AN EXAMINATION OF THE YARDMASTER'S ROLE IN RAILROAD YARD SAFETY

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The rate of U.S. railroad yard switching accidents is more than 10 times the rate of accidents on other-than-yard track. Railroad safety and accident prevention has traditionally focused on the crews that operate on-track equipment, yet accidents usually have multiple contributing factors, including supervisory and organizational factors. This paper describes the results of focus groups with 56 railroad yardmasters to identify yardmaster-related factors that have the potential to affect yard safety. Yardmasters are the frontline supervisors of railroad yards: they plan, control, and manage track use in switching yards and are responsible for the operating crews in the yard. Focus group questions fell into five major topic groupings: training and experience; communications and information flow; stressors, distractions, workload, and difficult aspects of the job; fatigue, staffing, and work schedules; and best practices and lessons learned. Results illuminate a number of areas that, if corrected, may result in improved yard safety and operations.

INTRODUCTION

Analysis of Federal Railroad Administration (FRA) accident data for 2004 (FRA, 2006; preliminary data) show that the rate of railroad yard switching accidents is more than 10 times the rate of accidents on other-than-yard track: 22.46 yard accidents per million yard switching miles versus 2.11 accidents per million train miles. While the other-than-yard track accident rate has declined over the last several years (down 9.2 percent between 2001 and 2004), the yard accident rate has increased over 22 percent between 2001 and 2004. Efforts to improve railroad safety, therefore, must include reducing accidents and incidents in railroad classification (switching) yards.

Railroad safety and accident prevention has traditionally focused on the crewmembers that operate on-track equipment (e.g., see Gamst, 2004). Accidents usually have multiple causes, however, and some are associated with factors beyond the crewmembers. A common approach to understanding human error within complex systems, known as the Swiss cheese model of error (Reason, 1990), depicts errors as arising from holes in an organization's defenses at several levels, beginning with the operator and working up through the organization. Reason (1997, p. 126) explains, "Errors…are shaped and provoked by upstream workplace and organizational factors." Petersen (2003) refers to these upstream factors as *traps* that set up the operator to fail. According to Reason's model, an operator's active failures combine with upstream, latent factors to result in an accident. Accidents are prevented by defenses in one or more of the organizational levels. Effective accident prevention, therefore, should focus on identifying a broad range of factors that contribute to an accident, from an operator's actions before the accident occurs, to supervisory factors, to organizational procedures.

Reinach and Viale (2006) recently investigated six yard switching accidents and found that each accident was associated with multiple contributing factors at multiple levels, including operator, supervisory and organizational factors. In their research, Reinach and Gertler (2002) also recognized the contribution of multiple contributing factors to railroad yard safety when they collected perspectives on how to improve yard safety from both yard officials and operating crews.

One supervisory layer within railroad yards that has not been systematically examined to date is that of yardmasters. Yardmasters plan, control, and manage track use in railroad switching yards (see Figure 1) and are responsible for inbound/outbound trains and switch crews operating in the yard. Several yardmasters often work together to supervise and run a large yard. Alternatively, one yardmaster may be responsible for multiple small yards. Yardmasters are the frontline supervisors of railroad yards.

Figure 1. Railroad classification (switching) yard

Yardmasters have numerous tasks and responsibilities that have the potential to result in temporary task overload and distraction. Furthermore, the yard environment is fast-paced and dynamic, with constant changes to train make-ups, track occupancies and assignments, track conditions, and traffic flow. In addition, since yardmasters are not normally covered under any Federal work hour restrictions, they may work up to 16 hours per day. These factors, plus possible mental fatigue,

can lead to errors and increase the risk of hazardous yard moves (e.g., conflicting instructions from the yardmaster to two different yard crews), incorrect or hazardous train consist arrangements, and possible negative health and well-being effects on yardmasters. Each has the potential to lead to an accident or casualty. Given yardmasters' critical role as frontline yard operations supervisors, the goal of this study was to conduct exploratory research to identify yardmaster-related factors and conditions that have the potential to compromise railroad yard safety. No public research to date has explicitly focused on the role of the yardmaster in the safety of switching yards. A search of the Transportation Research Information Services (TRIS) online transportation research database (available at http://trisonline.bts.gov/search.cfm) for the terms *yardmaster* or *yard master* yielded a total of 8 articles out of almost 450,000 records. All eight focused on modeling or analysis of railroad operations, including railroad yard operations, rather than on yard safety. In addition, all 8 reports were published more than 20 years ago, between 1973 and 1983.

METHODS

Three focus groups were conducted with yardmasters in each of three different cities across the United States. Researchers worked with two labor unions that represent yardmasters to recruit participants. Each focus group lasted 2 hours and was guided by the same pre-established set of questions.

Focus groups are a qualitative data collection research method in which open-ended questions are posed to small groups of individuals. Participants are encouraged to answer from their own experience, and group consensus is not sought. The advantages of focus groups are in the richness of information gathered in the group setting and the broad range and depth of information and insights, sometimes unanticipated, that can be obtained from participants.

Between August and December 2005, 56 yardmasters from 5 U.S. Class I railroads participated in 9 focus groups. Of the 56 yardmasters, 3 were women. Participants ranged in age from 27 to 60 (average 45 years), had a range of 3 to 41 years of railroad industry experience (average 21 years), and had a range of 1 to 36.5 years of yardmaster experience (average 13 years). Fifty-one of the 56 participants (91 percent) reported working full time as a yardmaster. Ninety-three percent of all participants worked another railroad craft before becoming a yardmaster; a majority had prior experience as switchmen and/or clerks.

RESULTS

Focus group questions concentrated around five major topic groupings:

- Training and experience
- Communications and information flow
- Stressors, distractions, workload, and difficult aspects of the job
- Fatigue, staffing, and work schedules
- Best practices and lessons learned

Results are organized according to topic and represent a broad sampling of the information that was collected from the focus groups.

Training and experience. Participants explained that their training primarily involved unstructured, informal on-the-job training (OJT). Some newer yardmasters also received classroom training on the mechanics of using the railroad's train management computer system. Participants noted that, in the past, this unstructured OJT was acceptable because experienced managers were always around to field questions and provide direction to compensate for the unstructured OJT. More recently, however, participants note that local managers have little railroad operations experience, including yard operations experience. Thus, while training has generally remained the same over time, the support structure has changed.

Most participants worked as clerks or switchmen before becoming yardmasters, and they felt this experience was essential at preparing them to do the job. Experience as a clerk helped provide an understanding of how trains are processed. Experience as a switchman helped participants learn the yard layout and how to switch cars, and it enabled participants to get to know some of the crews that they were now supervising.

Participants also identified a combination of technical and managerial knowledge, skills, abilities, and other attributes that they felt were critical to becoming a competent yardmaster: the ability to multitask; organizational and clerical skills; the ability to plan, coordinate, and prioritize; supervisory skills; patience; flexibility; and computer skills. Some of these suggestions may be incorporated into future yardmaster training programs or used as prerequisites to better prepare yardmasters for the job, especially given the change in support structure that was identified.

Lastly, participants identified several means of enhancing yardmaster training. These included job skill and procedural improvements. Job skill training suggestions included improved computer and communication skills training and ensuring that yardmasters are knowledgeable of all crafts and jobs with which they will interact. Procedural improvements included use of a formal OJT qualification program and tabletop simulations to enhance yardmaster decision making.

Communications and information flow. Given yardmasters' central role as managers of all yard activity, effective communication and information flow are essential to yard operations and safety. Participants noted that they speak with a large and diverse number of individuals on a daily basis, including representatives from their own railroad, other railroads, customers, and contractors. Those with whom yardmasters communicate include subordinates, peers, and several levels of superiors. Participants identified a wide array of factors that contributed to poor communication and information flow. These included management-related factors (e.g., multiple managers that request the same information, receiving incomplete information from managers), employee experience (e.g., the more experience a yard switch crew has, for example, the easier it is to communicate with them), technological factors (e.g., needing to monitor several forms

of communication), and procedural issues (e.g., FRA radio rules).

Participants suggested a number of ways to improve communication and information flow. These include improvements to radio equipment and FRA radio rules, reducing yardmaster responsibilities, increasing yardmasters' authority in yards, streamlining communications to and from the yardmaster, providing all yard-related information to the yardmaster, and providing this information in a timely manner.

Stressors, distractions, workload, and difficult aspects of the job. Participants identified a number of sources of stress. These included high manager expectations and demands; negative management interaction; high management rotation and inexperience; task and information overload; forced overtime and staffing shortages; productivity pressure; inadequate resources (e.g., poorly maintained track, too few locomotives available); inexperienced yard switch crews; poor communication with railroad dispatchers, managers, and yard switch crews; and a lack of opportunity to take a break.

Participants also identified a variety of sources of distraction. These included unrelated conversations within earshot, incoming communications (e.g., interrupting strategy planning), delays associated with moving trains in and out of the yard, mandatory Federal and carrier rule violation testing, changes to plans, malfunctioning on-track equipment, weather, and switch crew-related distractions.

Participants also suggested a number of ways to reduce stress, distractions, difficulties, and workload. Suggestions concentrated around four major areas: (1) personnel and staffing, (2) interaction and communication with others, (3) equipment and facilities, and (4) practices and procedures. Suggestions included adding clerks and yardmasters to distribute workload; reducing the number of managers with whom yardmasters interact; increasing positive interactions with managers; improving the timeliness of information communicated to the yardmaster; increased reliability and maintenance of track, on-track equipment, and office equipment and furniture; changes to work schedule practices; and providing for a meal period or other built-in break.

Fatigue, staffing, and work schedules. Participants were asked to what extent fatigue was a problem and to suggest ways to reduce fatigue. The most significant problem identified by participants was forced overtime, where a yardmaster is required to work beyond his/her 8-hour day, for up to another 8 hours. Although some participants felt that this was not a problem or that yardmasters had a choice to turn down the additional work, a majority of participants indicated that forced overtime does occur, in fact with some predictability (e.g., during the summer, when vacations are taken, resulting in staff shortages in an already thin yardmaster labor pool). Problems that were identified with extended hours included mental exhaustion during an extended shift and post-work fatigue. Several participants explained that, at one time or another, after working an extended shift, they slept in their personal vehicle before traveling home because they were so tired, or they had fallen asleep in their vehicle on the way home after work. Participants noted that, although railroad managers may also work extended hours, they have the opportunity to walk around and take breaks, while yardmasters must remain at their desks the entire time.

Suggestions to reduce fatigue primarily addressed the issue of forced overtime and staffing shortages. Some of these suggestions included: establishing a maximum number of hours that can be worked (8-12 hours was the range of maximum work hours recommended), offering alternate work schedules that allow greater time off after working extended hours, allowing split shifts, providing more than 8 hours rest after working 16 hours, increasing the number of yardmasters available to work, and providing a meal period or rest break where a yardmaster can leave his/her responsibilities for at least 20 minutes.

Best practices and lessons learned. Lastly, participants were asked about what they had learned on the job that would help a new yardmaster work safely and efficiently. Participants offered the following advice: treat people with respect; remember that the safety of the yard crews is the highest priority; be patient; do not try to be everyone's friend; always maintain situation awareness of the yard; be flexible; do your best at work, but leave the job at work once you are done; communicate effectively; and trust your crews.

Participants also offered several other, more general suggestions to improve yard operations and safety. Several suggestions focused on further enhancing a yardmaster's situation awareness of the yard. These included installation of yardmaster-controlled cameras around the yard (some yards have already installed cameras), providing detailed maps of the yard and surrounding area as a job aid (according to participants, maps that include track profiles and layout, old or new, are a rarity), and informing the yardmaster when any employee enters the yard to work.

DISCUSSION

As the frontline supervisor and manager of all yard activity, yardmasters have a significant amount of responsibility for overseeing yard safety. Whereas the accident rate has declined in other areas of the U.S. rail network, the train accident rate in railroad switching yards has increased. Much of the traditional focus on railroad, including yard, safety has concentrated on the on-track crews (e.g., Gamst's "blame it on the 'pin puller'"). However, inadequately prepared yardmasters and inadequate yardmaster work practices, procedures, and resources each have the potential to lead to yard switching train accidents (upstream factors) when yardmasters are working at less than optimal levels. It is important, therefore, to examine these upstream factors to improve yardmaster processes and procedures that may be insufficient or inadequate.

Yardmaster focus groups illuminated a number of areas that, if corrected, could improve yard safety and operations. These include: improved yardmaster training to compensate for the lack of support structure that previously existed; streamlined and improved communication procedures, such as reducing or eliminating unnecessary communication with the yardmaster; improved interactions between yardmasters and managers; increased employee operating experience of both

subordinates (such as yard switch crews) and managers; and elimination or mitigation of forced overtime.

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