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Action Learning: A New Method to Increase Tractor Rollover Protective Structure (ROPS) Adoption

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Abstract

Action Learning is a problem-solving process that is used in various industries to address difficult problems. This project applied Action Learning to a leading problem in agricultural safety. Tractor overturns are the leading cause of fatal injury to farmworkers. This cause of injury is preventable using rollover protective structures (ROPS), protective equipment that functions as a roll bar structure to protect the operator in the event of an overturn. For agricultural tractors manufactured after 1976 and employee operated, Occupational Safety and Health Administration (OSHA) regulation requires employers to equip them with ROPS and seat belts. By the mid-1980s, US tractor manufacturers began adding ROPS on all farm tractors over 20 horsepower sold in the United States (http://www.nasdonline.org/document/113/d001656/rollover-protection-for-farm-tractor-operators.html). However, many older tractors remain in use without ROPS, putting tractor operators at continued risk for traumatic injury and fatality. For many older tractor models ROPS are available for retrofit, but for a variety of reasons, tractor owners have not chosen to retrofit those ROPS. The National Institute for Occupational Safety and Health (NIOSH) attempted various means to ameliorate this occupational safety risk, including the manufacture of a low-cost ROPS for self-assembly. Other approaches address barriers to adoption. An Action Learning approach to increasing adoption of ROPS was followed in Virginia and New York, with mixed results. Virginia took action to increase the manufacturing and adoption of ROPS, but New York saw problems that would be insurmountable. Increased focus on team composition might be needed to establish effective Action Learning teams to address this problem.

Keywords

Action Learning; Agricultural safety and health; farmworker; fatal injury; NIOSH; ROPS; tractor overturns

Since the beginning of mechanized agriculture in this country, the agriculture industry has been regarded as one of the most hazardous in the United States. Surveillance efforts conducted by the US Bureau of Labor Statistics indicated that agriculture remains quantifiably hazardous today, with excessive levels of fatal and nonfatal injury. During 2010, the agricultural sector—crop and animal production—experienced 476 fatally injured workers for a fatality rate of 25.9 deaths per 100,000 workers[2] and a nonfatal injury

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incidence rate of 4.4 per 100 full-time-equivalent workers in crop production and 5.0 in animal production.[3]

The operation of a single item of farm equipment, farm tractors, has singularly contributed to the high rate of fatality in this sector. Nearly a third of all work-related farming deaths between the years 1992 and 2010 identified farm tractors as the factor responsible for the injury or that which precipitated the event or exposure. During 2003–2010, 1474 workers in agriculture, forestry, fishing, and hunting industries were killed due to tractor-related events and 933 were killed as a result of overturns or rollovers.[4] Fatal crushing injuries to operators from contact with the ground or being crushed between the ground and the tractor during a tractor rollover are frequent outcomes of injury events, and the most pressing occupational health problem to be addressed today is the fatal injury outcome resulting from an overturn event.[5] Simply said, injuries from tractor overturns are currently the leading cause of fatal occupational injury associated with tractor operation, indicating that injury prevention and amelioration efforts in the agricultural sector should focus on issues related to farm tractor rollover events.

The severe nature of injury from tractor overturn events has long been recognized within farm-safety circles and by the public at large. Research on methods to prevent such injuries dates almost to the beginning of mechanized agriculture. Beginning in the 1920s, there have been numerous research efforts to develop engineering controls and other methods of amelioration to reduce injuries to farmworkers.[6] Various engineering analyses of tractor stability under different operating conditions were conducted in the 1940s in the United States, with notable findings that operator response time was insufficient to prevent overturn events and subsequent injury.[7]

Parallel research efforts were conducted in other countries, most notably Sweden. Systematic research on methods to analyze fatality-causative tractor designs and operational parameters was carried out in the 1950s and 1960s. Following various research endeavors in that country, engineers from the National Institute of Sweden determined that the most efficacious control technologies to prevent injury was the protective cab or protective structure around the operator.[8] Legislation was put into place in 1959 to ensure that all newly manufactured farm tractors in Sweden were equipped with a suitable rollover protective structure (ROPS).[9] By 1965, all employees had to be protected by ROPS on tractors regardless of the age of the tractor.[10] Additional legislation to the same purpose was put into place in other countries that are now part of the European Union (EU). This legislation subsequently resulted in dramatic reductions in tractor rollover fatalities.[10,11]

Research efforts on vehicular protective structures in this country, focusing on industries other than agriculture, also began as early as the 1960s. The US agricultural industry saw the potential use of ROPS in reducing tractor-overturn injuries, and some tractor manufacturers began to voluntarily incorporate ROPS into tractor design as early as 1966. The American Society of Agricultural Engineers (ASAE, now known as ASABE) published their first standards for tractor ROPS design and utilization in 1967.

By the mid 1970s, the Society for Automotive Engineers (SAE) was heavily involved with developing ROPS for automotive, off-road, and agricultural applications, and methods of testing this safety device. The US Occupational Safety and Health Administration adopted the voluntary standard (SAE J334b) in a rule promulgated in 1975. All tractors operated by employees after October 25, 1976, were required to meet the provisions of this standard.[1,12]

Also in this time frame (1984) the National Institute for Farm Safety (NIFS) and the Agricultural Division of the National Safety Council called for incorporation of ROPS as standard equipment on agricultural tractors. However, no provision, either legislative or by consensus, was made for retrofitting existing tractors that had previously been sold without ROPS and no prohibition was established for their continued use.

It was anticipated that these US regulatory and consensus ROPS standards would lead to a decrease in the number and rate of tractor overturn deaths on US farms. Yet by the late 1990s, tractor overturn fatality rates had not decreased dramatically because of the large number of tractors not equipped with ROPS that continued to be used on US farms.[13] The projected replacement of farm tractors with newer models did not proceed as anticipated, because many tractor owners continued to operate older model tractors. The desire for these older tractors has been supported by a robust secondary market that also supports older collectible tractors.

The safety implications of the continued presence of tractors unprotected by ROPS was recognized by manufacturers and other concerned parties. In response to this awareness, the manufacturers began a concerted effort to promote retrofit ROPS to tractor owners.[14] By 1993, the five leading tractor manufacturers in the United States (AGCO Corporation, Case Corporation, Deere & Company, Kubota Tractor Corporation, and New Holland North America) contributed by instituting an incentive program where local dealers were encouraged to provide ROPS retrofit kits to farmers at their cost.[15] Various other manufacturers and fabricators of safety equipment instituted a program of providing fabricated ROPS upon request by end users. Furthermore, numerous parties and organizations contributed and continue to contribute to improving the safety and testing methods for ROPS, which includes the ASABE, Association of Equipment Manufacturers, International Labor Organization, and Health and Safety Executive, to name a few.

In subsequent years, chiefly in response to national, regional, and state-based surveillance of the sources of agricultural injury, various efforts have been made to promote the retrofit of ROPS to farm tractors without protection. For example, there were state-based initiatives to conduct social-marketing, awareness, and adoption campaigns. The National Institute for Occupational Safety and Health and partners have conducted various types of research to engineer, develop, and disseminate retrofit ROPS that focus on cost-effectiveness, utility, and safety. Additional information on the extent of the National Institute for Occupational Safety and Health (NIOSH) efforts to promote agricultural safety and develop effective interventions addressing tractor safety is available on the agency's Web sites: http://www.cdc.gov/niosh/topics/aginjury/ and http://www.cdc.gov/niosh/programs/agff/.

The percentage of farm tractors equipped with ROPS in the United States has increased significantly—from 38% in 1993 to 59% in 2006[14,16,17] as a result of ongoing efforts by NIOSH and other agencies as well as other factors, such as an increasing number of old tractors being replaced with new tractors. The increase in the number of ROPS-equipped tractors was instrumental in helping establish a significant decrease in the occupational fatality rate for tractor overturns—28.5%—between 1992 and 2007.[17,18] However, studies indicate that to reach near zero fatality rate levels, as demonstrated in Sweden, 75% to 80% of tractors would need to be equipped with ROPS and seatbelts.[10,11,19,20] Assuming that there will be no changes in the current adoption rate, the United States will not reach these proportions until 2024 to 2028,[14] resulting in continued high rates of overturn-based injury.

In recognition of this continued safety risk exposure, informal and qualitative studies were conducted by various agricultural-safety-focused organizations, which resulted in increased knowledge of decision processes affecting adoption of ROPS. In these studies, a common impediment identified by tractor owners was that of cost[21–23]; retrofit ROPS were widely considered to be either too expensive or were not a priority within their budget to be afforded by the majority of tractor owners. In response, NIOSH developed a less costly version of the ROPS structure known as the cost-effective rollover protective structure (CROPS).[24] Efforts to determine the decision criteria for the adoption of this item of safety equipment on the part of end users formed the basis for the current project.[25–28]

Additional impediments to adoption are known to exist, such as limits on product availability, a common perception that risk is controllable by operator response and experience, and other barriers. These factors have made the development of a national ROPS promotion campaign problematic, because underlying issues of belief must first be addressed before behavioral change can occur.

However, ongoing efforts continued to address impediments to adoption. A significant level of support for prevention efforts was funded by NIOSH, which included funding a consortium of university-based agricultural safety and health research centers across the United States (The Centers for Agricultural Disease and Injury Research, Education, and Prevention) and additional grants to various agricultural safety organizations. NIOSH also conducted internal research addressing impediments to adoption, including creating new designs for rollover protection structures. The support was intended to help the centers build their capacity to launch a national public health campaign for preventing deaths and serious injuries from tractor overturns and other tractor-related incidents. Progress has been made in developing an approach to address and overcome many of these barriers at the State level, and intervention efforts in Kentucky, New York, Virginia, and other states has resulted in increased distribution of tractor ROPS.[29,30]

Despite continued efforts, there remain a significant number of operational farm tractors that are unprotected by ROPS, and tractor rollovers remain as the most significant contributing factor in agriculture-related deaths. This project explored whether using an Action Learning approach is an effective method for increasing the adoption of ROPS by gaining fresh perspectives and new ways of seeing the challenges of transferring ROPS to farmers. If so,

this model could be applied to engineering controls and other occupational safety and health interventions in future efforts to improve technology transfer.

METHODS

Action Learning is a problem-solving methodology developed by Reg Revans in the 1940s; this approach was originally developed to address difficult productivity problems within the coal mines of Wales and England,[31] and was then extended to problematic issues in various kinds of organizations. It is widely practiced today, and remains primarily a process of inquiry to solve a complex mutual problem or area of concern where the solution is unknown.[32] In Action Learning, a group composed of persons with knowledge of a common, difficult problem participates in a dynamic inquiry process of considering a series of questions, which are then reflected on, to generate an action plan that is intended to solve the problem. According to The International Foundation for Action Learning,[33] the "process integrates: research (into what is obscure); learning (about what is unknown); and action (to resolve a problem) into a single activity and develops an attitude of questioning and reflection to help individuals and organisations change themselves in a rapidly changing world." Figure 1 illustrates the steps of this process.

In the current project, two institutions serving the agricultural safety and health community with a background and interest in tractor rollover protection—Virginia Farm Bureau Mutual Insurance Company (VA Farm Bureau) and New York Center for Agricultural Medicine and Health (NYCAMH)—participated in developing the Action Learning process. A single meeting for this purpose was held in each state. These institutions first agreed to participate in this process; they then identified and solicited qualified individuals to become open-discussion-group participants. The solicited participants numbered 10 to 12 individuals. There were approximately equal numbers of members from the following groups: farmers who owned tractors suitable for CROPS retrofit, potential fabricators of CROPS, and local influential agricultural community leaders. The members of the group were selected from locations throughout each of the participating states, with attention to shorter commuting distances to a proposed site to conduct the Action Learning meeting when possible. Letters of invitation were sent from each institution to prospect group members in their state. Participants were instructed on the purpose and methods of the meeting, and agreed to travel to a common location to participate.

Those solicited individuals who accepted the invitation were provided with travel funding to attend a single face-to-face meeting in their state of residence. The Virginia Farm Bureau held their meeting in Richmond, Virginia, and New York Center for Agricultural Medicine and Health (NYCAMH) held their meeting in Cooperstown, New York. Upon arrival, a discussion group leader, or coach, provided the discussion group with a detailed description of this problem-solving methodology, Action Learning. The coach also presented a description of the problem at hand—lack of adoption of an item of protective technology (CROPS) that was known to be effective in preventing injuries or fatalities associated with tractor rollovers and was also less expensive than other available ROPS. Because CROPS is a relatively new version of ROPS, a single-page description of the CROPS was provided to

the institution for distribution to participants (see Figure 2). This description established the unique characteristics of the CROPS from the larger category of ROPS.

The group was encouraged by the coach to participate in the discussion by asking questions, making suggestions, and providing feedback to clarify and understand the current environment, to identify new approaches, and to offer ideas and insights into solving the problem. In concurrence with the Action Learning process, there were no structured questions solicited by the coach during the 4-hour meeting.

Each group spent the first half of the 4-hour meeting discussing the issues and determining the extent of knowledge that each member of the team possessed concerning the approaches that had already been tried in their community and the remaining barriers to adopting the CROPS technology. During the second half of the Action Learning meeting, each group focused on developing an action plan that could be taken to resolve the problem. The participants decided if they were willing and able to take this action in their communities.

Follow-up discussions were scheduled for 1 year following the face-to-face meeting to determine if the action plans had been implemented. Information was also gathered on the number of CROPS that had been installed as a result of their action plans.

RESULTS

The Virginia Farm Bureau Mutual Insurance (VA Farm Bureau) and the New York Center for Agricultural Medicine and Health (NYCAMH) hosted their Action Learning meetings during July and August of 2010, respectively. The timing was selected to accommodate the schedules of the solicited participants. The VA Farm Bureau meeting was attended by a total of 11 people, with two from the Virginia Farm Bureau, five farmers, one fabricator, one leader in academia, and two meeting administrators (coach and scribe). At the NYCAMH Action Learning meeting, there were a total of 13 attendees, with four representing NYCAMH, one fabricator, one farmer, five leaders in government and academia, and the same two meeting administrators. Both meetings began with the coach presenting the problem statement, “Despite all the efforts made to date, there remain too many tractors without rollover protective structures in Virginia (New York).”

Each group member introduced themselves; their introduction included a broad description of their current and past positions as related to tractor safety efforts. For the most part, participants were knowledgeable about the need for ROPS, about past local efforts to increase the use of ROPS, and about NIOSH efforts to introduce cost-effective ROPS. They also provided information on their interests in the area of improving adoption rates. The group members continued by describing their knowledge of the NIOSH CROPS. The discussions also included sharing information on all existing activities that had been implemented in their community in an effort to increase the number of tractors being retrofitted with a ROPS, specifically the NIOSH CROPS. Questions to clarify these activities were asked by group members who were less familiar with specific activities.

It was established during the course of the VA meeting that the following activities were undertaken by a well-known organization in the public discussion over ROPS adoption, the

VA Farm Bureau, and that these activities represented common knowledge within the Virginia farming community. Beginning in 1995, the VA Farm Bureau had offered a cash incentive to their members who had a factory-built ROPS and seatbelt installed by an authorized dealer on any tractor originally purchased without a ROPS. The VA Farm Bureau also provided and continues to provide safety inspections to members on a voluntary basis. This activity provided an opportunity to have a trained safety specialist review hazards in tractor operation, including the common scenario of continued use of tractors that lacked the protection of ROPS. Additional information is available at the Web site of the Virginia Farm Bureau.[34]

Similarly, within the state of New York, the actions of NYCAMH as an advocate for ROPS retrofit were established as both significant and widely known. Public activities associated with NYCAMH included administration of a ROPS retrofit subsidy program, administration of a ROPS database and toll-free hotline, and community research activities to determine the motivators and barriers for New York farmers to adopt ROPS. This last information was used to create a social marketing campaign that incorporated farmer-tested marketing messages, economic incentives similar to those offered by the VA Farm Bureau, and a ROPS locator service. The activities were centrally administered by NYCAMH to members of the New York farming community.

In both communities, the Action Learning discussion focused on remaining difficulties. It became clear that the groups believed that a remaining impediment was that a standing inventory of ROPS to fit the tractors in need did not exist at any manufacturer or in any local distributors. When a recent fatality or injury event occurred, the desire for a fast delivery increased. However, too frequently tractor owners had limited knowledge of where and how to purchase a ROPS immediately and were not always willing to wait on a prolonged delivery. Furthermore, the group indicated that ROPS for some of the older tractors were not being commercially manufactured and may not have been designed at the time of this meeting.

In addition to the lack of availability of a ROPS to fit the tractors in their community, there was also a lack of belief that the risk remained substantial, uncontrolled, and elevated for each tractor operator, and the belief remained that risk of injury could be ameliorated through the mechanism of attentive control. Interestingly, the risk of injury or fatality was not the only consideration in purchasing ROPS; a secondary issue, which of comfort afforded by ROPS accessories such as sun shades, was identified.

As the questions and discussion concerning the impediments to adoption lessened, the coach suggested that the group consider developing solutions. The result in the VA Farm Bureau Action Learning team was an overarching solution of increasing the supply and demand for the NIOSH CROPS using three avenues. The first avenue was to increase the availability of CROPS by having local fabricators agree to produce the product within 1 to 2 weeks following an order. The second solution was increasing the knowledge of CROPS through demonstration using scale models at various farming venues. The final solution was to market CROPS as having the ability to shade the driver while providing safety.

At the conclusion of the meeting, an eight-component Action Plan for the state of Virginia was completed, with the party responsible for that Action identified (see Table 1). This group also devised specific measures of the successful implementation of their Action Plan, which included three items (see Table 2).

New York Center for Agricultural Medicine and Health (NYCAMH) adopted a very different approach to solving the problem of older tractors for which ROPS had not been retrofit. As the discussion began, it was determined that there were two paramount and insurmountable issues that needed to be resolved prior to conducting any further discussion of solutions. The first issue surrounded the specifications of Occupational Safety and Health Administration (OSHA) regulatory compliance. They were concerned that should an inspector arrive on site that they could receive a citation and fine for failure to comply with OSHA certification standards. The group wanted clarity on OSHA 1928.51(c),[12] which stipulates:

1928.51(c)

Labeling. Each ROPS shall have a label, permanently affixed to the structure, which states:

1928.51(c)(1)

Manufacturer's or fabricator's name and address;

1928.51(c)(2)

ROPS model number, if any;

1928.51(c)(3)

Tractor makes, models, or series numbers that the structure is designed to fit; and

1928.51(c)(4)

That the ROPS model was tested in accordance with the requirements of this subpart.

The second concern was over the provision of the label and designated authority to affix the label. Coupled with this liability was the additional concern over the assignment of liability for injury or property damage associated with any subsequent CROPS failure. Significant impediment to further action was seen to be dependent upon clarification of the legal liability of a local fabricator or individual farmer who fabricated or installed the CROPS, as opposed to the scenario in which CROPS were purchased and installed by a dealership.

The group disbanded with only a minimal Action Plan to address the liability and regulatory issues, as further action remained dependent on the resolution of these issues. Both NIOSH and NYCAMH agreed to explore these concerns. Subsequent efforts did not provide any clear-cut answer, but only the need for a written legal opinion and an OSHA standard interpretation. Because the original project did not include funding for this activity or a mechanism to secure such funding, no further action was taken.

DISCUSSION

Action Learning begins with identifying a real problem that has not been solved prior to initiating discussions among group members. All members of the Action Learning group should have a vested interest in solving the problem, with no single member being more advanced in their knowledge base that may limit the contribution of the remaining members of the group.[35] Additionally the concept is predicated on the fact that the members of the group are willing to share the "ownership" of solving the issue being explored. In general, the overall success of using Action Learning to increase adoption of a new technology is dependent upon a critical outcome in the procedure, namely, whether an action plan is developed and implemented. However, it should be noted that one benefit of discussions during the Action Learning process is additional learning regarding the identified problem that could be useful in later actions to solve that problem.

Virginia successfully developed an Action Plan during the group meeting and implemented the majority of their plan tasks (see Table 1). A single local firm demonstrated the ability to increase the supply of CROPS by fabricating a single unit using the specifications provided by NIOSH. Although the fabrication was successful, the VA Farm Bureau and the fabricator identified a number of factors that could inhibit an increase in supply of CROPS. First, it was reported that fabricating one CROPS at a time was cost prohibitive. It was estimated that the cost could be reduced by approximately 30% if a batch of 10 CROPS were fabricated. This reduction was the result of more efficient use of metal, bulk purchase of fasteners, and a reduced set-up time for the fabricator. Second, although producing 10 CROPS at a time decreased the cost, storage of those units was problematic at the fabrication location. The VA Farm Bureau was presented as an alternative warehousing option if the fabricator chose to invest in the process of producing multiple CROPS. Third, capital for fabricating a 10-CROPS batch was not readily available. Methods for securing financing were explored. Fourth, the fabricator had an initial concern regarding the extent of legal liability associated with producing and selling CROPS that needed legal clarification prior to beginning fabrication and sales of ROPS.

Additionally, there was a substantial effort to increase the knowledge of CROPS availability, with over 20 specific presentations highlighting the technology. Except for ascertaining the ability to modify the CROPS with a canopy, no additional efforts to market that capability (of shading the driver while increasing safety) were conducted. However, this continued to be a critical point in increasing the demand for CROPS, as most of the people who came to the fabrication shop indicated a strong desire to have a canopy included with the CROPS.

Despite these actions, they did not successfully solve their overarching solution of increasing the supply and demand for the NIOSH CROPS using the three avenues. Many discussions were held and alternative strategies were developed during the year of this pilot, demonstrating the learning element of Action Learning. An additional meeting of the Action Learning group may have been necessary for the next steps—determining ways to fund the CROPS fabrication.

In New York, the overall response to the Action Learning discussions and subsequent call for action differed from the response and action taken in Virginia. As in an ideal Action Learning group, the identified problem—continued operation of tractors without ROPS protection—was viewed as "real" and significant by the group, and all members were knowledgeable about this issue, with a desire to solve the problem. However, the success of the New York group was limited by the lack of detailed tasks and assignments in their Action Plan, a key requirement of a successful process.

Rather than focusing on developing detailed tasks in a plan for action, the group focused on the legal and regulatory status of the NIOSH CROPS. Ongoing concerns were expressed over whether these CROPS would meet the OSHA regulatory requirements—that is to say, if an incident occurred would the farmer be noncompliant and citable? Beyond the potential OSHA noncompliance liability, the extent of CROPS product safety liability was of prominent concern. However, there was no resolution on steps or actions that should be taken to resolve these issues.

The composition of the group, both in terms of their beliefs and their relationship to the Action Learning meeting host, may have contributed to the group identifying tasks and assignments necessary for a complete and operational Action Plan. The Action Learning group was composed of members who not only understood the problem, but also had high knowledge and awareness of alternative and additional organizational efforts to solve this problem previously conducted in their state. This awareness incorporated knowledge of efforts by NYCAMH, which had previously devoted sizable time, energy, and money to a separate and publicly visible campaign to increase ROPS adoption. NYCAMH was further seen as the focal point for prevention efforts in New York. This awareness and perception may have supported a belief that a viable Action Plan had already been established prior to the execution of the current project. It is possible that a group composed of knowledgeable persons with a more distant relationship with alternative organizational efforts may have been more willing to establish or initiate an independent Action Plan. Furthermore, the group members may not have believed that they had the ability to make changes to a NYCAMH Action Plan or develop one if NYCAMH did not have an Action Plan in existence. As a result, the group may have been unwilling to develop or assign actionable components of a plan. As was the case for Virginia Farm Bureau, this group would have benefited from additional meetings.

CONCLUSIONS

This study attempted to apply the methods of Action Learning, a widely used organizational tool for the resolution of difficult issues, to occupational safety and health, specifically the adoption of effective tools for the reduction of tractor rollover or overturn fatalities. The study returned mixed results, with a purposeful outcome identified in one study component and significant impediments to purposeful action identified in another.

Additional research is needed to determine if Action Learning can be used to solve occupational safety and health problems. One indeterminate component is that of group composition; research is necessary to determine the optimal group composition. Research

should be conducted to determine if an Action Learning group benefits from an action orientation among group members. Action orientation includes, among other issues, the willingness of group members to focus solely on producing an Action Plan and taking actions to implement that plan. Research is also needed to determine the effects of independent selection criteria for an Action Learning group, that is, if group members are selected without concern over affiliation or association with an existing organization. It also remains undetermined whether prior work on the problem by team members influences the effectiveness of Action Learning sessions. A second area of concern is whether preexisting organizational approaches to solving the problem influence the effectiveness of Action Learning. The current research project indicates a potential use for Action Learning in an occupational safety and health setting; the full extent of its usefulness for this purpose remains dependent on more extensive studies.

REFERENCES

1. Pennsylvania State University. Rollover protection for farm tractor operators. National Agriculture Safety Database. Updated. Available at: http://www.nasdonline.org/document/113/d001656/rollover-protection-for-farm-tractor-operators.html.
2. US Department of Labor, Bureau of Labor Statistics. [Accessed July 11, 2012] Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries by selected worker characteristics, occupations, civilian workers, 2010. Updated April 12, 2012. Available at: http://www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2010hb.pdf
3. US Department of Labor, Bureau of Labor Statistics. US Department of Labor, Bureau of Labor Statistics; Table 5. Incidence rates and numbers of nonfatal occupational injuries by selected industries and ownership, 2010. Updated October 20, 2011. Available at: http://www.bls.gov/news.release/osh.t05.htm [Accessed July 11, 2012]
4. US Department of Labor, Bureau of Labor Statistics. [Accessed July 2012] Census of fatal occupational injuries. 2003. forward. Available at: http://www.bls.gov/iif/
5. Owusu-Edusei K, Biddle E. Installing a cost-effective roll-over protective structure (CROPS): a cost-effectiveness analysis. J Agric Saf Health. 2007; 13:165–176. [PubMed: 17555205]
6. Ross B, DiMartino M. Rollover protective structures: their history and development. Prof Saf. 1982; 27(May):15–23.
7. Liu, J.; Ayers, PD. Control Strategies and System for Tractor Protective Structure Deployment. Columbia, MO: National Institute for Farm Safety; 1999. Paper No. 99–11
8. Myers ML. Prevention effectiveness of roll-over protective structures part I: strategy evolution. J Agric Saf Health. 2000; 6:29–40. [PubMed: 10938751]
9. Springfeldt, B. Effects of Occupational Safety Rules and Measures With Special Regard to Injuries: Advantages of Automatically Working Solutions. Stockholm: The Royal Institute of Technology, Department of Work Science; 1993.
10. Springfeldt B. Rollover of tractors—international experiences. Saf Sci. 1996; 24:95–110.
11. Springfeldt B, Thorson J, Lee BC. Sweden's thirty-year experience with tractor rollovers. J Agric Saf Health. 1998; 4:173–180.
12. Roll-over protective structures (ROPS) for tractors used in agricultural operations. 29 C.F.R. Sect. 1928.51. 2005
13. Myers, JR. Tractor Occupational Safety and Health Update: Record of the Tractor Related Injury and Death Meeting. Morgantown WV: National Institute for Occupational Safety and Health; 2003. p. 5-23.
14. Loringer K, Myers J. Tracking the prevalence of rollover protective structures on U.S. farm tractors: 1993, 2001, and 2004. J Saf Res. 2008; 39:509–517.
15. Freeman SA. Potential impact of a ROPS retrofit policy in central Iowa. J Agric Saf Health. 1999; 5:11–20.

16. Myers JR. Prevalence of ROPS-equipped tractors on minority operated farms in the U.S. Am J Ind Med. 2009; 52:408–418. [PubMed: 19204917]
17. Murphy D, Myers J, McKenzie EA Jr, Cavaletto R, May J, Sorensen J. Tractors and rollover protection in the United States. J Agromedicine. 2010; 15:249–263. [PubMed: 20665310]
18. Myers JR, Hendricks KJ. Agricultural tractor overturn deaths: assessment of trends and risk factors. Am J Ind Med. 2010; 53:662–672. [PubMed: 19894222]
19. Thelin A. Rollover fatalities—Nordic perspectives. J Agric Saf Health. 1998; 4:157–160.
20. National Institute for Occupational Safety and Health. Public health focus: effectiveness of rollover protective structures for preventing injuries associated with agricultural tractors. MMWR Morb Mort Wkly Rep. 1993; 42:57–59.
21. Myers JR, Snyder KA. Rollover protective structure use and the cost of retrofitting tractors in the United States, 1993. J Agric Saf Health. 1995; 1:185–197.
22. Etherton J, McKenzie EA Jr, Lutz T, Cantis D, Kau T-Y. An initial farmer evaluation of a NIOSH AutoROPS prototype. Int J Ind Ergon. 2004; 34:155–165.
23. Myers JR. Factors associated with the prevalence of non-ROPS tractors on farms in the U.S. J Agric Saf Health. 2010; 16:267–280.
24. National Institute for Occupational Safety and Health. [Accessed February 8, 2012] Agricultural safety: cost-effective rollover protective structures (CROPS). Updated February 8, 2012 [about 12 screens]. Available at: http://www.cdc.gov/niosh/topics/aginjury/crops/
25. Myers ML, Pana-Cryan R. Prevention effectiveness of roll-over protective structures part II: decision analysis. J Agric Saf Health. 2000; 6:41–55. [PubMed: 10938752]
26. Pana-Cryan R, Myers ML. Cost-effectiveness of roll-over protective structures. Am J Ind Med. 2002; 2(Suppl):68–71. [PubMed: 12210685]
27. Sorensen JA, May JJ, Jenkins PL, Jones AM, Earle-Richardson GB. Risk perceptions, barriers, and motivators to tractor ROPS retrofitting in the New York state farm community. J Agric Saf Health. 2006; 12:215–226. [PubMed: 16981445]
28. Sorensen JA, May JJ, Paap K, Purschwitz MA, Emmelin M. Encouraging farmers to retrofit tractors: a qualitative analysis of risk perceptions among a group of high-risk farmers in New York. J Agric Saf Health. 2008; 14:105–117. [PubMed: 18376539]
29. Sorensen JA, May JJ, Ostby-Malling R, et al. Encouraging the installation of rollover protective structures in New York state: the design of a social marketing intervention. Scand J Public Health. 2008; 36:859–869. [PubMed: 19004904]
30. Cole, HP.; Westneat, SC.; Piercy, L., et al. The Kentucky ROPS Project: Final Technical Report for Partners in Prevention: Promoting ROPS and Seat Belts on Family Farm Tractors. Morgantown, WV: National Institute for Occupational Safety and Health; 2001. University of Kentucky, Southeast Center for Agricultural Health and Injury Prevention. CDC/NIOSH Cooperative agreement number U06 CCU4129000
31. Inglis, S. Making the Most of Action Learning. Brookfield, VT: Gower Publishing; 1994.
32. The Leadership Alliance Incorporated. The Leadership Alliance, Inc.; ca. 2011 Available at: http://www.tlainc.com/ifalcwot2.htm.
33. [Accessed November 2011] The International Foundation for Action Learning web site. Available at: http://www.ifal.org.uk
34. Virginia Farm Bureau. Virginia Farm Bureau Federation; ca. 2011 Available at: http://vafarmbureau.org.
35. Atherton JS. Action learning: teaching and learning. Updated February 10, 2010. Available at: http://www.learningandteaching.info/teaching/action_learning.htm.

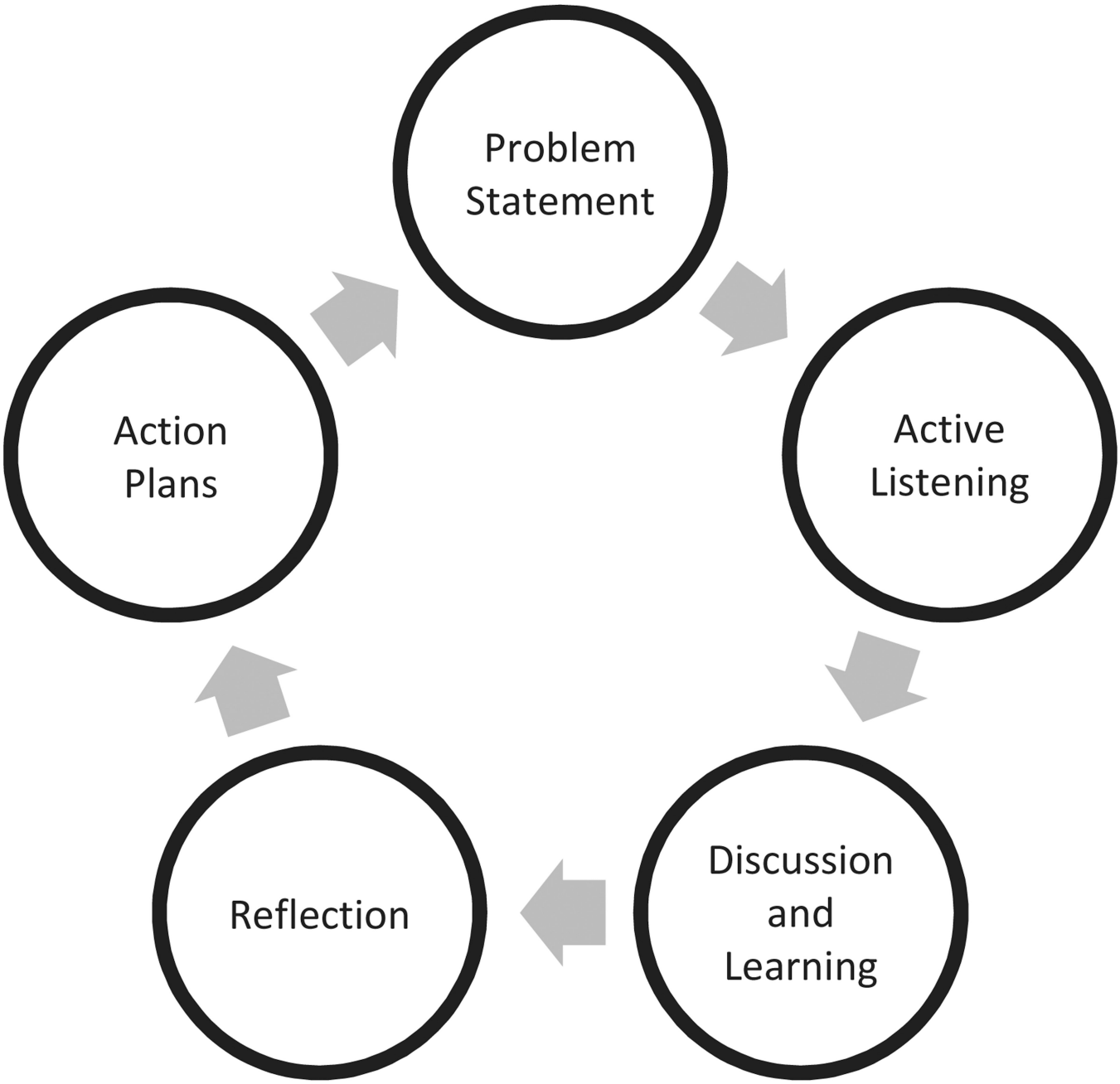

FIGURE 1.
Action Learning flow.

The NIOSH CROPS:
Cost-Effective Protection against Tractor Rollover Injury

What is the NIOSH CROPS?
CROPS is a cost-effective, standard-tested ROPS for use on non-ROPS tractors. It is designed for and must be used with a seatbelt.

Why is it needed?
Tractor rollovers are the leading cause of occupational fatal injury among farmers.

Low Cost
Less expensive than an OEM or aftermarket retrofit

Shipped via standard carriers like UPS or Fedex

Fig 1. Ford 4000 with CROPS Installed, Side View

Fig 2. Ford 4000 with CROPS Installed, Rear View

Ease of Installation
Easily installed by one person

Assembled with hand tools and a torque wrench

Current Availability
Ford 8N
Ford-3000
Ford-4000
Ford 4600
Massey-Ferguson 135

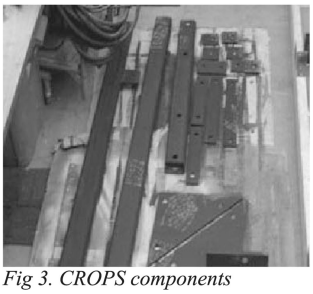

Fig 3. CROPS components

FIGURE 2.
Description of CROPS that was provided for distribution to participants.

TABLE 1

Increasing CROPS Adoption in Virginia: Action Plan and Progress

Action Plan	Completion Progress
1) Provide technical specifications for each of the CROPS designs (Responsibility: NIOSH)	
a. Include a list of materials required for each CROPS design	**a.** Completed October 2010
b. Include instructions for installation of CROPS and seat belts for each design	**b.** Completed October 2010
c. Include a list of tools needed to install CROPS	**c.** Completed October 2010
2) Provide materials and specifications to fabricate one CROPS (Responsibility: NIOSH)	Completed August 2010
3) Fabricate a CROPS by Virginia manufacturer of farm equipment (Responsibility: Local Fabricator)	
a. Determine fabrication time (break down time by task or function)	**a.** Completed December 2010
b. Determine cost of fabrication (parts and labor)	**b.** Completed December 2010
c. Estimate sales price	**c.** Completed December 2010
4) Build prototype(s) for demonstration and promotion by VA Farm Bureau and other interested parties (Responsibility: NIOSH)	Completed January 2011
5) Develop list of potential CROPS fabrication shops by Virginia county (Responsibility: VA Farm Bureau)	Completed list of 30 by September 2010
6) Explore enhancements to CROPS to provide additional functionality (Responsibility: NIOSH)	
a. Canopy for shading	**a.** Completed January 2011
b. Mounting brackets	**b.** Completed February 2011
c. Wiring harness for electricity	**c.** Completed February 2011
7) Explore establishing cost-sharing or subsidizing programs (Responsibility: NIOSH and VA Farm Bureau)	Completed May 2011
8) Publicize availability of CROPS (Responsibility: VA Farm Bureau)	
a. At conferences, meetings, county fairs	**a.** Attended 15 venues by June 2011
b. Newsletters, e-mails, radio, speaking engagements	**b.** Completed 5 communications products by June 2011

TABLE 2

Measures of Successful Implementation of Action Plan

Measure	Completion Progress
1) Provide the number of fabricators agreeing to participate and provide CROPS within 1–2 weeks (Responsibility: VA Farm Bureau)	Thirty interested fabricators were identified
2) Provide the number of CROPS ordered and received over a one year test period (Responsibility: VA Farm Bureau)	No orders but 5 indicated they would be interested if they were available
3) Provide the number of sites where the scale model was demonstrated (Responsibility: VA Farm Bureau)	One site demonstration with intent to continue in the future