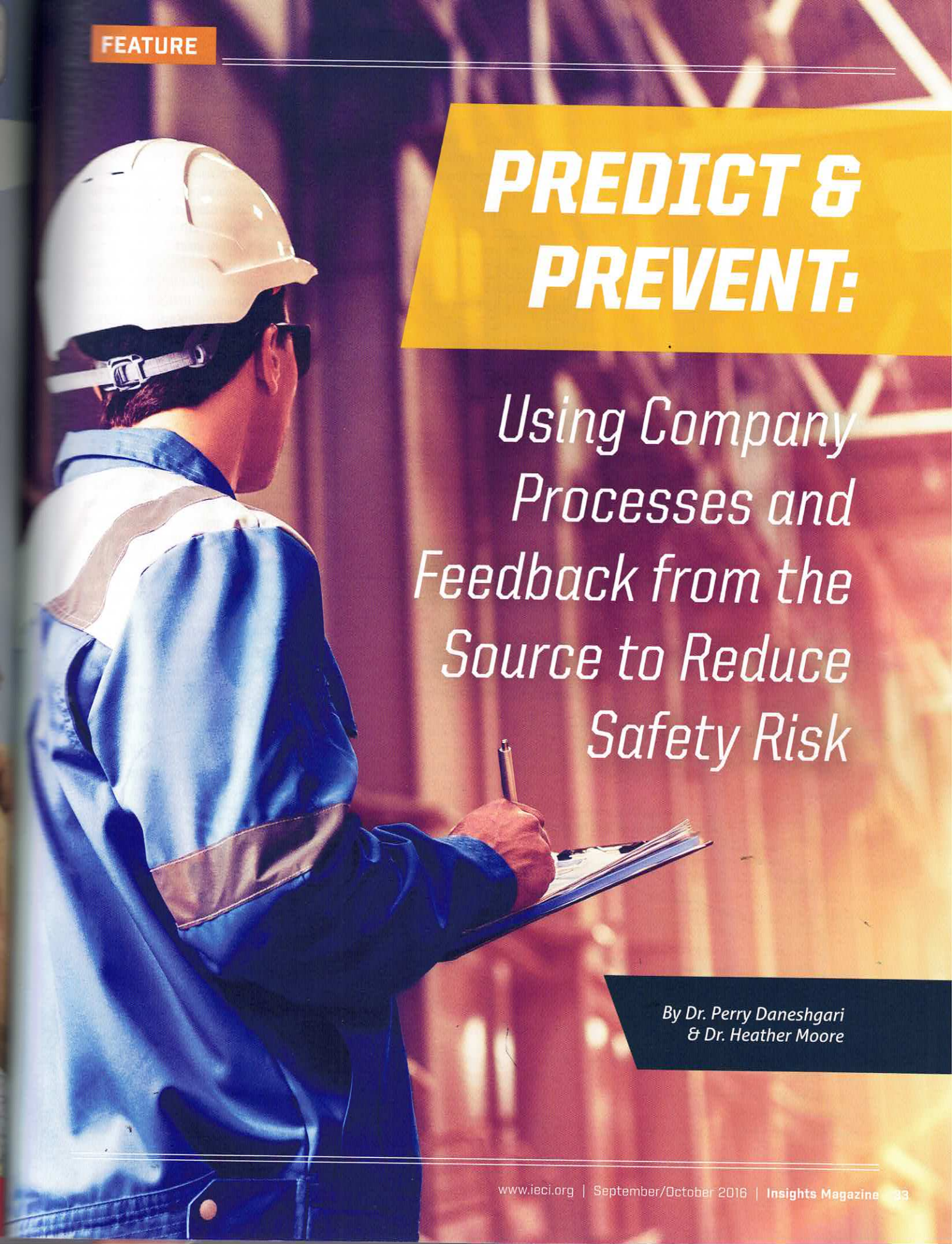


PREDICT & PREVENT:

Using Company Processes and Feedback from the Source to Reduce Safety Risk

By Dr. Perry Daneshgari
& Dr. Heather Moore

Most electrical contractors (EC) would tell you that "safety is a top priority." In fact, many institute company-wide safety programs that include training, procedures, and documentation, and they focus from top to bottom on safety. Construction is one of the most dangerous occupations in terms of safety, as the national level safety data and trends indicate. So, how is it that ECs have come so far in training and focus on safety yet we still are left with incidents and accidents?

According to the Bureau of Labor Statistics (BLS), construction represents about 10-15% of all industry injuries (Figure 1), and the contribution often increases year after year. Electrical construction contributes about 10% of all construction hours missed due to nonfatal injuries and illnesses, with approximately 3 million hours per year. At an average loaded labor cost of $50/hour, the industry loses about $150 million per year in unrecoverable scheduled work due to injuries and illnesses, and these are only the recorded and reported ones. With these numbers in mind, safety should be a high priority for the construction industry as a whole and for each contractor. An EC takes on significant risk every time he or she wins a job, including business risk, technical risk, and integration risk. Safety impacts all three of these and is the highest potential loss – in terms of human capital – if not managed correctly.

PREDICT AND PREVENT

National data is useful but does not help a contractor to "predict and prevent" on a project level and on a day to day basis. Agile Construction® is a method that focuses on prediction and prevention by using real-time and regular feedback from the source of work – primarily the electrician and the job site environment. Safety prediction and prevention of incidents begins with a solid planning process, which takes safety risk into account; it also requires useful and accurate data from the field and analysis of the data that can be used to predict safety incidents.

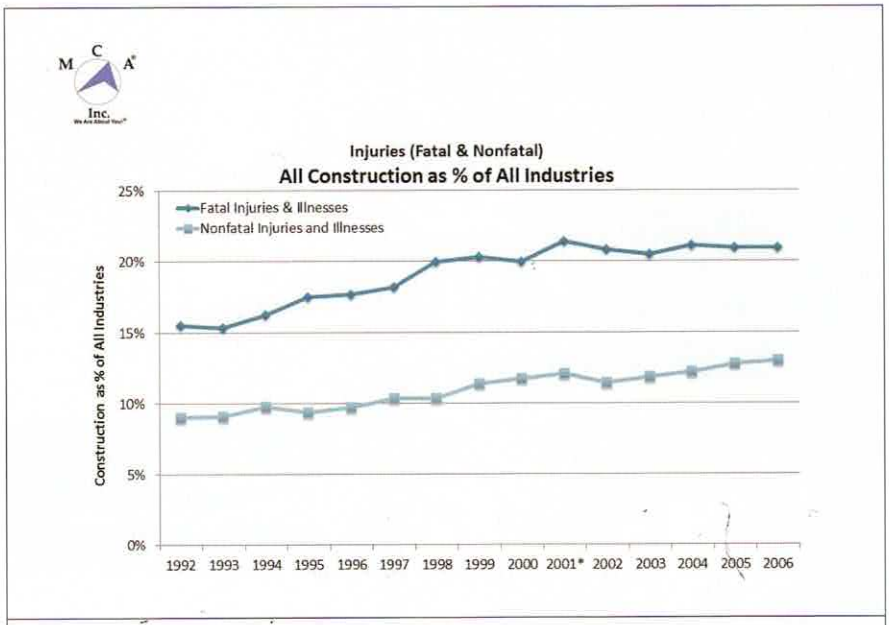


Figure 1

Project-level data can be used to model what input factors are either correlated or causal to safety incidents. Correlation and causation are two different things, which is important to keep in mind. Certain factors on a job site may highly correlate with frequency or severity of safety incidents, but it does not necessarily mean that the factors cause the safety incidents to occur. Both pieces of information are useful though; even though given factors do not cause safety incidents, if the factors correlate with the safety incidents it means their presence or absence on a job can be used to predict a potential incident's occurrence. For example, the following factors could be used to correlate with safety incidents:

- Project financials, such as cost to complete and underbillings;
- Job productivity data, using ASTM E2691 – Standard for Job Productivity Measurement;
- Data from short interval scheduling (SIS®), which tabulates obstacles to scheduled work and provides a view to daily scheduled tasks;
- Project audit information, from reviews performed every 25% complete on a project;
- Safety reporting, such as job hazard analysis, safety stand-downs, and incident reporting; and
- Project demographics, such as job site conditions, crew structure, job duration, and shift times.

Using data to predict and prevent helps to be ahead and hopefully avoid safety incident occurrence. However, further upstream to the feedback coming from

the field once a job starts is the process for planning and avoiding safety risk in the first place. It is one thing to say we "plan for safety on every job" and another to have a rigid process that turns tacit knowledge into explicit knowledge, which will then be used to mitigate specific safety risks on each project. The process that has been used successfully in construction and many other industries to make this planning a reality is Work Breakdown Structure (WBS). The WBS allows the project team to see and plan for the project as a whole, plus the individual activities. Planning for mitigating safety risk can happen at all of these levels during WBS development. There are various levels of influence that any single field leader, project manager, safety coordinator, and the EC owners may or may not be able to control on a project. For example, OSHA requirements are obligatory and part of the environment of doing business for electrical contractors. Project contractual requirements are also obligatory to the customer and/or owner of the project. Individual company policies regarding safety should be setup to be followed, but they could be questioned internally within the company for process redesign outside of any single job site condition. Furthermore, the individual behaviors and practices that field leaders follow and instill in their crew are completely under their control and influence.

At the job level planning, a WBS can be used to evaluate risk on activities, locations, phases, or other elements of the project. Once the work is visible, the project team can make a pass at all of the work and activities to evaluate risk overall and specifically evaluate safety risk. There are two aspects of this process that should be visible on the WBS once it is completed:

1. Activities listed on the WBS that will accomplish the work that is regulated and required on the project pertaining to safety. In other words, the contractual requirements, company policy requirements, site-specific requirements, and task-specific requirements for safety need to be specifically planned for and should show up on the WBS.

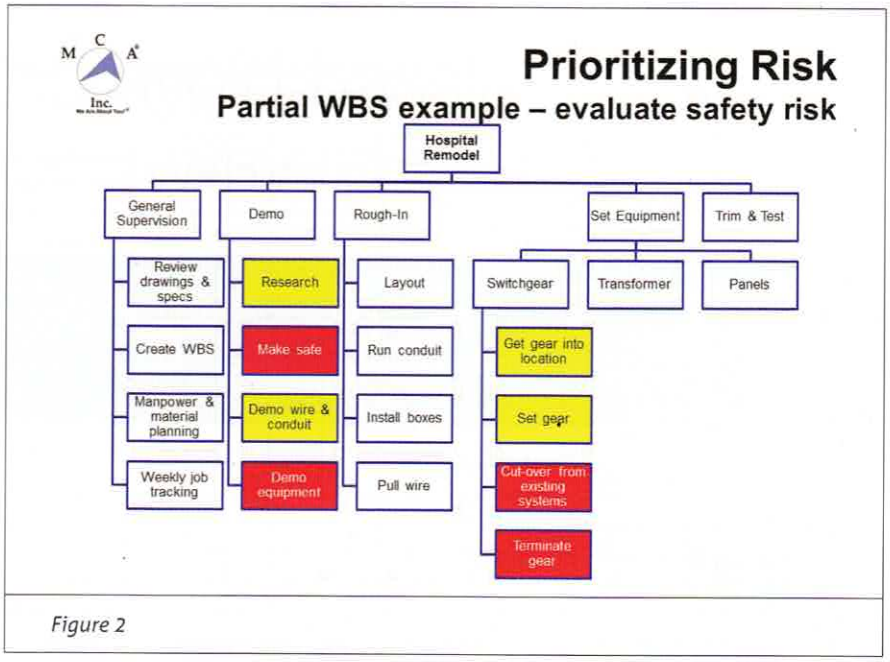


Figure 2

For example, the WBS should include activities such as the following:

a. Weekly toolbox talks

b. Daily task analysis for safety hazards

c. Stretch & flex

d. Make-safe activities

If these activities are not recognized and planned for by the project team, then they are just "after the fact" or nuisances not seen as part of the required work. They will become secondary to just "getting the work done," which is what leads to safety risk and incident occurrences.

2. Activities and more detailed planning on the WBS for safety risk on specific parts of the project (Figure 2). As the project team reviews the WBS and evaluates for safety risk, the risks should be prioritized by:

Frequency – How often is this risk likely to occur.

Severity – How severe will the outcome of the risk be if it does occur.

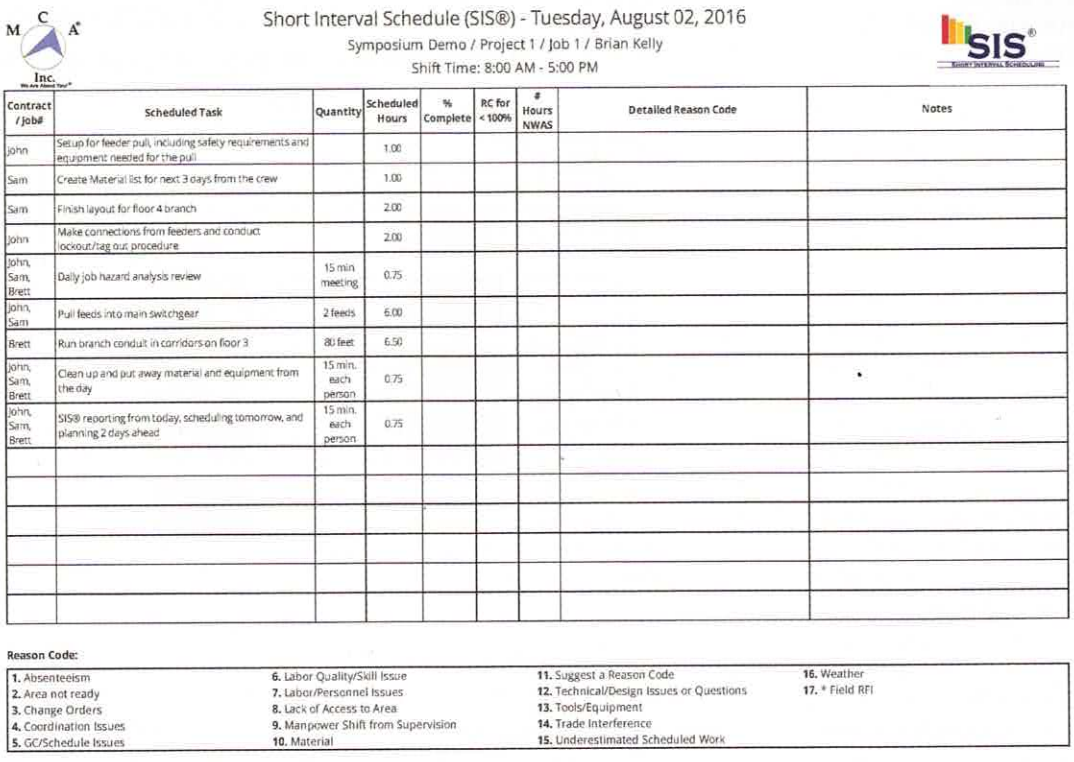
Detectability – What is in place now to detect or prevent the risk.

Based on prioritizing these three elements, which is part of a larger process called Failure Mode Effect Analysis (FMEA), the project team can select the top-prioritized items and create specific plans for those elements of the work to reduce the risk. This should be a focused effort of the project team to identify:

- What is the safety risk?
- What is the cause of the safety risk?
- What can be done to prevent the risk?
- What can be done to detect the risk?
- What can be done to contain the risk should it occur?

These should lead into specific work activities that are associated with the task on the WBS to ensure the project team has planned and will track the activities as part of the project.

Another process that can be used to ensure that the up-front planning effort involving data forecasting and planning using WBS are both happening is SIS®. The daily schedules should reflect the activities that were identified in the plan listed in the two items above. An example of this is shown in Figure 3. Here are obstacles that have been



Short Interval Schedule (SIS®) - Tuesday, August 02, 2016
Symposium Demo / Project 1 / Job 1 / Brian Kelly
Shift Time: 8:00 AM - 5:00 PM

Contract / Job#	Scheduled Task	Quantity	Scheduled Hours	% Complete	RC for < 100%	# Hours NWAS	Detailed Reason Code	Notes
John	Setup for feeder pull, including safety requirements and equipment needed for the pull		1.00					
Sam	Create Material list for next 3 days from the crew		1.00					
Sam	Finish layout for floor 4 branch		2.00					
John	Make connections from feeders and conduct lockout/tag out procedure		2.00					
John, Sam, Brett	Daily job hazard analysis review	15 min meeting	0.75					
John, Sam	Pull feeds into main switchgear	2 feeds	6.00					
Brett	Run branch conduit in corridors on floor 3	80 feet	6.50					
John, Sam, Brett	Clean up and put away material and equipment from the day	15 min. each person	0.75					
John, Sam, Brett	SIS® reporting from today, scheduling tomorrow, and planning 2 days ahead	15 min. each person	0.75					

Reason Code:

1. Absenteeism	**6.** Labor Quality/Skill Issue	**11.** Suggest a Reason Code	**16.** Weather
2. Area not ready	**7.** Labor/Personnel Issues	**12.** Technical/Design Issues or Questions	**17.** * Field RFI
3. Change Orders	**8.** Lack of Access to Area	**13.** Tools/Equipment	
4. Coordination Issues	**9.** Manpower Shift from Supervision	**14.** Trade Interference	
5. GC/Schedule Issues	**10.** Material	**15.** Underestimated Scheduled Work	

Figure 3

reported in SIS® related to safety that may not otherwise be visible:

- "Multiple safety issues; had to clear roads and cut back slopes to help prevent mudslides."
- "Had to hydrovac area due to unknown utilities."
- "Had safety shutdowns at various times."
- "Unsafe conditions were found above the equipment shaft."
- "Scaffolds were not safe with tag; had to get it altered."

SAFETY IS NUMBER ONE

In conclusion, safety is a top priority for construction companies and the construction industry as a whole. National data indicates that there is room for improvement, which would have a positive impact on job productivity but more importantly would have a lifetime impact on workers' well-being. In addition to just "focusing on safety," tangible approaches like WBS and SIS® can be used by the job site crews to incorporate safety into job planning and daily task scheduling and reporting without "extra paperwork." Furthermore, job and company data can be mined to identify correlations and causal relationships that would predict safety incident occurrence. This predictive modeling can be used to actually prevent the incidents in the first place.

HEAR MORE AT IEC CON 2016

Dr. Perry Daneshgari is the president/CEO of MCA Inc. MCA Inc. is a research and implementation company that focuses on implementing process and product development; waste reduction; and productivity improvement of labor, project management, estimation, accounting, and customer care. He has also published four books and an ASTM Standard for Job Productivity Measurement.

Dr. Heather Moore is vice president of operations for MCA Inc. She holds a Ph.D. in Construction Management from Michigan State University. Additionally, she holds an MBA from University of Michigan, Flint, and a B.S.E. in Industrial and Operations Engineering from the University of Michigan, Ann Arbor. She was a contributor for the ASTM Standard E2691 "Job Productivity Measurement" and also was co-author of the newly published ASTM book, "Application of ASTM E2691 Standard Practice for Job Productivity Measurement in Agile Construction®."