RAYMOND
SINCE 1992

Integrating ChatGPT for Facility Condition Assessments

Michael Ramos, BE-116

CEU Certificates

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RAYMOND
SINCE 1992

Learning Objectives

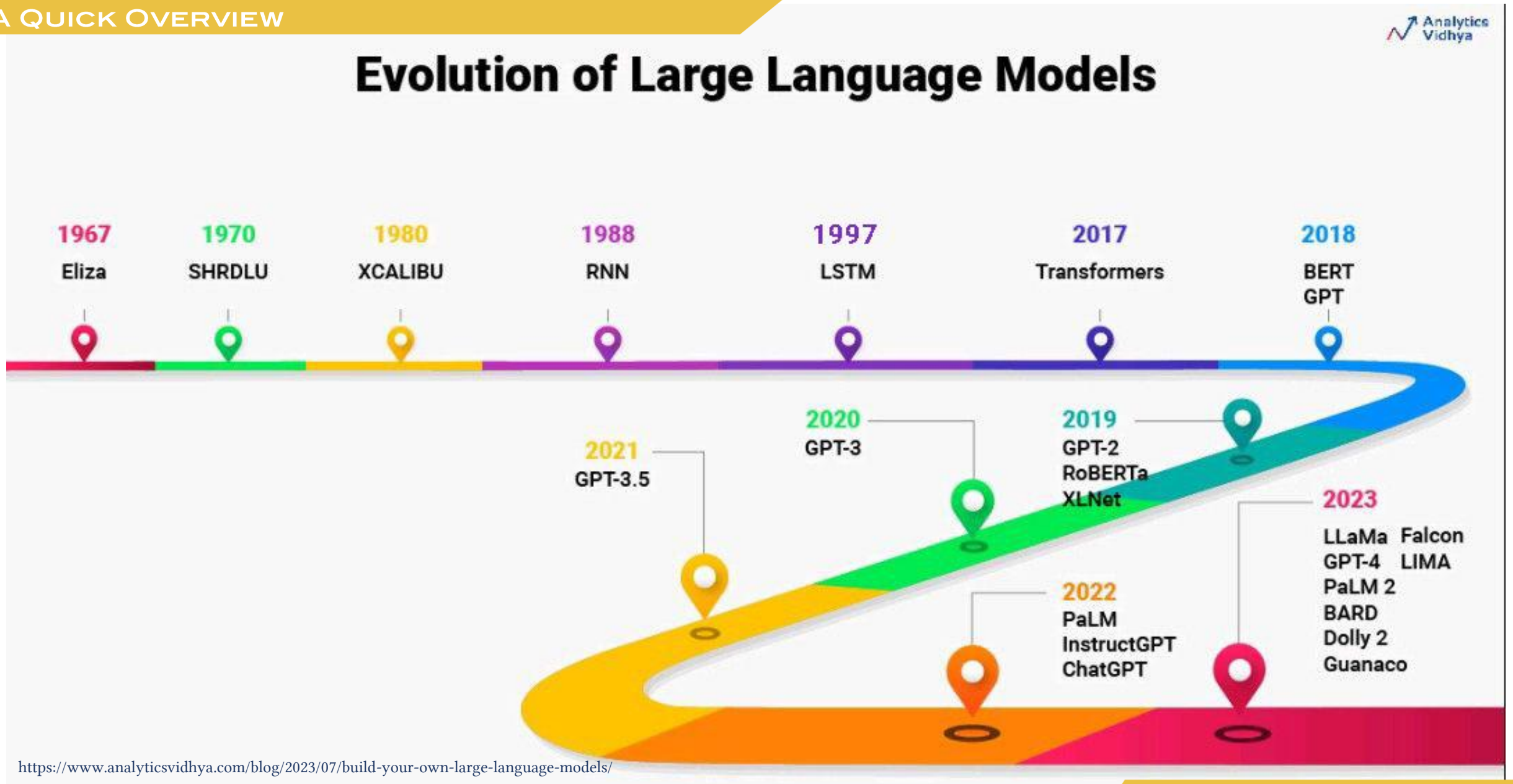
This course will meet the following learning objectives

1. **Learning Objective 1:** Learning how to identify a potential software use case for the A/E industry.
2. **Learning Objective 2:** Understanding how software can be effectively designed for Owners, Architects, Engineers, and Contractors.
3. **Learning Objective 3:** Understanding the historical development of AI and how to select a Large Language Model.
4. **Learning Objective 4:** Analysis of AI outputs compared to traditional report generation

What is Artificial Intelligence?
A Quick Overview

"AI, or Artificial Intelligence, refers to the development of computer systems that can perform tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, understanding natural language, and speech recognition. The goal of AI is to create machines that can mimic or simulate human cognitive abilities."

— ChatGPT



https://www.analyticsvidhya.com/blog/2023/07/build-your-own-large-language-models/

How Does it Work?

All AI is built on a large language model (LLM), with the specific algorithm using deep learning techniques and large data sets to understand, summarize, generate, and predict content. LLMs are a type of generative AI that uses statistical models to analyze large amounts of data, learning the patterns and connections between words and phrases.

LLMs can perform a variety of natural language processing (NLP) tasks, such as generating and classifying text, answering questions in a conversational manner, and translating text from one language to another. They can also be used to generate original audio, images, video, synthetic data, 3D models, and other non-text outputs.

Some examples of language models include voice assistants like Siri, Alexa, and Google Home, and Google Translator and Microsoft Translate.

AI Use Cases

- Quickly synthesizes and summarize information from multiple sources
- Uses NLP algorithms to accurately recognize and respond to questions
- Has access to a vast amount of information across a wide range of topics
- Can generate responses based on the user's input
- Can improve efficiency by providing important information in a quick and efficient manner
- Can automate repetitive tasks

THE 2022 MARKET LEADER

ChatGPT is a large language model-based chatbot developed by OpenAI and launched on November 30, 2022. It is notable for enabling users to refine and steer a conversation towards a desired length, format, style, level of detail, and language used. Successive prompts and replies, known as prompt engineering, are taken into account at each stage of the conversation as a context.

ChatGPT is trained on a massive dataset of text and code, including books, articles, code, and conversations. This allows it to generate text that is both informative and engaging.

OpenAI
ChatGPT **4.0**

KEY FACTS

- OpenAI was founded in 2015
- Microsoft has invested over $10,000,000,000 towards the development of ChatGPT
- GPT = Generative Pre-trained Transformer
- ChatGPT 4 uses 100 Trillion parameters (1 petabyte) vs. 175 Billion parameters (45 terabytes) for ChatGPT 3

The Growing AI Landscape

New Alternatives

Gemini

Jasper

Perplexity

OpenAI

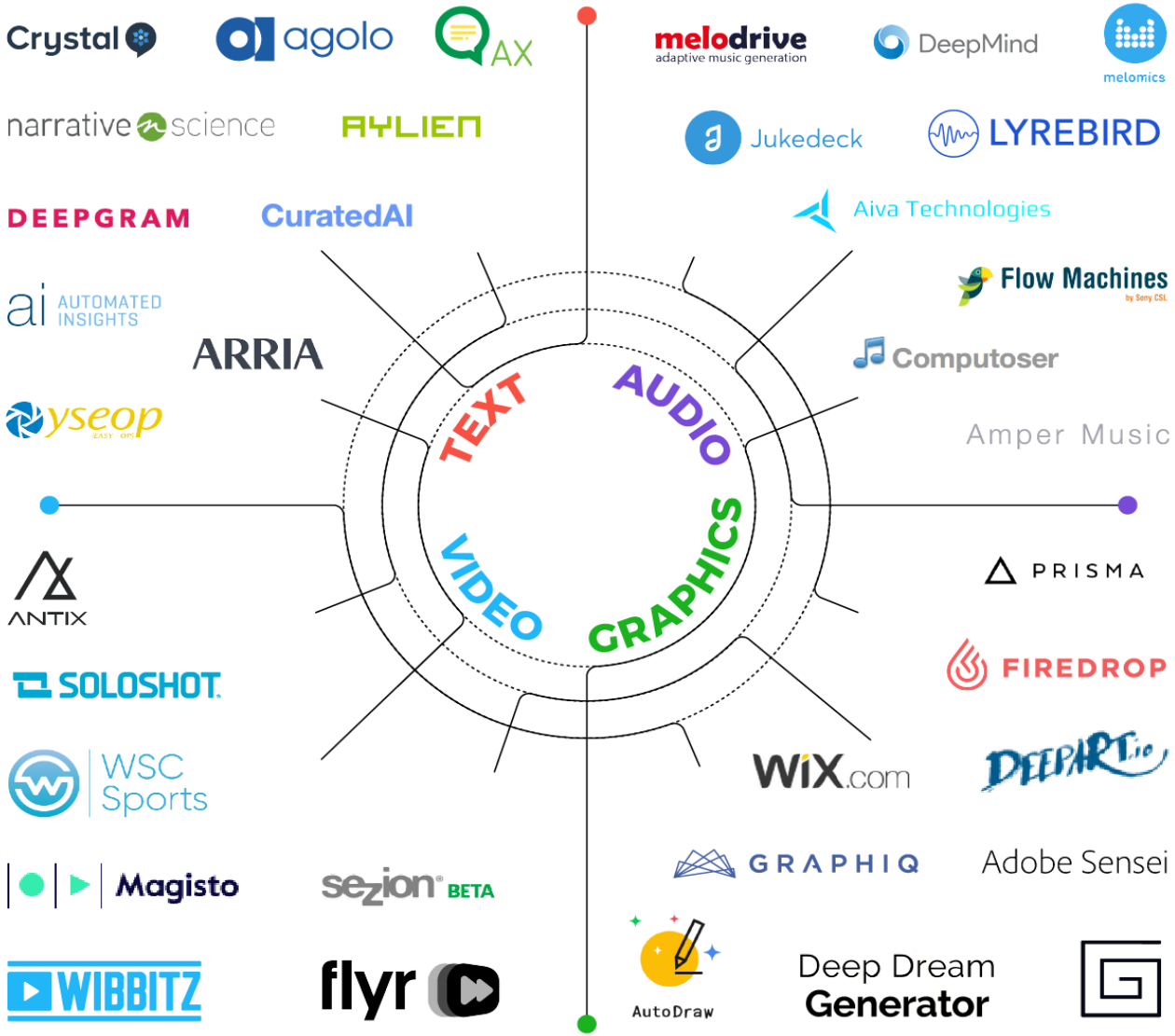
ANTHROPIC
CLAUDE 2

Writesonic

GitHub Copilot

Amazon
CodeWhisperer

The Growing AI Landscape
New Alternatives



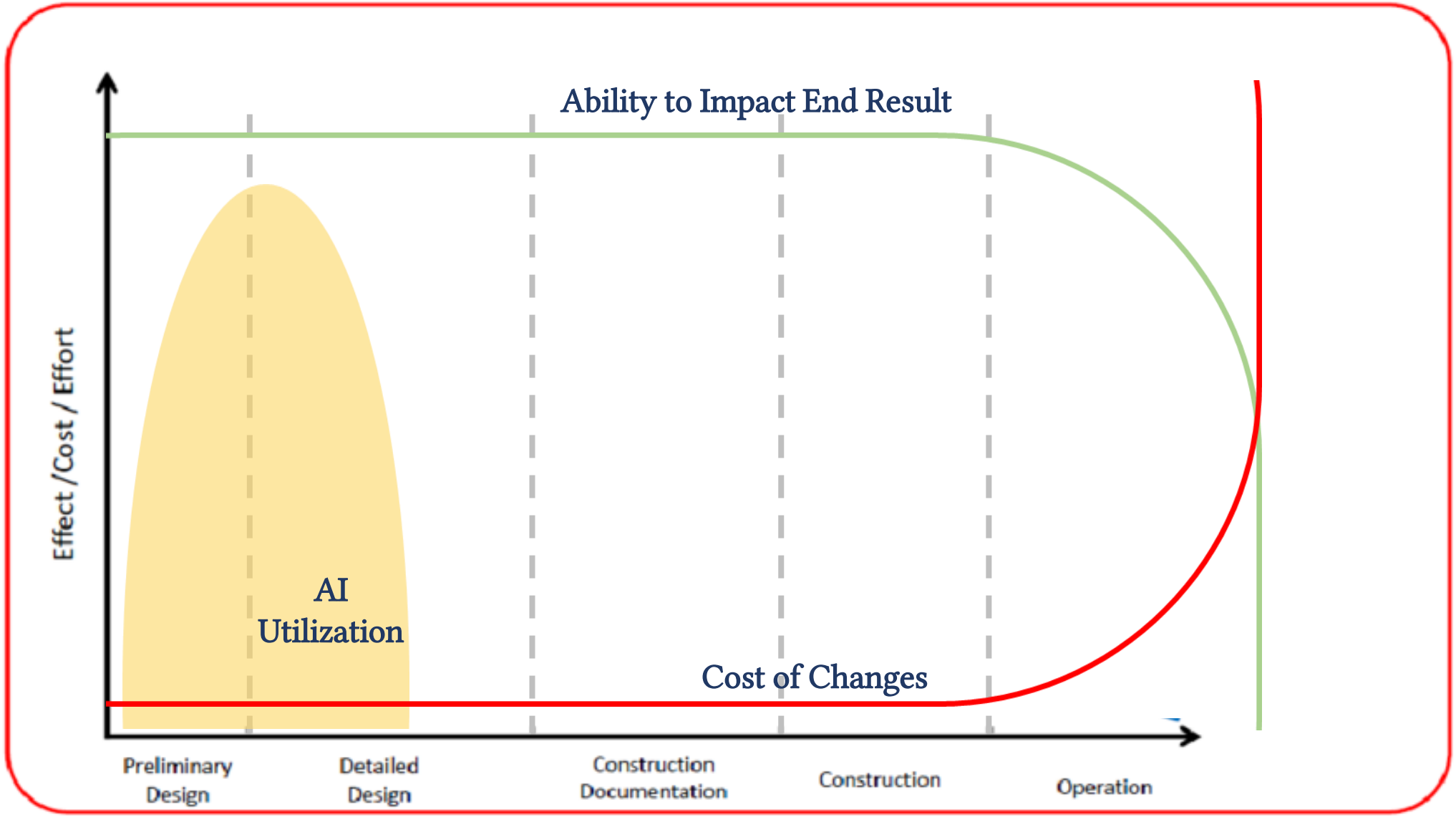
https://medium.com/@Wibbitz/infographic-the-creative-ai-landscape-c20b031729f3

We're in the early phase of a massive expansion of AI services…

What does this mean for us?

- New services coming online every month
- Integration of AI into existing products
- Potential to be more efficient at lower costs
- Upcoming waves of hype for new technology
- Great startups and products coming to market that never make it…
- …the scary potential that more work is created for us…

Why Do We Care About AI?
The Macleamy Curve



Ilozor, D.. (2012). Building Information Modeling and Integrated Project Delivery in the Commercial Construction Industry: A Conceptual Study. Journal of Engineering, Project, and Production Management. 2. 10.32738/JEPPM.201201.0004.
Paulson, Boyd C (December 1976). "Designing to reduce Construction Costs" (PDF). Journal of the Construction Division. 102 (C04): 587. doi:10.1061/JCCEAZ.0000639

Cyber Security + Government Regulations

Technically, we could build an infinite number of models because every model can be developed to perform different use cases, leveraging different data sets or data types. Its important to understand the role of data and how it is being used relative to new and existing AI models

KEY DEFINITIONS

TRAINING MODEL

An AI model that is actively being trained on a set of data at the current point in time.

Data set to this model can (and likely will) be incorporated into the existing, and growing, training data set.

Key Consideration: Any data sent for use by the model may be permanently retained by the host company and/or the model, leaving you with no control over the data that you've sent.

LIVE MODEL

An AI model that has already completed training on a specified data set and is not undergoing additional training.

While data sent to it does not inform (train) how the model works in the future, there is still a chance that the host company can retain the data you send to it, even if the model itself is not retaining it in real time.

Key Consideration: Understand the host company's data privacy and retention policies and whether or not they plan to retain, use, or train on that data at a future date.

"The suit does not include an exact monetary demand. But it says the defendants should be held responsible for "billions of dollars in statutory and actual damages" related to the "unlawful copying and use of The Times's uniquely valuable works." It also calls for the companies to destroy any chatbot models and training data that use copyrighted material from The Times."

Grynbaum, Michael and Mac, Ryan. "The Times Sues OpenAI and Microsoft Over A.I. Use of Copyrighted Work." *New York Times*, 27 December 2023

According to OpenAI, the New York Times had to specifically query ChatGPT ("red teaming") in order to discover that their data was being used by the AI model.

The problem? There's no easy way to know if your data is being used by an AI model or not.

RELEVANT EXECUTIVE ORDERS:

- E.O. 14110 – Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence (October 30, 2023)
- E.O. 13960 – Promoting the Use of Trustworthy Artificial Intelligence in the Federal Government (12/8/2020)

Safe and Effective Systems

Algorithmic Discrimination Protections

Data Privacy

Notice and Explanation

Human Alternatives, Consideration, and Fallback

https://www.whitehouse.gov/ostp/ai-bill-of-rights/
https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence/

Understanding Data Security
How AI Models Operate

The AI Act classifies AI according to its risk:

- Unacceptable risk is prohibited (e.g. social scoring systems and manipulative AI).
- Most of the text addresses high-risk AI systems, which are regulated.
- A smaller section handles limited risk AI systems, subject to lighter transparency obligations: developers/deployers must ensure that end-users are aware that they are interacting with AI.
- Minimal risk is unregulated (including the majority of AI applications currently available on the EU single market as of 2021).

The majority of obligations fall on providers (developers) of high-risk AI systems.

- Those that intend to place on the market or put into service high-risk AI systems in the EU, regardless of whether they are based in the EU or a third country.
- And also third country providers where the high risk AI system's output is used in the EU.

Users are natural or legal persons that deploy an AI system in a professional capacity, not affected end-users.

- Users of high-risk AI systems have some obligations, though less than providers (developers).
- This applies to users located in the EU, and users where the AI's output is used in the EU.

General purpose AI (GPAI):

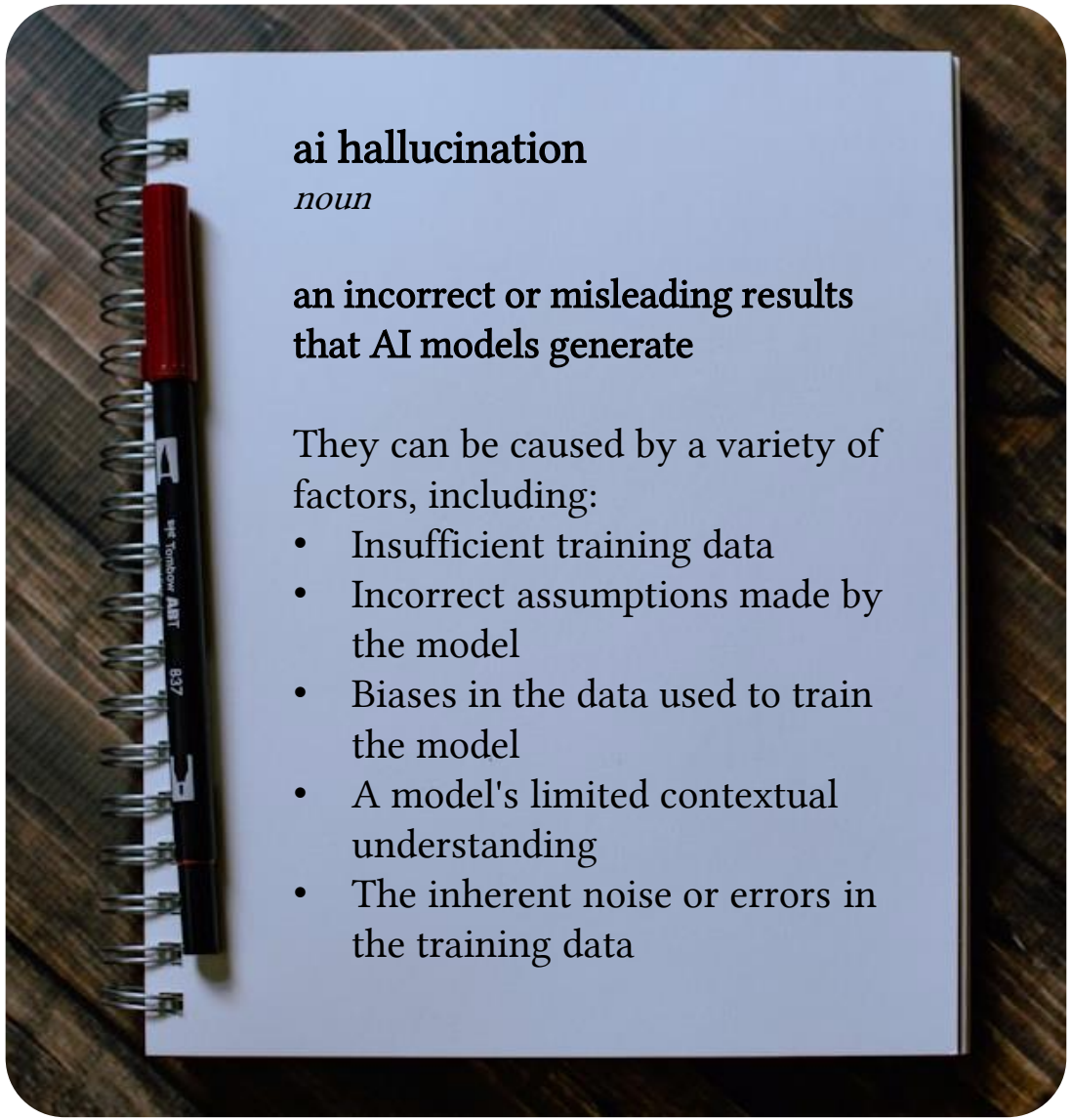
- All GPAI model providers must provide technical documentation, instructions for use, comply with the Copyright Directive, and publish a summary about the content used for training.
- Free and open licence GPAI model providers only need to comply with copyright and publish the training data summary, unless they present a systemic risk.
- All providers of GPAI models that present a systemic risk – open or closed – must also conduct model evaluations, adversarial testing, track and report serious incidents and ensure cybersecurity protections.

https://artificialintelligenceact.eu/wp-content/uploads/2024/01/AI-Act-Overview_24-01-2024.pdf

Any regulation ever created aims to keep people safe.

So, can we assume that Artificial Intelligence safe?

Why Do Regulations Matter?
Ethics, Data Integrity, AI Use



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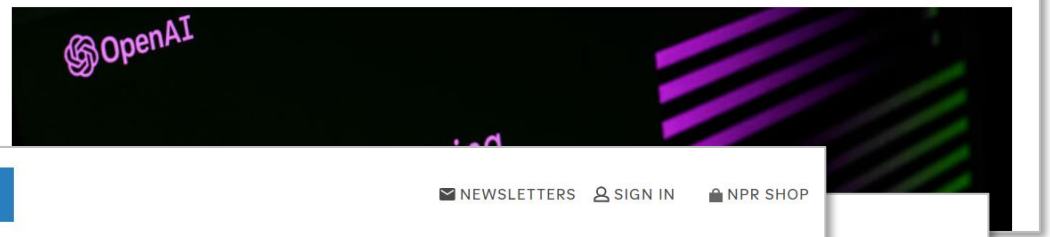
MISSOURI INDEPENDENT

CANNABIS CRIMINAL JUSTICE ENERGY + ENVIRONMENT HEALTH CARE EDUCATION ELECTION 2024

COURTS

Missouri appeals court fines litigant after finding fake, AI-generated cases cited in filings

BY: RUDI KELLER - FEBRUARY 13, 2024 11:23 AM



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NEWSLETTERS SIGN IN NPR SHOP

NEWS CULTURE MUSIC PODCASTS & SHOWS SEARCH

LAW

Michael Cohen says he unwittingly sent AI-generated fake legal cases to his attorney

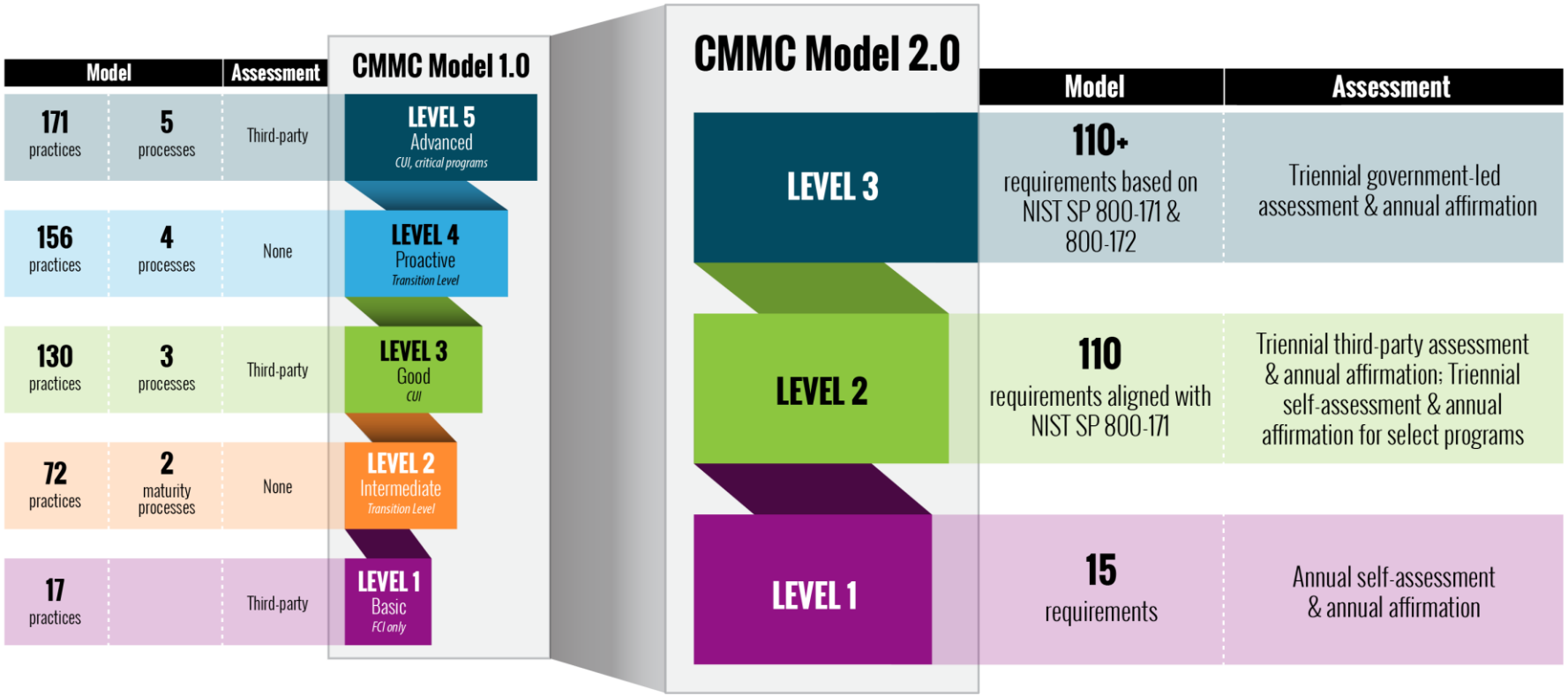
DECEMBER 30, 2023 · 8:20 AM ET

By The Associated Press

https://missouriindependent.com/2024/02/13/missouri-appeals-court-fines-litigant-after-finding-fake-ai-generated-cases-cited-in-filings/
https://www.theguardian.com/world/2024/feb/29/canada-lawyer-chatgpt-fake-cases-ai
https://www.npr.org/2023/12/30/1222273745/michael-cohen-ai-fake-legal-cases

Understanding Data Security
How AI Models Operate

With CMMC, the Department of Defense is putting in place aggressive contractor compliance measures that mimic data access/protection controls similar to how classified data is handled, but for unclassified information



Depending on the Level that your company requires, data may require sandboxing or other secure access controls.

For DoD data, then would naturally preclude being allowed to use a training AI model on the data, as you will lose control over what happens to and/or where the data is stored

However, an interesting AI use case is using AI to write your compliance checklists…

https://dodcio.defense.gov/CMMC/About/

Facility Condition Assessments

Condition Assessments
A Quick Overview

Why do Facility Condition Assessments matter?

- Provides information about the current state of a facility, including its functionality
- Helps determine the long-term needs of a building, such as repairs, maintenance, and replacements
- Provides actionable data for making informed decisions, such as staffing, project timelines, budgets, and capital planning
- Can help lenders or buyers understand how the condition of the building and site improvements will impact the asset's financial performance

FCA Nuances

- Written reports remains the preferred customer format
- Data collection can be highly variable between inspectors and/or companies

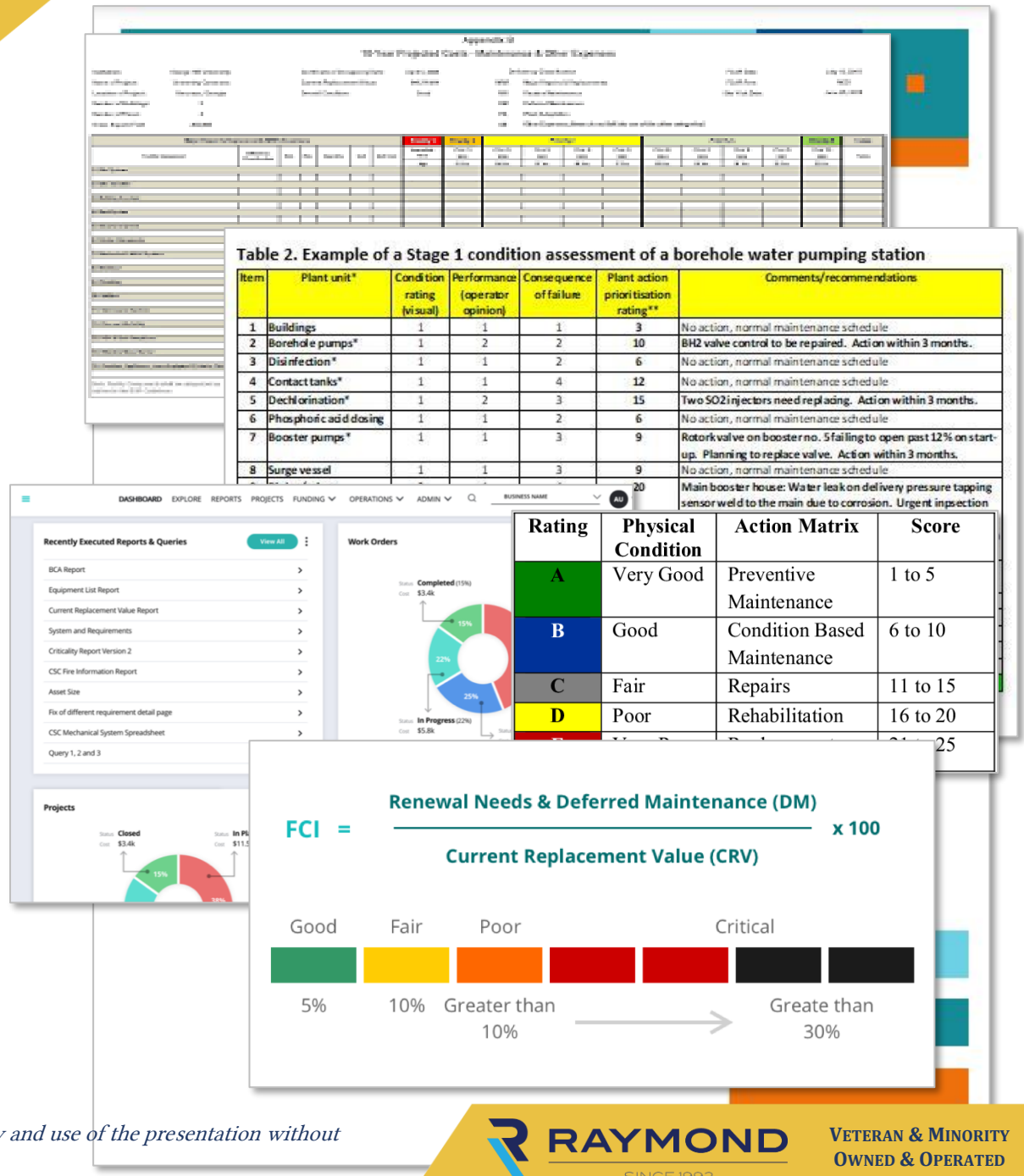


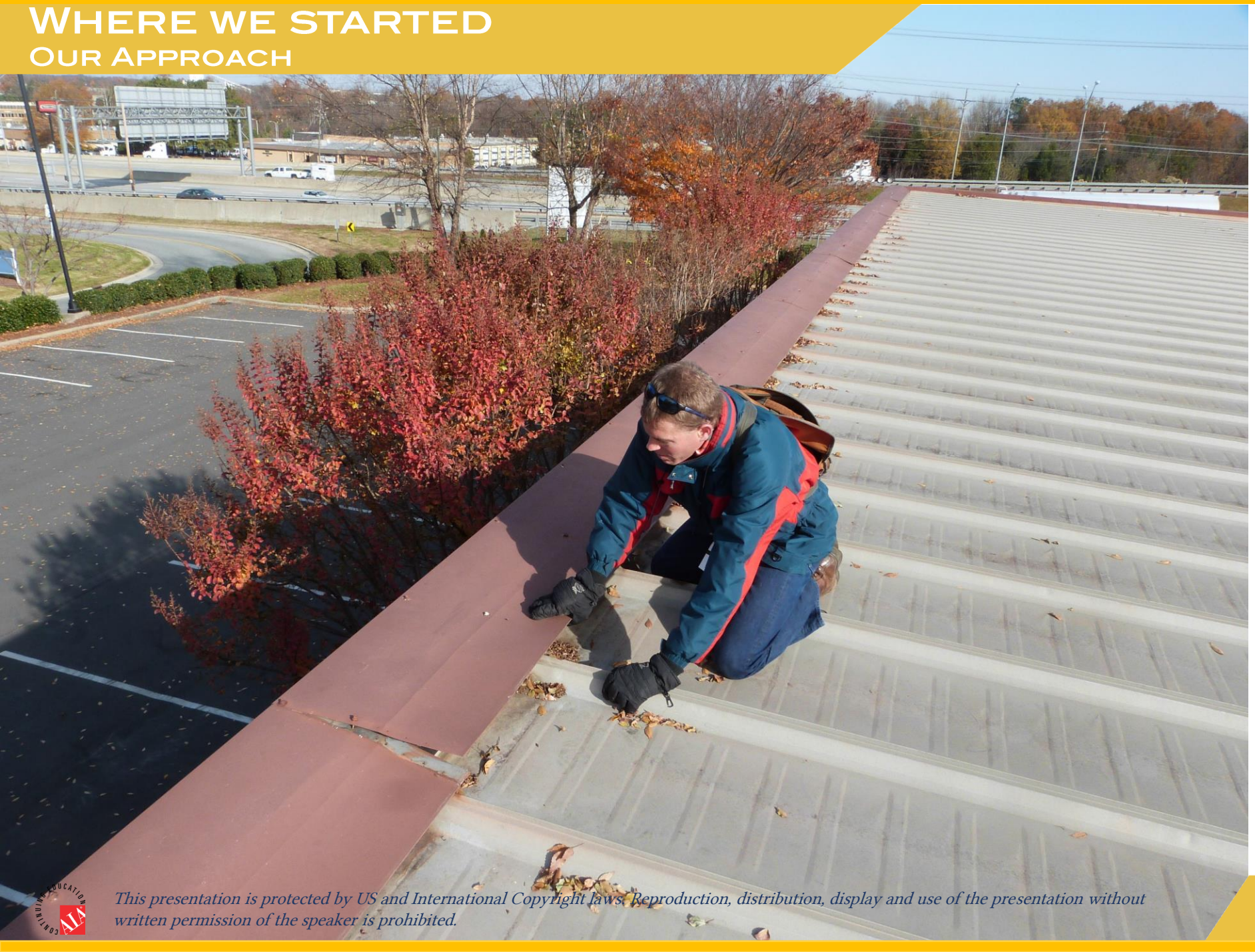
Table 2. Example of a Stage 1 condition assessment of a borehole water pumping station

Item	Plant unit*	Condition rating (visual)	Performance (operator opinion)	Consequence of failure	Plant action prioritisation rating**	Comments/recommendations
1	Buildings	1	1	1	3	No action, normal maintenance schedule
2	Borehole pumps*	1	2	2	10	BH2 valve control to be repaired. Action within 3 months.
3	Disinfection*	1	1	2	6	No action, normal maintenance schedule
4	Contact tanks*	1	1	4	12	No action, normal maintenance schedule
5	Dechlorination*	1	2	3	15	Two SO2 injectors need replacing. Action within 3 months.
6	Phosphoric acid dosing	1	1	2	6	No action, normal maintenance schedule
7	Booster pumps*	1	1	3	9	Rotork valve on booster no. 5 failing to open past 12% on start-up. Planning to replace valve. Action within 3 months.
8	Surge vessel	1	1	3	9	No action, normal maintenance schedule
					20	Main booster house: Water leak on delivery pressure tapping sensor weld to the main due to corrosion. Urgent inpsection

Rating	Physical Condition	Action Matrix	Score
A	Very Good	Preventive Maintenance	1 to 5
B	Good	Condition Based Maintenance	6 to 10
C	Fair	Repairs	11 to 15
D	Poor	Rehabilitation	16 to 20

https://www.newmarket.ca/TownGovernment/Documents/Mulock%20Property/041305_Building%20Condition%20Assessment%20Report_%2016780%20Yonge%20St%20Newmarket.FINAL%20STAMPED.pdf

2017



MANUAL CONDITION INVESTIGATIONS

- "Par for the course"
- Requires an inspector to be on-site
- To some degree will always be inefficient
- Continues to be the standard mechanism for understanding existing condictions

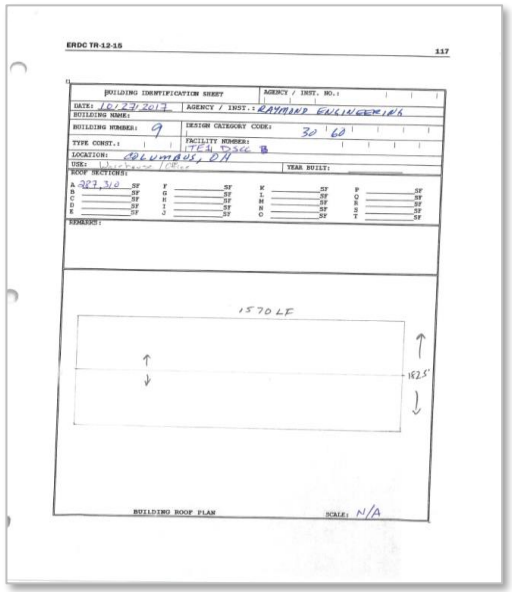
DIGITAL DATA COLLECTION

- The big “advancement” since the 1990s – we now use digital cameras in the field
- Requires the inspector to correlate photographs with other collected data
- Inefficient in file transfers, building a photo log, or tracking information over time

MANUAL DATA RECORDING

- Still very common across firms, owners, and disciplines
- Some advancements in looking into how to use construction software for digital data collection
- Even if digital, most inspectors are still inefficient when writing reports

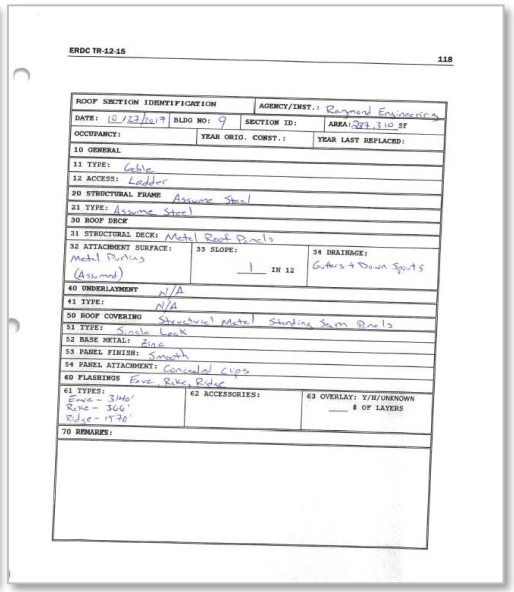
To this day, some customers still require physical forms to be filled out and submitted, so that hard data entry can be completed in the owner's database


ERDC TR-12-15 117

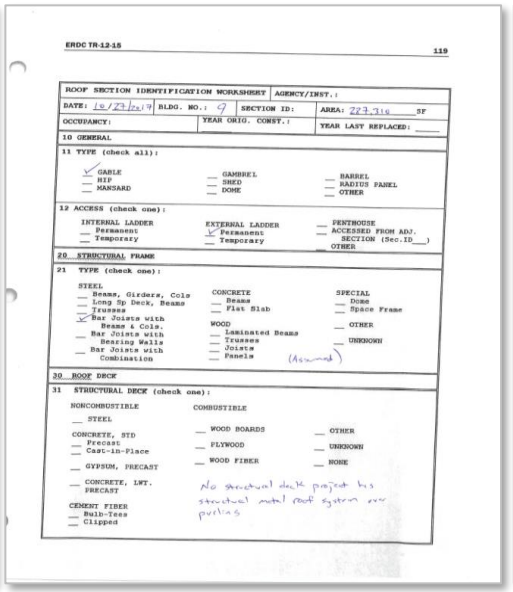
BUILDING IDENTIFICATION SHEET

1570 LF

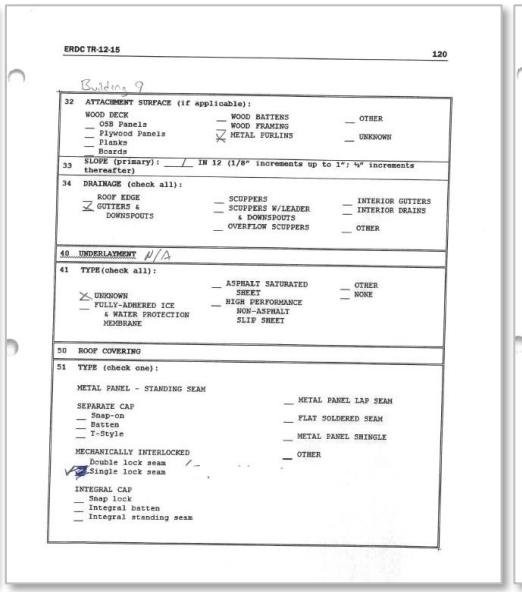
BUILDING ROOF PLAN SCALE: N/A

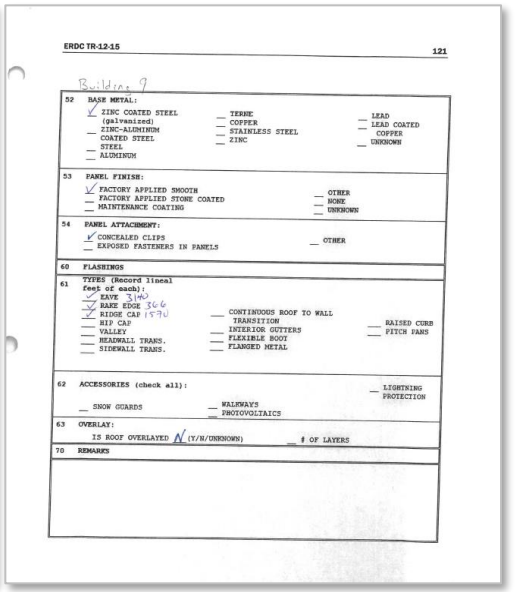

ERDC TR-12-15 118

ROOF SECTION IDENTIFICATION


ERDC TR-12-15 119

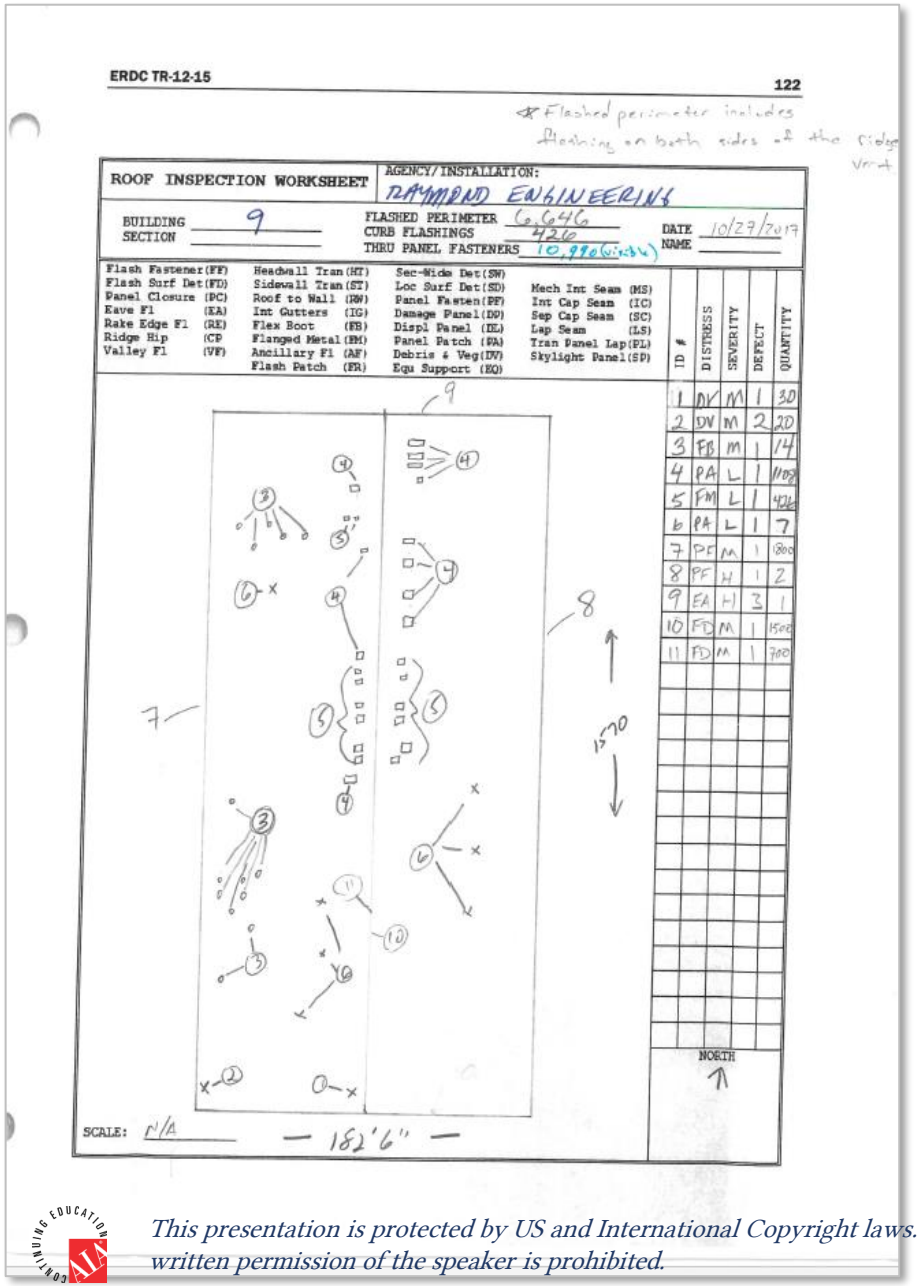
ROOF SECTION IDENTIFICATION WORKSHEET


ERDC TR-12-15 120


ERDC TR-12-15 121

The above examples are the forms required to be submitted for data entry in the Roofer program (within the Builder program), maintained by the United States Army Corps of Engineers

Where we started
Our Approach



ERDC TR-12-15 122

* Flashed perimeter includes flashing on both sides of the ridge vent

ROOF INSPECTION WORKSHEET

AGENCY/INSTALLATION: RAYMOND ENGINEERING

BUILDING 9
SECTION

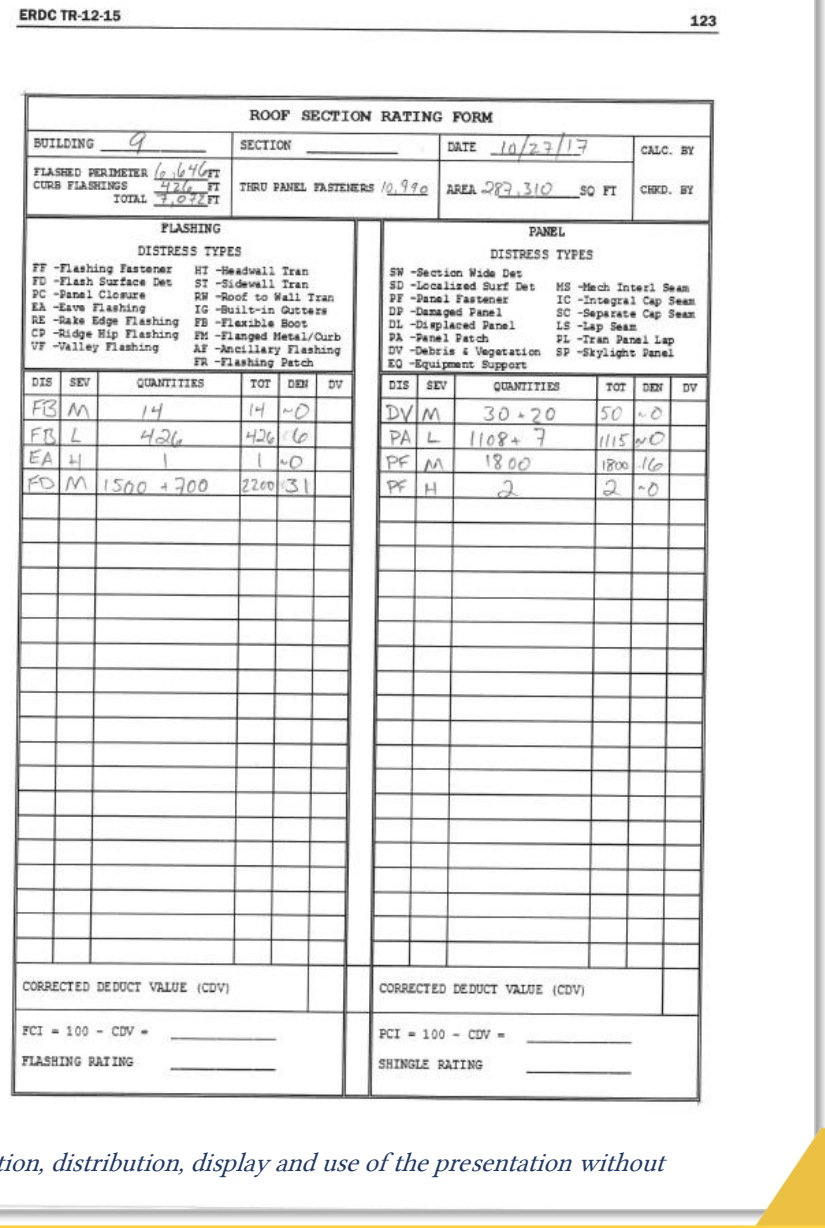
FLASHED PERIMETER 6,646
CURB FLASHINGS 426
THRU PANEL FASTENERS 10,990 (WITH)

DATE 10/27/2017
NAME

Flash Fastener (FF)	Headwall Tran (HT)	Sec-Wide Det (SW)	Mech Int Seam (MS)
Flash Surf Det (FD)	Sidewall Tran (ST)	Loc Surf Det (SD)	Int Cap Seam (IC)
Panel Closure (PC)	Roof to Wall (RW)	Panel Fasten (PF)	Sep Cap Seam (SC)
Eave Fl (EA)	Int Gutters (IG)	Damage Panel (DP)	Displ Panel (DL)
Rake Edge Fl (RE)	Flex Boot (FB)	Displ Panel (DL)	Lap Seam (LS)
Ridge Hip (CP)	Flanged Metal (FM)	Panel Patch (PA)	Tran Panel Lap (PL)
Valley Fl (VF)	Ancillary Fl (AF)	Debris & Veg (DV)	Skylight Panel (SP)
	Flash Patch (FR)	Equ Support (EQ)	

ID #	DISTRESS	SEVERITY	DEFECT	QUANTITY
1	DV	M	1	30
2	DV	M	2	20
3	FB	M	1	14
4	PA	L	1	1108
5	FM	L	1	426
6	PA	L	1	7
7	PF	M	1	1800
8	PF	H	1	2
9	EA	H	3	1
10	FD	M	1	1500
11	FD	M	1	700

9
8
7
170
NORTH
SCALE: N/A
182'6"



ERDC TR-12-15 123

ROOF SECTION RATING FORM

BUILDING 9
SECTION
DATE 10/27/17
CALC. BY
FLASHED PERIMETER 6,646 FT
CURB FLASHINGS 426 FT
TOTAL 7,072 FT
THRU PANEL FASTENERS 10,990
AREA 287,310 SQ FT
CHKD. BY

FLASHING

DISTRESS TYPES

FF -Flashing Fastener
FD -Flash Surface Det
PC -Panel Closure
EA -Eave Flashing
RE -Rake Edge Flashing
CP -Ridge Hip Flashing
VF -Valley Flashing
HT -Headwall Tran
ST -Sidewall Tran
RW -Roof to Wall Tran
IG -Built-in Gutters
FB -Flexible Boot
FM -Flanged Metal/Curb
AF -Ancillary Flashing
FR -Flashing Patch

DIS	SEV	QUANTITIES	TOT	DEN	DV
FB	M	14	14	~0	
FB	L	426	426	6	
EA	H	1	1	~0	
FD	M	1500 + 700	2200	31	

CORRECTED DEDUCT VALUE (CDV)

FCI = 100 - CDV = _____

FLASHING RATING _____

PANEL

DISTRESS TYPES

SW -Section Wide Det
SD -Localized Surf Det
PF -Panel Fastener
DP -Damaged Panel
DL -Displaced Panel
PA -Panel Patch
DV -Debris & Vegetation
EQ -Equipment Support
MS -Mech Interl Seam
IC -Integral Cap Seam
SC -Separate Cap Seam
LS -Lap Seam
PL -Tran Panel Lap
SP -Skylight Panel

DIS	SEV	QUANTITIES	TOT	DEN	DV
DV	M	30 + 20	50	~0	
PA	L	1108 + 7	1115	~0	
PF	M	1800	1800	16	
PF	H	2	2	~0	

CORRECTED DEDUCT VALUE (CDV)

PCI = 100 - CDV = _____

SHINGLE RATING _____

Not Ideal Record Management

- Aimed for quantification
- Potential first attempts at location-based data collection and reporting
- Didn't tie technical, location, and digital data together for long-term use and asset management

DATA COLLECTION IN THE FIELD

1-2

MINUTES

REPORT WRITING IN THE OFFICE

4-5

HOURS

EXAMPLE DATA POINT: In 2017, my team did a roof condition assessment at a DoD logistics site in Ohio – approximately 7M SQFT of metal panel roofs. With a team of four inspectors, we finished the full roof and eave inspection within a week of on-site work. In the field, we averaged about 2 minutes per marked defect. This included marking a hand drawn diagram of the roof with a code and taking a photo. Back in the office, we had GBs of data to review ***again***, leading to nearly two weeks of report writing time.

2018

Starting in 2018, we wanted to solve our inefficiency problem….

COMMERCIALLY AVAILABLE SOLUTIONS

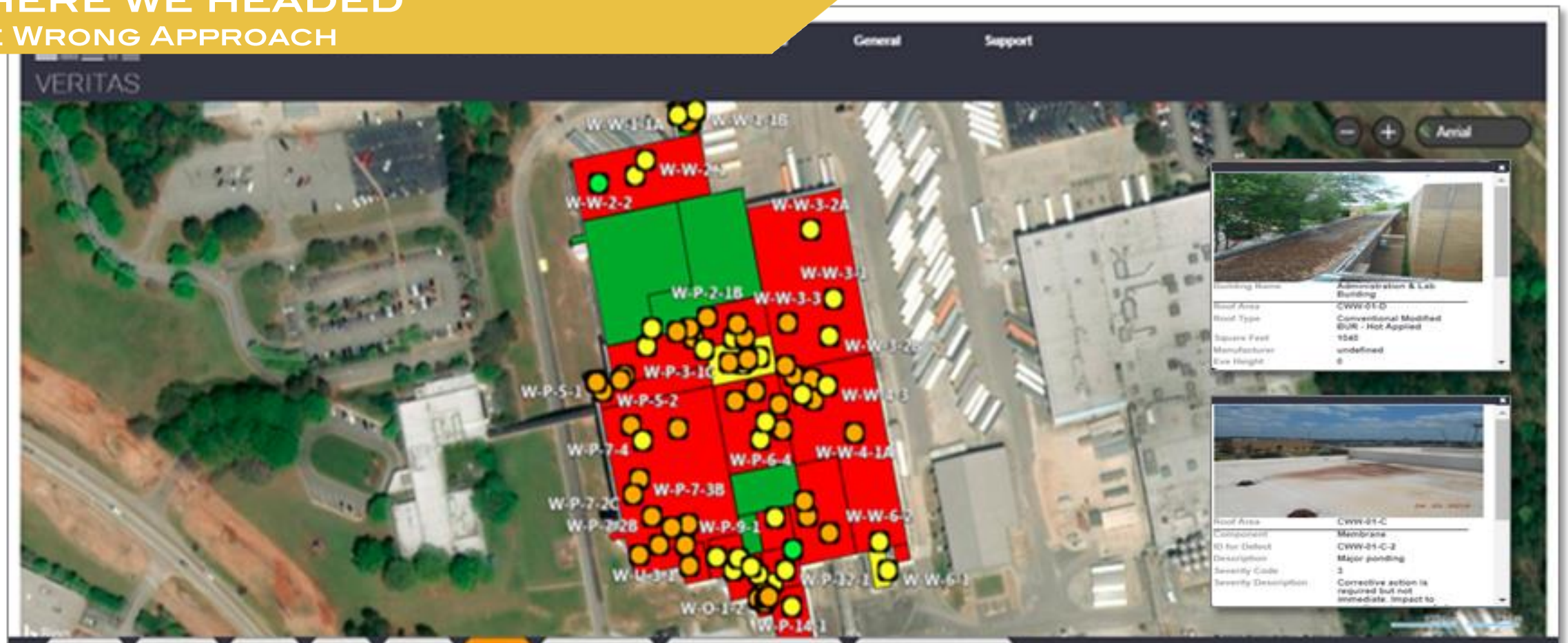
- Did not have a digital data collection solution
- Not designed for A/E condition assessments
- Created additional work time
- Expensive

WHAT WE THOUGHT WE NEEDED FOR OUR PROJECTS

- Enabled an asset management program
- Adapted for real field use and the condition assessment use case
- Customer focused
- Web-enabled

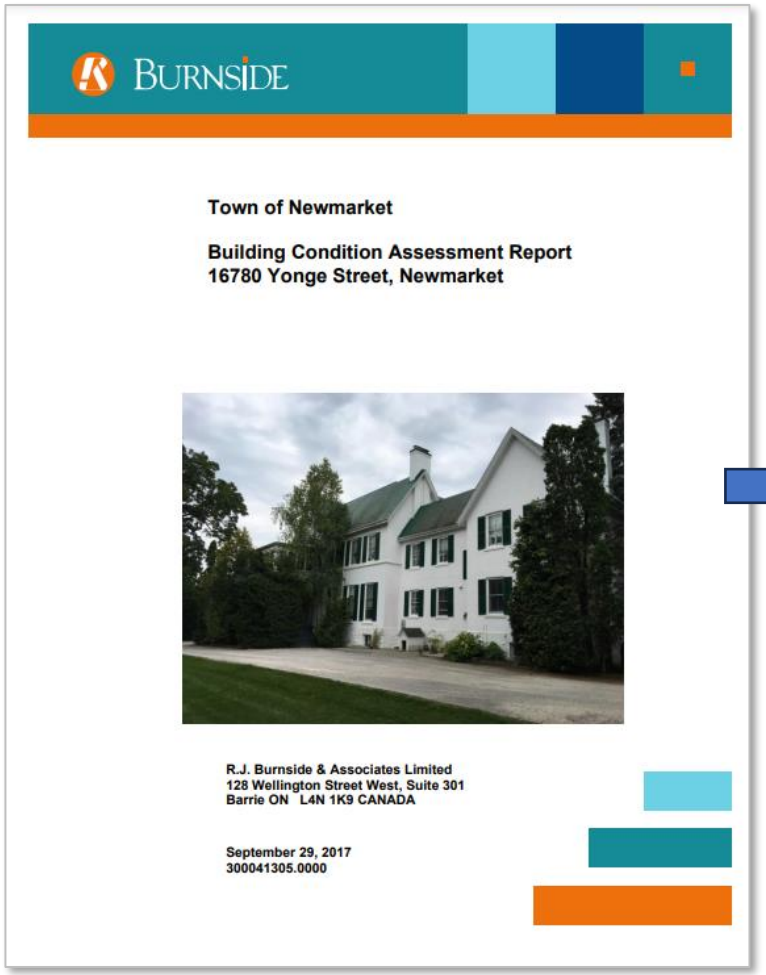
And that's what we set out to build….

Where we headed
The Wrong Approach



Building Name	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
70 - Leighton School for the Performing Arts	6000	2250	1300	11350	201400	1450	1500	1550	1600	1700
70-A	6000	2250	1300	11350	201400	1450	1500	1550	1600	1700
Repairs	5000	1000	0	0	0	0	0	0	0	0
Design	0	0	0	10000	0	0	0	0	0	0
Replacement	0	0	0	0	200000	0				

What We Realized
Matching Customer Requirements to Ours

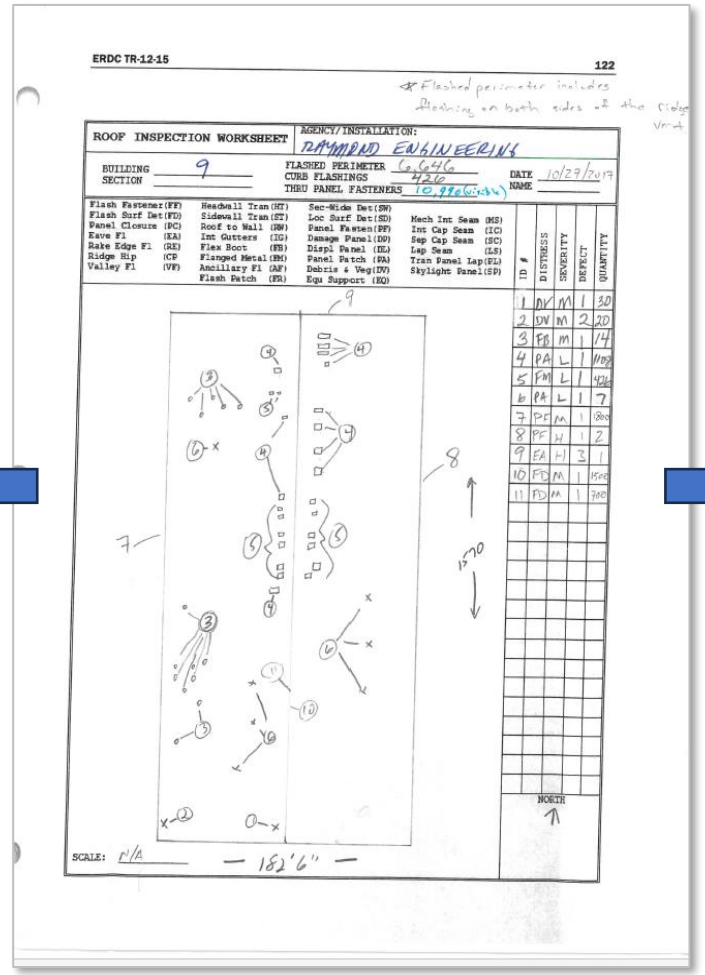

BURNSIDE

Town of Newmarket

Building Condition Assessment Report
16780 Yonge Street, Newmarket

R.J. Burnside & Associates Limited
128 Wellington Street West, Suite 301
Barrie ON L4N 1K9 CANADA

September 29, 2017
300041305.0000


ERDC TR-12-15 122

ROOF INSPECTION WORKSHEET

AGENCY/INSTALLATION: RAYMOND ENGINEERING

BUILDING 9
SECTION

FLASHED PERIMETER 6,646
CURB FLASHINGS 420
THRU PANEL FASTENERS 10,996

DATE 10/27/2017
NAME

SCALE: N/A — 182'6" —

NORTH

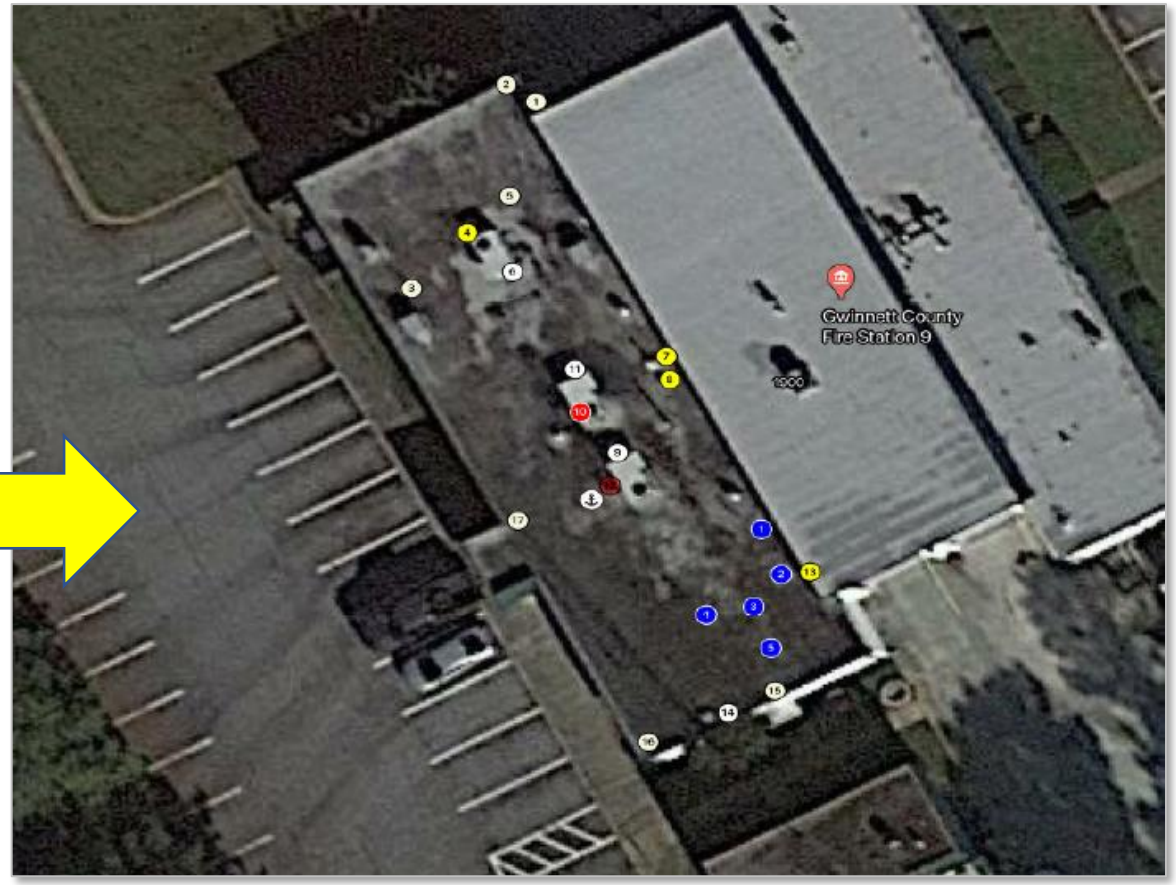
Written Report

Geospatial Data

Field-Enabled

2019

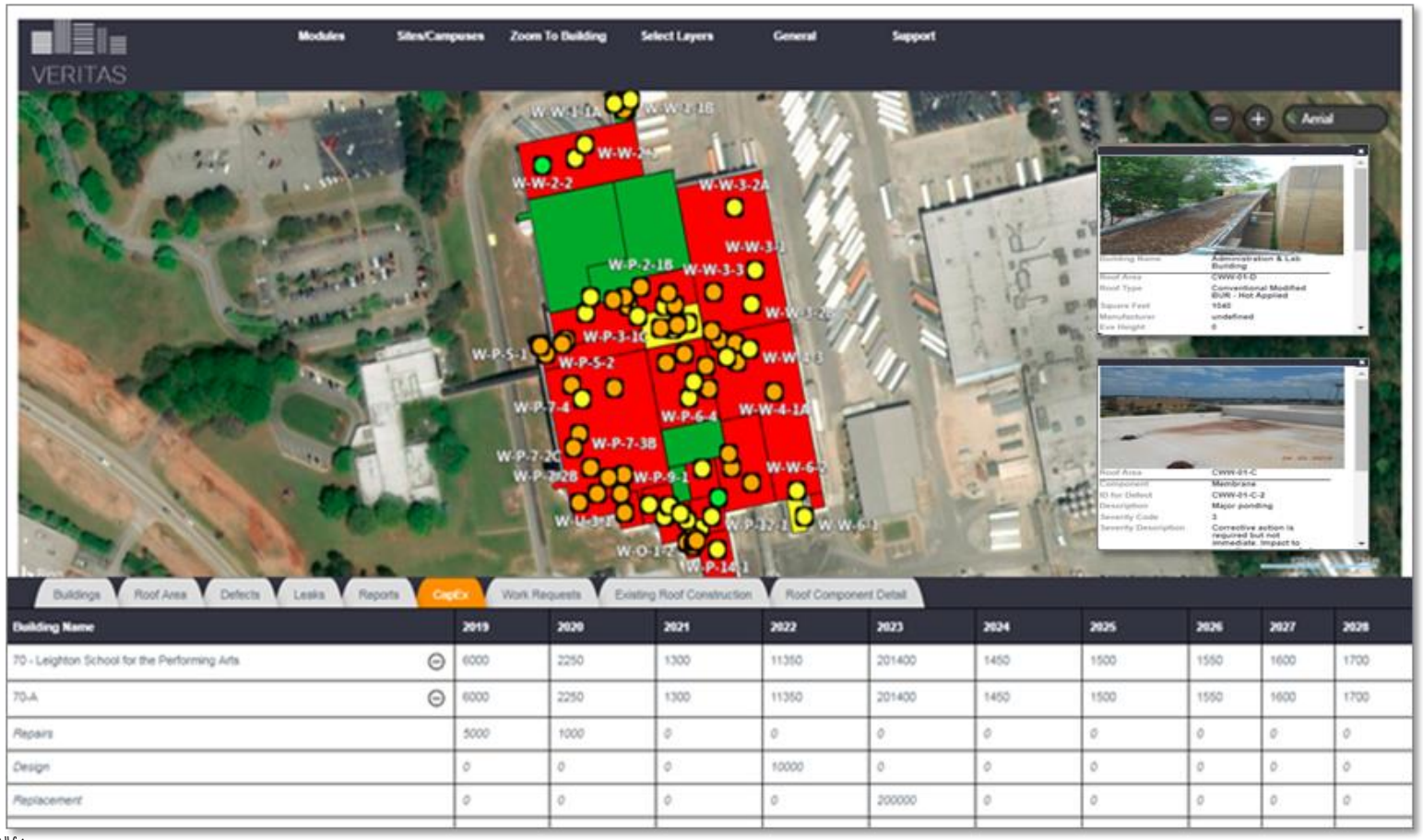
What Happens w/Digital Data
New Use Cases



We could finally achieve 10-15 seconds per data point speeds

What Happens w/Digital Data
New Use Cases

In 2019, we surveyed Millions of Square Feet of roofs, proving that digital data collection was possible, efficient, and easy. However, we were still aiming at the wrong end goal – we kept focusing on populating the customer portal…



Building Name	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
70 - Leighton School for the Performing Arts	6000	2250	1300	11350	201400	1450	1500	1550	1600	1700
70-A	6000	2250	1300	11350	201400	1450	1500	1550	1600	1700
Repairs	5000	1000	0	0	0	0	0	0	0	0
Design	0	0	0	10000	0	0	0	0	0	0
Replacement	0	0	0	0	200000	0	0	0	0	0

Pros

- We solved the digital data collection issue in the field
- Enabled a web-based asset management platform

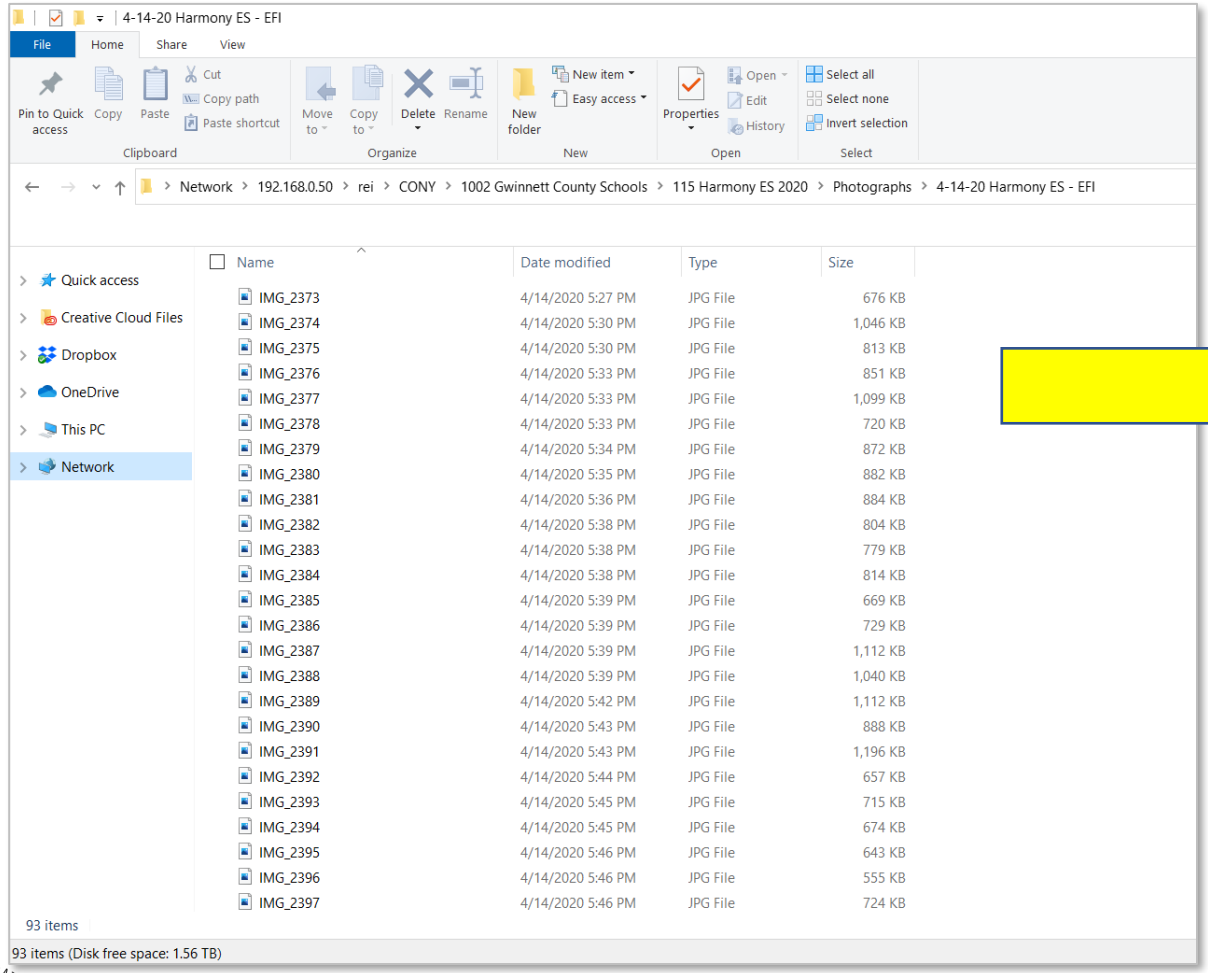
Cons

- Double work for inspectors
- Didn't meet customer preferences

Customer feedback told us, owners still wanted reports. And it finally begged the question:

Could we automate report writing now that we had digital data?

Within two months, we had built a prototype to start automated report writing. Efficiency skyrocketed just by being able to automatically build a photo log.



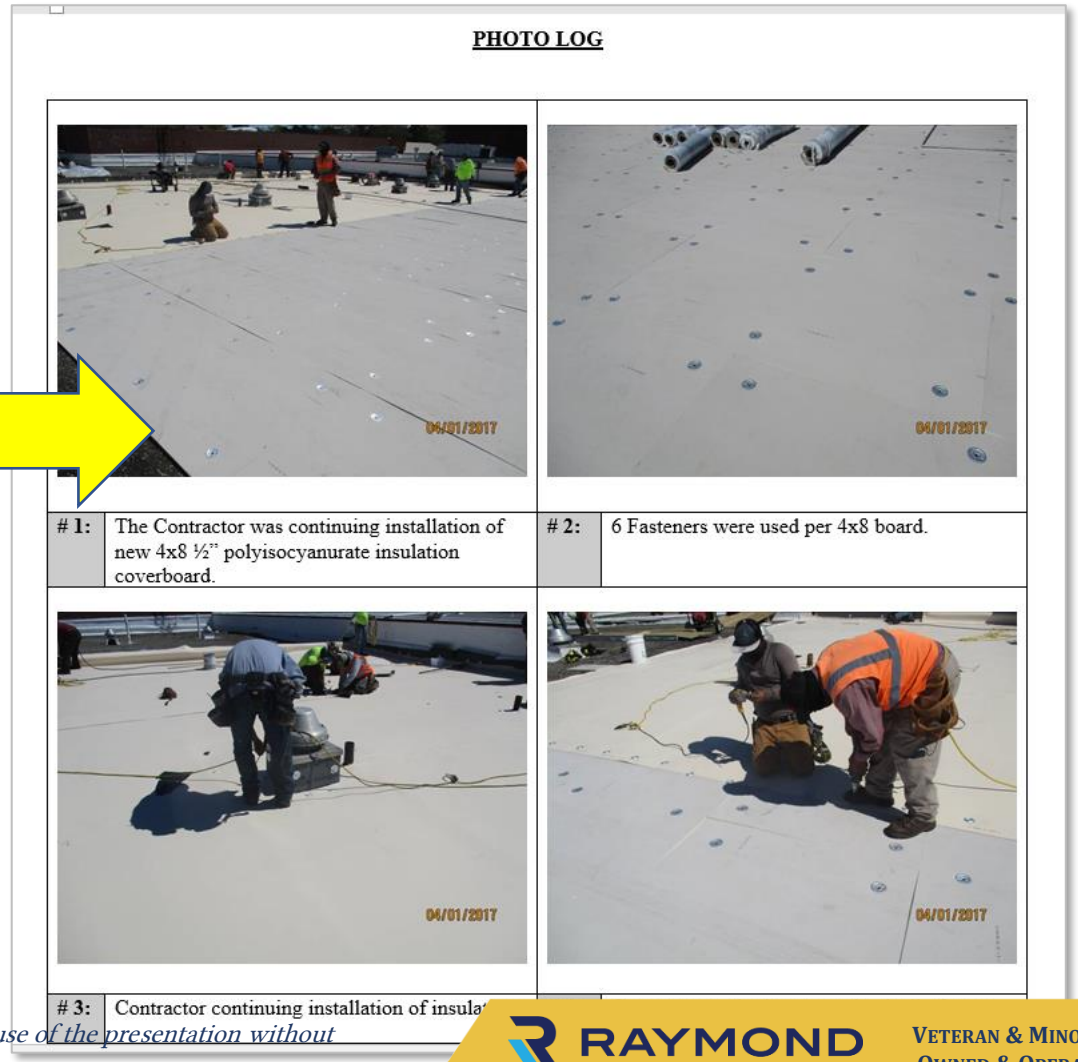


PHOTO LOG

# 1:	The Contractor was continuing installation of new 4x8 ½" polyisocyanurate insulation coverboard.	# 2:	6 Fasteners were used per 4x8 board.

# 3:	Contractor continuing installation of insula

What Happens w/Digital Data
New Use Cases

Using a standardized format, automated technical data and photo inputs, and sample stock text, we estimated we could now generate a 70% report

Data Collection in the Field

1-2 → 10-15

Minutes Per Data Point → Seconds Per Data Point

Report Writing

4-5 → 20-30

Hours (Simple Report) → Minutes (Simple Report)

And while training, standardization, quality, and profit margins all increased…we kept hearing that the platform users were still struggling with writing the remaining 30% of the report that wasn't automated…

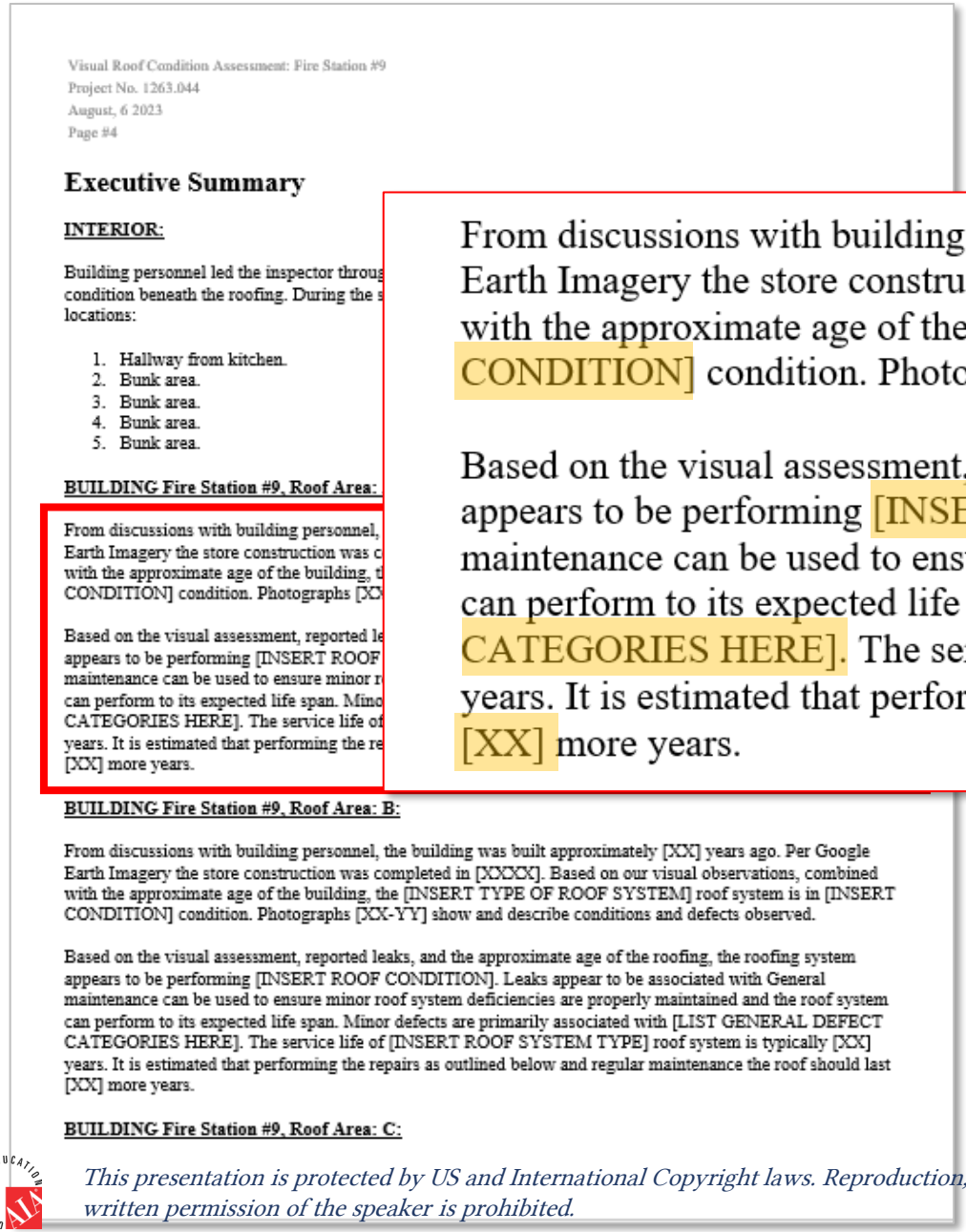
2023

AI finally hits "Critical Mass"

And what is it best at?

Writing

The Problem Statement
Where We Started



Visual Roof Condition Assessment: Fire Station #9
Project No. 1263.044
August, 6 2023
Page #4

Executive Summary

INTERIOR:

Building personnel led the inspector throug
condition beneath the roofing. During the s
locations:

1. Hallway from kitchen.
2. Bunk area.
3. Bunk area.
4. Bunk area.
5. Bunk area.

BUILDING Fire Station #9, Roof Area:

From discussions with building personnel,
Earth Imagery the store construction was c
with the approximate age of the building, t
CONDITION] condition. Photographs [XX

Based on the visual assessment, reported le
appears to be performing [INSERT ROOF
maintenance can be used to ensure minor r
can perform to its expected life span. Mino
CATEGORIES HERE]. The service life of
years. It is estimated that performing the re
[XX] more years.

BUILDING Fire Station #9, Roof Area: B:

From discussions with building personnel, the building was built approximately [XX] years ago. Per Google Earth Imagery the store construction was completed in [XXXX]. Based on our visual observations, combined with the approximate age of the building, the [INSERT TYPE OF ROOF SYSTEM] roof system is in [INSERT CONDITION] condition. Photographs [XX-YY] show and describe conditions and defects observed.

Based on the visual assessment, reported leaks, and the approximate age of the roofing, the roofing system appears to be performing [INSERT ROOF CONDITION]. Leaks appear to be associated with General maintenance can be used to ensure minor roof system deficiencies are properly maintained and the roof system can perform to its expected life span. Minor defects are primarily associated with [LIST GENERAL DEFECT CATEGORIES HERE]. The service life of [INSERT ROOF SYSTEM TYPE] roof system is typically [XX] years. It is estimated that performing the repairs as outlined below and regular maintenance the roof should last [XX] more years.

BUILDING Fire Station #9, Roof Area: C:

From discussions with building personnel, the building was built approximately [XX] years ago. Per Google Earth Imagery the store construction was completed in [XXXX]. Based on our visual observations, combined with the approximate age of the building, the [INSERT TYPE OF ROOF SYSTEM] roof system is in [INSERT CONDITION] condition. Photographs [XX-YY] show and describe conditions and defects observed.

Based on the visual assessment, reported leaks, and the approximate age of the roofing, the roofing system appears to be performing [INSERT ROOF CONDITION]. Leaks appear to be associated with General maintenance can be used to ensure minor roof system deficiencies are properly maintained and the roof system can perform to its expected life span. Minor defects are primarily associated with [LIST GENERAL DEFECT CATEGORIES HERE]. The service life of [INSERT ROOF SYSTEM TYPE] roof system is typically [XX] years. It is estimated that performing the repairs as outlined below and regular maintenance the roof should last [XX] more years.

Going back to the 30% that we couldn't generate from our digital data collection, we aimed to use "stock" text to solve some of the problem

And while we had hoped to solve "writer's block", we started to see inspectors using it verbatim in reports.

So, we did our first integration with ChatGPT.

BUILDING: Fleet, AREA: A

The building has a mod bitumen roofing system with a remaining service life of 3-5 years and a fair condition rating. The roofing system is supported by concrete double tees and has an unknown pitch and age. The roof has several defects, including severe loss of surfacing or minerals, somewhat-severe detached flashing membrane, somewhat-severe ponding, and two instances of somewhat-severe defective repair to the membrane.

BUILDING: Fleet, AREA: B

The building's roof is a built-up type with a remaining service life of 3-5 years and a fair condition rating. Despite being approximately of age, the roofing system appears to be functioning well based on a visual assessment and lack of reported leaks. However, minor roof system deficiencies need regular maintenance to achieve its expected lifespan. Some of the most severe defects include severe detachment of counter flashing and rusting of the exhaust vent, while there are also several instances of moderate and minimal loss of surfacing or minerals in the flashing membrane.

Veritas Asset Management, Inc. conducted a comprehensive condition assessment of the roof at Fire Station #9. The study focused on identifying areas of concern, particularly those exhibiting similar characteristics. The evaluation revealed the presence of leaks in several locations within the structure, predominantly in the hallway leading from the kitchen and in multiple spots within the bunk area. These leaks were detected in the roof area categorized as 'A', which was constructed using the built-up roofing method. The overall condition of this section was rated as poor.

In addition to the leaks, the assessment also identified various defects in the same 'A' roof area. These included repeated instances of alligatoring, loose sections, loss of surfacing or minerals, drainage issues leading to water accumulation on the roof, and holes. Other less frequent defects such as rust, damage, the presence of vegetation and debris, deformations, and unsecured sections were also noted. These findings suggest that this section of the roof, despite its construction year, has a limited service life remaining and requires urgent attention to prevent further deterioration.

A useful feature within ChatGPT is the ability to adjust how much text is written. We started with assuming that our original write-ups would be sufficient, but we later switched to more comprehensive Executive Summaries

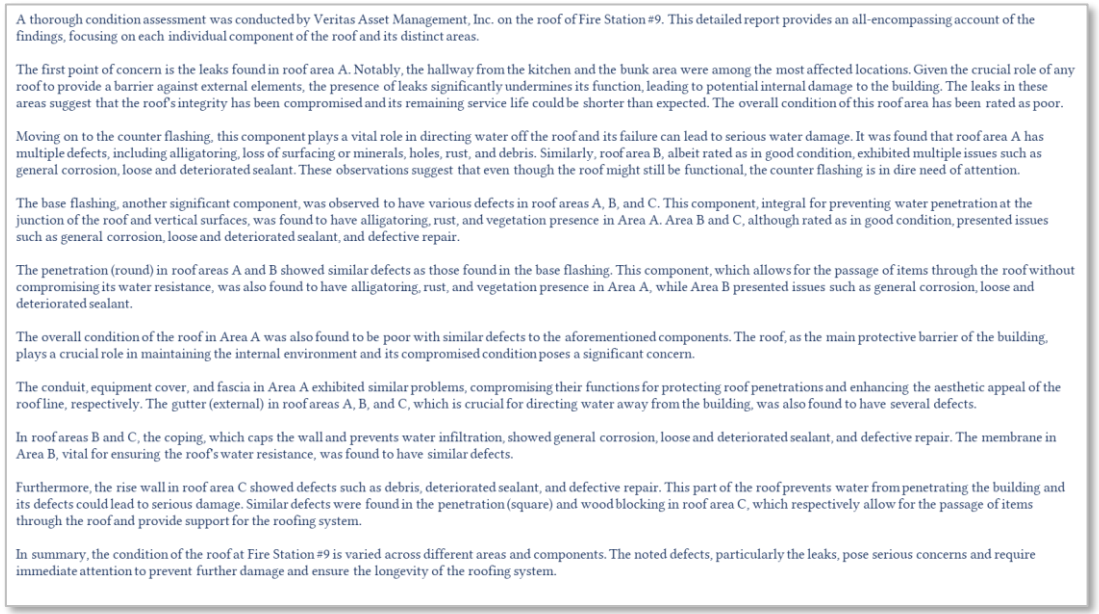
BUILDING: Fleet, AREA: A

The building has a mod bitumen roofing system with a remaining service life of 3-5 years and a fair condition rating. The roofing system is supported by concrete double tees and has an unknown pitch and age. The roof has several defects, including severe loss of surfacing or minerals, somewhat-severe detached flashing membrane, somewhat-severe ponding, and two instances of somewhat-severe defective repair to the membrane.

BUILDING: Fleet, AREA: B

The building's roof is a built-up type with a remaining service life of 3-5 years and a fair condition rating. Despite being approximately of age, the roofing system appears to be functioning well based on a visual assessment and lack of reported leaks. However, minor roof system deficiencies need regular maintenance to achieve its expected lifespan. Some of the most severe defects include severe detachment of counter flashing and rusting of the exhaust vent, while there are also several instances of moderate and minimal loss of surfacing or minerals in the flashing membrane.

CHATGPT 3.5



A thorough condition assessment was conducted by Veritas Asset Management, Inc. on the roof of Fire Station #9. This detailed report provides an all-encompassing account of the findings, focusing on each individual component of the roof and its distinct areas.

The first point of concern is the leaks found in roof area A. Notably, the hallway from the kitchen and the bunk area were among the most affected locations. Given the crucial role of any roof to provide a barrier against external elements, the presence of leaks significantly undermines its function, leading to potential internal damage to the building. The leaks in these areas suggest that the roof's integrity has been compromised and its remaining service life could be shorter than expected. The overall condition of this roof area has been rated as poor.

Moving on to the counter flashing, this component plays a vital role in directing water off the roof and its failure can lead to serious water damage. It was found that roof area A has multiple defects, including alligatoring, loss of surfacing or minerals, holes, rust, and debris. Similarly, roof area B, albeit rated as in good condition, exhibited multiple issues such as general corrosion, loose and deteriorated sealant. These observations suggest that even though the roof might still be functional, the counter flashing is in dire need of attention.

The base flashing, another significant component, was observed to have various defects in roof areas A, B, and C. This component, integral for preventing water penetration at the junction of the roof and vertical surfaces, was found to have alligatoring, rust, and vegetation presence in Area A. Area B and C, although rated as in good condition, presented issues such as general corrosion, loose and deteriorated sealant, and defective repair.

The penetration (round) in roof areas A and B showed similar defects as those found in the base flashing. This component, which allows for the passage of items through the roof without compromising its water resistance, was also found to have alligatoring, rust, and vegetation presence in Area A, while Area B presented issues such as general corrosion, loose and deteriorated sealant.

The overall condition of the roof in Area A was also found to be poor with similar defects to the aforementioned components. The roof, as the main protective barrier of the building, plays a crucial role in maintaining the internal environment and its compromised condition poses a significant concern.

The conduit, equipment cover, and fascia in Area A exhibited similar problems, compromising their functions for protecting roof penetrations and enhancing the aesthetic appeal of the roof line, respectively. The gutter (external) in roof areas A, B, and C, which is crucial for directing water away from the building, was also found to have several defects.

In roof areas B and C, the coping, which caps the wall and prevents water infiltration, showed general corrosion, loose and deteriorated sealant, and defective repair. The membrane in Area B, vital for ensuring the roof's water resistance, was found to have similar defects.

Furthermore, the rise wall in roof area C showed defects such as debris, deteriorated sealant, and defective repair. This part of the roof prevents water from penetrating the building and its defects could lead to serious damage. Similar defects were found in the penetration (square) and wood blocking in roof area C, which respectively allow for the passage of items through the roof and provide support for the roofing system.

In summary, the condition of the roof at Fire Station #9 is varied across different areas and components. The noted defects, particularly the leaks, pose serious concerns and require immediate attention to prevent further damage and ensure the longevity of the roofing system.

CHATGPT 4.0

While we provided condition assessment ratings for each roof area, we did not expect expanded language that was accurate to how roofs are prioritized for replacement vs. maintenance

Given the poor condition rating and the type of roof (built up), it may be beneficial to consider a comprehensive roof replacement. This could prevent further damage, improve energy efficiency, and extend the roof's service life.

However, if the budget or circumstances do not allow for a full replacement, a thorough repair and maintenance plan should be implemented, taking into account the defects identified in this report.

INTERIOR

Raymond Engineering has conducted an interior leak inspection at Fleet in several buildings. During the inspection, the team closely analyzed and examined the interior of the buildings to identify any possible leaks or water damage. Unfortunately, they discovered that in Fleet 1, there were multiple leaks present. To ensure the safety and well-being of the occupants of the building, immediate action was taken to repair and address the issue. Raymond Engineering took the necessary steps to ensure that all the leaks were fixed and the building was safe for occupation. The team at Raymond Engineering is committed to providing high-quality services to prevent and solve any issues related to water damage and leaks.

There were several leaks found during the inspection. One of the leaks was found at the flue stack.

The existing roof leaks have been assessed and rated as minimally severe. This means that although there are some leaks present, they are not causing significant damage or posing any immediate risk to the structural integrity of the building. However, it is still important to address these leaks as they can lead to mold growth, decreased energy efficiency, and potential damage to the interior of the building over time. It is recommended to take proactive measures to fix the leaks and prevent any potential escalation of severity in the future.

- The loose flashing membrane, which is rated somewhat-severe, should be repaired immediately to prevent further damage. To fix the problem, first remove any loose materials and debris from the surface of the membrane. Clean the area thoroughly, and then apply a durable, waterproof sealant or flashing tape to the affected area, ensuring that it is fully adhered and sealed. For larger or more complex issues with the flashing membrane, it may be best to contact a professional for assistance.

- To fix failed sealant on the equipment cover, the recommendation is to remove the old sealant and clean the surface thoroughly. Then, apply new sealant according to the manufacturer's instructions and ensure a proper seal. Regular maintenance and inspection can prevent future occurrences of this defect.

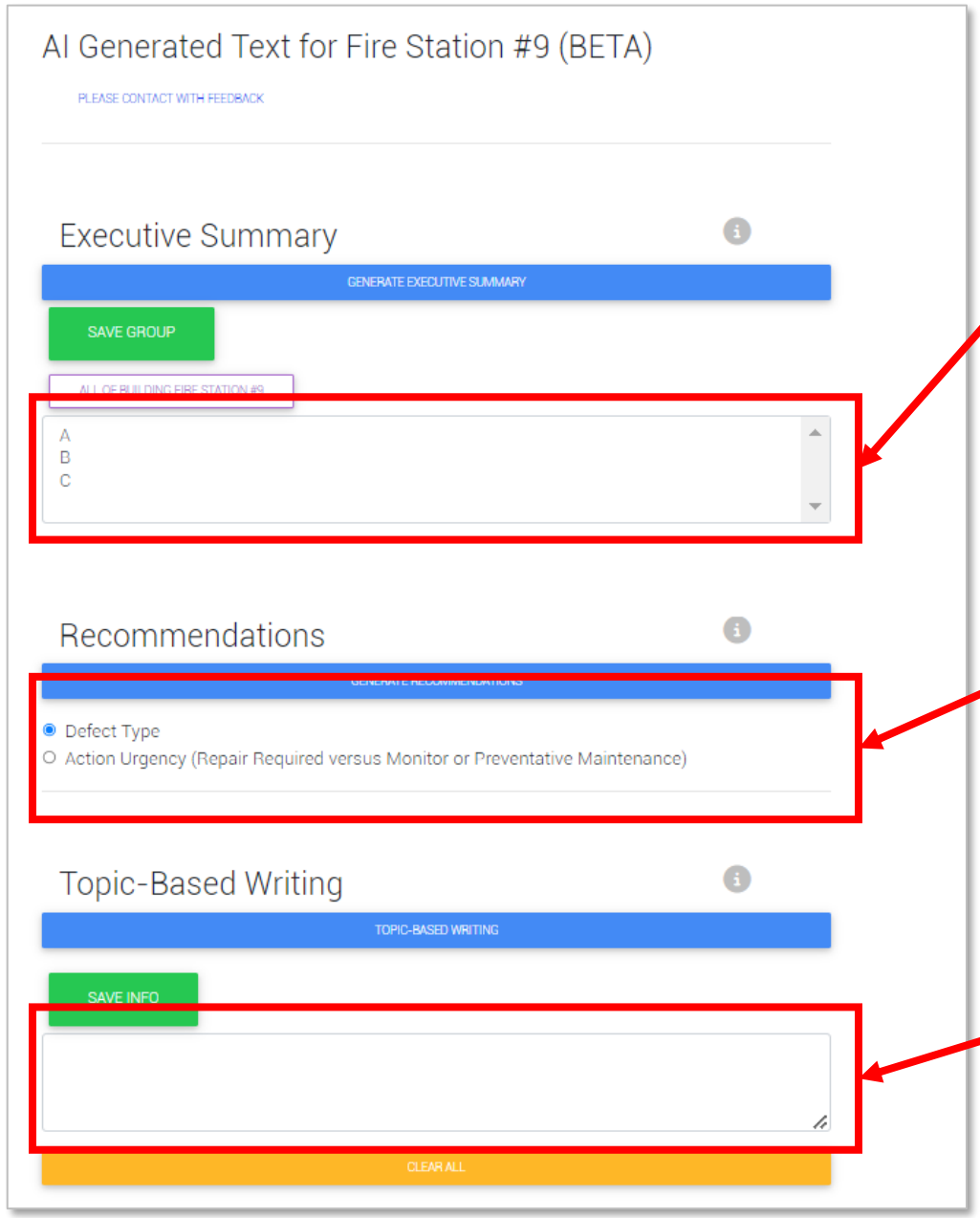
- For the minimally severe rust defect on the equipment cover, it is recommended to follow the manufacturer's guidelines and apply a protective coating and/or paint to the exposed surface. This will address general corrosion issues and prevent the defect from worsening over time.

- In order to address the severe defect of a pipe that is not properly sealed, it is recommended that the transition be properly terminated and any necessary sealant repairs be made. This will ensure that the pipe is functioning properly and prevent any further damage or safety concerns.

Compare & Contrast
ChatGPT vs. Inspector

ChatGPT	Inspector
The Base Flashing also displayed alligatoring and the presence of holes, some of this alligatoring is more severe. We recommend a comprehensive repair or replacement of the affected flashing to prevent water intrusion.	*Significant instances of "alligatoring" and bridging in the base flashing was observed. Base Flashing should be re-covered according to design specifications within the next 3-5 years.*
The Equipment Cover was found to be unsecured, which is a significant concern. We strongly recommend immediate action to secure any loose equipment covers, as they can cause extensive damage to the roof and building if they become airborne during high winds.	*Correct attach and secure all mechanical unit doors and covers to ensure the penetration remains watertight.*
Lastly, the Gutter (External) had some debris. A simple cleaning should suffice to ensure proper water flow and prevent any overflow onto the building	*Trim existing trees adjacent to the roof so as to prevent excess debris from collecting on the roof.*

User Interface
Design Use Cases



Ability to generate custom Executive Summaries

The User can simply generate a singe write-up

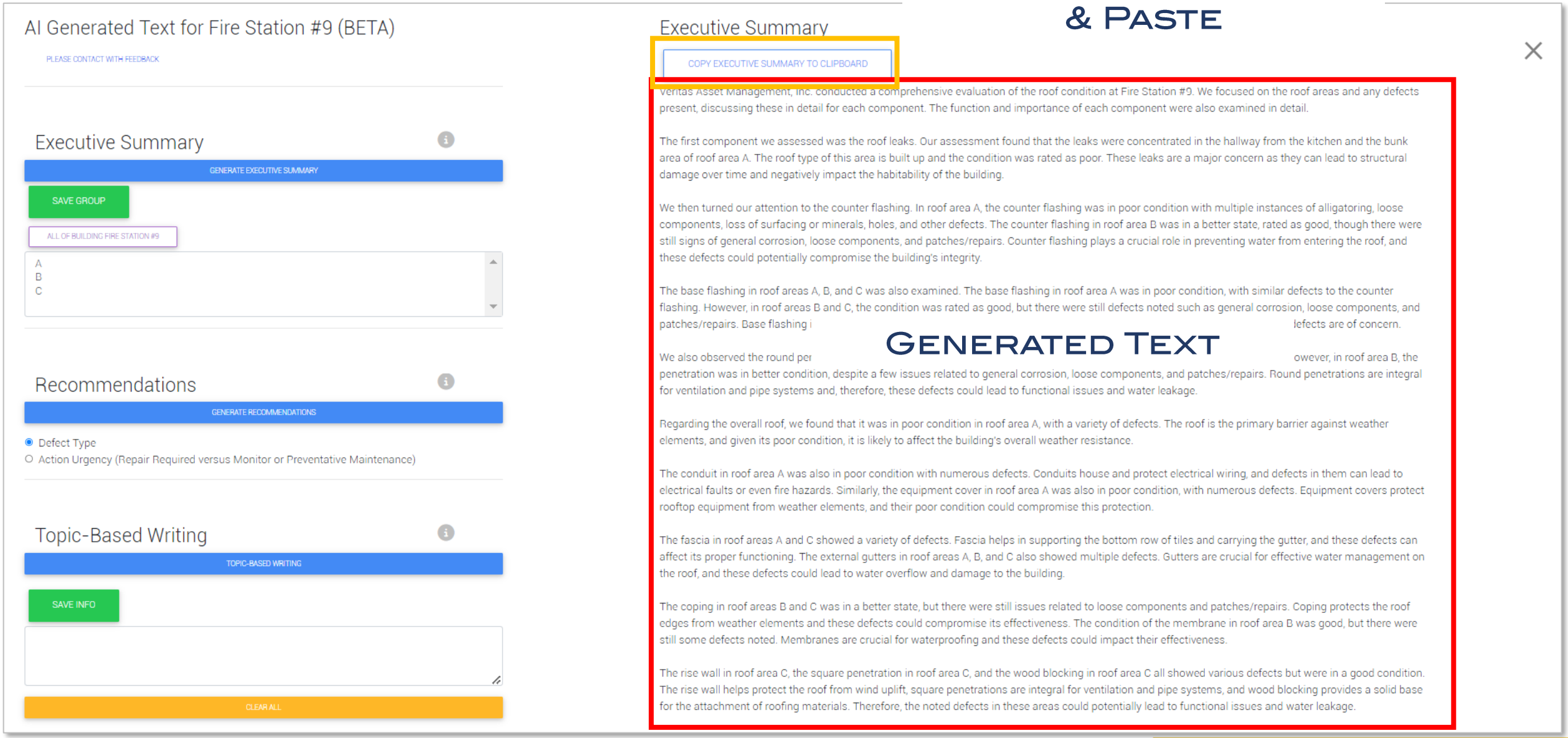
The User can choose to group specific areas together that are known to have similarity

The User can choose to generate Recommendations by either the Defect Type or the Defect Action Urgency

Defect Type still consolidates write-ups, while Action Urgency is based on when defects have been marked as higher severity or for repair

The User can ask ChatGPT to write on a specific topic that is need as part of the final report write-up

User Directed Copy & Paste



Generated Text

REPAIRING HOLES IN BASE FLASHING

Introduction:

Base flashing is a waterproofing measure often used in construction to prevent water from infiltrating various parts of a building, such as the roof or walls. Over time, due to weather conditions or other environmental factors, the base flashing may develop holes or cracks, compromising its functionality. This report explores the step-by-step process of repairing holes in base flashing.

Procedure:

I. Assess the Damage:

The first step in repairing holes in base flashing is to assess the extent of the damage. It is important to understand the size and location of the holes to plan the repair process effectively.

II. Gather Necessary Tools and Materials:

To effectively repair holes in base flashing, you will need the following tools and materials:

1. Brush or broom for cleaning the area
2. Patching compound or roofing cement
3. Metal flashing strip (if required)
4. Utility knife
5. Caulking gun
6. Gloves and safety glasses for protection

III. Clean the Area:

Before starting on the repair, clean the damaged area thoroughly. Use a brush or broom to remove any loose debris or dirt. Any residual dirt may prevent the patching compound from adhering properly.

IV. Apply the Patching Compound:

If the hole is small, a patching compound or roofing cement can be used. Using a utility knife or a similar tool, apply the patching compound over the hole. Make sure to spread it evenly, covering the hole and the surrounding area completely.

V. Apply the Flashing Strip:

For larger holes, a new strip of flashing may be necessary. Cut a piece of flashing that is larger than the hole. Apply a generous amount of roofing cement on the underside of the new flashing strip and press firmly over the hole. Make sure the edges are well sealed with the cement.

VI. Apply a Final Layer of Patching Compound:

Once the flashing strip is in place, apply another layer of patching compound over it. This ensures a waterproof seal and helps to blend the repair with the rest of the flashing.

VII. Let it Cure:

Allow the patching compound or cement to cure as per the manufacturer's instructions. This could take anywhere from a few hours to a few days, depending on the product used.

TESTING

1. Our initial testing demonstrated that we could, at minimum, automatically generate a similar output to our stock language.
2. Evaluation of ChatGPT 3.5 vs. 4.0 was key to us choosing how we would implement an AI solution.
3. Length of text generation is a key "toggle" that needs to still be more fully evaluated long-term.
4. ChatGPT can be "grandiose" in its writing.

Implementation

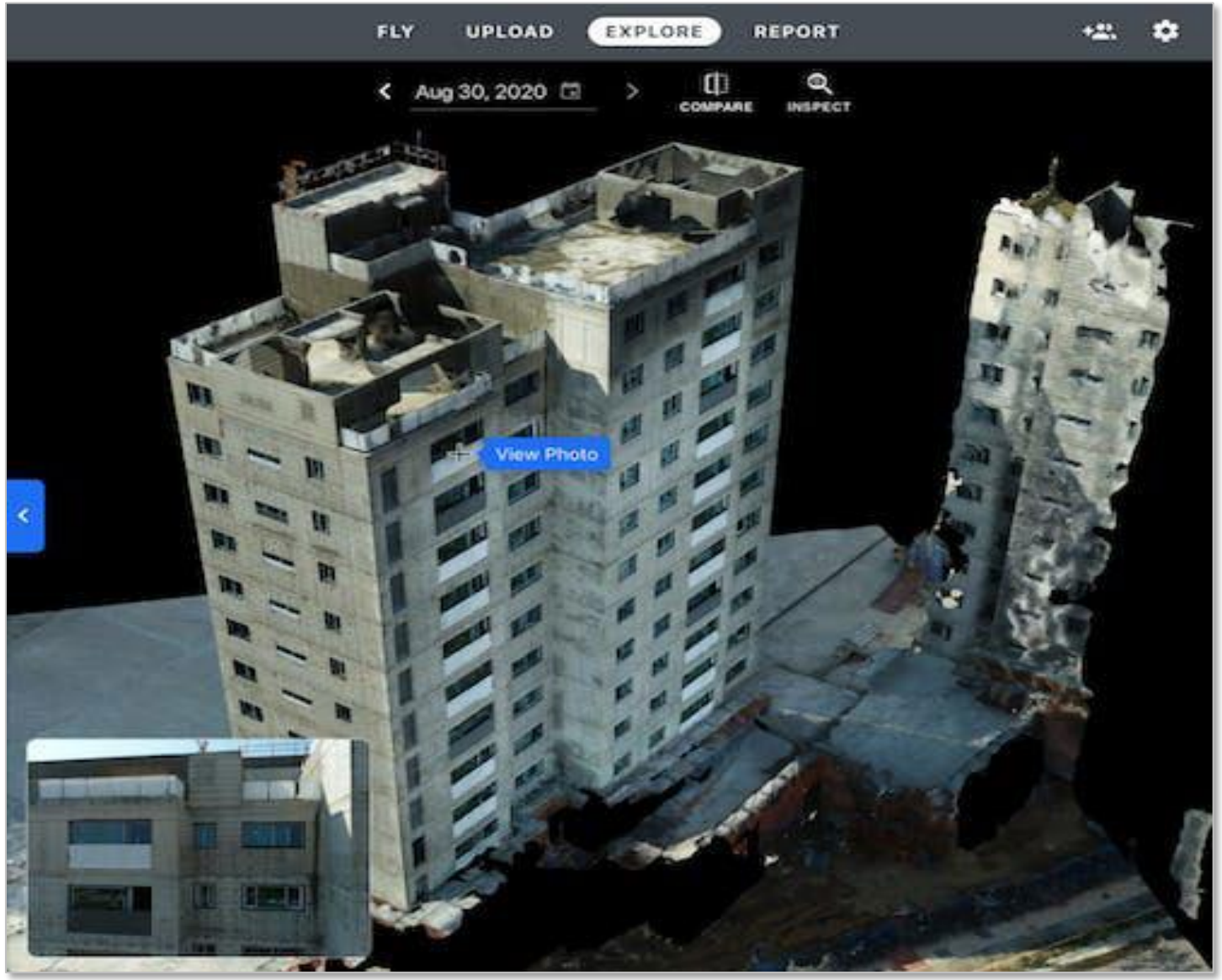
1. A paid account gives early access to the latest version(s) of ChatGPT.
2. A user cannot simply go through the generic text prompt to generate a condition assessment report.
3. Passing historical writing examples makes the output more realistic.
4. Focusing on specific use cases is key for user adoption.
5. Implementing while giving the user the option to use ChatGPT has been beneficial.
6. We are not providing client-specifics (customer names, addresses, etc.) to ChatGPT.

RULES OF USE

1. This is a **chaperoned** algorithm.
2. ChatGPT does **not** replace the user in the process.
3. All writing, conclusions, and recommendations must be fact checked (by the inspector) during quality review.
4. Senior Reviewers are more critical for both training inspectors and setting expectations.

2024

Three-Dimensional Rendering
Building Facades



Multi-Story Façade Inspections

New software does allow for the same three-dimensional rendering of the full building structure, similar to how roofing and walls rendering works (previously discussed).

A key consideration is that this type of image processing is usually offered as an added feature by these software platforms.

Can enable better tracking of defects and issues found during the inspection.

Three-Dimensional Platforms
Options for Mapping & Defects

Autonomous Mapping

- Drone Manufacturer
- Especially popular for original drone models focused on recreational applications and user tracking (e.g., following the user while running, skiing, climbing, etc.)
- More recently focused on autonomous flight operations with applications for automated mapping 3D spaces

AI + Image Processing

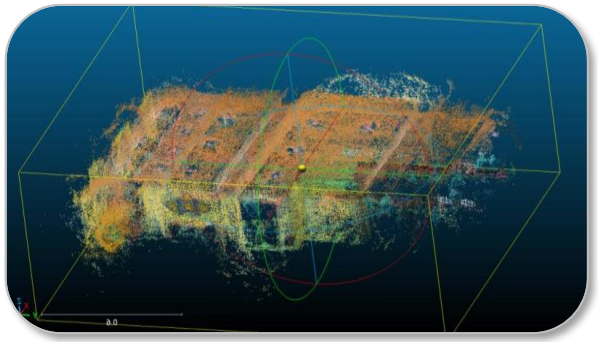
- Software-as-a-Service (SaaS) company that can process drone imagery to identify façade defects automatically.
- Leverages a trained image recognition model for identifying defects
- Currently building for scale in the cloud
- Pricing is based on cost per square meters and provides subscription asset management
- In-house engineering team provides quality assurance

AI + Image Processing

- Software-as-a-Service (SaaS) company that can process drone imagery to identify façade defects automatically.
- Leverages a trained image recognition model for identifying defects
- Spin-out startup from Thornton Thomasetti
- Pricing is based on cost per square meters
- In-house engineering team provides quality assurance

Integration w/Construction
"Cross Pollunation" of Technology

Constructn



Drone & LIDAR Based Mapping of Construction Sites

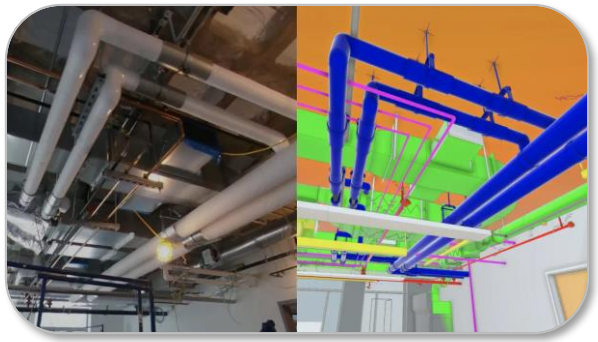
ConstructN is an automated construction monitoring solution that enables asset owners, contractors, and project managers to have complete, accurate, measurable, and accessible insights into the construction site. ConstructN consumes data from multiple sources such as drones, 360 cameras, Laser scanners, and LiDAR to capture progress.

structionsite

Rapid cataloging of progress by date & location

StructionSite is a platform that helps construction professionals document and track jobsite progress, with photos organized by date and floor plan. It allows users to capture photos, videos, and 360-degree documentation of their jobsites. StructionSite's AI-powered algorithms place 360-degree videos on the project drawing.

OPENSPACE



AI Processing for Site to BIM Matching

OpenSpace provides AI-powered analytics and reality capture tools for builders. OpenSpace's features include: 360° photo documentation, site capture, and analytics. Use AI-powered analytics to help with progress, work-in-place verification, coordination, and risk reduction.

In the near-term (i.e., next 3-5 years), we're likely to see more AI integrations into how the consultant uses the existing platforms, which should drive better efficiency, quality, and standardization

Analysis of Defect Conditions

With more data comes greater potential to build AI image processing that recognizes the building system and defect in real-time, in the field.

Platforms, such as TensorFlow, will be used to move this custom AI model development.

Improved Platform User Interfaces

Existing platforms tend to be very menu-driven, thus requiring the user to be heavily trained or experienced in using the system for a FCA.

Moving forward, the same AI image processing could be used to dramatically reduce data input times by the user.

Questions & Follow-Up

Please Feel Free to Contact Us

This concludes The American Institute of Architects Continuing Education Systems Course

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