UT5413 - It’s the “V” in “BIM”

A Vision for BIM for Electric & Gas Utility Engineering Design

Willie Thomas, P.E.

Manager, Electric Transmission Engineering & Design
San Diego Gas & Electric Co.

Class summary

Transformation of an organization’s legacy engineering design systems first requires a vision. This class discusses the vision for transforming SDG&E’s Electric Transmission and Substation Engineering design and construction process using BIM for 3D intelligent design. The transformation includes the implementation of a number of Autodesk solutions in an integrated mosaic of engineering design workflows, starting with conceptual design using Infraworks, followed by detailed design and analysis with Civil3D, Inventor, ACAD Electrical and SDS (Substation Design Solution). A fundamental concept is the adoption of 3D model components for engineering design standardization and construction standards publishing and training. The transformation will be complete with the implementation of BIM 360 for construction QA/QC management. A strategic multi year plan will be discussed and visuals will be demonstrated that are being used to convey the vision and build consensus across the organization.

Key learning objectives

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

- Describe methodologies for gathering **requirements** and **strategic planning**
- Understand how Autodesk tools can be used to **collaborate**
- Understand how Vault can **improve workflows** and **data management**
- Develop a **vision** to develop requirements, solution design, implementation plan and business case

San Diego Gas & Electric – About US

A Sempra Energy Utility

SDG&E Geographically

- San Diego County
- Southern Orange County

http://www.energy.ca.gov/maps/serviceareas/Electric_Service_Areas_Detail.pdf

SDG&E Background

- Founded 1881
- Sempra Energy – Our Parent Company
- 5,000 SDG&E Employees
- Population Served = 3.4 M
  - Electric Meters = 1.4 M
  - 4,100 square-mile service area
  - 2 Counties & 25 Communities
- Distribution Voltages = 12kV, 4kV, and 2.4kV
- Transmission Voltages = 69kV, 138kV, 230kV, and 500kV

http://www.sdge.com/aboutus

Note - Numbers above are approximate

Intelligent Model Design (IMD) – Possibilities of BIM At An Electric Utility

IMD Project

- Today's Challenges at an Electric Utility
  - Old process built on traditional 2D technology & paper processes
  - Resistance to change (Culture)
  - Competition in the energy market (Solar Rooftops)
  - Regulatory changes
  - Doing more with less
  - Communication between all stakeholders
    - Engineering, Regulatory, Environmental, Land, Consultants
  - Risk Reduction
  - Streamlining process & procedures (efficiency)

IMD Project

- Business Objective
  - Develop Intelligent 3D/2D Database to provide **more accurate drawings and standards** (BIM – Building Information Modeling) and leverage model & drawing database throughout the project lifecycle

- Project Summary to Date
  - Mapped As-Is & To-Be State
  - Gathered Requirements
  - Identified Autodesk products that can **reduce risk and project cost**, and **accelerate project design** by using off-the-shelf products
  - Define Implementation Strategy **(Scope, Schedule & Costs)**

Understanding who is Autodesk?

Software Offerings

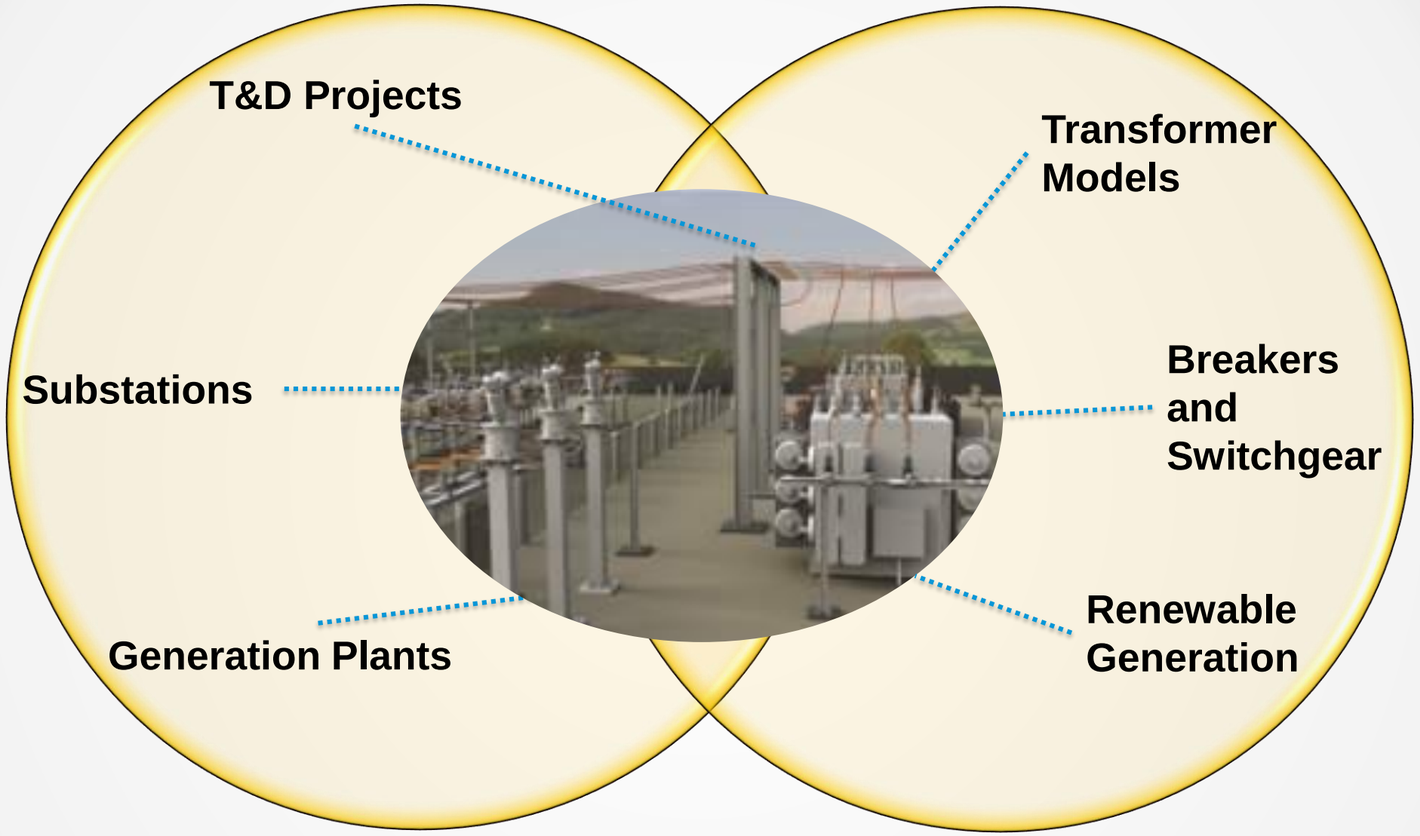
- AutoCAD
  - Flagship Product, introduced in 1982)
  - 82 Other Software Products… and counting
- Civil 3D
- Map 3D
- Raster
- Inventor
- ReCAP
- Autodesk Utility Design (AUD)
- Infraworks
- Navisworks
- Vault
- …

Industries

- Manufacturing
- Automotive
- Architecture
- Engineering
- Construction
- Entertainment

Leveraging Industry Partnerships & Industry Leaders

Engineering & Design Consultants



Manufacturers

Utility

IMD Requirements & Planning Schedule

November 2013

- Kick-off
- Design Workshops

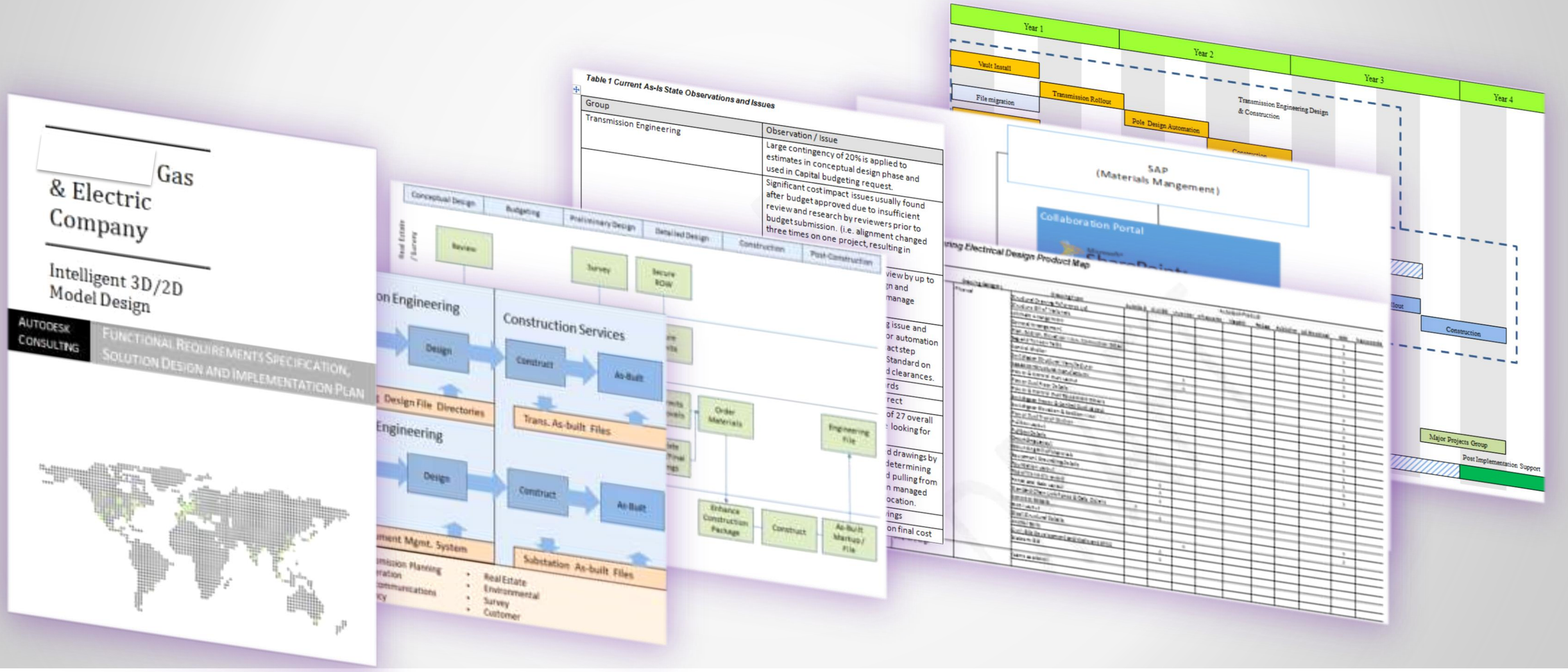
December 2013

- Interface Workshop
- Architecture Workshop
- Hi Level Spec/Tech Requirements

January – May 2014

- Initial Findings Workshop
- POC Development
- Implementation Plan/Schedule

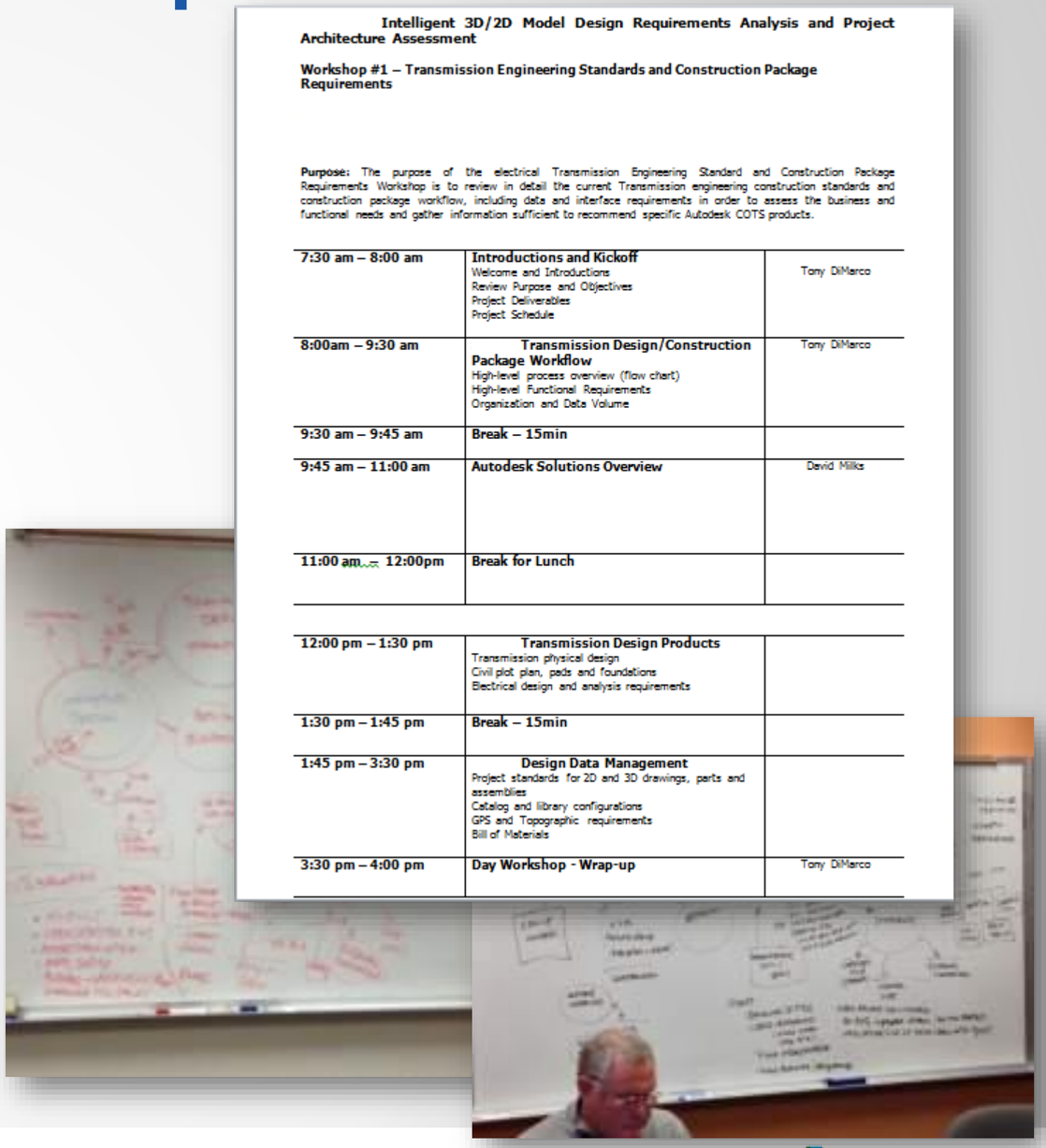
Requirements, Solution Design, Strategic Planning



Requirements Gathering Workshops

- Engineering
  - Distribution
  - Transmission
  - Substation
  - System Protection & Controls
  - Civil/Structural
- Construction & Maintenance
  - Transmission Construction & Maintenance
  - QA/QC Programs
- Major Projects Group
- IT
  - Technical Architecture and Interfaces

8 Workshops/ 40 interviews



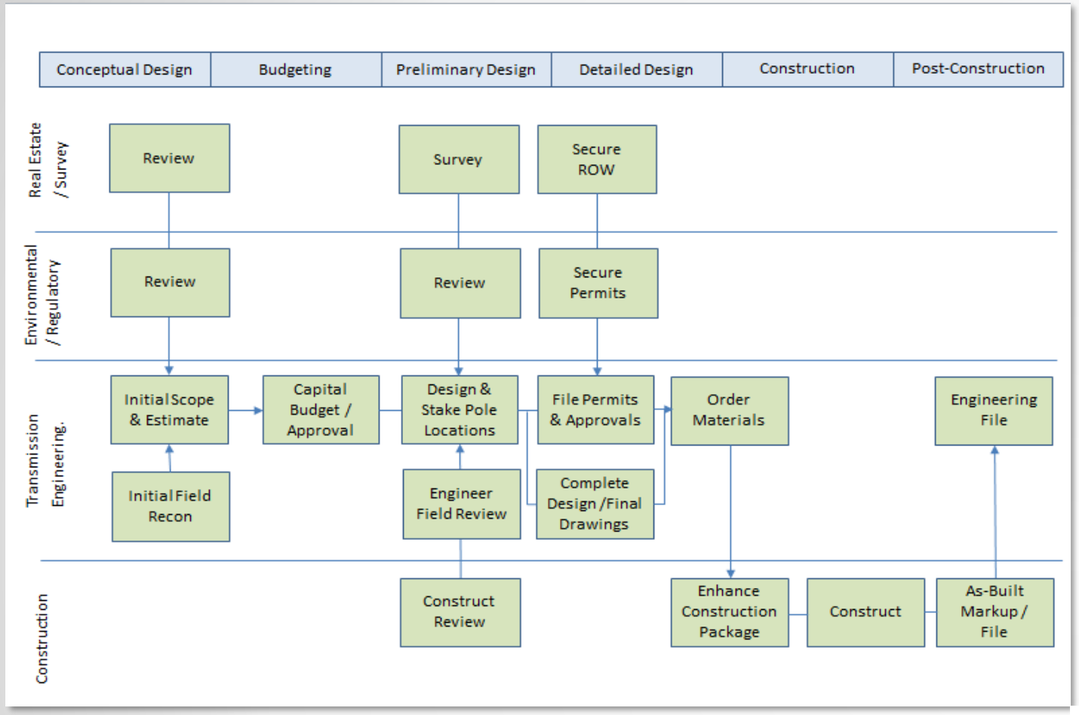
Intelligent 3D/2D Model Design Requirements Analysis and Project Architecture Assessment

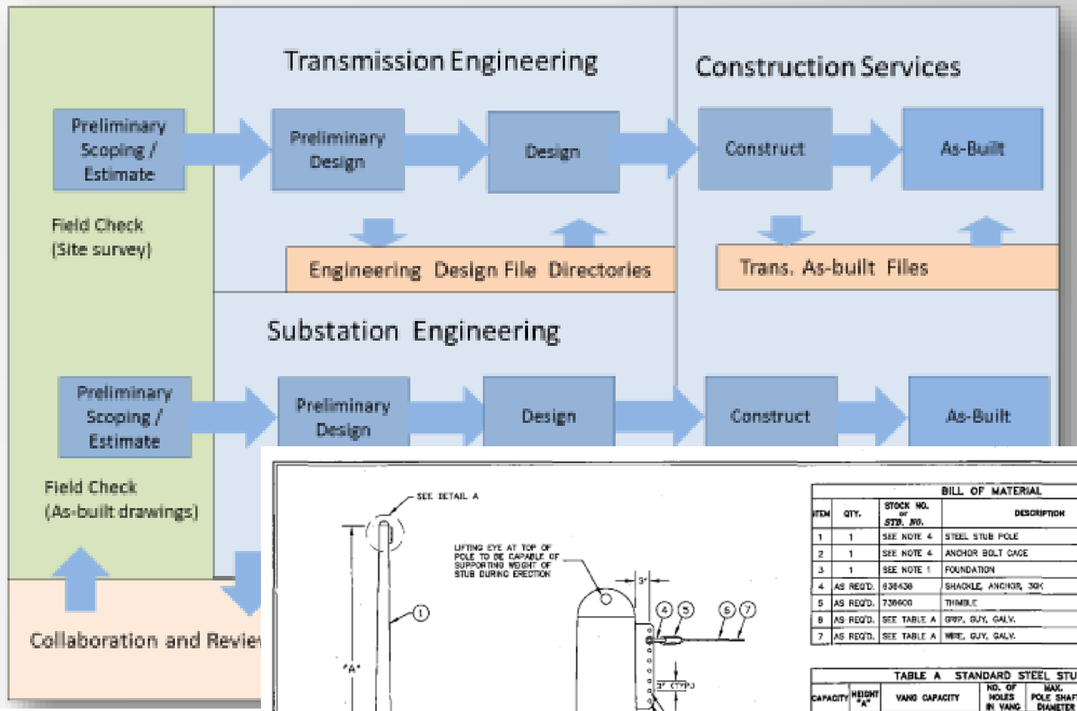
Workshop #1 – Transmission Engineering Standards and Construction Package Requirements

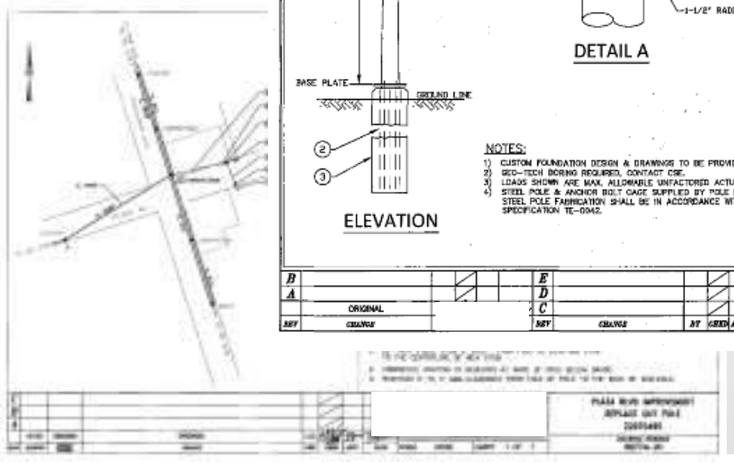
Purpose: The purpose of the electrical Transmission Engineering Standard and Construction Package Requirements Workshop is to review in detail the current Transmission engineering construction standards and construction package workflow, including data and interface requirements in order to assess the business and functional needs and gather information sufficient to recommend specific Autodesk COTS products.

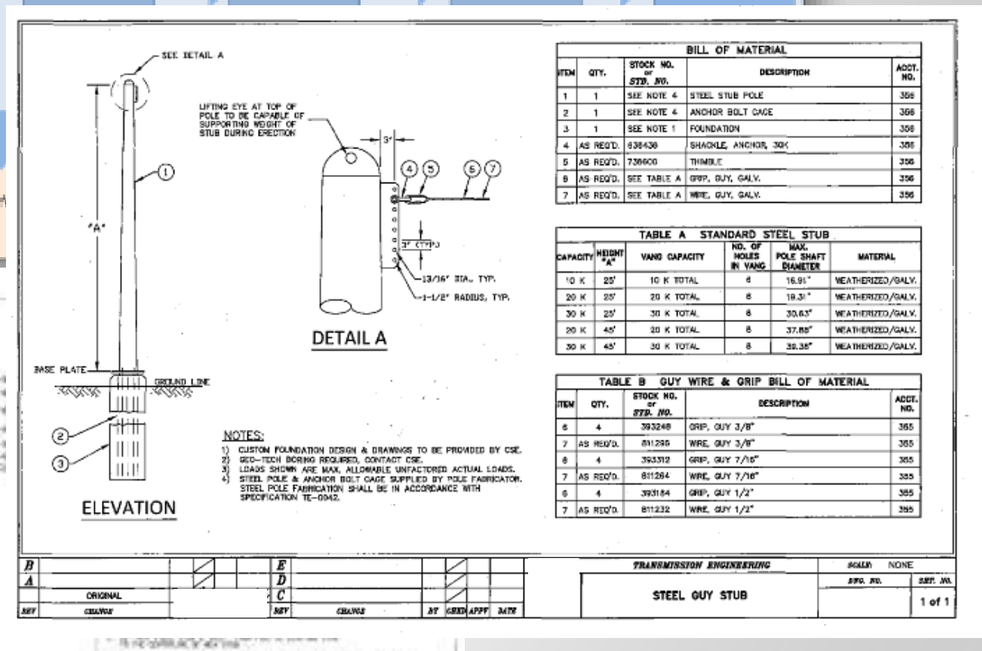
7:30 am – 8:00 am	**Introductions and Kickoff** Welcome and Introductions Review Purpose and Objectives Project Deliverables Project Schedule	Tony DiMarco
8:00am – 9:30 am	**Transmission Design/Construction Package Workflow** High-level process overview (flow chart) High-level Functional Requirements Organization and Data Volume	Tony DiMarco
9:30 am – 9:45 am	**Break – 15min**	
9:45 am – 11:00 am	**Autodesk Solutions Overview**	David Milks
11:00 am – 12:00pm	**Break for Lunch**	
12:00 pm – 1:30 pm	**Transmission Design Products** Transmission physical design Civil plot plan, pads and foundations Electrical design and analysis requirements	
1:30 pm – 1:45 pm	**Break – 15min**	
1:45 pm – 3:30 pm	**Design Data Management** Project standards for 2D and 3D drawings, parts and assemblies Catalog and library configurations GPS and Topographic requirements Bill of Materials	
3:30 pm – 4:00 pm	**Day Workshop - Wrap-up**	Tony DiMarco

Work Process Descriptions









What Did We Hear?

In Summary | “Pain Points”

- Need to **“do more with less”** is taxing current resources
- Dealing with a **backlog of “as-built” drawings**
- Backlog of **construction standards**
- Need for **consistency** and **material standardization**
- Need to **improve design productivity** of existing resources
- Need to **attract and retain young talent**
- Need to **better share information** and collaborate
- Better **manage engineering revisions** and engineering document control
- Need to **improve ability to interpret drawings** and design intent
- Need to improve **accuracy of information**
- Need to improve **currency of information**

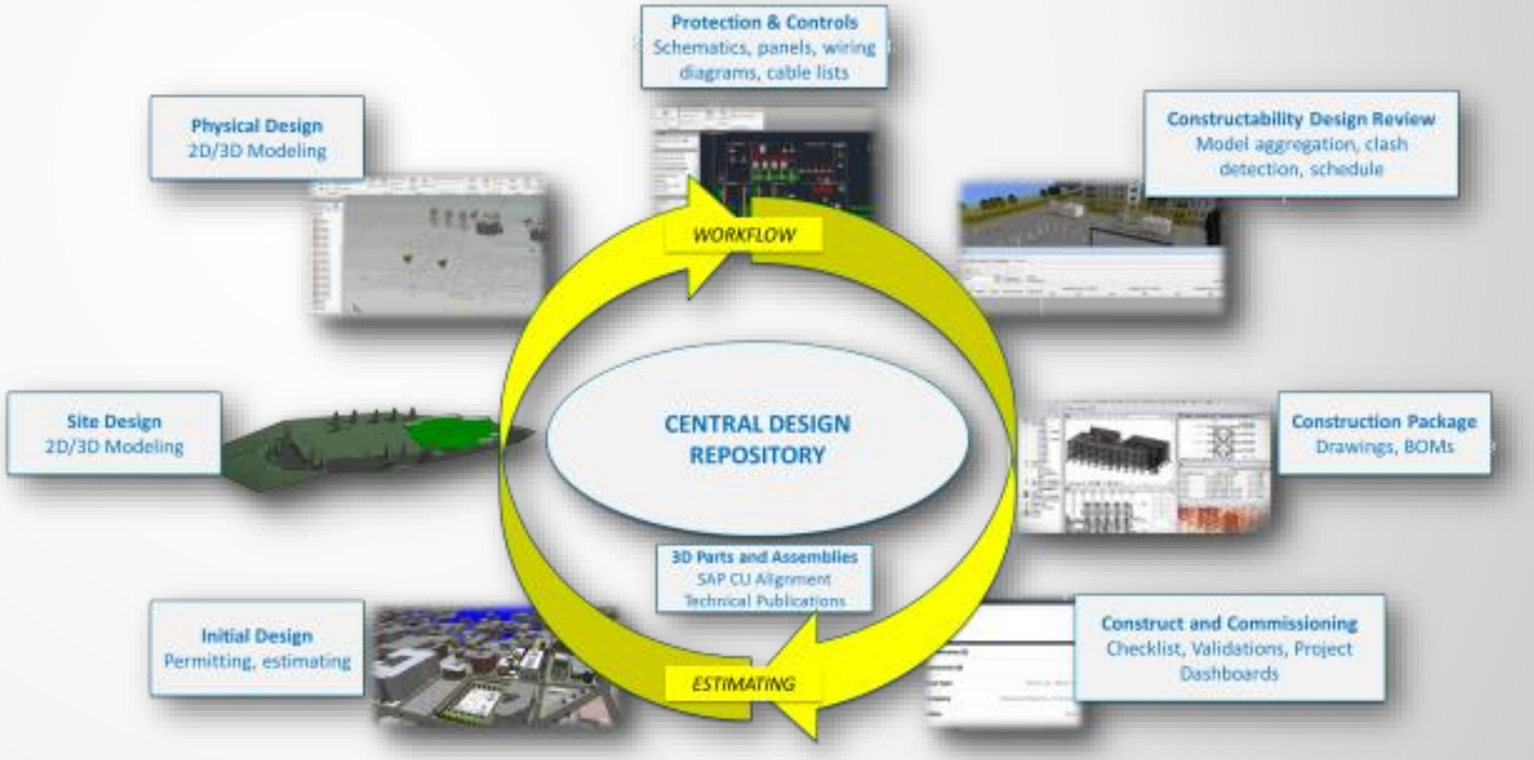
Crafting a Vision – Building Information Models (BIM)

OPERATIONAL EFFECTIVENESS
3D Digital Model v. 2D Drawing File
Business Process Improvement

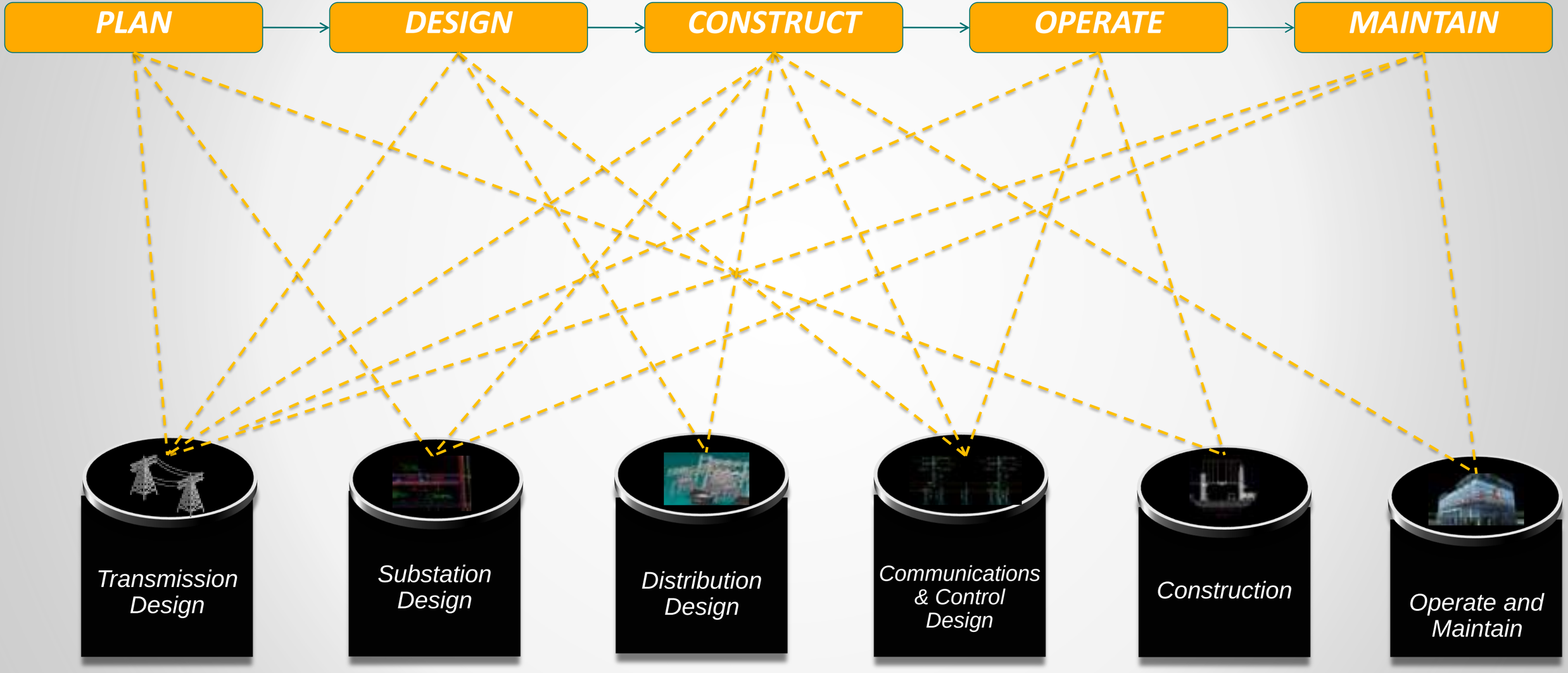
COST CONTROL
Reduce construction waste
Increase confidence in cost estimates

SAFETY
Improved Data Quality
Validate Standards

A unified workflow for the project lifecycle



Disparate Design Disciplines Working in Silos



BIM – A Unified Workflow Across Design Disciplines

PLAN → DESIGN → CONSTRUCT → OPERATE → MAINTAIN

BIM
Unified Model

Engineering &
Construction
Service Providers

Field / Mobile
Workforce

Transmission
Design

Substation
Design

Distribution
Design

Communications
& Control
Design

Construction

Operate and
Maintain

Project Lifecycle

Protection & Controls
Schematics, panels, wiring diagrams, cable lists

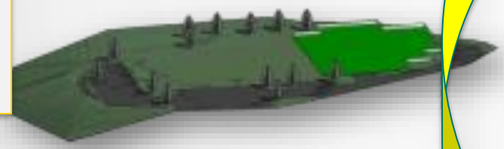
Physical Design
2D/3D Modeling

Constructability Design Review
Model aggregation, clash detection, schedule

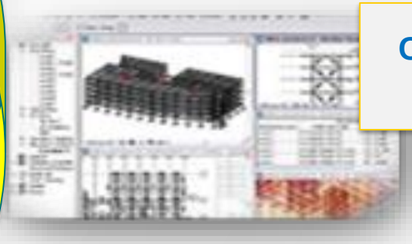
WORKFLOW

CENTRAL DESIGN REPOSITORY

Site Design
2D/3D Modeling



Construction Package
Drawings, BOMs



3D Parts and Assemblies
Technical Publications

Conceptual Design
Permitting, estimating

ESTIMATING

Construct and Commissioning
Checklist, Validations, Project Dashboards

COTS Products Considered| Technical Architecture

Transmission Engineering
- Inventor
- Civil3D
- Infraworks
- ReCap
- Map3D
- Vault

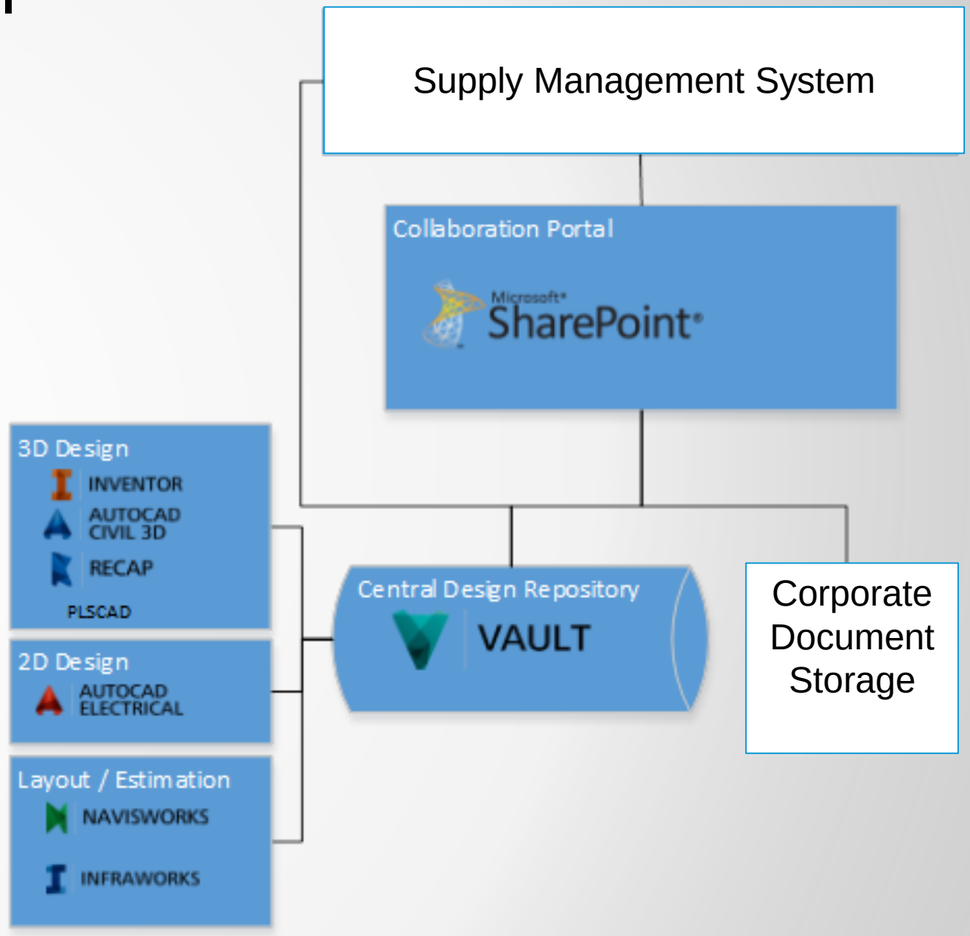
Substation Engineering
- Inventor
- Civil3D
- AutoCAD Electrical
- Substation Design Solution
- NavisWorks
- ReCap
- Vault

Transmission Construction
- BIM360
- Vault

Substation Construction
- BIM360
- NavisWorks
- Vault

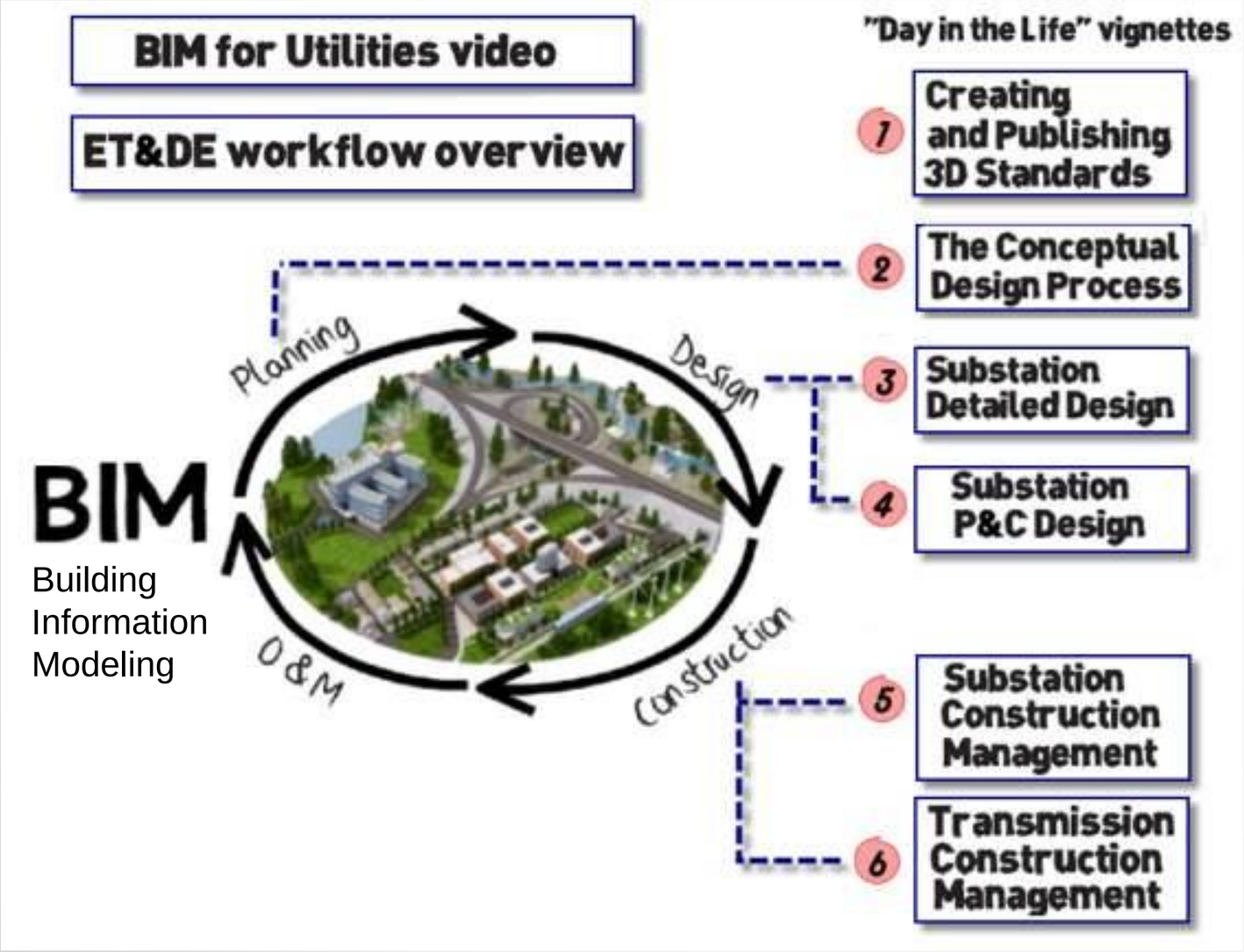
Distribution
- Inventor/Publisher
- Vault

Major Projects
- BIM360
- NavisWorks
- Vault



"COTS" – Commercial Off The Shelf (no customization required)

Conveying the Vision – “Proof Of Concept” Vignettes



8 Vignettes
Approx. 57 Minutes Total
Approx. 6-8 Minutes Each

Strategic Plan (3 Years)

Year 1

- Database
- 3D Model Standards/Process
- Transmission Design & Standards

Year 2

- Substation Design & Standards
- Distribution Standards

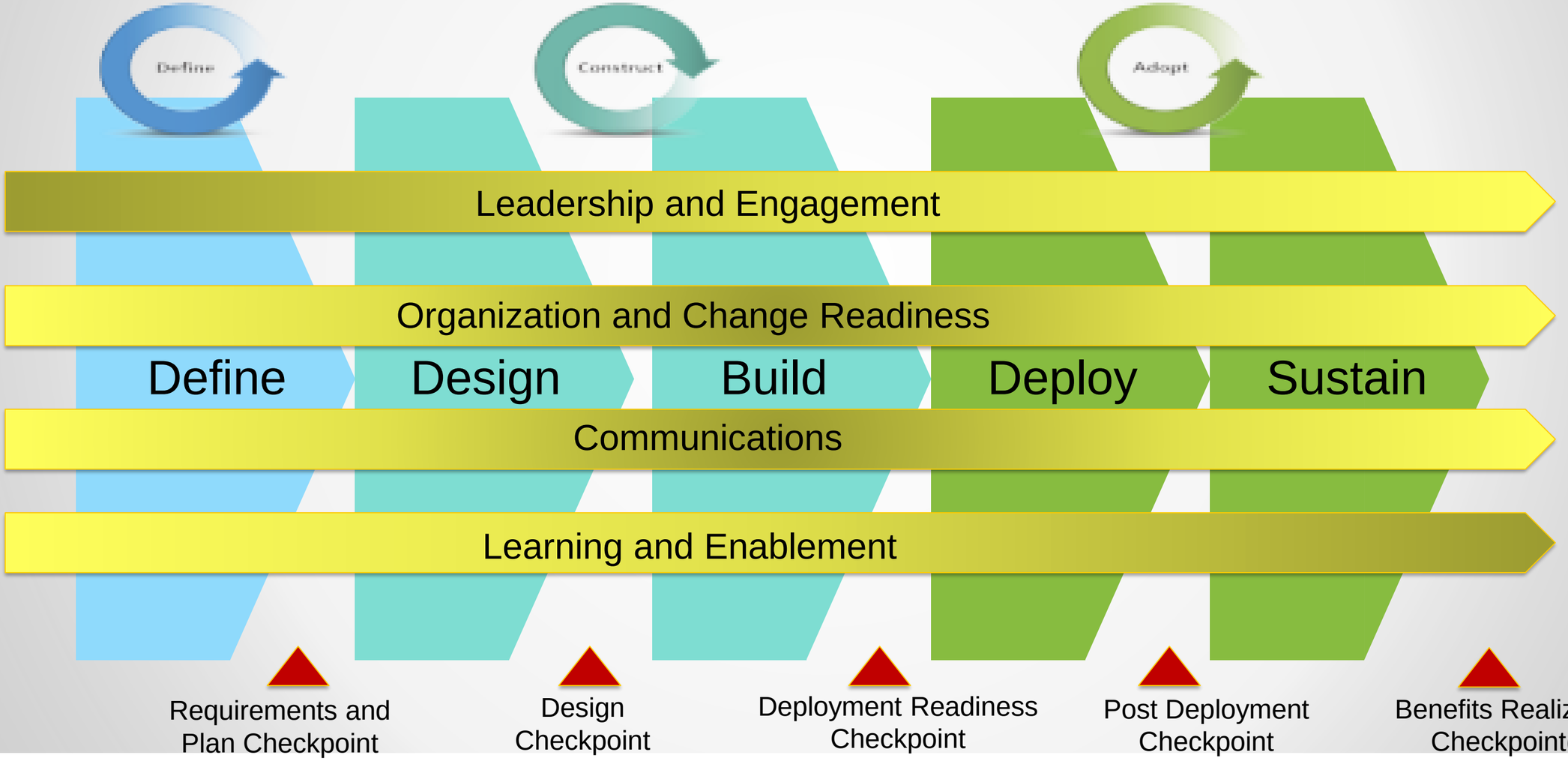
Year 3

- Construction Rollout
- Major Projects Rollout

CHANGE MANAGEMENT & TRAINING SUPPORT

Integrated Approach

Change Management starts at the inception of the program to engage sponsors, develop overall change component plans and approaches:



3D/2D Model Design – Cost Benefit Analysis Approach

- **Key Benefits Quantified in the Analysis:**
  - Productivity improvements for Transmission Engineering (~15%)
  - Productivity improvements for Substation Engineering (~15%)
  - Productivity improvements for As-Built creation (using Lidar/ReCap)
  - Cost avoidance benefits in construction by earlier detection of issues
  - Reduction in contingency and construction costs of ~1% on capital projects

- **Phase realization of benefits typically over three years**

- **Calculate Net Cash Flow and Financial Metrics**
  - Include all project costs: Hardware, Software, Services, SDG&E Business and IT
  - Calculate IRR and Payback Period

Key learning objectives

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

- Describe methodologies for business requirements gathering and strategic planning
- Understand how Infraworks, Civil3D, Inventor, SDS and Vault can be used to collaborate
- Understand how Vault can be used to improve engineering workflows and engineering data management
- Develop a vision to develop requirements, solution design, implementation plan and business case

Conclusion

- *BIM is right for an Electric Utility*
  - *Central Design Database allows cross departmental sharing of information and direct access to the “truth”*
  - *Memorialization of tribal knowledge*
  - *Attracts new talent to an old industry*
  - *Allows engineers and designers to engage stakeholders more directly and collaboratively*
  - *Potential for 5D estimating (3D, Cost, Schedule)*
  - *Leverages existing partnerships and leaders in the industry*