Enhancing Cattle Handling Safety with the Work Crew Performance Model

S. G. Isaacs, L. A. Powers, G. T. Lineberry, T. Scharf

ABSTRACT. *Kentucky farmers and University of Kentucky extension agents applied the principles of the Work Crew Performance Model (WCPM), used previously in mining and construction, to identify and prioritize critical action factors (CAFs) for safe handling of cattle. One focus group of farmers helped identify a set of 32 critical action factors in four categories: environmental conditions, animal behavior, facilities and equipment, and handling techniques. A second focus group of farmers used a Q-sort nominal group process to rate each of the factors on the basis of the cost consequences of failure to properly perform the activity. A three-stage binary sort process resulted in a five-point ordinal ranking of tasks within each of the four categories. The Q-sort procedure was performed with assumptions of both routine and emergency animal handling activities. The list and the rankings were validated and modified by extension agriculture agents and by an expert panel of animal scientists and an agricultural engineering educator. The validation process added seven CAFs to the original list. The result of the process was the development of a cattle safety handling checklist that has been used with success in Master Cattleman educational workshops conducted for approximately 1500 Kentucky farmers.*

Keywords. *Cattle handling, Cattle safety, Q-Sort, Work Crew Performance Model.*

One Kentucky cattle farmer responded to a focus group facilitator's question, "How often do you get injured when working livestock?" with, "Every time!" He went on to explain that not every injury was serious or life threatening, but that kicks, butts, and sprains were common to virtually every livestock handling situation.

While agriculture consistently ranks as one of the most hazardous industries in the U.S., much of the focus on injury prevention tends to be on machinery and tractors. However, according to national statistics, 19% of farm injuries are related to livestock, while 15% are related to machinery other than tractors and 6% are related to tractors (NASS, 1994). This statistic is consistent with recent studies' findings of occupational injury experience among farmers in California (McCurdy et al., 2004) and Iowa (Rautiainen et al., 2004). In the former, the category of "animals" (primarily livestock) represented the fourth most frequent external cause of nonfatal occupational injury among farm operators (12.4%), close behind machinery (14.3%) and falls (13.0%), yet

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well behind overexertion's 24.2% (some of which the authors acknowledge is related to animals, especially livestock). In the latter study, the significant finding was that machinery-related injuries were less prominent than generally reported in the literature, with livestock handling among the higher-risk factors for injury. Farm injuries can, and do, arise from a variety of sources. This study addresses the human/livestock interface with particular attention to cattle handling.

This current study was conceived to apply the methodology of the Work Crew Performance Model (Wiehagen et al., 1996) to farm livestock handling practices. The Work Crew Performance Model (WCPM) was introduced more than a decade ago to better define performance variability within similar tasks of an underground mining work crew and to relate observed variability to a cost consequence (Wiehagen et al., 1994). Subsequently, its precepts have led to the development of a practical tool to identify critical action factors (CAFs) in any task or activity where safe performance requires adherence to proper completion of a set or sequence of sub-tasks. Failure to perform critical sub-tasks can lead to a higher risk of injury or death. Sub-tasks can and do vary in cost consequences and criticality. Some sub-tasks may be avoided with relatively low cost and low likelihood of adverse consequences. Other sub-tasks, if avoided, have a greater likelihood of causing serious injury or death, resulting in large cost consequences in terms of safety and/or productivity.

WCPM Applications across Mining, Construction, and Agriculture

The WCPM has been applied successfully to mining and construction activities. Wiehagen et al. (1994) used the WCPM in underground coal mining to identify and assess the CAFs associated with shuttle car operation (a shuttle car is a mobile underground haulage device commonly used in continuous mining operations throughout the U.S.). Tenets of the model also provided a framework for better evaluation of training and performance within this specific underground coal mining task.

The WCPM seeks to define performance variability within similar tasks. The WCPM offers an improved method of measuring training effectiveness and evaluating crew member performance within the practical confines of the work system. Key components of the WCPM, which are detailed elsewhere (Wiehagen et al., 1996), include: (1) job definition through task analysis, (2) the ranking of job elements by perceived cost consequence, (3) observational techniques to establish performance baselines, and (4) cost linkages between adherence to task procedures and measures of consequence for noncompliance. To validate the WCPM for a mining application, a face-production simulator was used in conjunction with the job elements that were identified and ranked by experienced operators, front-line supervisors, and maintenance personnel as important to improving work crew performance (Lineberry and Wiehagen, 1996). The results showed that, in the case of shuttle car operation, the minimization of continuous miner (face excavator) wait time and maintenance of shuttle car payload were much more important to face production than the shuttle car velocity between the miner and the discharge point (into a feeder and onto the belt conveyor). This study provided an objective approach toward identifying and ranking job elements, under the direct control of the equipment operator, for implementation of intervention strategies. This, in turn, can help human resource developers, or others charged with hiring or staffing decisions, better target groups of tasks and subtasks as candidates for improved training or coaching, for job/equipment/condition modifications, or for changes in management practices/policies. The net result is the acquisition of an ability to offer more specific guidelines for

human resource development at the mine site, guidelines that are based on empirical evidence and meaningful analysis of performance metrics. This field trial of the WCPM affirmed the congruency between production and operator training by providing a unique cost linkage between performance engineering and human behavior. Furthermore, the general nature of the WCPM, as a framework for developing practical strategies for identifying engineering, human factor, and human resource needs, permits its use across a wide range of industries, thus its application to agriculture and, more specifically, to cattle handling.

Focus groups of workers were convened to identify and assess the CAFs in various mining tasks. Two focus groups were used in the project. The first group's participants were led through a facilitated discussion to identify all the separate sub-tasks required for safe and productive completion of the task. The second group validated the list of sub-tasks and used a simple nominal group process (Souder, 1975) to rate each of the factors on the basis of the cost consequences of failure to properly perform the activity. A multi-stage binary sort process resulted in an ordinal ranking of sub-tasks for each activity.

As a precursor to the WCPM application to agriculture, the same technique of systematically collecting details on work tasks and their perceived priorities for safe and effective performance has been used with success in the construction industry (Lineberry et al., 2002; Lineberry et al., 2003). The targeted tasks are (1) setup and (2) use of common extension ladders. Focus groups composed of workers from small construction companies have identified conflicting knowledge about procedures to set up and use extension ladders and especially about their assessment of risk in the context of ladder use, both for access to an upper level and for use as a working platform. Based on these focus groups, a practical training intervention in the form of two sets of simply-worded guidelines was developed. Each set of guidelines is grouped into manageable numbers of tasks and subtasks. The guidelines were validated by applying them in short job site "toolbox" sessions (field trials) with two groups of experienced ladder users employed by small construction companies in Kentucky. The guidelines have undergone technical review by a panel of safety experts representing government, labor, and product manufacturers. They represent the culmination of the combined efforts of approximately 80 individuals with an interest in reducing the risks associated with the setup and use of common extension ladders.

The primary use of the ladder safety guidelines is as a point of departure for job site "toolbox" talks or other training aids, but they may also be applied in a variety of work places where extension ladders are used. Other potential uses of the guidelines are as aids to: (1) create better on-the-job ladder training for new workers, (2) serve as a refresher guide for experienced workers, (3) more systematically observe worker practices during ladder setup and use, and (4) promote a structured investigation of ladder-related fall incidents.

The formulation of a checklist for use in the specific high-risk task of cattle handling, as discussed herein, has taken a similar track. Furthermore, multiple uses for the animal handling checklists are envisioned, as was the case for the ladder safety guidelines now finding their way into construction practice (Lineberry et al., 2004; Lineberry et al., 2003). This approach to improving worker safety around cattle, in the performance of both routine and emergency tasks, focuses on eliciting mainly non-prescriptive safety guidelines from those persons most directly and intimately involved in the high-risk activity. This approach is in sharp contrast to previous related research that has centered primarily on system components of chutes, restraining cages, or other similar facilities (e.g., Baker and Mayes, 1977; Grandin, 1982; Larsen and Short, 1993).

Methods Used in WCPM Application to Agriculture

Focus groups of experienced cattle farmers from Harrison and Montgomery counties in Kentucky were utilized to develop and rank the critical factors associated with safe and efficient cattle handling. An expert panel of land-grant university specialists and a group of Kentucky agricultural extension agents provided further refinement and validation of the CAFs.

Focus Group I

The first focus group (Harrison County, Kentucky) consisted of ten farmers (including three spouses), the local county extension agent for agriculture and natural resources, and four project facilitators. Of the seven farms represented, all had produced beef cattle, although one was primarily a dairy operation and one was a swine farm. The focus group was led through a series of open-ended discussion questions intended to elicit information about the type of cattle handling injuries they had experienced and how and why the injuries had occurred. Additional questions addressed safe or hazardous cattle handling activities, the role of environmental factors, behavioral variability of animals, adequacy or inadequacy of handling facilities and equipment, and observations on training first-time workers and/or youth.

With the advised consent of the participants, the focus group discussions were video- and audiotaped. Verbatim transcripts of the audiotapes were compiled and reviewed. From the transcript and the facilitator notes, a list of 32 critical action factors was constructed. The University of Kentucky project team categorized these 32 factors into four general classifications: environmental conditions, animal behavior, handling equipment and facilities, and handling techniques (table 1, items designated FG-I).

Focus Group II

The second focus group (Montgomery County, Kentucky) was asked to validate and prioritize the 32 tasks identified by the first focus group. In attendance were fourteen farmers (representing ten farms), four facilitators, and the local county extension agent for agriculture and natural resources. All the Montgomery County farmers present were experienced with beef cattle. A few had experience with horses as well. The participants ranged in age from teenager to elderly retired.

After being familiarized with the WCPM and its application to cattle handling, the participants were asked to individually sort and rank the activities. The criterion for the sort was the set of cost consequences associated with failure to perform the specified task. Participants were allowed to apply their own interpretation of cost consequences to the sorting and ranking procedure. A Q-sort nominal group process was employed in a multi-stage, binary sort process (fig. 1). Each of the 32 CAFs was printed on a single card (the "original deck"). Using the cost consequence criterion, participants were asked to perform an initial dichotomous sort, placing each card in one of two stacks: "critical" or "important." In the second sort, participants took each stack of cards from the first sort and performed another dichotomous sort using the same cost consequence criterion. The "critical" stack from the first sort was sorted into "critical" or "medium level." The "important" stack from the first sort was sorted into "medium level" or "important." The CAFs identified as "medium level" in the second sort were combined into one stack. In the third sort, the critical CAFs from sort two were further divided into "very critical" or "critical," the factors identified as "important" were further classified as "very important" or "important," and the "medium level" classification remained unchanged.

This three-stage, dichotomous sort resulted in all 32 activities being ranked across five levels from the highest level of importance ("very critical") to the lowest level of

Table 1. Critical action factors.[a]

Environmental Conditions	
FG-I	Evaluate today's weather.
FG-I	Evaluate today's surface conditions.
FG-I	Wear properly fitting clothing and protective footwear.
FG-I	Avoid handling animals during extreme hot and humid or cold weather.
Animal Behavior	
FG-I	Understand gender and breed behavioral differences.
FG-I	Take advantage of your knowledge of the animal's historical behaviors.
FG-I	Assess the degree of animal's agitation and anxiety.
FG-I	Operate within the animal's natural daily patterns.
FG-I	Increase caution around mothers with offspring, and bulls.
FG-I	Understand and utilize the animal's flight zone.
FG-I	Take advantage of the animal's herding instinct.
EP	Avoid lone animals.
Handling Equipment and Facilities	
FG-I	Lay out facilities to take advantage of animals' natural responses (and behavior).
FG-I	Design and operate for appropriate capacity and expansion.
FG-I	Construct sturdy and durable handling facilities.
FG-I	Provide escape gates and barriers.
FG-I	Match cost and complexity to herd composition, size, and location(s).
FG-I	Judiciously use proper handling aides (cattle prods).
FG-I	Use proper and adequate restraining devices (chutes, ropes, headgates).
FG-I	Organize and have available appropriate tools, medications, and equipment.
FG-II	Make sure there are no sharp edges that may cause injuries.
FG-II	Do not use, or make minimal use of, electric prods and sticks.
FG-II	Do not hit an animal if he/she does not have a place to go.
EP	Maintain latches on squeeze chutes.
Handling Techniques	
FG-I	Match age, experience, and skill of the handler(s) to the task.
FG-I	Be especially cautious around animals that are handled less frequently or are agitated.
FG-I	Minimize unwanted noise and visitors during animal handling.
FG-I	Use extra caution when loading, transporting, or unloading animals.
FG-I	Plan an escape route.
FG-I	Dedicate appropriate number of workers to task (too many or too few).
FG-I	Use a calm voice, deliberate actions, and confident approach.
FG-I	Don't trust or take animals for granted or become complacent with routine jobs.
FG-I	Use proper lifting techniques.
FG-I	Know when to seek assistance (veterinarian, additional worker).
FG-I	Alternate tasks to avoid repetitive stress/motion injuries.
FG-I	Take special precautions to avoid cuts and needle pricks.
FG-I	Minimize exposure in the "kicking zone."
FG-II	Try to handle cattle in groups rather than individually.
EP	Never tie a lead rope to yourself.

[a] FG-I = critical action factors (CAFs) identified by first focus group, FG-II = CAFs added by second focus group, and EP = CAFs added by expert review panel.

importance ("important") within each of the four general classifications of activities (environmental conditions, animal behavior, handling equipment and facilities, and handling techniques). Each level was assigned a numeric value from 5 ("very critical") to 1 ("important"). Results from the fourteen farmers' sorts were compiled on-site, and

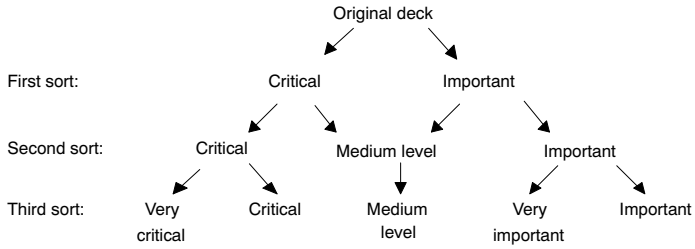

Figure 1. Q-sort procedure performed to sort CAFs into levels of importance.

participants were shown the resulting average numeric rankings. The Q-sort procedure was performed twice with the second focus group. The first Q-sort was performed with an assumption of routine animal handling activities, such as vaccinations, pregnancy checking, feeding, or transporting. For the second Q-sort, the assumption of the handling activity was changed from routine to emergency treatment (e.g., acute injury or illness, calving difficulties, or retrieval of escaped animals).

The second focus group was given the opportunity to discuss the original list and clarify or elaborate on apparent variability in the ranking of CAFs. Discussion also ensued about the relative differences between routine and emergency handling situations. Participants indicated that in emergency situations the given task must be performed, often with less concern for safety. The discussion resulted in validation of all 32 factors from the first group and the addition of four more critical action factors (table 1, items designated FG-II).

Expert Panel Validation

A panel of livestock handling experts reviewed the resulting list of 36 critical action factors (32 CAFs from the first focus group and four additional CAFs from the second focus group). The three reviewers were all professors at major land-grant universities: an agricultural engineer from the University of Kentucky who specializes in structures and facilities, an animal science beef extension specialist from the University of Kentucky, and an animal behavioral specialist from Colorado State University. The reviewers independently assessed the expanded checklist. They refined the wording on some of the CAFs, added three new items, but did not suggest removal of any factor. One of the new items was to “never tie a lead rope to yourself.” This factor had never been mentioned in a focus group, but one of the panel experts was aware of two fatalities resulting from this action (table 1, items designated EP). Thus, the final list included a total of 39 CAFs as identified by the two focus groups and the expert panel.

Extension Agent Validation

A group of 29 Kentucky extension agents for agriculture and natural resources was asked to validate the list and rank the factors. The agents were in attendance at a beef production in-service training session, and all had significant livestock production programming efforts in their assigned counties. The validation was conducted in a two-stage process. The agents were first given the list of CAFs and asked to make a binary decision determining whether an item was considered critical in handling cattle safely. From among each of the four general classifications, the agents were asked to select approximately half of the total number of items as “critical.” In the second stage, the agents were asked to ordinally rank the top two or three “critical” items they selected in the first stage.

The final stage of this process was the development of an educational tool for cattle handlers. The critical action factor list, now expanded to 39 items, was reformatted into a cattle safety handling checklist. The checklist is used as one component of a facilities and handling workshop that is part of a statewide ten-workshop Master Cattleman program in Kentucky and can be found at: www.uky.edu/Ag/AgEcon/pubs/ext_other/Lvstk_Handling_Checklist1.pdf.

Results

Identify Critical Action Factors

As previously stated, the first focus group was held to identify safety factors when handling cattle. The resulting data from that meeting yielded 32 CAFs to consider when handling cattle. Furthermore, these 32 items were categorized under four headings: environmental conditions, animal behavior, handling equipment and facilities, and handling techniques.

Validation and Prioritizing Items within the Checklist

The validation with farmers was achieved by charging Focus Group II to review the CAFs identified by the first focus group and modify the list as needed. (The main result of this research stage was minor rewording of checklist items for clarity and context.) Members of this validation panel then individually employed the Q-sort procedure to identify each of the 32 CAFs as very critical, critical, medium, very important, or important. This process was completed twice: once considering a routine procedure (e.g., vaccinations, pregnancy checking), and then for an emergency procedure (e.g., assisted calf delivery). Again, this sort was based on the perception of "consequences" from failure properly perform the CAFs. In ranking the farmers' priority list within each category for tasks under an emergency situation versus a routine situation, many of the items maintained their rankings (table 2).

Table 3 is a listing of those items that became more critical in an emergency situation, and table 4 is a listing of those items that became less critical in an emergency situation. In calculating weighted averages, the least critical was assigned a value of 1 and the most critical was assigned a value of 5. Discussions after the sorts were completed indicated that many participants held the opinion that, in emergency situations, higher-risk tasks sometimes must be performed (frequently without proper tools, equipment, or safety precautions), often with less concern for one's own personal safety. This finding is entirely consistent with the work of Green (1999), who concluded, in a study of rural couples' beliefs and practices regarding farm health and safety, that farmers [engaged in grain and/or livestock farming] are almost always aware of the risks they take. Such external factors as time pressure (as in an emergency), the inconvenience and/or discomfort of personal protective equipment, and the absence of external imposition of safety regulations all contribute to what Green (1999) referred to as "calculated risks, considering the costs and benefits of particular ways of working."

Also during this first validation process, the FG-II participants felt the need to add four additional CAFs, resulting in a total of 36 CAFs. These additional items include the following: make sure there are no sharp objects that may cause injury; do not use, or make minimal use of, electric prods and sticks; do not hit an animal if he/she has no place to go; and try to handle animals in groups rather than individually (table 1, items designated FG-II).

When the county extension agents for agriculture reviewed and prioritized the list of 36 CAFs in the second validation process, their opinions were similar to the farmers'

Table 2. Farmer rankings of critical action factors for safe cattle handling under routine and emergency conditions, where 1 is "important" and 5 is "very critical" (NA indicates factors not ranked by farmers in this study; these factors were added in the validation process.)

	Routine	Emergency
Environmental Conditions		
Evaluate today's weather.	2.64	1.80
Evaluate today's surface conditions.	2.43	1.40
Wear properly fitting clothing and protective footwear.	2.79	2.20
Avoid handling animals during extreme hot and humid or cold weather.	2.64	1.60
Animal Behavior		
Understand gender and breed behavioral differences.	2.50	3.07
Take advantage of your knowledge of the animal's historical behaviors.	3.14	3.00
Assess the degree of animal's agitation and anxiety.	3.14	3.13
Operate within the animal's natural daily patterns.	2.43	1.80
Increase caution around mothers with offspring, and bulls.	4.14	3.73
Understand and utilize the animal's flight zone.	3.29	2.87
Take advantage of the animal's herding instinct.	2.86	1.93
Avoid lone animals.	NA	NA
Handling Equipment and Facilities		
Lay out facilities to take advantage of animals' natural responses (and behavior).	3.29	2.07
Design and operate for appropriate capacity and expansion.	2.86	1.93
Construct sturdy and durable handling facilities.	3.71	3.47
Provide escape gates and barriers.	3.43	3.27
Match cost and complexity to herd composition, size, and location(s).	1.86	1.67
Judiciously use proper handling aides (cattle prods).	3.00	2.53
Use proper and adequate restraining devices (chutes, ropes, headgates).	4.07	4.07
Organize and have available appropriate tools, medications, and equipment.	3.50	3.60
Make sure there are no sharp edges that may cause injuries.	NA	NA
Do not use, or make minimal use of, electric prods and sticks.	NA	NA
Do not hit an animal if he/she does not have a place to go.	NA	NA
Maintain latches on squeeze chutes.	NA	NA
Handling Techniques		
Match age, experience, and skill of the handler(s) to the task.	2.79	2.73
Be especially cautious around animals that are handled less frequently or are agitated.	3.07	2.73
Minimize unwanted noise and visitors during animal handling.	2.85	3.27
Use extra caution when loading, transporting, or unloading animals.	3.29	2.33
Plan an escape route.	3.71	3.67
Dedicate appropriate number of workers to task (too many or too few).	2.36	2.20
Use a calm voice, deliberate actions, and confident approach.	3.14	3.53
Don't trust or take animals for granted or become complacent with routine jobs.	3.50	3.73
Use proper lifting techniques.	2.00	1.87
Know when to seek assistance (veterinarian, additional worker).	3.57	3.73
Alternate tasks to avoid repetitive stress/motion injuries.	2.29	2.07
Take special precautions to avoid cuts and needle pricks.	2.14	2.53
Minimize exposure in the "kicking zone."	3.50	3.07
Try to handle cattle in groups rather than individually.	NA	NA
Never tie a lead rope to yourself.	NA	NA

Table 3. CAFs determined by farmers to be more critical in an emergency situation than in a routine situation, where 1 is "important" and 5 is "very critical."

	Weighted Averages	
Critical Action Factor	Routine	Emergency
Understand gender and breed behavioral differences.	2.50	3.07
Minimize unwanted noise and visitors during animal handling.	2.85	3.27
Use a calm voice, deliberate actions, and confident approach.	3.14	3.53
Don't trust or take animals for granted or become complacent with routine jobs.	3.50	3.73
Take special precautions to avoid cuts and needle pricks.	2.14	2.53

Table 4. CAFs determined by farmers to be less critical in an emergency situation than in a routine situation, where 1 is "important" and 5 is "very critical."

	Weighted Averages	
Critical Action Factor	Routine	Emergency
Understand and utilize the animal's flight zone.	3.29	2.07
Use extra caution with loading, transporting, or unloading animals.	3.29	2.33
Minimize exposure in the "kicking zone."	3.50	3.07

Table 5. CAFs whose ordinal ranking varied between the farmer rankings for routine and emergency activities and extension agent rankings for CAFs under the category of "Handling Techniques."

Critical Action Factor	Farmer Ranking, Routine	Farmer Ranking, Emergency	Extension Agent Ranking
Match age, experience, and skill of the handler(s) to the task.	9	7*	2
Be especially cautious around animals that are handled less frequently or are agitated.	7	7*	1
Use a calm voice, deliberate actions, and confident approach.	6	4	10
Know when to seek assistance (veterinarian or additional worker).	2	1	7

* Tied.

responses in the first three categories. There were some differences of opinion in the "Handling Techniques" category. Of the 36 CAFs, the four with the greatest disagreement related to the age and experience of the workers, caution around agitated animals, confidence and calm demeanor, and knowing when to ask for help. Agents thought that age/skill and caution were more important and that confidence/calmness and knowing when to seek assistance were less important. These ranking differences are summarized in table 5.

A final review by external experts in the areas of livestock handling and behavior led to the addition of the following items: avoid the lone animal (under "Animal Behavior"), maintain latches on squeeze chutes (under "Handling Equipment and Facilities"), and never tie a lead rope to yourself (under "Handling Techniques") (table 1, items designated EP). These additional items had not been included when the extension agents validated and prioritized the list.

Checklist Developed

After completing the validation process, the CAFs were organized into a final checklist. The final list included 39 CAFs to be considered when handling cattle. One intended use of this checklist is for cattle farmers to post a laminated copy of this list on or close to their handling facilities, as well as one in the farm office or house. The items within each category were ranked according to results from the most recent validation

process. Items suggested by external reviewers were added to the end of their respective category.

An additional outlet for this checklist has been as a part of the Kentucky Master Cattlemen program (KMCP), sponsored by the University of Kentucky, the Kentucky Beef Network, and the Kentucky Agricultural Development Board. The KMCP consists of a series of ten farmer-oriented, topical workshops. To date, over 1500 farmers have participated in the program. This final version of the safety checklist has been included in the facilities section of the program.

Conclusion

Agriculture consistently remains one of the most hazardous industries in the U.S. While machinery is one of the primary sources of injury in agriculture, livestock is by no means inconsequential, accounting for up to 19% of farm injuries. This article examined the use of the Work Crew Performance Model as a method to identify specific critical action factors of a task or activity where safe performance would lessen the risk of injury within that task or activity. The WCPM has now found use in specific occupational tasks within mining, construction, and agriculture, all widely recognized as industries with historically high occupational injury and fatality rates.

Two farmer groups (all having livestock handling experience), a group of county extension agents, and selected experts specializing in livestock facilities and behavior participated in the study. The facilitated discussion of the first farmer group yielded 32 CAFs. The list was then validated by a second farmer group and a group of highly experienced extension agents. After the second validation round and after comments were received from domain experts and incorporated into the product by the University of Kentucky project team, the list of 39 CAFs was finalized and crafted into checklist form. The checklist was subjected to further review and input through presentation at two forums for parties interested in occupational safety and health (Isaacs et al., 2003a; Isaacs et al., 2003b), further validating the utility of the research product.

The final step of this study is to have farmers incorporate this checklist on their own farms. The current mechanism for achieving this goal is its incorporation into the Kentucky Master Cattlemen program. Informal feedback from participants in this training segment has been highly positive, although to date, no formal evaluation of segment-specific training components has been undertaken by the program training staff.

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