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Outcome-and-behavior-based safety incentive program to reduce accidents: A case study of a fluid manufacturing plant

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ABSTRACT

The study proposed an outcome-and-behavior-based safety incentive program (OBBSIP). The study addressed the limitation of outcome-based program, i.e. accidents underreporting and behavior-based safety program, i.e. not having direct link to safety performance. The OBBSIP has two principles, i.e. an outcome-based approach through tiered incentives and a behavior-based approach through regular peer monitoring and feedbacks on compliance with safety precautions and safe behaviors (SPSB). Its effectiveness is validated through a case study i.e. a field experiment in dairy fluid plants. An AB (baseline-treatment) method was used to compare an experimental plant with a control plant. Results show that the program reduced the number of accident by 75% (measured by claims). The program created a positive work environment through (1) social influence where there was peer pressure to comply with the SPSB to help reduce accidents; (2) outcome feedback from the Bingo board updates, and positive and negative feedbacks on compliance/non-compliance with the SPSB; and (3) social recognition e.g. team members' praises and small incentive awards. Prior literature provided explanation for the program's effectiveness, i.e. the combination of social influence, feedback and tiered incentive awards with achievable goals. The program is low cost, easy to understand and effective in reducing accidents.

1. Introduction

There are many approaches to improve workforce safety in manufacturing. Erdinç and Yeow (2011) and Drury (2000) proposed an ergonomics approach to reduce work related musculoskeletal disorders and improve workforce safety. Another approach is to introduce a safety incentive program (SIP) (Sparer and Dennerlein, 2013; Choi et al., 2012; Toft, 2006; Gambatese, 2004; Gilkey et al., 2003; Sims, 2002; Cooper and Phillips, 1994). SIPs are programs where rewards are given by companies to encourage safety behavior in organizations. There are 10 types of incentives identified by Toft (2006) and Sims (2002) i.e. stock ownership, special assignments, training and education, recognition, time off, advancement, social gatherings, increased autonomy, prizes, and money. Haynes et al. (1982) were one of the early pioneers in this research area where they conducted a field research at a transport company and found that the combination of social influence, feedback and incentives reduced accidents among urban transit drivers. Aksorn and Hadikusumo (2008) and Hasan and Jha (2013) studied the construction industry in Thailand and India and found that SIP has potential to improve safety performance. However, these studies did not provide important details i.e. how were the SIPs introduced and implemented?

Sparer and Dennerlein (2013) classified SIP into leading and lagging safety performance metric programs. Leading safety performance metric programs include metrics that could predict the future safety performance such as percentage of safety audit, inspection and walkthrough (Dennerlein et al., 2009; Mikkelsen et al., 2010) compliance whereas lagging safety performance metric programs make use of the past safety performance metrics to reward workers (Mohamed, 2003). Gambatese (2004) classified the former as behavior-based SIPs (Geller, 2004a) and the latter as outcome-based SIPs (Geller, 2004b). Behavior-based SIPs are programs that reward workers for their safe behaviors (with the hope of that the behavior will result in improved safety performance) which can be measured through audits (Al-Hemoud and Al-Asfoor, 2006; Cooper, 2009; Hurst and Palya, 2003; Geller, 2004a, 1999, 1998). On the other hand, outcome-based SIPs are programs that reward workers for their safety performances such as number of days without accidents. There are strengths and weaknesses for both programs. The outcome-based SIPs are directly measuring the safety performance indicators, e.g. the

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accident reports and the injury claims, which are the direct concerns of the stakeholders of any company. However, such programs may cause under-reporting due to peer pressure and the reluctance to forgo the incentives (Hurst and Palya, 2003; Fell-Carson, 2004; Sparer and Dennerlein, 2013). As for the behavior-based SIPs, they are focused on prevention of accidence and reduction of risky behaviors which can be measurable through audits of safe behaviors (Sparer and Dennerlein, 2013; Dennerlein et al., 2009; Mikkelsen et al., 2010). However, the weakness is the relationship between safe behaviors and safety performance cannot be ascertained (Sparer and Dennerlein, 2013). Unlike outcome-based SIP, the key performance indicator is safe behavior (not the number of accidents/incidence reports). Additionally, Sparer and Dennerlein (2013) highlighted the difficulty of establishing the right safety behavior to measure and the setting of threshold/goals for the incentives. This is because it is difficult to ascertain which behaviors are important determinants to safety performance and how to assign a weighting to their importance. The current study addressed these gaps, i.e. to develop a new SIP that combines the strengths of both behavior-based and outcome-based SIPs. The objective was to investigate the effectiveness of the new SIP i.e. tiered monetary incentives coupled with clear expected safe behaviors named outcome-and-behavior-based safety incentive program (OBBSIP). This paper presents a case study of field experiment of the OBBSIP at fluid manufacturing plants. A field experiment was conducted because it provided high external validity (Erdinç and Yeow, 2011).

1.1. Outcome-and-behavior-based safety incentive program (OBBSIP) principles

There are two principles in this program. The first principle was the outcome-based approach where tiered incentives were given based on safety performance, that is, the duration of accident free period measured by from the last worker accident compensation claim/s (WACC). The monetary incentive given should be small to discourage report avoidance due to social pressure of teammates. If the incentive is a large sum of money, teams may pressurize their teammate not to report an accident so as the team would not be disqualified and lose the incentive. Therefore, the incentive should be some sum and viewed as a token, i.e. as a form of social recognition for a team's achievement (Hurst and Palya, 2003; Fell-Carson, 2004). In this case, there were 3 tier incentives (i.e. $20, $100, and $100) that were too small for an injured worker to justify for not filing the WACC and for the teammates to socially coerce the injured worker not to make the claim. Besides, there was no guarantee that the teammates would get the Tier 1, Tier 2 and 3 rewards, as they would have to win the Bingo game in Tier 1 or have to be picked in random drawings in the Tiers 2 and 3. The tiered incentives were based on Bateman and Ludwig's (2004) principle of setting multiple levels of achievable incentives, with each one harder to attain than the previous. The principle was tested and found effective in motivating behavior in a large industrial distribution center. For the 1st tier, if all members in a small team went a week without any WACC, the team stood a chance to win an award in a Bingo game. The first tier should be achievable with reasonable effort and the subsequent tiers would require more effort. For the 2nd tier, if all teams in an area went a full month without any WACC, then ten names were randomly drawn for $100 gift certificates. For the 3rd tier, if all teams in an area went a full 3 months without any WACC, then fifty names were randomly drawn for $100 gift certificates. Table 1 summarizes the details of the 3-tier incentives.

The second principle, is the behavior-based approach where a set of expected safety precautions and safe behaviors (SPSB) were attached to this program and team members were encouraged to monitor and discuss regularly on team members' compliance and provide feedback. Table 2 summarizes the expected SPSB. The rationale is that in many workplaces, supervisors found it difficult to monitor/audit the SPSB of their workers given the large number of employees as well as the other duties and responsibilities they have to carry out (Ludwig and Goomas, 2007). Additionally, it is costly to perform such a task, which is one of the key weaknesses of behavior-based safety programs (Sparer and Dennerlein, 2013; Brown and Barab, 2007). This principle makes use of social influence (Thomae, 1972; Geller, 1998; Fell-Carson, 2004; Burns et al., 2006; Marquardt et al., 2012), that is, the influence of the teammates to 'look after' and monitor each other's SPSB so as to avoid accidents. Praises (social recognition) and reprimands were encouraged to be exchanged among group members daily in conjunction to viewing their safety outcomes (Safety Bingo board, days since last accidents).

2. Case description

2.1. Participants and setting

This study involved an experimental and a post hoc comparison fluid manufacturing plants. The experimental plant, located on the west coast of the United States served over 3000 retail customers, distributing fluid products from its 22,000 square foot cooler. This facility operated 3 shifts, 7 days a week. Out of 502 employees at the plant, there were 362 people in the 'production' workforce (that is, people involved in the manufacturing, bottling, packaging, picking, and loading of fluid product), 82 were drivers, 15 were maintenance and repair, 38 were front-office associates (e.g. clerical, sales, order entry), and 5 worked in the lab (e.g. quality control testing). Workers ranged in age from 19 to 62 years, with a mean age of 26.7, with a mean seniority of 8.1 years. The work-force had been on the payroll ranging from 3 months to 22 years.

The post hoc comparison fluid manufacturing plan, also owned and operated by the fluid manufacturing company as the experimental plant, was located in the south-west United States and served over 3200 retail customers distributing milk from its 18,000 square foot cooler. This facility operated 3 shifts, 7 days a week. Out of 469 employees at the facility, there were 338 in the 'production' workforce, 101 drivers, 7 were in maintenance and repair, 18 front-office associates, and 5 in the lab. Workers ranged in age from 22 to 63 years, with a mean age of 28.2 years. The work-force had been on the payroll ranging from 1 month to 40 years. The plant is equivalent because it is owned by the same company and was similar in terms of machines, processes, resources, management and products manufactured and has about the same number of production workers.

At both fluid manufacturing plants white milk is the primary fluid manufactured, (but also includes flavored milk such a chocolate milk and fruit drinks such as grape and orange drinks). Raw milk is received via tanker trucks from farms or co-ops into silos. After storage, the milk is separated from the cream where the raw cream is stored in-house or sold. Cream is then re-added back to the milk to produce whole, 2%, 1%, or skim milk and is pasteurized and homogenized into tanks. Before or after pasteurization, vitamins are added. After pasteurization and homogenization, the milk goes to a filler tank where it is then bottled, packaged, palletized, refrigerated and available for immediate distribution and delivery the next day. Lab testing for component testing and quality analysis was done every day.

2.2. Safety hazards

Both experimental and comparison plants face similar safety hazards including slips and falls caused by wet or soapy floors,