SOOT PROOF

Fire investigation technology

DBI
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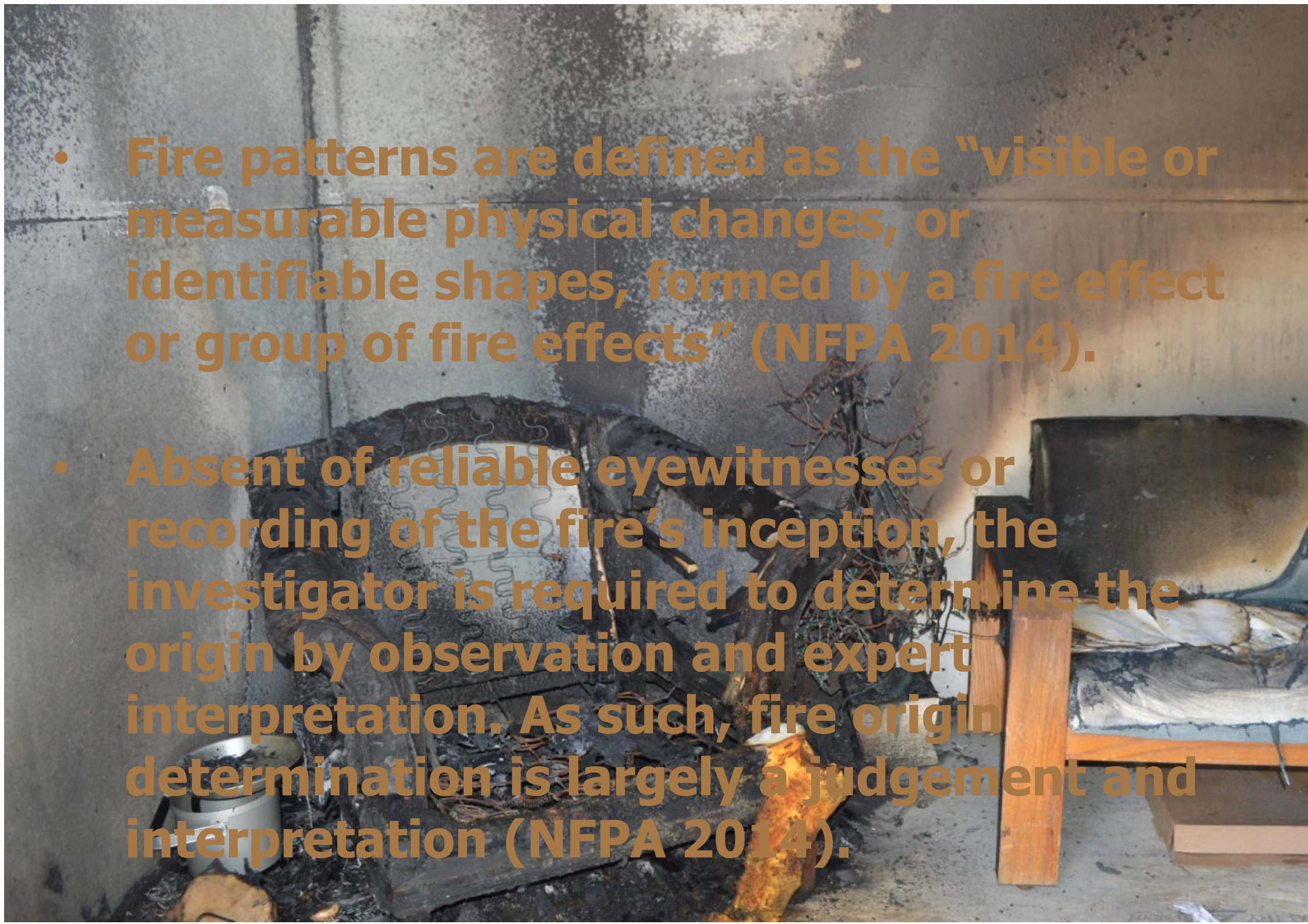
- **The scene investigator's most important hypothesis is the correct identification of the origin of the fire (NFPA 2014).**

- **Since the beginning of organized fire investigation in the late 1940's, fire investigators have relied on fire patterns as their basis for determining the fire origin (Rethoret 1945).**



- Fire patterns are defined as the "visible or measurable physical changes, or identifiable shapes, formed by a fire effect or group of fire effects" (NFPA 2014).

- Absent of reliable eyewitnesses or recording of the fire's inception, the investigator is required to determine the origin by observation and expert interpretation. As such, fire origin determination is largely a judgement and interpretation (NFPA 2014).

BACKGROUND SUMMARY

- Determining fire origin is important.
- Interpretation of patterns is largely dependent on the individual investigator's knowledge, experience, education, training and skill.
- Much of this interpretation is implicit.
- Potentially subject to investigator bias.
- Implicit knowledge can be hard to communicate to others (especially the non-fire investigator).

MOTIVATION STATEMENT

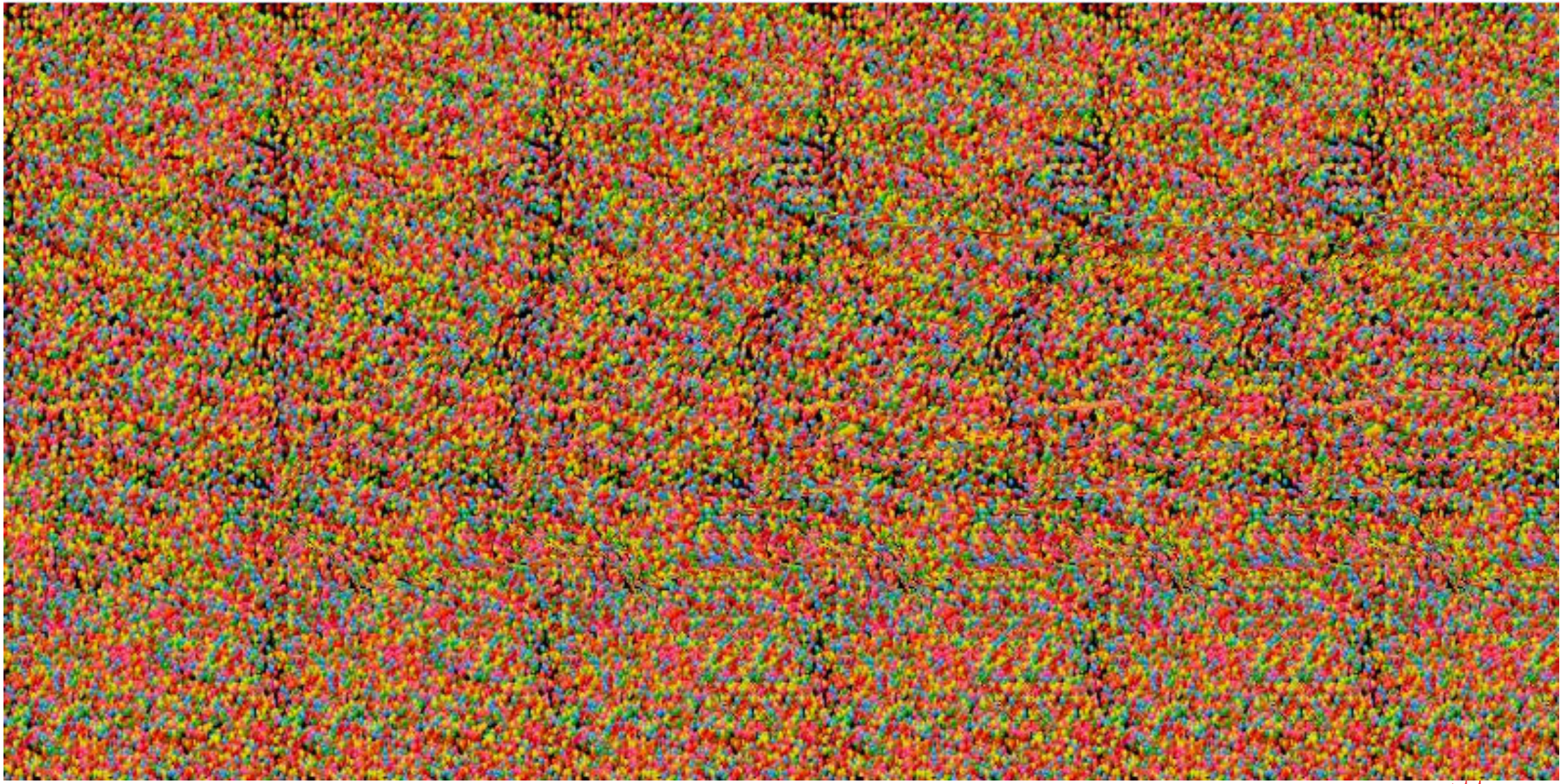
- There is a need for the introduction of less 'human-experience' based, more technologically reliant systems within the area of fire investigation.
- This is a must if we are to move away from the current system to a more quantitative, less user reliant/bias approach to fire investigation.

- How can opinion/implicit knowledge be better documented?

New concept:

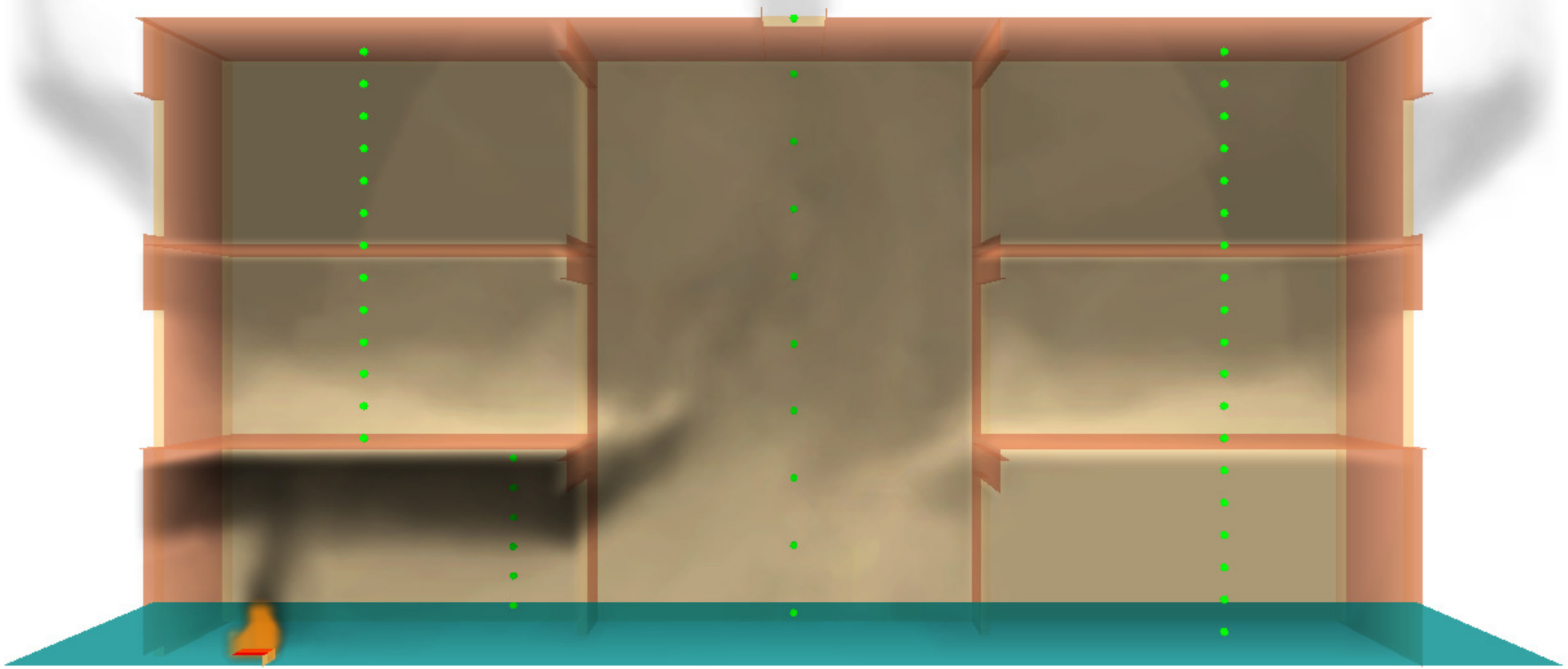
SOOT PROOF

INTRODUCTION



HOW TO TEACH A COMPUTER?

SOOT DEPOSITION ANALYSIS

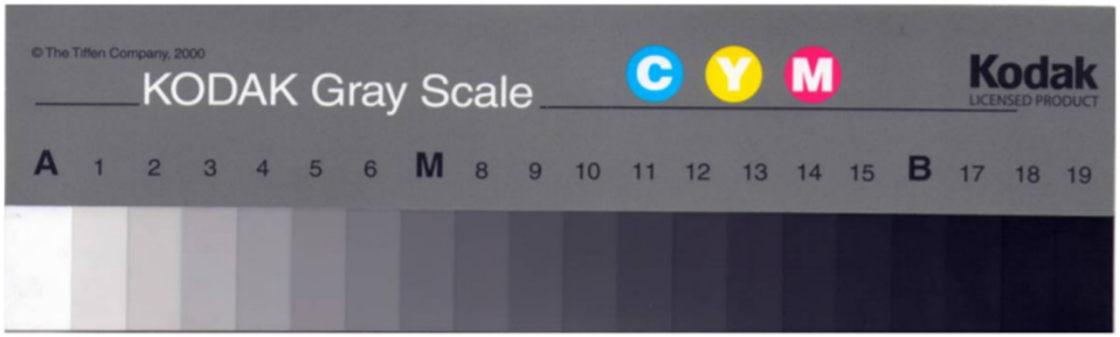


>571 (kW/m3)

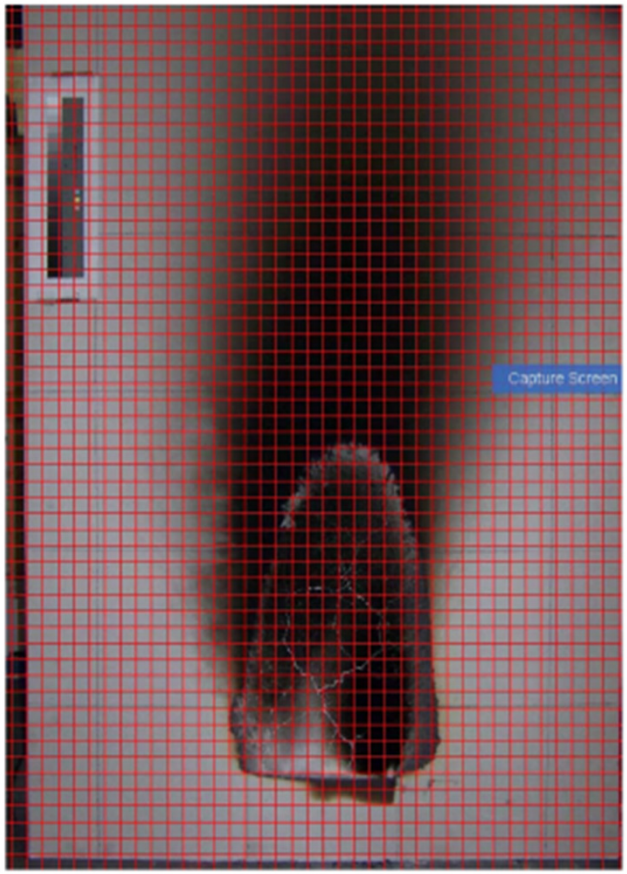
Frame: 1000
Time: 600.0

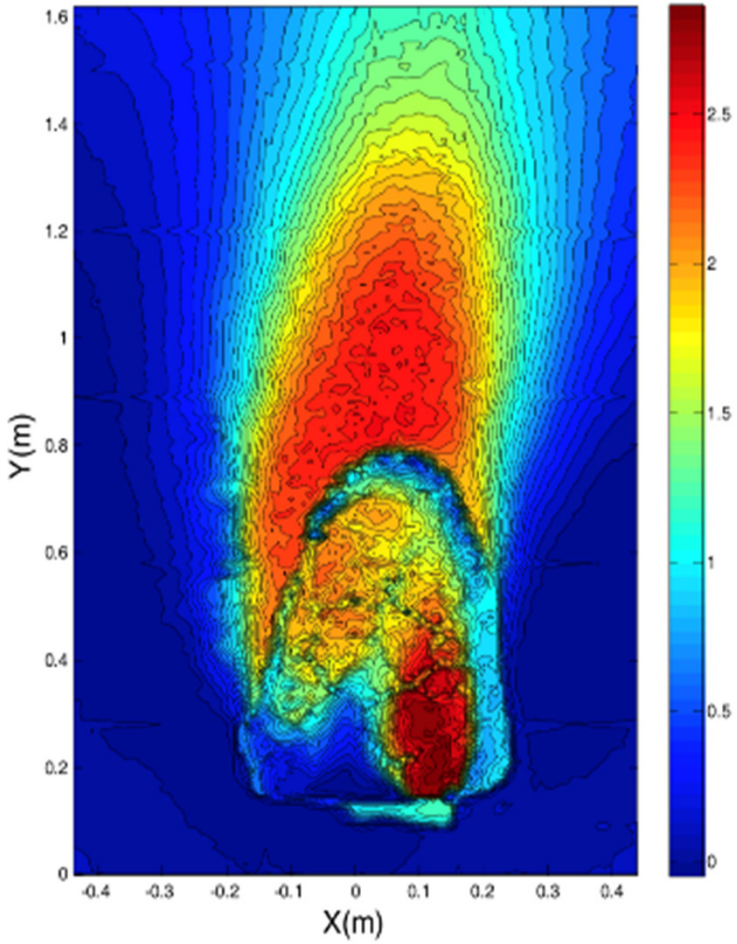
SOOT DEPOSITION + IMAGE ANALYSIS

- Computer vision deals with how computers can be made to gain high-level understanding from digital images or videos.
- Automate tasks that the human visual system can do.
- High res images + Computer can pull subtle details from a scene that the human eyes cannot.
- Previous research into soot deposition (Riahi 2012 + others) has shown that thickness of the soot layer on an object is correlated with the "blackness" of the object.



PREVIEW

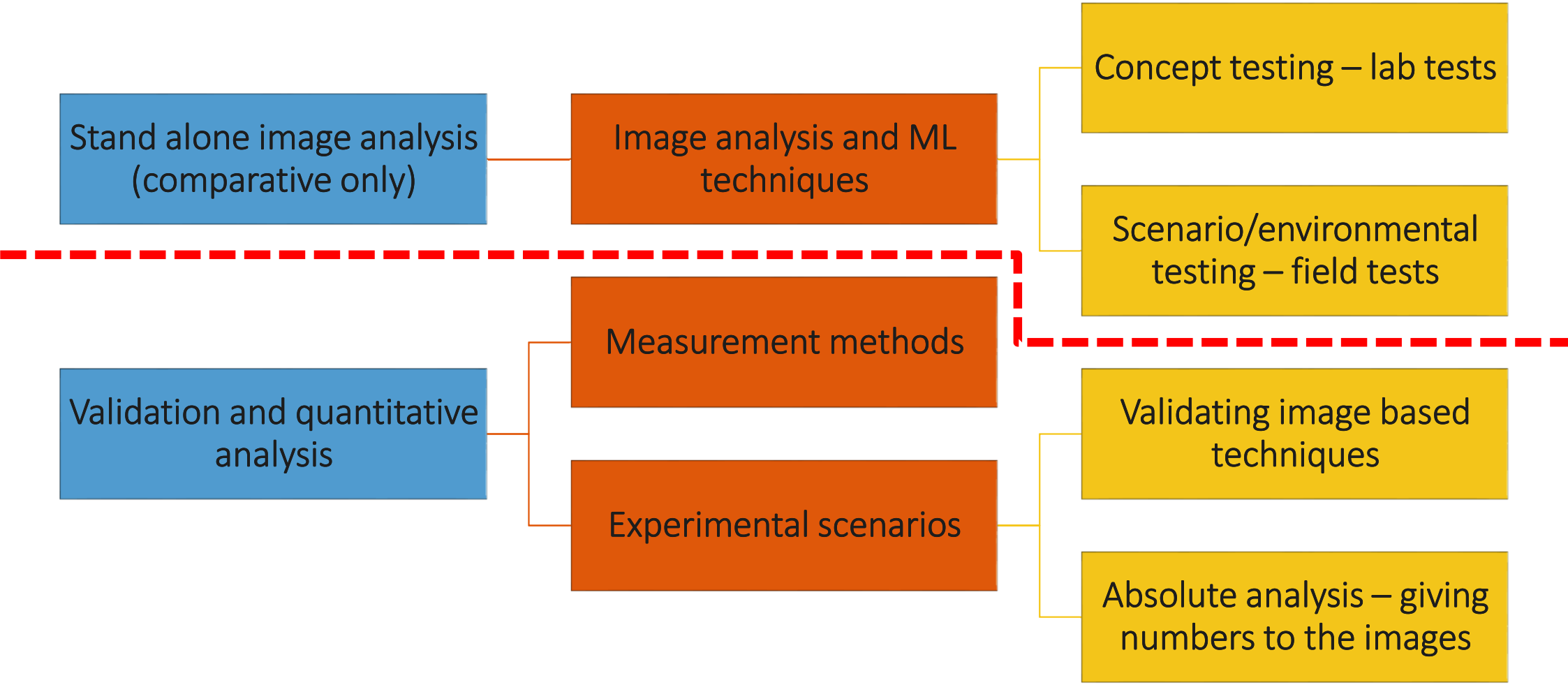

Capture Screen


Y(m)
X(m)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
2.5
2
1.5
1
0.5
0

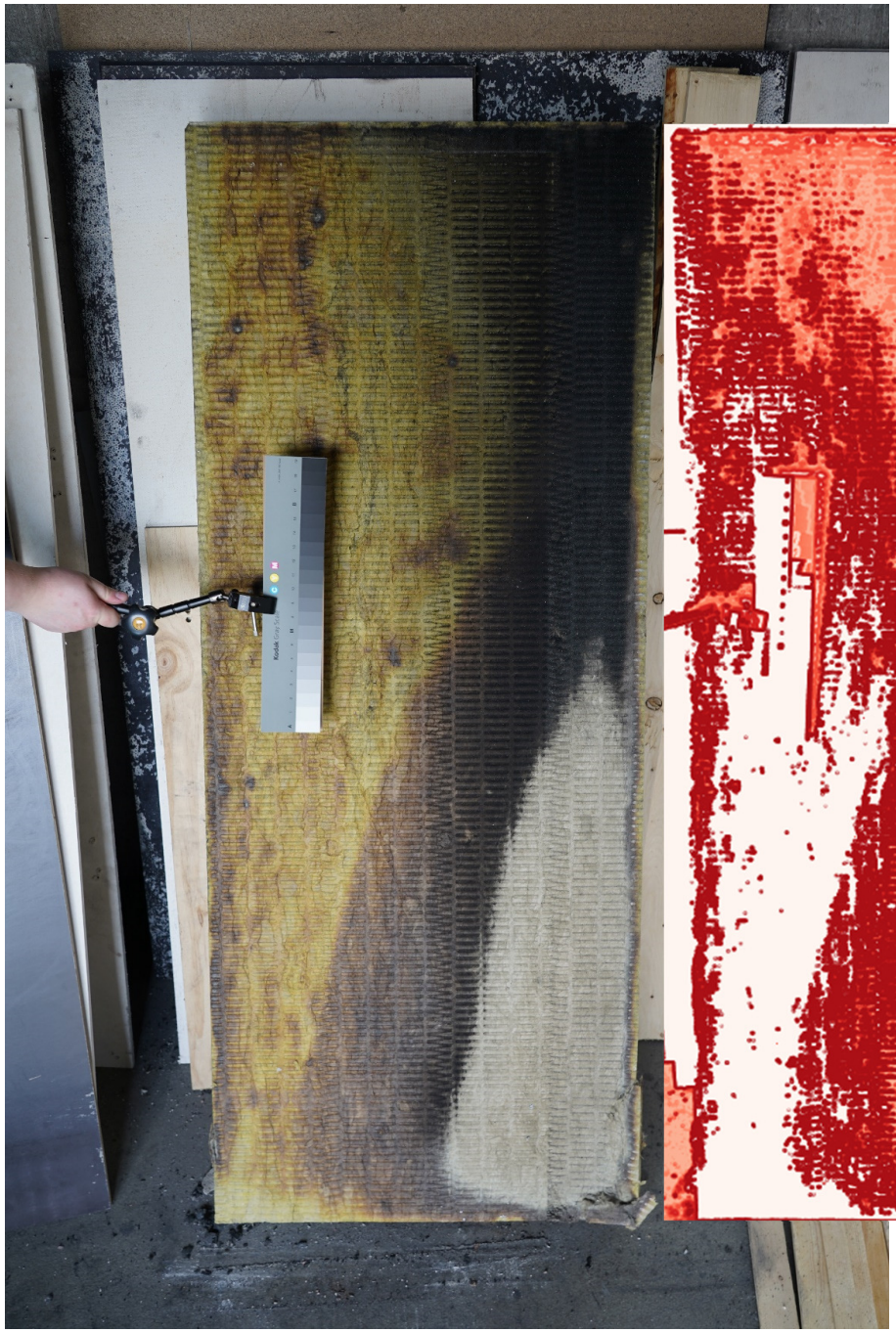
Progress..

THE PROJECT SO FAR

PHASE 1


Stand alone image analysis (comparative only)
Image analysis and ML techniques
Concept testing – lab tests
Scenario/environmental testing – field tests
Validation and quantitative analysis
Measurement methods
Experimental scenarios
Validating image based techniques
Absolute analysis – giving numbers to the images

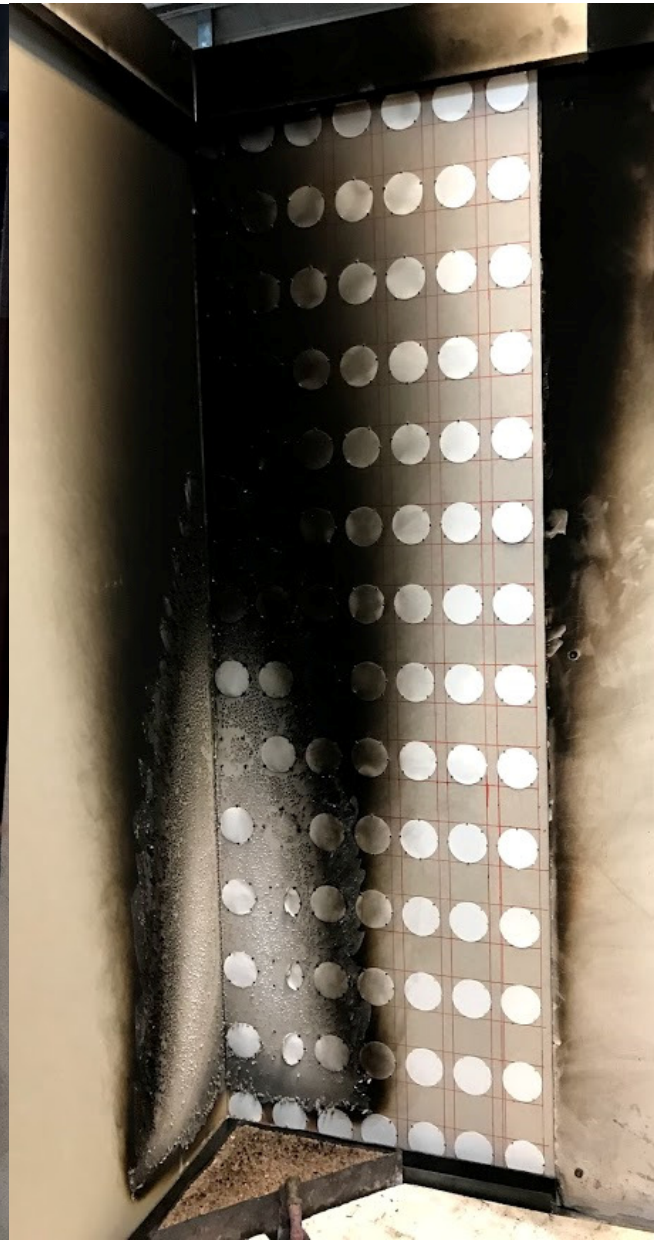
PHASE 1.1 – LAB TESTS



PHASE 1.1 – FIELD TESTS

- In progress…
  - Image tracking – automated calibration strip finding.

PHASE 1.2 – VALIDATION TESTS

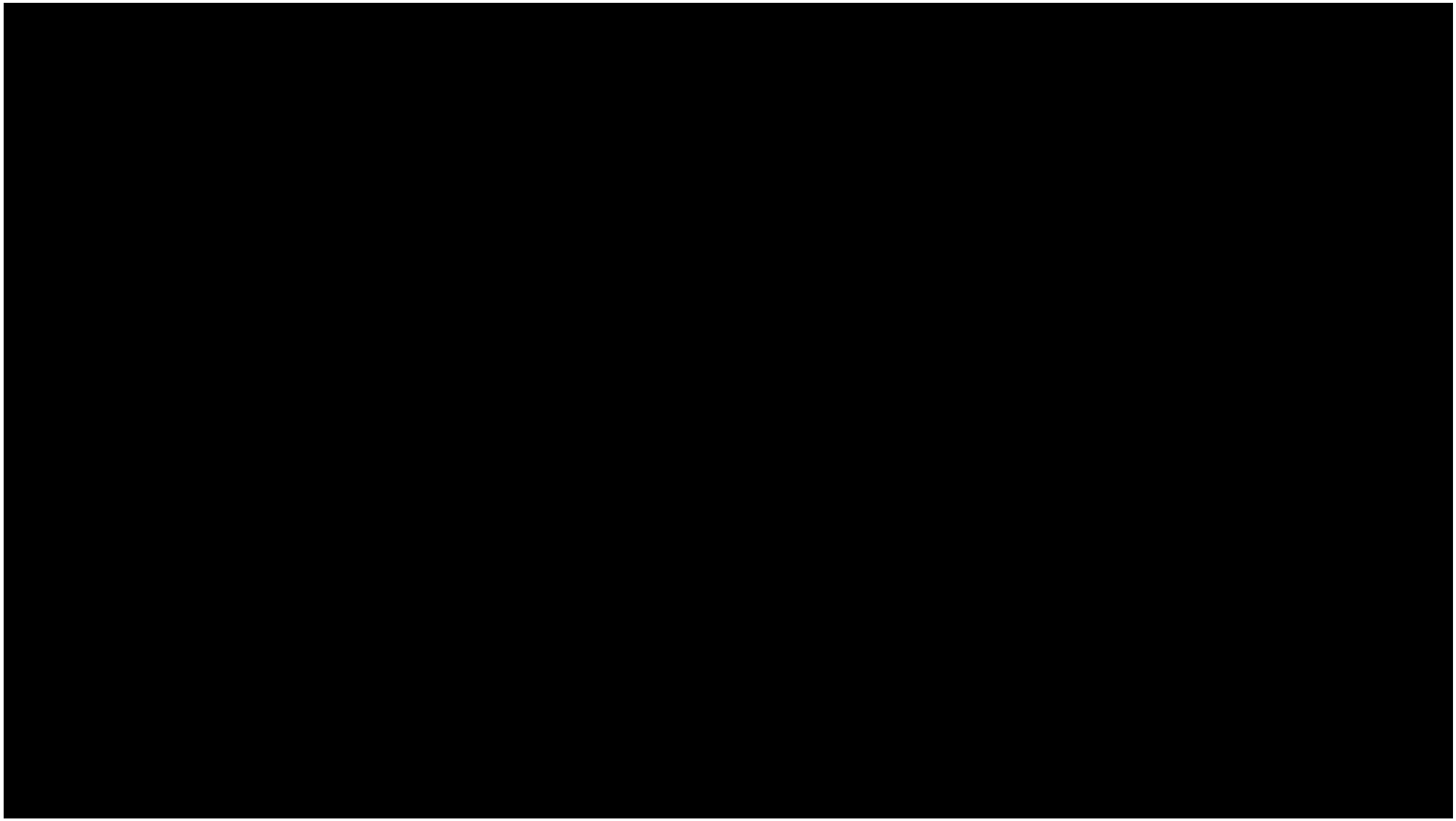


SUMMARY

What can this tool provide?

- Quantitative/unbiased results.
- Method to better document/support an investigators conclusions.
- New investigation tool?
  - Potential to find new things out.
  - Research tool, to help answer more fundamental questions like:
    - How when burn off happens
    - Material and fuel influences etc..
- Used in conjunction with simulation techniques to investigate probable scenarios.

SIMULATION EXAMPLE



SIMULATION EXAMPLE