


Autodesk BIM 360 IQ



Applying Machine Learning to Construction

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Principal Data Scientist

Shubham Goel
Data Scientist

A wide-angle photograph of the San Francisco skyline across the water. The Bay Bridge is prominent on the left, and the city's skyscrapers, including the Transamerica Pyramid, are visible in the background under a blue sky with light clouds. A yellow location pin icon is placed over the city skyline.

APPLYING MACHINE LEARNING TO CONSTRUCTION

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Principal Data Scientist
Autodesk BIM 360 IQ

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Agenda

- Introduction Autodesk BIM 360 IQ?
- Our production data science process
 - Dealing with no labels (LUSI)
 - Data Science Strategy
 - Using Spark
- Conclusion



Image courtesy of Tesla Motors, Inc.



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A black and white photograph showing the Empire State Building under construction in New York City. The building is the central focus, with its distinctive Art Deco design and a crown of construction cranes. It stands tall above a dense urban landscape of other skyscrapers and lower buildings. The sky is overcast.

circa 1930

construction technology revolution

An aerial photograph of the Transamerica Pyramid in San Francisco, California, during its construction in 2017. The building is a tall, slender skyscraper with a distinctive top section. It is surrounded by other city buildings, and the San Francisco Bay is visible in the background. Two large construction cranes are positioned around the building. The sky is clear and blue.

2017

construction 80 years later...

circa 1930



automobiles

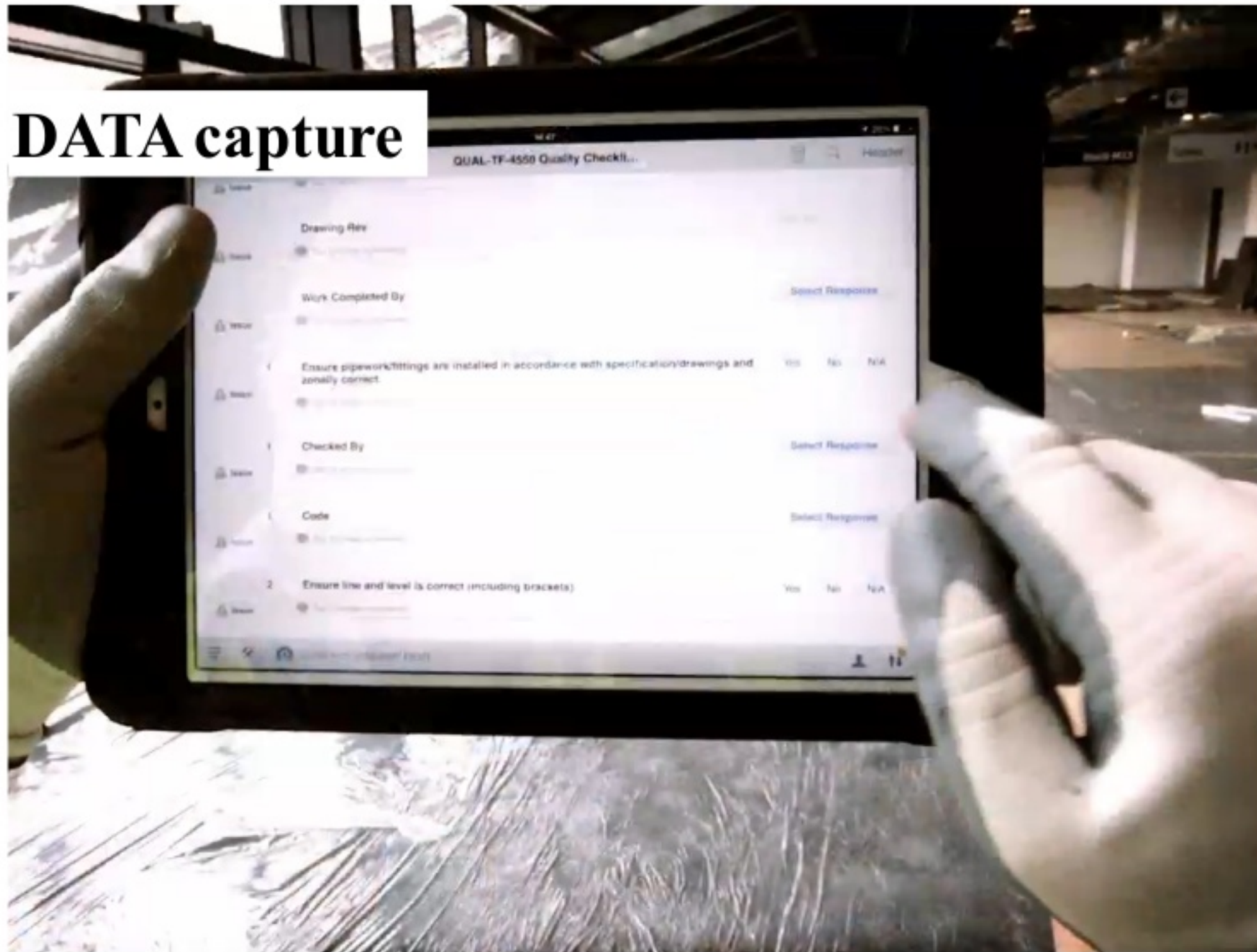
2017



self driving, smarter



DATA capture



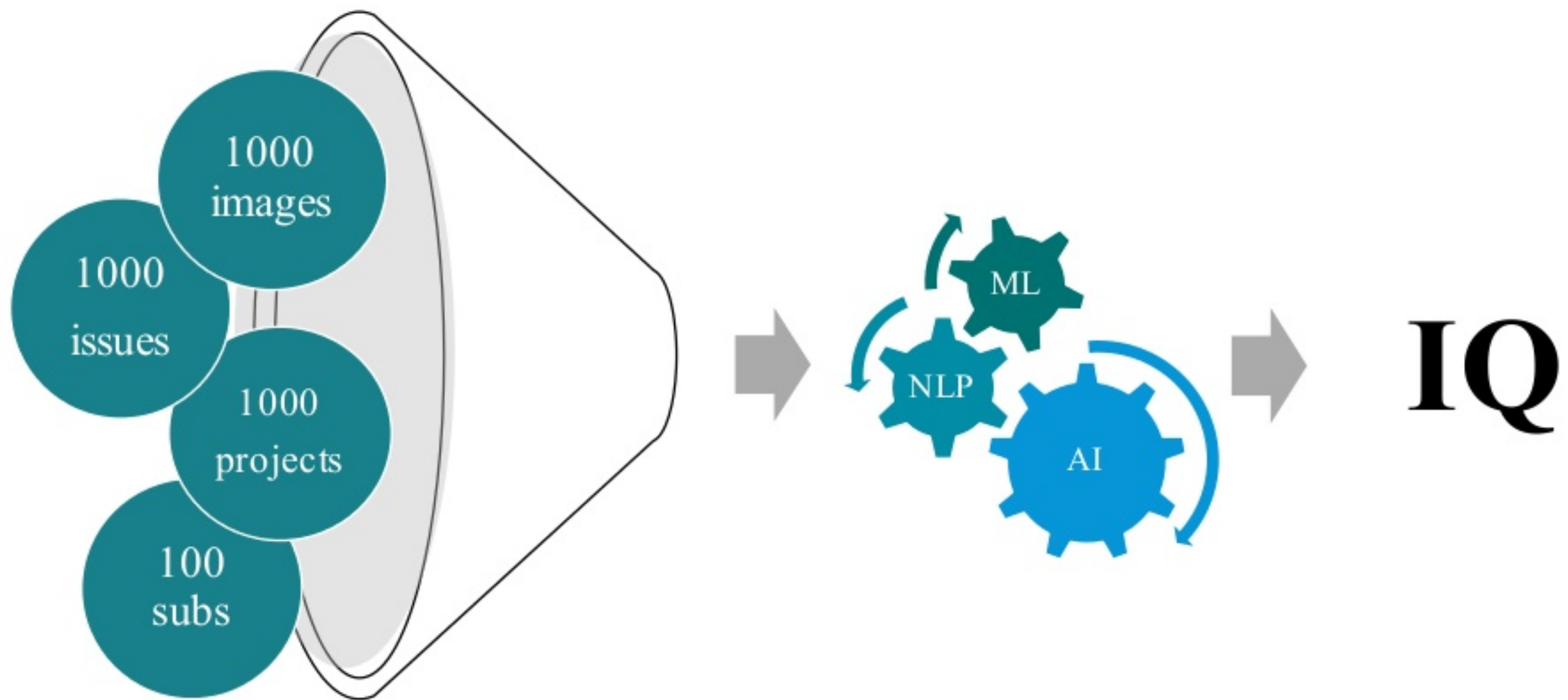
Quality

Safety

Schedule

Cost

IQ





thousands of issues

[Add](#) [Edit](#) [Void](#) [Print](#) [More Actions](#)

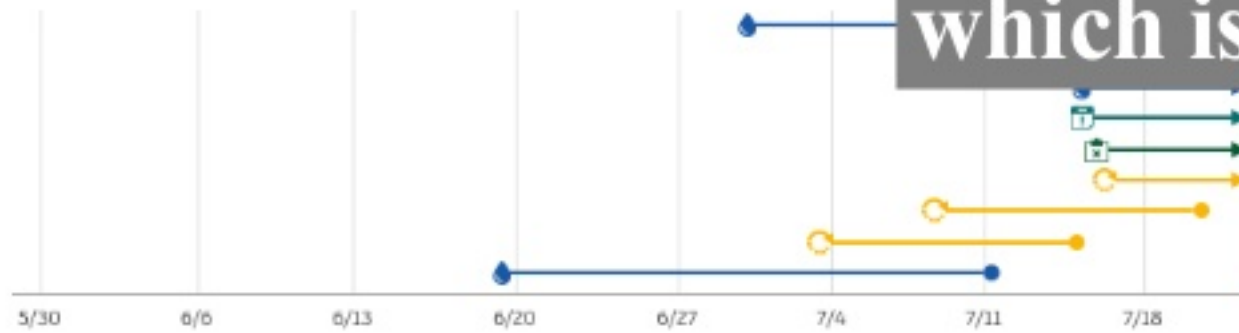
ID	Description	Company	Location Path	Type	Status
000333	Verify surfaces to receive glass are dry, clean, and properly prepared.	Stark MEP	Building A>Floor 1	QA/QC	Open
000368	Install light fixture	Stark MEP	Building A>Floor 1	QA/QC	Open
000646	Chipping at end	CC Concrete	Building A>Floor 1	QA/QC	Open
000337	Verify fixtures comply with specified fixtures and accessories are provided	Stark MEP	Building A>Floor 1	QA/QC	Open
000482	Forms are not maintained nor snug against concrete surface. See attachment	CC Concrete	Building A>Floor 1	QA/QC	Open
000098	Forms need to be tightened and maintained snug against concrete surface	CC Concrete	Building A>Floor 1	QA/QC	Open
000387	Missing light fixture see schedule for correct install	Stark MEP	Building A>Floor 1	QA/QC	Open
000014	Chipping at end	CC Concrete	Building A>Floor 1	QA/QC	Open
000237	Verify existing lines are coordinated to avoid congestion or interference.	Joe's Plumbing	Building A>Floor 1	QA/QC	Open
000251	Verify mounting height and location are as indicated.	CC Concrete	Building A>Floor 1	QA/QC	Open
000239	Concrete, Concrete Block: New Concrete: Do not start surface preparation	CC Concrete	Building A>Floor 1	QA/QC	Open
000010	Light fixture incomplete / missing on several floors and there is an inspection	Stark MEP	Building A>Floor 1	QA/QC	Open
000087	Wood quality as specified	CC Concrete	Building A>Floor 1	QA/QC	Open
000582	Missing exit sign, see attachments for correct installation	Stark MEP	Building A>Floor 1	QA/QC	Open
000415	Verify surfaces to receive glass are dry, clean, and properly prepared.	Stark MEP	Building A>Floor 1	QA/QC	Open
000258	Missing light fixture	Stark MEP	Building A>Floor 1	QA/QC	Open
000009	Door handle is broken, see attached photo and schedule for correct installation	Steelers	Building A>Floor 1	QA/QC	Open
000270	Verify mounting height and location are as indicated.	CC Concrete	Building A>Floor 1	QA/QC	Work Completed
000261	Has the excavation soil density been checked?	CC Concrete	Building A>Floor 1	QA/QC	Open
000343	Light fixture incomplete / missing.	Stark MEP	Building A>Floor 1	QA/QC	Open
000314	Broken light fixture	Stark MEP	Building A>Floor 1	QA/QC	Open
000605	Install light fixture, clean existing space	Stark MEP	Building A>Floor 1	QA/QC	Open
000259	The EIFS installed is not per manufacturers documents. There is no fastener	Xavier Rainscreens	Building A>Floor 1	QA/QC	In Dispute
000339	Missing light fixture, install per attached schedule	Stark MEP	Building A>Floor 1	QA/QC	Open
000510	Excavate site to line and grade indicated.	CC Concrete	Building A>Floor 1	QA/QC	Open
000419	Pour concrete slab	CC Concrete	Building A>Floor 1	QA/QC	Open
000543	Device and/or trim plate is missing.	Stark MEP	Building A>Floor 1	QA/QC	Open
000421	Missing light fixture, see attached schedule for installation	Stark MEP	Building A>Floor 1	QA/QC	Open
000276	Device and/or trim plate is missing.	Stark MEP	Building A>Floor 1	QA/QC	Open
000353	Repair concrete at base. There is damage and cracking already visible in	CC Concrete	Building A>Floor 1	QA/QC	Open
000110	Light fixture incomplete / missing.	Joe's Plumbing	Building A>Floor 1	QA/QC	Open
000327	Open penetrations in the concrete framing are not sealed and water is leaking	CC Concrete	Building A>Floor 1	QA/QC	Open
000025	Air distribution damaged	Steelers	Building A>Floor 1	QA/QC	Open
000303	Light fixture incomplete / missing.	Stark MEP	Building A>Floor 1	QA/QC	Open
000108	Install light fixture	Stark MEP	Building A>Floor 1	QA/QC	Open
000115	Device is not flush with trim plate.	Stark MEP	Building A>Floor 1	QA/QC	Open
000643	Coat surfaces with wash primer.	CC Concrete	Building A>Floor 1	QA/QC	Open
000326	Cracked concrete slab	CC Concrete	Building A>Floor 1	QA/QC	Open

50 Items Filter: All Unresolved Issues

Show: 50

HIGH RISK ISSUES

Water Rework Key Activity Inspection Uncategorized



- #22244 - Open penetrations in concrete...** To: CC Concrete, Inc. Open 24 days
Open penetrations in the concrete framing are not sealed and water is leaking after the recent weather event. There is damage to the finishes. Detailing of the penetration is in progress.
- #22116 - The waterproofing barrier...** To: NextGen Panels Open 14 days
The waterproofing barrier installed does not meet the required standards. These needs to rectified and QC verified before the external walls are closed out.
- #22105 - The EIFS installed...** To: NextGen Panels Open 7 days
The EIFS installed is not per manufacturers documents. There is no flashing and moisture is seen inside the enclosure. The whole enclosure needs to be made weatherproof.
- #21984 - The concrete treads...** To: CC Concrete, Inc. Open 7 days
The concrete treads on the South side of Arena stairs are sloped incorrect!! Ponding of water noticed after a weather event. This has to be fixed ASAP. And the slope on all treads needs to be checked. There might be a potential RFI to the architect.
- #21966 - Fireproofing incomplete at...** To: Majestic Steel Open 6 days
Fireproofing incomplete at steel members. Needs to be completed before the scheduled external inspection
- #21898 - Repair concrete at base...** To: CC Concrete, Inc. Open 5 days
Repair concrete at base. There is damage and cracking already visible more than expected. Need to verify the sinking is within the permissible limits and if not conduct soil test.

Modified Risk Level

- #228 -Air/moisture barrier...** Risk Level: Medium To: Majestic Steel Open 1 day
Air/moisture barrier not continuous at inside corners on west balconies at multiple locations/levels.

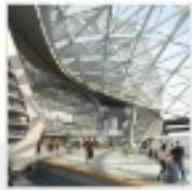
which issues do I focus on first?

31 high risk issues detected

5 with water risk

hundreds of subcontractors





United Construction

Bayfront Arena

Project Dates: Fri Sep 30 2016 - Sat Oct

SUBCONTRACTOR RISK

Today	Overall
CC Concrete	High <div></div>
Stark MEP	Medium <div></div>
Sunshine Weatherp...	Medium <div></div>
Drywall Inc.	Medium <div></div>
Joe's Plumbing	Medium <div></div>
Steelers	Medium <div></div>
Closet Closets	Medium <div></div>
Xavier Rainscreens	Medium <div></div>
United Construction	Medium <div></div>
Carolina Fire	Low <div></div>
Ceiling Experts	Low <div></div>
Click Electricals	Low <div></div>
Martha's Landscapi...	Low <div></div>
Rebar Co.	Low <div></div>
Rebar Masters	Low <div></div>
Silver Oaks Applianc..	Low <div></div>

Who do I talk to first?

Risk Today: High

Contributing Factors

- 3 High Risk Issues
- 1 Water Risk Issues
- +6 Weekly Issue Trend
- 21 Days Open (avg.)
- 6 Long-standing Issues

Daily risk is assessed nightly, based upon analysis of issue keywords and timing.

- [About Risk](#)
- [Give us feedback](#)

937 construction fatalities

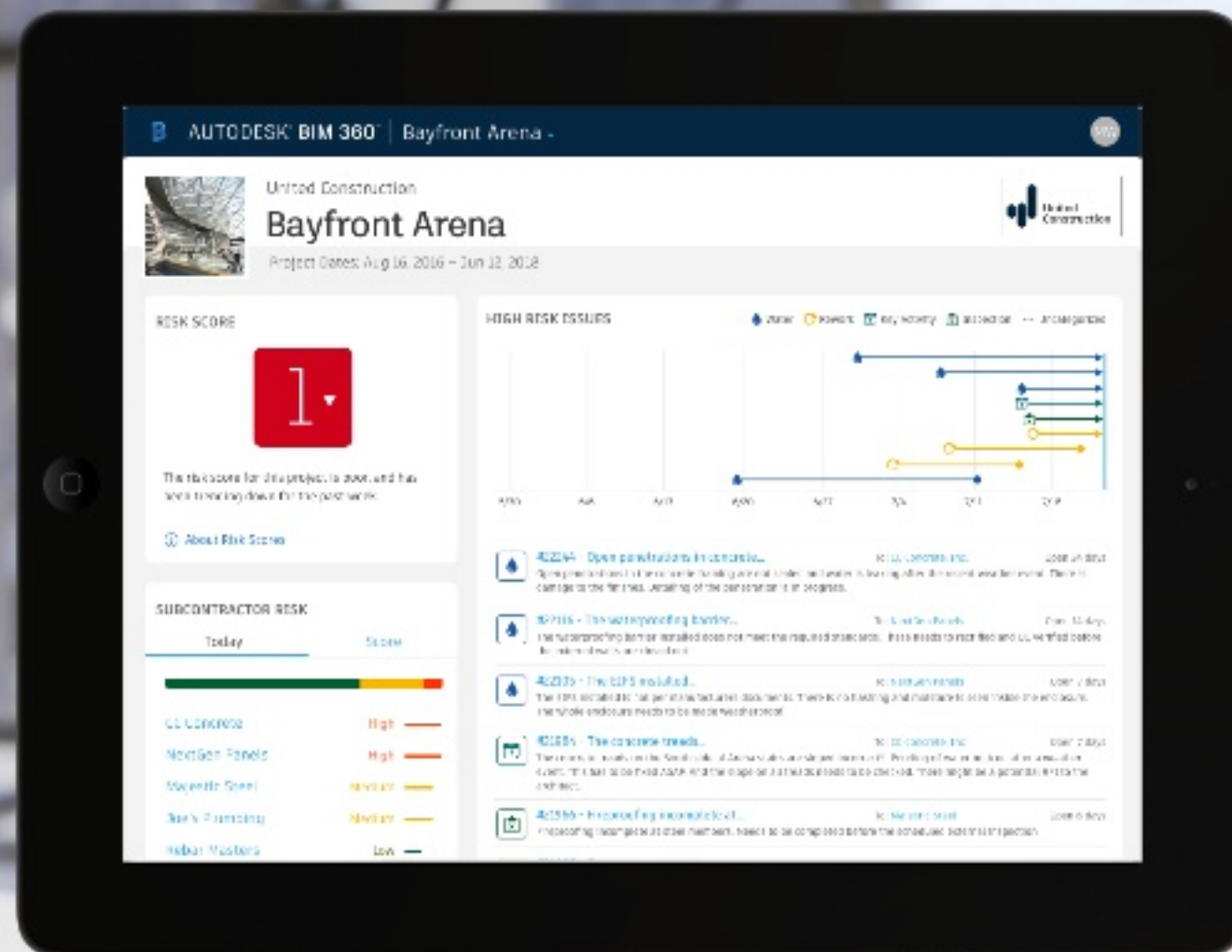


How do we prevent them



BIM 360 IQ

Superintendent

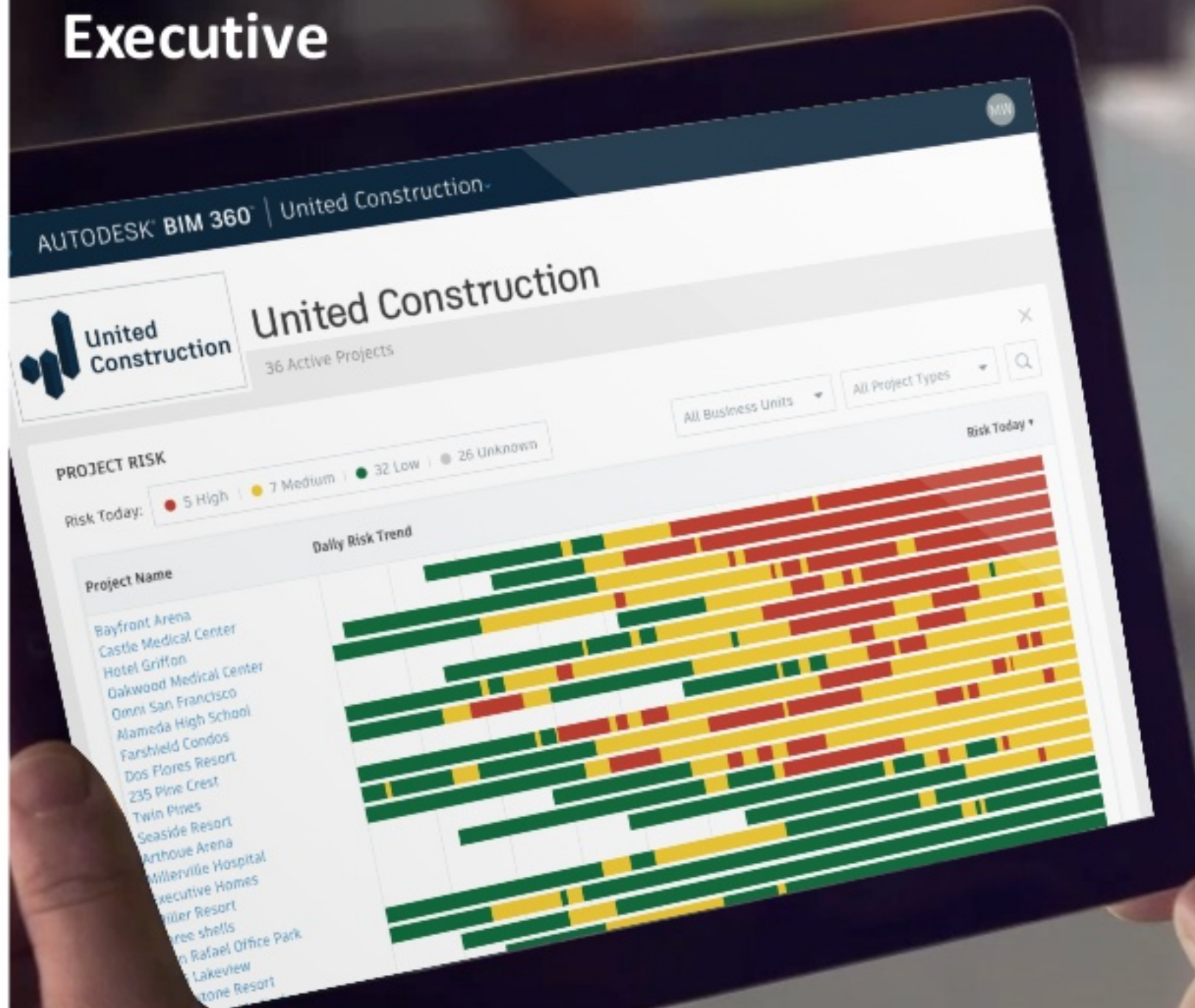


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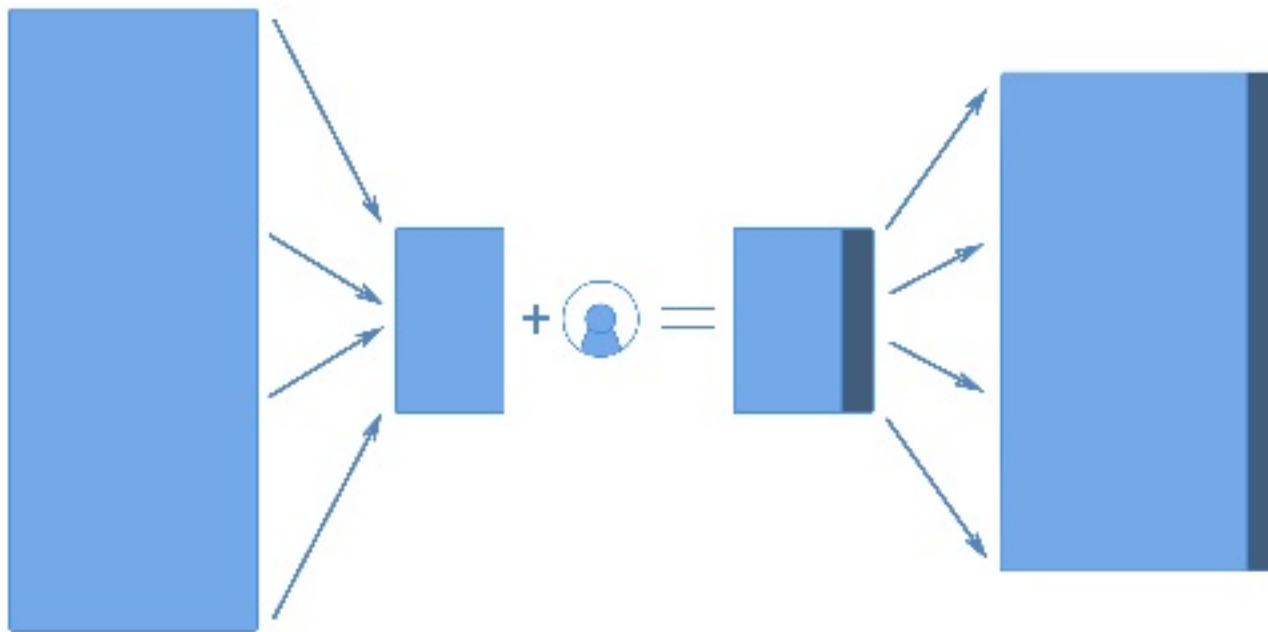
Executive



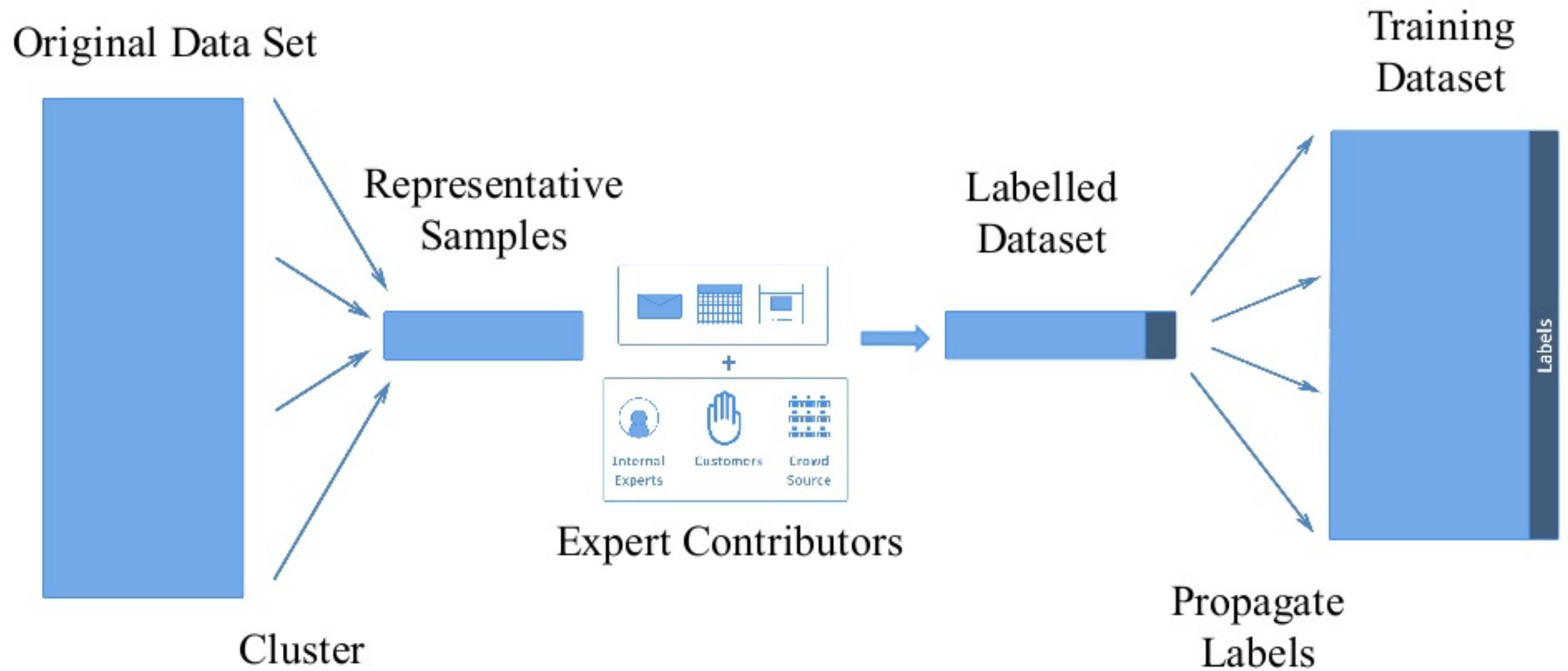
No Labels



LUSI - Labelling Large Datasets Using Human Scale Input



LUSI Methodology



Feedback loop


(Forward Looking)


Advantage:


- Easy model performance tracking
- Collect labels for new categories

About Issue Risk ✕

HIGH RISK ISSUES
The construction assistant automatically reviews all quality issues and predicts which ones create high risk for one or more key project outcomes, such as on-time delivery, margin, or customer satisfaction. Surfacing high risk issues helps ensure that something important doesn't get overlooked. It helps you to focus on the most important things each day and take action early before a risk turns into a liability.


**On Time**


**On Budget**


**High Quality**


Don't Agree? If you don't agree with an issue risk level, you can change it. Changes immediately update the issue list and issue details. A history of changes appear at the bottom of the project issue list.

KEY RISK CATEGORIES
The construction assistant automatically tags issues into risk categories to help you understand and manage key risk areas.


**Water**
Water penetration or a water event.


**Key Activity**
May impact a key activity or milestone.


**Rework**
May cause time consuming and costly rework.


**Inspection**
May fail a planned inspection or test.


01/26 02/05 02/16 02/26 03/08 03/18 03/29 04/08 04/18


 #000073 - verify steel is...
To: Steelers 189 days
Verify steel is installed in accordance with approved drawings and of grade and sizes indicated: bar length, bar diameter, bar-to-bar spacing. Verify spacing is coordinated to suit units where masonry walls are scheduled. yb/b jbbh hbbw h hb hbbu hbbw hbbvh hbbvhh hbbhbb hbbhbbh h hb


 #000661 - The concrete slab...
To: CC Concrete 177 days
The concrete slab is not aesthetically looking good. there is an RFI that was closed. It was recommended , once attained rinse surface well with clear water, allow to dry, and paint an epoxy. This will require grinding of the surface and preparation. Will delay the schedule.

 #000702 - Water is leaking...
To: Drywall Inc. 167 days
Water is leaking in though the gap in the curtain wall, there might a fault with the flashing

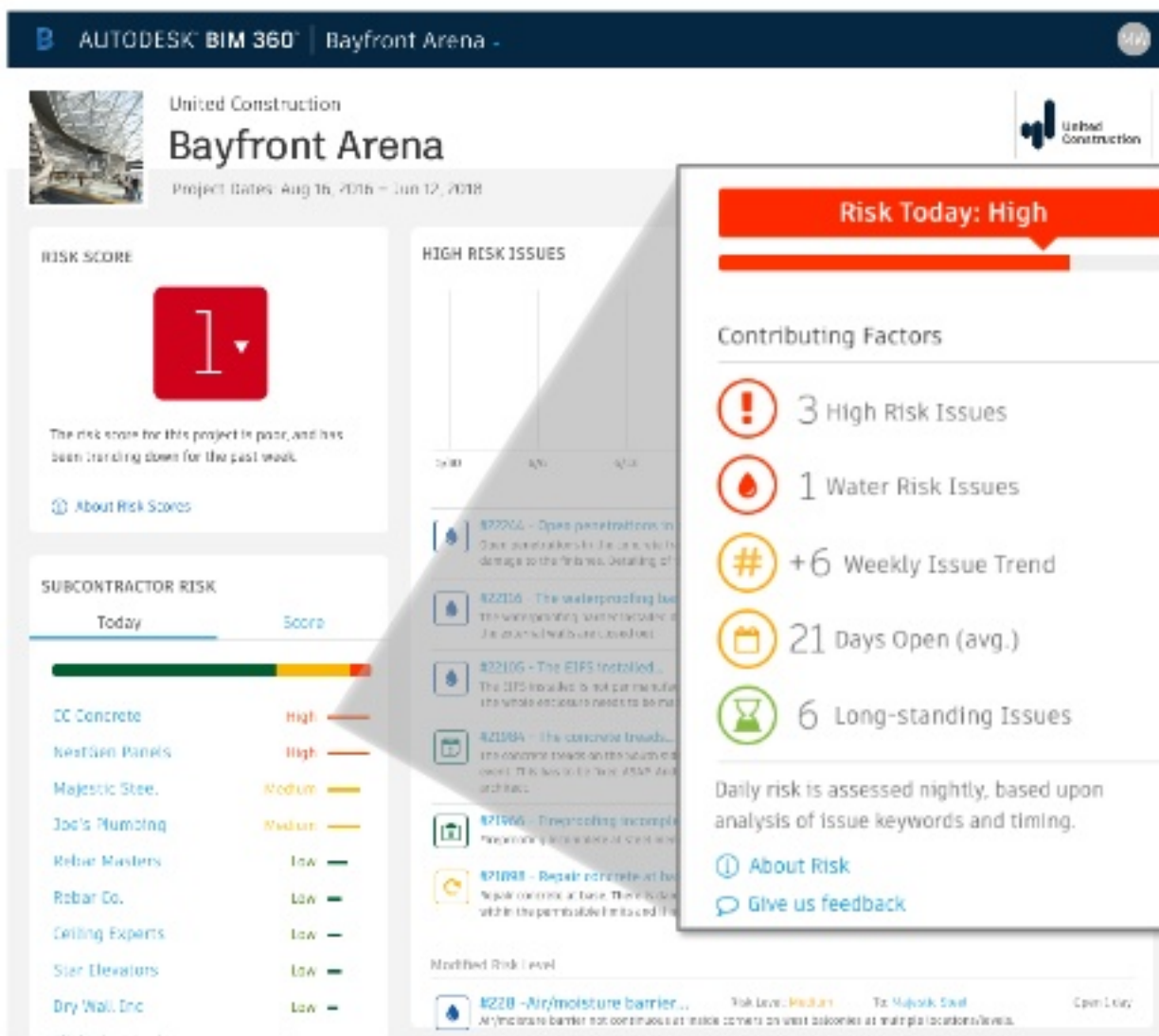
 #000196 - Concrete barrier wall...
To: CC Concrete 165 days
Concrete barrier wall.. Open penetrations in the concrete framing are not sealed and water is leaking after the recent weather event. There is damage to the finishes. Detailing of the penetration is in progress. These need to be temporarily sealed and protected.

 #000212 - The waterproofing barrier...
To: Drywall Inc. 165 days
The waterproofing barrier installed does not meet the required standards. These needs to be rectified and QC verified before the external walls are closed out.

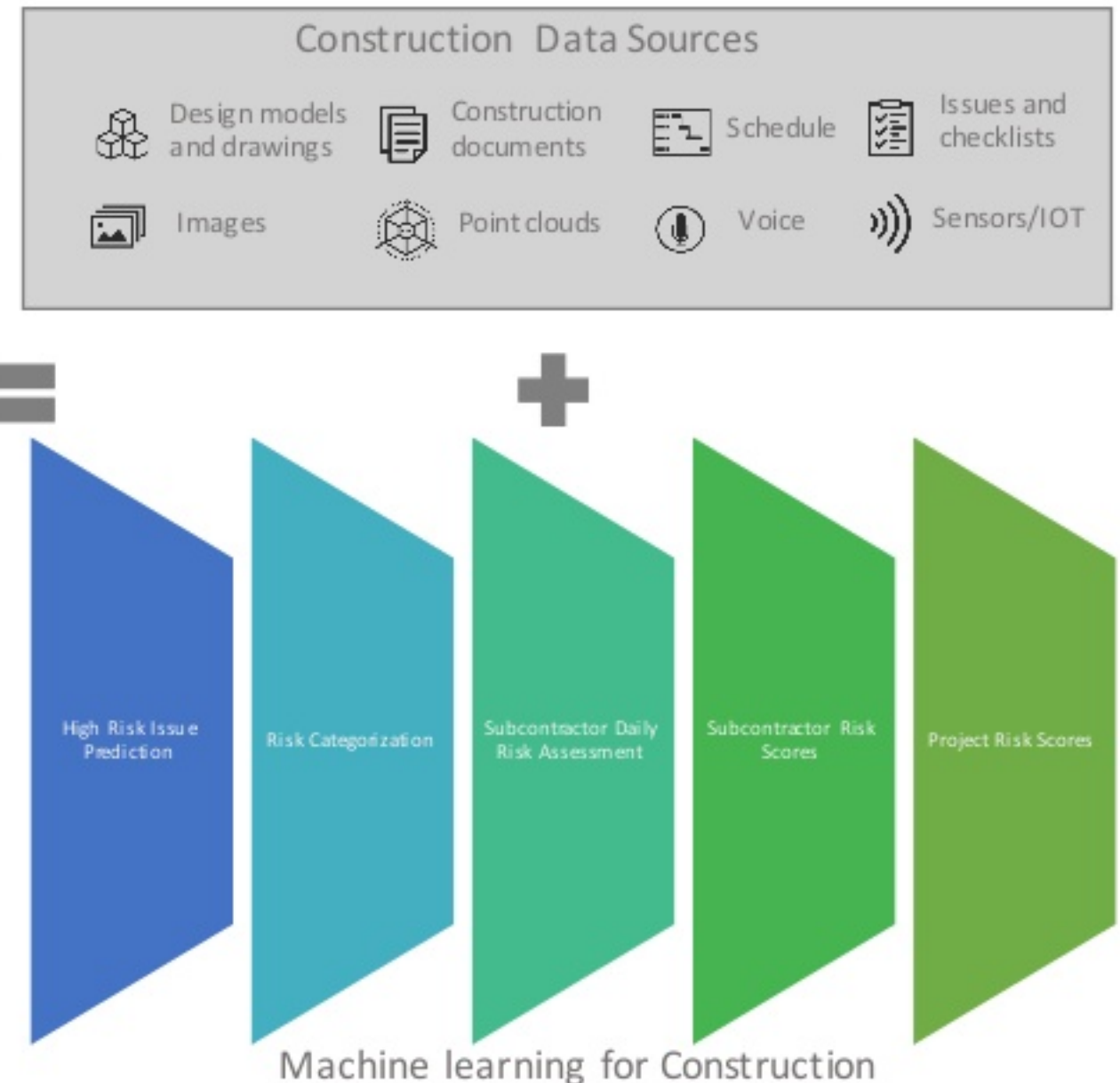
 #000292 - The concrete treads...
To: CC Concrete 165 days
The concrete treads on the South side of Arena stairs are sloped incorrect!! Ponding of water noticed after a weather event. This has to be fixed ASAP. And the slope on all treads needs to be checked. There might be a potential RFI to the architect.

 #000319 - Air leaking at...
To: Stark MEP 165 days
Air leaking at multiple conduits and around the transformer. All penetrations need to be

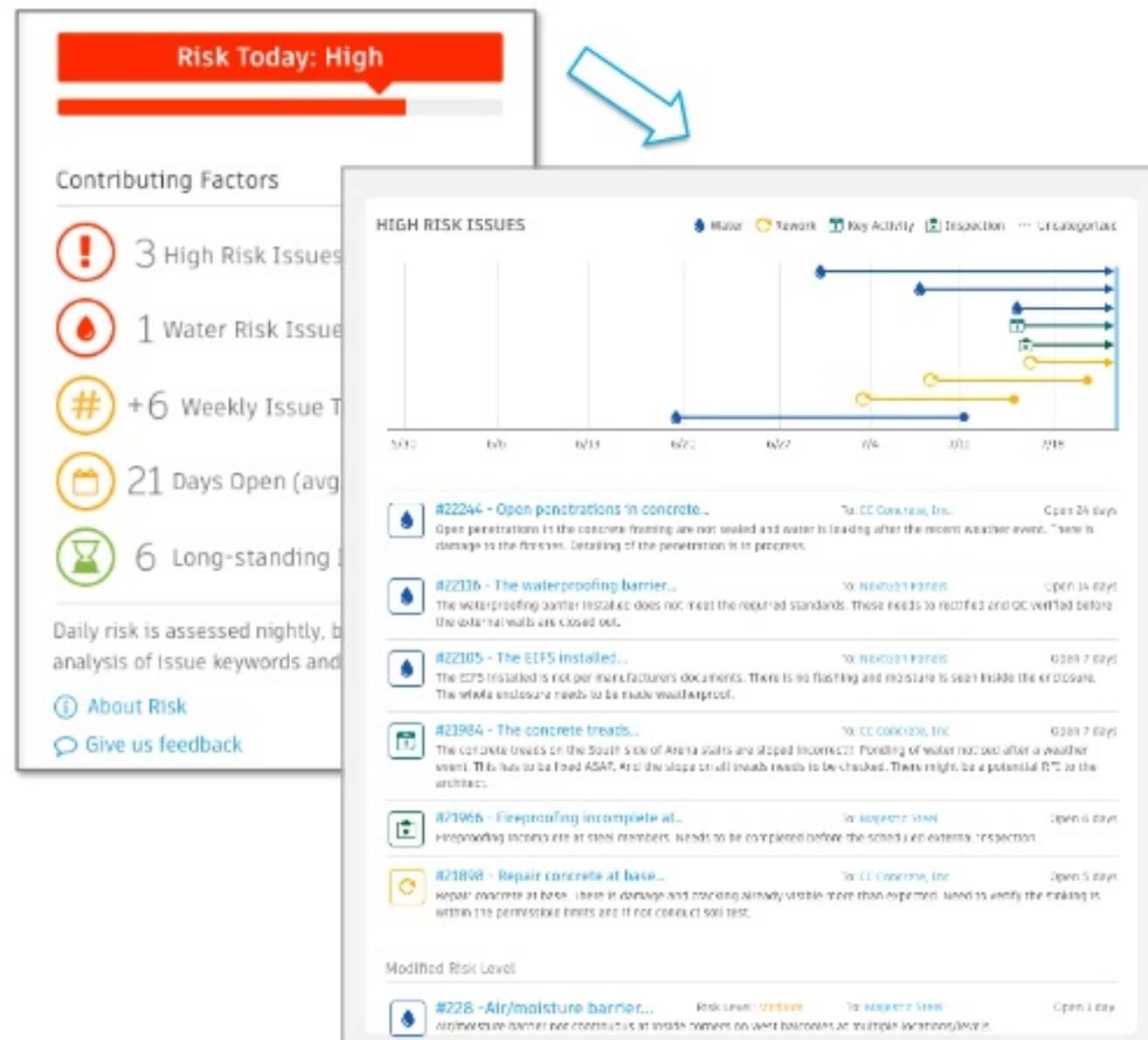
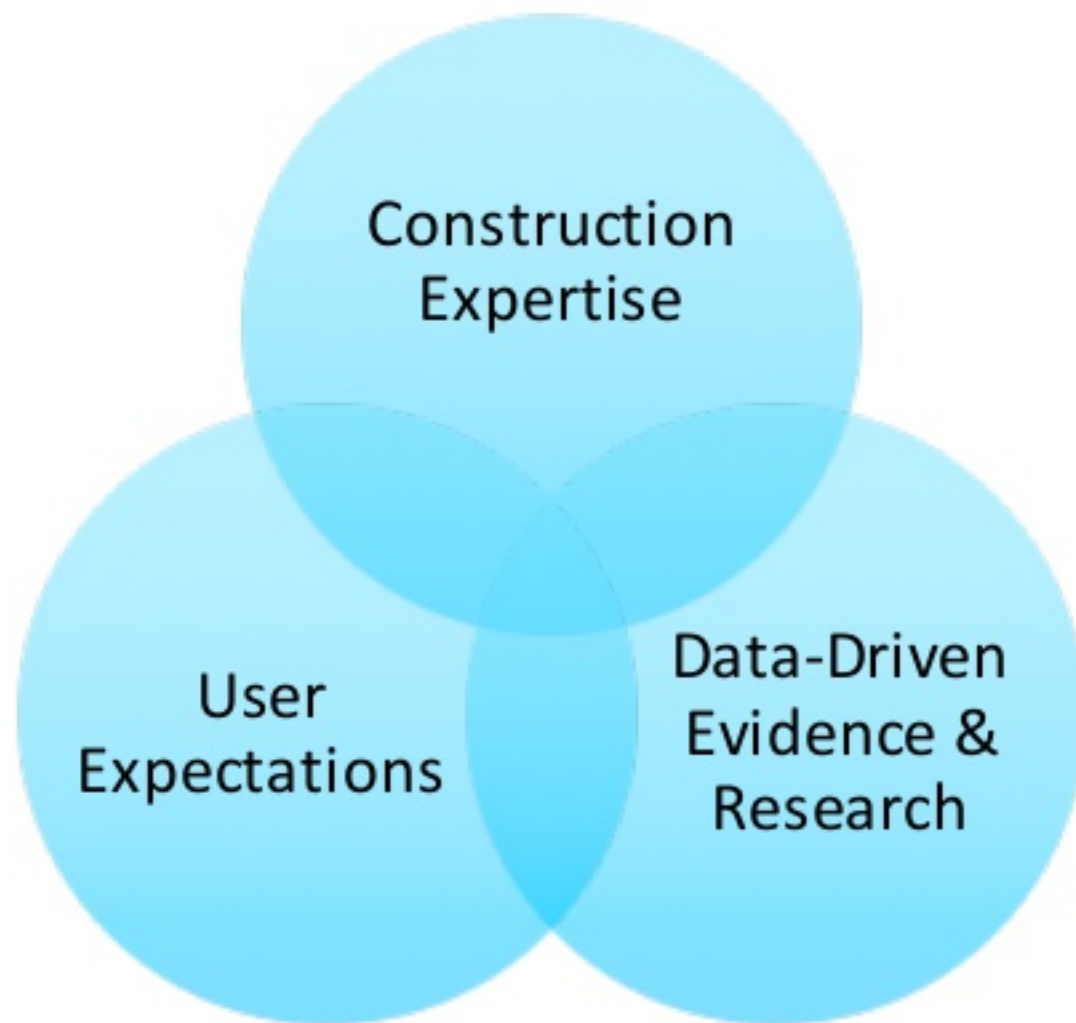
Assistive Predictive Modeling in Construction



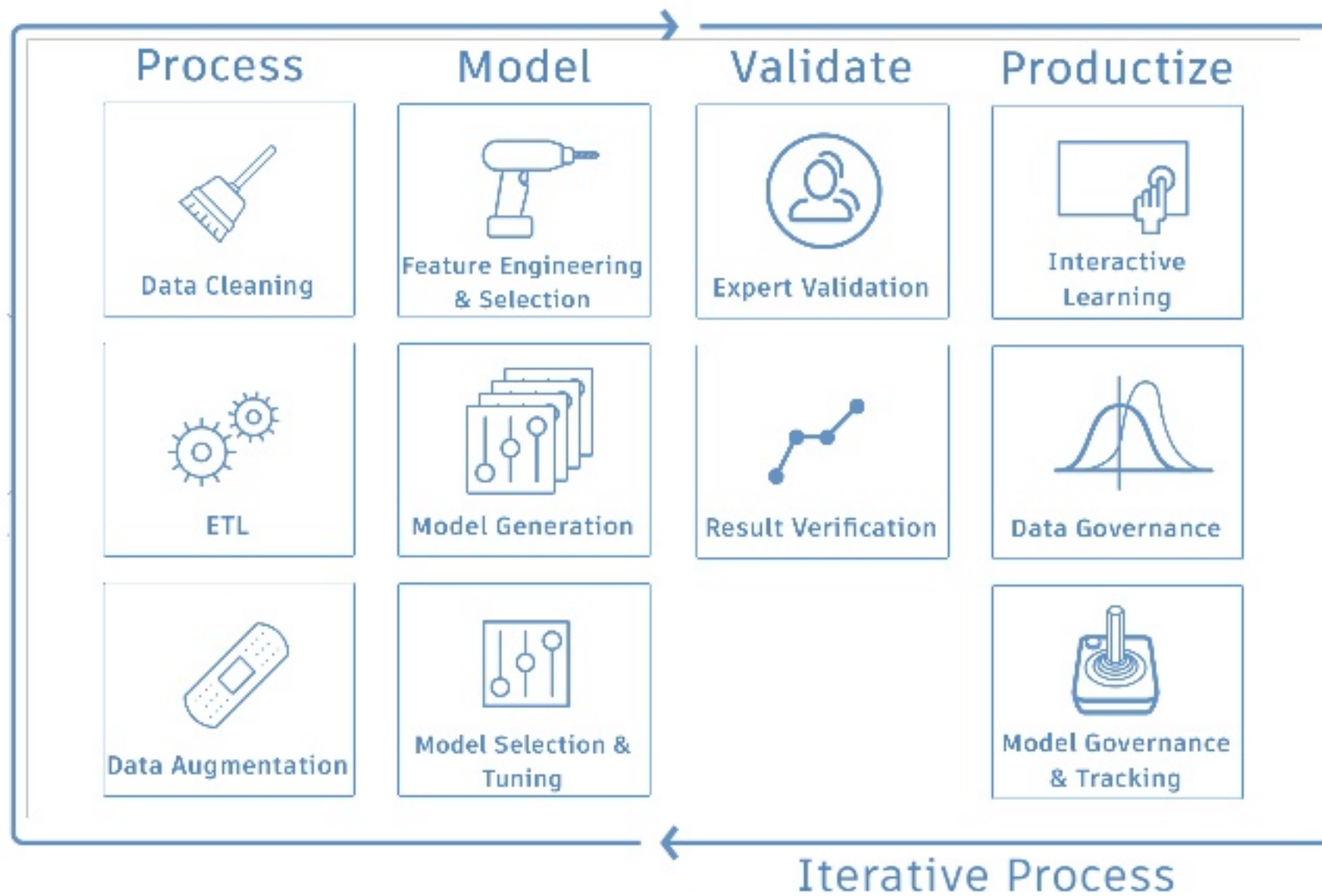
Construction Risk Assistant



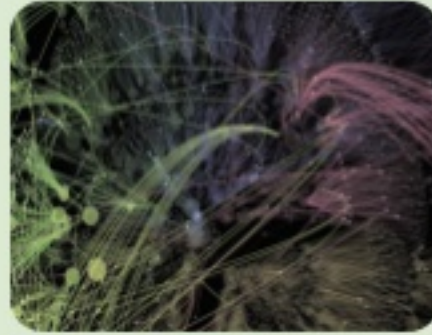
Evidence-Based Practices & Modeling



BIM 360 Data Science Methodology







 databricks



DATA

○ **classify**

○ **verify**

○ **utilize**

○ **trust**



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Thank You.

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