



# THE DIGITAL EVOLUTION OF ASSET MANAGEMENT

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BRENDAN DILLON, C.M.  
DIRECTOR OF DIGITAL FACILITIES & INFRASTRUCTURE

# DEN BY THE NUMBERS



- 53 square miles of campus (largest airport in North America)
- 17 million square feet of facilities
- 69.2m pax 2022 (Third Busiest Airport in the World)
- 200+ Destinations
- 25+ International Destination in 16 countries
- 161 Total Gates
- Six runways
- 39k badged employees
- 15,000+ acres of active farmland



# SUMMARY



In this presentation we will discuss the evolution of facility data, shortly touching on where we have come from with CAD and spreadsheets, expanding into where we are with BIM, SCADA, and CMMSs, and what the future holds with Digital Twins and AI in the context of Denver International Airport.

Denver International Airport is the third busiest airport in the world with 53 square miles of campus and 17m sf of facilities. Built in 1997 it is the newest major airport in the US and was the first major airport in the US designed entirely using CAD technologies. DEN has an advanced BIM program and has had a dedicated Asset Management program since 2013.

DEN's CAD and BIM tools have been an instrumental element in supporting and advancing the asset management program at the airport, and DEN's asset management program has grown in concert with our Information Requirements and capabilities.

As DEN prepares for deploying a comprehensive Digital Twin, our Information requirements and Asset Management program are preparing again for yet another leap in our capabilities.

# IN THE BEGINNING...



**AS BUILT  
DRAWINGS**

# CURRENT STATE



# COMPUTERIZED MAINTENANCE MGMT SYSTEMS (CMMS)



Welcome, Brendan Dillon - DIA

Maintenance | Everyplace | Maintenance Analyst

Find Navigation Item

Go To Applications

My Recent Applications

Administration

Analytics

Assets

Contracts

Financial

Inventory

Planning

Preventive Maintenance

Purchasing

System Configuration

Warranties (Tr)

Work Orders

Mobile Start Center

Bulletin Board  Filter > 🔍 🗑️

To filter for specific records, specify data in the filter fields and then press the Enter key.

Subject	Message	Post Date	Expiration Date	Viewed
				N

There are currently no bulletin board messages to view.

Quick Insert

New Work Order

Favorite Applications

- Work Order Tracking
- Assets
- Failure Codes
- Labor Reporting
- Locations

- Centralized platform
  - Automated processes
  - Data Schema consistency
  - Improved communication/collaboration
- Resulting in...
- Improved asset visibility
  - Streamlined, consistent maintenance workflows
  - Reduced downtime
  - Improved asset life
  - Improved Compliance

Inbox / Assignments

KPI Graph

This portlet has not been set up. To set up, select the edit icon in the portlet header.

Result Set  Filter > 🔍 🗑️ ⬇️ 📄

Asset

Asset	Manufacturer
100000	STI
100001	STI
100003	STI
100004	STI
100005	STI
100007	STI
100008	STI
100009	STI
100011	STI
100012	STI

Set Chart Options

KPI List

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# SCADA & IOT

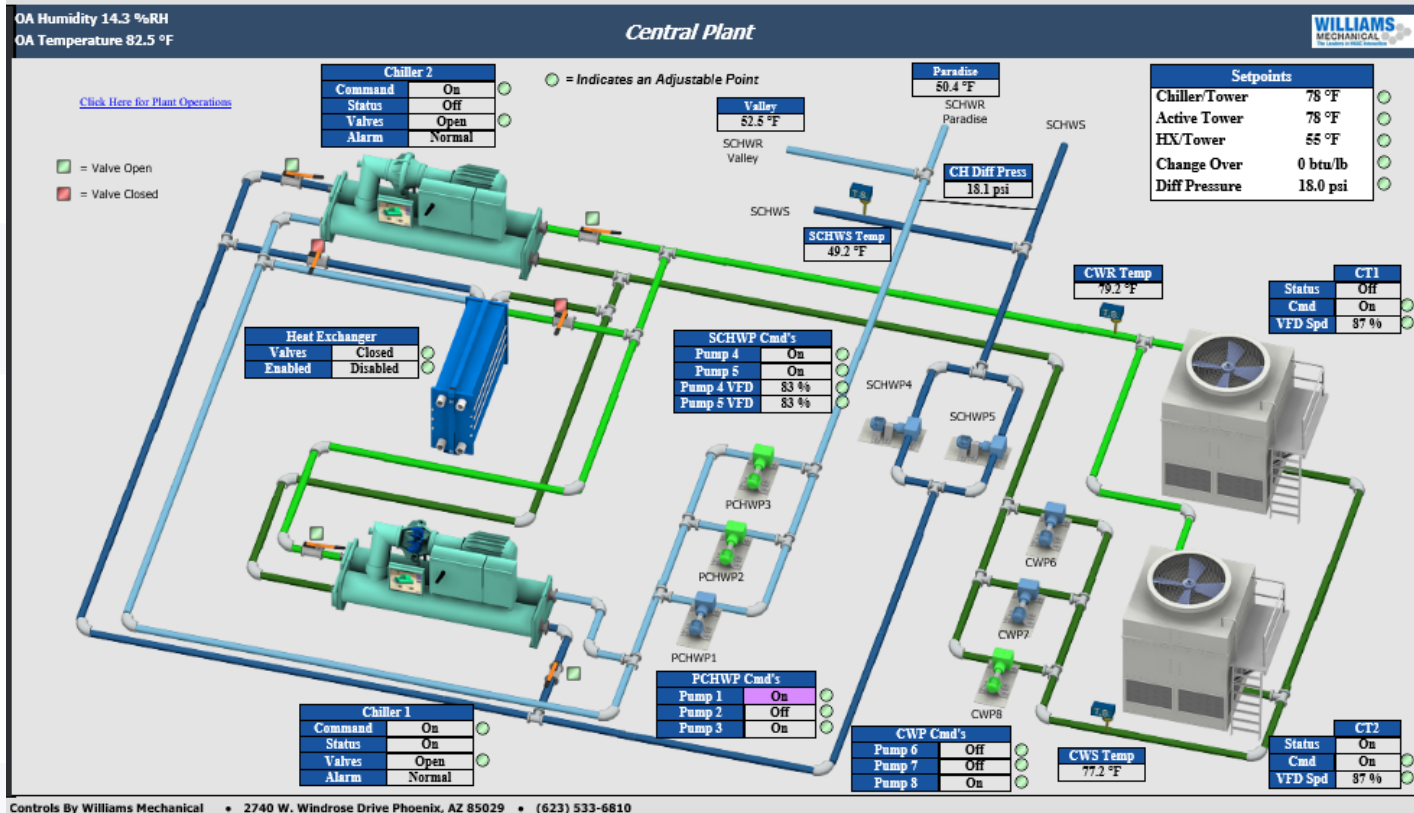
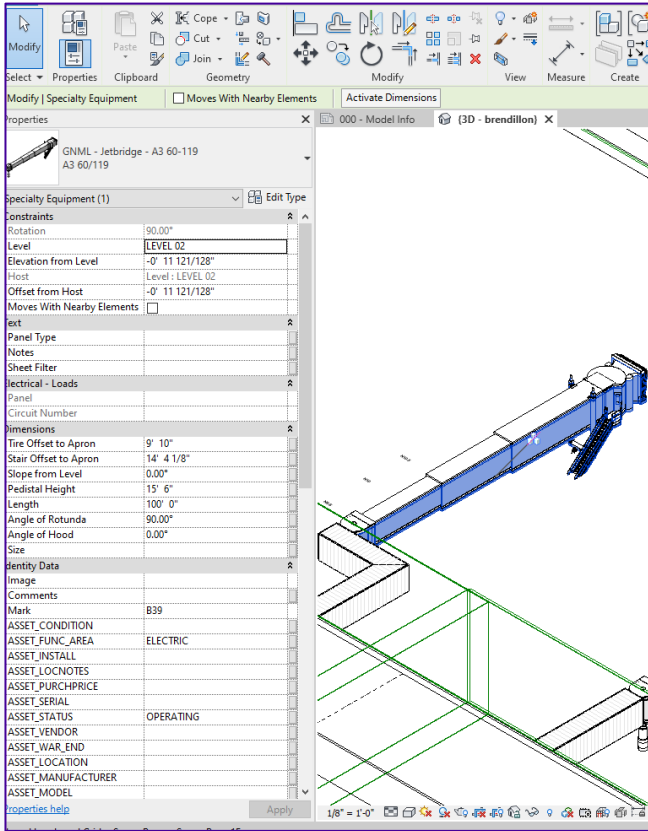


Image by Williams Mechanical

# BUILDING INFORMATION MODELING



A	B	C	D	E	F	G	H
	DEN Project #: YY-####			P	P	P	P
	Tenant? (Y/N)	N		C	C	C	C
	Last Edited: 8/12/21			F	F	F	F
ID	ITEM DESCRIPTION	CRIT	REFERENCE				
				30%	60%	90%	95%
Overall Score							
Critical Item Score							
1. Model Setup							
1.1	DEN Template Used	X	3.1.2				
1.2	Project File Name (meets standards)		3.1.3				
1.3	Phasing	X	3.1.4				
1.4	Worksets		3.1.5				
1.5	Correct Project Information		3.1.6				
1.6	CAD files must be approved and linked; not imported or exploded	X	3.1.7				
1.10	Design Options, purge for 100%		3.1.8				
1.11	Project Location - LDP Coordinates	X	3.1.9				
1.12	Model Levels	X	3.1.10				
1.13	Model Delivered On-Time via DEN CDE	X	3.1.11 & 3.0.2				
2. Modeling							
2.1	Model all designed elements	X	3.2.2 - 3.2.5				
2.2	Existing Assets Modeled to LOD 200	X	3.2.4.3				
2.3	All modeled elements tagged correctly	X	3.2.6				
2.4	Model content from DEN Library		3.2.7				
2.5	Meets Revit Family File naming conventions	X	3.2.7.5				
2.6	No unapproved In-Place Models	X	3.2.8				
2.7	No unapproved Generic Models	X	3.2.9				
2.8	Systems Connected	X	3.2.10				
2.9	Minimize Use of Groups, ungroup all for 100%		3.2.11				
2.10	Rooms/space placed/Enclosed/numbered -OR- ASSET_LOCATION data complete	X	3.2.12				
2.11	Spatial Coordination	X	3.2.13				
2.12	Model Reconciliation	X	3.2.14				
3. Data & Parameters							
3.1	All Assets Identified	X	3.3.3				
3.2	Existing Assets Identified	X	3.3.3 & 3.2.4.3				
3.3	Asset Design Information Complete	X	3.3.4				
3.4	Asset Sheet	X	3.3.4				
4. Model Views							
4.1	Number of Views		3.4.2				
4.2	Number of Views not on sheets		3.4.2				

Compar	#	OA Gra	OA Grade	OA Ra	#	F Grad	F Grade	# Pa	% Pa
	3	90%	97%	1	1	92%	100%	1	100%
	37	92%	97%	6	2	100%	100%	2	100%
	8	95%	94%	2	0			0	n/a
	27	93%	97%	5	3	86%	83%	0	0%
	137	90%	97%	7	8	76%	74%	0	0%
	104	28%	30%	50	0			0	n/a
	10	88%	88%	8	0			0	n/a
	3	76%	88%	9	1	68%	75%	0	0%
	52	88%	86%	11	12	90%	90%	4	33%
	31	90%	88%	10	0			0	n/a
1. Model Setup									
	6	77%	85%	13	3	90%	90%	1	33%
	4	86%	84%	14	2	82%	82%	0	0%
	3	82%	83%	18	1	93%	100%	1	100%
	33	83%	83%	19	8	84%	80%	0	0%
	69	83%	84%	16	0			0	n/a
	15	83%	87%	20	6	83%	83%	0	0%
	37	91%	93%	3	3	78%	79%	0	0%
	6	74%	77%	26	3	84%	87%	0	0%
	28	80%	76%	27	0			0	n/a
	3	70%	84%	17	0			0	n/a
	15	75%	77%	24	2	88%	93%	0	0%
	33	87%	85%	12	1	74%	74%	0	0%
	202	56%	54%	45	17	87%	75%	1	6%
	25	81%	80%	21	2	80%	83%	0	0%
2. Modeling									
	1	58%	73%	30	0			0	n/a
	30	72%	73%	31	12	83%	79%	1	8%
	63	80%	74%	29	10	69%	56%	0	0%
	12	71%	72%	33	2	87%	77%	0	0%
	53	80%	78%	23	13	64%	60%	0	0%
	115	74%	72%	32	21	70%	66%	1	5%
	3	65%	69%	34	2	62%	69%	0	0%
	2	62%	67%	36	0			0	n/a
	55	75%	77%	25	5	57%	67%	1	20%
	5	90%	93%	4	0			0	n/a
	2	62%	66%	37	1	67%	70%	0	0%
	9	64%	68%	35	3	54%	69%	0	0%
	7	81%	80%	22	0			0	n/a
	24	73%	74%	28	7	63%	68%	0	0%
	2	64%	59%	39	2	64%	59%	0	0%
	2	61%	58%	40	0			0	n/a
	5	70%	57%	41	2	68%	68%	0	0%
	1	45%	56%	42	0			0	n/a
	1	54%	54%	43	1	54%	54%	0	0%
	6	51%	54%	44	3	49%	53%	0	0%
	24	86%	84%	15	3	61%	44%	0	0%
	5	57%	57%	46	0			0	n/a
	2	47%	50%	47	0			0	n/a
	12	62%	60%	38	3	46%	50%	0	0%
	6	38%	47%	48	4	56%	53%	0	0%
	3	42%	47%	49	1	57%	54%	0	0%
	2	21%	22%	51	0			0	n/a
	1	25%	0%	52	0			0	n/a



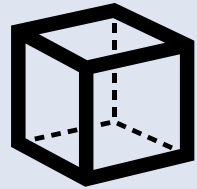
## LOCATION INFORMATION

Location information identifies where something is, this may be high level (what building) or specific (room number or coordinates).



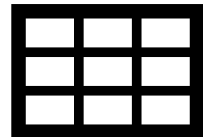
## SPATIAL INFORMATION

Identifies how something relates to space, the size of it and any space it needs around it, and usually builds on location information. It is particularly valuable in relating multiple elements to each other.

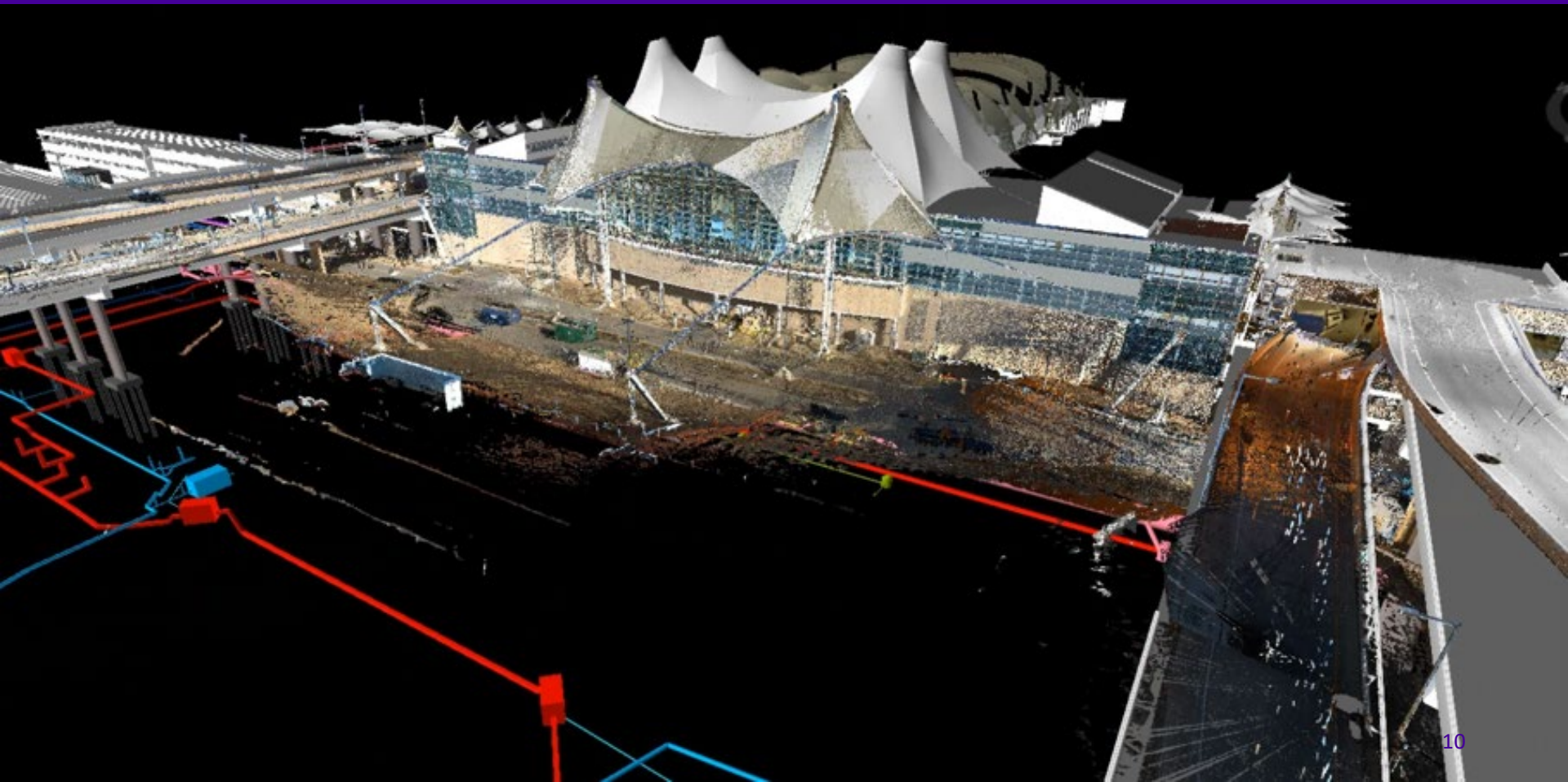


## ASSET INFORMATION

This gives us the details of an element. Is it tile flooring or carpet? An air handler worth \$150k or a heater worth \$150?

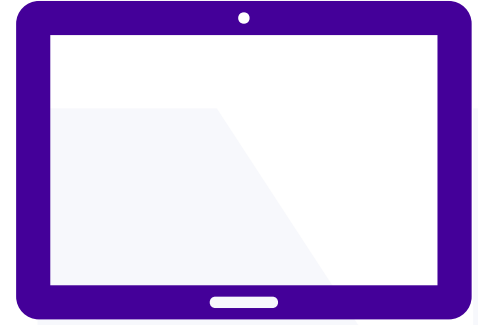
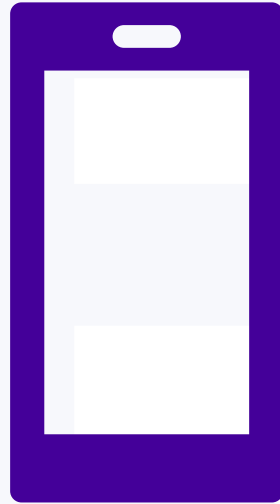


# LiDAR (LIGHT DETECTION AND RANGING)



# CLOUD COMPUTING

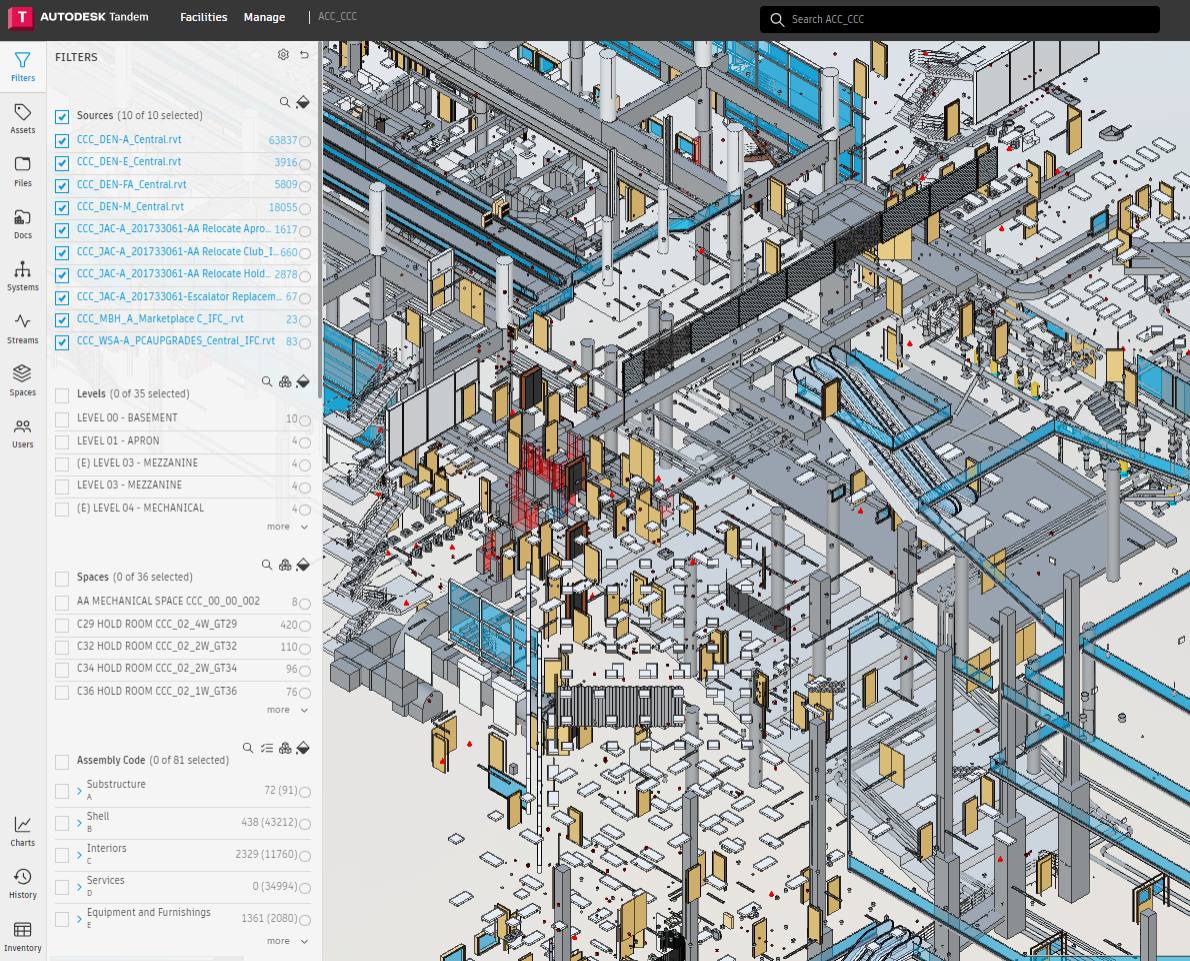




THE FUTURE... IS NOW!



# DIGITAL TWINS



A digital twin is a virtual representation of real-world entities and processes, synchronized at a specified frequency and fidelity.

- Digital twin systems transform business by accelerating holistic understanding, optimal decision-making, and effective action.
- Digital twins use real-time and historical data to represent the past and present and simulate predicted futures.
- Digital twins are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems.

Credit: Digital Twin Consortium

# BLOCKCHAIN





LANGUAGE MODEL  
(CURRENT)

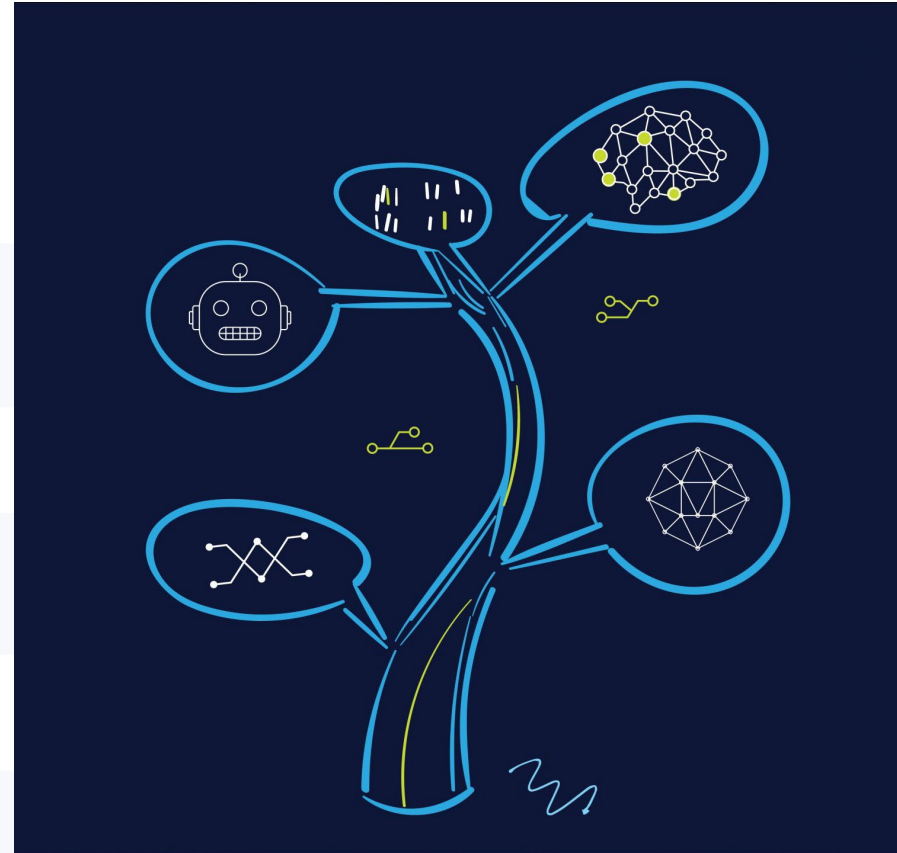


ARTIFICIAL INTELLIGENCE  
(FUTURE)



# LLM BENEFITS

- Automation
- Can reduce errors
- Large data analysis
- Fairly intuitive
- “Alternate Voice/Perspective”



- Requires specificity
- Requires large amounts of GOOD data to be useful
- Only knows what you tell it...
- Yet somehow capable of making things up completely?
- Legal gray areas on liability
- Privacy issues
- Bias issues

I'm giving a presentation to the Institute of Asset Management on "Digital Evolution of Asset Management", give me an outline for the presentation.

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Outline for a presentation to the Institute of Asset Management on "Digital Evolution of Asset Management"

Introduction

- What is digital evolution?
- Why is digital evolution important for asset management?
- What are the key trends driving digital evolution in asset management?
- How is digital evolution transforming the asset management industry?

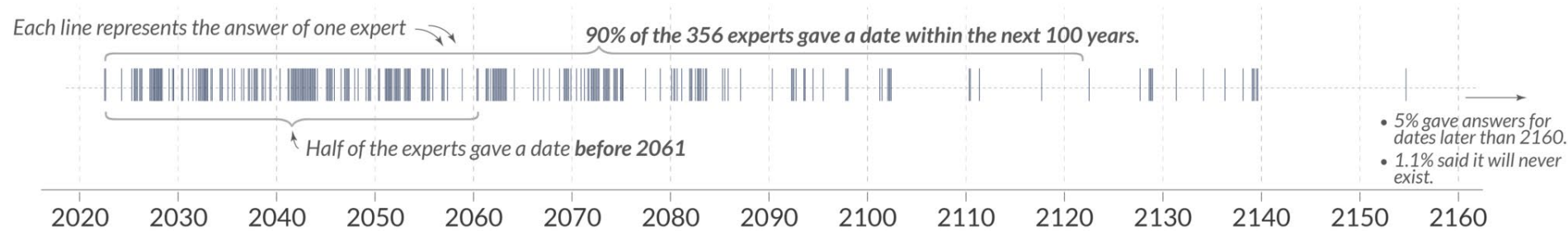
Body

- Data and analytics: The rise of big data and advanced analytics is enabling asset managers **to make better investment decisions, optimize their portfolios**, and improve their risk management capabilities.
- Artificial intelligence (AI) and machine learning (ML): AI and ML are being used to automate tasks, improve decision-making, and develop new investment products and services.
- Cloud computing: Cloud computing is providing asset managers with access to scalable and affordable IT resources, which is enabling them to adopt new technologies more quickly and easily.
- Blockchain: Blockchain technology has the potential to revolutionize the

## When will there be a 50% chance that Human-level Artificial Intelligence exists?

Timelines of **356 AI experts**, surveyed in **2022** by Katja Grace and colleagues.

The experts were asked when unaided machines will be able to accomplish every task better and more cheaply than human workers.

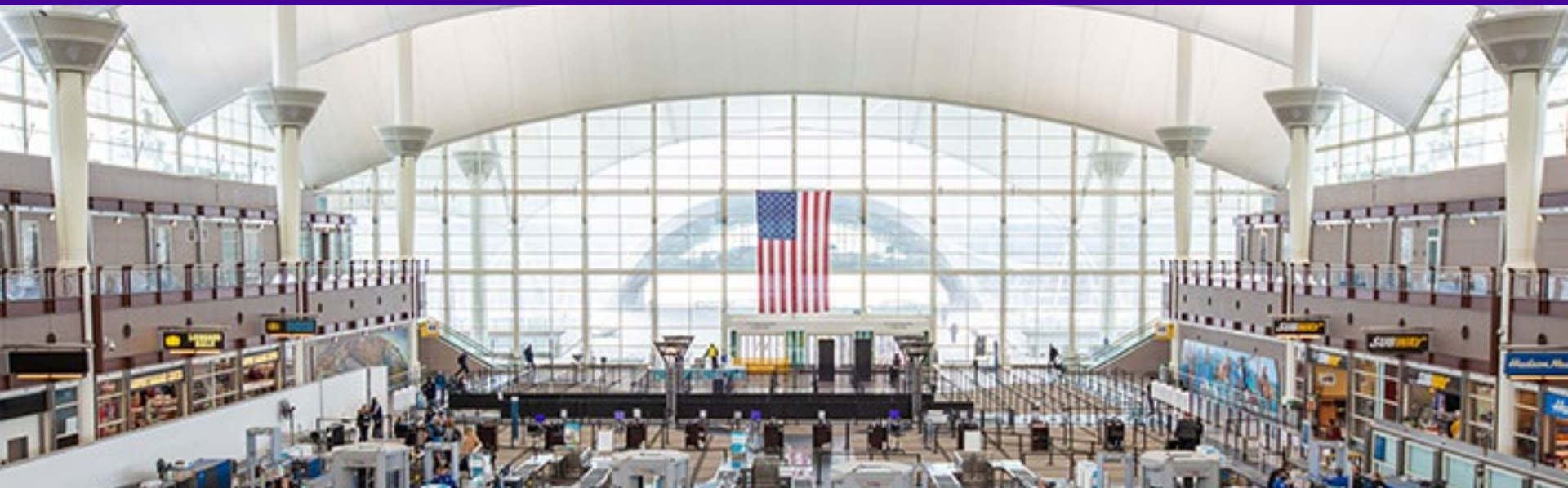


Data from Zach Stein-Perlman, Benjamin Weinstein-Raun, Katja Grace – 2022 Expert Survey on Progress in AI.

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# THE CHANGING WORLD...





# QUESTIONS?

Contact: [Brendan.Dillon@flydenver.com](mailto:Brendan.Dillon@flydenver.com)