if one or two people do that, it will not work. If everyone closed their App and went to the office, it could help. But many were from [country] and [country], and they were scared to lose their job ... many disagreed with the situation, and we deleted it. (DP2-FL6)

Despite having a social platform, collective action among the DP2 workers may have been hindered by their lack of knowledge in the Nordic working life and fear due to lack of job alternatives. The social relations among the DP2 couriers were primarily due to their background as immigrants from the same countries. Those who do not share these may feel individualistic tendencies in their work.

4. Discussion

As identified through our analysis, PMW has features that deviate from the traditional concept of the organization in three main ways. In PMW, equipment, maintenance, and safety responsibilities are mainly relegated by the platforms to the individual. Also, control, reward, and communication systems are highly embedded in the platform technology. Workers function remotely, managed by the algorithms to perform standardized services. Finally, the service is primarily organized in an individualistic fashion, with limited opportunities for socialization. Although PMW is an extreme case of legal, functional, and social fragmentation, workplace fissuring is observable in many sectors. Hence, organizational fragmentation implies that some influential perspectives in safety science might lose some of their explanatory power. We discuss some examples in the following.

4.1. PMW and the sociotechnical model

4.1.1. PMW and STS thinking

From a traditional hierarchical structure with distinct levels, some present-day and future organizations may constitute flatter structures, more in line with dynamic networks weakly linked to smaller units (e.g., independent contractors) through digital technology. Our empirical study reveals that in PMW, safety management is consigned to the individual contractor. Accordingly, workers outside the organization's legal boundaries may not be protected by established safety margins and workplace regulations (Garben, 2017). In delivery work, this is reflected

by multiple freelancer allusions to safety as an individual responsibility, coinciding with references to self-determination or being one's 'own boss.'

The platform delivery case also underlines the expedited move to detailed standardization where operations are reduced to discrete tasks and labor into atomized products to be sold (Almklov & Antonsen, 2019). Not only does platform technology have the ability to constrain behavior, but it also has become a business strategy in delimiting the organization's responsibilities (Pujadas & Curto-Millet, 2019).

The organization's perpetual struggle to balance safety with production goals is well-established within safety literature (Hollnagel, 2017; Hu et al., 2020). We proposed that in platform-mediated work, where the platform strategy is to reap the benefits of network effects, new conflicting goals emerge (Fig. 5). Economic failure is a common boundary shared by the employer and the employee since organizational viability is a goal that benefits both parties. However, our empirical results demonstrate two new boundaries emerging in PMW: the platform's viability and the individual's economy. The means of production and maintenance are relegated to the worker. In addition, low piece rates and temporary contracts may create greater financial pressures on independent contractors than employees receiving an hourly wage and open-ended contracts.

Moreover, as the platform expands its market, the increasing number of available workers may exceed market demands for the service, leading to fewer tasks and a lower income. Platforms backed by venture capitalist funding enable them to lose money as they conquer the market (Cusumano, 2015; Muller, 2019). Hence, the goal of financial viability in the platform economy has metamorphosed into a game of market domination, where a platform's win is an independent contractor's potential loss, at least in the shorter run. Our proposal on new conflicting goals, therefore, hold.

Although some platforms like DP1 are open to relations similar to traditional employer-employee relations, expansion pressures and tight competition result in a divided management system where freelancers fall outside organizational responsibilities. Hence, a need for higher-order control, such as regulatory or state intervention, may level the playing field. Kenney and Zysman (2015) point out that social protection based on employer contributions may no longer suffice; hence, the gaping hole in the social safety net may be mended by a more extensive welfare system that ensures basic rights and benefits for all, regardless of organizational affinity.

While the migration model has been applied to accident prevention, the model fails to highlight the long-term consequences on health and safety from prolonged exposure to stressful conditions caused by

performance within an extremely restricted space of possibilities. The lack of job security and income unpredictability, in the long run, can be deleterious for worker health and well-being (Quinlan, 2015). The interviews illustrate that PMW also introduces a different concept of workload. The migration model addresses workload as work performed for the organization. Thus, it becomes inadequate in considering the compounded workload through multi-apping or engaging in other income-producing activities. Together with low piece rates that encourage long hours of unregulated hard physical labor, independent contractors may find themselves closer to their workload limits. Moreover, efficiency pressures from evaluation systems linked to acquiring future shifts and income move the worker closer to the functional performance boundary. In the absence of counter gradients applicable to independent workers, couriers face an increasingly limited space of possibilities to safely conduct their activities (Nilsen et al., 2020).

Gaining an overview of workload and safety performance is arduous for platform management and safety regulators because of potential multi-apping, moonlighting, and bifurcated reporting and SMS systems, excluding independent contractors. Moreover, platform control features and piece-rate payment contribute to underreporting even among employees. Safety management systems restricted to employees and measures based on accident reporting systems may thus prove to be perfunctory actions that merely satisfy regulatory requirements. To better understand risks in specific types of platform work, independent contractors need to be included in the management of safety and greater transparency and sharing of data on working hours across platforms are critical.

Sociotechnical systems thinking enables a multi-level work and work context analysis by considering the organization's environment. As seen in our study, participation in PMW may be transient, and individuals may also be members of more than one organization at a given time. Hence, there is a need to acknowledge transitory organizational memberships (Pasmore et al., 2019). Moreover, the triadic relations and relegated responsibility to individuals in PMW call for broadening our lenses so that our concept of work systems includes individuals at the fringes of organizations (Cross & Swart, 2021; Winby & Mohrman, 2018). These actors are likely to be in greater need of social and workplace protection but fall outside safety management paradigms delimited by traditional boundaries of the workplace and employment relations.

4.2. PMW and safety culture

Safety culture has been addressed almost exclusively within a traditional work context in safety science. This is not surprising, as 'the parent concept' is organizational culture (Antonsen, 2009a), a concept that has been applied mainly to work organizations. Thus, when some central aspects of the organization dissolve, safety culture might lose relevance and explanatory power.

We proposed that in PMW, the applicability of management approaches to safety culture is significantly reduced, as the work is coordinated and controlled by the technology. The empirical findings correspond to our proposition. Platform relegation of responsibility to the individual is one aspect of the organization's dissolution. To some extent, PMW, from the workers' perspective, means being your own boss and being responsible for your own safety. Within the functionalist perspective on culture, safety culture development is related to management activities, such as providing resources and tools for safety, solving goal conflicts, and involving employees in safety issues. When the responsibility for safety is relegated in platform companies, prescriptive models like Hudson's (2007) cultural ladder and Reason's (1997) engineering of a safety culture become of limited relevance. Management in its traditional form and the employer-employee relationship no longer apply.

We also proposed that the opportunities for interaction between platform workers are reduced, and consequently that the possibility for

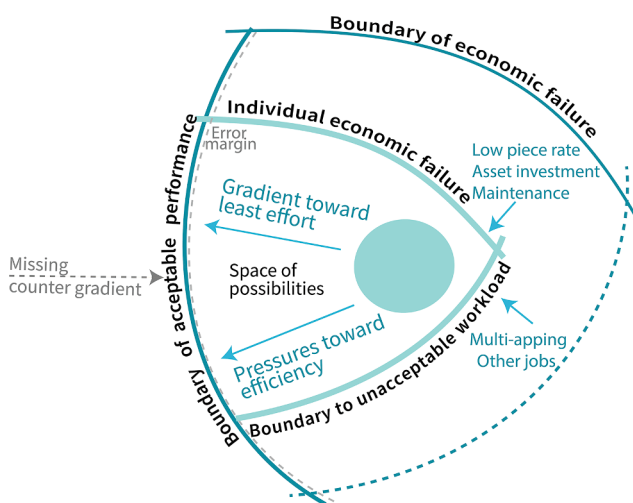


Fig. 5. Rasmussen's migration model adapted to platform-mediated work.

cultural development is also reduced. A necessary condition for safety culture development is interaction and communication between individuals, so that *shared* values, norms, and perceptions of reality can develop. The platform workers report that they have limited opportunities to interact. In line with our proposition, couriers have no common physical workspace, and their main line of communication when problems arise is the dispatcher.

Although the company receives customer feedback, it may not be conveyed to the courier. Several informants also complain about poor management communication and 'being kept in the dark.' App descriptions from the workers indicate features of algorithmic management with unclear logic behind performance calculations. Such a system rewards blind compliance to the App and provides a breeding ground for competitive and individualistic behavior.

A general finding from the interviews is that there is limited communication between couriers, and to a large extent, one-way communication between couriers and the company. The functional models on safety culture tend to emphasize communication. Hudson's (2007) model highlights communication as key to developing trust and 'climbing up the cultural ladder.' The importance of communication and feedback is also highlighted by Reason (1997).

Behind PMW lies a business model designed to reduce interaction between individual workers and the company. The responsibility that rests on the employer in traditional ways of organizing work is relegated to the individual worker. Such a consignment makes functional models on safety culture less relevant for analyzing PMW.

There are still some symbols that could foster a perception of community among the couriers. They usually wear an easily recognizable uniform. Also, the App gives some common guidelines and formats for communication. Such factors could provide a basis for group identity, even if the high turnover among the couriers makes it reasonable to assume that it is fragile and unstable. However, we observed some sense of community in informal online forums such as WhatsApp and Slack, where experiences on work and the companies were exchanged.

Interpretive perspectives of safety culture might thus be better suited for studying PMW. According to Smircich (1983), such perspectives are grounded in anthropological approaches to culture, in essence viewing cultural development as a bottom-up process. Culture is used as a root metaphor for the organization, i.e., something that an organization is (rather than *has* in the functional view). For instance, the symbolic perspective sees cultures as systems of shared symbols and meanings. Analyzing culture involves interpreting such symbols and their underlying themes. The cognitive perspective involves seeing cultures as distinct systems of shared cognition, knowledge, and beliefs. The cultural analysis then explores the members' world views and common logic and rules valid in a community.

Thus, culture as a concept is interesting as an analytical concept, but more in a descriptive rather than normative way. What characterizes platform worker communities as cultures? Are there any bottom-up constructed common beliefs and world views developing in informal arenas that have implications for safety? To answer such questions will require ethnographic research strategies and anthropological approaches to culture. Our interviews and observations point toward some elements of a community of practice among platform workers, where they, primarily online, share experiences among their peers. This can be seen as a kernel that could improve their work situation. If we look at ethnographic literature, there are some similarities to be seen with Orr's (1996) copy machine maintenance workers, exchanging experience through radios, and Palsson and Helgason (1998) fishing boat captains. Both are examples of communities of practitioners not working physically together but still sharing experiences. The online communities we observed were not as developed as these examples but could indicate that there might be a way forward, e.g., for unions or authorities to foster a more cultural or practice-oriented community among the workers.

5. Conclusion

This paper has demonstrated that influential organizational perspectives in safety science have the traditional organization as their context and the resulting limitations necessitate some adaptations to emerging work arrangements such as PMW. As technology further enables the performance of functions, network-based ways of organizing work will be more common. Platform-mediated work is an emerging work arrangement that breaks with the logic of dyadic employer-employee relations and confronts established views on the monolithic concept of organizations at the heart of safety science research.

Applying sociotechnical systems thinking, we underscored the limitations of the organization's safety management system, which does not include independent workers. Using the migration model, we provided insight into two-sided markets where expanding markets create an oversupply of highly dispersed workers governed by algorithmic controls and face financial risks traditionally belonging to the firm and a more compounded concept of workload. Safety management systems and safety research need to include independent contractors with loose ties to the organizations, especially those who perform PMW due to a lack of alternatives. These individuals may be less capable of balancing safety with other goals and need additional safety nets in the absence of an employer. Although STS enables multi-level analysis and considers the work system's environment, we propose a further broadening of our lenses to capture the granularities existing within the ecosystem.

As organizational boundaries dissolve, responsibility for risks incurred in their operations may also dissolve. PMW is part of the growing trend in the outsourcing of activities as well as safety management to independent contractors. Airline companies, health services, and other industries are a few examples of the splintering of organizations. Thus, other actors such as policymakers, labor institutions, and non-governmental organizations may need to address issues that emerge within the work ecosystem explicitly. If platform companies are unwilling to take on this responsibility, how will it be distributed? In most cases, leaving it to individual platform workers exposed to conflicting pressures is not a viable solution. Both nationally and internationally, unions, NGOs, and public agencies need to find ways to address HSE issues and the social protection of these groups.

Accelerated by technology, the organization's continued fragmentation confronts us with the relevance of functional views on safety culture and communities of practice within its boundaries. Our study indicates that functionalist safety culture models and approaches may have limited applicability in work settings where infrastructures constrain social relations and social ties and interactions are transitory, but interpretive approaches to culture are interesting to pursue.

Still, technology also offers avenues for studying safety in PMW. In the absence of a workplace, observing social interactions and communities of practice may require specific forms of ethnographic studies, such as netnography (Kozinets, 2010). Safety science can potentially contribute to investigating the potential for technoregulation (Lettieri et al., 2019; Pagallo & Durante, 2016) and universal social protection (Dijkhoff, 2019), as well as coming up with ways to enrich the safety regulatory toolbox through digital technology. Though legally challenging given the platform providers' secretive business models, one such possibility is to draw on the extensive amounts of data collected by the apps regulating the PMW and possibly utilize the information infrastructure to implement better worker protection. Safety science researchers can also investigate risk governance beyond national borders and provide foundations for developing holistic policies to protect workers in a fissuring workplace.

Developing safety theories and addressing issues at the nexus between humans, technology, organizations, and society will benefit from broader sociotechnical systems thinking that includes independent contractors operating outside the organizational boundaries. By focusing on humans, regardless of membership and spatial distribution, we can truly address contemporary work issues and move towards the

goal of safety in 'all fields of human activity' (Boustras et al., 2020). While safety science can contribute to alleviating some of the downsides or symptoms of the platform economy for the workers in the most precarious situations, the main tasks lie with authorities and regulators to ensure more general sustainability of the work situation and lives of the platform workers.

CRedit authorship contribution statement

Marie Nilsen: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Trond Kongsvik:** Supervision, Conceptualization, Methodology, Investigation, Validation, Writing – original draft, Writing – review & editing. **Petter Grytten Almklov:** Conceptualization, Investigation, Validation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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