Digital QA in Construction

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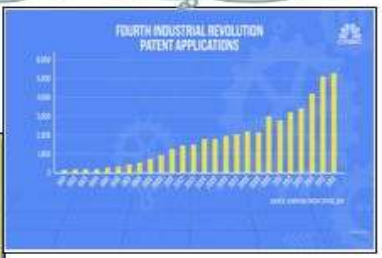
Agenda

- Industry Quality Issues & Risks
- MRPV QA Framework
- Application of Digital technology
- Conclusions

Evolution of Industrial Revolution (IR 4.0 - Klaus Schwab)

Quantum Computing · IoT · AI/AR/VR · 3DPrinting · Biotechnology · Robotics · Nanotechnology

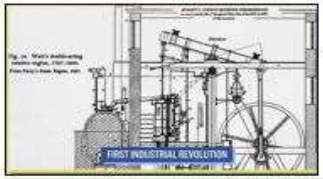


Semiconductor

CNBC https://youtu.be/v9rZOa3CUC8

Mass Production

Steam Engine



1st Industrial Revolution 1750 -1800	2nd Industrial Revolution 1800 - 1930	3rd Industrial Revolution 1960 - 1990	4th Industrial Revolution > 1990

- Inadequate Capacity & Capability
- Laggard in adopting digital technology
- Poor uptake of Innovation
- Paper based Construction & Quality records
- Poor understanding of Quality Management principles
- Quality is a secondary priority.

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Key Quality Industry Issues

- Lack of Quality Leadership
- Poor quality culture
- QC/QA practices that are not keeping pace with the construction works and technology
- Inadequate constructability reviews
- Constructability issues
- Inadequate data analytics - “Data Rich Analysis Poor”

Opportunities for Improvement

MRPV QA Framework

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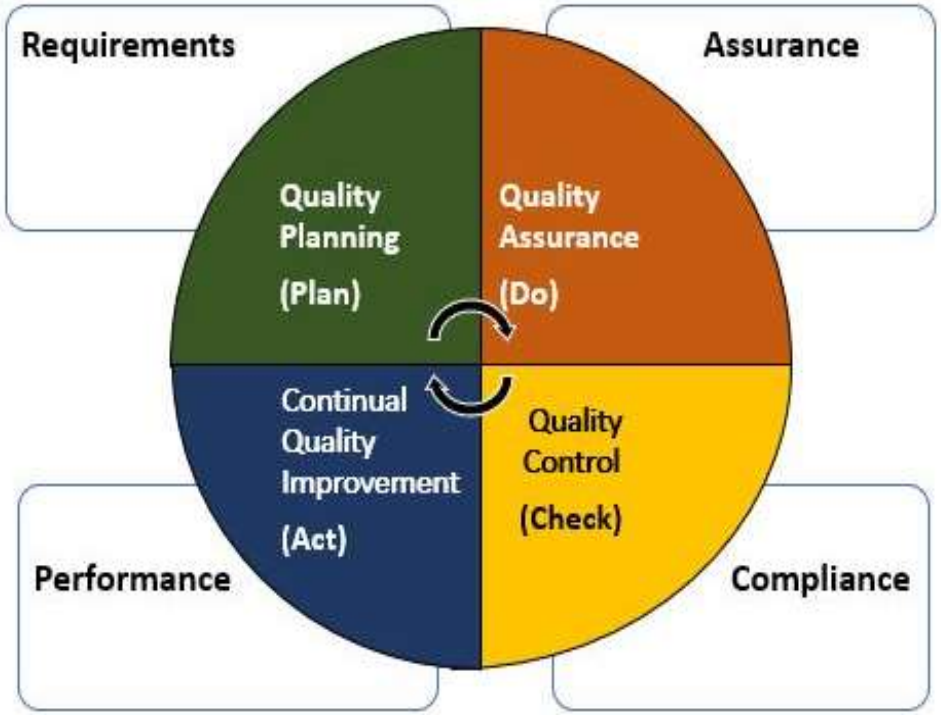
MAJOR ROAD PROJECTS VICTORIA

MRPV QA Framework



Active Client Model - *Contractor's Success is our Success*

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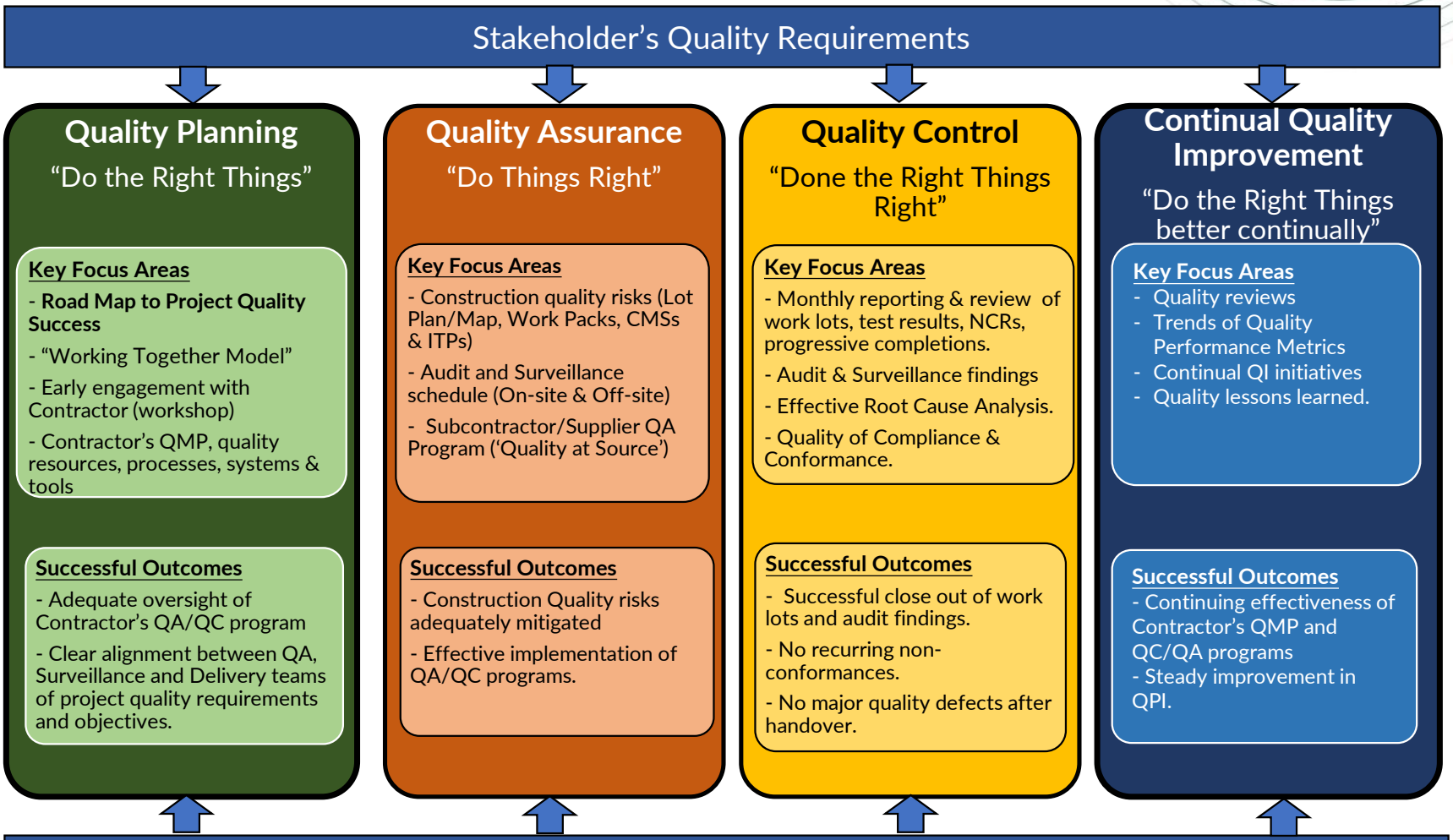
MRPV QA Framework



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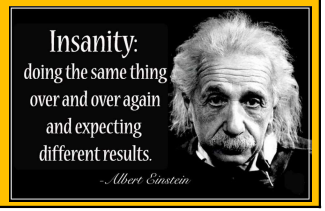
Compliance Assessment Performance Evaluation (CAPE Grid™)

Performance	Compliance: Poor	Compliance: Good
Good	"Quality by Chance"	"Quality by Leadership"
Poor	"Quality by Hope"	"Quality by Faith"



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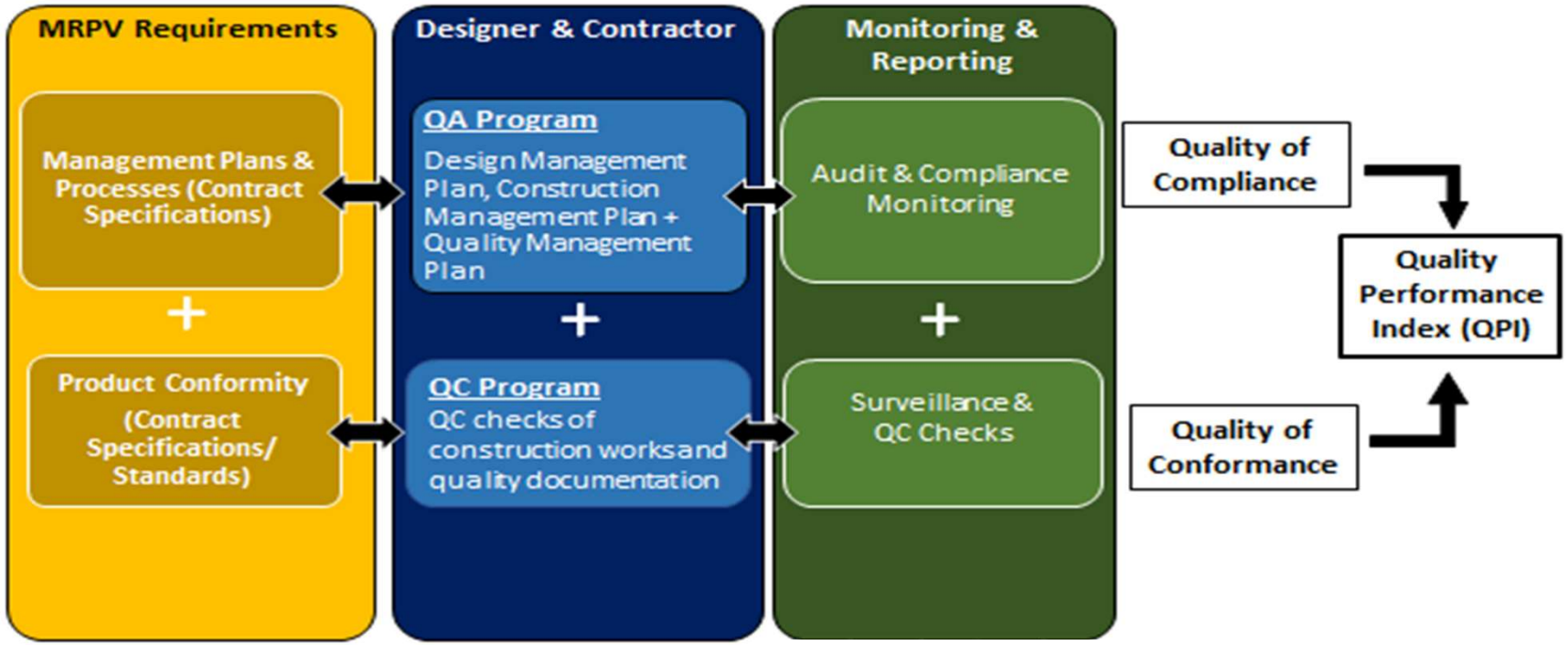
Quality Performance Indicator (QPI)

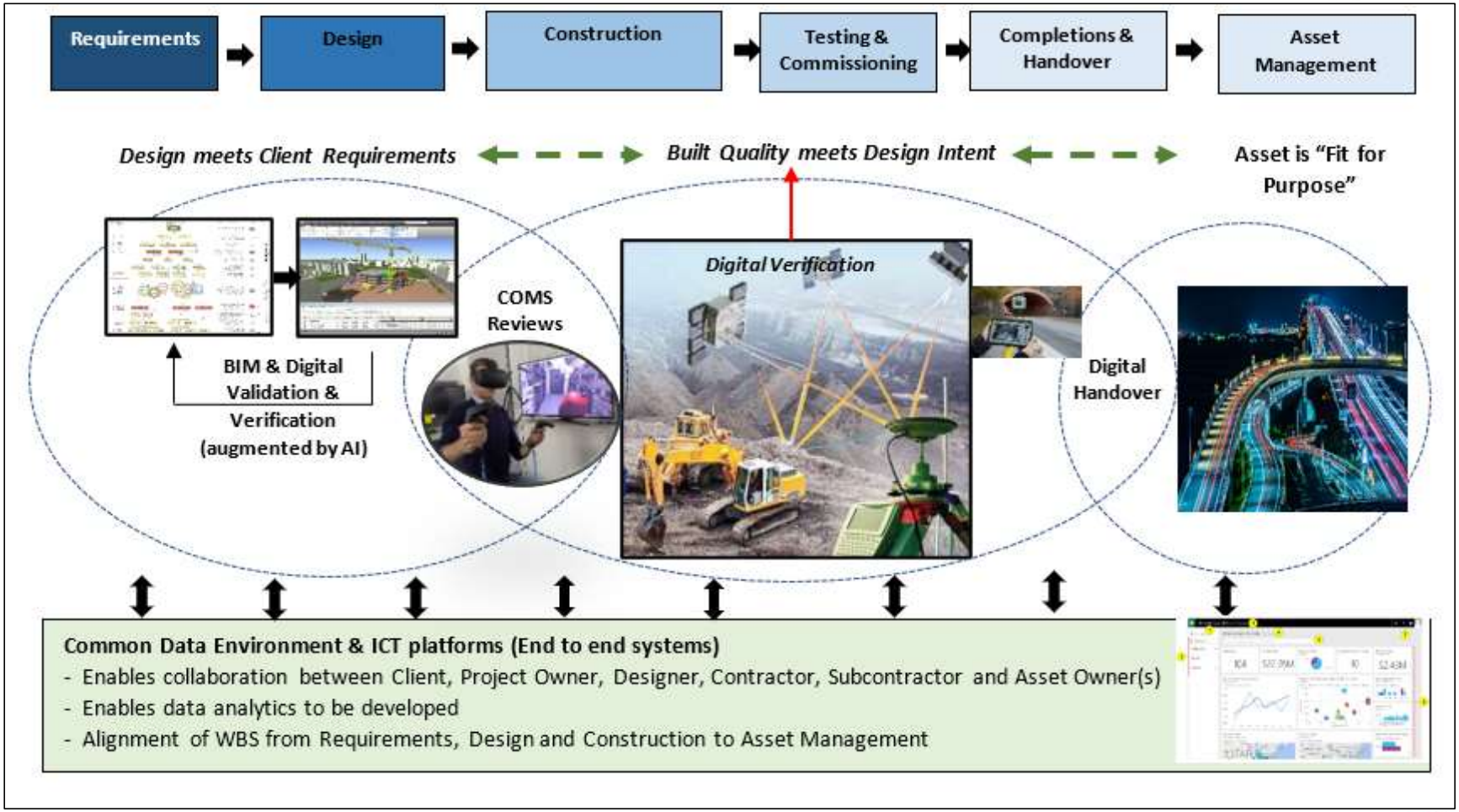
QPI – Aggregate of Quality of Compliance and Quality of Conformance



Application of Digital QA in Construction

- QC/QA during Construction
- Digital As-Builts
- Data Analytics
- Digital Quality Reporting

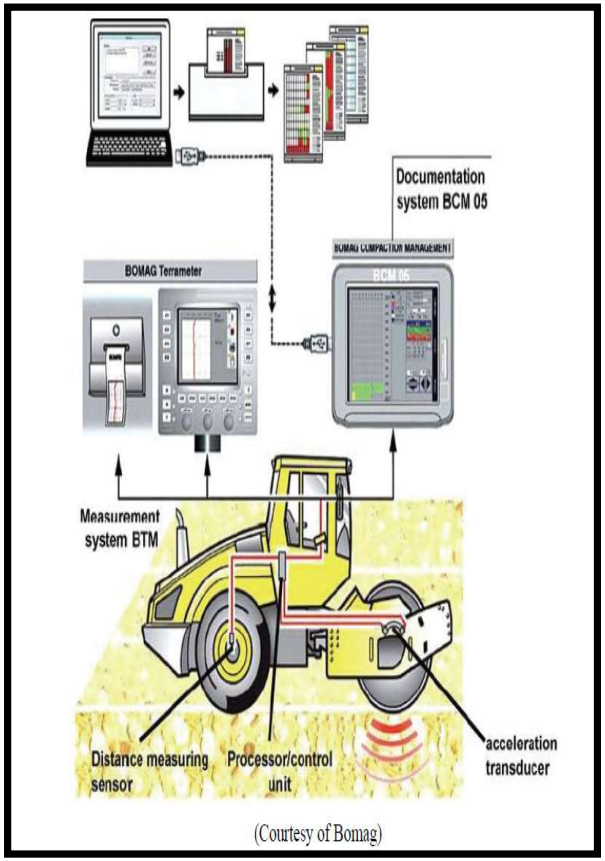
Use of Digital Engineering



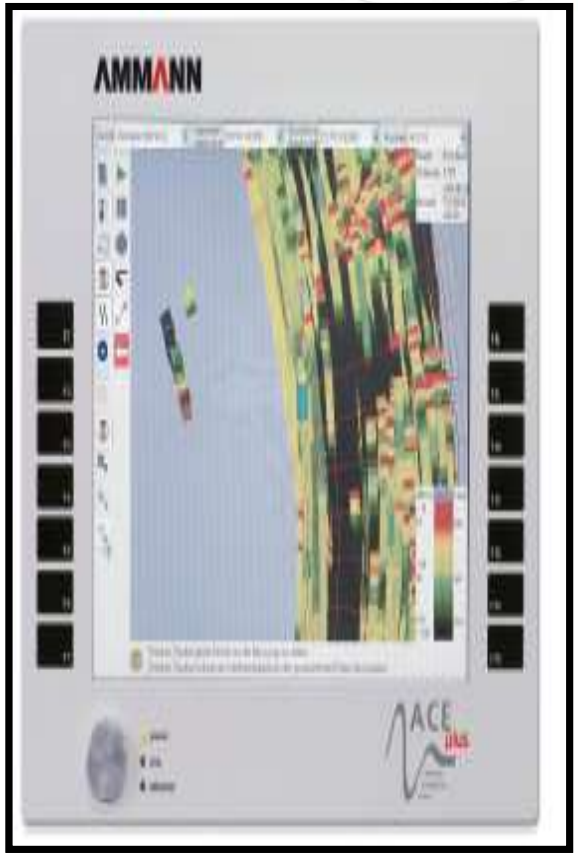
QC/QA in Construction - Intelligent Compaction

Figure 13. A Trimble GPS base station (ICPF MnDOT demo).

Figure 14. Validation of roller mounted GPS with a hand-held rover.

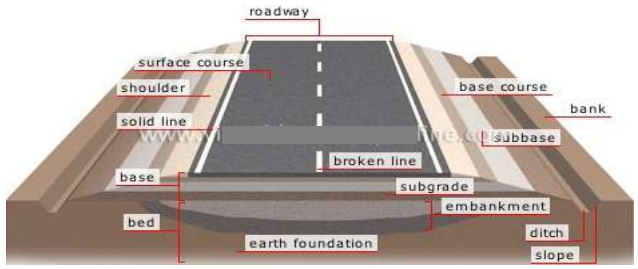


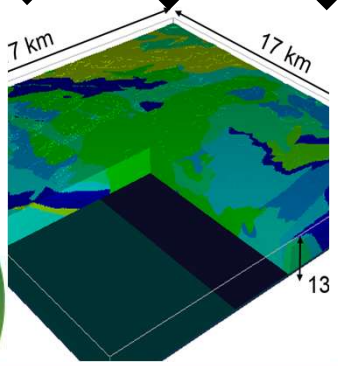
(Courtesy of Bomag)

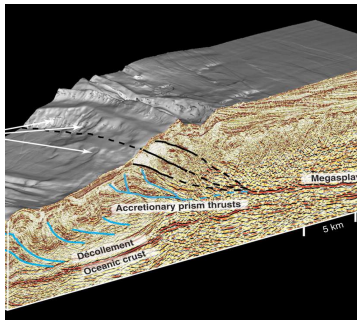


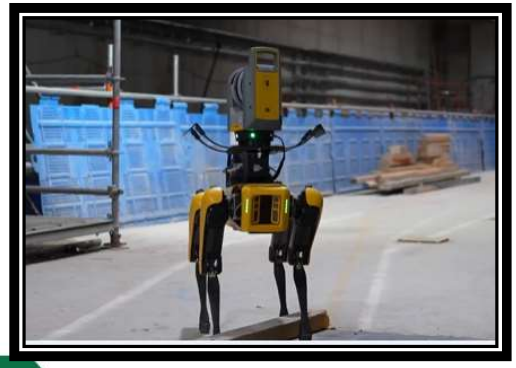
Source - US FHWA Intelligent Compaction

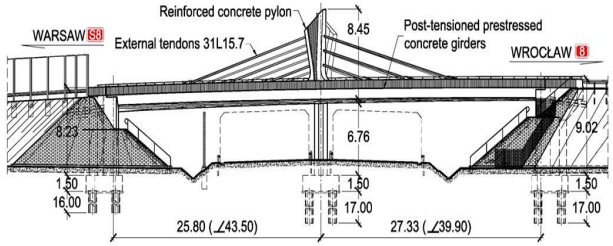
Digital Preparation of As-Builts











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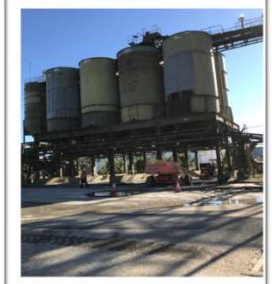
Data Analytics

- Diagnostic
- Exploratory
- Predictive

Concrete Batching Plant Process Control & QC Program

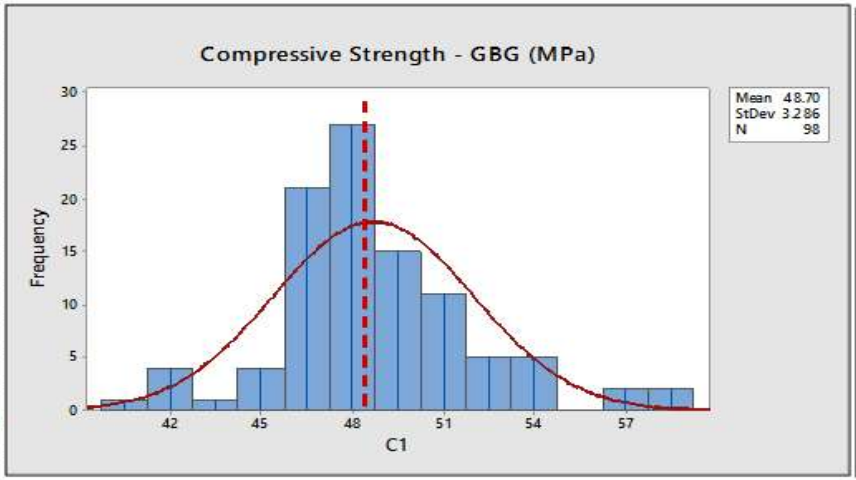


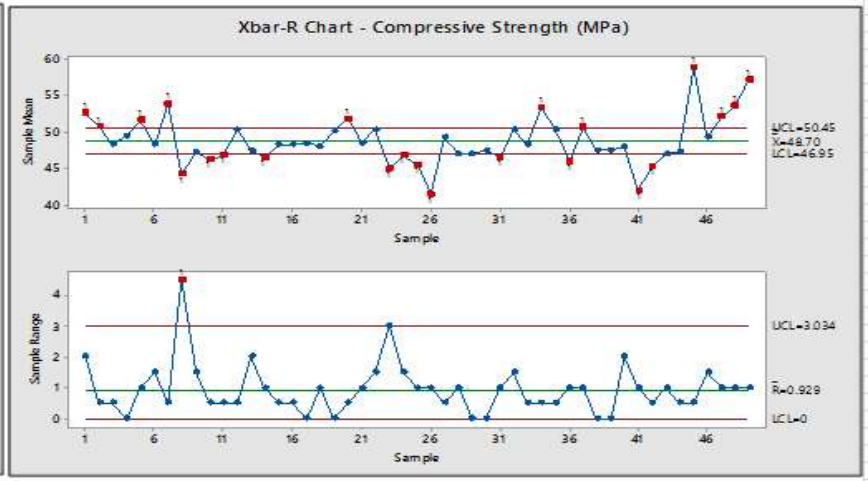


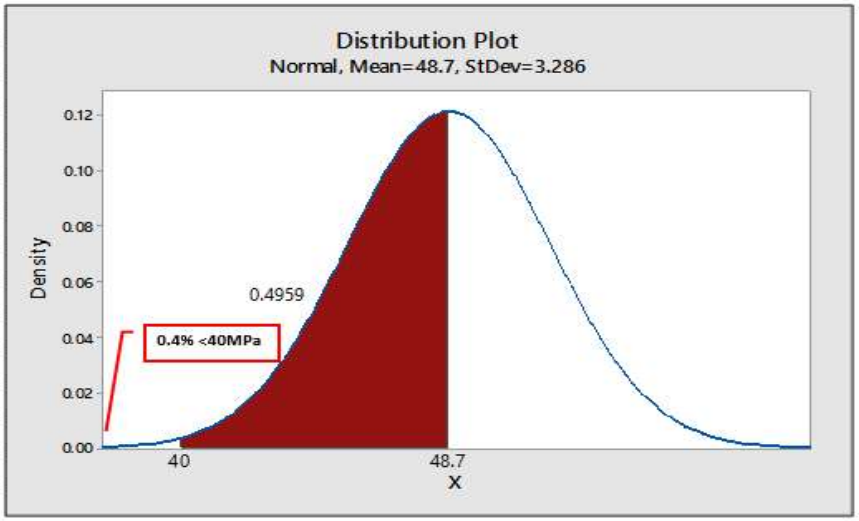


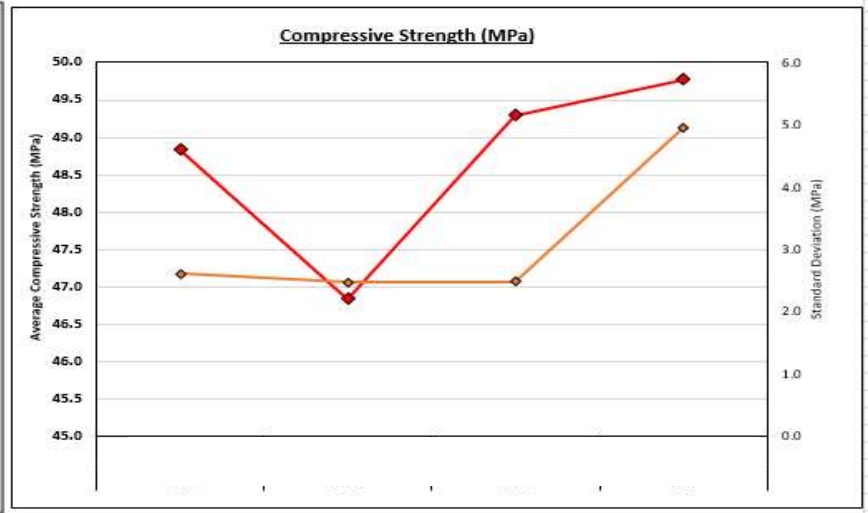

Process	CTQ	CTP
Receipt of Materials (Aggregate, Sand, Cement, Admixtures, etc).	- Client approved concrete mix design - Quality of materials - Certificate of Compliance	- Prequalification of suppliers. - Unloading to the correct loading bays.
Batching Plant - Loading & mixing of materials - Water addition @Slump stand	- Correct proportion of materials/admixtures added - Cleanliness of truck prior to loading - Moisture control of sand/aggregates - Compressive strength, VPV, Slump, J-ring test, drying shrinkage, etc	- Process validation - Correct mix design keyed into batching system - Weight Control of materials - Volume of admixtures/ water
Transportation	- No segregation, loss or leakage of materials	- Uniformity of agitation
Sampling 	- Slump, J-ring tests, etc - Sampling frequency - Sample integrity & quality	- Sampled in accordance with AS 1012 - Preservation of sample - Moisture proof container
Concrete placement	- No cold joints - Free of voids /blow holes - Workability/flowability - No segregation of aggregates - Concrete Compressive strength (> 40 MPa) - Durability – 100 years design life	- Continuous pour - Placement time (60-90mins) - Adequate Vibration - Ambient temp (5-35C) & relative humidity - Concrete temperature (10-32C) - Water control - Use of tremie

Concrete Batching Plant – Process Control Charts









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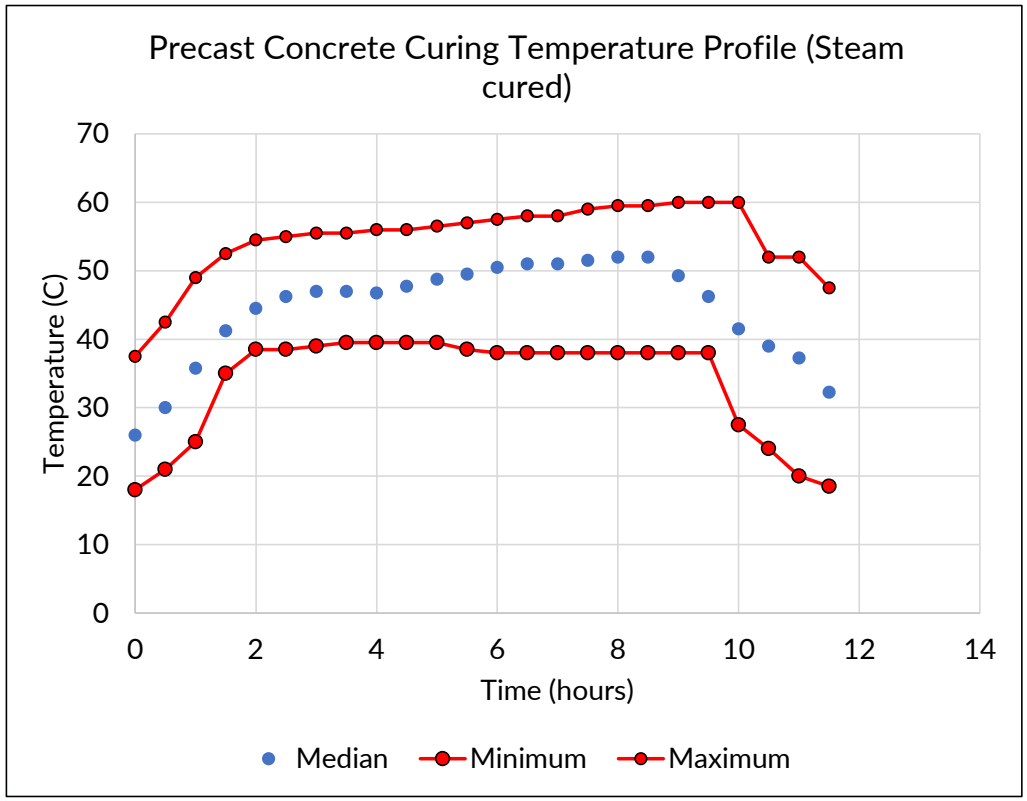
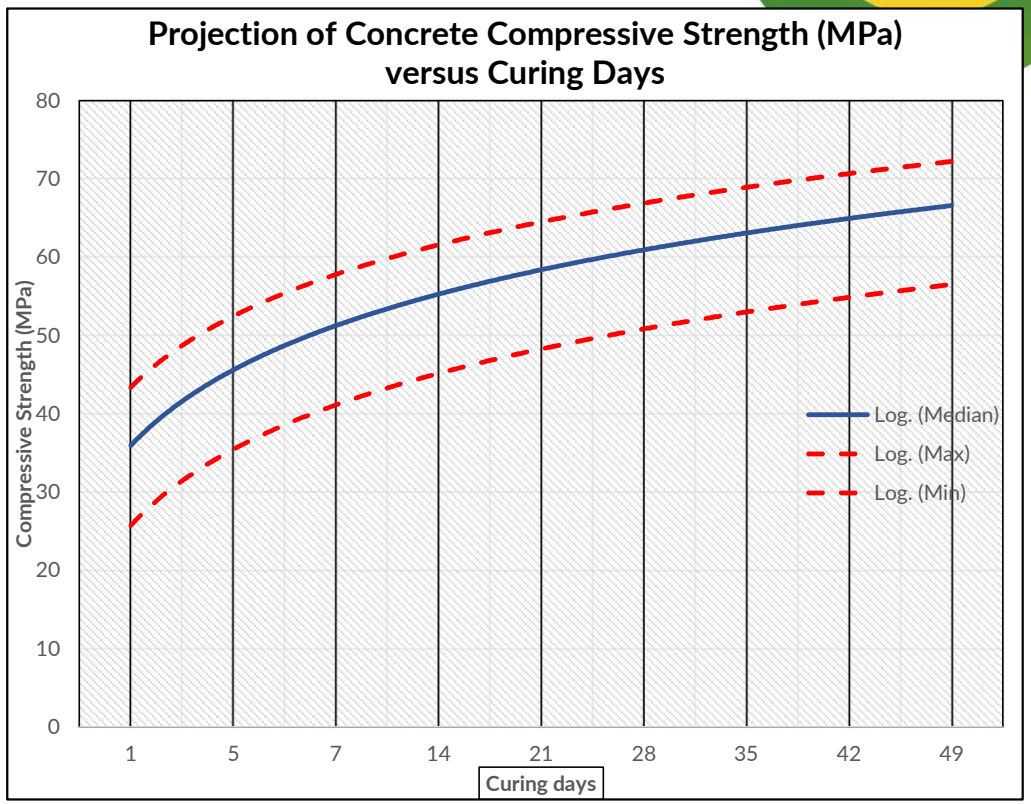
Early Warning System – Concrete Curing Process Control





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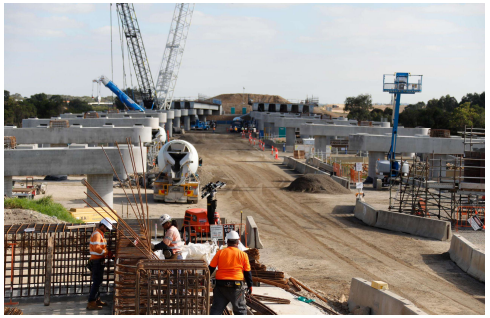
Digital Quality Reporting

Site Activities



Team Binder

- Document Management System
- Construction Work Lots
- Lab Test Results (LIMS)
- Digital Forms (Test Request, HP Release, NCR, RFI, DCR, ITP, etc)

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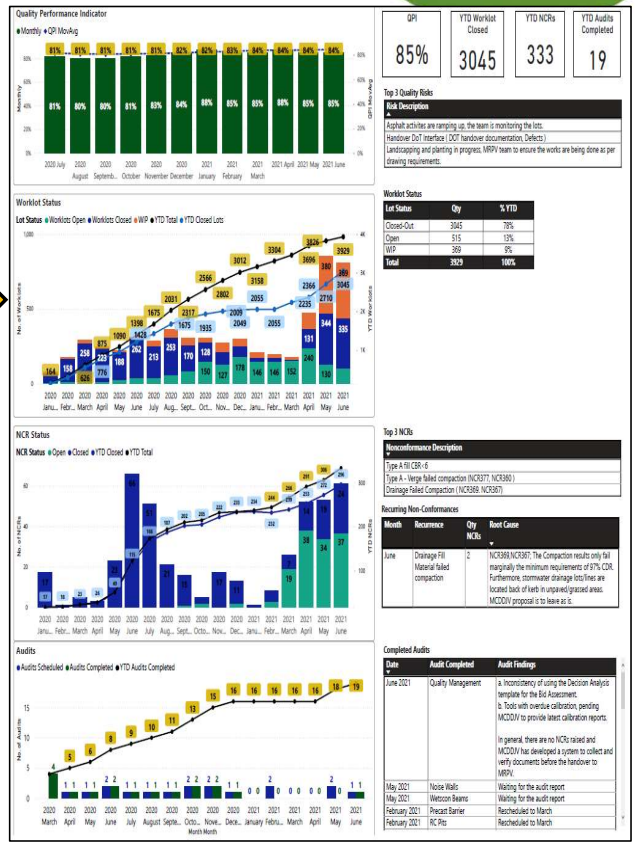
Reporting Tools

- Surveillance, Audit & Defects Management

Application Programming Interface (API)

Quality Dashboards – MS Power BI



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Conclusions

- Digital QA improves compliance, assurance and quality performance in construction.
- Reduce Total Cost of Quality through early intervention and prevention of nonconformances.
- Data captured digitally enables real time reporting of quality performance metrics.
- Quality documentation can be handed over to Asset Owner through a digital platform.

THANK YOU

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