

Advancement of SHM systems

Practical considerations for long term
monitoring systems
Research to reality

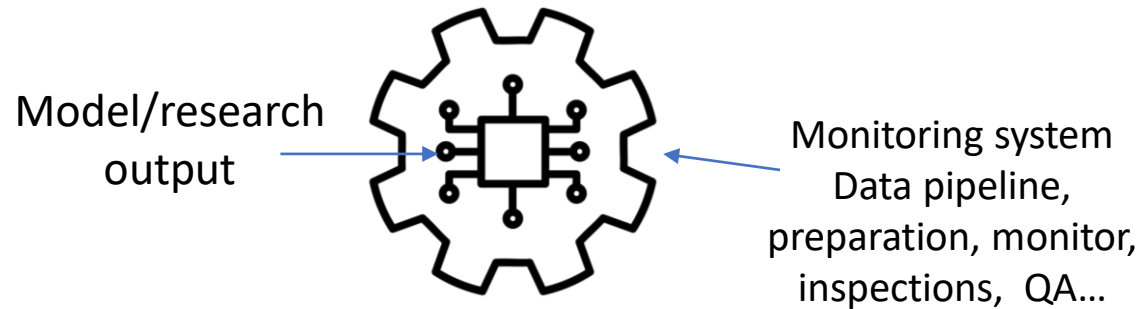
14th ANSHM Workshop

EngAnalysis

Henry Griscti



Introduction



- Motivation for this topic
 - Share lessons learnt and provide considerations for: implementing long-term measurement systems, writing SOW
- Contents:
 - Objectives and actions
 - System/experiment design
 - System build – hardware and software, infrastructure requirements
 - Reporting – communication of results
 - Operations and maintenance
 - Conclusion

Research & Development

Long term tests, Monitoring system development

Monitoring system operations & maintenance

New and novel ideas

Development

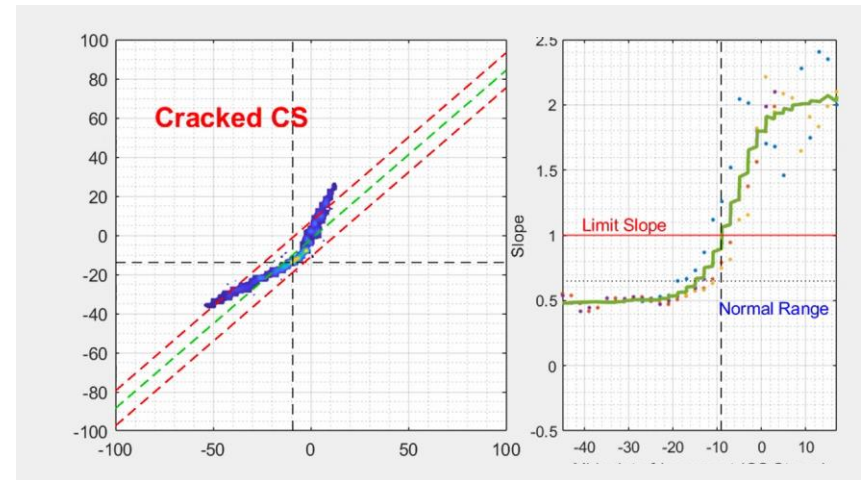
Manual inputs / supervised

Less supervision required, but it still makes some questionable decisions

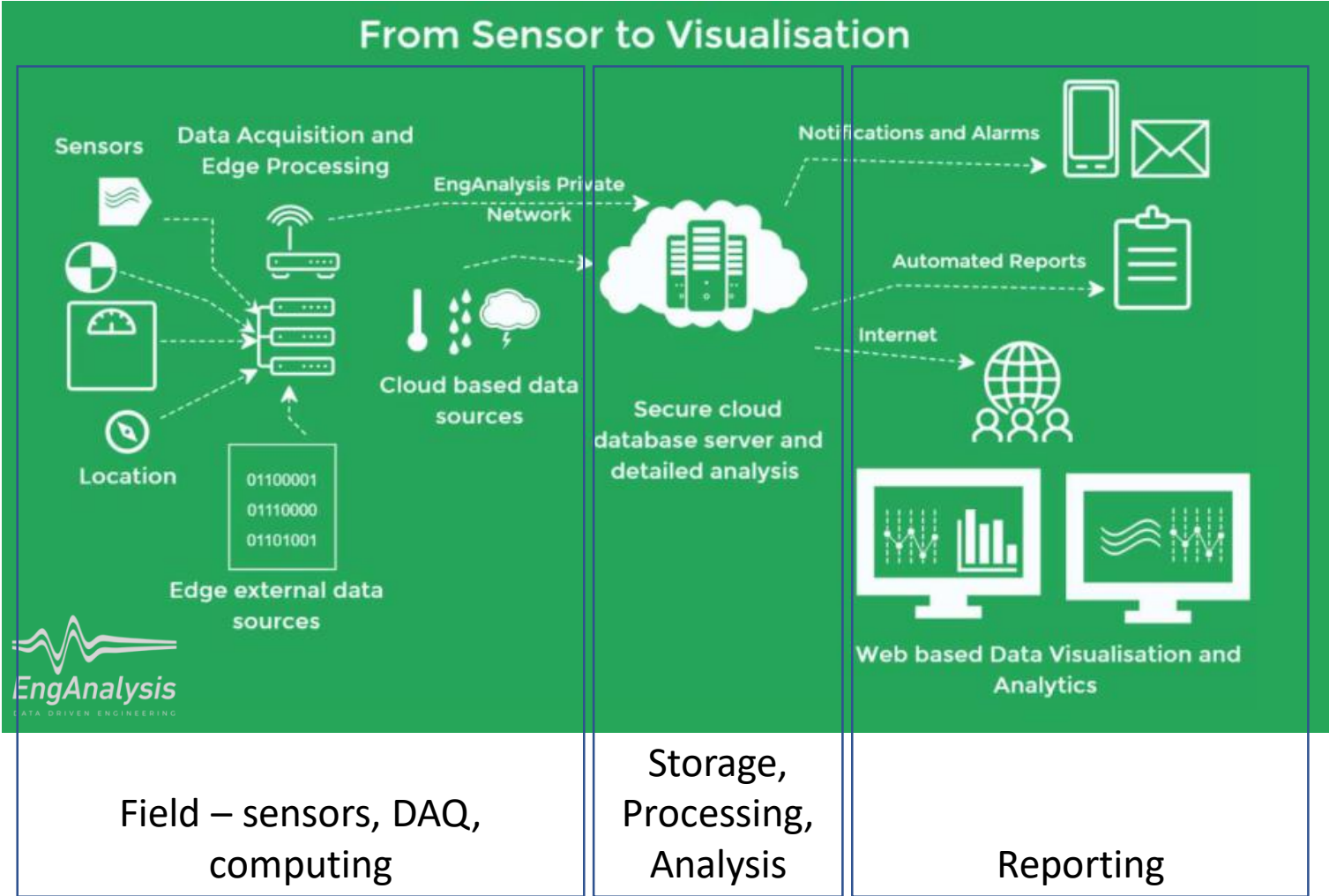
Unsupervised, independent, still good to check in on occasionally

Objectives and Actions

- What is the problem being addressed?
 - Design of experiment to focus on the problem
- Is SHM required?
 - Is more data required to make informed decisions?
- Approach:
 - Short term data acquisition and analysis
 - Long term monitoring
- Actions:
 - When a problem is found, then what?
 - Action plan
 - Inspections, manual review of data, stop work



System Design - Components



System Design – On Site

Strain gauges

- Resistance based foil
- Resistance based transducer
- Vibrating wire
- FBG optical
- Distributed optical
- Weld on / glue
- Etc.

• Sensors

- Type (durability, cost, measurement type, protection, wiring, fastening/adhesives, maturity, difficulty, frequency response)
- What is being measured? What are the limitations?
- How many?
- Redundancy, fault tolerance – if there are failures can the system still meet functional requirements
- Temperature (and environmental variables)

• DAQ & Computing Equipment Selection

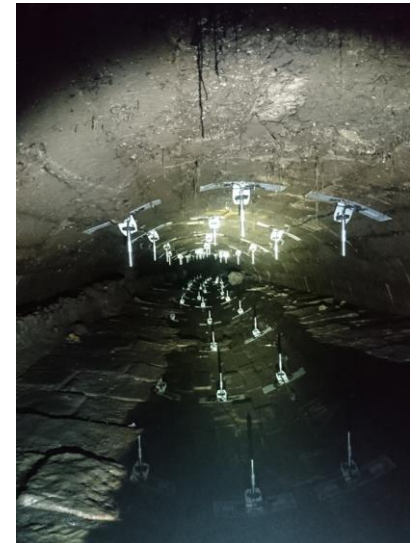
- Sensor type
- Suitable sample rates, filtering and processing capability
- Data transmission

• Alternative / External Data Sources

- Site operations or asset data
- Weather, other online accessible data

• Data Communications & Power

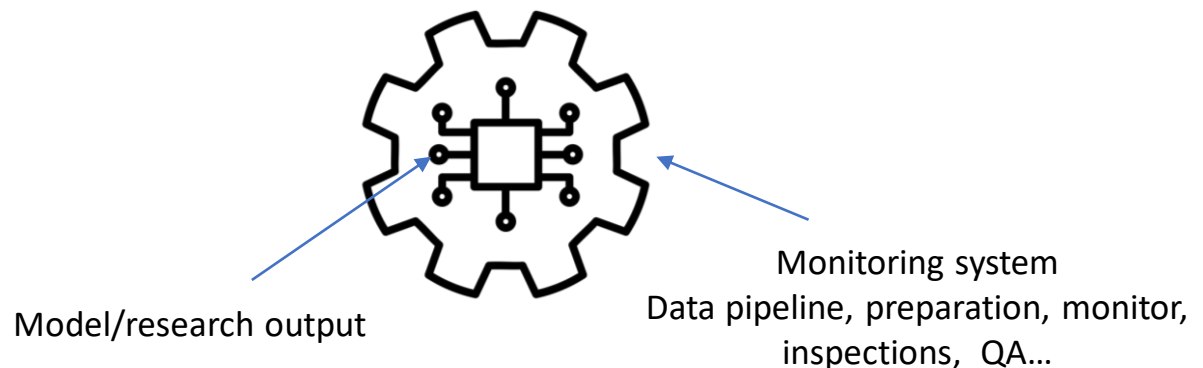
- Reliability and security
- How much to send?
 - Is all the data required?
 - Edge processing?
 - Local storage



Different sites/environments = different requirements

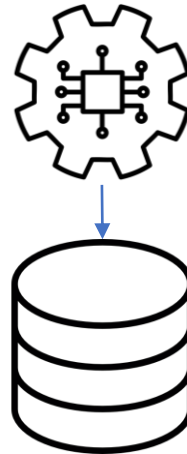
System Design – Storage and Analysis

- Preparation: Cleaning / pre-processing
 - Noise, erroneous data, environmental variables, power issues, damage
 - Planned space in the analysis/processing for filtering and cleaning
- Data storage – sensible database choice and structure (ease and speed of write/read to suit requirements)
- Mechanism for checking different stages of analysis and output of results
- Operate unsupervised



Reporting and Access to Data

- Different stakeholders, different requirements
 - Executive level, asset manager – often want the visualized results, green light, all ok
 - Analysts and Engineers – as above + often want the raw or processed data for their own analysis and reporting
 - You – inspection/checks, improvements



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curl -X GET -H "Content-Type: application/json" -d '{"name": "bridge", "type": "number", "typeInfo": {"value": "252"}, "nullable": true}' http://localhost:8080/api/v1/bridge/252
```

Raw or processed data, analysis outputs

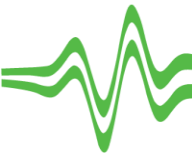


Custom analysis and visualizations, internal reporting

Operations and Maintenance

System deployed, commissioned and working

- Unexpected data
 - Interpret results, and explain why
 - QA – look back and be able to report that everything was checked and working
 - Ability to assess if it is real or a result from an erroneous data or unexpected input to the analysis
- Transparency - Ability to see final outputs, intermediate and raw data
- Improvement cycle
 - Fix problems, improve outputs
- Plan for growth
 - New requirements, changes



Conclusion

- Research vs implementation
- Objectives and Actions
- Robust design – sensors/DAQ, communication, analysis, reporting
- Storage, preprocessing/preparation
- Reporting – accessible data in multiple forms
- Operations and maintenance – ability to check, maintain, improve

- Questions?
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