



# Writing Analytics Specifications for Smart Buildings

TridiumTalk | Specifier Series

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### **SPEAKERS**







#### **STEPHEN HOLICKY**

Director of Product Management, Tridium, Inc.

#### J. CHRISTOPHER LARRY

Director of Energy Engineering, EXP

Experience



- 30 years of comprehensive experience on energy-efficient high-performance buildings
- Design-build expertise specializing in unique HVAC control solutions which solve problems, improve comfort, and reduce consumption.
- Named "Energy Engineer of the Year 2000" by the Association of Energy Engineers (AEE)
- Chairman of Technology, Energy and Governmental Activities, Chapter Technology Transfer Committees for ASHRAE.
- Chairman of Building Intelligence Quotient and Zero Energy Consortium Committees for CABA.



### AGENDA



# 1.0 ANALYTICS 101



By 2031, the market size for Global Building Analytics is estimated to be US\$ 21.1 billion at a CAGR of 15.4%

Adroit Market Research Building Analytics Market – Global Industry Analysis October 2022



## WHAT ARE ANALYTICS?

Analytics provide the capability to extract accurate and actionable insights from large amounts of data.

According to the Lawrence Berkely National Laboratory in a 2020 report, building owners and operators can leverage analytics, "to continuously monitor building performance and automate its analysis [...] leading to energy savings, peak demand reduction, and a reduction in service calls"



Kramer, H., Lin, G., Curtin, C., Crowe, E., and Granderson, J. Proving the Business Case for Building Analytics. Lawrence Berkeley National Laboratory, October 2020. https://doi.org/10.20357/B7G022

"Big data analytics has been of growing interest to the building industry, especially with the introduction of disclosure/energy benchmarking laws and the need for medium and large building owners and operators to reduce their portfolio's energy consumption. "

> ~ Center for Building Performance and Diagnostics at Carnegie Mellon University School

> > https://www.cmu.edu/cbpdanalytics/about.html



" Can someone make the case for analytics showing a real payback in the commercial HVAC controls market? I'm not sure I believe the hype. "

 $\sim$  Anonymous Mechanical & Controls Contractor HVAC Talk

https://hvac-talk.com/vbb/threads/2129061-Analytics









### WHY ANALYTICS?

What is it good for?!....Absolutely something!

Data Large or Small

Building systems generate vast amounts of data over their lifespan, analytics provide meaning from that data

Analytics algorithms **process data at scale** to detect **patterns and trends** which could **represent system or equipment problems** that would otherwise be missed or overlooked by the building maintenance technicians. Provides fertile ground for optimizing the operation of building systems and equipment.

### Efficiency Save \$\$ and Energy

Analytics make it easier to manage operations and achieve energy goals.

**Increases building performance and reduces a facility's operating costs** by making the building staff more efficient and increasing equipment lifespans

#### **Revenue** Happy Tenants Renew Leases

Predictive Analytics proactively **informs facility staff when a system or equipment isn't functioning properly and creates action items** (work orders) for the building staff so they can quickly correct the problem before building tenants' notice the problem.

# 2.0 SPECIFYING ANALYTICS

### **SPECIFICATIONS**

Know that often times contractors just look at the drawings and not the specifications.

Include details on drawings and specifications (but don't repeat).

Drawings – sketches/tables

Specifications – details

Determine what you want to specify...



## **BEST PRACTICES**

Use Construction Specifications Institute (CSI) format.

Choose either:

- Prescriptive know what you want
- Performance know how you want it
- Proprietary know who you want

Division 25 – Integrated Automation PART 1 – GENERAL PART 2 – PRODUCTS PART 3 - EXECUTION



## MAJOR SECTIONS OF DIVISION 25 – INTEGRATED AUTOMATION

**Based on CSI** 

25 01 00 Operation and Maintenance of IA 25 05 13 Conductors and Cables for IA 25 06 00 Schedules for IA 25 08 00 Commissioning of IA 25 10 00 IA Network Equipment 25 11 00 IA Network Devices 25 12 00 IA Network Gateways 25 13 00 IA Control and Monitoring Network 25 14 00 IA Local Control Units 25 15 00 IA Software 25 30 00 IA Instrumentation and Terminal Devices 25 31 00 IA Instrumentation and Terminal Devices for Facility Equipment 25 32 00 IA Instrumentation and Terminal Devices for Conveying Equipment 25 33 00 IA Instrumentation and Terminal Devices for Fire-Suppression Systems 25 34 00 IA Instrumentation and Terminal Devices for Plumbing 25 35 00 IA Instrumentation and Terminal Devices for HVAC 25 36 00 IA Instrumentation and Terminal Devices for Electrical Systems 25 37 00 IA Instrumentation and Terminal Devices for Communications Systems 25 38 00 IA Instrumentation and Terminal Devices for Electronic Safety and Security System 25 50 00 IA Facility Controls 25 51 00 IA Control of Facility Equipment 25 52 00 IA Control of Conveying Equipment 25 53 00 IA Control of Fire-Suppression Systems 25 54 00 IA Control of Plumbing 25 55 00 IA Control of HVAC 25 56 00 IA Control of Electrical Systems 25 57 00 IA Control of Communications Systems 25 58 00 IA Control of Electronic Safety and Security Systems 25 90 00 IA Control Sequences 25 91 00 IA Control Sequences for Facility Equipment 25 92 00 IA Control Sequences for Conveying Equipment 25 93 00 IA Control Sequences for Fire Suppression Systems 25 94 00 IA Control Sequences for Plumbing 25 95 00 IA Control Sequences for HVAC 25 96 00 IA Control Sequences for Electrical Systems 25 97 00 IA Control Sequences for Communications Systems 25 98 00 IA Control Sequences for Electronic Safety and Security Systems

# **Document Information View**



## Integrated Function Example: Demand Response

Ensure any data collected from other systems is specified for analytics (HVAC, lighting, CCTV, electrical metering, etc.)





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# Use these for support to help with specifications

## MANUFACTURER'S

Tridium Niagara – N4 Analytics SkySpark – Skyfoundry ICONICS platform Clockworks Analytics Coppertree Analytics – Kaizen/Distech BuildingLogix Key2Act – BOB Others

Many others – from other spaces and industry (auto, industrial, software, etc.)

## How do I start to specify my project (design)?

Understand the project - BOD

- 1. Determine what the project entails and what the customer is expecting.
- 2. Determine the points, devices and systems which are included in the project.
- 3. Is the project controls based or part of a bigger project.
- 4. Who will use the system? Where will the analytics reside?
- 5. Is the system local or remote (cloud based). manufacturer based.
- 6. Where will data be stored?
- 7. What are your KPI (Key Performance Indicators)?

Is it energy, comfort, operations, maintenance, performance or other based?

## **Different project types:**

How we design analytics is mostly the same, but it depends on:

- □ The size of the project. 100,000 sf or 1,000,000 sf.
- □ The number of points, tags and registers.
- □ Single building, campus or portfolio.
- □ The number and types of systems being analyzed.
- □ The number and type of equipment being analyzed.

The hardest thing about this is understanding what the owner wants. Often the people who will use this system have not even been hired yet.

## **BEST PRACTICES**



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## **IDEAS FOR CONFIRMING CONFORMANCE**

#### Outline:

- What
- Who ٠
- Where •
- When
- How •

Specifications Bidders Check that the bidders can meet the Owner specifications – review

Ensure the owner agrees with the scope.



Figure 1. Automated FDD performance evaluation procedure, generalized and adapted from (Yuill and Braun 2013)



This might help you understand what you need.

## **Optimization of the Building**

## Control \*more things\* in \*smarter ways\*



# How do I specify Analytics for my project?

There are two (2) ways to contract for and therefore design Integrated Automation into a project:

- 1. Using the BAS contractor to install Integrated Automation, for this you would use the Division 23 sections in the CSI format specifications.
- 2. Using the Integrated Automation contractor to install the IAS, you would use the Division 25 sections in the CSI format specifications.

The key here is to ensure the architect, owner and GC understand the subcontractor requirements for Analytics.

To program Analytics, the contractor needs data from multiple systems, so the other contractors need to work to coordinate the points on their systems to connect and share data with the IAS.

**Designing the Analytics install for my project?** 

There are two (2) ways to design and install Analytics into a project:

- 1. Analytics can be purchased as software and installed in a server similar to other BAS software. (Separate from controller). Division 25.
- 2. Analytics can be **purchased integral with a JACE 8000 similar to other BAS hardware.** The hardware specification needs to be augmented with the analytics software, so the contractor understands the installation and how the software is purchased. (as part of the controller). Division 23.

Will Analytics be centrally located or "on the edge".

The key here is to ensure the contractor understands how the software and hardware is purchased and installed.



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## **POSSIBLE PROBLEMS**

There can be many:

Owners may not understand what they want or what they are getting.

General Contractors may not understand what is specified.

Not all BAS contractors may offer analytics and some offer in different ways.

Not all contractors may understand analytics and what data to provide.

Interface issues

# 3.0 ANALYTICS SHOWCASE

# **Building Analytics**

 Browser-based dashboard application monitors multiple facilities in real time

- Presents volumes of data in a clear, visual way, allowing users to quickly identify issues, assess relationships, and take action
- User-centric interface is highly intuitive and configurable

# **Analytics Dashboard (examples)**





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# **Types of Building Analytics**

- Alarms 1<sup>st</sup> & 2<sup>nd</sup> generation something wrong
- Conditional Alarms (Fault Detection and Diagnostics)
  3<sup>rd</sup> generation something not right
- Predictive Analytics 4<sup>th</sup> generation predict an alarm
- Prescriptive Analytics 5<sup>th</sup> generation rectify issue

# **Analytics Maturity**







# Alarms (1<sup>st</sup> & 2<sup>nd</sup> Generation)

- 1<sup>st</sup> Generation Automatic Temperature Controls
  - Analog and electric devices (Freeze stats, pressure switch, current switches etc.)
- 2<sup>nd</sup> Generation Direct Digital Controls
  - Analog Temperature and Pressure Hi and Low Limits
  - Filter pressure set-point alarm
  - Equipment dry contact and soft alarms
  - Electrical Demand alarms
  - Current set-point alarms

# Conditional Alarms (3<sup>rd</sup> Generation)

- A.K.A. Fault Detection and Diagnostics (FD & D)
- Can Eliminate 'False Positives'
- Utilizes Real Time Data
- Utilize Boolean Logic to add 'conditions to the alarm'
  - If, Then, Else, Or, And, etc., statements
  - IF the DAT exceeds 60 deg. F AND the AHU-1 SAF status is TRUE AND the Chiller status is TRUE AND OA Temp EQUAL 55 deg. F THEN ALARM AHU-1
- Utilize Totalized Equipment Runtime and Energy
- Apply Rate of Rise to Analog Points

# **Predictive Analytics (4<sup>th</sup> Generation)**

- Sometimes referred to as Predictive Maintenance
- Utilizes Historical data to Predict a Fault or a Maintenance Work Order
- Compare Rotating Equipment vibration today to yesterday, last week and same time last year.
- Electrical Signature Analysis
  - Compare Rotating Equipment Amps, KVAR and Waveforms to Commissioned Baselines
- Implement a Regression Analysis on a Group of Historical Data Points
- Most Predictive Analytics require Big Database and Application Servers (SaaS model)

# **Prescriptive Analytics (5<sup>th</sup> Generation)**

- Bypasses the Alarm or Fault and Utilizes Al to Address the Problem
- N4 and Niagara Analytics is Prescriptive Analytics Capable
  - Faults Detected
  - Control Logic Applied to Rectify Fault
- Example WHEN Electrical Demand EQUAL 95% of ElecDemandLimit THEN OVERRIDE AHU-1 and AHU-2 DAT SP to 62 deg F AND Lighting Groups 1, 2, 3, 4, 5 Lux SP to 250 LUX

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#### Batch Recipe Configuration

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Batch Order Configuration

## **Screen Shots**



#### Running Batch Operator View





# **Point and Tag Definition**

Point Name	Description	Actual IAS Point Name (typ.) - Site- Name_Building#Build- ingWing Floor Equipment	BACnet Ob- ject Type (typ.)	IAS Gra phic	FDD	D R	Trend
STPT	Set point (Zone Temperature Set point)	XXXX_XXXX_XXXX_RTU#_STPT	Analog Value	×	X	х	Х
UNOCC	Unoccupied Mode	XXXX_XXXX_XXXX_RTU#_UNOCC	Multi-state Value (19)	х			×
FCUs:							
AMP	Amperage	XXXX_XXXX_XXXX_FCU#_AMP	Analog Input				х
CLT	Cooling (Coil) Leaving Tem-	XXXX_XXXX_XXXX_FCU#_CLT	Analog Input	х			х
CO2	(Space) Carbon-Dioxide	XXXX_XXXX_FCU#_CO2	Analog Input	х			х
DAT	Discharge Air Temperature	XXXX_XXXX_XXXX_FCU#_DAT	Analog Input	х		х	х
KW	Kilowatts	XXXX_XXXX_FCU#_KW	Analog Input				×
KWH	Kilowatt Hour	XXXX_XXXX_FCU#_KWH	Analog Input				х
RH	(Space) Relative Humidity	XXXX_XXXX_XXXX_FCU#_RH	Analog Input	×	Х		×
VLT	Voltage	XXXX_XXXX_XXXX_FCU#_VLT	Analog Input				×
ZNT	Zone or Space Temperature	XXXX_XXXX_FCU#_ZNT	Analog Input	х	Х	х	х
ALM	Alarm - General Alarm or Fault	XXXX_XXXX_XXX_FCU#_ALM	Binary Input	х	Х		х
FLTR	Dirty Filter Alarm (via Differen- tial Pressure Switch)	XXXX_XXXX_XXXX_FCU#_FLTR	Binary Input (3)		Х		х

## Automatic actions based upon analytic alarms

The Floor Plans demonstrate how Niagara Analytics running in a JACE-8000 can optimize the AHU Supply Temperature setting. By changing either the Outside Air Temp, or Sun Intensity, the user can show how the AHU Static Pressure Setpoint will respond accordingly to maintain a Maximum VAV Damper Position in between 80% and 85%.





## **Dashboard On Demand**







# Things to think about

- How will the analytics be installed
- Where will analytics software be installed?
- Where will the analytics data be stored?
- How long will the data be saved in the controllers?
- How long will the data be saved in analytics?
- How will all the systems be connected to share data?
- How will the faults be communicated?
- What kinds of graphics will be provided?



# 4.0 NIAGARA ANALYTICS



#### Harness the Power of Open

Because our technology is open, it's effectively agnostic. Use Niagara Analytics for a variety of applications and industries, including energy, manufacturing, data centers and more



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#### Migrate to Proactive

Niagara Analytics takes the robust analytics capabilities of Niagara 4 to a whole new level

### WHY USE NIAGARA ANALYTICS?

Niagara Analytics Framework gives you the real-time business intelligence you need to make smarter, swifter decisions and improve operations with less time, less work, less waste and less expense

#### Niagara Data Model

Design time reduction by leveraging Niagara histories, hierarchies and tags

#### **Algorithms Library**

Provides a variety of predefined algorithms

#### Intuitive Programming

Single Tool Approach via Workbench

#### Automated FDDs

Ensures proactive response with complete customization

#### **On-Prem Analytics**

Run on-site analytics directly on an embedded controllers such as the JACE-8000

#### **Powerful Visualization**

Leverage a default library of standard reports and widgets for dashboarding and reporting

### **NIAGARA ANALYTICS UNLOCKED**

With Niagara Analytics, you can unlock significant value throughout the building management cycle

### **Smart Alerts**

### Persistent Optimization

Continuous Commissioning

Energy Reports Visualization Robust Cost Analysis

### **NIAGARA ANALYTICS LIBRARY**



"Niagara Analytics takes the robust analytics capabilities of Niagara 4 to a whole new level"



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### **NIAGARA ANALYTICS REPORTING**

#### Average Profile Report

- Average value vs TimeReduce Peak Demand
- Reduce Feak Demand
- Reduce Runtime

#### **Ranking Report**

- Compare Buildings
- Normalize by square foot

#### **Aggregation Report**

 Aggregates Data from Buildings, Submeters, and Tenants

#### Spectrum Report

 Hot-Spots or Problematic Trends at a glance

#### **Relative Reporting**

 Shows how various loads contribute to the entire usage

#### Load Duration Report

 This report shows how long a certain amount of energy is used.

#### **Operations Report**

• This report shows the percentage of time equipment is running.

#### Ad-Hoc Reporting

• Build your own custom report



## **Resources and Links**

Tridium Website <u>https://www.tridium.com/us/en</u>

Intelligent Buildings <a href="https://www.intelligentbuildings.com/">https://www.intelligentbuildings.com/</a>

Tridium Cybersecurity Page <u>https://www.tridium.com/us/en/Products/niagara-cyber-defense</u>

NIST Cybersecurity Framework - <u>https://www.nist.gov/cyberframework</u>

IEC 62443 https://www.isa.org/standards-and-publications/isa-standards/isa-iec-62443-series-of-standards

Page for Specifying Engineers <u>https://www.tridium.com/us/en/Learn/by-role/specifying-engineer</u>

Page for Cybersecurity Personnel <u>https://www.tridium.com/us/en/Learn/by-role/cybersecurity</u>

Search prior TridiumTalks on Cybersecurity <u>https://www.tridium.com/us/en/services-support/events</u>

Building Cyber Security <a href="https://buildingcybersecurity.org/">https://buildingcybersecurity.org/</a>

## **Resources and Links** ... continued

Edge10 https://www.tridium.com/us/en/Products/niagara/edge10 Niagara Analytics https://www.tridium.com/us/en/Products/niagara-analytics Enterprise Security https://www.tridium.com/us/en/Products/niagara-enterprise-security Niagara Drivers https://www.tridium.com/us/en/Products/niagara-drivers Tridium University https://www.tridium.com/us/en/services-support/tridium-university Marketplace https://www.tridium.com/us/en/services-support/niagara-marketplace Pro Services https://www.tridium.com/us/en/services-support/professional-services

# **THANK YOU**

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