FactorLab

Conversations Are the New Currency to Operationalize Culture, Engage Employees, and Improve Planning

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September 2020

About FactorLab, Inc.

Founded in 2010, FactorLab designs, builds, and deploys innovative digital services that improve safety defenses and increase productivity in high-risk workplaces. Our integrated application, SmartTagIt, is used to mitigate potential hazards, address human factor opportunities, engage field leaders, and harden incident prevention systems. FactorWear is a wearable application that allows you to visualize the relationship between the physical requirements of a team, worksite constraints, and such measurable outcomes as daily production and accident/injury rates.
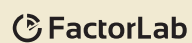
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EXECUTIVE SUMMARY

Organizations with effective daily planning conversations get more done and do it more safely than organizations that do not.

And yet, while there is extensive research supporting this assertion, little has been done to effectively aggregate and analyze the impact of daily planning conversations on worker productivity and jobsite culture. That is, until now.

Together with AI and machine learning, recent advances in video and mobile technology have created breakthroughs in our ability to capture and process these conversations to understand how work is being done and how serious injuries and catastrophic events and fatalities can be avoided. For the first time, C-suite leaders can assess whether their aspirational culture is being fully realized in the field as demonstrated by what takes place during the informal, unfiltered conversations that frontline leaders and work teams have every day.

These advancements have never been more vital than during the current COVID-19 pandemic. Leaders need to convey caring to motivate employees to collaborate and engage safely with others. Access to the rich insights that daily conversations provide allows them to identify and prioritize needed investments in training, leadership development, and rewards and recognition.

The Power of a Conversation

When your frontline leaders speak to those closest to the work each morning, they are consciously and unconsciously accomplishing several critical and interrelated objectives:

1. Communicating what needs to be done.

2. Sharing how it can be done in a manner that reduces the risk of a catastrophic event.

3. Signaling to themselves that it's time to switch their brains to "work" mode and engage with crew members.

4. Internalizing how their actions reflect and reinforce their company's culture and values.

5. Contributing to the productivity of a best-in-class, high-performance company.

6. Valuing these exchanges as a vital contribution to their company's safety system health.

7. Reinforcing senior leadership's commitment to the success and wellbeing of employees.

Daily conversations make these interactions meaningful and personally relevant and allow frontline leaders to communicate back to management what employees want and expect. When conversations exhibit care, engagement, and serve as conduits for critical information, they are not just meaningful and personally relevant, they also form a platform for how an organization renews and advances itself.

Looking back over the last 20 years, many of today's insights about worker safety, the importance of

culture, and the realities of what happens at the jobsite in daily planning sessions are not new. What is new—and perhaps even revolutionary—is that they have never before been connected as parts of a technology-enriched system using math models that have only just been developed.

This is what we've achieved with FactorLab's SmartTagIt system. Our premise is simple: By recording daily safety conversations via a smartphone application and with built-in video and mobile technology, teams now have real-time access and longitudinal analytics to show exactly what occurs in every daily safety conversation throughout the company, as well as snapshots on how the company is progressing as a whole.

About this Whitepaper

In this paper we lay out a vision and an actionable road map for executive leaders to capitalize on the opportunities emerging technologies provide. In our examination and synthesis of the work of 27 academic researchers and leading management consultants, we show 1) the importance of daily safety conversations to robust defense systems and 2) that these conversations also provide powerful insights into an organization's culture, the health of which has long-reaching competitive benefits that extend beyond the jobsite to the performance of the organization as a whole.

This is a valuable resource for the CEO and COO, safety and risk leadership, heads of HR, operations executives, and technologists whose role is to bring advances into the company. Most importantly, it is for the safety management and frontline supervisors who are the ones on point to seize on theory to save lives. It is also an invitation for innovators to join us on this journey. So much is possible, but it is through broader collaboration and adoption that possibilities are converted to positive outcomes that reduce risk and protect our workers.

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An organization's culture is communicated every day through informal planning conversations between frontline leaders and those closest to the work. We discuss the need for real-time, unfiltered access to these interactions and how they can be used to not only identify actionable precursors for incidents and potential safety system failure, but also provide executives with insights into the health of their organizational culture.

I. PREAMBLE & SETTING THE STAGE

Work crew conversations may be your most untapped currency. When thousands of them are taken in the aggregate, they reveal how well a company's culture is being operationalized and actualized.

For nearly 20 years, the FactorLab team has been on a mission to help reduce or even eliminate serious injuries and fatalities (SIFs) in the workplace. Our journey started with digital hazard forms on PalmPilots that went beyond completing paper forms or taking a survey. More recently, we developed sophisticated predictive models that incorporated over a billion field safety observations to prove that employee engagement was a strong factor and positive contributor to company culture. We successfully conducted use cases to establish the importance of everyday conversations in the field.

At the same time, we knew the essence of engagement could only be captured in a real-world, real-time setting and that its ultimate value would be realized when we could aggregate and synthesize individual conversations. We challenged ourselves to find a way to use these interactions to identify actionable precursors for incidents, as well as potential safety or risk system health failure. This inspired us to develop new ways to visualize and capture data through video to provide organizations a view into the heart and soul of their culture. With this visibility, it was our intentions that CEOs would be able to develop new metrics to measure the effectiveness of their improvement efforts.

An Aha Moment

In early 2020, during construction of a major project in Austin, Texas, a pipe fitter opened FactorLab's SmartTagIt application and captured a selfie video of him and his partner discussing their daily pre-task plan. A day later, their safety leader called excitedly to share what had happened. As we discussed the video and the informal conversation it captured, we had one of those rare career epiphany moments that connect 18 years of activities related to worker safety and risk mitigation (which, ironically, occurred on the 18th floor of a construction site).

This brief video made us reevaluate the premise that a company operates as a top-down system. How can a CEO lead effectively with such limited access to what occurs where the work is performed? Today, there are no good mechanisms for leaders to obtain honest, unfiltered feedback or visibility into conflicting work priorities. This reality creates a disconnect between them and their workers and their supervisors, which impacts productivity and increases the risk of SIFs.

About FactorLab

Through our SmartTagIt suite of digital tools, FactorLab works with leading construction and

industrial companies to capture and mathematically and contextually organize jobsite conversations using models developed together with the University at Buffalo, The State University of New York. We then use machine learning and multi-person interaction analysis of these individual conversations to objectively survey the state of an organization's culture and safety system health.

Daily conversations illuminate the gaps between what is written on a plaque and what those closest to the work really feel and fear relative to their relationship with the rest of the leadership team. As our customers focus on understanding and improving these conversations, they experience significant improvements in worker safety and engagement levels, as well as productivity and reduced rework. Although we realize more work is needed to be able to distinguish a top-performing company from a low performing one, we can offer three insights:

You know your conversations are not where you want them to be. Nowhere is culture more on display than during the two minutes in the morning when a team is preparing for the day. World-class cultures are defined by how frontline leaders communicate with their people on a regular basis and experienced every day through conversations at the jobsite. They renew, reinforce, or test a culture.

You are already paying to survey and assess safety. You don't need a new system or costly process to do this. Your current approach to conversations is *ad hoc* because you don't have a cost-effective way to access and learn from individuals or aggregate insights to derive deeper contextual understandings.

It is possible to do the unthinkable. You can now model the conversations of frontline leaders to drive better safety outcomes. Our work with the University at Buffalo pored over 5,000 unedited daily planning conversations. Using machine learning, we collected and organized thousands of conversations that you wouldn't have been able to access and measure otherwise. Executives can now observe how their words filter down to those closest to the work.

Raw, Unbiased Insight

While a company's leadership sets the vision, values, and blueprint that "build" a successful business, it is the everyday conversations at jobsites that connect them. These reflect, in raw and unbiased ways, the organization's ability or willingness to plan, engage, and recognize hazards, as well as show authentic care. That 18th floor conversation reinforced our decision to expand SmartTagIt's conversational analytics into advancing the application of AI through machine learning and contextual analysis.

The state of a culture comes out of the mouths of frontline leaders every morning during the ten-minute pre-planning meeting involving those closest to the work. We have witnessed thousands of these informal sessions and conversations between a supervisor and crew through real-time videos. Table 1 on the following page illustrates what they accomplish and the essential questions they help answer.

FactorLab has shown it is possible to use mobile devices to capture conversations in video form and to apply machine learning techniques to create a previously unimagined topography of a company's cultural landscape. Using this information, we are able to build a system health map to navigate the unexpected and measure progress. With an enlightened, fact-based mental model, a CEO who values unvarnished truth can see where they need to focus and when the walk and the talk are not the same.

Jobsite conversations matter. That you have them, how you have them, and what they address needs to fit your organization, its processes, values, and culture. It is essential that these conversations reflect four critical dimensions: Planning, Engagement, Hazards, and Caring. The nexus of engagement and caring is where meaningful two-way communication takes place.

At no other moment in our lifetimes is this capability more valuable than during the current COVID-19 crisis. One SmartTagIt customer doubled down on the importance of their pre-planning meetings due to the virus. Leadership measured which crew conversations

Table 1. What conversations convey and the essential questions they help answer.

What conversations can accomplish	Key questions to be answered
• Indicate ability/willingness to discuss high-risk hazards • Reveal more than words and images • Make it transparent that people care • Demonstrate how well they plan • Reinforce confidence in supervisor • Show the real hazards they face • Indicate willingness and engagement • See teams share and actively listen • Provide CEO with a window into culture • Witness systems health at the site • Test and validate CEO assumptions • Allow or force power to listen to truth.	• Do participants know the purpose of the planning activity? • Is pre-planning just pencil whipping? • Are leaders equally ready to lead? • Can you improve systems health? • How do you measure improvement? • Is there a feedback loop? • Are recognition systems healthy? • How do conversation impact CEOs? • How do they impact operations executives? • How do safety leaders use them? • How do HR leaders relate to culture?

changed behavior the most and which of these behaviors had the greatest impact. These actions not allowed management to get a reading on the anxiety levels that not only increase safety risk, but also make it difficult to focus on the work at hand. Total cycle time to do this was under 72 hours.

About This Paper

This paper shares and references 27 different studies conducted by scholars, researchers, and leading consulting firms on safety, culture, engagement, AI technology, and the role of conversations to enlighten and drive change. We analyze research by academics, including E. Scott Geller, Matthew Hallowell, Jan Wachter, and safety-focused organizations such as DEKRA. We incorporate the work of thought leaders at Harvard, Gallup, Gartner, McKinsey, and others centered on culture; the importance of ordinary conversations; and the challenge of establishing, monitoring, and adapting cultural alignment between the C-suite and the jobsite. These discussions are organized in the following sections:

Trends in Safety Research: High performing cultures where leaders engage their teams in effective

safety behaviors significantly outperform their peers. We review empirical studies on the effectiveness of conversations between leaders and workers. The best ones are safer, perform better, and deliver results.

Operationalizing Culture: Describes how to move from "CEO aspirational" to a culture that reflects what occurs at the jobsite. This extends into other areas beyond matters of safety.

Conversations Are the New Currency: Examines the central importance of conversations and how they are fundamental to organizational health and superior performance.

Innovations in the Field: Examples of FactorLab deployment both in the field and the board room.

Machine Learning & AI to Advance Safety Initiatives: We have drawn on 5,285 conversations collected from 124 worksites over a period of 24 months. In this section, we cover the hypotheses we tested, summarize results, and share implications and recommendations.

Recently we released a new model that evaluates seven aspects of a multi-person industrial

conversation. With this, organizations can, with over 80 percent accuracy, classify multi-person conversations in industrial settings. It is now mathematically possible to organize multi-person pre-planning conversations by the vectors of engagement, caring, planning, and common hazard precursors potentially associated with SIFs. Our findings can help academics in their research and safety experts gain insights from empirical observations.

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II. TRENDS IN SAFETY RESEARCH

High-performing cultures are distinguished by how frontline leaders engage with those closest to the work.

And yet, when we asked ten people to watch ten videos of safety conversations and define which ones were "good," we received ten different definitions. The good news is that when we asked a subject matter expert to watch these videos, they were able to determine in a matter of seconds if they were good or needed improvement.

Because we knew safety professionals and operating executives would be interested in watching videos of good planning conversations to learn from them and coach their own teams, FactorLab developed objective criteria to organize and classify the conversations within our software applications. To accomplish this, we drew on the work of respected researchers in human performance, behavior science, and safety management. We incorporated their findings into our organizing principles and built upon them, which ultimately led us to identify what really matters, including:

- Conversations: when they happen, how are they conducted/accessed

- Discussing Hazards: which hazards, how they are discussed, severity levels, risk

- Planning Work: anticipating work, pre-planning, enhancing productivity

- Engagement: multi-person conversations are more effective than one sided

- Care: when demonstrated with words and actions caring can avert injury

- Truth: together with trust, this is even more important in unprecedented times

Matthew Hallowell

Dr. Hallowell is a professor of construction engineering at the University of Colorado specializing in construction safety research on leading indicators, hazard recognition, safety risk assessment, and precursor analysis. He heads up CSRA, an industry organization supporting research on how to prevent serious incidents and fatalities. Hallowell discovered that workers are able to recognize only 50 percent of hazards they will face on the job. Rather, day-to-day interaction among workers and supervisors drives and sustains safety and open, frequent communication differentiates high performing from low performing safety crews.

This contradicts the assumption that people can always see danger lurking and just need to follow procedures to mitigate hazards. Hallowell showed that recognizing serious hazards is far more complex. His program in precursor analysis identifies the presence of known precursors of serious incidents and fatalities through brief but targeted conversations among a work crew. Through this work, he found 16 strong predictors that range from high levels of schedule pressure to a poor plan for change.

With precursor analysis, managers can quickly engage with crews to identify the presence or absence of

specific warning signs of events through structured discussions, which allows them to take action before an event occurs. Hallowell showed that top-performing crews receive regular safety communication from management at least weekly. The greater the number of crew members connected through informal conversations, the better the safety performance, indicating that shared attitudes and behaviors enhance performance and capacity to avoid errors.

Helen Lingard

Australia has set a goal to reduce worker fatalities due to injuries by 20 percent by 2022. At Melbourne's RMIT University, Professor Lingard conducted field-based empirical studies on supervisory leadership, work safety communication practices, and informal crew conversations by analyzing network patterns among small groups in the field and listening to informal conversations by supervisors and workers.

Lingard's work provides insights on how the best supervisors distinguish themselves by linking self-reported safety behaviors to how they adopt leadership practices. Safety climate was the highest priority and was achieved through daily pre-planning meetings focused on key issues. Informal conversations build trust; lack of frequent contact does the opposite. In her research, Lingard found that authenticity influences how workers view their supervisors and that they expect their supervisors' behavior to be consistent with their words.

Top supervisors are active listeners, which facilitates recognition and reward of individual accomplishments and builds worker trust. They organize and plan work in advance to anticipate safety hazards. They are role models that maintain high standards of safety; being consistent in their approach fosters a shared purpose among crew members.

High-performing supervisors have earned respect through proven experience, expertise, and technical capabilities. They show they care when they demonstrate that they understand individual workers' needs and are responsive to personal issues and

challenges at work and at home. If all these factors are supported, a trusting environment is established where workers are listened to and respected and are comfortable voicing concerns to executives without personal risk.

Bhavana Pandit

Ms. Pandit is a researcher at North Carolina State University in construction engineering and management. She has studied how poor safety communication is a widely recognized challenge. Chief among her findings is that workplace factors that foster safety communication include frequent informal conversations among workers.

A company's safety health correlates with how effectively and frequently safety information is exchanged at the crew level. Investing in efforts to promote crew-level cohesion and reduce tensions can yield significant safety benefits and higher engagement levels. A synergistic effect exists between safety climate and crew-level cohesion.

E. Scott Geller

Professor Geller from Virginia Tech has been at the forefront of behavioral research on safety for over two decades. His research is foundational in understanding worker behavior and crew level interactions. He is a visionary in active caring, listening, and how trust leads to team cohesion and worker safety. A core tenet of Geller's findings is that in an active caring culture, people look out for the welfare of others.

Behavior-based safety directives will not make a difference unless people have the courage to speak up. Culture can either reinforce compassionate caring or create obstacles and tensions. The better employees feel about themselves the more willing they are to care for others. Crews come together when supported by supervisor coaching and collaborative conversations.

Jan Wachter

Professor Wachter teaches in the Department of Safety Sciences at Indiana University of Pennsylvania

and is recognized as an authority in safety management. His area of interest is error precursors and understanding which unfavorable conditions increase probability of human error. Error traps include time pressure, mental pressure, fatigue, being new to a task, distractions, and overconfidence.

Human error is a symptom of deeper trouble in safety health, which is why organizational weaknesses arise in safety systems. Effective tools start with pre- and post-task planning and self-checking "take-a-minute," and "stop and seek" activities.

One can't plan for, control, or defend against all error-prone situations. To believe one can creates a false sense of preparedness that will only make incidents worse for workers when they do not believe they have the knowledge to make good decisions. These tools engage workers to be situation-aware about their safety, hazard avoidance, and recognition of conditions surrounding them.

Joe McGuire & Emily Haas

Mr. McGuire from CRH and Dr. Haas from the National Institute for Occupational Safety and Health (NIOSH) have written on supervisor practices where field-based leadership is critical. Proximity, having more conversations, and communication with supervisors enhances workers' trust. These behaviors indicate that supervisors care and help workers feel safe when raising issues.

Although 20 percent of workers have witnessed a severe injury or fatality, only 25 percent report it. Trust diffuses the tension between doing what is needed vs. trying to justify unsafe behaviors because of tight schedules or fear of retribution. The statistics are eye-opening: 78 percent of workers have observed co-workers taking short cuts; 67 percent have observed co-workers disregard safety rules because they are "overkill"; and 61 percent have seen co-workers in unsafe situations because a lack of training. Yet only 20 to 30 percent would report this to a supervisor.

McKinsey on What Distinguishes Companies that Excel in Safety

A 2018 study published in the McKinsey Quarterly, "Symbiotic Relationship between Organizational Health and Safety," surveyed 100,000 managers and employees from 52 firms using data collected on organizational health and safety. The study authors demonstrated that companies in the top tier of McKinsey's Health Index have the best safety records. The authors then identified which practices correlate closest with superior safety performance.

Companies with good safety records outperform others on such organizational health indicators as innovation, a focus on outcomes, and ability and desire to learn and continuously improve. Engaged employees identify hazardous situations more frequently, accurately, and propose solutions to mitigate risk. They also raise individual and group awareness, lower the tolerance for risk, and improve quality while reducing costly rework. Top quartile firms in organization health have six times fewer safety incidents than those in the bottom quartile. Conversely, bottom quartile firms have three times as many incidents, resulting in lost work time and lower productivity.

McKinsey shows that programs to improve safety can succeed only when employees see their leaders as authentic and when leaders put in place the learning cultures essential for improvement, including encouraging employees to speak up and share their concerns. Perhaps most important, the authors argue that none of this can happen without CEO support and that companies with high safety standards focus on soft practices encouraging employees to own safety problems.

Dodge and CPWR

CPWR—The Center for Construction Research and Training and Dodge Data examined factors contributing to safety. Not surprisingly, the most influential factors relate to frontline supervisors holding informal safety planning meetings and having frequent conversations with their crew.

Top-performing supervisors spend 70 percent of work time in verbal interactions with their crews. These actions have positive impact: 71 percent of workers urged by top performing supervisors will report incidents vs. only 6 percent with the worst. Fifty percent of the top supervisors ask for worker input on safety conditions while only 8 percent of the poorest performing do.

The Bottom Line

FactorLab was informed by these findings and found them consistent with our research and experience. It is these daily interactions that increase preparedness, confidence, and commitment. Conversations do convey when teams care, trust each other, and collaborate. We have learned how the best organizations actualize their cultural imperatives. Too often, CEOs expect workers to be informed by culture. Rather, the corpus of this collective work shows that culture is informed and developed by frontline leaders and those closest to the work.

We explore the importance of evaluating whether company culture and values are being realized in the field. We review current discussions around the concept of culture itself, where it is most evident, and how its health is determined by the relationship between leadership, employee engagement, and caring. We also share insights from top leaders on how to cultivate and sustain it.

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III: OPERATIONALIZING CULTURE

Consultants, generals, and coaches agree: the way to a strong culture and engaged employees is through conversations.

Much has been written about connecting and cultivating culture, yet no one seems to understand it, especially the employees who are asked to live by it. Unlike strategy, where one can define, articulate, and prioritize activities and execute them operationally, culture is more abstract, amorphous, and at times disconnected from the real world.

There are many longitudinal studies and annual surveys conducted by senior leadership to gauge and measure culture. One area these assessments often focus on is employee engagement as this is what fuels culture. A limitation that CEOs often face however, is that the most impactful conversations on culture aren't in the board room but at the jobsite. When only 6 percent of executives get employee feedback directly where work is performed, it is not hard to understand why surveys, periodic site visits, or employee sensing sessions do not provide feedback in an unvarnished way.

That only one in 16 executive leaders have this type of information readily available is why FactorLab is proud that for the first time, through videos that capture honest conversations, senior management can evaluate whether company culture and aspirational messages are aligned with the day-to-day work environment and worker mindsets. Where are the disconnects and tensions that confuse, demotivate, and frustrate employees and put their safety at greater risk? Gone unnoticed, these issues impact one's ability to retain key employees. In this section, we cover current

discussions around culture and its interdependence on executive leadership, field engagement, and caring.

Gallup

Gallup is one of the leading firms working on the issues of employee engagement and its relationship to organizational culture. For over two decades, they have measured and tracked the engagement of 27 million employees and more than 2.5 million work units. Little has changed over time.

Gallup has found that less than one-third of employees are engaged in their jobs. If we know that highly engaged organizations build up from the individual and crew levels, how can leaders better understand what occurs during the informal conversations these workers have with their supervisors? The greatest discrepancy between highly engaged and disengaged employees is in worker safety at a difference of 70 percent. Most CEOs lack the data and insights that would help them identify cultural tensions, hardened mindsets, and resistance to change.

McKinsey

McKinsey has examined culture closely as it sees it in as central to a company's Organizational Health and Financial Performance. This finding is based on research on 1,000 firms involving 3 million individuals.

Top quartile cultures have financial returns that are 60 percent higher than median ones and a staggering

<mark>200 percent higher than cultures scoring in the bottom quartile.</mark> Becoming a top quartile culture is hard to achieve. Why? McKinsey has found that only 12 percent of employees understand their culture, especially as it relates to them personally. Surprisingly, 70 percent of senior executives see culture and company strategies as disconnected and not mutually reinforcing. One likely reason is that while 83 percent of CEOs talk the culture, only 33 percent of them behave consistent with it. This percentage is even smaller when you try to tie operations and culture structurally. Only 19 percent of CEOs manage operations and processes by their culture.

John Wooden and Stanley McChrystal: Coach and Leader Insights

Addressing culture and engagement has major payoffs beyond the workplace. John Wooden, perhaps the most successful basketball coach of all time, used to tell his players, "be quick but don't hurry," because he was intentional about building the right culture. He knew which behaviors, skills, and efforts would strengthen and sustain excellence. He led by example, recognizing he was first a teacher and mentor.

To convey caring about his players, Wooden recognized that he needed to be involved in their lives. This extended well beyond college, and in some cases for the rest of his life. So much of this was achieved through frequent communication and ongoing team conversations. He knew great teams won championships, not great individuals (this tenet also applies to work crews). Football coaching great Urban Meyer put it more simply, "Leaders create culture > culture drives behavior > behavior produces results > results drive winning, but it all begins with culture."

General Stanley McChrystal has written extensively on leadership and his book, *Team of Teams: New Rules of Engagement for a Complex World*, is one of the top explorations on the importance of engagement. His insights come from his time commanding Joint Special Operations during the Iraq War. Today, he advises top companies and is a Senior Fellow at Yale's Jackson Institute for Global Affairs. The defining principles of his leadership system include:

- Give small groups the autonomy they need to innovate.
- Do this so they can share what they learn in their team across the organization.
- Talk often about shared goals through ongoing informal conversations.
- Value every interaction and exchange no matter how small.
- Motivate, recognize, and reward the team so everyone has a stake in its success.
- Every conversation provides insight into a person and their needs.
- Don't hide from mistakes; admit them and take accountability.
- If a leader cuts corners or holds back, these actions can permanently reduce trust.

Great teams and crews work together, perform better, engage more, and are safer than ones where everyone is focused on their own individual needs.

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IV. CONVERSATIONS ARE THE NEW CURRENCY

Conversations are where culture, operations, and performance intersect.

In this section, we discuss recent notable publications on the relationship between conversations and organizational culture and strategies for operationalizing it. Interestingly, all of the authors acknowledge they lacked the math modeling to bring their findings more readily into the workplace, which is what FactorLab's platform offers. Our technology interprets individual and multi-person conversations among supervisors and crews that are analyzed and aggregated based on planning, caring, engagement, and hazards.

Gartner: *Three Cultural Conversations Every CEO Must Have*

CEOs increasingly recognize that a high-performance culture provides financial and organizational benefits. At the same time, they struggle to operationalize such cultures because they have little access to real-world evidence of how their employees are performing. Case in point: only 10 percent of HR leaders believe their CEO understands the company's "real" culture.

Gartner, one of the world's leading research and advisory companies, believes CEOs must engage in three conversations with HR leaders to secure the success of culture initiatives:

1. Define the company culture as a set of tensions, not attributes.

2. Listen to unfiltered employee feedback to uncover the true culture.

3. Embed culture leadership into business leadership.

Operationalizing culture addresses existing tensions more than workforce attributes. Listening to employee's unfiltered feedback allows senior leadership to uncover the true culture employees live by as they perform their tasks.

An organization must identify where tensions exist and work with employees to resolve them. Gartner identifies three gaps CEOs should look out for: knowledge, mindset, and behavior. 1) Where culture exists as an intangible idea, there is a **knowledge gap** for 69 percent of employees because they do not believe in it. 2) Eighty-seven percent of employees experience a **mindset gap**: while there may be buy-in to what they believe the culture is, they don't understand how to act according to it. 3) A **behavior gap** effects 90 percent of employees. Here, employee actions seem aligned with the culture but workers don't believe in it, so even if they are compliant, they don't engage.

Most efforts to operationalize culture target the best performers hoping that if they adopt others will follow. But how do you know who the "top" performers are? Gartner suggests that leaders ask the following questions: What are the most troubling tensions in our culture today? Which are vital to our culture going forward? How do we help employees navigate them?

The most difficult of Gartner's proposed conversations is getting CEOs to listen to their employees' unfiltered, truthful feedback. CEOs often do not want to hear about what isn't working and most employees

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Table 2. Once you operationalize culture, you can hold leaders accountable.

Gartner research shows that four in five organizations rely on senior leader role modeling to drive culture. Great role modeling is characterized by: **What they say:** Leaders communicating the importance of culture. **How they behave:** Leaders behaving in a way that is consistent with the culture. **How they operate:** Leaders managing business processes (such as budgets, structures, and policies) based on the culture. The operate component has the biggest impact on workforce-culture alignment, meaning that leaders are least focused on the most important aspect of role modeling.

Activities and Impact	Say	Behave	Operate
% of organization leaders consistently do this activity	83%	29%	19%
% impact on workforce culture alignment	1%	9%	18%

Source: Gartner 2017 Culture Workforce Survey; Gartner 2017 Culture Benchmarking Survey

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do not want to be bearers of bad news. Gartner argues that progress happens when companies move from a culture-centric view of leadership to one where leaders are focused on commitment and execution. Change occurs when CEOs make it clear this is a top priority and not just something to do when you have time. Table 2 above shows the relationship between CEO behavior and culture alignment. When something is only verbalized, the impact is minimal; when it becomes operational, the impact significant.

Michael Beer: *Open Your Organization to Honest Conversations*

Harvard Business School's Michael Beer has been a visionary in understanding organizations and leadership. His "truth speaks to power" message has resonated with many as it gets to the heart of connecting culture at the top to what is on the ground.

Although low-level employees who put the actual work in place are fully aware of the problems that plague their company and know why particular initiatives don't work, they remain silent as they fear speaking up could put their careers at risk, even if the hazard might threaten their own physical safety and that of their crew. Beer calls this a "cyclical organization incapable of change or improvement." Stress and mental fatigue cause workers to be disengaged and lose trust in their

organization. Their reluctance makes them passive and they lack the trust needed to collaborate with others. The antidote to this, Beer argues, is having workers share information from the jobsite to top executives freely and frequently.

CEOs have to make themselves vulnerable by asking workers and frontline supervisors to speak truthfully about what is and is not working, Equally important, Beer argues, they should work on getting candid feedback from employees before attempting any organizational or culture-centric changes, Encouraging workers to speak openly communicates authenticity, caring, and a commitment to drive change. What was once viewed as career limiting needs to be rebranded as sharing information to elevate performance of the company.

An organization must have the capabilities to support honest and open conversations about how well it is adapting to changing competitive or social forces and realities. In the current COVID-19 pandemic, this means modifying traditional practices to address the inherent threats of the crisis on all aspects of a person's personal and professional life. For example, practices where people are in a circle in close physical proximity and in physical contact with handshakes and first bumps must adjusted. Even with physical separation and mask-wearing, however, teams still need to continue to interact and have conversations

and share with each other. This will require more active listening.

Boris Groysberg & Michael Slind:
Leadership is a Conversation

Groysberg, a professor in the Organizational Behavior unit at Harvard Business School and Slind, a communications strategist, examine how one can improve employee engagement and alignment in today's flatter, more networked, and digitally connected organizations. Technology's advances in opening up new ways to create value and interact with customers and employees run in the face of hierarchical, command-and-control leadership models.

To bring about disruptive changes in how a company is managed, workers in the field must connect with management on a cultural plane. This is accomplished with communication. From his interviews with hundreds of executives, Groysberg has learned that frequent, real conversations between leaders and their teams matters. Rather than formal or rehearsed, Groysberg argues that these conversations should be unstructured and occur spontaneously and they should become the norm in how people interact with their supervisors and among themselves. Once a hierarchical approach is abandoned as the prevailing mindset, the culture becomes the sum of many informal interactions that people have throughout the company each day. This can't come from HR. It has to be conversational and from the CEO. Conversations are less about issuing or taking orders, and more about asking and answering questions. Because physical proximity between leaders and employees isn't always feasible, mental or emotional proximity becomes essential in high performing companies.

Groysberg and Slind identify four mutually reinforcing attributes of organizational conversations that are essential: intimacy, interactivity, inclusion, and intentionality. Leaders need not excel at all four, but the greater number they are proficient in, the greater the impact on their culture.

Intimacy is how workers get to know and trust each other as they start to listen to each other. Company

communications are no longer top-down decrees, but a bottoms-up exchange of ideas. Gaining trust is the heart of establishing intimacy and listening is its expression. If you never listen to each other, how can you together advance initiatives or address problems? Listening also reflects respect and humility.

Interactivity is about encouraging and promoting dialogue through jobsite conversation. When leaders seek out employees to engage in conversation, they increase engagement. A truly interactive culture includes values, norms, and behaviors that encourage and stimulate natural conversations that reinforce the values themselves.

Inclusion expands the role of individual employees and spurs personal ownership for things important to the CEO. Much content comes from the field, not top executives. It strengthens intimacy and interactivity.

Finally, **intentionality** captures the energy and activity created by the first three elements and converts them into plans and road maps to achieve these goals. It is where process and people come together. What distinguishes intentionality is the other three are about opening up things through conversation. Intentionality brings closure and integration to the process and addresses the actualization of high purpose activities into day to day work. It is where a big-picture view and what it stands for becomes relatable to every individual.

FactorLab's research supports these findings. Our platform is being used to bring honest, informal conversations into jobsites in ways that engage employees, build caring relationships, and foster collaboration. We have been able to collect and analyze videos of conversations in unprecedented ways. Our math models identify where to emphasize, evaluate progress, work on bottlenecks, and integrate it all into actionable data visualization. We have shown that high scoring conversations do correlate with high performing frontline leaders and that top quartile supervisors are more effective in connecting and engaging crew behaviors and mindsets.

V. INNOVATIONS IN THE FIELD

Harnessing new systems to understand and address precursors to accidents and risk mitigation.

Every day, too many frontline leaders read their daily safety plans to their crews from a piece of paper while the crews pray for the meeting to be over. Why are they reading off the paper? Because they think they are supposed to even if they know workers are disengaged and just "listening" until it is over. And yet, we know that organizations don't need to fix employees to get them more engaged. Rather, they need to fix broken and ineffective systems to operationalize the intent of their overarching culture.

FactorLab was founded n 2010 to help organizations use technology and data science to solve the most vexing human-centered challenges in the workplace. We focus on how organizations and the systems they employ impact the performance of individuals in the field. Our solutions are designed to harness the power of conversations. As shown in the preceding sections, we know that conversations are not only critical components of robust safety defense systems, but they also serve as harbingers of culture and engagement.

About FactorLab and SmartTagIt

FactorLab's SmartTagIt is a unique SaaS product of interconnected applications, technologies, and data science models. We partner with organizations committed to protecting the safety of their workers and uncovering innovative ways to further enhance their safety programs. Users see dramatic improvement in field engagement with their critical safety systems and attest that improved pre-planning conversations

help save time, put more work in place, and significantly reduce accidents and injuries.

SmartTagIt's user experience is more akin to Instagram or Slack than typical mobile applications; it is easy to access information, provide feedback, and create a positive cycle of engagement (see Figure 1 on the next page). Users see dramatic improvement in field engagement with their critical safety systems and attest that improved pre-planning conversations help save time, put more work in place, and significantly reduce accidents and injuries.

We know that video animates what is occurring during a conversation far better than disconnected static snapshots. Customers use SmartTagIt to record videos of conversations between supervisors and crews at jobsites. These are uploaded to the platform and, in addition to freeing front line leaders from onerous paperwork and forms (both physical and digital), the videos can be can be "liked" and shared, creating opportunities among the team to learn from each other, recognize and reward good work, and fostering a sense of camaraderie and shared commitment to safety.

But this is only the first level of SmartTagIt engagement. The easy interface belies a rich reservoir of safety system intelligence. Using AI and machine learning, together with an array of next-generation structure metrics, SmartTagIt transcribes the conversations into text, which is analyzed and scored around the themes of planning, caring, engaging, and hazard

Figure 1. SmartTagIt Interface

SmartTagIt's user interface functions more like Instagram or Slack than a typical safety application. Within the app, users upload videos of daily planning conversations and colleagues watch, like, and comment.
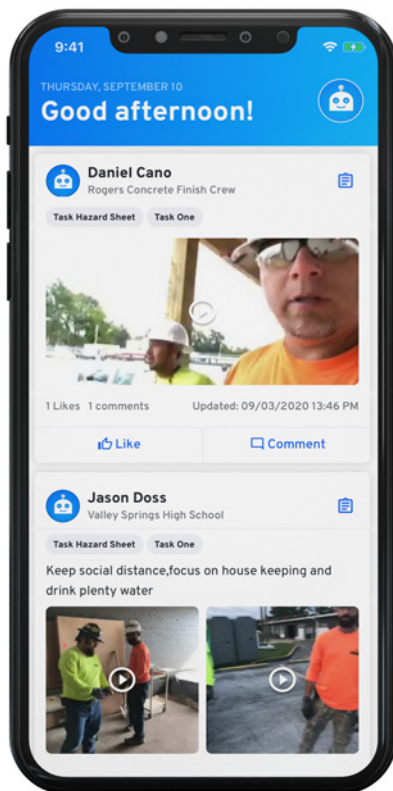
avoidance. Our analysis of thousands of recorded conversations shows that high-scoring conversations correlate with high-performing frontline leaders who use daily planning meetings to address at-risk situations, reinforce positive safety behaviors, provide operational context, and encourage best practices.

Rather than proprietary models, FactorLab offers modules that customers can combine and adapt to their needs to create an almost entirely custom solution. Below, we share examples of SmartTagIt's benefits in action. These range from the immediate benefits of improving the quality of conversations, to enterprise programs that provide an entirely new level of predictive and analysis in a competitive market.

A Point of Entry: Moving from Paper to Human Connection

Small Tweaks Yield Significant Results. FactorLab worked with Carlos, a caring and thoughtful guy who does his PTP every day. He fills out a form, looks it over, grabs his people, and reads it to them. When done, he has them sign another form and give it to the general contractor. In spite of this, he and his team had a series of eye injuries. Welders were forgetting to clear metal shavings from face shields before lifting them up and shavings were falling into their eyes.

Clearly, experienced welders knew this risk and had been trained on how to avoid it, yet they still didn't act accordingly, and preventable accidents occurred. When the general contractor introduced the SmartTagIt concept to Carlos, he was puzzled because he did not believe he had a problem. He believed the eye incidents were just accidents and his pre-planning process was fine. He agreed to use SmartTagIt to capture conversations. The safety professional sat with Carlos to watch the conversations and it led to a small tweak to Carlos' approach: he should just ask the team questions about the daily hazards rather than read the form.

The videos showed the activity went quickly from monologue to true conversations. Crew members were smiling, engaged, and doing their best to think about hazards. There were zero incidents for the rest of the project for any of Carlos's crews and they went from being behind schedule to getting caught up. Do we believe that recording a video of their PTP conversation is the singular reason for this potential improvement? Absolutely not. But we do know Carlos' team was more engaged than before and having more conversations about the work put in place.

Breaking Down Silos to Motivate and Support Coworkers. Leading organizations are distinguished by how they create capacity for systems to address inevitably unplanned events. The cost of this realization

FROM THE FIELD

What we know about workplace safety culture in the age of COVID–19

At the time of writing, FactorLab's SmartTagIt technology platform is being used in the field by organizations with revenues that range from a few hundred million dollars to several billion. We focus on organizations that procure or deliver large capital-intensive projects, which tend to have significant labor components. We work with CEOs from a range of industries who want easy access to what is occurring at the jobsite every day in real time, and this is particularly important during the current COVID-19 crisis when uncertainty is pervasive, long-term investment decisions are uncharted, and the margin for error is narrow.

The SmartTagIt system provides insight into the concerns of workers as they perform their jobs under unprecedented conditions—not only is incident prevention important, but now there are concerns about personal health risks and job security. This is not to say that organizations can't overcome these obstacles and position themselves for future success; the best companies build on a culture that flexes to new realities without bending on the vision that guides them.

is nothing, but the payoff and return on caring can be priceless. We saw this when we were invited by Dan Saddler of Structure Tone Southwest to lead a workshop with future superintendents about how to be better coaches by improving planning conversations.

Most safety professionals get into safety to make a difference in the lives of those they touch but finding time to do this can be difficult. Too often, they are pulled in different directions ranging from selling to new customers, to completing audits, inspecting a crane, or explaining how to perform complex tasks safely. Rarely do they get a chance to coach young foremen. As we shared numerous examples of safety conversations captured by their own team, the room lit up as they saw that with little practice, they could look at their safety system with a fresh set of engaged eyes. Just as important, however, by equipping these young engineers with this insight, Structure Tone underscored its core values and reinforced its commitment to them.

A Little Caring and Recognition Goes a Long Way.
We all love gift cards. Workers especially see them as recognition for a job well done. One of our customers videoed a project superintendent giving out a gift card at a staff meeting. The recipient was a Hispanic concrete foreman who was rewarded for getting his crew engaged. It was the first staff meeting in 20 years where someone was rewarded for a PTP. One reason this hadn't occurred more often is that there is no definition of "good" that defines when a reward should be given.

SmartTagIt gave them a benchmark for what "good" looked and felt like. When we asked if the superintendent spoke Spanish, the reply was no. We then asked if the foreman conducted the PTP in English or Spanish, we were told he held them in Spanish. How was the superintendent able to know the foreman had done a good job if he didn't know what was being said?

It is easy to identify engagement when you watch a video because regardless of language, we can see how actively the participants are engaging in conversations about hazards and work. The superintendent was able to witness caring in action. Of course, this would not be possible to communicate on paper. Having a PTP video shared among a business unit or region is shared recognition, and it is free.

Going Deeper: Launching New Safety Metrics and Mindsets

The insights that conversations provide have given rise to next-generation prediction models for operational and safety system health. FactorLab collaborates closely with our customers' data science teams to leverage our infrastructure and tailor it to their most critical needs. Rather than building proprietary

models, we provide building blocks that organizations can use to accelerate their exploration to meet requirements and develop their own tools and product enhancements.

Rapid Iteration = Rapid Response. Our customer, a leading mechanical contractor, invited FactorLab to present on the future of safety metrics to their executive team. The company has an incredible culture and is well along the journey to developing an interdependent engaged workforce. Everyone does their PTP daily and they have developed a digital application to capture and report on PTPs. After incorporating SmartTagIt into their safety metrics, they saw a 10x bump in engagement. They realized they could use conversations to take their culture to a higher level and operationalize culture and worker safety

When we discussed how to improve the conversations associated with their PTP, you could see the light bulbs come on. Yes, they had a PTP safety system and strong engagement in it, and yes, they care and want their culture to flow down to those closest to the work. It never occurred to them however, that they could access videos of all conversations between leaders and crews. In minutes, they came up with an action plan, made real-time decisions, and began to imagine new ways to help their employees work together. At the end of the meeting, one executive said, "I had no idea I could do so much to help and that it is my job to remove the barriers to helping our employees improve our critical safety system."

Introducing Next Generation Safety System Intelligence

SmartTagIt is prompting executives and safety leaders to rethink how they use SaaS applications and data science to ensure their incident prevention systems provide healthy and robust defenses against the impact and risk of serious injuries and fatalities. Our goals are simple yet ambitious: 1) Offer our customers a reliable, objective way to look at leading safety indicators along proven themes that indicate a healthy, interdependent safety culture. 2) Provide a new lens to accelerate how organizations look at and

measure engagement on a daily basis and equip them with tools and actionable insights to improve it.

Using New Lenses to Analyze and Leverage Everyday Conversations. Recently, we were talking to a board member of a multi-billion-dollar company about what customers really focus on when pitching for large capital projects. FactorLab's hypothesis was that these they put a high priority on safety in these presentations. The board member indicated this was not the case. He estimated only 20 percent of their customers really cared and put real value on this topic. The other 80 percent? Not so much. Why is this? We believe it is the disconnect between stated corporate culture and values and what really happens on a day-to-day basis where work is performed.

We described how we capture and analyze conversations and how it is possible to examine a cluster of conversations for each trade partner by levels of planning, hazards, engagement, and care. The board member picked up quickly on the planning aspect and the possibility of showing a prospective customer how their team could determine which contractors are better planners. They would be able to achieve this by analyzing construction outcomes, seeing what "good" conversations look like, why they result in less rework, and how they are able to get more done with fewer changes.

Over the course of our discussion, the possibilities and benefits of using conversations expanded: The company could use videos to compare conversations from contractors with less accidents to ones with more and explore why this was the case. Nothing else was needed; no new data, no new models—just looking at the same conversations through new lenses to unlock new insights.

Too often safety is viewed as a general contractor problem and responsibility, not that of others involved in a project. The importance of safety matters to all parties on any given project. It impacts productivity, risk reduction, and avoiding issues that can impede schedule or cause budgetary issues.

Where to Start: First Steps to Apply Insights

It is time to move from paper forms to captured conversations; from sites first to insights first; from risk quantification to risk mitigation; from conflict to collaboration; from bottom-tier performance to bottoms up, top-tier performance. If a company's systems, processes, and leaders are at such a state that they can't get workers to wear PPE or fall protection, then it should not come as a surprise that those jobsites are at risk. ==Getting "basic metrics" in place is exponentially more difficult when a site is predicted to be more at risk, as is the challenge of determining which levers to pull.==

Currently used metrics are valuable, yes, but more is needed given the magnitude and complexity of the challenges companies face. Much has been documented in research on human error, behavior science, and human performance. While we know that organizations need to move beyond measuring percentage safe or unsafe or if someone filled out a form, it is also difficult to measure what is most important: quality, planning, culture, engagement, system health, and safety management.

FactorLab encourages organizations to build models to predict the impact on behavior when a certain intervention is put in place. Models inform leaders of expected behavioral outcomes when they improve the health or capacity of their critical systems. Why don't organizations measure the efficacy or predict how a certain communication or training approach actually impacts behavior? We strongly suggest shifting the focus of prediction to first determining which systems and procedures are more at risk. While it makes sense to want to predict which site is more likely than another to have an accident or injury, that does not mean it is the best place to invest your prediction dollars. Here are a few reasons why:

- Serious injuries and fatalities are incredibly difficult to predict;
- because they are so infrequent, the target variable is small and hard to get enough data;
- factors of such an event are incredibly complex and hard to control; and finally
- research has identified other factors within your control to help prevent terrible things.

This is why we suggest focusing on predicting how planned investments (i.e., training, people, leadership, and internal communication) will impact your culture and organization's willingness and ability to engage your critical safety systems. This requires being better at investment decisions around activities, people, and systems that improve the quality of conversations between crew leaders and those closest to the work.

VI. MACHINE LEARNING & AI TO ADVANCE SAFETY INITIATIVES

Just imagine the almost unlimited possibilities that come with access to thousands of conversations.

Patterns emerge and hypotheses are formed that will be tested on the next set of thousands more conversations. Some might exhibit lots of caring but little time spent on engagement; others may be weighted more towards planning.

Nowhere is the impact of video more vital than in the pre-planning most companies perform. A video of a conversation provides a deep repository of information that can unlock what is generally invisible; it captures words, reveals body language, shows interactivity, and gives insight into the capabilities of a frontline leader. For example, we know that when there is genuine trust for each other, the crew collaborates more. A conversation can reveal to what degree a leader involves their team in discussing how he or she has planned the daily work and communicated it. When a SmartTagIt user captures a conversation, the system transcribes the audio and parses it into specific factors that are objective, unbiased, and easy to understand. Having a library of real people having real allows organizations to see for themselves what is working and what they need to improve.

Many factors influence behavior even when people have required knowledge. To improve conversations among supervisors and workers, we must let them know what is expected and address the circumstances and other factors that affect the ability to achieve this. FactorLab has operationalized a model of measurement focused on four dimensions of conversational effectiveness: engagement, care, planning,

and hazards. Essential attributes of each are indicated in Table 3 on the next page.

At the same time, one can tell people to improve conversations, but it is far more effective to show how important these conversations can be. We think a great deal about how companies can know their incident prevention systems are working, including measurement and metrics and how to improve them. FactorLab's library of custom metrics can serve as proxy indicators of how current values, culture, and systems influence interactions between supervisors and crew members. They can also inform executive teams on who they hire, how they lead, and where to invest in operational systems that prevent injuries and improve productivity.

One class of these metrics can be used to help individuals and crews better understand the organization's expectations relative to the pre-planning activity, as well as highlight when additional capacity should be created in the system to tolerate an unplanned event (see Figure 2 on the next page). Another addresses culture, values, and operational systems, all of which impact a crew leader's likelihood to improve the health of this system.

Using Unstructured Data to Understand and Address Precursors to Accidents and Injuries

Data science has helped create solutions to some of industry's great challenges, including increasing productivity, overcoming cost/schedule overruns, risk

mitigation, and making quantum advances in worker safety. But limitations persist when it comes to leading indicators and actionable precursor metrics.

There is a growing appreciation of unstructured information as a complement to observation processes.

As experts better understand how to harness this, we can refine current practices to eliminate the collection of data of little value. AI applications in particular are starting to get the attention of CEOs to address these complex problems. A recent analysis by data and media analytics firm IDG predicts digital data will
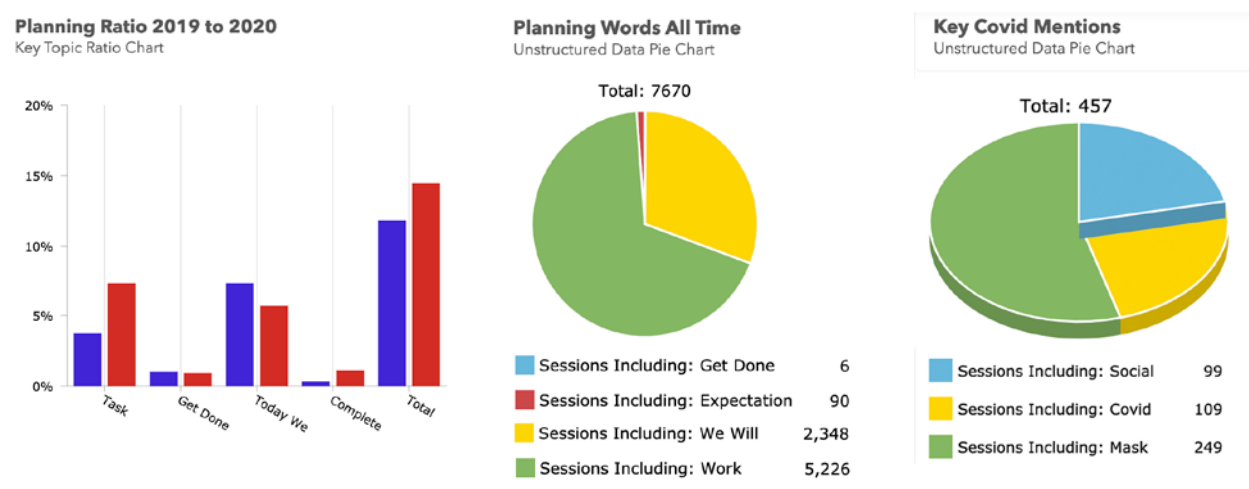
Table 3: FactorLab's Four Dimensions of Safety Planning Conversations and Essential Attributes of Each

The SmartTagIt system measures and categorizes data captured in videos of safety planning conversations along four dimensions.

Care	Engagement	Planning	Hazards
Do the conversations reflect trust?	Is this a monologue or dialogue? What kinds of questions are asked?	Are expectations being set?	What kinds of hazards are they talking about? Are they real ones?
Is the dialogue creating or reducing capacity for unplanned events?	How many people are participating?	Are they talking about the work or only hazards?	Who and how many people are talking about these hazards?
Is the speaker demonstrating genuine interest in conversations or people?	How much are they engaged?	Does everyone understand the expectations for the day?	How likely are they to report near incidents, unsafe conditions or behaviors?
Is there any indication speakers care for one another?	What level of collaboration are we seeing?	Do multiple people ask questions about the work as well as hazards?	

Figure 2. Accessing the Data

SmartTagIt users are able to request whatever answers, text, observations, audits, inspections, transcriptions, or comments that have occurred in the analyzed videos. For example, one can search how many times someone mentioned "thank you," "please," or "good job" in one month compared to the previous to gauge their level of active caring. Phrases are categorized by theme, such as planning, caring, engagement, or any other areas. The model is not limited only to planning conversations; the technology can be used to collect analyze many types of safety metrics captured in many different ways.

Planning Ratio 2019 to 2020
Key Topic Ratio Chart

Planning Words All Time
Unstructured Data Pie Chart
Total: 7670

Sessions Including: Get Done	6
Sessions Including: Expectation	90
Sessions Including: We Will	2,348
Sessions Including: Work	5,226

Key Covid Mentions
Unstructured Data Pie Chart
Total: 457

Sessions Including: Social	99
Sessions Including: Covid	109
Sessions Including: Mask	249

grow from 33 billion terabytes in 2018 to 175 billion by 2025. This growth in digital data will not be in highly structured form, but in unstructured formats like in video conversations. Video, audio, and text free will be 80 percent of the gains and 75 percent of work activities will require natural language understanding. This will be achieved through automated methods. Nowhere will one see greater attention focused than on risk and injury reduction. Key is understanding precursors and multi-party conversation.

Partnering with the University at Buffalo on Machine Learning Models. When humans watch and listen to a conversation, their brains are unconsciously doing many things at the same time. They figure out very quickly if multiple people are paying attention. They determine if the speaker sounds like they care and if those receiving information are engaged. Because our brains under-stand context, they can look at the environment and make judgments about a conversation's relevance.

Technical questions to emulate and model this brain activity include teaching a machine to organize tens of thousands of conversations in a way that would be actionable in the field. To accelerate and deepen our exploration of advanced modeling, we established a partnership with the University at Buffalo, The State University of New York to capitalize on their deep bench of experience and rigor in both natural language processing and machine learning. The goal of the project was to develop a machine learning model to classify conversations among seven distinct measures that are aligned to FactorLab's dimensions of safety conversations and tie them back to highest performing leaders at various work sites (see sidebar below for information on the seven measures).

Led by Dr. Rohini Shirhari, the research was conducted by a team of three data scientists over seven months, from November 2019 to May 2020. They independently analyzed over 5,000 pre-planning conversations from

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How we measure conversation effectiveness

We trained a multi-label long short-term memory (LSTM) classifier to classify sentences as one of FactorLab's themes or a combination of classes. We were able to derive features from the transcripts and include embedding based features. We developed a way to rank systems starting with bucketing classes, outlier removal, model fitting, observer engagement levels, evaluating question quality, and determining the planning effectiveness. We analyzed the important but highly subjective area of caring. Because of its critical nature, we examined hazard related behaviors associated with less

frequent but most lethal types of SIFs and number of fatalities.

Working with the team at the University at Buffalo, we developed an integrated model scoring each conver-sation, which is capable of generating scores for all metrics simultaneously. The model was also designed to main-tain the existing correlations between the metrics. It can generate predic-tions that cluster transcripts and users to help determine the overall health of a particular conversation.

We demonstrated how to extend clustering results to assess perfor-mance of an observer along seven conventional metrics. The reason for seven as opposed to four dimensions (caring, planning, engaging, and haz-ards) was that we distinguished the engagement category as having three components. We looked at both the engagement level of a participant in a conversation and an observer of the

same conversation. One challenge is the reluctance of individuals to iden-tify issues, near misses, or unreported events because of concerns of how this may impact them personally. To capture this tendency, we included a measure focused solely on the quality of questions asked.

We also distinguish between two types of hazards. The first, which we call "real hazards," tend to be more frequent like not wearing PPE or slips trips and falls. The second, termed "high hazards," are the more consequential hazards or precursers often associated with potential SIFs. Finally, because we predict seven metrics simultaneously, it is difficult to ensure that the same distribution of data is maintained in the distinct categories of "train", "dev" and "test" sets. To address this, we created a unique metric identifier for all data set combinations.

Figure 3. Total Conversation Scores by Individual, Over Time, and by Cluster

This figure, captured from SmartTagIt's data dashboard, shows a Total Conversation Score of 13.0 for an individual conversation (as captured in the video on the right), as well as its breakdown along FactorLab's seven different measures of conversation effectiveness, which are on a scale of 0–3. It also shows how this particular conversation compares with others.

Figure 4. Team Conversation Effectiveness Matrix

This figure, also captured from the SmartTagIt dashboard, shows the effectiveness of the conversations captured by the same individual above compared to those captured by coworkers. This includes change over time.

SELECTED:	Max. index_index_ convo_switcher	CARE	CHANGE IN CONVO SCORE	CONVO CONSISTENCY	HIGH HAZARD	OBSERVER ENGAGEMENT	PARTICIPANT ENGAGEMENT	PLANNING	QUESTION QUA
Taylor Sullivan	19.2	1.7	3.0	3.0	1.2	2.4	1.9	1.4	1.3
Mark Kufner	19.2	1.5	3.0	3.0	1.3	2.5	1.6	1.8	1.2
Zach Adkins	19.1	1.7	3.0	2.0	1.1	2.4	2.1	1.9	1.4
James Lott	18.1	1.4	2.0	2.0	1.2	2.5	2.2	2.0	1.4
Jan Herbert	17.6	1.6	1.0	3.0	1.1	2.1	2.4	1.9	1.3
Chris Moormond	17.5	1.5	0.0	3.0	1.3	2.6	2.1	2.3	1.3
Tim McGinley	17.4	1.5	1.0	2.0	1.8	2.6	1.6	2.2	1.4
Dan Deutsch	17.3	1.1	2.0	3.0	1.1	2.4	1.9	2.3	1.0
Scott Craney	17.3	1.4	2.0	2.0	1.0	2.4	1.4	2.0	1.1
	17.3	1.4	2.0	3.0	0.9	2.4	2.1	2.1	1.1

six FactorLab customers who together were managing over 100 different projects with more than 50 frontline leaders. The conversations were collected and analyzed using the SmartTagIt application. To minimize bias, participants conducted normal activities without any predisposition or exposure to relationships between conversations and how they may reflect the culture. Each leader used the SmartTagIt application to collect daily pre-planning conversations in real time as they naturally occurred. All information provided was anonymous.

Each conversation was broken into over 100 features and modeled accordingly. Neither FactorLab nor our customer edited any of the recordings. We were aware of the problem of mining finer details in conversations that involved multiple speakers in interactive

exchanges. To accommodate this, we used a hybrid system to holistically assess the health of team meetings at complex, high risk work sites, looking at an ensemble of domain-specific features. These included the intensity of discussion related to hazard recognition and work planning and other general conversational features (i.e., engagement by the primary speaker and the participants, quality of questions in the conversation, and demonstration of care).

We are especially pleased with the breakthroughs in understanding and classifying multi-speaker analyses. In our testing, the model's classification of a conversation matched an expert's classification an impressive 82 percent of the time. We were also able, with 80 percent accuracy, to classify multi-person conversations in harsh noisy environments.

Results of our study confirm that a combination of semantic and syntactic features indeed help in assessing the health of a conversation along FactorLab's four dimensions of effective conversations. Using a variety of machine learning approaches, the team was able to reliably classify each dimension of conversation effectiveness, allowing us to build an integrated model that combines this data into a Total Conversation Score (TCS). We tested model accuracy against a training set of 1,400 conversations that were scored independently by eight different safety experts to test the unified model's ability to match scores.

Each conversation in the corpus was termed as a transcript that contains several turns with each belonging to a particular speaker. We were able to determine the primary and non-primary speakers in any transcript and derive features from each turn of the primary and non-primary speakers. Keep in mind that as humans, we can effortlessly gauge care, planning, hazards, and engagement in a sentence.

Figures 3 and 4 on the previous page show both a single user's conversation along with the scores of the entire team. At a glance, you can see exactly how effective the user's conversations are, how they compare with those of coworkers, and observe changes

in quality over time. SmartTagIt can group the data by individual, role, project, region, or company.

What Cluster Analysis Tells Us and How We Can Apply It

In Figure 5 on the next page, we plot every conversation that was captured by an organization for a 180-day period. Our analysis portioned the conversations with similar characteristics into one of five clusters, each identified in the figure as a different color. The white circles represent the conversations for the same individual we featured in Figures 3 and 4. We can see that the majority of this user's conversations are in the dense yellow cluster on the left. To understand what these conversations look like, we refer to the colored bars on the right, which show the average scores on each measure for that particular cluster.

Conversations in the yellow cluster have the highest average scores across all the measures. Leaders will want to better understand their sources. Individuals like our user with a higher number of conversations in this cluster may be promoted or asked to coach others. (Of course, the software allows for easy recognition of exactly who these individuals are so you can seek them out and congratulate them on a job excellently done.)

Conversations in the purple cluster are relatively similar to those in yellow with two exceptions: low Question Quality and low Participant Engagement. We could think of individuals with a high number of conversations in this cluster as 'preachers.' They are talking at the teams more than listening. We don't suggest these individuals are either good or bad, but leaders may suggest they consider speaking a little less and encourage others to share their insights relative the work and hazards at hand.

Similarly, conversations in the orange, blue, and teal clusters have their own shared characteristics. Those in the teal have the lowest average scores. Individuals with a higher number of conversations in that group may not understand the purpose of the activity and need additional support or investment.

Figure 5. Average Scores by Cluster

This cluster analysis illustrates the quality and effectiveness of the same individual's conversations. It reflects the amalgamation of the seven categories assessed: Care, High Hazard, Observer Engagement, Participant Engagement, Planning, Question Quality, and Real Hazard. The white circles represent each of the conversations that were captured by this particular team member.
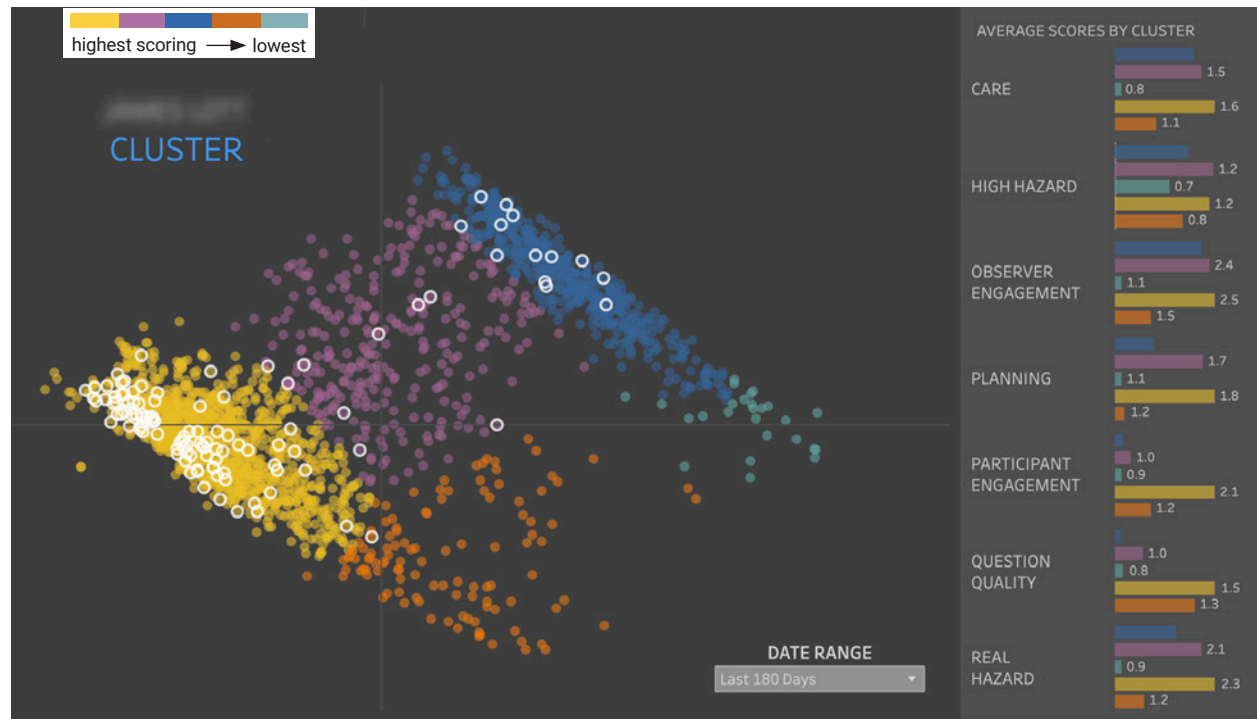
Looking at the data in this way helps organizations quickly identify differences and patterns, which can be tied back to specific individuals, projects, regions, and personality types. Across the clusters, the map shows there is opportunity for emphasis, improvement, and recognition. For example, all of the clusters score higher on Real Hazards (less "high risk" hazards like PPE or trips and slips) than they do on High Hazards. This isn't surprising because we know that most workers are familiar with obvious risks. It also indicates that the frontline leaders often ignore or never get around to discussing topics that could lead to SIFs. Another measure with lower scores across all clusters is Question Quality. This might be because employees are uncomfortable asking questions or questioning safety practices, which is why we also see lower average Participant Engagement scores in many of the clusters.

FactorLab

In 2008 in the United States, about 100 people died every week while they were doing their jobs. And where were we 10 years later? In the same exact place.*

And yet, we do not believe the problem of workplace safety is intractable. In fact, we're more hopeful about it than at any other time. Why? Because our industry has just entered a new era.

There is more thought and innovation around the issue than ever before—see Sections II through IV of this paper! Behavior scientists and human error experts, the military, and the world's leading workplace engagement experts are in agreement: frontline leaders who communicate effectively with those closest to the work are the key to significantly reducing the chance of a serious injury or fatality and ultimately cultivating a high performance culture.

Together with this, there is a convergence of technology that finally gives leaders the tools we need to measure, calibrate, and continuously improve. It might not be obvious, but countless lives will be saved thanks to Google's natural language processing, Facebook's showing us how humans prefer to share information, Instagram's proof of the power of visual communication and simplification, and Apple's elegant devices that are easy to use.

These two forces, insights on conversations and culture together with technological advancements, are colliding at the humble, often broken, well-intended and yet disconnected daily planning conversation. After decades forecasting the seismic shifts that

unstructured data, machine learning, and artificial intelligence will bring to the industrial workplace, we're excited to announce that not only have they arrived, but you can find them on your smartphone.

At this moment, senior leaders can mine the thousands of informal interactions that take place in the 10-minute daily planning conversations that happen at every jobsite. They can activate this data to close the gap between what an organization says its values are, and how it they are operationalized in the field. They can gather evidence of whether their safety defense initiatives are working and react accordingly. They can recognize and reward those individuals who are excelling at fostering engagement and they can coach those who are not. They can grow camaraderie and trust to empower teams to imagine new ways to solve complex and critical problems.

This paper is ultimately about an opportunity for those willing to consider the possibilities to do something that was never before possible. Avoiding unplanned events and SIFs is a continuous challenge. No one is immune from it, but the organizations that harness technology to understand their systems to handle it and move forward will outperform those that do not.

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*As reported by the U.S. Bureau of Labor Statistics, on 2008, there were 5,214 fatal workplace injuries in the U.S.; in 2018, the number was 5,250.

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Barry is the President and CEO of FactorLab Inc., a company integrating technology along with data and behavioral science to dramatically reduce the risk of serious injuries and fatalities in the workplace. Barry has spent the last two decades helping organizations achieve sustainable and dramatic reductions in worker injuries. He has proudly supported executive and safety teams at some of the largest contractors, utilities, and energy companies in the world. In 2001, he founded DBO2/Predictive Solutions, which now serves thousands of users and is the largest known repository for leading risk indicators in the world. During his time at Predictive Solutions and now at FactorLab, Barry has helped organizations find new ways to apply technology and data science as a source of competitive advantage.

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Steve is leading FactorLab's effort to bring the power of its technology breakthroughs into practice at our customers' jobsites, as well as equipping CEOs and operations leaders with data insights to effectively operationalize culture, engage employees, and coach supervisors and frontline leaders to improve worker safety and productivity.

Steve spent 24 years at Honeywell, where he headed up corporate strategy, leading strategic planning and exploration of new businesses and transformational growth. Steve has since advised 45 companies ranging in size from Fortune 50 to tech startups across multiple industries, many of which serve construction and industrial markets. Steve has a B.A. in mathematics from Rutgers University and an M.A. in Mathematics and a Ph.D. is Cognitive Psychology and Modeling from the University of Minnesota. He graduated *summa cum laude* and is a member of Phi Beta Kappa. His background helps Steve identify connections and interdependencies that solve complex problems in the workplace.