Designing Beyond - Improving Airport Operations through BIM

September 22, 2020

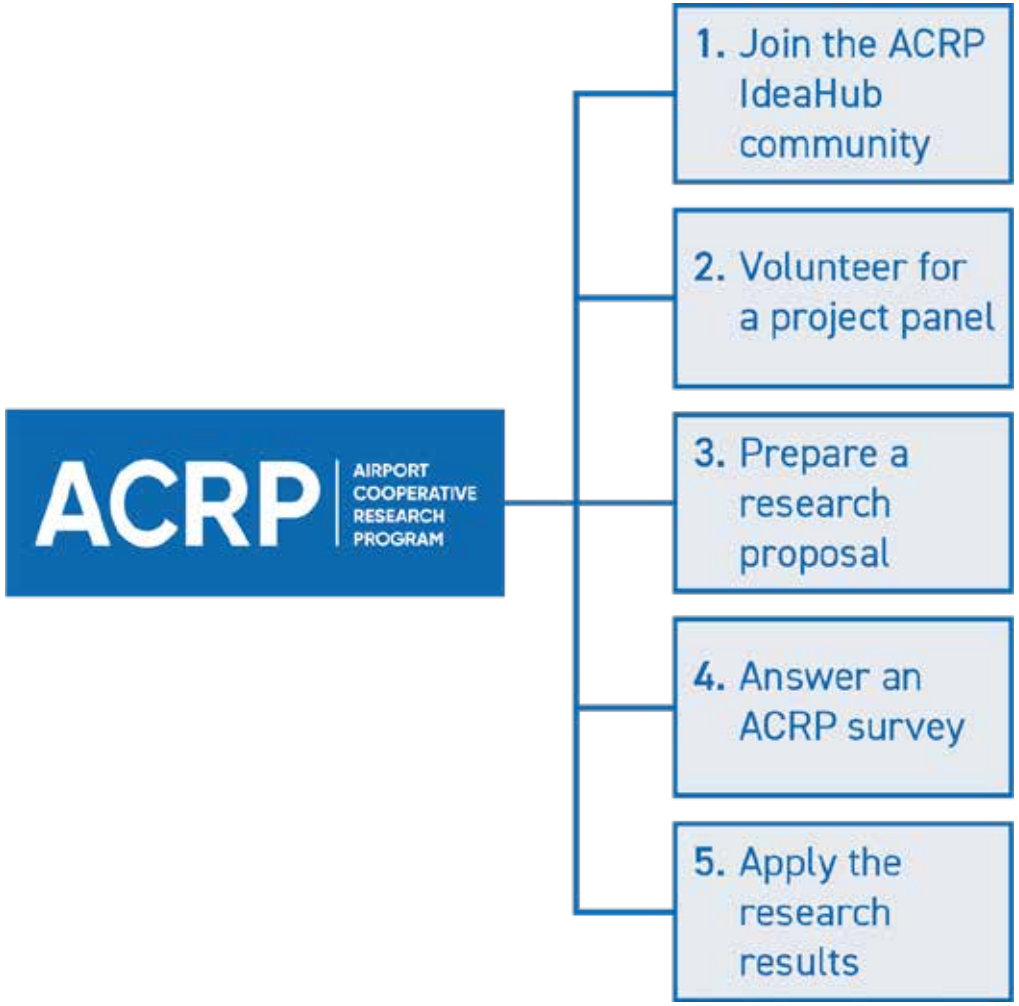
The National Academies of
SCIENCES · ENGINEERING · MEDICINE
TRB
TRANSPORTATION RESEARCH BOARD

ACRP
AIRPORT COOPERATIVE RESEARCH PROGRAM

Mark Day
Blue Grass Airport

Q Director of Development and Facilities

Five Ways to Get Involved!



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www.trb.org/ACRP

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Principal Investigator

- Vice President and COO, CCI Engineering Services
- CM-BIM
- Over 60 BIM Projects in Aviation, Healthcare, Universities and Public Utilities
- 30+ years of technology and information management experience

Angela Newland, P.E., A.A.E.

- Senior Project Manager, CCI Engineering Services
- Former Assistant Director of Aviation – Airport Development, Broward County Aviation Department (FLL, HWO)
- Former Vice President of Planning & Engineering, Columbus Regional Airport Authority (CMH, LCK, TZR)

Josephine Pofsky
San Francisco International Airport (SFO)

- Director of Infrastructure Information Management
- Oversees both enterprise GIS and BIM operations
- Technology visioning lead for Planning, Design and Construction

ACRP Report 214

Designing Beyond –Improving Airport Operations through BIM

Mark Day, Blue Grass Airport - Moderator
Jack Ray, CCI Engineering Services
Angela Newland, CCI Engineering Services
Josephine Pofsky, San Francisco International Airport

ACRP Report 214 Oversight Panel

Mark J. Day, Blue Grass Airport, Panel Chairman
Eddie R. Clayson, Salt Lake City Department of Airports
Jennifer L. Mims, Jacobs Engineering
John M. Payne, Pueblo Technology Group, Inc.
Mindy J. Price, Direct Effect Solutions, Inc.
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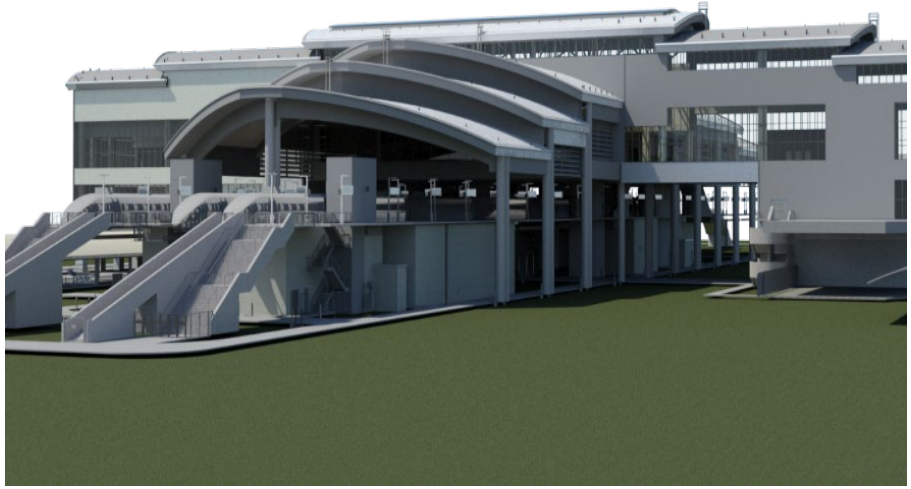
Danielle J. Rinsler, FAA Liaison
Paul J. Eubanks, Airports Council International – North America Liaison
Christine Gerencher, TRB Liaison
Marci Greenberger, ACRP Senior Program Officer

ACRP Report 214: BIM Beyond Design Guidebook Overview

- Assist airports in developing the business case to use Building Information Modeling (BIM) for asset management
- Provide guidance in developing BIM strategy, identifying stakeholders, determining BIM governance structure, and establishing BIM performance metrics
- Help airports identify how to scale the use of BIM

Webinar Agenda

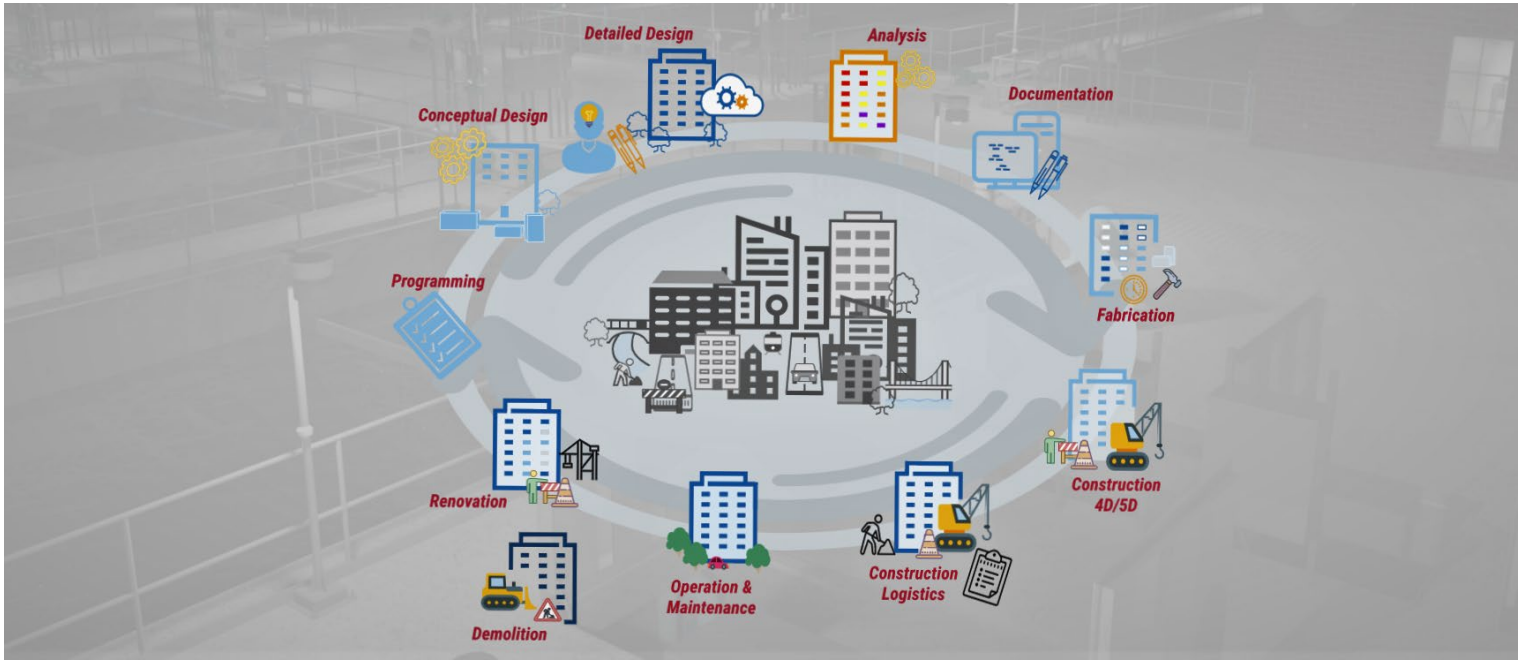
- 1. Major components of a comprehensive, lifecycle BIM program - Angela
- 2. Metrics to establish effective BIM controls and to measure BIM program success - Jack
- 3. Overview of airport survey data on current uses of BIM – Angela
- 4. Airport Case Studies – Jack Ray and Josephine Pofsky, SFO



Learning Objectives

At the end of this webinar, you will be able to:

- ✈ Describe lifecycle BIM practices
- ✈ Identify how to implement BIM effectively

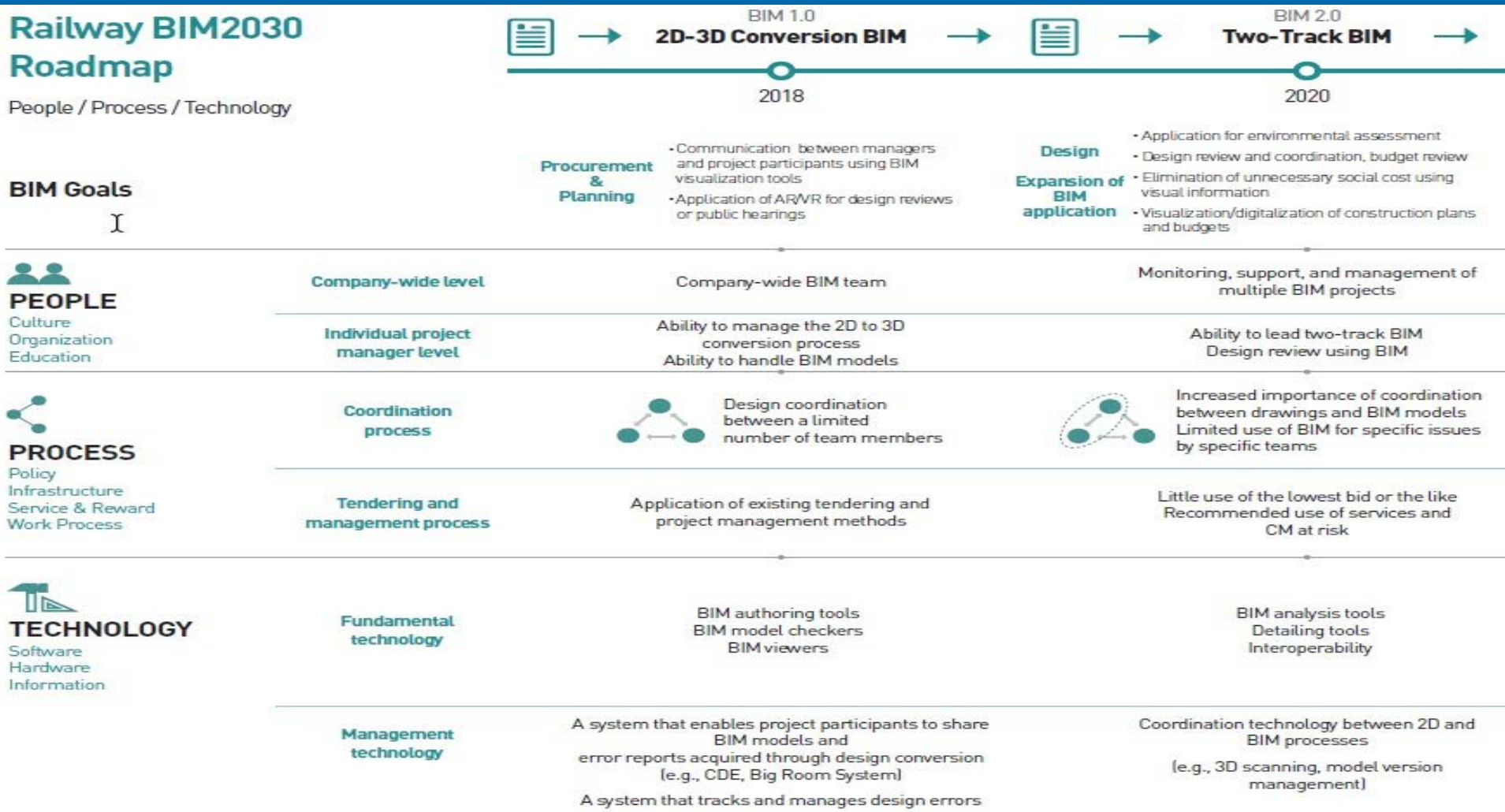


Major components of a comprehensive lifecycle BIM program

BIM Organizational Assessment

- ✈ Perform a BIM Needs Assessment
- ✈ Develop a Data Flow Diagram
- ✈ Perform a BIM Capabilities Assessment
- ✈ Develop a BIM Roadmap

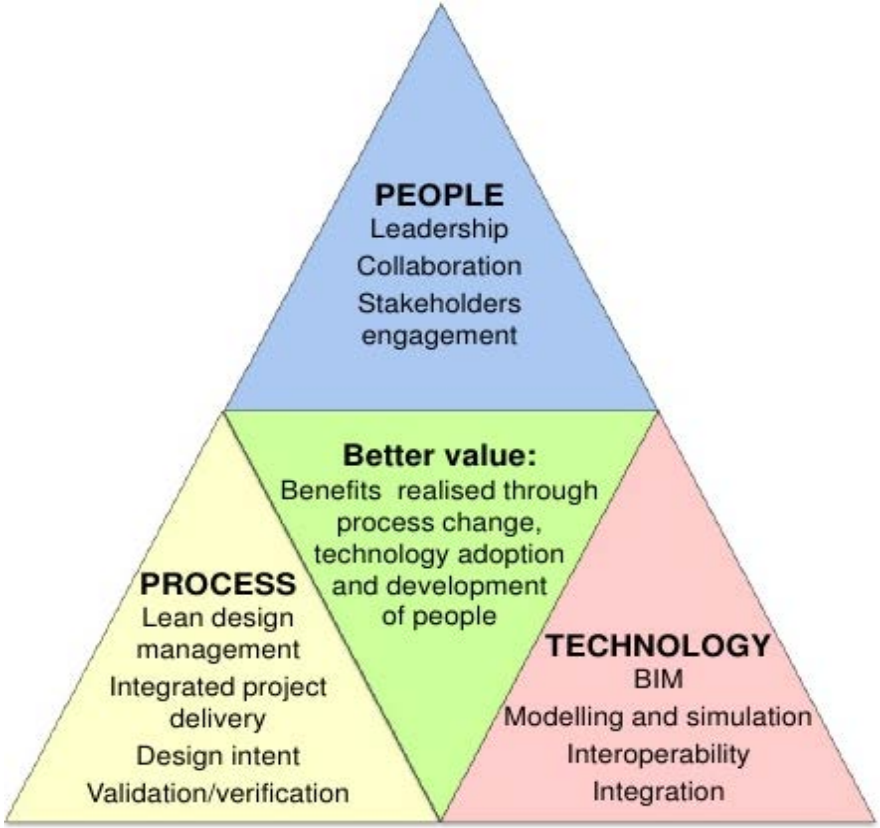
Major components of a lifecycle BIM program – Korean Rail BIM Roadmap



Major components of a comprehensive lifecycle BIM program

Prepare Stakeholders for Implementation

- Develop a BIM Capabilities Maturity Model
- Identify the Airport's BIM Champion
- Determine who will maintain the Airport's BIM
- Provide BIM training

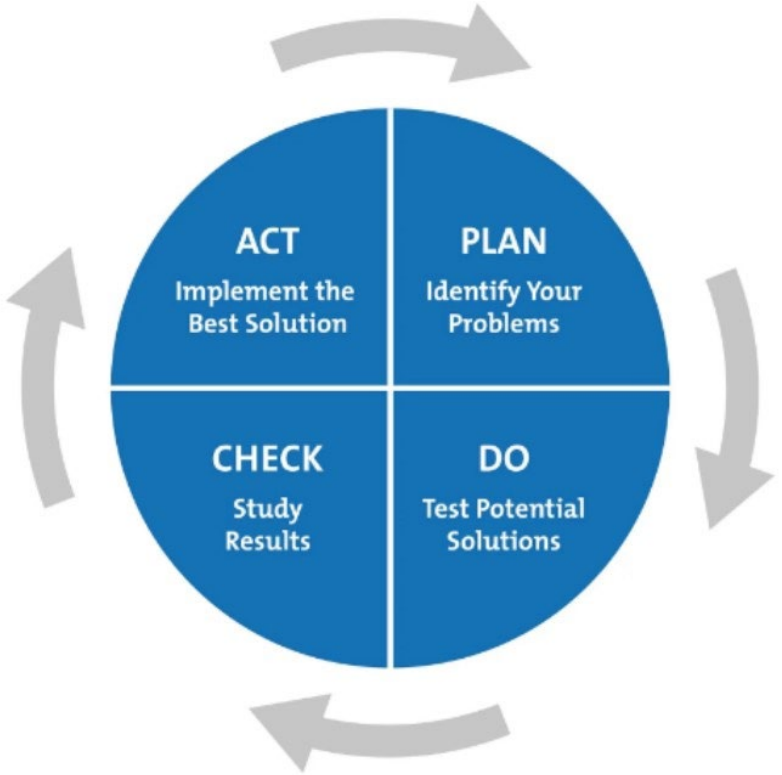


Source: buildingSmart Finland

Major components of a comprehensive lifecycle BIM program

Financial Analysis

- BIM Pilot Program
- Benefits and costs of BIM
- Business Case for BIM
- BIM Return on Investment (ROI) goals



Source: Six Sigma Plan Do Check Act Cycle

Major components of a comprehensive lifecycle BIM program

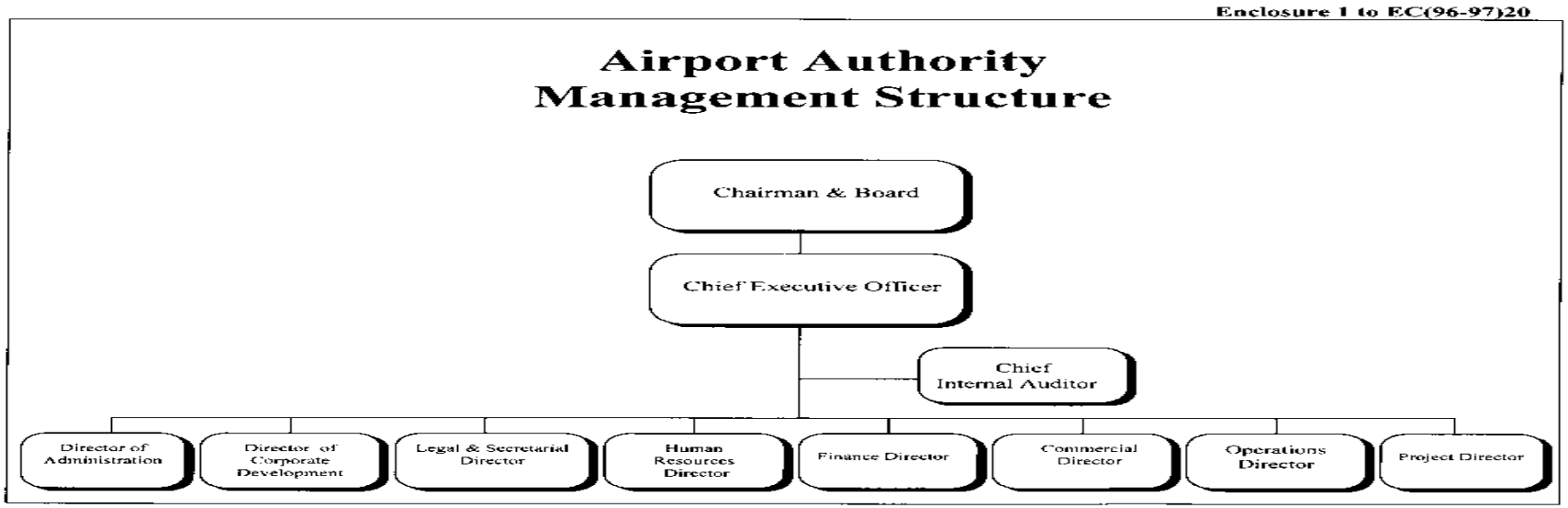
BIM Implementation

- Technical Architecture
- Integration of BIM with existing systems
- Standards, Execution Plans, Required Data Elements

Major components of a comprehensive lifecycle BIM program

BIM Controls

- ✈ Governance
- ✈ Progress Metrics
- ✈ Legal and Liability Issues



Metrics to establish effective BIM controls and measure success

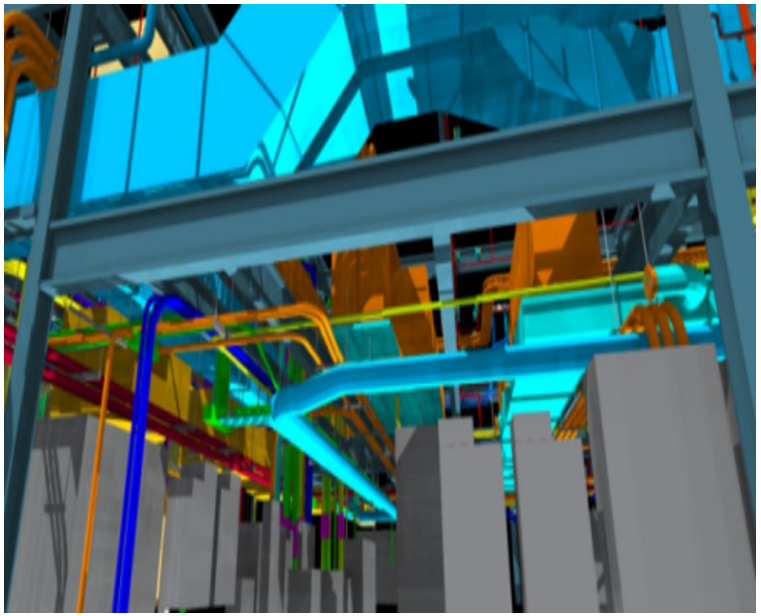
Maintenance Planning

- Wrench Time/Average Time to Resolve Issues
  - Reduced time for field investigations
  - PM tasks bundling reduces travel time
  - Design for maintainability reduces maintenance time per asset

Metrics to establish effective BIM controls and measure success

Maintenance Planning

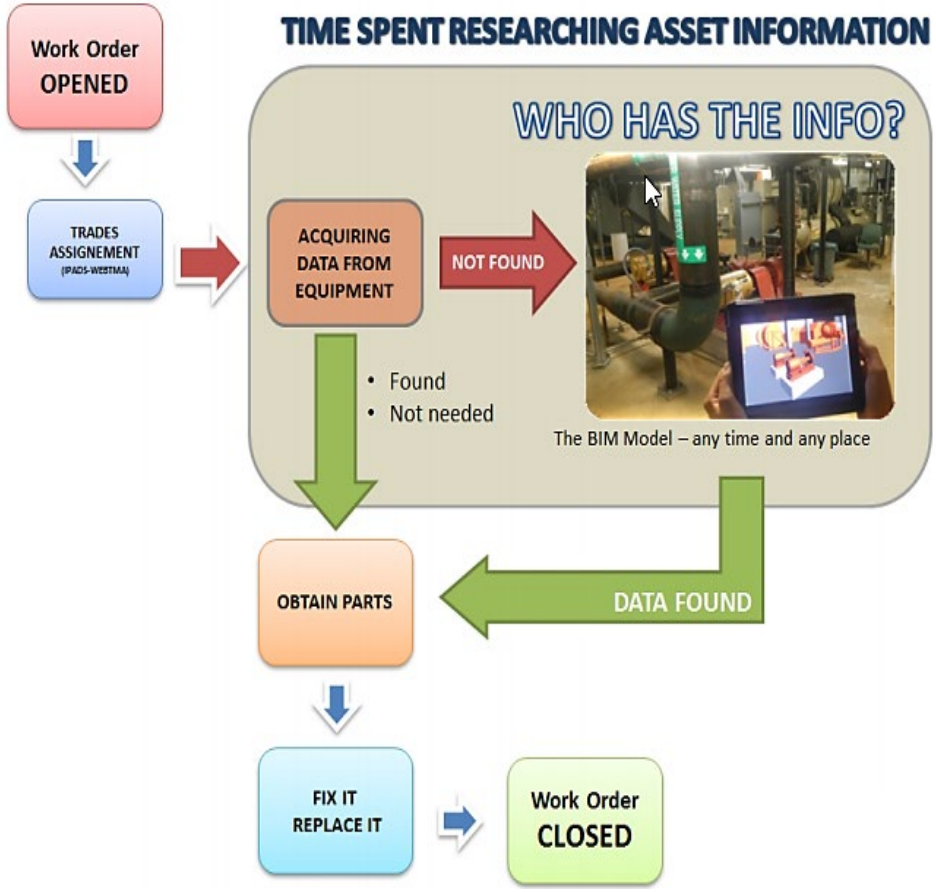
- Asset Uptime
  - Increased wrench time reduces PM backlog and increases asset uptime
- Condition Assessment
  - Spatial analysis/correlation of asset condition deficiencies with environmental and PM backlog issues



Metrics to establish effective BIM controls and measure success

Asset Management

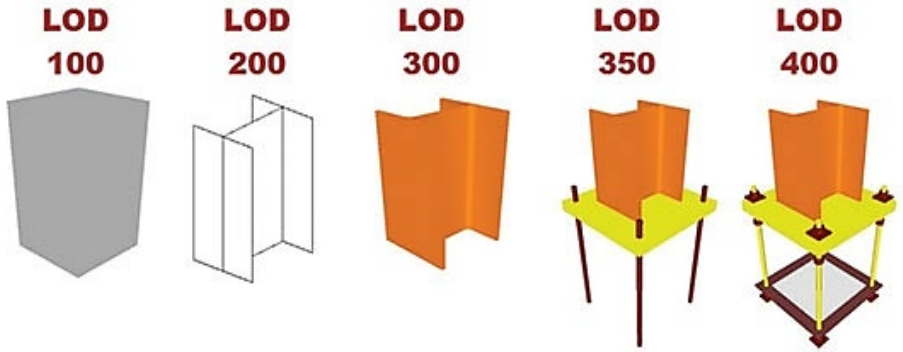
- Time to enter new assets after capital project completion
  - BIM to Enterprise Asset Management (EAM) exports/ integration
- Asset Inventory
  - Reduce reliance on institutional memory
- Capital Planning
  - Spatial visualization of condition deficiencies, asset end-of-life



Metrics to establish effective BIM controls and measure success

Additional Metrics

- Contractor BIM Capabilities
  - BIM submittal reviews/report cards
  - Ability to meet BIM PxP requirement/standards
    - Level of Development
    - Equipment Information Requirements (EIR)
    - Coordination capabilities



Metrics to establish effective BIM controls and measure success

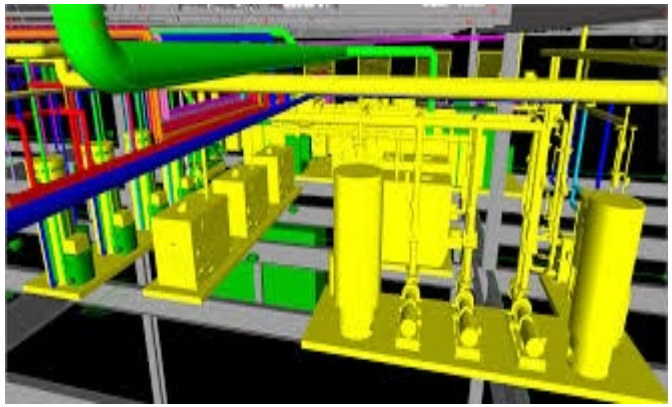
Additional Metrics

- ✈ Airport Organizational BIM Capabilities
  - Existence of BIM standards and processes
  - BIM accessibility to staff/number of BIM accesses
  - # of BIM information exchanges with other info systems
  - % of staff with BIM training

Metrics to establish effective BIM controls and measure success

Data Collection

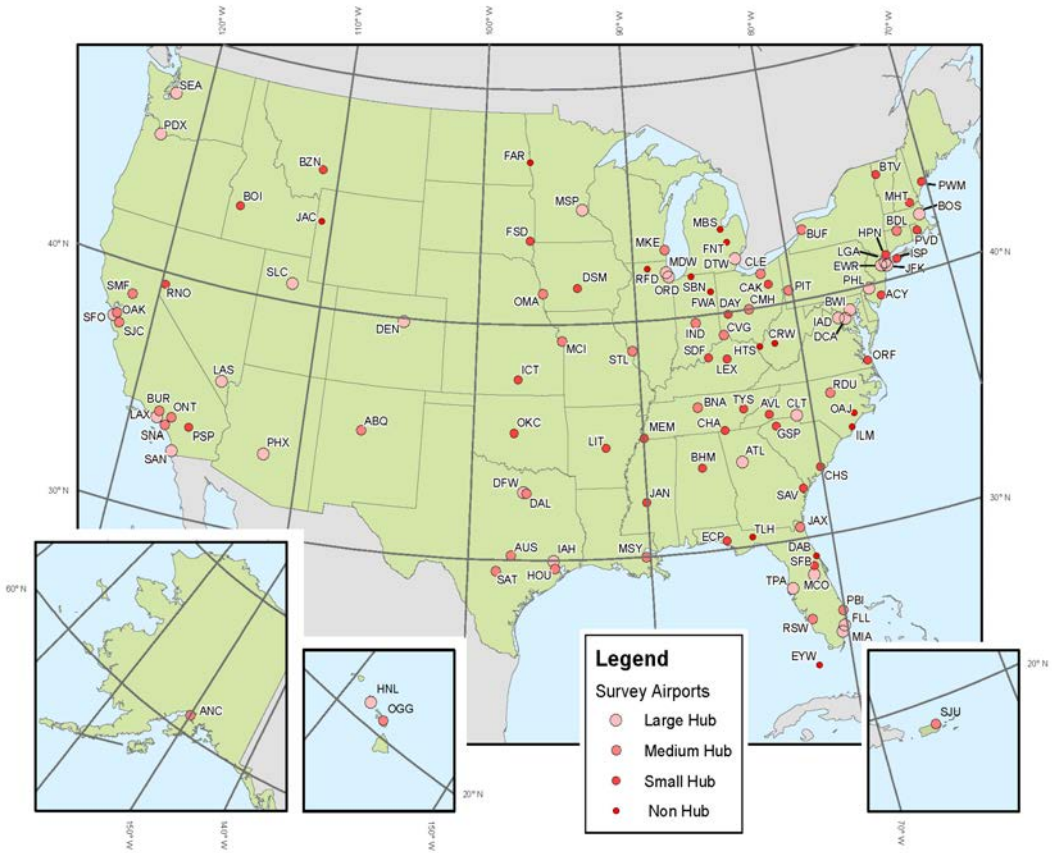
- BIM tied to airport coordinate system
- % of capital projects where BIM is utilized
  - Defined criteria for when BIM is required
- % of managed facility space included in BIM/SlimBIM
- Average time for integration of new assets with BIM & EAM systems after new capital projects
- Well defined asset hierarchy, asset attributes used with BIM & EAM



Airport survey data on uses of BIM

Summary

- 64 U.S. airports responded
- Most from FAA Eastern & Southern Regions
- 75% from large & medium hub airports
- Less than 40% are using BIM
- 30% have used BIM in operations & maintenance

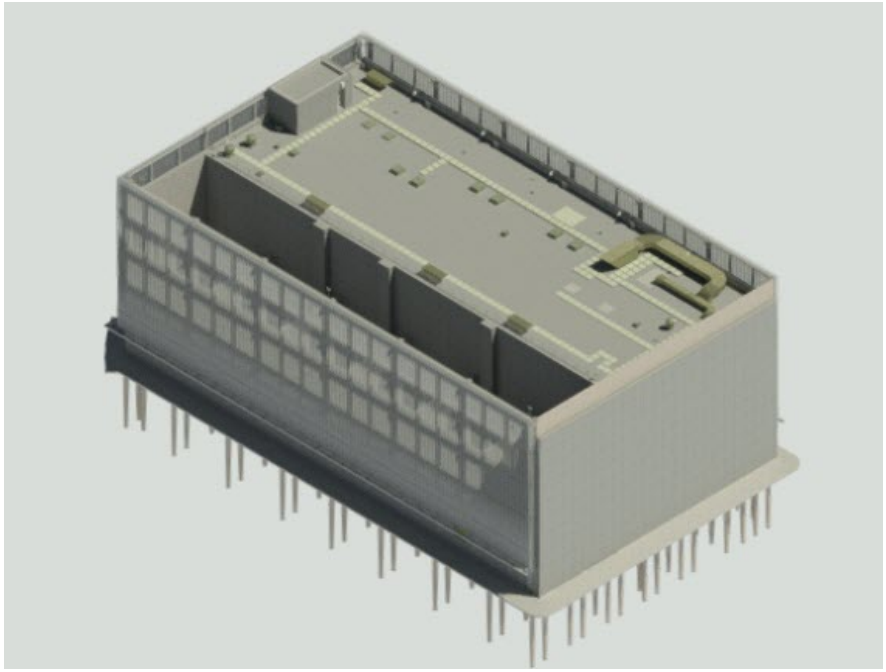


--U.S. Airports Receiving Surveys—

Airport survey data on uses of BIM

Summary

- 50% maintain BIM after project completion
- Only 10% expect BIM to not be worth the cost
- No airport had a complete BIM for all facilities
- No airport had complete and accurate CAD for all facilities
- 75% plan on using BIM in the next 5 years



Airport survey data on uses of BIM

Summary

- Few airports have a BIM Manager
- BIM Manager usually resides in Engineering Department
- 63% rely solely on BIM consultants
- 50% have BIM Standards, 40% have BIM Execution Plans
- 53% have standard contract language for BIM
- 20% have more than 5 completed BIM projects

Non-airport entities using BIM

Case Studies

- Ohio State University
- Western Michigan University
- New York Presbyterian Hospital
- Perth Children's Hospital
- New Royal Adelaide Hospital
- Sydney Opera House

Airport Case Studies - DEN

Denver International Airport BIM:

- ✈ BIM Standards and Processes Developed
- ✈ Contractor BIM Capabilities Development
  - Submittal Reviews/Report Cards
  - Contract Language
- ✈ Organizational BIM Capabilities Maturity
  - Dedicated BIM Team
  - All major facility spaces scanned and BIM accessible
  - All major projects performed with BIM requirements
  - Post construction BIM uses
  - BIM ROI measurements

Airport Case Studies - MassPort

Massachusetts Port Authority

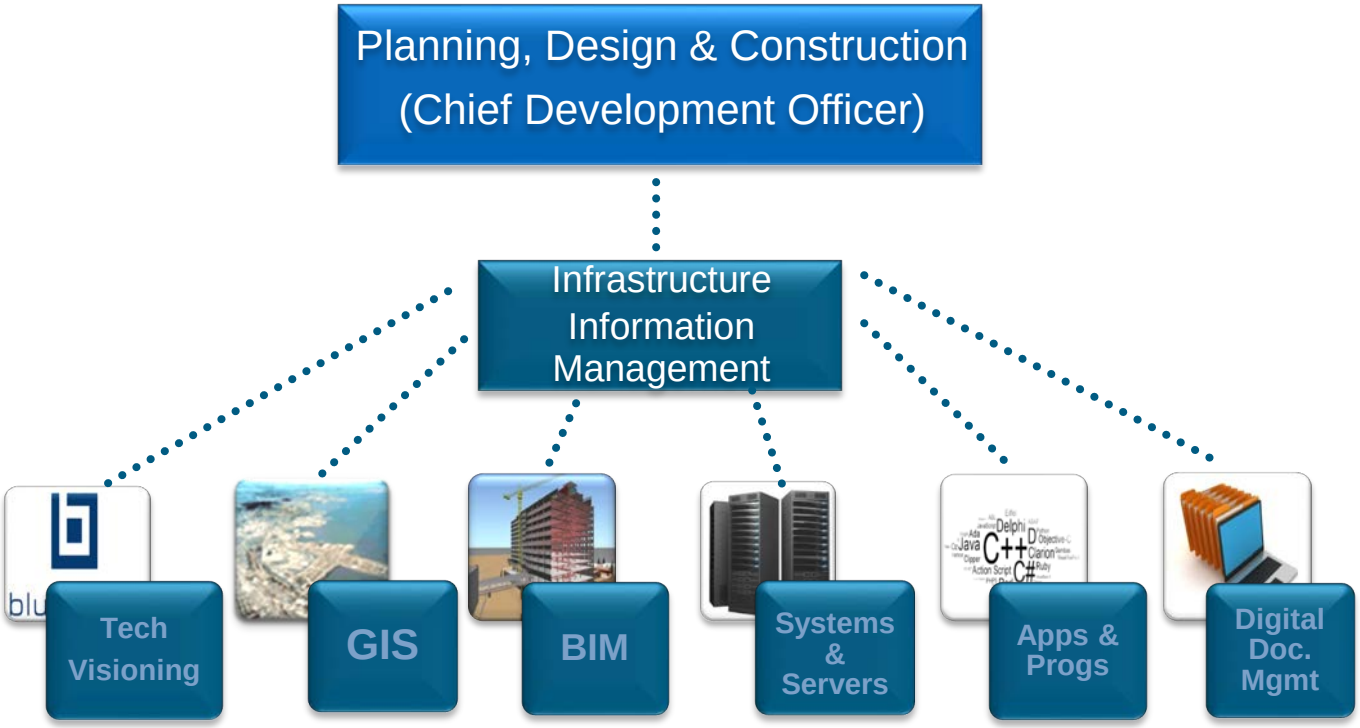
- BIM Roadmap developed
- BIM Standards and Processes
- BIM supports Lean Process Flows
  - Reduces cost of facility data management
  - Predictive Maintenance capabilities
- Integrated facility management platforms
  - Life cycle planning and management

Airport Case Studies - SFO

San Francisco Int'l Airport BIM:

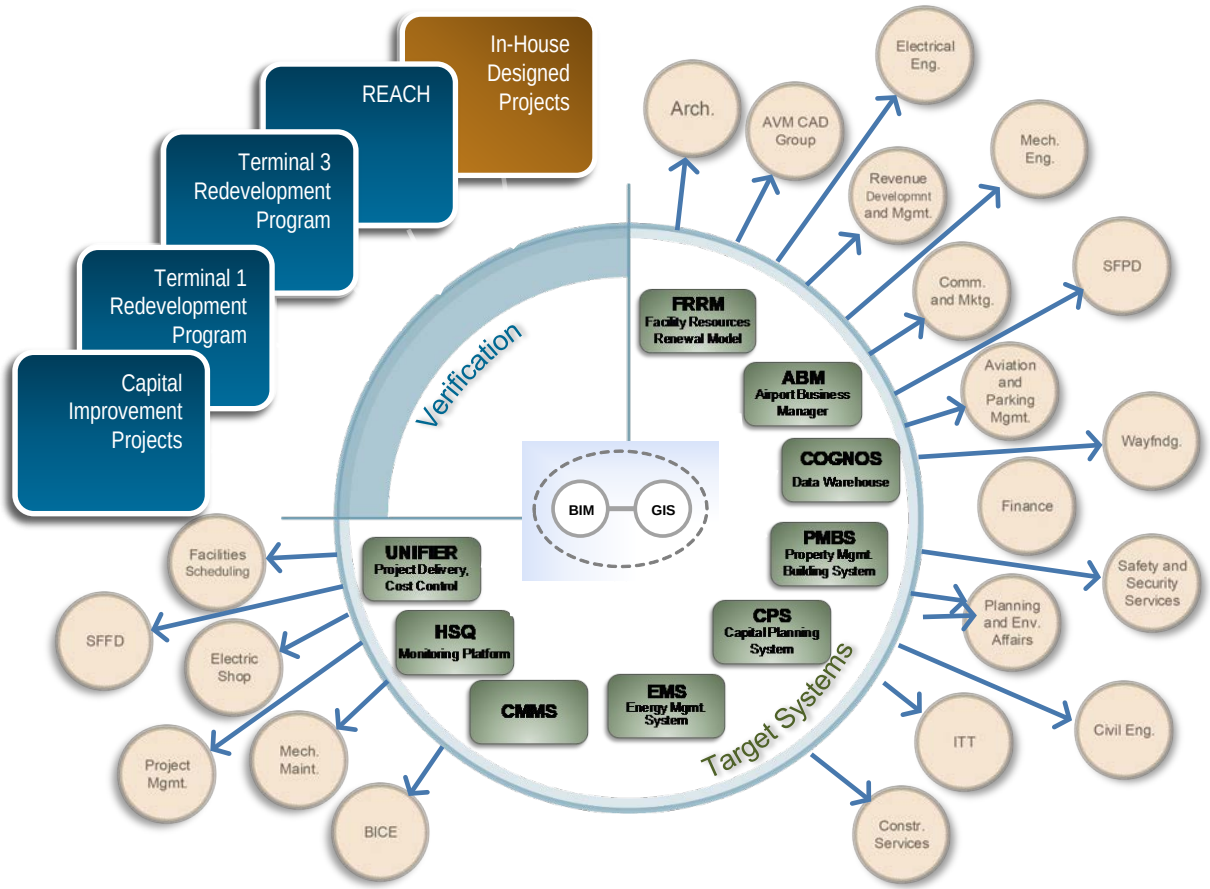
- BIM as a tool to support Progressive Design Build (PDB) methodology
  - Increased collaboration/communication
  - Reduced change orders
  - Reduced schedules
  - Improved quality
  - Improved organizational readiness when new facilities come online
- Rapid post-construction asset creation in EAM

Organization Structure

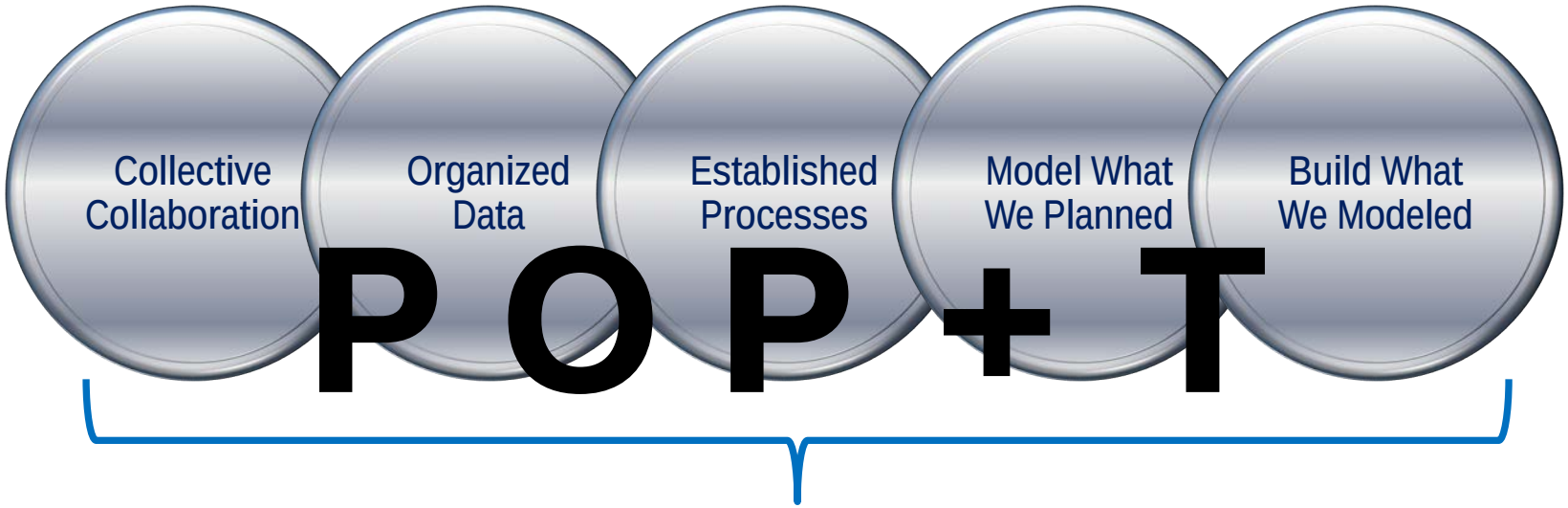


Capital Program

Centralized Integrated Infrastructure Info.

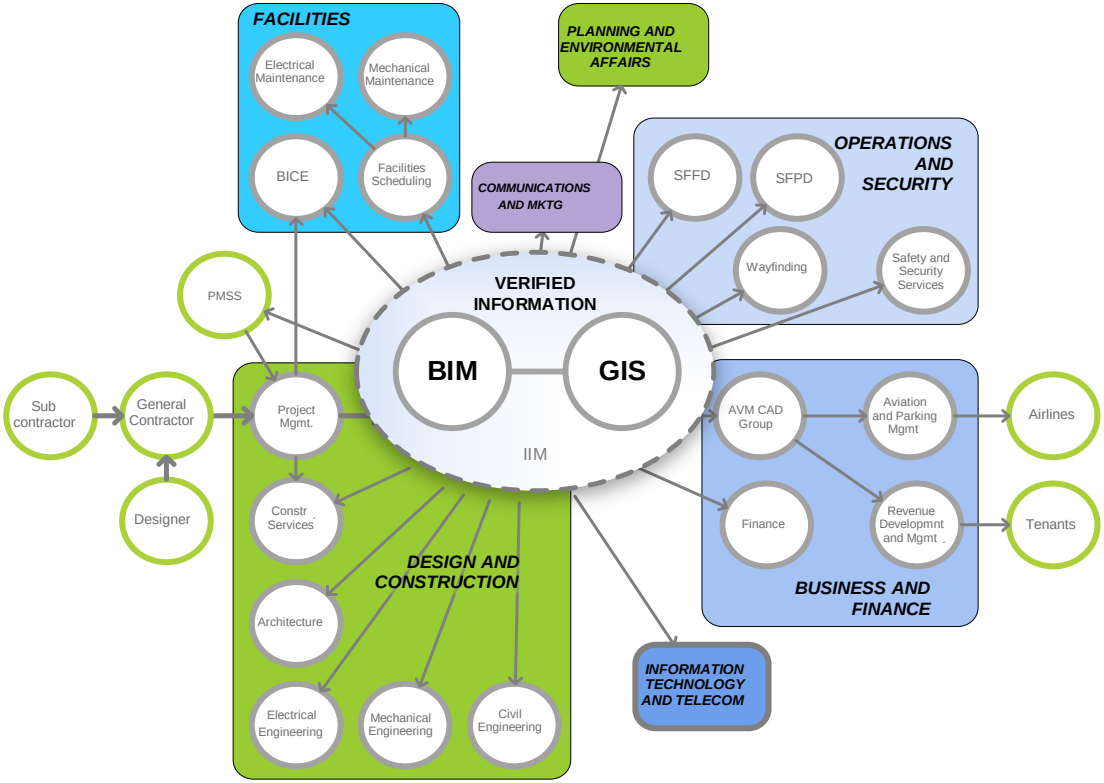


Virtual Design & Construction Principals

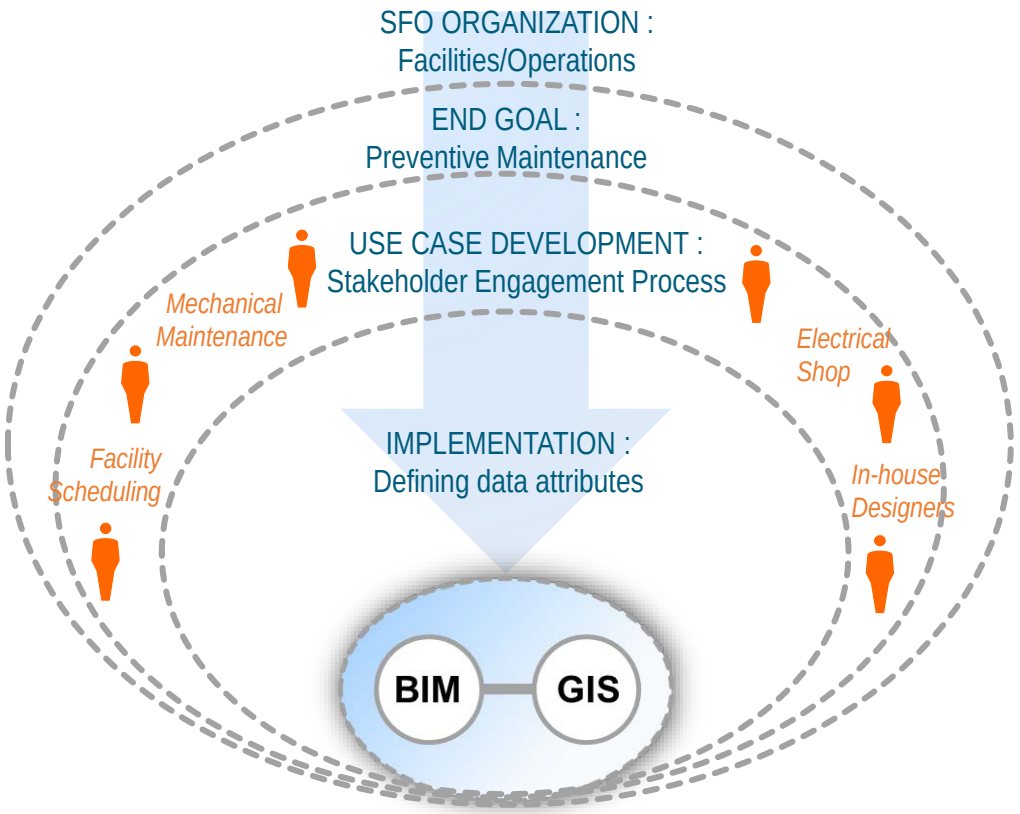


People, Organization
Process + Technology

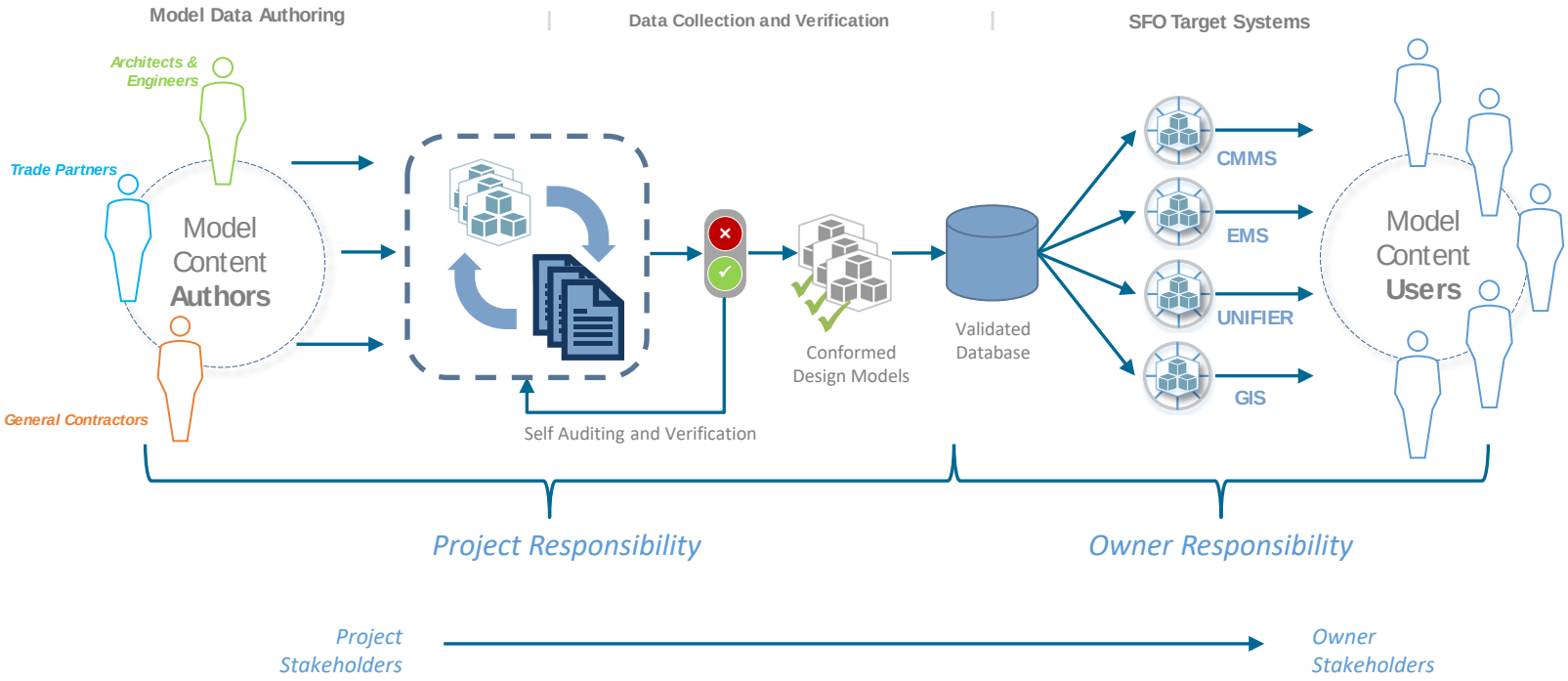
Stakeholder Engagement



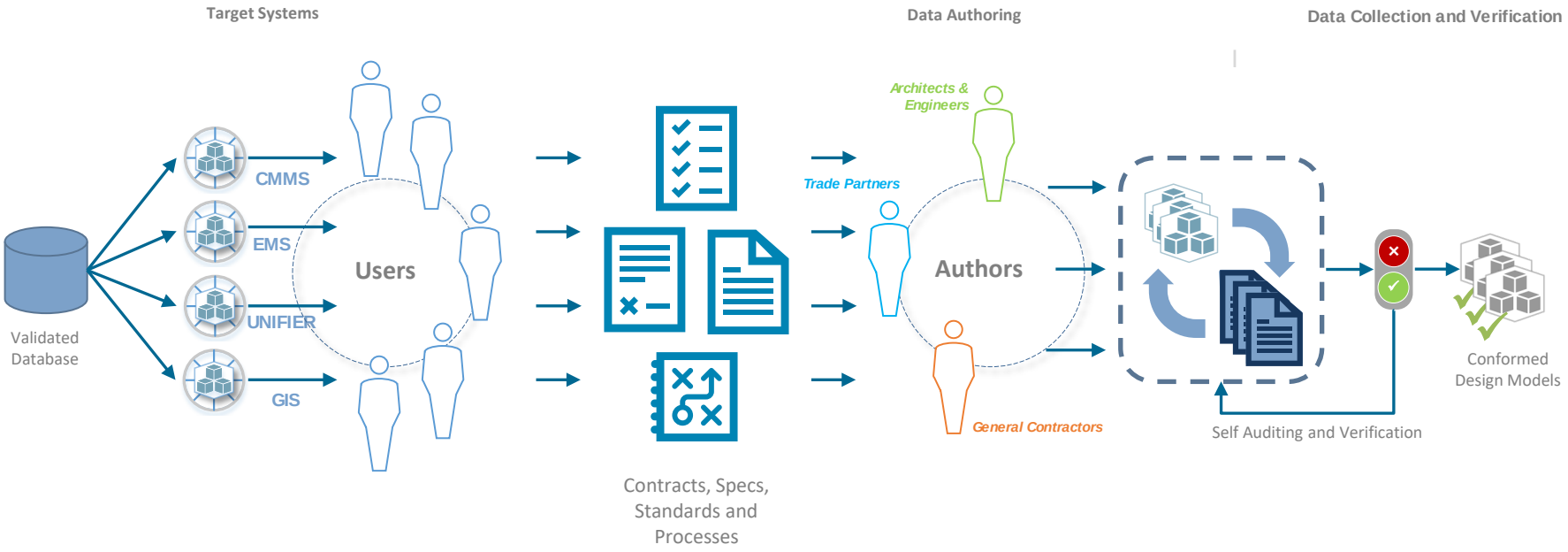
Stakeholder Engagement



Project Workflow



Project Workflow

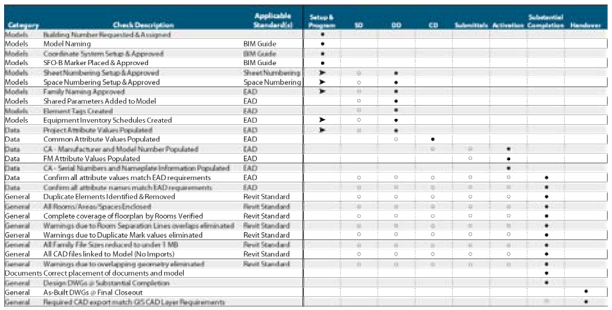



Building Information Modeling Guide
Element Attributes Standard
Coordinate System
Sheet Numbering
Version: December 2018
Numbering and Naming Levels, Spaces and
Revit Standard
CAD Standard
BIM to GIS Standard
SFO

Collaboration Tools

Engagement Strategy
(Execution Roadmap)

Deliverable Checklist
(Performance Tracking)



Model and Data
Acceptance Criteria
(Sign-off for Closeout)

Collaboration Tools

Category	Check Description	Applicable Standard(s)	Setup & Program	SD	DD
Models	Building Number Requested & Assigned		●		
Models	Model Naming	BIM Guide	●		
Models	Coordinate System Setup & Approved	BIM Guide	●		
Models	SFO-B Marker Placed & Approved	BIM Guide	●		
Models	Sheet Numbering Setup & Approved	Sheet Numbering	➤	○	●
			➤	○	●
			➤	○	●
Models	Space Numbering Setup & Approved	Space Numbering		○	●
Models	Family Naming Approved	EAD		○	●
Models	Shared Parameters Added to Model	EAD	➤	○	
Models	Element Tags Created	EAD	➤	○	
Models	Equipment Inventory Schedules Created	EAD			
Data	Project Attribute Values Populated	EAD			
Data	Common Attribute Values Populated	EAD			
Data	CA - Manufacturer and Model Number Populated	EAD			
Data	FM Attribute Values Populated	EAD		○	○
				○	○
Data	CA - Serial Numbers and Nameplate Information Populated	EAD		○	○
Data	Confirm all attribute values match EAD requirements	EAD		○	○
Data	Confirm all attribute names match EAD requirements	EAD		○	○
General	Duplicate Elements Identified & Removed	Revit Standard		○	○
General	All Rooms/Areas/Spaces Enclosed	Revit Standard		○	○
General	Complete coverage of floorplan by Rooms Verified	Revit Standard		○	○
				○	○
General	Warnings due to Room Separation Lines overlaps eliminated	Revit Standard			
General	Warnings due to Duplicate Mark values eliminated	Revit Standard			
General	All Family File Sizes reduced to under 1 MB	Revit Standard			
General	All CAD files linked to Model (No Imports)	Revit Standard			
General	Warnings due to overlapping geometry eliminated	Revit Standard			
Documents	Correct placement of documents and model				
General	Design DWGs @ Substantial Completion				
General	As-Built DWGs @ Final Closeout				
General	Required CAD export match GIS CAD Layer Requirements				

SFO BIM INTEGRATION TEAM

SFO

Model & Data Validation Report Transmittal

Project Name:	T1C
Submitter:	TBD
Submittal Date:	7/11/2019
Milestone:	9 Gate
Report Author:	Ryan Meacham
Report Date:	8/9/2019

Report Contents:

- Cover Sheet/Transmittal
- Tutorial
- Coordinate System Checks
- Model Fidelity
- Model Fidelity Results
- Appendix: MVR Corrective Actions

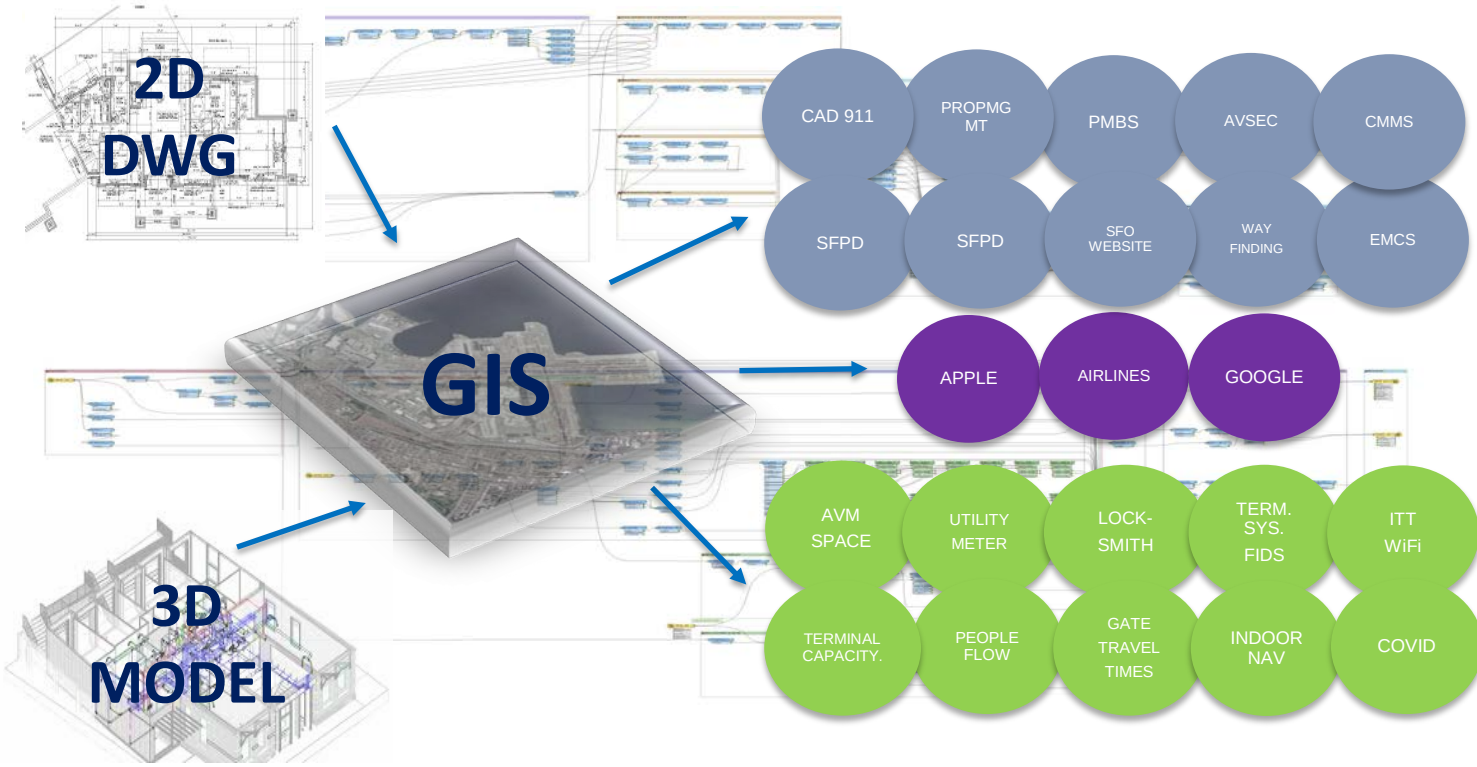
Purpose:

The Airport verifies the incremental development of models to avoid the need for last-minute, extensive clean-up or re-organization. The checks are based on current industry best practices and recommended modeling techniques. Refer to the SFO Revit Standard for further details. No checks should result in recommended corrective actions at project handover. Follow recommended corrective actions as appropriate after intermediate reports.

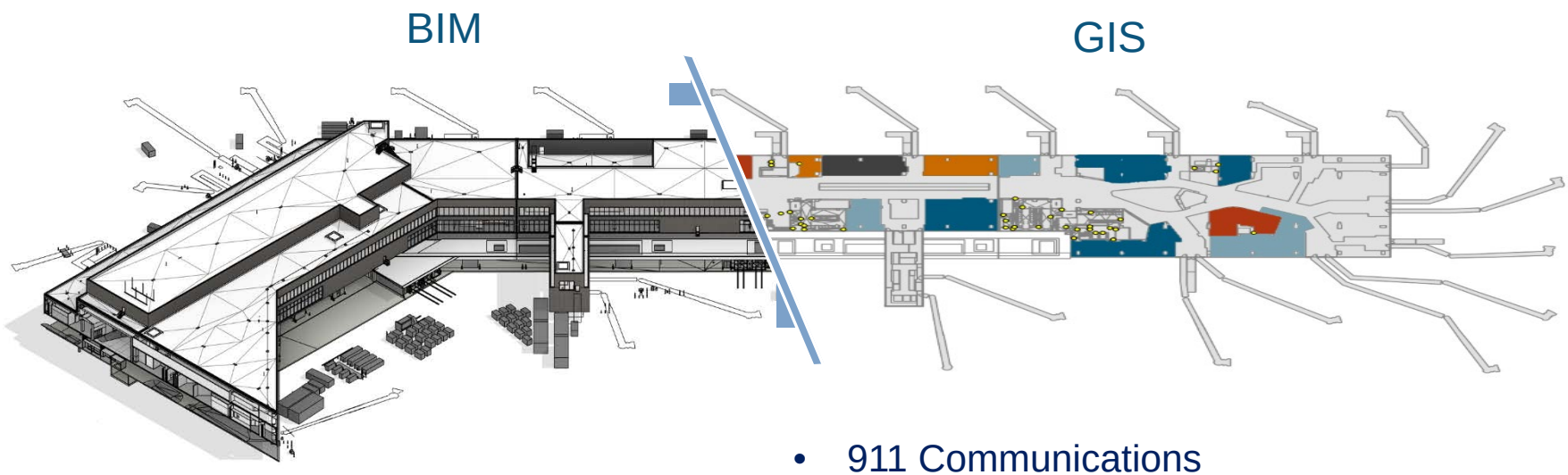
List all models submitted below with the intended checks you wish the SFO BIM Integration Team to perform. Insert rows as needed. Please note, some checks are mandatory at all milestones and will be reflected accordingly.

Submitted Models	Model Fidelity	Data Fidelity	Coordinate System
SFIA-T1C_A_EXT_GEN.rvt	Yes	Yes	Yes
SFIA-T1C_A_FURN_GEN.rvt	Yes	No	Yes
SFIA-T1C_A_INT1_GEN.rvt	Yes	Yes	Yes
SFIA-T1C_A_INT2_GEN.rvt	Yes	Yes	Yes
SFIA-T1C_E_REG.rvt	Yes	Yes	Yes
SFIA-T1C_FP_TFP.rvt	Yes	Yes	Yes
SFIA-T1C_M_CMI.rvt	Yes	Yes	Yes
SFIA-T1C_MP_CMI.rvt	Yes	Yes	Yes
SFIA-T1C_P_CMI.rvt	Yes	Yes	Yes

BIM to GIS

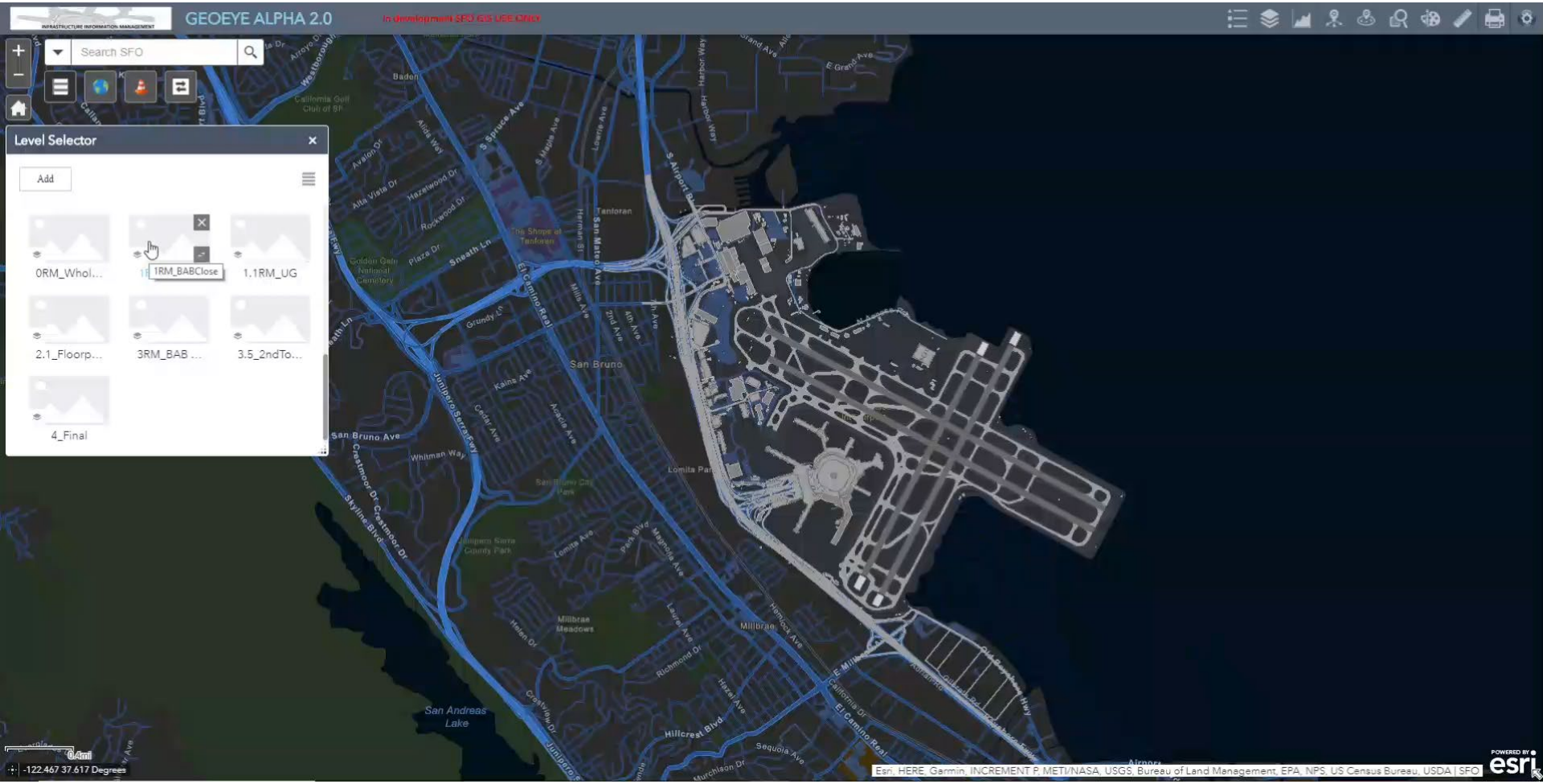

2D
DWG
3D
MODEL
GIS
CAD 911
PROPMG MT
PMBS
AVSEC
CMMS
SFPD
SFPD
SFO WEBSITE
WAY FINDING
EMCS
Internal Systems
APPLE
AIRLINES
GOOGLE
External Applications
AVM SPACE
UTILITY METER
LOCK-SMITH
TERM. SYS. FIDS
ITT WiFi
TERMINAL CAPACITY.
PEOPLE FLOW
GATE TRAVEL TIMES
INDOOR NAV
COVID
Planning & Analytics

BIM to GIS



- 911 Communications
- Facilities Maintenance (CMMS)
- Space Planning (COVID / Safety by Design)
- Commissioning and Activation
- Wayfinding
- Indoor Navigation

BIM to GIS


GEOEYE ALPHA 2.0
In development SFO GIS USE ONLY
Search SFO
Level Selector
Add
0RM_Whol...
1RM_BABClose
1.1RM_UG
2.1_Floorp...
3RM_BAB ...
3.5_2ndTo...
4_Final
San Bruno
San Andreas Lake
Millbrae
Millbrae Meadows
Lomita Park
-122.467 37.617 Degrees
Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA | SFO
esri

Summary – Improving Airport Operations through BIM

ACRP Research Report 214

- Based on extensive research of airport and non-aviation BIM uses beyond construction
- Describes lifecycle BIM practices
- Identifies how to implement BIM effectively for each airport's specific needs
- Continued research is recommended as BIM continues to be more widely used in operations and maintenance

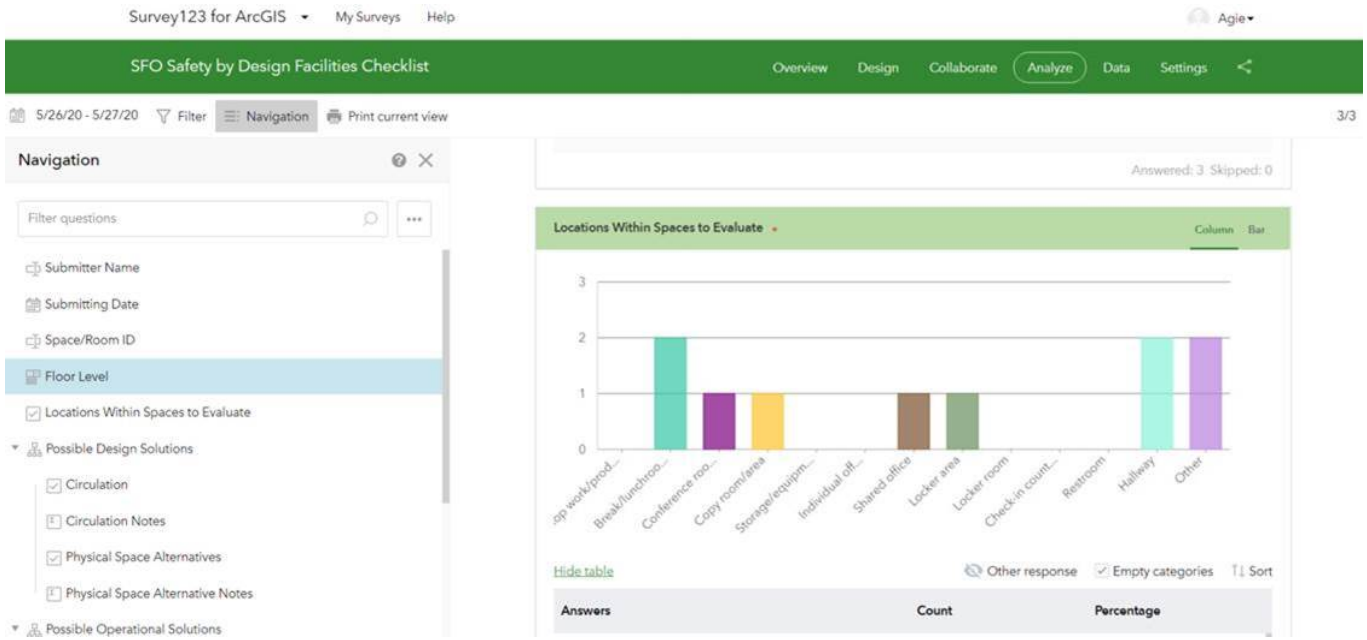
FOR ADDITIONAL INFORMATION

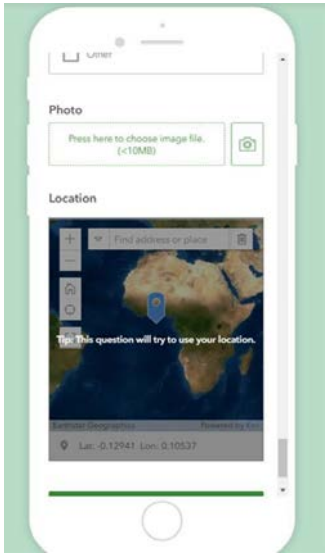
Jack Ray
jack@ccitechs.com

BIM and Airport COVID Responses

- Facility disinfection planning tool
  - Surface cleaning and treatment specific asset attributes using CDC recommendations
  - Generate facility cleaning maps and "quantities" of surface types for budgeting and manpower scheduling
- BIM transit analysis tools can be used to plan required terminal modifications to enforce spatial distancing requirements and the impacts on airport capacity
- BIM and computational fluid dynamics (CFD) can be used to identify areas of low air flow/turnover where air filtration is not providing adequate protection- and design required HVAC system improvements
- BIM and lighting analysis tools can be used to optimize the placement of permanent/temporary UV lighting sources for overnight disinfection

COVID Responses (SFO)





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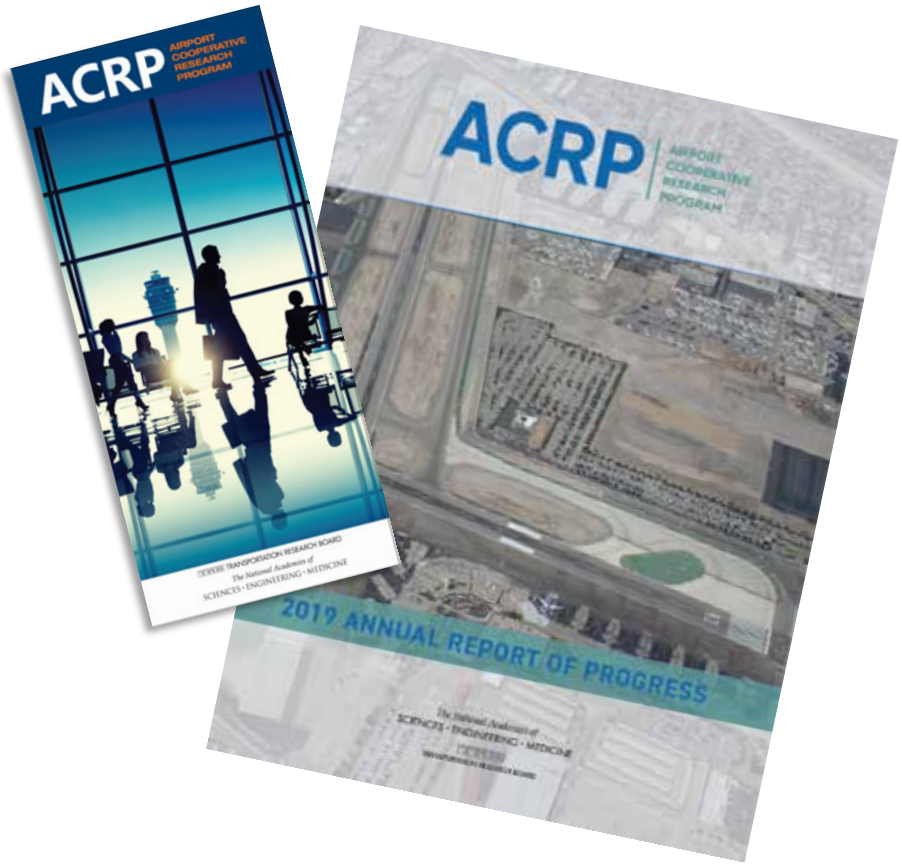
- Managed by TRB and sponsored by the Federal Aviation Administration (FAA).
- Seeks out the latest issues facing the airport industry.
- Conducts research to find solutions.
- Publishes and disseminates research results through free publications and webinars.



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Sponsor or become an ACRP Champion. The champion program is designed to help early- to mid-career, young professionals grow and excel within the airport industry.

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Other ACRP Research on Today's Topic

Report 19A: ***Resource Guide to Airport Performance Indicators***

Report 155: ***Guidebook for Advanced Computerized Maintenance Management System Integration at Airports***

Report 172: ***Guidebook for Considering Life-Cycle Costs in Airport Asset Procurement***

Synthesis 70: ***Building information Modeling for Airports***

Synthesis 94: ***Attracting Investment at General Aviation Airports Through Public-Private Partnerships***

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October 7
Weather the Storm - Climate Resilience at Airports

October 29
Set the Stage - Estimating Market Values for Small Airports

November 5
Wetland Mitigation at Airports