EARLY WARNINGS:

How Suffolk & Smartvid.io learned to predict and prevent construction incidents

Data from Procore feeds artificial intelligence model that predicts reduced incident cost of $1.4M-$3.6M per year

PREDICTIVE ANALYTICS: A NEW INDUSTRIAL FRONTIER

Artificial Intelligence is now being applied across industries at many levels of technological sophistication.[1] From automotive robots that can "see" what to weld to medical devices that warn doctors of risks during surgery, computers that can observe the world around them are improving efficiency and providing new insights across a range of industries. But this is just the beginning of the potential for AI. Some companies are moving beyond the capability of training AI to observe to training AI to *predict* the future. It sounds futuristic, but leading firms have been doing this kind of predictive analytics for years. In 2009, for example, Google began creating predictive models to reveal if employees were at risk of leaving the firm. More recently, due to the massive amounts of available data and improvements in the underlying AI engines, new predictive applications have emerged. One healthcare system monitors patient data to predict if costly and painful falls are going to occur on a specific floor of a hospital.[2] The banking industry uses predictive data to provide clients a warning if they are going to overdraw their account based on spending patterns.[3] In collaboration with Smartvid.io, Suffolk construction asked the question, could this new frontier in AI, predictive analytics, be applied to construction safety risk?

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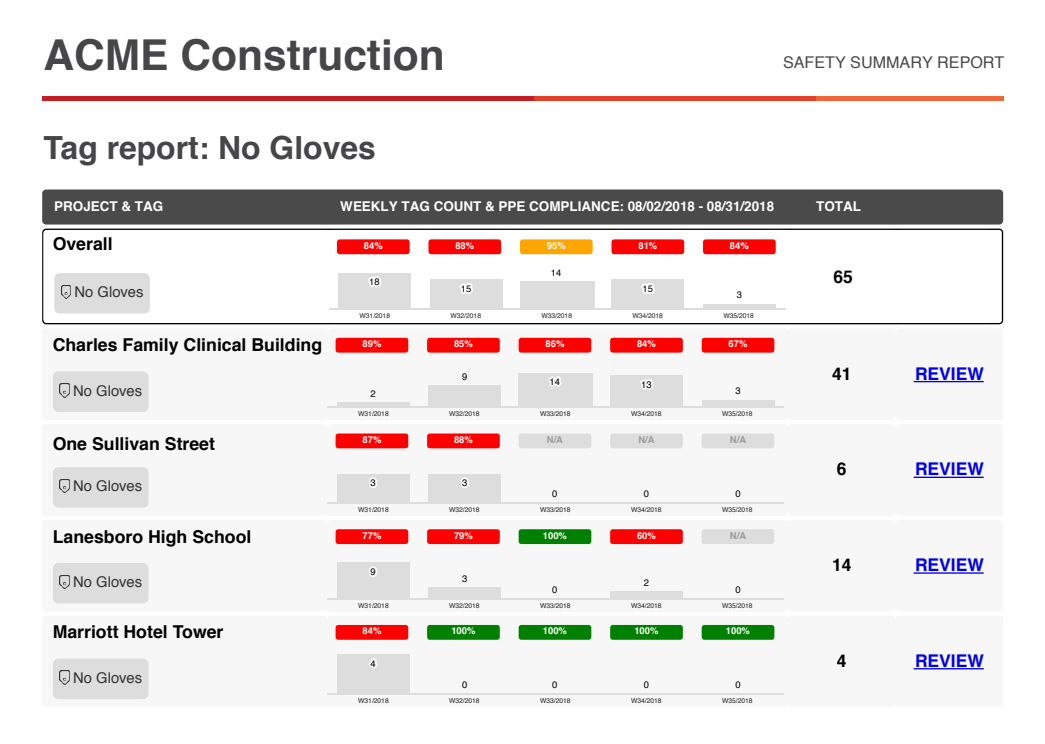
FROM OBSERVING RISK TO PREDICTING IT TO BE "SAFER TOGETHER"

Suffolk and Smartvid.io were already working together to apply AI to observe and report on current safety risks as a part of the "Safer Together" Safety program. Suffolk's "Safer Together" program is designed to foster collaboration between Suffolk and subcontractors on identifying and preventing project safety risks. The emphasis is on positive and collaborative safety discussions vs. negative and "audit-driven" results. Smartvid.io's safety analytics were helping Suffolk teams be "Safer Together" by showing overall compliance with observed use of PPE and by driving positive feedback. To complete this job, Smartvid.io's artificial intelligence engine, nicknamed "Vinnie" (after an early user), was automatically analyzing all photos coming from construction management systems like Procore, site camera data from OxBlue cameras and other legacy systems. For example, a progress photo containing workers completing a concrete pour would be analyzed to see if all of them had proper PPE (e.g., hard hats, high vis, etc). Vinnie's automated visual analysis of thousands of photos then generates compliance statistics (e.g., % PPE compliance) that teams can use collaboratively to drive positive feedback and reward teams for these leading indicators of overall safety as can be seen in the report example.



ACME Construction

SAFETY SUMMARY REPORT

Tag report: No Gloves

PROJECT & TAG	WEEKLY TAG COUNT & PPE COMPLIANCE: 08/02/2018 - 08/31/2018					TOTAL	
	W31/2018	W32/2018	W33/2018	W34/2018	W35/2018		
Overall	84%	88%	95%	81%	84%	65	
No Gloves	18	15	14	15	3		
Charles Family Clinical Building	89%	85%	86%	84%	67%	41	REVIEW
No Gloves	2	9	14	13	3		
One Sullivan Street	87%	88%	N/A	N/A	N/A	6	REVIEW
No Gloves	3	3	0	0	0		
Lanesboro High School	77%	79%	100%	60%	N/A	14	REVIEW
No Gloves	9	3	0	2	0		
Marriott Hotel Tower	84%	100%	100%	100%	100%	4	REVIEW
No Gloves	4	0	0	0	0		

Jit Kee Chin, Suffolk EVP and Chief Data Officer, knew of the overall industry trends towards predictive analytics and wondered if Vinnie could do the same. Could Vinnie move from observing risks to predicting an incident in a coming week? How accurate could Vinnie be in predicting the incident? How many incidents could be avoided if project teams could know of the risks ahead of time?

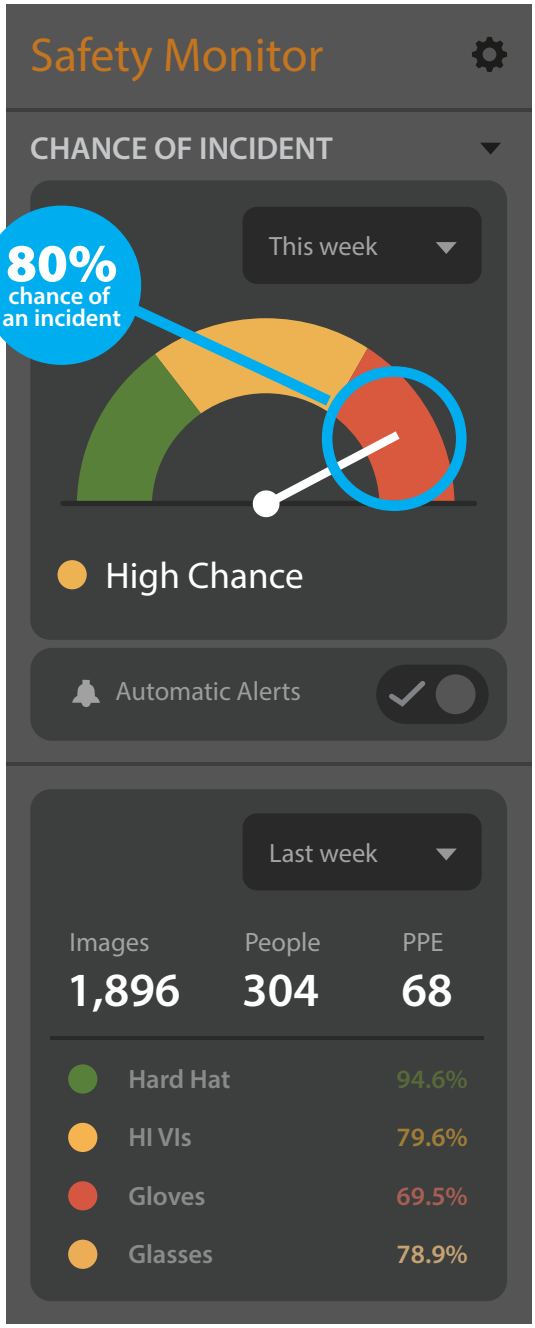
To answer these questions, Suffolk partnered with Smartvid.io, and the "Vinnie Predictive Analytics" project was launched. Suffolk contributed massive amounts of data to the project, including ten years of project photos, project data, and hundreds of thousands of images pulled directly from Procore for analysis. Suffolk utilized the Smartvid.io-Procore integration which allowed for the easy transfer of hundreds of thousands of images directly into Vinnie. Vinnie's observation-based AI looked at every picture and automatically identified safety risks like workers missing PPE (e.g., hard hats, high vis gear, etc.). PPE compliance, and project information like the project type, weather, and phase were also incorporated into the model - much of this information was pulled from Procore. Lastly, Smartvid.io evaluated every single safety incident by project and date for the same 10 year period. This set of information gave Vinnie enough information to build a predictive model.

"INCIDENT EARLY WARNING SYSTEM" RESULTS ARE COMPELLING

Predictions from the early warning system (aka, the Vinnie Predictive Model) were evaluated along two dimensions. If an incident early warning alert was to go out to a safety manager from Vinnie, how often would it be right? And secondly, how many incidents would it catch? To determine this, the Vinnie "early warning system" was run against 3 years of project data, photos and incidents that it had never seen before.

The results were compelling. The early warning system predicted 20% of all incidents in that 3 year period with an 80% accuracy rate. For a given project this translates into 4 alerts/year, with one of the 4 alerts being a "false alarm". If the manager was open to more alerts, they could be warned of a full 40% of incidents during that 3 year period, with 66% accuracy (2/3 of predicted incidents occurred). For a given project this would translate into roughly 12 alerts/year, with 4 being "false alarms".

But how many of these early warnings would result in an incident being avoided? Here a conservative assumption is useful. Even if only 25% of the predicted incidents are avoided, a company with 50 projects/year will avoid 40-100 incidents/year. At the cost of roughly $36,000/incident in 2018 dollars (NIH Study, Costs of Occupational Injuries in Construction in the United States), that's somewhere between $1.4M and $3.6M in safety related savings per year.[4] If we assume that 50% of the alerts from the "early warning system" result in preventing an incident, the financial benefits are double this amount (e.g., from $2.8M to $7.2M).



If just 1 of 4 predicted incidents is avoided that translates to $1.4–3.6 million in savings.

THE FUTURE OF PREDICTIVE ANALYTICS IN CONSTRUCTION

As Jit Kee Chin stated to a packed house at ENR FutureTech in San Francisco in May, 2018, the results demonstrated it was possible to have a "data-driven predictive safety management system" based off of learned historical data, which incorporates statistical probabilities to control safety risk.[5] Where do we go from here? Additional factors are being included in the predictions made by Vinnie to further enhance the accuracy of the "early warnings". Businesses are exploring how these predictions can be used to drive better rates for insurance, a tremendous cost on most projects at 4-6% of project budgets.

And last but not least, there are opportunities to explore how predictions can be applied to other areas of project risk. Safety, quality, cost and schedule are the four critical drivers of project success. Could Vinnie start predicting early warnings of cost overruns before they happen? That's one prediction that may be too early to make.

To learn more about predictive analytics, and how the "Vinnie" and the early warning system from Smartvid.io can be implemented on your next project, contact us today.

"There is demonstrable opportunity to control hazards and improve safety performance by deploying resources to those sites where elevated risk is predicted." **– Alex Hall , EVP, Environmental Health & Safety, Suffolk**

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1. GrAIt expectations. "Non-tech businesses are beginning to use artificial intelligence at scale". Web article. The Economist. March 31, 2018. https://www.economist.com/special-report/2018/03/31/non-tech-businesses-are-beginning-to-use-artificial-intelligence-at-scale

2. Ockerman, Emma. "AI Hospital Software Knows Who's Going to Fall" Web article. Bloomberg Businessweek, June 21, 2018. https://www.bloomberg.com/news/articles/2018-06-21/ai-programs-fight-medical-alarm-fatigue-with-patient-fall-alerts

3. Dickson, Amanda. "Coming to your bank soon: Predictive Analytics" Web article. Bankrate, February 28, 2018. https://www.bankrate.com/banking/predictive-banking-makes-it-easier-to-manage-your-money/

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5. Chin, Jit Kee. (2018) Seeing the Future with Data Analytics, ENR FutureTech, San Francisco, CA, June 5th, 2018. https://cdn2.hubspot.net/hubfs/710233/collateral/JitKeeChin_FutureTech-presentation_Suffolk_20180604.pdf

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Suffolk is a national building construction firm based in Boston, MA with a clear vision to "transform the construction industry by building smart."

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Smartvid.io is a software company headquartered in Cambridge, MA which provides machine learning tools for the management and analysis of industrial media.