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Collaboration, Workplace Practice Adoption, and Performance: Evidence from a Field Experiment

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Abstract. Many performance-enhancing workplace practices require collaboration between managers and workers for successful adoption. However, managers and workers often have diverging incentives and misunderstandings regarding what needs to be done, impeding collaboration. We conduct a field experiment involving 12,761 small- and medium-sized firms, encouraging collaboration between owners/managers and workers on workplace safety. We find that the treatment increases safety training and reduces the rate and severity of accidents. Further, firms achieve these safety improvements without an increase in the number of workers. We explore heterogeneous treatment effects and find the following: At the managerial level, managers informed about safety yield stronger results; at the firm level, pre-existing intermediate levels of safety practices, low supervisory span of control, and low worker turnover enhance the effectiveness of the collaboration treatment; and at the environmental level, low market competition strengthens the treatment's impact. Overall, we provide evidence on the importance of manager-worker collaboration and its contingencies for practice adoption and performance.

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1. Introduction

Scholars in strategy and economics have long grappled with a central question: Why do practices that improve firm performance not diffuse more widely (Bartelsman and Doms 2000, Hsieh and Klenow 2009, Syverson 2011, Bloom et al. 2013). An important reason is that many firms fail to generate conditions conducive to collaboration between the firm or manager and the workers (Ichniowski et al. 1997, Helper and Henderson 2014, Puranam 2018). Collaboration is the combination of coordination—the alignment of actions—and cooperation—the alignment of incentives (Gulati et al. 2012, Kretschmer and Vanneste 2017, Puranam 2018) and is often required for adopting workplace practices (Gibbons and Henderson 2012a). However, achieving collaboration for workplace practices is challenging because managers and workers often have misunderstandings of what to do and diverging incentives. This results in the all-too-frequent situation where the manager simply "cannot get the organization to get it done" (Gibbons and Henderson 2012a, p. 1350).

The existing literature has primarily focused on formal drivers of manager-worker collaboration: the use of authority (Faraj and Sproull 2000, Roels and Corbett 2024), delegation (Aghion and Tirole 1997), human resource systems (Alchian and Demsetz 1972, Holmstrom 1982, Aoki 1988, McAfee and McMillan 1991, Ichniowski et al. 1997), workers' voice and participation (Boudreau 2024), and incentive systems (Gibbs et al. 2004, Gillan et al. 2009, Lazear and Oyer 2012). However, implementing workplace practices involves numerous contextual details and nuances that can limit

the effectiveness of formal mechanisms (Gibbons and Henderson 2012a). Thus, a growing body of research suggests that informal factors, such as organizational culture (Blader et al. 2020), trust (Ichniowski et al. 1997), managerial soft skills (Hoffman and Tadelis 2021), social capital (Gant et al. 2002), and relational contracts (Gibbons and Henderson 2012a), are critical for implementing workplace practices. Most empirical research in this domain relies on case studies (Helper and Henderson 2014), laboratory experiments (Gibbons et al. 2023), or detailed empirical analyses within individual firms (Ichniowski et al. 1997, Gant et al. 2002, Blader et al. 2020, Hoffman and Tadelis 2021).[1] To date, however, large-scale empirical research on collaboration in workplace practice adoption and its impact on performance is absent.

This study tackles this gap by examining the impact of collaboration between managers and workers on adopting workplace practices and firm performance through a field experiment involving 12,761 small and medium enterprises (SMEs) in Chile (defined in our setting as firms with up to 50 workers). Our experimental intervention, which we detail below, targets the informal aspects of collaboration by fostering a shared understanding of required actions (coordination) and emphasizing the importance of teamwork (cooperation) between the SME owners or chief executive officers (CEOs) and their workers. For ease of discussion, we refer to the owner or CEO of the SMEs as the "manager."

The context of this study is workplace safety practices. Workplace accidents are costly and can significantly influence firms' financial performance (Gray 1987, Viscusi and Aldy 2003, Yakovlev and Sobel 2010, Pagell et al. 2014, Gowrisankaran et al. 2015, Cohn and Wardlaw 2016). Many firms fail to implement safety practices that could reduce accident rates (Pouliakas and Theodossiou 2013). A recent review on the adoption of workplace safety practices highlights the importance of collaboration between managers and workers (da Silva and Amaral 2019). Effective safety implementation requires managers to provide workers with the relevant information, training, procedures, and resources, and not punish workers when safety practices reduce organizational efficiency. In turn, workers must actively engage with safety practices (not in a ritualistic, perfunctory way), assist colleagues, and reciprocate with effort in their daily tasks.

In manager-worker interactions, there are barriers to collaboration. Workers may prefer that the firm invests in safety without reciprocating with effort or helping colleagues or may exploit safety measures to justify lower productivity. Anticipating this behavior, managers' cooperation becomes conditional on worker's reciprocity (Fehr and Gächter 2000, Englmaier and Leider 2012). Managers may distrust workers and refrain from investing in safety, even though collaborative outcomes are frequently mutually beneficial.

We conducted a large-scale randomized control trial (RCT) in partnership with the "Asociación Chilena de Seguridad" (ACHS), the largest occupational safety and health (OSH) services organization in Chile, whose affiliated firms employ 40% of the country's workforce. The RCT involved 12,761 SMEs participating in ACHS's "SME community" prevention program. The sample is broadly representative of Chilean SMEs. As part of this program, ACHS safety experts visited roughly 1/12th of their 31,500 affiliated SME firms each month. For each visit, the ACHS collects firm-specific information and sends a lengthy, customized, but difficult-to-understand, report that includes an assessment of safety conditions and a nonmandatory prevention plan tailored to the firm. Our experimental intervention consists of a collaboration treatment and a pure control group, with a cross-randomization of information treatments directed at managers. Firms were assigned to treatment or control using a stratified randomization of the firms visited each month over five consecutive months starting in March of 2013. The intervention was delivered in the month after the visit.

In the collaboration treatment, we sent a letter to SME managers emphasizing the importance of teamwork between managers and workers for workplace safety and inviting them to share a set of pamphlets with their workers. The pamphlets emphasized teamwork, invited worker engagement in safety practices, informed workers about the recent visit by ACHS and the safety plan provided to their manager, and highlighted the main safety risks at the firm along with practical measures for improving safety, such as links to ACHS training. By encouraging managers to share the pamphlets and emphasizing teamwork, the intervention tackled the cooperation aspect of collaboration. By informing workers about the safety plan and risk-relevant prevention measures, the intervention created shared actionable knowledge between managers and workers, thereby addressing the coordination aspect of collaboration.

The intent-to-treat (ITT) analysis indicates that the collaboration treatment increased training and resulted in a significant sustained reduction in workplace accidents. For training, the main prevention practice in our setting, there was an immediate and substantial increase in classes addressing the specific risks highlighted by the intervention. Additionally, 12 and 15 months after treatment, we observed increases in general training across all ACHS courses. For accidents, the treatment group experienced a 15% reduction per worker per year compared with the pure control group, with effects persisting 6, 12, and 15 months posttreatment. These results are robust to the inclusion of controls and different model specifications, increasing

with dosage (20 pamphlets were distributed to all firms; therefore, stronger effects are expected in firms with fewer than 20 workers than in those with more than 20), and also impacted the intensive margin: Accident severity decreased by roughly 10% at 12 and 15 months. Simple calculations suggest that a substantial portion, but not all, of the reduction in accidents is attributable to increased training.

We then conduct an exploratory analysis of heterogeneous treatment effects at the managerial, organizational, and environmental levels. In particular, we expect the intervention to have a greater impact when managers are informed about firm-specific safety issues. We also anticipate that a firm's initial safety practice position will affect the costs of collaboration; that its organizational structure, specifically greater supervision, may enable richer manager-worker interaction and facilitate collaboration; and that high baseline worker rotation may impede collaboration. Finally, we anticipate that high market competition may undermine collaboration by reducing the future value of manager-worker relationships and increasing incentives to defect. We summarize these in turn.

To explore the manager's role in manager-worker collaboration, we implemented additional treatments. Orthogonal to the collaboration treatment, managers were randomly assigned to receive one of three emails, each targeting a managerial limitation highlighted by Gibbons and Henderson (2012a): (1) perception email: compared the firm's accident record to its sector, alerting the manager to underperformance; (2) inspiration email: provided a link to a two-page summary of the firm-specific but difficult-to-understand[2] prevention plan they had received, clarifying what needs to be done; and (3) motivation email: monetized the firm's accidents and the hidden costs of unsafe workplaces, thereby motivating managers to act. Because of limited statistical power (discussed in detail later), we combine these into a single treatment, interpreted as "manager exposure to firm-specific workplace safety information." The results indicate that the effect of the collaboration treatment on reducing accidents was concentrated among managers exposed to firm-specific safety information. Although this finding should be interpreted with caution, it suggests that managerial awareness is critical for enhancing the effectiveness of manager-worker collaboration.[3]

Regarding the initial safety position of SMEs, we find that the impact of the collaboration treatment on accidents is concentrated in firms with partial implementation of safety practices—those that have adopted some, but not all, necessary safety measures. These firms can achieve significant improvements in safety at a relatively low cost. In contrast, firms with low safety levels may encounter high costs or resistance, because many basic but costly practices must be implemented before collaboration is effective, and those with well-established safety practices are already collaborating effectively, rendering the treatment redundant. We provide several converging lines of evidence for this from take-up and moderation analyses, which utilize detailed information on the pretreatment safety levels and practices.

For organizational structure, we use detailed data from the ACHS visit on the number of supervisors in each SME to calculate the average span of control (i.e., workers per supervisor). We find that the impact of collaboration is concentrated in firms with a low span of control, suggesting that in this setting, greater supervisory presence complements informal collaboration. It is possible, for example, that building collaborative relationships requires strong communication channels between the manager and workers. This finding contributes to the literature on whether formal and informal organizational elements are complements or substitutes (Poppo and Zenger 2002, Mayer and Argyres 2004, Bandiera et al. 2005, Ashraf and Bandiera 2018, Akerlof et al. 2020).

To assess baseline worker rotation, we use detailed employment data to measure pretreatment worker turnover and investigate its effects on collaboration. We find that the collaboration treatment is effective only in firms with low rotation; firms with high turnover exhibit no impact. This result aligns with research in human resources, personnel economics, and relational contracting whereby high worker turnover lowers the expected future value of manager-worker relationships, making them less stable and hindering collaboration. This result suggests that our low-cost intervention was ineffective for fostering collaboration in firms where workers turn over more frequently.

With respect to the SME environment, we find that the collaboration treatment is most effective in industry-regions with fewer competitors (excluding the focal firm). Although other explanations may fit this pattern, this result is consistent evidence from the relational contracting literature (McMillan and Woodruff 1999, Macchiavello and Morjaria 2021, Ghani and Reed 2022): In highly competitive environments, parties are more likely to defect from collaboration because "competition—by increasing temptations to deviate and by lowering future relationship values—might destroy valuable relationships" (Macchiavello and Morjaria 2023, p. 16).

Finally, we analyze the treatment's impact on firm employment and find no effect on the number of workers, suggesting that improved safety does not require incurring the extra costs of more personnel.

This study offers two additional contributions beyond providing large-scale, causal evidence on collaboration, practice adoption, and performance, and identifying the conditions that enable collaboration to thrive. First, we contribute to the workplace safety literature in economics by providing evidence of collaboration as a central mechanism for successfully adopting

safety practices. Economics research often attributes the under-provision of safety to uninternalized externalities by firms (i.e., workers bearing a significant portion of costs) and information asymmetries (which firms may exploit) (Pouliakas and Theodossiou 2013). However, the role of manager-worker collaboration has not been discussed, despite its prominence in the safety literature (da Silva and Amaral 2019) and the possibility that collaboration remains important even when externalities and information asymmetries are addressed through regulation. An exception is Boudreau (2024), a study closely related to ours. The author conducted a field experiment examining the impact of an intervention designed to boost OSH committees—a *formal* instance between managers and workers that allows them to work cooperatively and as equals on safety issues—and finds that the intervention increased safety—improved compliance and the presence of safety indicators, and lowered visits to onsite medical clinics—and this is due to better operation of the committees (i.e., increased communication flows). Our study complements Boudreau (2024) by focusing on the *informal* dynamics of manager-worker collaboration.

Second, for policymakers, in addition to the practical implications for improving workplace safety, our paper demonstrates that, although many government programs (e.g., vocational training) are typically directed at or mediated by firm owners/CEOs, it may be more impactful to engage managers and workers simultaneously.

2. Theoretical Background

This section first reviews prior work on the role of collaboration in adopting workplace practices. It then reviews workplace safety and discusses the importance of collaboration for safety practices.

2.1. Collaboration Between the Manager and Workers

Collaboration is defined as "the situation of two or more people working together to create or achieve the same thing."[4] It combines coordination—the alignment of actions (or common understanding)—and cooperation—the willingness to put effort toward a common goal (Gulati et al. 2012, Kretschmer and Vanneste 2017, Puranam 2018). The notion of parties working together to achieve a common goal is prevalent in the collaboration literature (Salvato et al. 2017).[5]

Collaboration between managers and workers is often difficult to achieve due to misaligned incentives, which hinder cooperation, and to well-intentioned misunderstandings about actions, which complicate coordination. Although formal contractual approaches can sometimes promote collaboration, the adoption and implementation of new practices often involve subtleties and nuances that make formal mechanisms ineffective (Gibbons and Henderson 2012a). As a result, managers must find ways to foster collaboration through informal noncontractual methods.

This often entails building a culture of cooperation and establishing behavioral norms. Studies have shown that building collaboration can involve the role of leaders as exemplars and enforcers (Barnard 1968, Schein 2010, Hermalin 2012, Kosfeld and Rustagi 2015); workers' identification with the organization (Akerlof and Kranton 2005); setting corporate culture and purpose (Gartenberg et al. 2019, Grennan 2019); and relational contracts that regulate what to do, when and how to do it, who does what, and rely on the expected future value of the relationship for parties to cooperate (Macleod and Malcomson 1989; Levin 2003; Gibbons and Henderson 2012a, b; Helper and Henderson 2014; Gibbons et al. 2023).[6]

2.2. Workplace Safety in Firms

Workplace safety is important for both firms and workers. According to the International Labour Organization (ILO), work-related fatalities accounted for 5%–7% of all global deaths in 2019, with more than two million work-related deaths and more than 300 million workplace accidents annually (Wadsworth and Walters 2019). Pouliakas and Theodossiou (2013) cite ILO estimates indicating that the economic cost of work-related accidents and diseases is as high as 4% of global gross domestic product (GDP). In our context, during the sample period, 1 in 20 workers experienced a workplace accident each year, resulting in an average loss of 16 workdays per incident.

We provide a high-level summary of the incentives underlying workplace safety, drawing heavily on the review by Pouliakas and Theodossiou (2013). This will contextualize the role of collaboration discussed in Section 2.3.

First, in unregulated markets, firms do not internalize all costs associated with unsafe workplaces, as workers bear the long-term consequences of injuries and diseases. To address this, insurance-based regulations have been implemented globally, requiring firms to pay premiums that fund safety-related expenses, such as medical treatment, compensations, and pensions. As in our setting, these premiums typically increase with a firm's workplace accident record. In principle, this system would make firms internalize safety externalities and incentivize them to implement appropriate measures. However, Pouliakas and Theodossiou (2013) present evidence that, despite such regulations, workers still bear a significant portion of the costs, especially in low- and middle-income countries where compensation is limited and health services are inadequate. This is consistent with the situation in Chile (Brahm et al. 2011). Second, it is well documented that insurance can lead to moral hazard. Pouliakas and

Theodossiou (2013) review evidence that workers underinvest in safety due to the expectation of compensation in the event of an accident. Third, asymmetric information problems may persist. Although regulations typically require firms to share safety information with workers (as in our case), firms may fail to comply, withholding or selectively disclosing information with workers (and potential new hires) to avoid additional costs or potential worker turnover.

In summary, despite regulation, firms do not fully internalize externalities, workers may engage in moral hazard, and firms may exploit informational advantages. As a result, both firms' incentives to invest in safety and workers' incentives to engage in safe behavior are weakened.

2.3. Collaboration in Workplace Safety

Although the extant economics-oriented literature has focused on the individual incentives of firms and workers, as summarized by Pouliakas and Theodossiou (2013), it overlooks collaboration between firms and workers in adopting and implementing safety practices. In the spirit of Gibbons and Henderson (2012a), adoption of safety practices requires collaboration rooted in subtle, context-specific interactions in a social dilemma situation—collective collaboration tends to yield optimal outcomes, yet each party is tempted to defect. Thus, achieving workplace safety may remain challenging, even when regulations address externalities, moral hazard, and information asymmetries. Boudreau (2024) provides relevant evidence through a field experiment that randomized the enforcement of the formal institution of "OSH committees"—a mandated manager-worker committee for communication, coordination, and cooperation on workplace safety practices. The intervention improved safety—it increased compliance with safety rules, enhanced the presence of safety indicators, and reduced the visits to onsite medical clinics—due to improved operation of the committees (i.e., increased communication flows).

In contrast, the workplace safety literature provides ample case evidence that workplace safety entails a range of organizational practices that hinge on collaboration between managers and workers in a context of incentive misalignment and coordination frictions, and thus, disengagement and riskier workplaces are likely if collaboration is not sustained by formal or informal means (Michael et al. 2005, Wirth and Sigurdsson 2008, Battaglia et al. 2015, Ghahramani 2016, Mohammadfam et al. 2016, da Silva and Amaral 2019, He et al. 2021).

Table 1 outlines the collaborative roles for each party in workplace safety. Managers are responsible for investing in safety (e.g., purchasing high-quality personal protective equipment (PPE), maintaining equipment, sending workers to training, hiring safety experts, etc.), sharing safety information with workers, and pursuing productivity through safe practices like preventive maintenance and design of safe procedures (Pagell et al. 2014, Johnston et al. 2020). Workers are expected to comply with safety guidelines, such as by wearing PPE, attending training, applying acquired knowledge, and engaging in organizational citizenship behaviors, including helping colleagues with safety and reciprocating better working conditions with increased effort.

Not collaborating for managers may take the subtle form of "performative" but ineffective actions, such as investing in safety while still prioritizing productivity through unsafe practices like increasing production line speeds. Workers may not collaborate and resist safety measures, sometimes responding with hostility (Zeng et al. 2007). This can include avoiding uncomfortable PPE, bypassing safety procedures to save time or effort, ignoring new practices that disrupt routines, or failing to comply when practices conflict with their interests. Additionally, workers may reduce effort in retaliation for unsafe working conditions (Michael et al. 2005).

Manager-worker collaboration can be attained through goodwill, for example, when managers and workers care about each other or are encouraged to adopt a team mindset. It can also be achieved via mutual convenience, as in relational contracting (see Online Appendix A.3). We remain agnostic, a priori, about which mechanism is operating.

Collaboration can be difficult to achieve due to misaligned incentives (cooperation problems) and misaligned actions (coordination problems). We next discuss how these problems manifest in workplace safety.

2.3.1. Cooperation Problems. In general, managers have the resources and primary responsibility to ensure workplace safety, as mandated by regulations worldwide. However, managers may be reluctant to invest in PPE, new equipment, or safety practices if they believe workers will not fully comply with safety guidelines, assist colleagues, or reciprocate with increased safety effort.

Workers might not cooperate because these actions impose costs that are not fully offset by benefits. For example, helping colleagues or reciprocating efforts may not be rewarded with higher compensation or recognition. Further, wages may decrease if safety is treated as a valued workplace amenity priced into the labor market (Viscusi and Aldy 2003, Lavetti 2020) or if safety practices reduce productivity; in both cases, the worker will be reluctant to engage with safety initiatives. Workers' overconfidence or hyperbolic discounting is also problematic (Pouliakas and Theodossiou 2013) because it causes them to overweight immediate safety costs (e.g., time, learning to use PPE, changing tasks and routines) and to undervalue safety benefits. Finally, when a worker adopts safety practices, they

Table 1. Manager and Workers Collaboration

	Manager (firm)	Workers
Collaboration	(i) Investing in safety (e.g., buying high-quality PPE, updating equipment, sending workers to training, hiring orcontracting safety experts, etc.), (ii) sharing safety-related information with workers (workplace risks, prevention strategies, and available resources), (iii) pursuing productivity through safe means (e.g., advance planning, proactive equipment maintenance, high-performance work systems).	(i) Complying with safety guidelines (e.g., wearing PPE, attending training, and adjusting behavior accordingly), (ii) Demonstrating organizational citizenship behaviors, such as helping colleagues with safety and exerting greater effort due to good working conditions.
Non- collaboration	(i) Not investing in safety, (ii) withholding safety-related information from workers (e.g., not sharing available prevention options), (iii) pursuing productivity through practices that may compromise workers' safety (e.g., extending work hours, cutting corners, increasing production line speed).	(i) Not complying with safety guidelines (e.g., not using PPE), (ii) maintaining or reducing effort, especially using inadequate or cumbersome PPE or restrictive safety guidelines as an excuse.

often inadvertently improve their coworkers' safety. Workers may further underinvest in safety if this positive externality is not internalized.

Uncertainty about worker behavior creates a dilemma for managers because it is plausible *that collaboration is not a dominant strategy for the firm*, but *mutual collaboration is the desired outcome*. It is worse for the firm to invest time, effort, and resources in safety without worker collaboration (i.e., firm collaborates, workers defect) than not collaborating in the first place (i.e., both firm and workers defect) because resources are not wasted in the latter scenario; thus, collaboration is pursued only if managers expect that workers will also collaborate.

Regarding mutual collaboration as the desired outcome, the safety literature points to the importance of manager-worker collaboration for realizing productivity gains from investments in safety practices (Das et al. 2008, Longoni et al. 2013, Pagell et al. 2014, da Silva and Amaral 2019, Johnston et al. 2020). In addition to improving worker morale and encouraging effort reciprocation, mutual collaboration enables well-planned safety implementations that also enhance productivity. These include preventive maintenance; the rational addition of rules or protocols (avoiding unnecessary or overly burdensome measures); the adoption of safety practices that streamline processes; the use of lean and quality management techniques; and the empowerment workers through high-performance work systems (ibid). In the absence of worker collaboration, managers will instead (rationally) seek productivity by increasing production line speed, elevating safety risks (a defect-defect scenario), rather than attempting safe and productivity-enhancing techniques that require collaboration and would otherwise be ineffective if workers do not participate (the firm collaborates-workers defect scenario).

2.3.2. Coordination Problems. Coordination issues compound the problem of cooperation. Manager and worker safety actions are often subtle, context specific, and subject to interpretation, resulting in misalignment even when both parties cooperate. For manager actions, both parties may lack a common understanding of "safe productivity" (e.g., whether it includes working extra hours to meet deadlines) or clarity on which investments in PPE, equipment, or safety practices are genuinely effective versus merely symbolic or perfunctory (e.g., referencing safety guidelines in meetings while disregarding them in practice). Similarly, for worker actions: The standards for proper use of PPE are not always clear (e.g., what exceptions are acceptable), nor is it always evident whether workers are investing effort or whether safety measures are impeding effort and productivity.

3. Context

3.1. Workplace Safety in Chile

In Chile, worker safety and accident compensation are managed by private nonprofit institutions known as "mutuales de seguridad," established under Ley # 16.744 in 1968.[7] The Chilean system integrates all OSH services: prevention (e.g., training), medical treatment, and compensation for accidents. The system covers work and commuting accidents. It operates as an insurance system funded by firms through monthly premiums ranging from 0.95% to a maximum of 6.8% of payroll. Firms pay a base rate of 0.95% of the monthly taxable wage bill, an additional 0%–3.4% based on industrial sector, and 0%–2.4% according to the firms' accident record, adjusted every two years. Training is the most important prevention activity offered by the mutuales. ACHS provides a wide range of safety courses, typically lasting at least eight hours per participant, accommodating 10–20

participants, with 95% training conducted onsite (Brahm and Singer 2013).[8]

Chilean firms regularly receive information on their accident level from their mutual. Because premiums are updated every two years, firms are formally notified of their accident records at least biennially. By law, firms must disclose their risk levels to workers and establish safety committees (in large firms) or appoint safety representatives (in small firms) to disseminate safety information and represent workers. However, compliance is low; only around 19% of firms in our sample meet this requirement (see Section 5.1). Although mutuales may monitor compliance, they lack enforcement authority and do not liaise with the enforcement body, which is the Ministry of Labor.

In general, mutuales serve a consultative and remedial role, providing healthcare and compensation when accidents occur, and offering preventive advice. They do not have legal authority to monitor, order, or enforce workplace safety regulations or norms; this legal responsibility lies with the Ministry of Labor. This is widely understood by Chilean firms.

3.2. SME Community Program

In 2012, the ACHS, Chile's largest mutual with over half of the market share, launched the SME Community Program to deliver prevention strategies to approximately 31,500 SMEs. Firms are classified as SMEs biannually, in January and July, based on an average workforce of fewer than 50 employees over the previous year.[9] Each firm receives an annual visit from an ACHS expert, with the ACHS making roughly 2,500 visits per month. During these visits, the expert engages with managers and assesses the firm's safety practices. By March 2013, the program was well established, with all SMEs having received at least one visit.

Within days of the expert visit, the manager receives a detailed "prevention plan" via email. This document, typically 30–40 pages and legalistic in style, includes four sections: (1) an assessment of compliance with basic safety regulations; (2) an evaluation of potential emergencies (e.g., flooding, fire, etc.); (3) an analysis of workplace risks (e.g., working at heights, underwater, etc.); and (4) a proposed prevention plan (e.g., specific training courses). ACHS also provides safety signs and posters for display in key areas when needed. Additionally, ACHS offers a dedicated SME website with prevention and risk information, an e-learning platform, and a call center for support. Ongoing contact with the SMEs is maintained through check-in calls, newsletters, and email campaigns announcing training courses.

4. Field Experiment

Our experimental intervention employed a stratified double randomization design, including a pure control group, three email treatments, and a collaboration treatment. The collaboration treatment was randomized and delivered by physical mail to the owner/CEO (henceforth, "manager") and the SME workers. Separately, we orthogonally randomized three emails sent to SME managers, each designed to expose managers to relevant firm-specific safety information.

Two procedural clarifications are necessary regarding the presentation of our results. First, the primary focus of this study is the impact of the collaboration treatment on practice adoption and performance. The email treatments serve to *explore* whether exposing the manager to safety information moderates the effects of the collaboration treatment. Our orthogonal design makes this interaction fully experimental.[10] Second, as detailed below, the email opening rate is not high, resulting in low take-up and statistical power. To reduce (but not eliminate) this problem and thus be able to explore the interaction, we aggregate all email treatments into one single treatment of "any email." We provide more details below, including how to interpret this aggregated treatment (we also present the disaggregated results in the Online Appendix).

Our sample for the experiment consists of all 12,761 firms visited by the ACHS under the SME Community Program between March and July of 2013. These firms represent a wide range of sectors, with the largest being real estate (18%), commerce (15%), manufacturing (14%), and agriculture (13%). They are geographically dispersed, although 54% are in the central region, where most of the economic activity in Chile is concentrated. Thus, given that ACHS serves approximately 40% of all firms in Chile, with an even distribution across sectors, and that the SME program visits are also evenly distributed across sectors and geographies each month, our sample broadly represents the Chilean SME population. During the experiment, we worked exclusively with the head of the SME Community Program and his assistant to avoid knowledge of the experiment elsewhere in ACHS until the results were collected and analyzed.

4.1. Collaboration Treatment

For the collaboration treatment, we sent via physical mail a cover letter and 20 pamphlets to each treated firm's manager (illustrated in Figures A.1 and A.2 in the Online Appendix; we present the original Spanish version on the left and its English translation on the right for all treatments). This material was sent by certified mail in the month following the ACHS expert's visit.

The cover letter emphasized the importance of collaboration between workers and the firm for workplace safety, and it prompted the manager to distribute the pamphlets to workers or display them prominently within the firm. Collaboration is emphasized at three

primary points in the letter: (i) the first paragraph states "We also know that effective prevention of accidents is accomplished through a collaborative effort among all members of the firm"; (ii) the third paragraph states "We invite you to distribute this information among your workers; this will contribute to teamwork around prevention"; and (iii) the final paragraph states "We hope to keep on helping you in the prevention efforts, which is everybody's work."

The pamphlet has three main instances that prompt collaboration: (i) the title of the pamphlet reads in large, bold text "Workplace safety is everybody's work"; (ii) the first paragraph states "Be a part of everybody's effort to make your workplace a safer place!"; and (iii) the last paragraph states "We invite you to participate in the prevention of accidents in your firm." In addition, the middle section informs workers that an ACHS expert visited the firm, provided a prevention plan, and identified the firm's three main risks.[11] The final section invites workers to address these risks and prevent accidents and directs them to the SME community web page with safety tips for each risk and trainings offered, along with email and phone contact information for further support.

Aligned with prior research, our definition of collaboration includes both cooperation and coordination. The treatment prompts both these elements as follows. Cooperation is promoted by (i) placing both the manager and the workers in a teamwork mindset, (ii) the manager sharing the pamphlets with workers, signaling their cooperative intent to workers, and (iii) informing workers about the firm's prevention plan, which increases the credibility of their commitment to safety and motivates managers to execute the plan (because it increases the reputational cost of not implementing the plan). Coordination is promoted by (i) the manager sharing information about the prevention plan and resources, which generates a common understanding of the actions to pursue; and (ii) providing detailed information about risks and associated resources on the SME community web page (advice and training), which helps both parties to understand how to implement the necessary actions.[12]

4.2. Email Treatments to Managers

To study managerial-level limitations of workplace practice adoption and their interaction with the collaboration treatment, we designed three email interventions that target the barriers to the adoption of practices described and popularized by Gibbons and Henderson (2012a): "perception"—managers may be unaware that their firms are lagging and therefore fail to adopt practices; "inspiration"—managers may be uncertain about which practices are appropriate; and "motivation"—managers may lack sufficient incentives to implement change. For the analysis, we group these emails into a single treatment category, "any email," and report the corresponding results in the main text. The Online Appendix provides the results for each individual email intervention.

4.2.1. Perception. The first email treated the manager's perception of their firm's safety performance relative to peers. It contained information comparing the firm's 2012 accident rate with its sector average accident rate at the two-digit level of the International Standard Industrial Classification (see Figure A.3 in the Online Appendix).

4.2.2. Inspiration. The second email addresses managers' understanding of what to do to improve safety. It contained a link to download two pages that were extracted from the postvisit official document, which was originally 30–40 pages (Figure A.4 in the Online Appendix). These two pages were extracted because they contain the ACHS' concrete guidance on what to do. The first page shows the firm's compliance with each legal requirement and its overall compliance percentage (see Figure A.5 in the Online Appendix). The second page lists the firm's safety issues in order of importance, followed by a checklist of actions and their frequency to address each issue (see Figure A.6 in the Online Appendix).

4.2.3. Motivation. The third treatment addresses motivation by making the costs of accidents salient. It quantifies the financial savings an average SME in the firm's sector could achieve by reducing accidents from the 2012 sector average to zero,[13] as well as the number of lost workdays experienced by an average SME in the firm's sector in 2012, and emphasizes that the "hidden costs" of accidents may exceed the insurance premium (see Figure A.7 in the Online Appendix). We did not include an estimate of the compensating wage differential (Viscusi and Aldy 2003, Lavetti 2020) because (i) applying hedonic estimates from other countries was inappropriate given the lack of evidence for Chile and (ii) the ACHS had reservations about "monetizing" accidents, which is also why we used sector-level rather than firm-level data.

4.2.4. Any Email. We computed a binary variable equal to one if the manager received any of the email treatments described above, and zero otherwise. We interpret the aggregated treatment as "manager exposure to firm-specific workplace safety information."

4.3. Randomization Procedure, Treatment Statistics, Take-up, and Statistical Power

We randomly assigned interventions to firms each month from March to July 2013, based on the prior month's list of roughly 2,500 SMEs visited by ACHS. The

randomization procedure is depicted in Figure A.8 in the Online Appendix. The experiment was registered in the American Economic Association (AEA) RCT registry.[14]

We assigned the collaboration and the email treatments using a cross-randomization design, enabling estimation of both main and interaction effects. The perception and motivation treatments required firm information from the prior year. We separated firms based on their inclusion in the ACHS database in 2012, because some firms lacked data due to recent ACHS affiliation. For firms not in the 2012 database, half were randomly assigned to receive the inspiration treatment and half to no treatment. Firms present in the 2012 data were randomly assigned, stratified by region, to one of the three email treatments or a control group, with each email treatment assigned to 22% of the firms and the control group to 34%. We loaded customized email data on a spreadsheet and used an automated system to email via MailChimp. Next, we stratified by email assignment and randomly selected 1,000 firms per month to receive the collaboration treatment. Because of budget constraints, fewer firms received the collaboration treatment than the email treatments. The collaboration and email treatments were implemented contemporaneously (but assigned to emails first, followed by orthogonal assignment to the collaboration treatment).

Table 2 summarizes the sample sizes for each treatment combination. Of the 12,761 firms, roughly 5,000 were assigned to the collaboration treatment. Around 2,900, 2,700, and 2,500 firms received the inspiration, perception, and motivation email treatments, respectively. In total, about 8,000 firms received one of the emails, of which 1,900 were opened. Among the 5,000 firms that received the collaboration treatment, 3,200 also received an email intervention.

Regarding "take-up," Table 2 reports an overall email opening rate of approximately 24%: 22% for perception, 19% for motivation, and 31% for inspiration. Although these rates are typical for email interventions, they reduce the statistical power of our experiment despite the large sample size. For the collaboration treatment, we conducted a small-scale survey of a random subsample, reaching 297 of 560 selected firms that were treated. Of these, 44% remembered receiving the package, and 84% of those reported distributing the pamphlets. Responding firms are generally similar to nonrespondents, at least in terms of accidents (see first two columns of Table A.1 in the Online Appendix), although they are slightly larger. This suggests that the take-up rate for the collaboration treatment is at least 37% (=84% × 44%),[15] which is reasonable for this type of intervention and translates to approximately 1,900 SMEs. Given the average firm size of 14.0 employees, our experiment likely reached 26,600 employees.

Our initial power calculations assumed a 50% take-up rate. We revised these calculations using actual take-up data. Assuming a significance level of 0.05, a power of 0.8, a correlation between the baseline and the follow-up of 0.4, and no attrition, the minimum detectable effect (MDE) on accident rates was approximately 0.13 standard deviations for the collaboration treatment (0.4 take-up). For the email treatments, the MDE for receiving "any email" is 0.19 standard deviations (0.24 take-up). Analyzing the impact of receiving "any email" rather than individual email treatments improves statistical power.[16] These ranges are reasonable for experiments with firms; the low-cost interventions used here are expected to produce effects in the range of 0.10–0.20 standard deviations. Moreover, the observed take-up rates in our experiment closely align with expectations if such a policy was implemented at scale.

For the interaction analysis, given that the smaller sample size of firms receiving both the collaboration and the "any email" treatments (3,182 firms; Table 2) and the lower take-up rates, the MDE increases to 0.36 standard deviations.[17] Thus, although the interaction analysis is fully experimental (and the interaction's coefficients, if meaningful, tend to be larger than the average treatment effect), we interpret the results with caution and present them as exploratory findings.

5. Data and Empirical Strategy

Because our take-up information is partial, the analysis focuses on ITT estimates rather than treatment-on-the-treated effects. Despite the panel nature of our data, we chose to estimate the postlevel outcome by the firm against its treatment status and control for baseline values of the outcome because this is more efficient than other ways for estimating the treatment impact (McKenzie 2012).[18] We will discuss the difference-in-difference results as a comparison. We estimate the average impact of our collaboration treatment with the following equation:

$$Y_{jst} = \beta_1 Collaboration_{js} + \gamma Y_{js0} + \delta_s + \varepsilon_{jst}. \quad (1)$$

We regress firm j's dependent variable in strata s at time t (Y_{jst}) on the collaboration treatment indicator.[19] As dependent variables, we use *adoption of safety training*, *accident rates*, and *accident severity*. Training, the primary prevention tool for ACHS, captures the adoption of safety practices. Accident rates and severity capture safety performance outcomes. δ_s is a vector of dummies for strata: the assignments to the "perception," "inspiration," and "motivation" treatments, interacting with the ACHS visit-month. We use robust standard errors to account for heteroskedasticity.[20]

Following McKenzie (2012), we control for each firm's historical training and accident rates using Y_{js0}, calculated as the cumulative rates over the 12 months preceding the intervention. Because of random imbalances in some covariates (see the next section), we also

Table 2. Assignment by Email Information and Take-up

Month of visit	Perception treatment			Motivation treatment			Inspiration treatment			Any email			No emails		Collaborative treatment
	N	Opened	Collaborative treatment	*N*	Opened	Collaborative treatment	*N*	Opened	Collaborative treatment	*N*	Opened	Collaborative treatment	*N*	Collaborative treatment	Total
March	555	126	204	563	127	207	556	190	204	1,674	443	615	1,053	387	1,002
April	603	136	211	613	111	215	550	176	193	1,766	423	619	1,100	382	1,001
May	549	142	201	557	111	204	568	130	208	1,674	383	613	1,065	388	1,001
June	470	98	196	479	78	199	520	161	216	1,469	337	611	942	391	1,002
July	506	88	252	271	42	136	672	220	336	1,449	350	724	839	283	1,007
Total	2,683	590	1,064	2,483	469	961	2,866	877	1,157	8,032	1,936	3182	4,999	1,831	5,013

Notes. N refers to the total number of firms visited. "Opened" refers to the number of emails sent to firms that were opened.

control for the firm's degree of compliance with the legal minimum safety provisions and the average number of workers. We do not directly control for month or include month fixed effects because the outcome observation month is perfectly correlated with the treatment month in our strata controls.[21]

We also report regressions analyzing only the "any email" treatments. These regressions have the same set of controls as above; however, the strata are the month for firms not present in 2012 and the month-region interaction for those present in 2012.[22]

5.1. Data Sources, Variables, Descriptive Statistics, and Balance

We collected data from the ACHS on all its affiliated firms every month from January 2011 to December 2014. This firm-month database contains information on the number of workers, safety trainings, reported nonfatal accidents, accident rates, lost workdays, and other firm characteristics (e.g., sector, SME status).[23] Because firms were treated in different months, we recentered the data according to the intervention date. We also obtained detailed information from the expert visits, including each firm's degree of compliance with legal minimum safety provisions (e.g., informing workers about risks, having a safety manual, etc.), identified risks, and name and email of the SME manager, among other information.

To understand the effects on the adoption of workplace practices, we focus on the adoption of safety training. We calculate *Courses per 100 workers* as the cumulative number of completed safety classes per worker at 2, 6, 12, and 15 months after intervention, multiplied by 100.[24] We normalized the time windows on a per-year basis for comparable annual rates.

Our primary dependent variable for safety outcomes is the *Accident Rate*, calculated as the total number of accidents divided by the average number of workers over the relevant period. We construct the cumulative accident rate for each firm over 2, 6, 12, and 15 months after the intervention, and convert these to annual rates by multiplying it by six for the 2-month rate, by two for the 6-month rate, and so on. This normalization ensures comparability across time windows.

Our secondary safety outcome is *Accident Severity*, measured by the number of lost workdays due to accidents. Although the ACHS data include each firm's monthly lost workdays, it does not link specific accidents to lost days. As such, it is difficult to identify a change in trends because some of the current month's lost workdays might have originated several months ago (i.e., there is high autocorrelation). To address this, we implemented an algorithmic correction that assigns lost workdays in month "t" to accidents occurring in the same month and the two preceding months, "$t-1$"

Table 3. Summary Statistics of Preintervention Firm Characteristics and Balance Tests

			Difference between treatment and control			
	N	Mean (standard deviation)	Perception	Inspiration	Motivation	Collaboration
Accident rate ($t-1$ to $t-12$)	12,372	0.048 (0.153)	0.001 (0.003)	0.000 (0.004)	−0.001 (0.003)	0.001 (0.003)
Days lost per accident ($t-1$ to $t-12$)	4,043	15.951 (20.256)	−0.748 (0.784)	1.525* (0.909)	0.513 (0.863)	0.722 (0.662)
Classes per 100 workers ($t-1$ to $t-12$)	12,372	0.319 (3.545)	−0.017 (0.074)	0.046 (0.091)	−0.104 (0.071)	−0.060 (0.054)
Number of workers ($t-1$ to $t-12$)	12,603	14.033 (29.104)	−0.620 (0.614)	−1.295* (0.773)	0.909 (0.589)	0.874 (0.536)
Number of risks	12,761	4.519 (3.479)	−0.031 (0.069)	0.008 (0.069)	−0.052 (0.069)	0.027 (0.058)
Green classification by ACHS	11,612	0.919 (0.273)	−0.001 (0.007)	0.004 (0.007)	0.005 (0.007)	−0.003 (0.005)
Yellow classification by ACHS	11,612	0.077 (0.266)	−0.002 (0.007)	−0.004 (0.007)	−0.004 (0.007)	0.004 (0.005)
Compliance with legal requirements	12,761	0.188 (0.391)	0.004 (0.007)	−0.009 (0.007)	−0.004 (0.007)	0.017*** (0.005)

Notes. The perception, inspiration, and motivation columns report the coefficients of a regression of variable in the first column on the indicator variables for each email treatment in which strata fixed effects are also included. The collaboration column is constructed in an analogous form. Robust standard errors were used in these regressions. No comparison between perception, inspiration and motivation are significant except for the days lost per accident that is significantly larger in "Inspiration" than in "Perception," classes per 100 workers that are larger in "Inspiration" than in "Motivation" (at 10%), and compliance with legal requirements which is smaller in "Inspiration" than in "Perception" (at 10%).
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

and "$t-2$," allowing for a reasonable approximation of each accident's severity.

Table 3 contains the descriptive statistics of the baseline data. There are 12,761 firms in our sample, and some have missing data. On average, firms employed 14 workers and experienced 0.048 accidents per worker in the 12 months preceding the expert visit. The number of accidents is highly skewed toward zero (see Figure A.9 in the Online Appendix); this is reflected in the ACHS's accident-based riskiness classification: 91.9% of firms are classified as green (low risk), 7.7% as yellow (medium risk), and only 0.4% as red (high-risk). Before the intervention, firms averaged only 0.319 prevention classes per 100 workers. Among firms with accidents (roughly one third of firms), the average number of lost workdays per accident is 15.95 (with a standard deviation of 20.26). On average, 4.5 risks were identified during the expert visit, and compliance with minimum legal safety requirements was low at 18.8%.

Table 3 also displays the differences between each treatment and its respective control, accounting for randomization strata. Although there are a few statistically significant differences—in legal compliance and number of workers—nothing suggests that the randomization failed, because some outcomes would be expected to differ at the 10% level by chance. We include these unbalanced pretreatment variables as controls in our regressions to ensure they do not bias the results.

6. Results

6.1. Average Effect of Collaboration on the Adoption of Safety Training

If the collaboration treatment influences the adoption of safety practices, it should be reflected in changes in preventive measures. Although we do not have information on all prevention activities, safety training is the primary preventive measure offered by ACHS, as evidenced by its prominence in the postvisit prevention plans (see Figure A.6 in the Online Appendix).

The first four columns of Table 4 examine the impact of the treatments on the number of training courses per 100 workers per year. Panel A shows that the collaboration treatment has a positive and statistically significant effect, with coefficients of 0.17–0.18, over 50% of the baseline classes per worker reported in Table 3 at months 12 and 15.[25]

Although comparing the collaboration treatment to the "any email" treatment is not our focus (the different medium precludes a clean comparison), we nonetheless report the results for completeness in Panel B of Table 4. The results reveal no effect on training when the manager is exposed to firm-specific safety information.[26]

We next investigate whether the training response is stronger for courses specifically related to the risks prompted by the collaboration treatment. This allows for a cleaner identification of whether the collaboration treatment changed behavior. The collaboration treatment drew attention to specific risks in two ways. First, the pamphlet informed workers that the company had received a prevention plan after the expert visit. This may have prompted managers to revisit the prevention plan, which included among its pages the risks identified at their firm and recommended safety actions, including training for those specific risks (i.e., an "action plan"). Figure A.6 in the Online Appendix provides an example of this action plan (page 2 of the inspiration treatment). In the figure, the risks are displayed in the first column, whereas the corresponding safety actions (including recommended training) are listed in the second and third columns. Because we have firm-level data on both the action plan and training course enrollments, we can link the identified risks to the corresponding training courses.[27] The middle four columns of Table 4 present the intent-to-treat estimates for training courses per 100 workers for only the

Table 4. Impact of Treatments on Courses per 100 Workers, by Type of Classes

	Courses per 100 workers (standardized to a year)				Linked to action plan				Linked to collaboration pamphlet			
	2 months	6 months	12 months	15 months	2 months	6 months	12 months	15 months	2 months	6 months	12 months	15 months
Panel A: Effect of collaboration treatment												
Collaboration	0.212	0.174	0.179**	0.171**	0.077	0.073	0.058**	0.047*	0.200***	0.132***	0.095***	0.079***
	(0.220)	(0.114)	(0.083)	(0.081)	(0.061)	(0.046)	(0.030)	(0.028)	(0.063)	(0.045)	(0.029)	(0.027)
Controls	Strata (month & emails), Courses per 100 workers $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance				Strata (emails & month), Courses per 100 workers $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance				Strata (month & emails), Courses per 100 workers $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance			
Observations	12,085	12,142	12,157	12,159	12,085	12,142	12,157	12,159	12,085	12,142	12,157	12,159
R-square	29.40%	18.60%	12.60%	10.40%	0.60%	0.60%	0.80%	0.70%	0.50%	0.60%	0.70%	0.70%
Panel B: Effect of any email treatment												
Any email	−0.111	−0.069	−0.080	−0.010	0.038	−0.024	−0.014	−0.009	0.028	−0.029	−0.022	−0.018
	(0.253)	(0.125)	(0.085)	(0.080)	(0.057)	(0.046)	(0.030)	(0.028)	(0.055)	(0.044)	(0.029)	(0.027)
Controls	Strata (month, region & presence in 2012), Courses per 100 workers $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance				Strata (month, region & presence in 2012), Accident rate $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance				Strata (month, region & presence in 2012), Lost workdays $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance			
Observations	12,085	12,142	12,157	12,159	12,085	12,142	12,157	12,159	12,085	12,142	12,157	12,159
R-square	29.80%	19.20%	13.20%	11.00%	0.70%	1.20%	1.40%	1.40%	0.70%	1.10%	1.40%	1.30%
Baseline mean (s.d.)	0.319 (3.545)				0.044 (0.895)				0.035 (0.599)			

Note. Robust standard errors in parentheses.
*** p-value < 0.01; ** p-value < 0.05; * p-value < 0.1.

courses associated with the risks in the firm's action plan. The estimated coefficient is sizeable—roughly equal to or greater than the baseline mean—and statistically significant in months 12 and 15. The effect size is approximately twice as large, relative to the baseline, compared with all training courses in the first four columns of Table 4.

Second, the pamphlet displayed up to three firm-specific safety risks (pamphlet space limitations constrained it to three risks; see Figure A.2 in the Online Appendix). These corresponded to the top three risks listed in each firm's action plan (i.e., the top three rows of page two of Figure A.6 in the Online Appendix). We repeated the same exercise as before in the last four columns of Table 4, now restricting training courses to only those associated with the risks explicitly listed in the pamphlet. The findings are strong: The collaboration treatment led to an immediate, persistent, and significant increase in training courses corresponding to the risks in the pamphlet. The effect size is large: The coefficient is two to five times the baseline mean.[28] These results indicate that the collaboration treatment functioned as intended through the training courses that were targeted at the manager and workers.

However, the results on training should be interpreted with caution. A concern for our analysis is the number of null hypotheses tested across models. To account for this, we apply the Benjamini-Hochberg correction to the standard errors in Table 4 and find that, although the coefficients in columns 3 and 4 remain significant, their p-values are now just below 0.10, and the coefficients in columns 7 and 8 are no longer statistically significant (p-values around 0.20 to 0.25). In contrast, the results in columns 9–12 remain strongly significant, with p-values below 0.05. We therefore conclude that there is clear evidence of increased training for courses related to the pamphlet, although the evidence for broader training is less robust.

Panel B shows that the "any email" treatment had no significant effect on these courses (individual email treatments also yielded null results; see Table A.2 in the Online Appendix); most coefficients are negative and smaller in magnitude compared with the collaboration treatment.

6.2. Average Effect of Collaboration on Safety Outcomes

Panel A of Table 5 reports the impact of the collaboration treatment on cumulative accident rates at 2, 6, 12, and 15 months, expressed as rates per worker per year for comparability.[29] The results indicate that the collaboration treatment reduced accident rates. The initial effect is modest (0.004) in the first two months post-intervention. Still, it increases over 6, 12, and 15 months, with sizeable reductions ranging between 0.006 and 0.008 (12.5%−16.7% of the preintervention mean).[30] These effects are statistically significant. Figure A.9 in the Online Appendix shows that the collaboration treatment shifts the entire distribution of firms' accident rates to the left, indicating a broad impact across firms (i.e., not just concentrated on low, medium, or high accident SMEs). Figure A.10 in the Online Appendix corroborates these results using a difference-in-differences estimator.[31]

The last four columns of Table 5 assess the impact of the treatments on accident severity, measured by lost workdays per accident. The collaboration treatment significantly reduced accident severity at 12 and 15 months, with substantial effect sizes ranging from 1.3 to 1.5 days, representing approximately 10% of the average workdays lost per accident.

Panel B of Table 5 again shows small and nonsignificant results for the "any email" treatment (for the disaggregated emails, see Table A.3 in the Online Appendix).

Table A.4 in the Online Appendix examines the robustness of the accident rate results using alternative specifications, including a Poisson model for accident counts, a linear probability model for the likelihood of the firm having at least one accident (weighted by the inverse number of employees), and an Ordinary Least Squares regression for accident counts (also weighted by the inverse number of employees). The results remain consistent across all specifications. Table A.5 in the Online Appendix corroborates that the results are robust to excluding control variables.

Table A.6 in the Online Appendix examines whether the impact of the collaboration treatment varies with dosage. Because each firm received 20 pamphlets, and each pamphlet addressed up three risks, we expect stronger effects in firms with fewer than 20 workers (as 20 pamphlets are diluted in a firm with 40 workers relative to a firm with 20 workers) and those with three or fewer risks (highlighting three risks in a firm that has seven risks also dilutes the pamphlet's impact). The results in Table A.6 in the Online Appendix confirm these expectations, indicating that the effect increases with dosage.[32]

As discussed in Section 6.1, a concern for our analysis is the number of null hypotheses tested. As before, we corrected our standard errors in Table 5 using the Benjamini-Hochberg procedure, and all coefficients remain statistically significant except for the last column (lost workdays at 15 months; corrected $p = 0.109$). These results provide reassurance regarding the impact of our treatment on performance, particularly with respect to accident rates.

When investing in safety, the firm may need to hire additional workers if current employees are overstretched, compromising safety. The first four columns of Table A.11 in the Online Appendix assess the impact of the collaboration treatment on the number of workers. We do not find evidence of any significant effect.

Table 5. Impact of Treatment on Cumulative Accident Rates, by Number of Months Since the Intervention

	Accident rate (standardized to a year)				Lost workdays per accident			
	2 months	6 months	12 months	15 months	2 months	6 months	12 months	15 months
Panel A: Effect of collaboration treatment								
Collaboration	−0.004	−0.007**	−0.006**	−0.008**	0.261	−1.424	−1.540**	−1.308**
	(0.005)	(0.003)	(0.003)	(0.003)	(1.418)	(0.947)	(0.708)	(0.661)
Controls	Strata (month & emails), Accident rate $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance				Strata (month & emails), Lost workdays $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance			
Observations	12,085	12,142	12,157	12,157	1,156	2,576	3,810	4,160
R-square	2.00%	1.60%	1.90%	1.90%	6.90%	3.80%	3.70%	3.40%
Panel B: Effect of any email treatment								
Any email	0.000	0.003	0.003	0.004	−1.385	0.555	0.023	0.086
	(0.005)	(0.003)	(0.002)	(0.003)	(1.442)	(0.982)	(0.726)	(0.680)
Controls	Strata (month, region & presence in 2012), Accident rate $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance				Strata (month, region & presence in 2012), Lost workdays $t-1$ to $t-12$, Average number of workers $t-1$ to $t-12$, Baseline legal compliance			
Observations	12,085	12,142	12,157	12,157	1,156	2,576	3,810	4,160
R-square	2.00%	1.90%	2.40%	2.40%	1.60%	5.80%	4.70%	4.30%
Baseline mean (s.d.)	0.048 (0.153)				15.951 (20.256)			

Note. Robust standard errors in parentheses.
***p-value < 0.01; **p-value < 0.05; *p-value < 0.1.

This suggests that the adoption of training (and other unobserved practices; see next paragraph) leading to improved safety did not require additional workers, implying that safety improvements did not impose additional labor costs.

We estimated, albeit imperfectly, the proportion of the collaboration treatment's impact on accidents attributable to training. The treatment increased the probability of training by 50%, which implies—using estimates of the effects of training on accidents for Chile (Brahm and Singer 2013)—a reduction in accident rates of around 0.003. This suggests that increased training could account for nearly half of the decline in accident rates resulting from the collaboration treatment. Thus, a significant portion of the effect happens through the expected training channel. This also implies that other prevention practices we do not observe, such as adopting behavior guidelines, creating safety roles, purchasing appropriate equipment, redesigning operating protocols, and conducting regular inspections of physical spaces, vehicles, and equipment, as outlined in the action plan handed out to firms (Figure A.6 in the Online Appendix), also contributed to the observed accident reduction.

6.3. Heterogeneous Treatment Effects

We now explore the conditions under which firms are more likely to respond to the collaboration treatment. Although these analyses are exploratory, they help provide a deeper understanding of some of the contingencies that can hinder or enhance the impact of manager-worker collaboration. We study three levels of analysis: (i) at the managerial level, we use the interaction between the "any email" and "collaboration" treatments to explore managerial barriers to collaboration; (ii) at the firm level, we evaluate initial safety engagement—which likely influences the expected costs and benefits of manager-worker collaboration, span of control—an important element of organizational structure, and baseline worker rotation—a central factor that can undermine collaborative relationships; and (iii) at the sector-region level, we study whether the firm's competitive environment moderates the impact of the collaboration treatment.

6.3.1. Managerial Barriers. SME managers may be inclined to collaborate with workers on workplace safety practices, but if they are not engaged, prepared, or motivated, such efforts may be ineffective. Table 6 investigates the importance of the manager in determining the impact of the collaboration treatment on the accident rate. In particular, we explore the interaction between the "any email" and collaboration treatments to assess whether exposing managers to firm-specific safety information moderates the effect of the collaboration treatment. The interaction coefficient is statistically

Table 6. Impact of the Interaction Between the Collaboration Treatment and any Email Treatment

	Accident rate (standardized to a year)			
	2 months	6 months	12 months	15 months
Collaboration	0.001 (0.008)	−0.001 (0.004)	0.001 (0.004)	0.001 (0.004)
Collaboration × *Any email*	−0.009 (0.011)	−0.010* (0.006)	−0.012** (0.005)	−0.015** (0.006)
Any email	−0.172 (0.160)	0.055 (0.042)	0.033 (0.031)	0.042 (0.039)
Controls?	Yes			
Observations	12,085	12,142	12,157	12,157
R^2	2.00%	1.70%	1.90%	1.90%
Baseline mean (standard deviation)	0.048 (0.153)			

Notes. Robust standard errors in parentheses. This table includes the same controls as in Panel A of Table 5, although three strata fixed effects are dropped given their collinearity with the dummy "any email."
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

significant at 6, 12, and 15 months, with the reduction in accidents from the collaboration treatment in those months entirely concentrated in firms where the manager was also exposed to firm-specific safety information. The size of the effect is large, ranging from two to three times the baseline mean. Table A.12 in the Online Appendix shows that the results do not change if we use a Poisson regression.

It is difficult to determine which specific information provided to managers was most influential. Although Table A.7 in the Online Appendix suggests that the inspiration and motivation emails may have had a greater impact, the low statistical power limits the strength of this conclusion.

Overall, these results suggest that the effectiveness of manager-worker collaboration depends on managers having access to firm-specific safety information broadly around relative performance, costs, and actions. Although we interpret the interaction results with caution due to the low statistical power, the findings suggest that successful adoption and performance improvements require active managerial involvement; there is no shortcut to collaboration.

6.3.2. Firm Level Moderators.

6.3.2.1. Initial Safety Position and the Costs and Benefits of Collaboration in Safety. We first explore whether a firm's initial safety conditions influence the effectiveness of the collaboration treatment. Because collaboration in safety requires investments from both managers and workers, the expected costs and benefits may vary by the firm's starting point. On one hand, firms with poor safety records—characterized by high accident rates, no training, and a lack of basic safety information sharing—may be less responsive to the collaboration treatment because distributing the pamphlets may expose the need for many costly upgrades, such as process improvements, worker training, and maintenance enhancements. In fact, training is often part of a broader set of resource-intensive safety measures that firms must undertake (Tamayo et al. 2023, Diaz et al. 2024). For these firms, committing to the treatment could require far more extensive investments overall. On the other hand, firms with established workplace safety practices may see little additional benefit from the treatment, as they are already engaged in effective collaboration. Thus, we expect the collaboration treatment to have the greatest impact on firms in the middle, that is, those that have implemented some safety practices, but still have substantial room for improvement.

We find evidence supporting this conjecture. Table A.8 in the Online Appendix shows that the impact of the collaboration treatment is concentrated in firms with safety records above the sector average, no accidents in the past year, and a green ACHS rating (indicating low safety risk according to the ACHS). Further evidence from the collaboration treatment's take-up survey indicates lower pamphlet distribution in firms with high accident rates and low training levels (see Table A.1 in the Online Appendix). These converging findings suggest that SMEs with poor prior safety records do not respond to the treatment. This is likely due to the high expected costs of addressing significant safety issues before effective collaboration can occur.

We further analyzed detailed data on SMEs' baseline engagement with safety practices, as assessed by the expert during their visit. First, we examined the provision and use of PPE.[33] Table A.9 in the Online Appendix indicates that the collaboration treatment is most effective in firms where managers already provide PPE and workers use it, but the quality of PPE provided by managers is low. This is consistent with the idea that SMEs in the middle: those with some safety measures in place but with room for improvement are more responsive to the collaboration treatment. Second, we assessed the firm's compliance with three types of generic safety practices: nonrelational actions (one-sided safety efforts by the firm that do not require worker collaboration); information sharing with workers; and costly safety actions undertaken by the manager.[34] The results in Table A.10 in the Online

Appendix indicate that the collaboration treatment had a stronger impact in firms that had implemented basic nonrelational safety measures and shared safety information with workers but had not yet undertaken costly safety actions. These results further support the idea that SMEs with intermediate levels of safety practice were more likely to benefit from the collaboration treatment.

6.3.2.2. Organizational Structure.

Firms structure the formal rules of the organization—incentive systems, control systems, decision rights, and so on—largely to foster cooperation with workers (Lazear and Oyer 2012). A stream of research explores whether these formal rules enhance or hinder informal cooperation in the firm (Poppo and Zenger 2002, Mayer and Argyres 2004, Bandiera et al. 2005, Bowles and Polania-Reyes 2012, Ashraf and Bandiera 2018, Akerlof et al. 2020). We can inform this literature by utilizing ACHS expert data on the number of supervisors in each firm (i.e., employees of the SME who oversee frontline workers but are not the owner or CEO). This allows us to compute the firm's span of control (measured as the ratio of workers to supervisors) and analyze whether it moderates the effect of the collaboration treatment.

Table 7 presents the results, using binary indicators for high and low span of control based on the median value of eight. The impact of the collaboration treatment is fully concentrated in firms with a low span of control, that is, those with fewer workers per supervisor. This result suggests that supervisory presence complements collaboration. One possible explanation is that effective collaboration on safety practices entails detailed and nuanced interactions, which requires a present supervisor with ongoing communication channels between workers and managers.[35]

6.3.2.3. Baseline Worker Rotation.

Research in human resources and personnel economics indicates that high worker rotation is correlated with poor morale and undermines collaboration between workers and the firm (Abbasi and Hollman 2000, Hancock et al. 2013, Hoffman and Stanton 2025). From a relational contracting perspective, high pretreatment turnover of employees reduces the ability to establish manager-worker collaboration for workplace practices because the shadow of the future (the expected future value from their relationship) is smaller (Heide and Miner 1992, Poppo et al. 2008, Gibbons and Henderson 2012a). In terms of the cost-benefit analysis, managers have less incentive to invest in safety practices, such as training, when employee retention is low, because the expected returns from such investments decline. Workers also have incentives to defect from collaboration because the long-term benefits of their extra effort are diminished (e.g., learning a firm's safety procedures is less valuable if the worker expects to leave soon than if they plan to stay).

To measure baseline worker rotation, we calculated one minus the percentage of workers in the SME in month t who were also present in month $t-1$ and then averaged this value over the 12 months prior to treatment. We defined high worker rotation as a binary variable equal to one if the baseline worker retention rate is higher than the median value of 5% (equivalent to more than 60% annual turnover). Low worker rotation is a binary indicator equal to one for firms with a monthly turnover rate below 5%.

Table 7 indicates that the treatment effects are concentrated in SMEs with low worker rotation. In contrast, we do not find statistically significant effects in high-rotation SMEs, where sustaining collaboration is more challenging. These results align with relational contracting theory and personnel economics research

Table 7. Role of Organizational Structure and the Environment on the Impact of the Collaboration Treatment on Accident Rates

	Accident rate in 12 months		
	By span of control	By firm rotation	By degree of competition
Collaboration × *High span of control*	−0.001 (0.003)		
Collaboration × *Low span of control*	−0.009** (0.004)		
Collaboration × *High rotation SME*		0.002 (0.004)	
Collaboration × *Low rotation SME*		−0.015*** (0.004)	
Collaboration × *Many competitors*			−0.000 (0.004)
Collaboration × *Few competitors*			−0.013*** (0.003)
F-Test (difference)	2.89*	11.34***	6.74**
Observations	11,811	12,157	12,157
R-square	2.3%	2.0%	2.0%
Baseline mean (s.d.)		0.048 (0.153)	

Notes. Robust standard errors are in parentheses. The same controls as in the Panel A of Table 5. The individual terms of the interactions are included as controls. *Span of control regression.* Given there was a small proportion of SMEs with no supervisors, span of control is measured as 'number of workers + 1" divided by "number of supervisors + 1." Other corrections, including not using firms without a supervisor, yielded the same results. Further, having or not a supervisor had no moderating effect on the impact of collaboration. In this regression, we also added the control "collaboration x size" (the result does not change if we remove it).

***p-value < 0.01; **p-value < 0.05; *p-value < 0.1.

on the detrimental effect of worker turnover, further supporting that the treatment operates through collaboration.[36] An implication is that high baseline worker rotation can significantly hinder collaboration on workplace safety practices.

6.3.3. Market Environment. We examine a key dimension of the market environment at the industry-region level: market competition. Research on organizational culture, prosocial behavior, ingroup-outgroup dynamics, and other perspectives has documented that competition is a threat to firm survival, and this promotes cooperation among the firm members (Bowles 2006, Gelfand et al. 2011, Böhm and Rockenbach 2013, Bauer et al. 2016, Richerson et al. 2016, Francois et al. 2018). In contrast, the relational contracting literature has shown that high competition increases the temptation to defect, which lowers collaboration (McMillan and Woodruff 1999, Macchiavello and Morjaria 2021, Ghani and Reed 2022). As summarized by Macchiavello and Morjaria (2023), there are two reasons for this, both of which are relevant in our setting: (i) employees have more outside options, increasing the likelihood of defection, and (ii) competition reduces firm profits, thereby diminishing the value of long-term employment relationships.

To explore the impact of competition, we calculated the number of firms in each industry-region and constructed a binary indicator equal to one when the number of firms exceeds 20, the median in our data, and zero otherwise. Table 7 shows that the effects of the collaboration treatment are fully concentrated in firms operating in less competitive environments, consistent with a relational contracting logic (see Online Appendix A.3 for a description of relational contracts between the manager and workers).[37]

7. Conclusion

Manager-worker collaboration is critical for the successful adoption of performance-enhancing workplace practices (Gibbons and Henderson 2012a). However, achieving collaboration is challenging due to potential misalignment of actions (coordination problems) and incentives (cooperation problems) (Puranam 2018). Most prior quantitative evidence on whether collaboration improves workplace practice adoption and firm performance has been limited to single-firm studies, and more research is needed to understand the conditions that enable or hinder collaboration and practice adoption (Blader et al. 2020).

This paper examines collaboration, practice adoption, and firm performance using experimental evidence across a large and representative sample of Chilean SMEs in the context of workplace safety. We find that the treatment designed to enhance collaboration between managers and workers effectively increased the adoption of safety training, especially those tackling firm-specific risks prompted by the treatment, and reduced workplace accident rates and severity.

Implementing workplace safety practices, like any management practice, involves numerous contextual details and nuances that are difficult to specify contractually and thus require collaboration between managers and workers (Gibbons and Henderson 2012a). Consequently, it is also important to examine the conditions that moderate the effectiveness of collaboration.

At the managerial level, we find that manager exposure to firm-specific safety information increases the impact of collaboration. At the firm level, we find that the collaboration treatment is more effective when (i) the firm has partially implemented safety practices (made some initial investments, such as in safety equipment and guidelines, but still has room for improvement); (ii) the firm has a low span of control, suggesting a complementary relationship between closer supervision and collaboration; and (iii) and the firm has low worker rotation, which supports collaboration through a longer expected relationship horizon. At the environmental level, the collaboration treatment has a larger impact in less competitive environments, suggesting that relational contracting may have played a role. These findings represent a first step toward unpacking the conditions that foster collaboration for workplace safety practices.

This study makes several contributions. First, it provides large-scale evidence on the effects of collaboration on the adoption of practices and firm performance. Second, it offers valuable insights into the managerial, firm, and environmental conditions that enable collaboration to thrive. Third, our findings across the various analyses are consistent with relational contracting theory, contributing to the limited empirical evidence on relational contracts within firms (Macchiavello and Morjaria 2023). Fourth, we contribute to the literature on safety in economics, which has largely focused on regulation to address information asymmetry and externalities, but, except for Boudreau (2024), has not considered the role of collaboration as a barrier to the adoption of safety practices, even when regulation is successful in solving the aforementioned problems.

Finally, for policymakers, in addition to the practical implications for improving workplace safety, our paper demonstrates that while many government programs (e.g., vocational training) are typically offered to or mediated by firm owners/CEOs, it is more impactful to engage managers and workers simultaneously. Still, we caution that our study focuses on a low-cost intervention, and we cannot assess its effectiveness relative to other approaches. We hope this research informs broader discussions about which interventions policymakers should consider scaling.

Nonetheless, this study has several limitations. First, the treatments were delivered through different mediums (physical mail versus email). Although this does not affect the interaction analysis, it precludes direct comparisons between the collaboration and email treatments. Second, collaboration is a complex concept, and we had only one treatment in which we manipulated both coordination and cooperation, and thus, we cannot distinguish their relative weight. Third, the take-up rates limited the statistical power. However, taken as a whole, our findings present a robust and coherent story. We observe a consistent pattern of results across many different dependent variables: training, frequency of accidents, and severity of accidents. Furthermore, the types of training taken by workers strongly indicate that our intervention functioned as intended, and the interaction analysis results align with expectations. We hope that future research will tackle these and other topics around collaboration, adoption, and performance.

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Endnotes

[1] An exception is the survey-based management practices literature (Bloom and Van Reenen 2007). However, this literature primarily describes management practices and their effects rather than investigating the drivers of their adoption. Bloom et al. (2013, 2019) are exceptions; however, they focus mostly on the environment and informational barriers to adoption and not on manager-worker collaboration.

[2] The reports are typically lengthy (30–40 pages) and written in a legalistic style, making them difficult to understand, especially for busy SME owners or managers.

[3] We did not find evidence that exposing managers to information alone (i.e., without the collaboration intervention) significantly affected safety training, accident rates, or severity.

[4] See https://dictionary.cambridge.org/dictionary/english/collaboration.

[5] Alternative definitions of collaboration often hail from research on interorganizational collaboration, where, for instance, scholars have defined it as "cooperative, interorganizational relationships in which participants rely on neither the market nor hierarchical mechanisms of control to gain cooperation from each other" (Hardy et al. 2005, p. 58) or "a cooperative, inter-organizational relationship that is negotiated in an ongoing communicative process" (Hardy et al. 2003, p. 323; Majchrzak et al. 2015, p. 1338). These definitions explicitly incorporate cooperation. Implicitly, coordination occurs through informal, relational contracts in the former definition (as an alternative to market and hierarchical control mechanisms), and through communication in the latter. We, however, adopt the definition above for our study because it is more relevant to and commonly used for within-firm collaboration.

[6] The informal nature of relational contracts often makes them difficult to build because of problems of *clarity*—where the parties do not understand what each party is supposed to do—and *credibility*—where the parties do not believe that the other party will do what it says it will do (Gibbons and Henderson 2012b, Gibbons et al. 2023). Problems of clarity and credibility relate closely to problems of coordination and cooperation, respectively.

[7] There are three institutions: IST (Instituto de Seguridad del Trabajo), ACHS (Asociación Chilena de Seguridad), and la Mutual de Seguridad CChC (Camera Chilena de la Construcción), which together cover nearly 85% of workers. The state-owned organization Instituto de Seguridad Laboral (ISL) serves the remaining 15%.

[8] Legally, "mutuales" must allocate at least 12% of total revenues to prevention activities, predominantly OSH training, provided for free for affiliated firms. ACHS offers a wide range of training courses, from general safety training to sector-specific topics such as the proper use of pesticides.

[9] Before this program, SMEs were not distinguished from larger firms and received the same services. As a result, a large proportion of SMEs were underserved due to the high fixed costs associated with serving individual firms (travel, administrative work, etc.).

[10] We do not focus on the individual effects of the email treatments (i.e., without interaction), because the use of different delivery methods—email versus physical mail—limits comparability between the collaboration and email treatments. We do so as a conservative approach. (However, recent research shows that the difference between email and physical mail does not lead to significantly different treatment effects (Valenti et al. 2024).

[11] All these risks (or hazardous actions/tasks) are listed on the second page of the inspiration treatment, in decreasing order of importance (see Figure A.6 in the Online Appendix). Although a firm may have more than three risks, only the top three were displayed in the pamphlet due to space constraints.

[12] Importantly, all the SMEs in our setting received a firm-specific prevention plan after the ACHS expert visit, and thus, the firm already had access to a firm-specific actionable safety recommendations. Our treatment did not introduce new safety guidelines but rather encouraged managers to share the pamphlets with workers.

[13] This calculation is based on the minimum insurance premium, which is 0.95% of a firm's pretax wage bill. We calculated the sector accident rate (X) and showed that if no accidents occurred the firm would save $(X - 0.95)\%$ of its wage bill.

[14] See https://www.socialscienceregistry.org/trials/498. The experimental design described here differs from the AEA registry in the number of firms included. When filing the registration, the total sample size was listed as 31,500 firms, which accidentally corresponds to the population of ACHS-affiliated SMEs. The AEA RCT registry was launched in May 2013, after the design and start of our experiment. We registered our experiment in September 2014, and thus we refer to it as "registration" rather than "preregistration." To verify that our treatment and analysis remained consistent from the design phase, we can share, upon request, the proposal submitted to ACHS, which was funded by their R&D unit, Fundación Científica y Tecnológica (FUCYT) (see Acknowledgments).

[15] Table A.1 in the Online Appendix presents two additional exercises. First, and although in an intent-to-treat estimate, this is

irrelevant, we explored the determinants of pamphlet distribution among firms that responded to the survey, as these may shed light on the underlying mechanisms (see Section 6.4). Column 4 shows that safer, larger firms and those more engaged in prevention training were less likely to distribute the pamphlets. Column 5 provides no evidence that receiving an email treatment affected the likelihood of distributing the pamphlets. Second, we validated the minimum take-up rate of 37% using regression analysis. In the last column, we included all survey respondents and firms not assigned to the collaboration treatment. Along with the covariates from columns 2 and 4, we added a binary indicator for assignment to the collaboration treatment. If we assume that survey responders are a random sample of those assigned to the survey (and by construction to those not assigned to the collaboration treatment) (column 2 of the table provides evidence supporting this assumption), we conclude that receiving the collaboration treatment increases the probability of sharing the pamphlets with workers by 40%.

[16] Statistical power for the individual email treatments is as follows: 0.36 standard deviations for perception and motivation (0.2 take-up) and 0.20 standard deviations for inspiration (0.3 take-up).

[17] Given our regression approach, this is as if we had an experiment with two treatments—3,182 firms that received both the collaboration and any email treatments ($0.4 \times 0.24 = 0.096$ combined take-up), and 1,831 firms that received only the collaboration treatment (0.4 take-up), and a control group (all other firms). Using standard power calculations, we compute the MDE for comparisons between the two treatment groups. Details are available upon request.

[18] In the spirit of Campos et al. (2017), we do not use monthly observations but instead construct accident rates using 6, 12 and 15 months to reduce the amount of noise in the data and increase statistical power.

[19] The control group in this case are firms that did not receive the collaboration treatment, irrespective of whether they received an email treatment. Similarly, in the treatment group some have randomly received the email, and some have not, which allows us to make a valid comparison. We use strata fixed effects to control for receiving an email.

[20] Because the randomization is at the firm level, there is no statistical requirement to cluster at a higher level. It is also unlikely that an accident in a firm is correlated with one occurring in other firms in the same sector or region. Nonetheless, Table A.14 of the Online Appendix replicates the results of Table 5 using different clustering, and the results remain unchanged (or even show improved statistical significance).

[21] We do not include industry fixed effects in the baseline specification because this was not a randomization strata, and we already control for firm-specific accident rates. Including industry fixed effects does not alter our results.

[22] In that case, the control group is not the same as in the previous regression equation because it now includes only firms that have not received any email, irrespective of whether they received the collaboration treatment. We do not control for whether they received a collaboration treatment since the randomization was stratified by email, and the collaboration treatment is orthogonal to "any email." Thus, including it does not change the results. Our strata controls should account for whether firms were present in 2012, and we have also replicated the results excluding firms that were not in present in the database in 2012 and the results are extremely similar.

[23] Less than 2.0% of the sample did not continuously report to ACHS, alleviating concerns about sample attrition.

[24] Reporting results per 100 workers improves interpretability. In 2012, training incidence among SMEs in ACHS was very low—about 4% per year, or 0.04 courses annually (roughly 20% of the rate for large firms with more than 50 employees). This equates to 0.003 courses per worker (using an average of 14 workers per firm; Table 3). This is an important reason why the SME community program started. Given that courses typically accommodate 10–20 workers, the probability of an SME having a course is similar to that of a single worker receiving training. Data on individual course attendance were not available.

[25] Beginning in 2013, ACHS increased its training delivery, doubling the amount in 2014 and raising it by at least 50% in 2015. Thus, the baseline in Table 3 might be too low to establish economic significance. An alternative is to use the control group average of 0.650 courses per 100 workers. This is twice the baseline and implies that the effect would be a 25% increase in training.

[26] Table A.2 in the Online Appendix contains the disaggregated email treatment results, none of which increased training.

[27] The ACHS identifies 13 distinct risk categories (e.g., manual handling of loads, work at height, operation of electrified equipment). We classified all available training courses into one of the categories based on the specific risk that each course addresses (for example, the course "driving in high-altitude" addresses "vehicle driving" risk).

[28] However, Endnote 26 also applies here, albeit to a lesser extent. The mean of the action plan-related courses for the control group at 12 months is 0.058 and for the pamphlet-related is 0.046, both of which are 30% to 32% higher than the baseline displayed in the bottom of Table 4.

[29] The R^2 in Table 5 is lower than Table 4 because prior accidents do not significantly predict this year's accidents. In contrast, for training, past participation in classes (along with other controls) is a stronger predictor of future training requests.

[30] The timing of the observed effects suggests a lag between the adoption of training and the reduction in accidents. Significant reductions in accidents occur over 6, 12 and 15 months. In contrast, increases in training, particularly for courses linked to the pamphlet are significant from the start. This lag may be due to several factors, including behavioral change from training may require practice and experience; firms may be slow in adjusting to safety requirements emanating from training (e.g., purchasing appropriate PPE); or a critical mass of trained workers may be necessary for peer pressure or safety norms to develop.

[31] An alternative explanation is that the collaboration treatment motivates managers to invest more in safety by providing simplified information from the report, which could generate the effect without worker collaboration. However, four analyses suggest that this is unlikely: (1) the dosage analysis indicates that the treatment effect is stronger in firms with fewer than 20 workers; (2) the collaboration treatment is null in SMEs with high worker rotation; (3) the results for market competition are consistent with relational contracting theory regarding manager-worker collaboration; and (4) the largest increases in training are for courses listed in the pamphlet, rather than the action plan.

[32] We conducted the same analysis for the email treatments and, as expected, found no changes in the impact based on workforce size (above or below 20 workers) or number of risks (above or below three). To further explore the dosage effects for the collaboration treatment, we categorized firms by size: 0–9, 10–19, 20–29, and 30+ workers. We find that the treatment was most effective in the smallest firms, indicating that the intervention was particularly beneficial when there were fewer workers than pamphlets.

[33] For this analysis, we created three binary indicators: (1) "Provides PPE" equal to one if "the organization provides PPE that are appropriate for the risks" and zero otherwise; (2) "Good PPE" equal to one if "the PPEs are certified and are in good shape" and zero otherwise; and (3) "Workers' Use the PPE" equal to one if "the workers use the PPE when exposed to risks." This information was obtained for each firm from the ACHS expert-completed table

depicted in Figure A.5 in the Online Appendix, which was included in the safety plan provided to the SMEs.

[34] Similar to the previous endnote, we categorized compliance into three groups based on data from the ACHS expert-completed table exemplified in Figure A.5 in the Online Appendix: (1) "Nonrelational actions" (one-sided efforts by the firm that do not require worker collaboration), a binary indicator equal to one if indicated that: "The organization has done a self-assessment of the basic legal requirements that apply to their activity," "The organization has an internal handbook/guidelines," and "the handbook/guidelines is up to date"; (2) "Information sharing," a binary indicator equal to one if "the organization handed a copy of the internal handbook/guideline to workers," "the organization informs about the risks the workers are exposed to," "the organization informs about preventive and control measures," and "the organization informs about proper ways of doing things"; and (3) "Safety actions," a binary indicator equal to one if "the organization has implemented a program of order an cleanliness," "the organization provides PPE, appropriate for the risks," "the PPEs are certified and are in good shape," and "the dangerous areas are properly signaled."

[35] We also examined whether treatment effects differed between SMEs with supervisors (the majority) and those without and found no significant differences.

[36] We find consistent results when measuring worker rotation at the market level (to be precise, at the sector-region level), excluding the focal firm. This approach reduces concerns about the endogeneity between baseline worker rotation and take-up. This analysis is available upon request.

[37] Another possibility is that firms in less competitive environments have higher margins, enabling more investments.

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