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Safe Practices, Operating Rule Compliance, and Derailment Rates Improve at Union Pacific Yards with STEEL Process

SUMMARY

After the success of the Federal Railroad Administration (FRA) Human Factors Program demonstration project at Union Pacific (UP) Railroad's San Antonio Service Unit (SASU), which focused on managers and road crews with a proactive safety risk reduction method called Clear Signal for Action (CSA) [1], the Livonia Service Unit (LVSU) applied the same method to managers and switching-yard crews in Spring 2006, hoping to improve safety and safety culture. The LVSU project, entitled Safety Through Employees Exercising Leadership (STEEL), has focused mostly on the Avondale Yard. CSA combines behavior-based safety, continuous improvement, and safety leadership. With sponsorship from FRA, Behavioral Science Technology Inc. is instructing and advising on the implementation of STEEL. In addition to sponsoring the CSA implementation, FRA is sponsoring a lessons-learned team (LLT) to examine what is necessary to implement CSA successfully, the impact on safety, and what factors help to sustain it. The impact of STEEL on switching-yard crew practices is evaluated in this paper from four sources of data: (1) sampling data collected by workers as part of STEEL, (2) field training exercise (FTX) test results, (3) perceptions of workers and managers as reported in interviews, and (4) human factor derailments.

The midterm results indicate an improvement in switching-yard practices. Sampling data show a significant increase in the percentage of safe behaviors, FTX test results show a significant improvement in the percentage of passes at the Avondale Yard, and in interviews, workers and managers reported similar improvements as well as improved labor-management relations. Moreover, a significant reduction in human factor derailments at Avondale yard suggests improved safety. Overall these midterm results provide promising evidence that the labor and management efforts of STEEL in the Avondale Yard are effective in promoting safer practices, improving labor-management relations, and better safety outcomes.

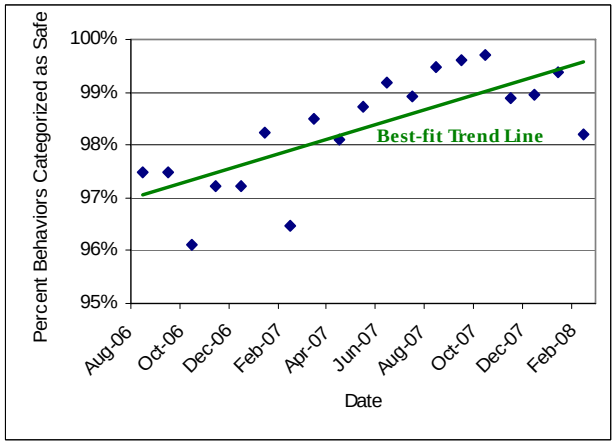

Figure 1. Worker-collected data on switching practices showed a trend toward greater safety.

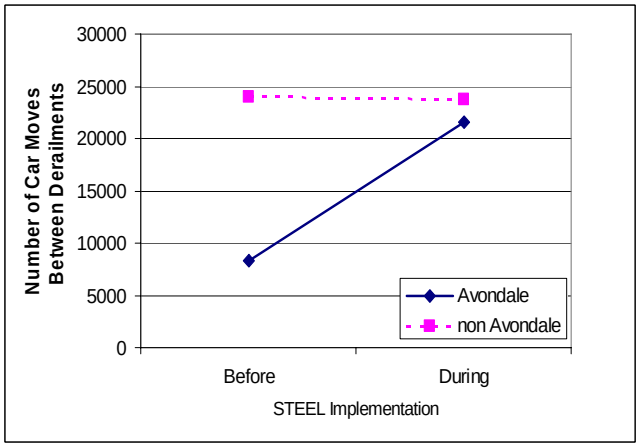

Figure 2. The number of car moves between derailments increased at Avondale compared with other vards.

BACKGROUND

After experiencing success with a new safety program in the San Antonio Service Unit (SASU), called Changing At-Risk Behavior (CAB), which was a demonstration of a Clear Signal for Action (CSA) process [2] for road crews, Union Pacific Railroad (UP), the Brotherhood of Locomotive Engineers and Trainmen (BLET), and the United Transportation Union (UTU), in collaboration with the Federal Railroad Administration's (FRA) R&D Human Factors Program, commenced a second demonstration project, Safety Through Employees Exercising Leadership (STEEL), at UP's Livonia Service Unit (LVSU), focusing on yard crews. Both SASU and LVSU are within UP's Southern Region.

The STEEL demonstration project began at the Avondale Yard in Spring 2006. LVSU is made up of numerous relatively independent switching yards, making a service unit-wide implementation challenging. In contrast, SASU was primarily made up of road operations with more interdependent terminals. The Avondale Yard (Avondale) was selected among other LVSU yards because it had the strongest management and labor support. Lake Charles, Louisiana and Beaumont, Texas have only recently implemented STEEL, and the other yards in the service unit, including Livonia and Alexandria, Louisiana, have not implemented STEEL at all. In this paper, we contrast Avondale's field training exercise (FTX) tests and derailment data with those from other yards in the service unit to determine if any unique effects might be attributable to STEEL.

A joint BLET/UTU steering committee developed a checklist of 18 switching-yard safety practices in seven categories for observation/feedback sessions. One hundred and seventy employees from Avondale, Beaumont, and Lake Charles, out of the combined workforce of 185 at the three locations and 800 for the entire service unit, have been trained in the observation/feedback process. Safety leadership training with service area managers has been completed. Approximately 140 feedback sessions are conducted each month at Avondale, Beaumont, and Lake Charles, a rate well above what was targeted by the steering committee, showing strong participation among workers. Management has been making the work environment safer in response to data supplied by workers. The BLET/UTU steering committee also has removed the barriers to safety over which they have control. [(Sounds awkward recast? Fine recast) The BLET/UTU steering committee also has removed the barriers, therefore improving safety, where they have control.

OBJECTIVES

This paper summarizes the midterm evaluation of STEEL and analyzes changes in worker practices, labor and management relations, and safety levels, using:

- Sampling data collected by workers as part of STEEL,
- FTX test results,
- Perceptions of workers and managers as reported in interviews, and
- Human factor derailments.

METHODS

Worker Peer-to-Peer Feedback

As in SASU, trained workers first observe their fellow workers and, using the checklist developed by the steering committee, give feedback on safe and at-risk behaviors and conditions. Aggregated data from these feedback sessions were analyzed to evaluate changes in practices over time. The percentage of behaviors/conditions regarded as safe among all behaviors in a given month was used as an index of the prevalence of safe yard practices. At the time of this analysis, data from over 322 samples from Avondale were included.

Manager Field Operations Tests

In FTX tests, managers observe train crews, record compliance with various operating rules, and then provide feedback. The aggregated percentage of passes of these tests provides a second measure of worker practices. If STEEL is having an effect, more compliance on FTX tests will be observed. Of particular interest for this evaluation was the percentage of passes of tests focused on operating rules for switching, the primary focus of STEEL. The facilitators identified the rules that most closely corresponded to the STEEL checklist, which we have named "checklist-related FTX tests." If STEEL is effective, then FTX test pass rates for these checklist-related rules should increase at Avondale, especially compared with the rates at other LVSU yards (excluding Beaumont and Lake Charles) that do not have STEEL.

Human Factor Derailments

Human factor derailments have not occurred frequently at Avondale, which is good for the railroad but makes the use of monthly derailment rates with many months of zero occurrences inappropriate for testing for significant improvement. Thus, the variable selected to

test for significant improvement was derailments normalized by the number of car moves between derailments. To obtain this variable, the time between derailments was calculated and then normalized against the number of car moves. This provided a continuous variable, preserving the exact length of time, down to the minute, between consecutive derailments. The analysis included data from January 2005 through November 2007; data from Avondale were compared with those from other yards within LVSU, excluding Lake Charles and Beaumont.

Worker and Manager Interviews

The perspectives of workers and managers were collected during semi-structured interviews of 17 employees and managers who work in the switching yard, many of whom had some knowledge of STEEL. To obtain valuable perspectives that could be used to help improve the implementation, the criteria used for selecting interviewees were that they be respected, have credibility, and be pro-safety (as opposed to pro-labor or pro-management).

Among other issues, the interviews covered the perceived impacts due to STEEL. Three researchers independently categorized the quotes obtained during the interviews into themes or summary topics. Researchers then conferred to cross-check and consolidate themes.

MIDTERM RESULTS

More Safe Practices Were Observed by Workers

Figure 1 shows a strong positive trend, with safe practices improving from month to month on all checklist items combined since the beginning of STEEL until the most recently acquired worker data. Behaviors and conditions labeled "safe" increased from about 97 percent to 99.6 percent ($r = 0.746$, $n = 19$, $p < 0.0002$). When a mathematically best-fit straight line is plotted on the monthly percentage of safe data, it indicates that, on average, risky behavior has become one-seventh as common, decreasing from approximately 2.9 percent to 0.4 percent of all observed behavior.

Implementation includes calibration and coaching processes to maintain checklist consistency and accuracy over time; these processes have proved to be generally effective. An independent analysis of data from training and coaching indicates sufficient interobserver reliability (over 80 percent agreement among pairs of workers observing the same work activities in training videos) and no drift in judgment over time in safe and at-risk behaviors, as indicated by comparing workers' ratings of videos of safe and at-risk behaviors.

Field Tests Showed More Rules Compliance

As shown in Figure 3, at Avondale the percentage of passes of management-conducted field tests for checklist-related operating rules has, on average, been significantly higher *during* STEEL (M = 99.7%) than *before* STEEL (M = 98.0%). Furthermore, the improvements at Avondale were significantly better than those at other yards in LVSU that did not have STEEL ($t = 4.809$, $n = 1{,}735$, $p < 0.0001$). Results indicated that FTX test failures of checklist-related operating rules were observed one-seventh as often during STEEL than before STEEL was implemented (see Figure 3). The fact that other, non-STEEL yards did not similarly improve suggests STEEL rather than other factors at LVSU promoted the improvements at Avondale.

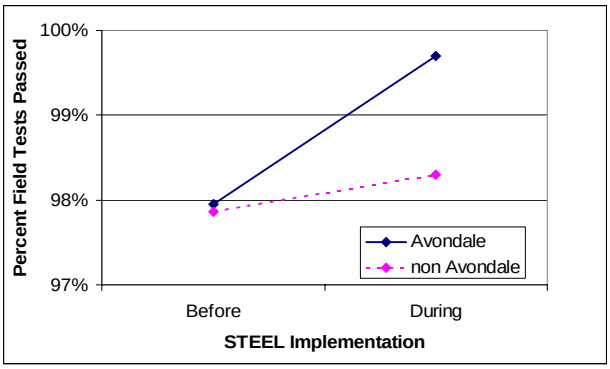

Figure 3. Average percentage of passes of checklist-related FTX tests before and during STEEL at the Avondale Yard.

Human Factor Derailments Rates Improved

Figure 2 shows that the safety level at Avondale, as measured by the number of car moves between derailments, improved significantly, from approximately 8,000 to 21,000 ($t = 2.38$, $n = 35$, $p < 0.05$ based on log transformation to achieve a normal distribution), while non-Avondale yards (excluding Beaumont and Lake Charles) did not show a significant increase in the number of car moves between derailments. This suggests a nearly threefold increase in the number of car moves between derailments during STEEL's implementation. The increase was greater at Avondale than at other yards (interaction effect between STEEL and Avondale, $F = 3.608$, $n = 181$, $p = 0.059$), which is close to significant, suggesting something unique may be occurring at Avondale compared with other yards in the service unit.

Interviews Revealed Positive Impacts

All workers and most managers reported, during interviews, a high acceptance of STEEL. Factors mentioned as contributing to its acceptance were support by local Avondale union officials, no retribution to any workers, the visible removal of facility-related barriers, and the high percentage of STEEL-trained employees. Workers and managers also reported positive impacts that could be attributed to STEEL. The impacts most often cited were improvements in work practices, general safety awareness, labor-manager relations, and barrier removal. These data confirmed what was seen with sampling and FTX data.

CONCLUSIONS

Overall, STEEL implementation at Avondale, as measured by employee acceptance and management commitment, seems to be effective. Systematic analysis of switching-yard practices, using worker sampling and manager field test data, **suggest** [(correct word?) verify?) improvement. Interviews with workers and managers confirmed this improvement and pointed to other positive effects. An increase in the number of car moves between derailments suggests the safety level has improved. The significant quantitative improvements seen in FTX tests and derailments at Avondale were not observed at the other yards in LVSU, suggesting something unique was occurring and that it might be attributable to management and labor efforts related to STEEL.

FUTURE DIRECTION AND ACTIVITIES

Future analyses will evaluate impacts further "downstream" from work practices, such as longer-term effects on cost, productivity, and profitability. These impacts will be examined in all the yards where STEEL is implemented, including Beaumont, Lake Charles, Livonia, and Alexandria. Given the decentralized nature of the service unit, it is hoped that the objective of a service unit-wide implementation is achieved.

ACKNOWLEDGMENTS

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