Time to take corporate innovation initiatives

The consequence of safety accidents in China's manufacturing industry

Ruiju Yang
School of Management,
University of Science and Technology of China, Hefei, China
Wei Zhu
Beijing Research Center of Urban Systems Engineering, Beijing, China
Dora Marinova
Curtin University, Perth, Australia, and
Jiuchang Wei
School of Management,
University of Science and Technology of China, Hefei, China and
Center for Crisis Management Research,
School of Public Policy & Management, Tsinghua University, Beijing, China

Abstract

Purpose – A bad safety accident at a manufacturing company usually results in casualties and economic losses. The company affected by such an accident must deal with pressure from multiple stakeholder groups. Employees, in particular, play a key role in pushing the affected company to develop strategies to improve occupational safety and health. The purpose of this paper is to seek answers to two questions: does a safety accident affect employee behavior in terms of giving up prospects to develop a career at the affected company? If yes, could innovation initiatives adopted by the company help moderate the negative consequences from a safety accident?

Design/methodology/approach – By investigating 120 safety accidents reported by publicly listed Chinese manufacturing companies between 2009 and 2016, the authors conduct an empirical study using regression-based statistical hypotheses testing to describe the companies' responses and prospects for their employees.

Findings – The results show that the magnitude of the accident and the accident being caused by an employee error positively affect the turnover of employees. Furthermore, technical innovation initiatives, such as spending on R&D, by the accident-affected companies increase the positive effect of the accident magnitude on employee turnover. On the contrary, management innovation initiatives, such as corporate social responsibility activities, weaken the impact of the accident magnitude and employee error on employee turnover.

Originality/value – This study contributes to knowledge development by adding a crisis perspective in human resource management research. It helps to better understand the impact of safety accidents on employee behavior and the response taken by companies through innovation initiatives.

Keywords Occupational safety and health, Career development, Employee turnover,
Innovation initiatives, Safety accident

Paper type Research paper

Introduction

With a large labor force and booming industries, China is part of the global manufacturing chain. The country's initial competitive advantages, based on availability of cheap resources, including labor, gradually weakened as people's quality of life and employee

wages increased. To maintain competitiveness, many sectors had to undergo economic restructuring and were upgraded; manufacturing was one of them (Chin and Rowley, 2018). The transformation of the manufacturing industry brought about improvements in product quality resulting in economic benefits. However, rapid technological upgrade, if not performed carefully, can also trigger concerns about safety and, indeed, workplace accidents (Khanzode *et al.*, 2012).

In 2007, China ratified the 1981 International Labour Office's Convention on Occupational Safety and Health (Casale and Zhu, 2013). The convention's purpose was to provide safe working environments for employees by offering protection and minimizing the causes of hazards. Nevertheless, industrial accidents and occupational injuries were (and continue to be) a frequent occurrence in China. According to the national workplace safety statistics (www.gov.cn/xinwen/2018-01/29/content_5261953.htm) released by the State Administration of Work Safety, there were 53,000 safety accidents and 38,000 deaths only between January and December 2017. In addition to casualties, these safety accidents also cause serious damage to the affected companies. They range from economic losses and costs due to suspension of production, to reduced competitiveness and employee dissatisfaction.

For example, in 2015, a safety accident of poisoning and suffocation occurred in Zhongyuan Special Steel Company, resulting in six casualties (www.szse.cn/disclosure/listed/bulletinDetail/index.html?b2671d18-7dad-4f94-bd0c-e264f31f58a6). The severe accident was caused by major defects in the project design and poor safety in the production process. Its negative impact on the company included a drop in share price and an increase in the number of employees leaving in search for safer working conditions. In response to the accident and loss of personnel, Zhongyuan Special Steel took some countermeasures, which included updating the company's safety management standards, developing new technologies and introducing protection procedures for the production floor employees. Many of these countermeasures were based on novel approaches and involved new initiatives, such as: protective alarm systems detecting unacceptable levels of contaminants; changes in the production process to avoid direct exposure; and regular interactive employee training based on virtual reality scenarios. This example raises an interesting question for both researchers and managers: can companies redeem their reputation after a serious safety accident by implementing innovation initiatives? More specifically, can a company use technical innovation (e.g. investing in research and development (R&D)) and management initiatives (e.g. adopting corporate social responsibility (CSR) activities) as a means to recover from the negative effects of a workplace safety accident?

Serious safety accidents are detrimental to companies in both human and financial terms. The affected company usually faces investigation followed by negative evaluation and punishment from the regulators, which triggers a series of unfavorable chain reactions, including employee dissatisfaction (Andrews *et al.*, 2014). As the occupational safety and health of the employees have been threatened by accident that have occurred or potentially could occur, the balance between career development within the company and family well-being can be disrupted (Ito and Brotheridge, 2012). Moreover, the complexity and severity of accidents increase employees' job insecurity, especially for people employed in front-line production, which reduces their job satisfaction (Lee and Jeong, 2017). Consequently, safety accidents may negatively affect the career plans of the employees, including their intention to maintain a career path in the company and overall well-being. This can lead to employee resignation, turnover, or even collective turnover (Wu *et al.*, 2017).

To retain employees and continue normal operation, accident-stricken companies have to implement measures which improve occupational safety and health performance along the other aspects of the workplace environment. The existing literature on industrial accidents has focused on aspects related to accident prevention and causation (Katsakiori *et al.*, 2009; Pillay, 2015), but little attention has been paid so far to the effectiveness of the safety

interventions. Therefore, this study links safety accidents with the management strategies of the companies by examining the impact of occupational safety and health management on employee behavior. Previous research has also identified that companies have the options to adopt technical and/or management innovations to strategically adjust their performance (Ling and Nasurdin, 2010). While technical innovation is usually related to technology changes, management innovation is associated with the social structure of an organization. For this study, we use spending on R&D as a proxy to represent the technical innovation initiatives and use CSR activities as a proxy for the management innovation initiatives. Both, the technical and management innovation initiatives impact the employees and their behavior, in particular, loyalty and commitment to continue or abandon a work environment that has experienced a significant industrial accident. It is thus of interest to understand the nature of such innovation initiatives.

Given the evidence that safety accidents may significantly affect employees, previous research has explored the relationship between work injuries and employee turnover (Lee and Jeong, 2017). However, the existing literature has not yet investigated the impact of different accident attributes, such as magnitude and causation, on employee turnover. Empirical studies about the effectiveness of innovation initiatives undertaken by companies in the aftermath of workplace accidents are also lacking. Based on data for Chinese manufacturing companies, this study analytically examines the relationship between safety accidents and employee turnover. It contributes to the literature by including two key attributes of safety accidents, namely, magnitude and employee error, to explain their effects on employee turnover. We also explore how technical and management innovation initiatives should be implemented to help companies regain employee support after such accidents.

Theory and hypothesis development
Career development
Careers can be viewed in different ways, including a series of jobs, a cumulative set of work experiences and a process of personal development (Newman, 2011). How employees' careers develop is of interest from both, a practical and research point of view. Career development involves an organized, formalized and planned effort to achieve a balance between an employee's needs and the organization's workforce requirements (Lips-Wiersma and Hall, 2007). Modern-day studies argue that career development is at one's control and responsibility, that is, employees can have multiple employment paths of their own choice and less commitment to an organization, whilst developing various commitments toward their profession, professional groups and industry (Foong-Ming, 2008). Specifically, an employee's career should be successfully integrated into a satisfactory personal and family life. It should provide a sense of sufficient security to meet the well-being and economic needs of the employees, allow flexibility to adapt to one's changing interests, and offer opportunities for rejuvenation (Greenhaus and Kossek, 2014). Thus, the decision for employees to stay or leave the employing organization depends on whether the job is needed and they are suited to perform it, but also whether it is meaningful, they feel supported or are spiritually satisfied at work (Tnay *et al.*, 2013).

Viewed across the life-span of employees, career paths are impacted and changed because of many factors and considerations. For example, many employees, especially women, are facing contradictory requirements between family and careers (Valcour, 2007). In some cases, middle-aged employees need to balance work requirements with care for elderly parents (Gautun and Hagen, 2010). Rapid technology development is also putting high demands on employees' skills and abilities to stay up-to-date with many jobs, which are drastically changing and even disappearing (National Academies of Sciences, Engineering and Medicine, 2017). Moreover, in the complex, competitive and volatile market environment, companies may not remain economically viable, and thus reduce or close their operations, resulting in the lay-off of employees.

This study, however, is particularly interested in crises during the daily production and operation processes, which constitute safety accidents. They may affect the physical and mental health of the employees, and subsequently influence their decision to stay at or leave a particular place of employment. In such situations, the employees make conscious decisions whether their loyalty to a workplace should continue or not. The companies, on the other hand, are looking for the best responses to avoid the occurrence of safety accidents in the future.

Safety accidents and employee turnover

The market environment for manufacturing companies nowadays is very complex. Economic factors (e.g. the cost of accident prevention), technological aspects (e.g. multi-product industries), work conditions (e.g. safety provisions in the work environment) and human characteristics (e.g. work experience and safety training) are all related to the likelihood of safety accidents (Fabiano *et al.*, 2004). Previous research shows that the consequences from safety accidents are also multifactorial, causing serious casualties, economic losses and employee turnover (Gucer *et al.*, 2003).

In fact, occupational safety and health are a major concern for employees. How to handle this issue is of both academic and practical importance. Previous studies have already indicated a relationship between accidents and employee turnover (Bell and Grushecky, 2006; Burt *et al.*, 2009). Safety accidents can cause personal injury to employees, damage the work environment and reduce job satisfaction. Production employees in manufacturing companies are particularly vulnerable to such negative impacts. If concerned about their physical and mental health, employees may decide to leave the work environment where they feel threatened and dissatisfied with the company's safety practices (Amponsah-Tawiah and Mensah, 2016).

The unfolding model of voluntary employee turnover (Lee and Mitchell, 1994) suggests that a negative shock to the organization's system will affect the behavior of the employees. A negative shock is a very distinguishable event that will push employees toward deliberate judgments about their jobs. It can even lead employees to voluntary quitting without considering other job alternatives (Morrell *et al.*, 2008). A safety accident may trigger job dissatisfaction and be considered incompatible with work values and well-being standards, making employees to leave the company (Heavey *et al.*, 2013). The idea of quitting is also contagious, particularly after a safety accident – witnessing colleagues leaving may increase others' desire to do the same. Safety accidents may thus lead to collective turnover (Hancock *et al.*, 2017). In line with previous research (Hausknecht and Trevor, 2011), this study defines employee turnover as the aggregate level of employee departures within a group, work unit or organization.

Safety accidents are usually assessed and investigated by the senior management and relevant departments. According to the regulations governing the reporting, investigation and risk management of production safety accidents (www.gov.cn/zwgk/2007-04/19/content_588577.htm), the analysis is centered on the magnitude of the accident and the cause behind it. These two aspects are discussed further below.

Accident magnitude. Serious safety accidents result in casualties in the affected companies. In this study, accident magnitude refers to the total number of employee casualties occurred as a result of a safety accident (Odero *et al.*, 2003). Safety accidents damage the company's reputation and change investors' confidence. On the other hand, they harm the interests of the employees and decrease their confidence in personal safety, which results in diminished loyalty and even in them leaving the company (Andrews *et al.*, 2014). According to the expectancy violations theory, conforming behavior remains largely unnoticed, but violations attract attention for their salience and deviance from commonly held expectations (Floyd *et al.*, 1999). A safety accident is an example of a negative violation of employee expectations, and is likely to generate negative emotional responses. That is, manufacturing companies with safety accidents may lose employee approval and

commitment because the accident violates the promise for occupational safety and places employees at risk (Gucer *et al.*, 2003). The following hypothesis is tested to empirically study the relationship between accident magnitude and employee turnover:

H1. Ceteris paribus, accident magnitude positively predicts employee turnover a company encounters.

Employee error. There are many reasons for safety accidents in a workplace and previous studies have looked at their causes. Raouf (1998) classifies accident causation as immediate causes (e.g. unsafe acts) and contributing causes (e.g. safety management performance). Katsakiori *et al.* (2009) propose an accident model to identify active and latent causes (e.g. organizational and personal factors). In general, the likelihood for an accident is affected by the type of activities performed, tasks and job levels combined with personal risk factors. A number of studies have investigated worker characteristics associated with severity and likelihood of safety accidents occurring (Niza *et al.*, 2008; Hofmann *et al.*, 2017). Employee error is one possible cause of safety accidents. The accident investigation reports released by the regulators disclose whether a safety accident was caused by an employee error. This study investigates the relationship between employee error triggered accidents and employee behavior after an accident.

From the perspective of expectancy violations, safety accidents may create cognitive dissonance by altering the individuals' views of the way things should be. Employees in a high-accident working environment may become more worried about their safety, and thus lower their recognition and commitment to the affiliated company (Heavey *et al.*, 2013). In addition, turnover caused by safety accidents due to employee errors can be contagious because other employees in the same company will also be worried about their occupational safety as they may make the same mistakes. Hence, a safety accident caused by an employee error is likely to subsequently increase the collective employee turnover. We therefore hypothesize the following argument:

H2. Ceteris paribus, employee error caused accidents positively predict employee turnover a company encounters.

Innovation initiatives following accidents

Organizational innovation is usually defined as the adoption of a new idea or behavior by an organization (Daft, 1978). According to Crossan and Apaydin (2010), organizations cope with changes and uncertainties by applying new technology and successfully integrating technical and management improvements in their organizational structures. Conceptually, "technical innovations are those that occur in the operating component and affect the technical system of an organization" (Damanpour *et al.*, 1989). Hence, they affect the used equipment and production methods. Although the employees are in contact with these innovations, they are not specifically aimed at them. By comparison, people are the main focus of the management innovations which involve the generation and implementation of new managing practices, processes or structures, and are intended to further organizational goals (Birkinshaw *et al.*, 2008). In this study, we investigate the effects of the companies' innovation initiatives from the perspective of technical and management innovations represented by R&D spending and CSR activity.

R&D spending. Technical innovations are defined as a means of changing and improving the performance of the technical system and are directly related to the main activities of an organization (Damanpour *et al.*, 1989). Rogers (2010) proposes that technical innovations can be the implementation of an idea for a new product or the introduction of new elements in an organization's production or services. Technical innovations generate changes in skill requirements, training needs and the occupational mix of employment, which, in turn, affect

hiring, staffing patterns and employees' career development (Flynn, 1988). Thus, technical innovations have an impact on the human resources management of companies. In line with Latham and Braun (2009), we use R&D spending – that is, investment in R&D, as a proxy for technical innovations in a company.

Moreover, organizational stability is highly correlated with employee turnover, indicating that employees are more likely to stay in a stable work environment in line with their desires for career development (Lee and Jeong, 2017). When employees' occupational safety and health are threatened by accidents, they may perceive job insecurity as an infraction of the implicit or explicit norm of reciprocity within the company (Hofmann *et al.*, 2017). Consequently, they will alter their behavioral attitudes, for example, by reducing their commitment to the company and increasing turnover intentions (Cheng and Chan, 2008). If a company affected by a safety accident invests in R&D and adopts a technical innovation, the employees need to adapt to new technical requirements or face new operating procedures. This further increases their job insecurity. Therefore, technical innovations after a safety accident may act as a catalyst and stimulate employee turnover by further diminishing the stability of the work environment. Two further hypotheses are formulated as follows:

> *H3a.* *Ceteris paribus*, R&D spending amplifies the impact of accident magnitude on employee turnover a company encounters.

> *H3b.* *Ceteris paribus*, R&D spending amplifies the impact of employee error caused accidents on employee turnover a company encounters.

CSR activity. CSR is defined as "categories or levels of economic, legal, ethical and discretionary activities of a business entity as adapted to the values and expectations of society" (Joyner and Payne, 2002). The CSR activities are related to the company's perceived societal or stakeholder obligations (Lee *et al.*, 2013). Employees are highly salient stakeholders to whom the firm owes a perfect duty. This means that they have significant power and legitimacy with which to influence the firm (Greenwood, 2007).

In the aftermath of safety accidents, many accident-stricken companies put new safety improvement initiatives in place which help to monitor their employees' safe and unsafe actions. Management innovation is defined as a difference in the form, quality or structure over time of the management activities in an organization. It represents a particular form of organizational change and introduces a novelty in an established organization (Birkinshaw *et al.*, 2008). For this study, we consider management innovations as innovative CSR activities targeted at employees after safety accidents, such as new safety training, emotional support and distribution of compensation. Moreover, CSR activities can significantly reduce the negative impacts of crises, and repair the relationship with stakeholders (e.g. employees) by establishing a positive corporate image (Jamali, 2008). Hence, employee-related CSR activities as management innovation initiatives, can improve employees' happiness at work, enhance their job satisfaction and retain employees (Bode *et al.*, 2015). The following two hypotheses are further formulated:

> *H4a.* *Ceteris paribus*, CSR activities attenuate the impact of accident magnitude on employee turnover a company encounters.

> *H4b.* *Ceteris paribus*, CSR activities attenuate the impact of employee error caused accidents on employee turnover a company encounters.

Method
Sample
The sample for this study was collected from the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) – the only two stock exchanges in mainland China

approved by government regulators. We analyzed listed manufacturing companies as they are more visible with information publicly available. They are also expected to be closely scrutinized by regulators and the media.

To produce a precise sample, a multistep process was developed to search and gather data about safety accidents. Usually, when an accident occurs, the involved listed company announces details about it to its stakeholders and the public via the stock exchange. Hence, we first searched the headlines of accident announcements on the websites of SSE (www. sse.com.cn/) and SZSE (www.szse.cn/), and created the initial set of terms used for a more detailed search. Next, we searched media reports which quoted the accident announcements and identified similar terms. Then we comprehensively analyzed the above results and narrowed the search terms to improve the accuracy of the findings. Finally, we identified the revised keywords to include "safety accident," "production accident" and "fire accident," and constructed the sample using them.

Following this procedure, each announcement from the search was individually reviewed to verify that it involved a safety accident which occurred in a manufacturing company. To avoid the risk of confounding effects, we eliminated accidents which had unclear announcements or occurred in companies viewed by the government as being at high risk in terms of quality of products and financial information (Green *et al.*, 2009). We also eliminated accidents which occurred in the same companies after another negative event during the same or following year. The outcome was 120 safety accidents from 110 manufacturing companies identified for the period between 2009 and 2016.

Dependent variable

Employee turnover is the dependent variable for the regression model to test the hypotheses. Employees in manufacturing companies with safety accidents have lower-level perceptions about the organizational safety environment, which reduces their job satisfaction. This is especially the case for production employees whose interests are directly affected. Furthermore, employee job dissatisfaction may impact career development prospects in the company and subsequently induce turnover behaviors (Cheng and Chan, 2008).

Thus, we measured employee turnover by dividing the number of production employees who left the affected companies in the year after the accidents, by the average number of production employees in the year and the following year of the accidents (Hausknecht and Trevor, 2011). The data were collected from the companies' annual reports detailing the number of production employees.

Independent variables

The independent variables include accident magnitude, employee error, R&D spending and CSR activity. Accident magnitude was a count of employee casualties related to the safety accidents collected from the accident announcements and accident investigation reports. Employee error was measured as a dummy variable. If the accident was due to employee errors, it was coded as 1; if the accident was caused by other factors, it was coded as 0. R&D spending was measured as log-transformed values of R&D expenditures of the affected company in the year following the accident.

CSR activity was measured as a count of the employee-related activities implemented by the companies following the accident. The CSR activity needs to be different from the activities conducted during daily operations and should not have direct effects on the company's economic benefits. Examples include new safety training, counseling and changes to improve the well-being of the employees. First, the authors collected all the news posted on the affected companies' websites within a year from the accident. Next, we invited two professional researchers in this field to review all collected news, identify and code CSR activities. The standard they followed was that if the activity in the news was a positive

activity for the employees, it was defined as a CSR activity and coded as 1. Alternatively, as 0, if it was not counted. The analysis of the discrepancies produced a relatively high inter-rater reliability score of 0.915. Finally, we summed up the CSR activities and took the total as the measure of CSR activity.

Control variables
We controlled for firm size, leverage, past negative event, past employee turnover, past R&D spending, average wage, accident loss and the year the accident took place. Firm size was measured as the log-transformed value of the total assets of the company reported during the year of the accident. Leverage was measured as the debt to equity ratio and obtained from the China Stock Market and Accounting Research Database. Past negative event was a count of previous negative events in which the company was involved one year prior to the accident. Past employee turnover was calculated by dividing the number of production employees who left the affected company in the year of the accident by the average number of production employees in the year of the accident and the previous year. Past R&D spending and average wage were measured, respectively, as the log-transformed values of R&D expenditures and per capita income of employees in the year of the accident. Accident loss was the direct economic loss of the affected company caused by the accident. Year was included as a dummy variable, based on the year in which the accident occurred.

Results
This study uses multiple linear regression to test the four hypotheses. Table I presents the means, standard deviations and correlations between all variables studied in the regression analysis. We note that employee turnover, past R&D spending and R&D spending are negatively correlated with CSR activity, and accident magnitude is positively correlated with CSR activity. There is also positive correlation between past R&D spending and R&D spending, and negative correlation between accident magnitude and past negative event. Furthermore, accident magnitude, employee error and average wage are positively correlated with accident loss and firm size, respectively. Finally, accident loss is positively correlated with firm size.

Table II displays the regression models predicting employee turnover in the affected companies. Model 1 contains only the control variables, while Model 2 includes the main effects of accident magnitude, employee error, R&D spending and CSR activity. The remaining models include the four interaction effects, respectively. We examined the variance inflation factors (VIF) to test the presence of multicollinearity and found the highest VIF was 2.964 in the six models, which is well below the accepted threshold of 10 (Neter *et al.*, 1985). Among the control variables in Model 1, the effect of past negative event on employee turnover is positive and significant ($\beta = 0.025$, $p = 0.035$). The effect of past employee turnover on employee turnover is negative and significant ($\beta = -0.162$, $p = 0.056$).

Model 2 tests the main effects of accident magnitude and employee error. Accident magnitude significantly and positively predicts employee turnover ($\beta = 0.004$, $p = 0.006$), supporting *H1* that severe safety accidents will exacerbate employee turnover. Moreover, we find a significant positive effect of employee error on employee turnover ($\beta = 0.038$, $p = 0.007$), supporting *H2* that accidents that are related to employee errors motivate more employees to leave. Models 3–6 examine the moderating effects of R&D spending and CSR activity. As shown in Model 3, there is a marginally significant positive effect of the interaction between R&D spending and accident magnitude on employee turnover ($\beta = 0.001$, $p = 0.086$) (Noack *et al.*, 2017). This means that the impact of casualties on employee turnover increases for companies which spend more on R&D after the accident. Thus, the result is supportive for *H3a*. Likewise, Model 4 tests the interaction between R&D

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Firm size	22.17	1.19											
2. Leverage	1.80	2.62	0.122 (0.185)										
3. Past negative event	0.84	0.60	−0.106 (0.249)	0.034 (0.716)									
4. Past employee turnover	−0.02	0.08	−0.004 (0.963)	0.036 (0.694)	0.091 (0.325)								
5. Past R&D spending	16.70	4.15	0.108 (0.239)	0.038 (0.678)	−0.053 (0.567)	−0.019 (0.834)							
6. Average wage	8.89	1.37	0.237 (0.009)	−0.070 (0.448)	0.048 (0.599)	0.101 (0.272)	−0.063 (0.492)						
7. Accident loss	1.78	2.57	0.217 (0.017)	0.086 (0.352)	−0.079 (0.391)	0.142 (0.121)	0.030 (0.747)	0.263 (0.004)					
8. R&D spending	16.33	4.90	0.081 (0.376)	0.091 (0.321)	0.035 (0.703)	−0.010 (0.914)	0.696 (0.001)	−0.090 (0.328)	0.012 (0.894)				
9. CSR activity	7.05	8.10	0.171 (0.061)	−0.003 (0.975)	0.052 (0.571)	0.073 (0.427)	−0.284 (0.002)	0.176 (0.055)	0.022 (0.815)	−0.349 (0.001)			
10. Accident magnitude	3.00	4.95	0.357 (0.001)	0.007 (0.936)	−0.266 (0.003)	0.076 (0.408)	−0.014 (0.879)	0.142 (0.121)	0.214 (0.019)	−0.086 (0.352)	0.302 (0.001)		
11. Employee error	0.52	0.50	0.182 (0.046)	0.103 (0.263)	0.014 (0.879)	0.136 (0.140)	0.004 (0.966)	0.009 (0.921)	0.201 (0.028)	0.150 (0.101)	0.012 (0.893)	−0.132 (0.151)	
12. Employee turnover	−0.01	0.07	0.120 (0.192)	−0.039 (0.668)	0.134 (0.146)	−0.145 (0.114)	0.041 (0.660)	−0.075 (0.414)	0.151 (0.099)	0.013 (0.884)	−0.303 (0.001)	0.063 (0.497)	0.151 (0.101)

Notes: $n = 120$. p-value are in parentheses

Table I.
Descriptive statistics and bivariate correlations

Variables	Model 1	p-value	Model 2	p-value	Model 3	p-value	Model 4	p-value	Model 5	p-value	Model 6	p-value
(Constant)	−0.145 (0.138)	0.297	−0.099 (0.130)	0.447	−0.089 (0.130)	0.496	−0.091 (0.132)	0.491	−0.160 (0.128)	0.241	−0.159 (0.127)	0.212
Firm size	0.010 (0.006)	0.126	0.009 (0.006)	0.147	0.008 (0.006)	0.200	0.009 (0.006)	0.150	0.010 (0.006)	0.108	0.012 (0.006)	0.055
Leverage	−0.003 (0.003)	0.342	−0.003 (0.002)	0.243	−0.003 (0.002)	0.186	−0.003 (0.002)	0.230	−0.003 (0.002)	0.196	−0.004 (0.002)	0.073
Past negative event	0.025 (0.012)	0.035	0.034 (0.011)	0.002	0.035 (0.011)	0.002	0.035 (0.011)	0.002	0.039 (0.011)	0.001	0.030 (0.011)	0.006
Past employee turnover	−0.162 (0.084)	0.056	−0.217 (0.076)	0.006	−0.216 (0.076)	0.005	−0.219 (0.077)	0.005	−0.228 (0.075)	0.003	−0.212 (0.074)	0.005
Past R&D spending	0.001 (0.002)	0.848	0.001 (0.002)	0.956	0.001 (0.002)	0.777	0.001 (0.002)	0.830	0.001 (0.002)	0.952	−0.002 (0.002)	0.434
Average wage	−0.011 (0.005)	0.052	−0.006 (0.005)	0.189	−0.008 (0.005)	0.124	−0.006 (0.005)	0.202	−0.007 (0.005)	0.136	−0.008 (0.005)	0.109
Accident loss	0.007 (0.003)	0.014	0.004 (0.003)	0.147	0.005 (0.003)	0.067	0.004 (0.003)	0.160	0.003 (0.003)	0.185	0.005 (0.003)	0.080
R&D spending			−0.003 (0.002)	0.071	−0.005 (0.002)	0.024	−0.004 (0.002)	0.066	−0.003 (0.002)	0.097	−0.002 (0.002)	0.384
CSR activity			−0.005 (0.001)	0.001	−0.005 (0.001)	0.001	−0.005 (0.001)	0.001	−0.005 (0.001)	0.001	−0.002 (0.001)	0.054
Accident magnitude			0.004 (0.002)	0.006	0.005 (0.002)	0.004	0.005 (0.002)	0.006	0.007 (0.002)	0.001	0.004 (0.002)	0.004
Employee error			0.038 (0.014)	0.007	0.039 (0.014)	0.005	0.037 (0.014)	0.010	0.042 (0.014)	0.003	0.034 (0.013)	0.012
AM × R&D					0.001 (0.001)	0.086						
EE × R&D							0.001 (0.003)	0.672				
AM × CSR									−0.001 (0.001)	0.039		
EE × CSR											−0.005 (0.002)	0.004
R^2	0.155		0.353		0.372		0.354		0.380		0.404	
R^2 adj.	0.042		0.238		0.252		0.231		0.262		0.291	
F-statistic	1.374		3.061		3.115		2.886		3.229		3.566	

Notes: $n = 120$. Values in table are unstandardized regression coefficients. Standard errors are in parentheses

Table II.
Regressions of
employee turnover

spending and employee error. The result is insignificant and indicates that *H3b* is not supported.

Model 5 shows a significant negative effect of CSR activity on the relationship between accident magnitude and employee turnover ($\beta = -0.001$, $p = 0.039$). This supports *H4a* that the positive effect of accident magnitude on employee turnover weakens for companies which conduct more CSR activities. Finally, Model 6 shows that the interaction between CSR activity and employee error is negative and significant ($\beta = -0.005$, $p = 0.004$), thus supporting *H4b*.

By graphically examining the effects of the chosen moderators, additional insight is provided about the ability of R&D spending and CSR activity to influence the retaining of employees (Hayes, 2013). Figures 1–3 are drawn using the respective coefficients from
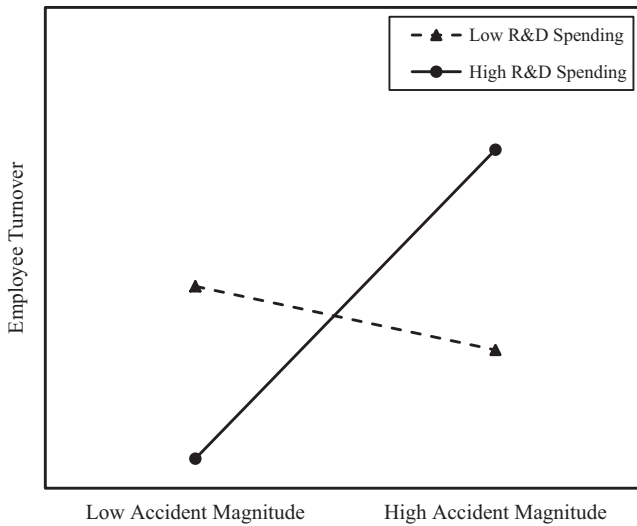

Figure 1.
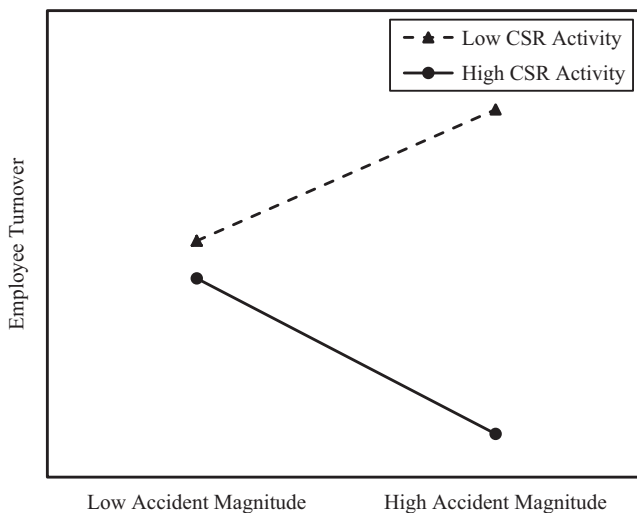Interaction effect of accident magnitude and R&D spending on employee turnover

Figure 2.
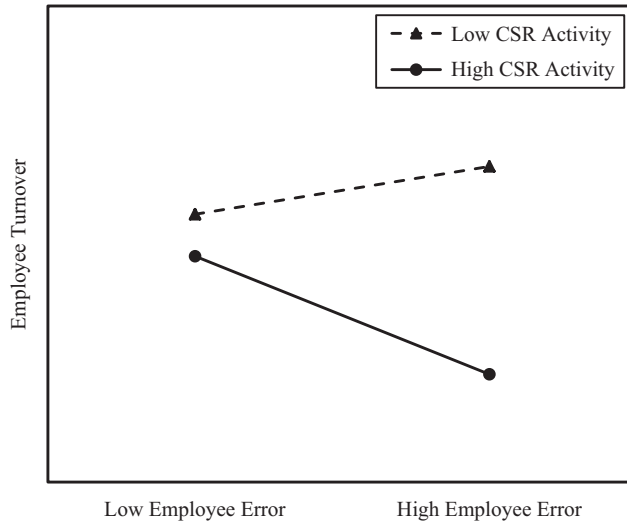Interaction effect of accident magnitude and CSR activity on employee turnover

Figure 3.
Interaction effect of
employee error and
CSR activity on
employee turnover

Model 2, with "Low" indicating the level of the standardized variable is one standard deviation below the mean and "high," one standard deviation above the mean. Figure 1 shows that higher R&D spending enhances the effect accident magnitude has on employee turnover more than lower R&D spending does. Figure 2 suggests that greater CSR activity more effectively mitigates the effect accident magnitude has on employee turnover than lower CSR activity does. Figure 3 shows a significantly negative moderating effect on the relationship between employee error and employee turnover in the condition of high CSR activity. That is, the positive impact of employee error caused accidents on employee turnover weakens for companies which undertake more CSR activities.

Discussion

This study sheds light on the impacts of companies' innovation initiatives on employee turnover after safety accidents. Using 120 safety accidents which occurred in China's listed manufacturing companies, we explored the relationship between accident magnitude, employee error, R&D spending, CSR activity and employee turnover. The empirical results suggest that the effects of innovation initiatives on employee turnover following the accident are more complex than previously understood.

First, we use accident attributes as the antecedent variables to investigate the effects of safety accidents on employee turnover. The results indicate that accident magnitude and employee error both increase the turnover rate of production employees in the year following the accident. In other words, safety accidents which result in serious casualties or are due to employee errors will trigger the departure of other employees from the company. These findings enhance the current understanding of the relationship between safety accidents and employee turnover (Bell and Grushecky, 2006). They also enrich the study of the causes of collective turnover by adding a safety accident perspective (Hancock *et al.*, 2017).

The examination of the companies' innovation initiatives reveals patterns that are relevant to research on company innovation and the growing literature on human resources management. A new insight provided by this study is that the companies' technical innovations (i.e. R&D spending) would increase the negative impact of the accident magnitude on employee behavior and aggravate employee turnover. When a safety accident occurs in a company, the occupational safety and health of its employees are often seriously threatened.

Employees will worry about their personal safety and reduce their trust in the company (O'Toole, 2002). In poor safety circumstances, technical innovation introduced by the affected company not only brings new work challenges to employees, but also makes the production environment more complex and unbalanced. Therefore, companies engaged in technical innovation initiatives after safety accidents will face higher levels of employee turnover. Conversely, companies' management innovation initiatives (i.e. CSR activities) significantly reduce the negative impact of accident magnitude and employee error and help the affected companies retain production employees. A possible explanation is that CSR activities help manage social evaluations, augment reputation, or can alter stakeholders' negative judgments after a negative event (Lee *et al.*, 2013). The affected companies can use CSR activities to eliminate the expectation gap with employees and to meet societal perceptions.

Additionally, the results show that past negative events of the affected company positively affect employee turnover, while past employee turnover negatively affects employee turnover in the year after the accident. These findings suggest that past negative events may have a negative impact on the company's overall image. Once a safety accident occurs, employees of companies with more negative events in the past are more likely to leave. By comparison, companies with higher levels of employee turnover in the accident year usually take measures to communicate with employees. These employee-related measures can reduce employee turnover in the year following the accident.

Implication and limitation

By studying the safety accidents in Chinese listed manufacturing companies, this study explores the strategies to manage employee turnover. The findings have both academic and practical implications. Moreover, this study contributes to the literature by linking human resource management with crisis management and by providing insights about strategies for managing employee turnover (Burt *et al.*, 2009). Furthermore, by exploring the impact of the companies' innovation initiatives (i.e. technical innovation and management innovation) on employee behavior after an accident, it enriches the organizational innovation management literature (Ling and Nasurdin, 2010).

In addition, this study extends practical implications for companies to better cope with the aftermath of safety accidents and retain employees. First, since safety accidents have negative effects on many aspects of the company, managers are strongly advised to pay attention to safety management in routine times and avoid the occurrence of major safety accidents. For example, strengthening safety education, conducting safety inspections on a regular basis and improving the safety management systems are effective ways to reduce the risk of accidents. Second, managers should recognize the impact a safety accident has on production employees and implement appropriate innovation initiatives to communicate with them. According to our research findings, managers should not prioritize technical innovation initiatives after serious safety accidents, but instead create a stable work environment and harmonious internal atmosphere. Moreover, managers could promote employee-related CSR activities after the accident to repair their relationship with the employees, strengthen their organizational commitment and enhance their job satisfaction, which, in turn, improves their loyalty and reduces turnover intentions. Finally, managers should regularly monitor employee issues to ensure occupational safety initiatives remain relevant and up-to-date.

Limitations in the current study, however, should also be acknowledged. First, the sample of this study involves only the listed companies in China, which are more visible and accessible to the public. This may limit the generalizability of the findings. Future studies could consider the representation of non-listed companies. While the findings show that management innovation (i.e. employee-related CSR activities) would be helpful in managing safety accidents and reduce employee turnover, it is not possible to ascertain whether the

involved companies should use CSR activities as strategic practices. Future research could add to the findings of the current study by revealing the motivations of managers for implementing CSR activities. Another area of future research is to explore these issues outside China (Chin *et al.*, 2018), which would allow for drawing international comparisons.

References

Amponsah-Tawiah, K. and Mensah, J. (2016), "Occupational health and safety and organizational commitment: evidence from the Ghanaian mining industry", *Safety and Health at Work*, Vol. 7 No. 3, pp. 225-230.

Andrews, M.C., Kacmar, K.M. and Kacmar, C. (2014), "The mediational effect of regulatory focus on the relationships between mindfulness and job satisfaction and turnover intentions", *Career Development International*, Vol. 19 No. 5, pp. 494-507.

Bell, J.L. and Grushecky, S.T. (2006), "Evaluating the effectiveness of a logger safety training program", *Journal of Safety Research*, Vol. 37 No. 1, pp. 53-61.

Birkinshaw, J., Hamel, G. and Mol, M.J. (2008), "Management innovation", *Academy of Management Review*, Vol. 33 No. 4, pp. 825-845.

Bode, C., Singh, J. and Rogan, M. (2015), "Corporate social initiatives and employee retention", *Organization Science*, Vol. 26 No. 6, pp. 1702-1720.

Burt, C.D., Chmiel, N. and Hayes, P. (2009), "Implications of turnover and trust for safety attitudes and behaviour in work teams", *Safety Science*, Vol. 47 No. 7, pp. 1002-1006.

Casale, G. and Zhu, C. (2013), *Labour Administration Reforms in China*, International Labour Office, Geneva.

Cheng, G.H.L. and Chan, D.K.S. (2008), "Who suffers more from job insecurity? A meta-analytic review", *Applied Psychology*, Vol. 57 No. 2, pp. 272-303.

Chin, T. and Rowley, C. (2018), "Challenges for manufacturing in China", in Chin, T. and Rowley, C. (Eds), *The Future of Chinese Manufacturing: Employment and Labour Challenges*, Elsevier, Amsterdam, pp. 5-24.

Chin, T., Rowley, C., Redding, G. and Wang, S. (2018), "Chinese strategic thinking on competitive conflict: insights from Yin-Yang harmony cognition", *International Journal of Conflict Management*, Vol. 29 No. 5, pp. 683-704.

Crossan, M.M. and Apaydin, M. (2010), "A multi-dimensional framework of organizational innovation: a systematic review of the literature", *Journal of Management Studies*, Vol. 47 No. 6, pp. 1154-1191.

Daft, R.L. (1978), "A dual-core model of organizational innovation", *Academy of Management Journal*, Vol. 21 No. 2, pp. 193-210.

Damanpour, F., Szabat, K.A. and Evan, W.M. (1989), "The relationship between types of innovation and organizational performance", *Journal of Management Studies*, Vol. 26 No. 6, pp. 587-602.

Fabiano, B., Currò, F. and Pastorino, R. (2004), "A study of the relationship between occupational injuries and firm size and type in the Italian industry", *Safety Science*, Vol. 42 No. 7, pp. 587-600.

Floyd, K., Ramirez, A. Jr and Burgoon, J.K. (1999), "Expectancy violations theory", in Guerrero, L.K., DeVito, J.A. and Hecht, M.L. (Eds), *The Nonverbal Communication Reader: Classic and Contemporary Readings*, 2nd ed., Waveland Press, Prospect Heights, IL, pp. 437-444.

Flynn, P.M. (1988), *Facilitating Technological Change: The Human Resource Challenge*, Ballinger Publishing Company, Cambridge, MA.

Foong-Ming, T. (2008), "Linking career development practices to turnover intention: the mediator of perceived organizational support", *Journal of Business and Public Affairs*, Vol. 2 No. 1, pp. 1-16.

Gautun, H. and Hagen, K. (2010), "How do middle-aged employees combine work with caring for elderly parents?", *Community, Work & Family*, Vol. 13 No. 4, pp. 393-409.

Green, W., Czernkowski, R. and Wang, Y. (2009), "Special treatment regulation in China: potential unintended consequences", *Asian Review of Accounting*, Vol. 17 No. 3, pp. 198-211.

Greenhaus, J.H. and Kossek, E.E. (2014), "The contemporary career: a work–home perspective", *Annual Review of Organizational Psychology and Organizational Behaviour*, Vol. 1 No. 1, pp. 361-388.

Greenwood, M. (2007), "Stakeholder engagement: beyond the myth of corporate responsibility", *Journal of Business Ethics*, Vol. 74 No. 4, pp. 315-327.

Gucer, P.W., Oliver, M. and McDiarmid, M. (2003), "Workplace threats to health and job turnover among women workers", *Journal of Occupational and Environmental Medicine*, Vol. 45 No. 7, pp. 683-690.

Hancock, J.I., Allen, D.G. and Soelberg, C. (2017), "Collective turnover: an expanded meta-analytic exploration and comparison", *Human Resource Management Review*, Vol. 27 No. 1, pp. 61-86.

Hausknecht, J.P. and Trevor, C.O. (2011), "Collective turnover at the group, unit, and organizational levels: evidence, issues, and implications", *Journal of Management*, Vol. 37 No. 1, pp. 352-388.

Hayes, A.F. (2013), *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, Guilford Press, New York, NY.

Heavey, A.L., Holwerda, J.A. and Hausknecht, J.P. (2013), "Causes and consequences of collective turnover: a meta-analytic review", *Journal of Applied Psychology*, Vol. 98 No. 3, pp. 412-453.

Hofmann, D.A., Burke, M.J. and Zohar, D. (2017), "100 years of occupational safety research: from basic protections and work analysis to a multilevel view of workplace safety and risk", *Journal of Applied Psychology*, Vol. 102 No. 3, pp. 375-388.

Ito, J.K. and Brotheridge, C.M. (2012), "Work-family and interpersonal conflict as levers in the resource/demand-outcome relationship", *Career Development International*, Vol. 17 No. 5, pp. 392-413.

Jamali, D. (2008), "A stakeholder approach to corporate social responsibility: a fresh perspective into theory and practice", *Journal of Business Ethics*, Vol. 82 No. 1, pp. 213-231.

Joyner, B.E. and Payne, D. (2002), "Evolution and implementation: a study of values, business ethics and corporate social responsibility", *Journal of Business Ethics*, Vol. 41 No. 4, pp. 297-311.

Katsakiori, P., Sakellaropoulos, G. and Manatakis, E. (2009), "Towards an evaluation of accident investigation methods in terms of their alignment with accident causation models", *Safety Science*, Vol. 47 No. 7, pp. 1007-1015.

Khanzode, V.V., Maiti, J. and Ray, P.K. (2012), "Occupational injury and accident research: a comprehensive review", *Safety Science*, Vol. 50 No. 5, pp. 1355-1367.

Latham, S.F. and Braun, M. (2009), "Managerial risk, innovation, and organizational decline", *Journal of Management*, Vol. 35 No. 2, pp. 258-281.

Lee, E.M., Park, S.Y. and Lee, H.J. (2013), "Employee perception of CSR activities: its antecedents and consequences", *Journal of Business Research*, Vol. 66 No. 10, pp. 1716-1724.

Lee, S.H. and Jeong, D.Y. (2017), "Job insecurity and turnover intention: organizational commitment as mediator", *Social Behavior and Personality: An International Journal*, Vol. 45 No. 4, pp. 529-536.

Lee, T.W. and Mitchell, T.R. (1994), "An alternative approach: the unfolding model of voluntary employee turnover", *Academy of Management Review*, Vol. 19 No. 1, pp. 51-89.

Ling, T.C. and Nasurdin, A.M. (2010), "Human resource management practices and organizational innovation: an empirical study in Malaysia", *Journal of Applied Business Research*, Vol. 26 No. 4, pp. 105-116.

Lips-Wiersma, M. and Hall, D.T. (2007), "Organizational career development is not dead: a case study on managing the new career during organizational change", *Journal of Organizational Behavior*, Vol. 28 No. 6, pp. 771-792.

Morrell, K., Loan-Clarke, J., Arnold, J. and Wilkinson, A. (2008), "Mapping the decision to quit: a refinement and test of the unfolding model of voluntary turnover", *Applied Psychology*, Vol. 57 No. 1, pp. 128-150.

National Academies of Sciences, Engineering and Medicine (2017), *Information Technology and the U.S. Workforce: Where Are We and Where Do We Go From Here?*, The National Academies Press, Washington, DC.

Neter, J., Wasserman, W. and Kutner, M.H. (1985), in Richard, D. (Ed.), *Applied Linear Statistical Models*, 2nd ed., Irwin, Homewood, IL.

Newman, K.L. (2011), "Sustainable careers", *Organizational Dynamics*, Vol. 40 No. 2, pp. 136-143.

Niza, C., Silva, S. and Lima, M.L. (2008), "Occupational accident experience: association with workers' accident explanation and definition", *Safety Science*, Vol. 46 No. 6, pp. 959-971.

Noack, D., Miller, D.R. and Smith, D. (2017), "Let me make it up to you: understanding the mitigative ability of corporate social responsibility following product recalls", *Journal of Business Ethics*, pp. 1-16, available at: https://doi.org/10.1007/s10551-017-3639-7

Odero, W., Khayesi, M. and Heda, P.M. (2003), "Road traffic injuries in Kenya: magnitude, causes and status of intervention", *Injury Control and Safety Promotion*, Vol. 10 Nos 1–2, pp. 53-61.

O'Toole, M. (2002), "The relationship between employees' perceptions of safety and organizational culture", *Journal of Safety Research*, Vol. 33 No. 2, pp. 231-243.

Pillay, M. (2015), "Accident causation, prevention and safety management: a review of the state-of-the-art", *Procedia Manufacturing*, Vol. 3, pp. 1838-1845, available at: https://doi.org/10.1016/j.promfg.2015.07.224

Raouf, A. (1998), "Theory of accident causes", in Stellman, J.M. (Ed.), *Encyclopedia of Occupational Health and Safety*, 4th ed., International Labour Organization, Geneva, pp. Part VIII-56.6.

Rogers, E.M. (2010), *Diffusion of Innovations*, Simon & Schuster, New York, NY.

Tnay, E., Othman, A.E.A., Siong, H.C. and Lim, S.L.O. (2013), "The influences of job satisfaction and organizational commitment on turnover intention", *Procedia – Social and Behavioral Sciences*, Vol. 97, pp. 201-208, available at: https://doi.org/10.1016/j.sbspro.2013.10.223

Valcour, M. (2007), "Work-based resources as moderators of the relationship between work hours and satisfaction with work-family balance", *Journal of Applied Psychology*, Vol. 92 No. 6 pp. 1512-1523.

Wu, W., Rafiq, M. and Chin, T. (2017), "Employee well-being and turnover intention: evidence from a developing country with Muslim culture", *Career Development International*, Vol. 22 No. 7, pp. 797-815.

Corresponding author

Jiuchang Wei can be contacted at: weijc@ustc.edu.cn