AutoCAD® Utility Design for the little guy

UT10701

Dan Leighton

Principal Consultant – DL Consulting

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Class summary

Adoption is growing for AutoCAD Utility Design (AUD) . Yet many small and mid-size utilities and engineering organizations view AUD deployment as a daunting challenge.

This session will break down the core AUD implementation requirements and walk through a practical process to:

- Identify and document the requirements
- Plan a phased implementation
- Develop a test plan
- Document use cases and job aids so designers can make effective use of the software
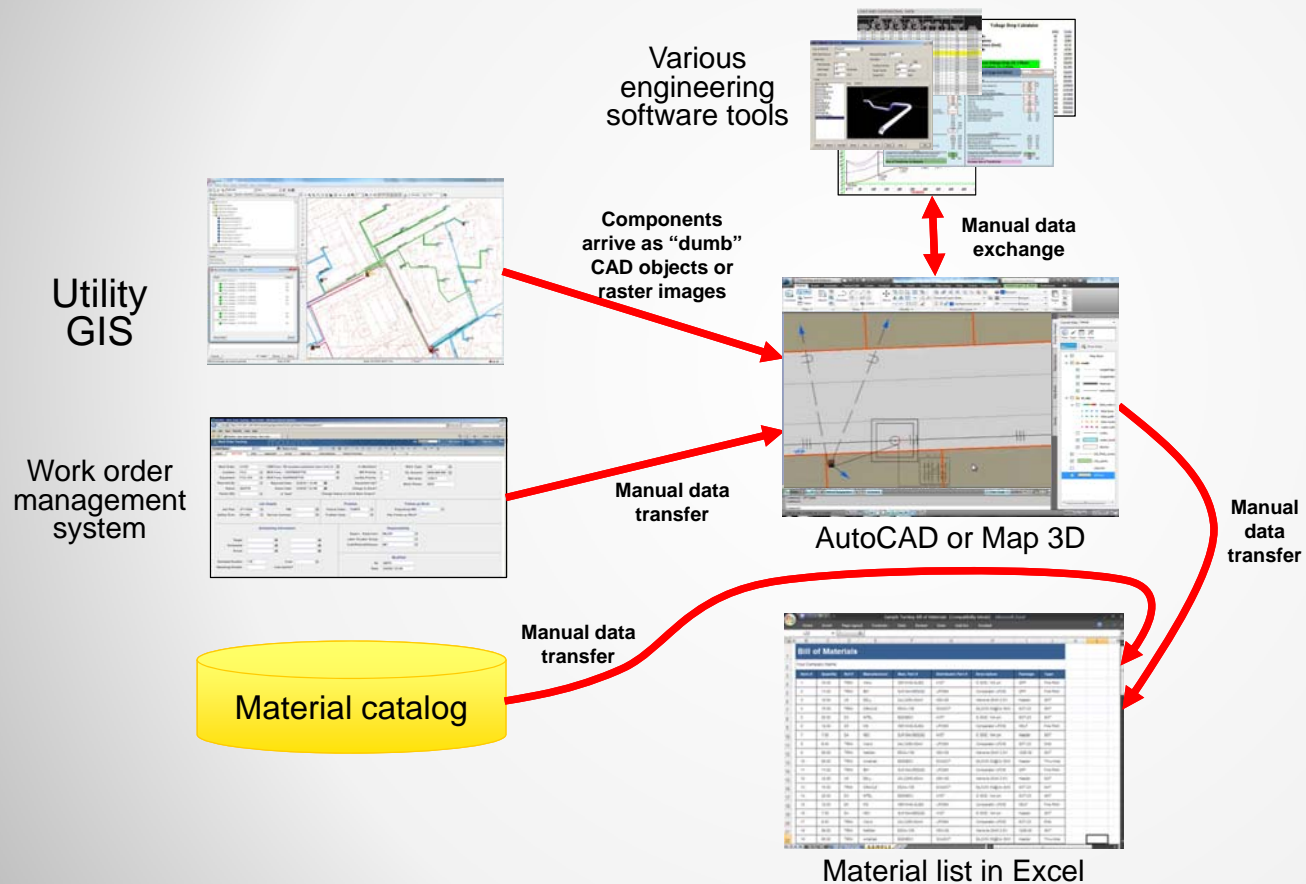
Key learning objectives

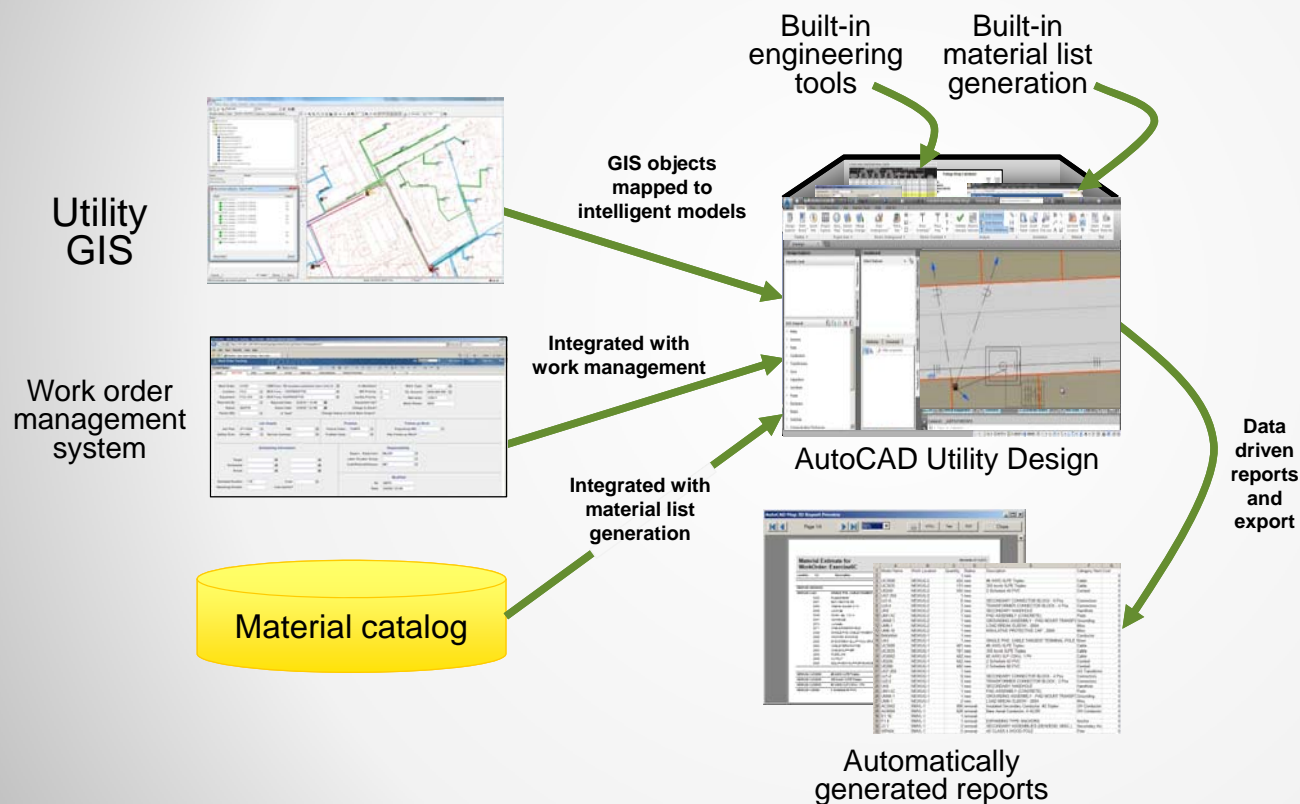At the end of this class, you will be learn the following:

- The benefits of AUD for small and mid-sized utilities
- Required and optional elements of an AUD configuration
- An approach to document AUD implementation requirements
- A practical phased approach for AUD implementation

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Benefits of AUD for small and mid-sized utilities

Typical approach today:
Multiple tools / manual interfaces

Various engineering software tools

Utility GIS

Components arrive as "dumb" CAD objects or raster images

Manual data exchange

Work order management system

Manual data transfer

AutoCAD or Map 3D

Manual data transfer

Material catalog

Manual data transfer

Material list in Excel

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The dream…

You draw something and **magic** happens…

➡ The styling changes to
meet your standards

➡ The engineering is analyzed
(and maybe corrected)

➡ Warning messages appear if
there are design issues

➡ The correct coding appears
in the material list

➡ Reports/tables summarize
all parts of your design

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Behind the magic

You draw something and **magic** happens… → *As you draw you create data about your design*

The styling changes to meet your standards → → → → → → → *…based on your layout/data and a bunch of configured information*

The engineering is analyzed (and maybe corrected) → → → → *…based on your layout/data and a bunch of configured information*

Warning messages appear if there are design issues

The layout and data drives everything…

The correct coding appears in the material list

…and AUD needs a significant amount of configuration

Reports/tables summarize all parts of your design

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How do you take advantage
of AUD's benefits…

…without years of configuration
and megabucks of consultants?

But before configuration…
#1: What problem are you trying to solve?

Ask your self – where does your time go?

➡️ Overhead engineering analysis?

➡️ Creating the material order?

➡️ Accurately drafting the design layout?

➡️ Looking things up in the standards catalog?

➡️ Voltage drop analysis?

➡️ Transferring data from one application to another?

➡️ Creating accurate drawing annotation?

But before configuration…
#2: Do you have the time and resources?

Ask yourself – who is going to configure AUD?

➡ Does the team have the required skill and know-how?

➡ What's your timeframe?

➡ What are management's expectations?

➡ Can you use (and afford) outside assistance?

➡ Is your team working only part time on AUD configuration?

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But before configuration…
#3: Perfection is unlikely so be pragmatic

➡ Stick with what is practical and useful

➡ Remember the 80-20 rule

➡ Magic that only works sometimes isn't worth it

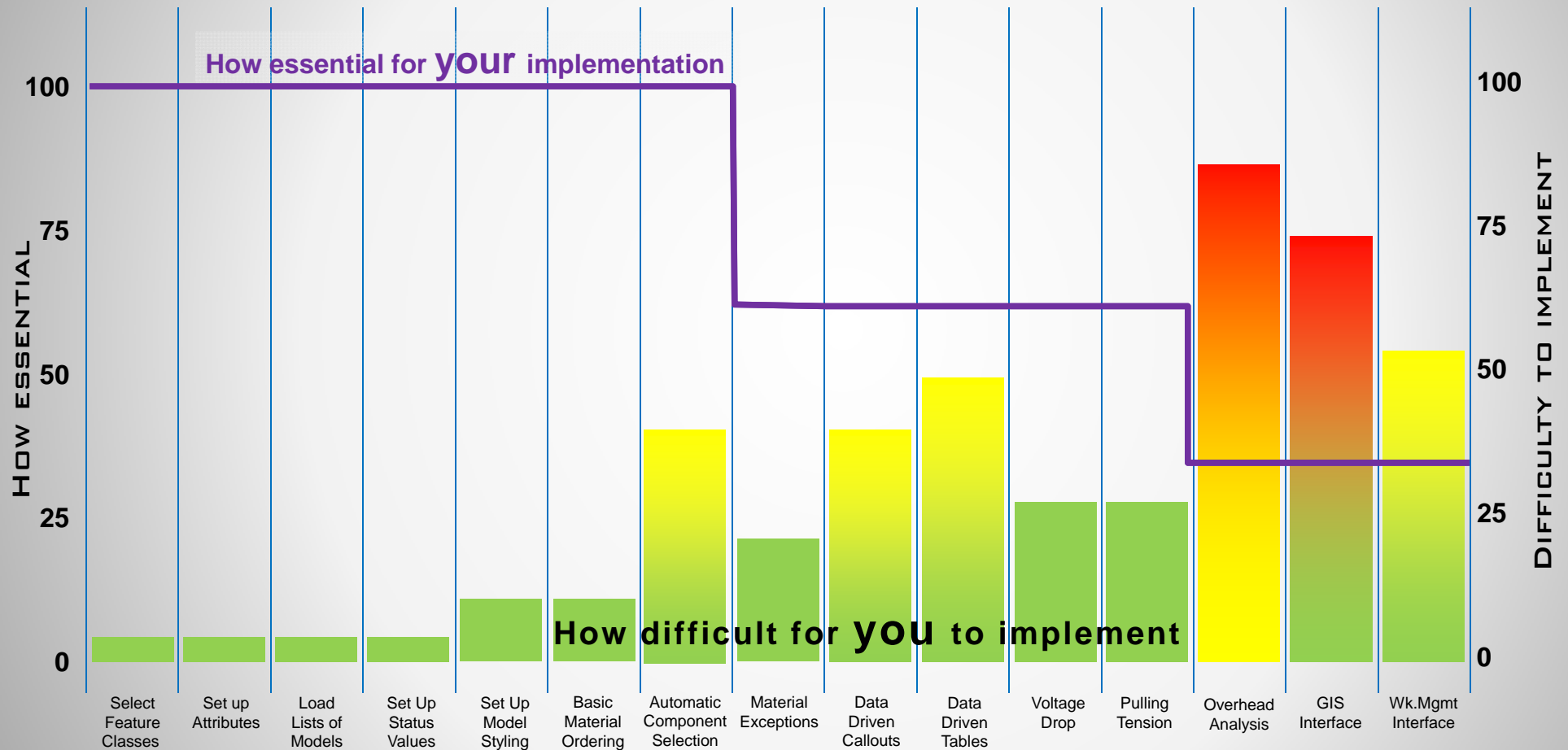➡ Think through the process from the designer's *perspective*

Can AUD do it? The answer is almost always YES.
Does it make sense from a cost and usability standpoint…

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Required and optional elements of an AUD implementation

What's involved in an AUD implementation

Identify the <u>components</u> you use in design (the feature classes)
Determine <u>required attributes</u> associated with each type of component
Define the <u>list of models</u> for each feature class
Figure out what <u>status values</u> you need
Identify the <u>styling for components</u>
Create plan for <u>automatic components selection</u>
Determine <u>basic material ordering</u> approach
Specify common <u>material ordering exceptions</u>
Identify required <u>data-driven callouts</u> and annotation
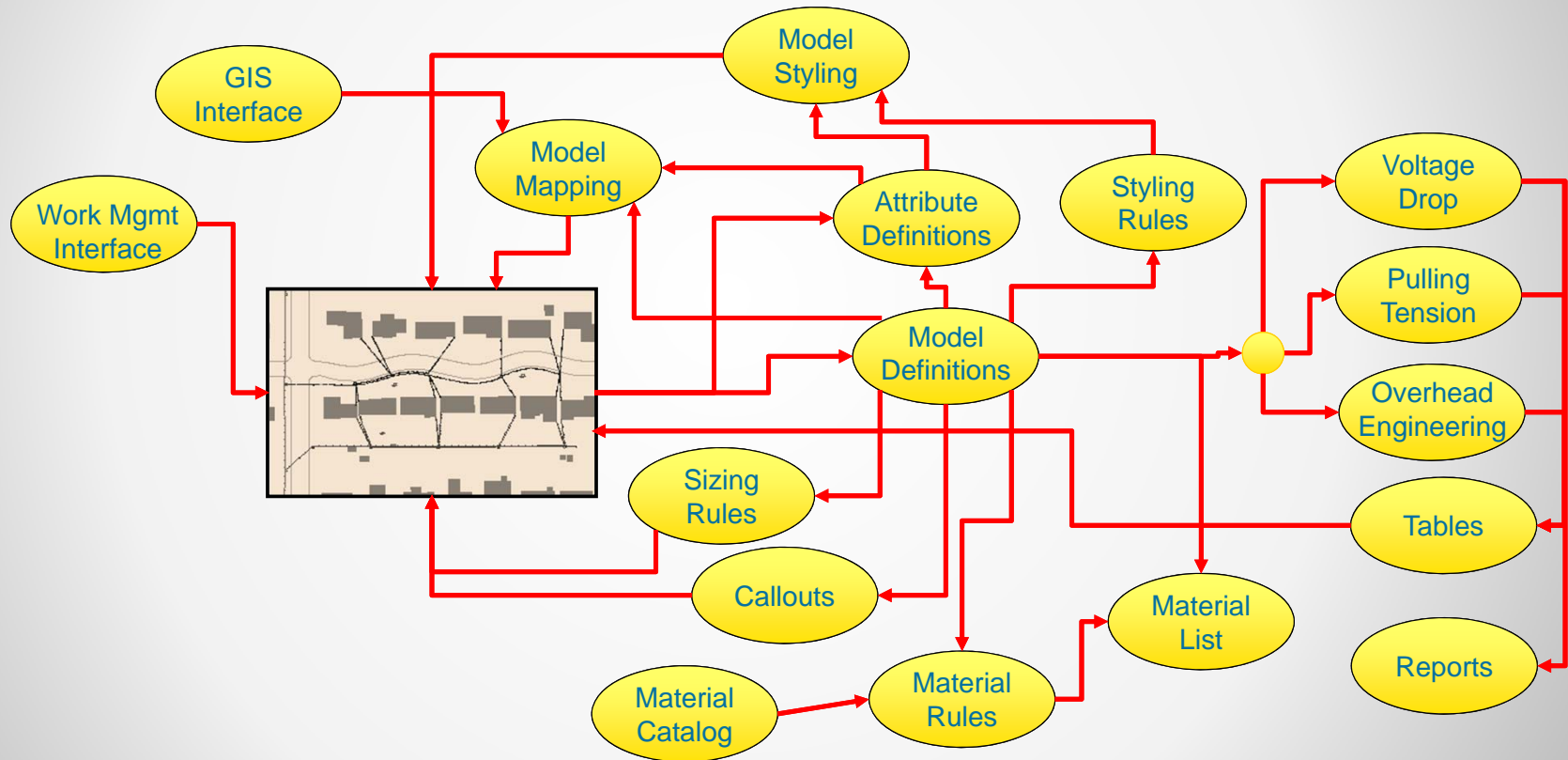Identify <u>data-driven tables</u>
Plan the approach for <u>voltage drop</u>, <u>pulling tension</u>, and <u>overhead analysis</u>
Identify what data comes <u>from GIS</u> and the GIS interface
Identify what data comes <u>from wk mgmt system</u> and the interface

An approach to document AUD implementation requirements

Why document the requirements?

1: Many things to consider…

Identify the <u>components</u> you use in design (the feature classes)
Determine <u>required attributes</u> associated with each type of component
Define the <u>list of models</u> for each feature class
Figure out what <u>status values</u> you need
Identify the <u>styling for components</u>
Create plan for <u>automatic components selection</u>
Determine <u>basic material ordering</u> approach
Specify common <u>material ordering exceptions</u>
Identify required <u>data-driven callouts</u> and annotation
Identify <u>data-driven tables</u>
Plan the approach for <u>voltage drop</u>, <u>pulling tension</u>, and <u>overhead analysis</u>
Identify what data comes <u>from GIS</u> and the GIS interface
Identify what data comes <u>from wk mgmt system</u> and the interface

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Why document the requirements?

2: Many moving (interrelated) parts…

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Why document the requirements?

Get from here… → … to here.

Identify the components you use in design (the feature classes)
Determine required attributes associated with each type of component
Define the list of models for each feature class
Figure out what status values you need
Identify the styling for components
Create plan for automatic components selection
Determine basic material ordering approach
Specify common material ordering excep...
Identify data-driven callouts and ...ion
Identify data-driven tables
Plan the approach for volt... pulling tens... and ov... ...sis
...a data comes from GIS and the G...
Identify what data comes from wk mgmt system and the interface
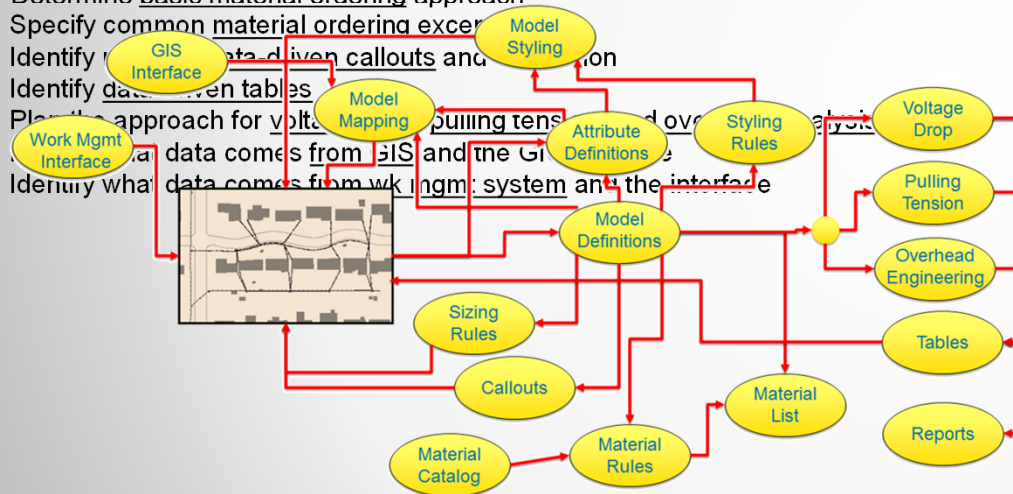
☑ Task 1
   ☑ Detail a
   ☑ Detail b
   ☑ Detail c
☐ Task 2
   ☑ Detail a
   ☐ Detail b
   ☐ Detail c
☐ Task 3
   ☐ Detail a
   ☐ Detail b
   ☐ Detail c
☐ Task 4
   ☑ Detail a
   ☐ Detail b
   ☑ Detail c
☐ Task 5
   ☐ Detail a
   ☑ Detail b
   ☐ Detail c

Configuration Checklist

Recommended table of contents

- Use cases and tasks
- Feature classes
- Styling
- Attributes
- Plan for status
- Material ordering & exceptions

- Auto component selection
- Engineering
- Reports and tables
- User interface
- Material catalog import
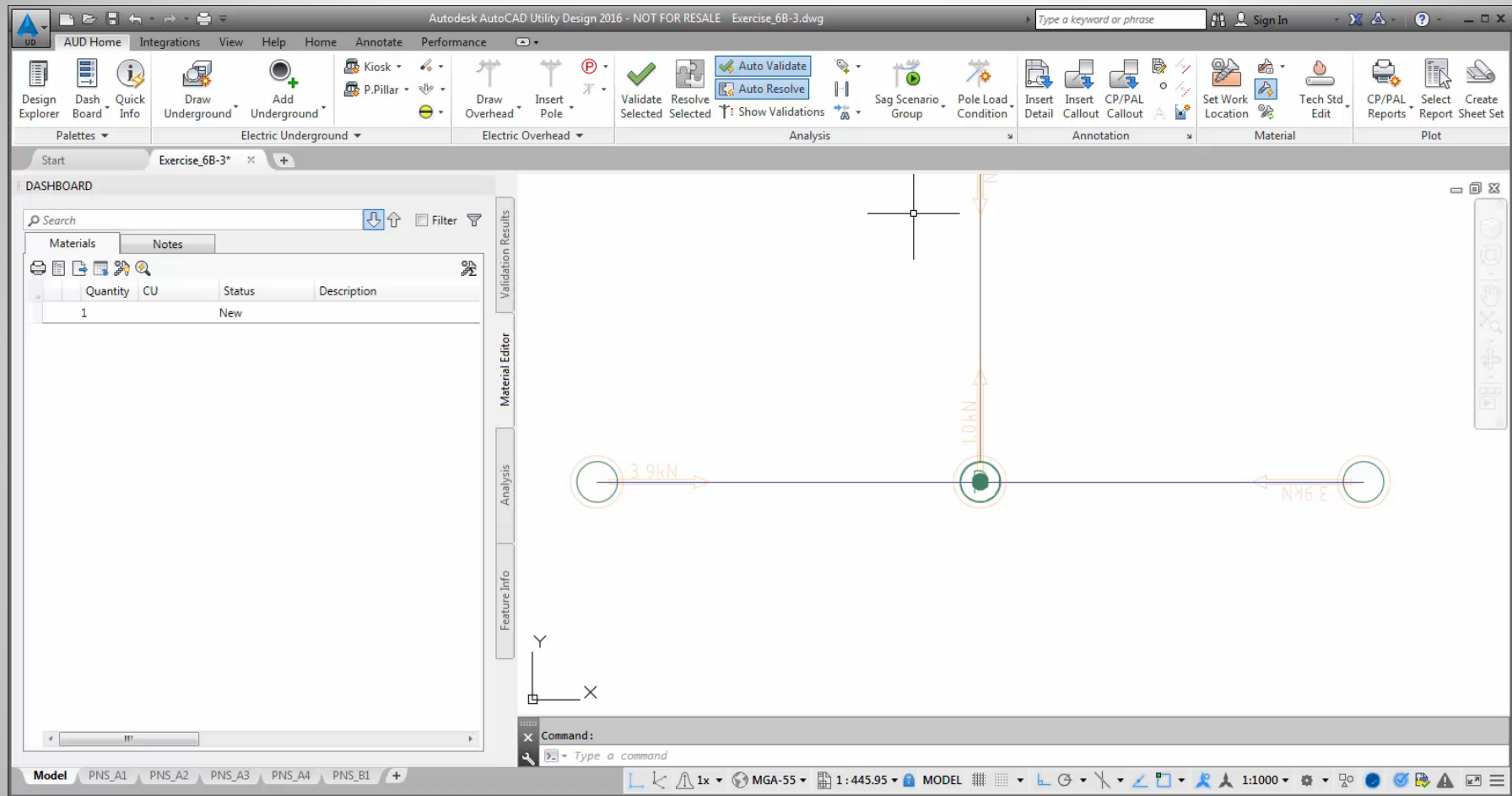- GIS interface
- Work management interface

Use cases and tasks

What tasks do you need to perform in a design project?
- Which ones are simple and easy to do with AUD?
- Which ones might be harder?

This becomes your list of what needs to be addressed in the rest of the design document

Use cases and tasks

Use cases and tasks

EL78: Use replace and transfer function

1: Select the "Replace and Transfer" function
2: Select the structure to be to be replaced
3: Use the Select function to select specific contained items to be retained
4: Confirm replacement in Feature Info.

EL78-01: Set configuration values for replace and transfer to match valid status values

EL78-02: Test replace and transfer for at least two things: objects contained on poles and for poles that contain objects.

Feature classes and models

- Make a list of all significant components in a design
- Think about each type of components:
  - Is it drawn in the main layout?
  - How will the designer select the specific model to use?
  - What attributes characterize each type of component?
    Which attributes need to be populated to define the models?
    Which attributes will the user regularly review or update?
    Are there custom attributes that need to be added?
  - What determines the component's appearance in the design?
  - If the component is included, what assembly/material is ordered?
    (and are there special considerations regarding materials for this component?)

Feature classes and models

4.1.5 Transformers

General data for this feature class			
OOTB Feature Class:	EL_TRANSFORMER		
Typical Creation:	Set default then use ribbon	Data in Symbol:	No
Special Styling:	No	Callout Handling:	See details in callout section
Material Exception(s):	Yes (terminations)	Feature ID Except.:	No
Validation:	Correct transformer type is used for given context (ex: if pad mounted then must be Above Surface model)		
Validation:	Transformer must have valid primary and secondary connections		
Other notes:	Need to support banked transformers		

Styling

- What is the basic appearance of design components?
- Does appearance change depending on status?
- Does appearance change based on other data?
- How do you draw multiple conductors?
- What callouts/details do you use to clarify the design?

Usually most items are "normal"
and there are some exceptions

Styling

May need to rationalize your layer and block definitions

Attributes

Every feature class has a large number of model attributes and feature attributes
- Which model attributes need to be populated?
- Are any custom attributes required?
- Are there attributes that users will regularly view or update?
- Are there attributes that should be hidden?
(or hidden only some of the time?)

Categorize attributes in terms of
how they will be used

Attributes

4.1.5 Transformers

Model attributes to populate		Custom attributes		High-visibility attributes	
CU	Text	Date Installed (F)	Date	Description	1. Key Attributes
Description	Text	GIS Annotation (F)	Text	Model Group	1. Key Attributes
kVA Rating	kilo volt-ampere	Bank configuration (M)	Domain	Model Name	1. Key Attributes
Model Group	Text	Has been ordered? (F)	True-False	Status	1. Key Attributes
Model Name	Text	Smallworld ID (F)	Text	Status GIS	1. Key Attributes
Percent Reactance	Real	Status GIS (F)	Text	CU	2. Assess/Update
Percent Resistance	Real	Style Prefix (M)	Text		
Phase Count	Integer	Tech Standard (M)	Text	GIS Annotation	2. Assess/Update
Structure Type	Domain (EL_STRUCTURE_TYPE_TBD)	Work Order # (F)	Text	Has been ordered?	2. Assess/Update
Bank configuration	Domain (PSE_BANKCONFIG_TBD)			Work Order #	2. Assess/Update
Style Prefix	Text				
Tech Standard	Text			Transformer ID	2: Assess/Update
Transformer diameter	feet				
Transformer height	feet				
Transformer Type	Domain (EL_TRANSFORMER_TBD)				
Voltage	Domain (EL_VOLTAGE_TBD)				
Voltage 2	Domain (EL_VOLTAGE_TBD)				
Weight	pound				

Even at this point you might not be done with attributes!

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Plan for status

- Identify status values required for all tasks/use cases
- Determine how status affect…
  - Styling
  - Material ordering
  - Engineering
  - GIS data exchange

Plan up front for incorporating
status into design projects

Plan for status

STAT-01: Configured AUD component status values

Note: These are values that all components in an AUD design (both imported and drawn) must have.

Status Value	Description (what it means for a component to have this status)
Proposed	Item will be added during construction
Proposed (duplicate)	
Existing (unchanged)	
Existing (modified)	
Demo	
Existing (proposed)	
Existing (abandoned)	
Deactivate	

STAT-02: Status effect on import, analysis, ordering, and styling

Status Value	Used in Analysis	Material Order	Style Category
Proposed	Yes	Yes (Order item)	proposed
Proposed (duplicate)			
Existing (unchanged)			
Existing (modified)			
Demo			
Existing (proposed)			
Existing (abandoned)			
Deactivate			

STAT-03: Required status interactions with GIS

Value set by incoming GIS data	Will be mapped to	AUD Status Value	Will be mapped to	Value exported to GIS (GIS Staging Area)
n.a.		Proposed	→	PROPOSED
n.a.		Proposed (duplicate)		Not exported
IN SERVICE or OUT OF SERVICE	→	Existing (unchanged)		Not Exported
n.a.		Existing (modified)	→	IN SERVICE or OUT OF SERVICE
n.a.		Remove	→	REMOVED FROM SERVICE
PROPOSED	→	Existing (proposed)		Not Exported
ABANDONED or REMOVED FROM SERVICE	→	Existing (abandoned)		Not Exported
n.a.		Abandon	→	ABANDONED
n.a.		Future	→	PROPOSED (for poles) otherwise not exported

Material ordering and ordering exceptions

- Identify basic material ordering requirements
  (the "Basic Material Ordering rule")
- Detail known material ordering exceptions
  - Write out the logic of how exceptions will work
  - Determine when the user should take over!
- Test (on paper) against uses cases and tasks
- What additional data will a designer need to specify?
- Can adding model attributes help?

Auto component selection (a.k.a. "sizing")

- Identify when automatic selection should occur…
  - During design layout
  - When imported from GIS
  - When engineering changes are required

  When is this needed (vs. "would be nice…"

- Document the logic for when and how components will automatically be selected

This logic will directly determine how AUD's sizing rules will work

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Auto component selection

SZ-FR03	Framing selection will be based on selecting the component that matches: • Pole material • Conductor phase • Style (horizontal, vertical, wing) • Configuration • # of circuits • Conductor deflection angle • Wire size • Voltage

SZ-GF02	A specific set of connectivity fitting model groups (Elbows, Reducing Elbows, In-line tees, HV Tapping Tees, Caps, Transition fittings, and Reducing fittings) will be automatically selected based on the following criteria: • # of connected pipes • Diameters of connected pipes • Material of connected pipes • Status of connected pipes • Purpose of connected pipes (service vs. main) • Intersecting angle of connected pipes (for elbow selection) • The table below shows the logic tree for this selection.

Do you have fields for all this data?
Have you populated all this data?
At what point does it make sense to go manual?

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Auto component selection

Example of gas fitting selection logic

If 1 pipe connecting	Go to section 1P
If 2 pipes connecting	Go to section 2P
If 3 pipes connecting	Go to section 3P
If 4 pipes connecting	Go to section 4P
1P (one pipe connecting)	Fitting Model Group = "CAP" Fitting material must match pipe material Fitting nominal diameter must match pipe nominal diameter Otherwise choose model "Default"

2P (2 pipes connecting) Selection depends on material and diameters)	If pipes are both the same material and same diameter go to 2P-1 If pipes are the same material but different diameters go to 2P-2 If pipes are the same diameter but different materials go to 2P-3 Otherwise choose model "Default"
2P-1 (same mat'l/same dia.) Must be an elbow	Fitting Model Group = "Elbow" Fitting material must match pipe material Fitting nominal diameters 1 and 2 must match pipe #1 diameter If connection angle>42 then Fitting angle=90° Else if connection angle >1° then Fitting angle=45° Else choose model "Default"
2P-2 (same mat'l/diff. dia.) Must be a reducer or reducing elbow	Fitting material must match pipe material Fitting nominal diameter 1 must match diameter of larger pipe Fitting nominal diameter 2 must match diameter of smaller pipe If connection angle < 2° then Model Group = "Reducer" Otherwise Model Group = "Reducing Elbow" If no models match choose model "Default"
2P-3 (diff. mat'l, same dia.) Must be a transition fitting	Model Group = "Transition Fitting" Fitting nominal diameter must match pipe 1 diameter If connection angle <2" then Model Group = "Transition" Otherwise choose model "Default"
2P-4 (soft split connection)	Model Group = "Tapping Tee" Fitting nominal diameter 1 must match pipe 1 diameter Fitting nominal diameter 2 must match pipe 2 diameter Fitting material must match pipe 1 material If no models match choose model "Default"

3P (3 pipes connecting)	If all 3 diameters and all 3 material the same and one angle is 180 and the other angle is 90 then
	      Fitting Model Group = "In-line Tee"
	      Fitting material must match pipe 1 material
	      Fitting nominal diameter must match pipe 1 nominal diameter
	Otherwise choose model "Default"

Be sure you can explain the logic on paper before you try to write the rule

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Reports and tables

What reports are needed for your job package(s)?

Where within AUD will the data come from?
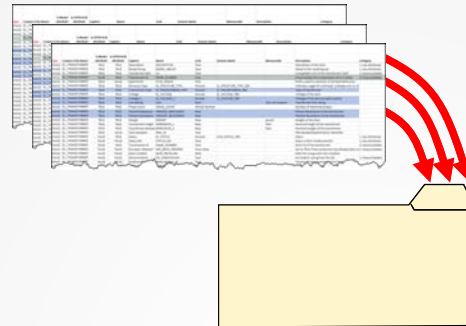
What is the format or layout of the reports and tables?
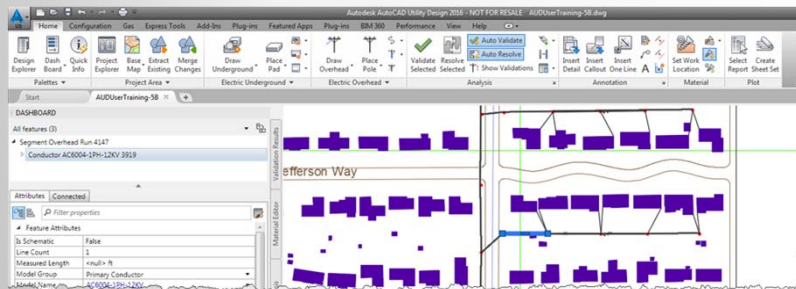
What tables commonly appear in design drawings?

- Decide what reports and layouts are required
- Learn to use the available tools
- Identify where data comes from

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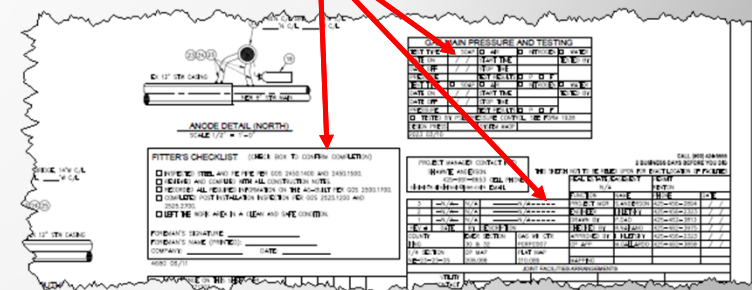
User interface

- Consider tasks and use cases -- what will users want?
- Leverage the UI for model selection

Customized symbols
and terms
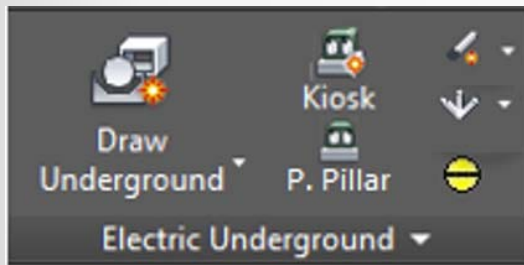
Customized ways to
select specific models

Create a checklist of UI changes that includes
notes on what the macros will need to do

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Engineering

- Key questions to ask before you go crazy…
    - What do you do today?
    - What problem are you trying to solve?
- Understand AUD's capabilities
    - What process is practical for the designer?
    - Is AUD close to what you need?

Find the balance between what you need
and what AUD can do

Material catalog import

- What information is needed in AUD?
- Where does that information reside today?
- Who maintains it?
- How do you get it into the required SQLite format?
- What is the long term maintenance strategy?

Work with the organization(s) that
have the data to find a strategy that works

GIS interface

- What information should be imported from the GIS
  - What MUST be imported to do design?
  - What would be useful from a *design* perspective?
- Consider 3 cases…
  - New design building off existing components
  - Designs that modify existing components
  - Designs that remove or replace existing components

Be pragmatic about what make sense for GIS data exchange

Work management interface

- Project initiation
  - What project information is needed during the design
  - What information might added by the designer
  - Where is information stored
  - How is information used
  - What are the steps of the project initiation process

    Walk through the likely scenarios
    Write them down

All of this messiness is what you need to capture in a design document!
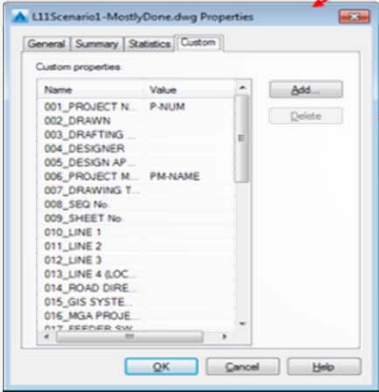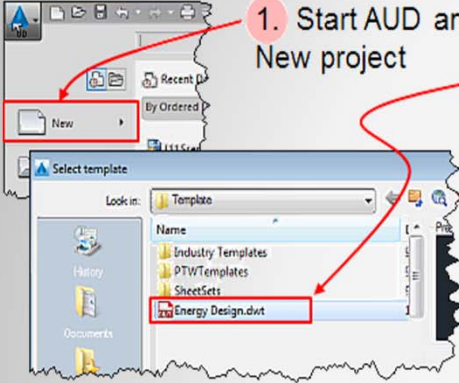
A good example of why you should think it through…

1. Start AUD and begin a New project

2. Always select the current Energy Design template
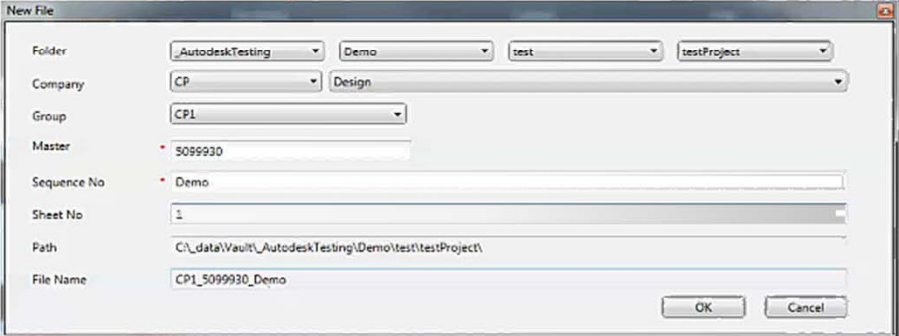
4. Set initial drawing properties

001_PROJECT NUMBER	Project Number
FIRE AREA	Y or N
COASTAL POLLUTED	Y or N
COMPANY CODE	CP or PCA

6. Enter file-related data in the New File dialog box

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But back to the original points…

What do you ~~want~~ **need**
AUD to do for you? **in phase 1**

How are you going
to get there?

But back to the original points…

- What problems are you trying to solve?
- What resources are available?

Are there any shortcuts?

For the smaller utility or consultancy…

Phased implementation

* Only if it makes business sense
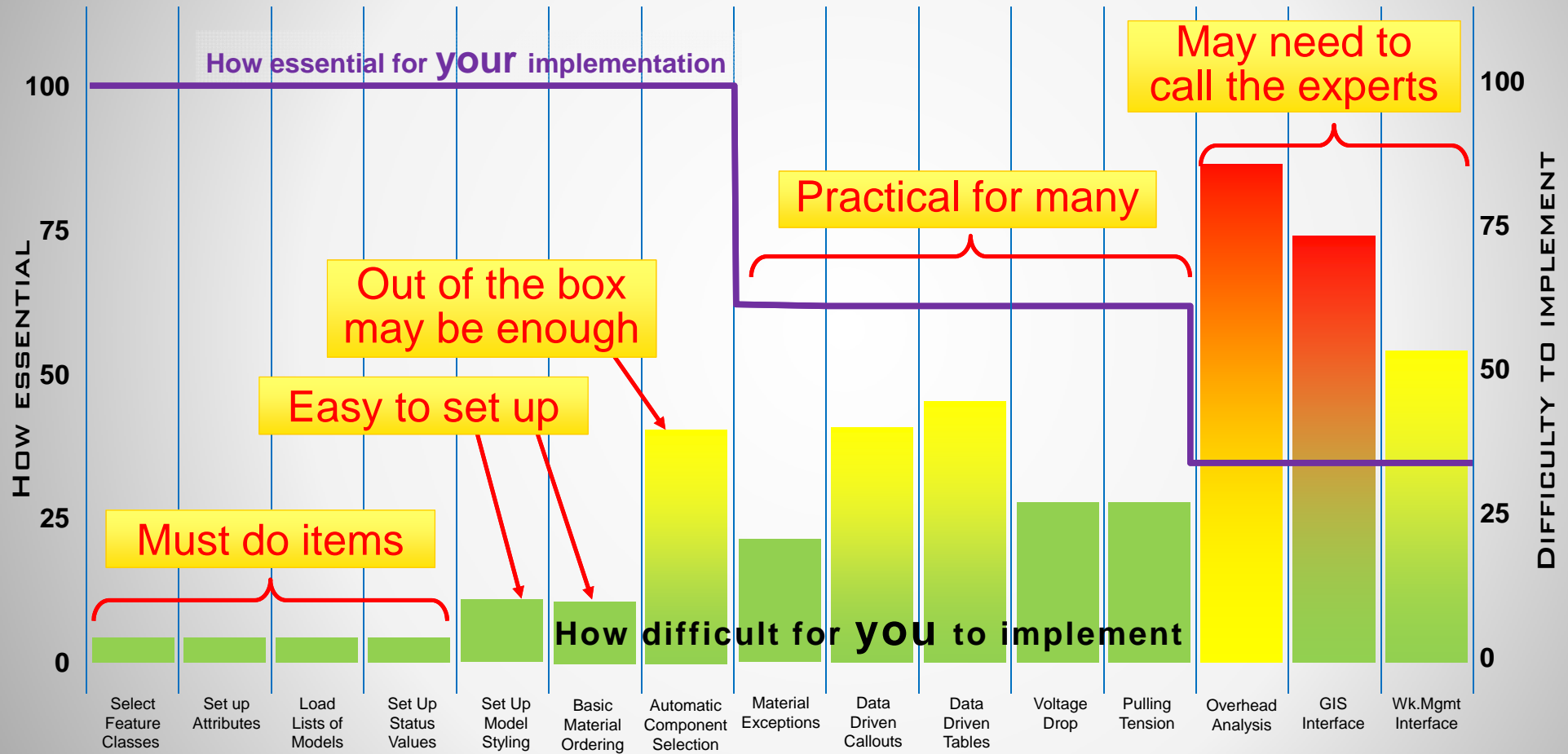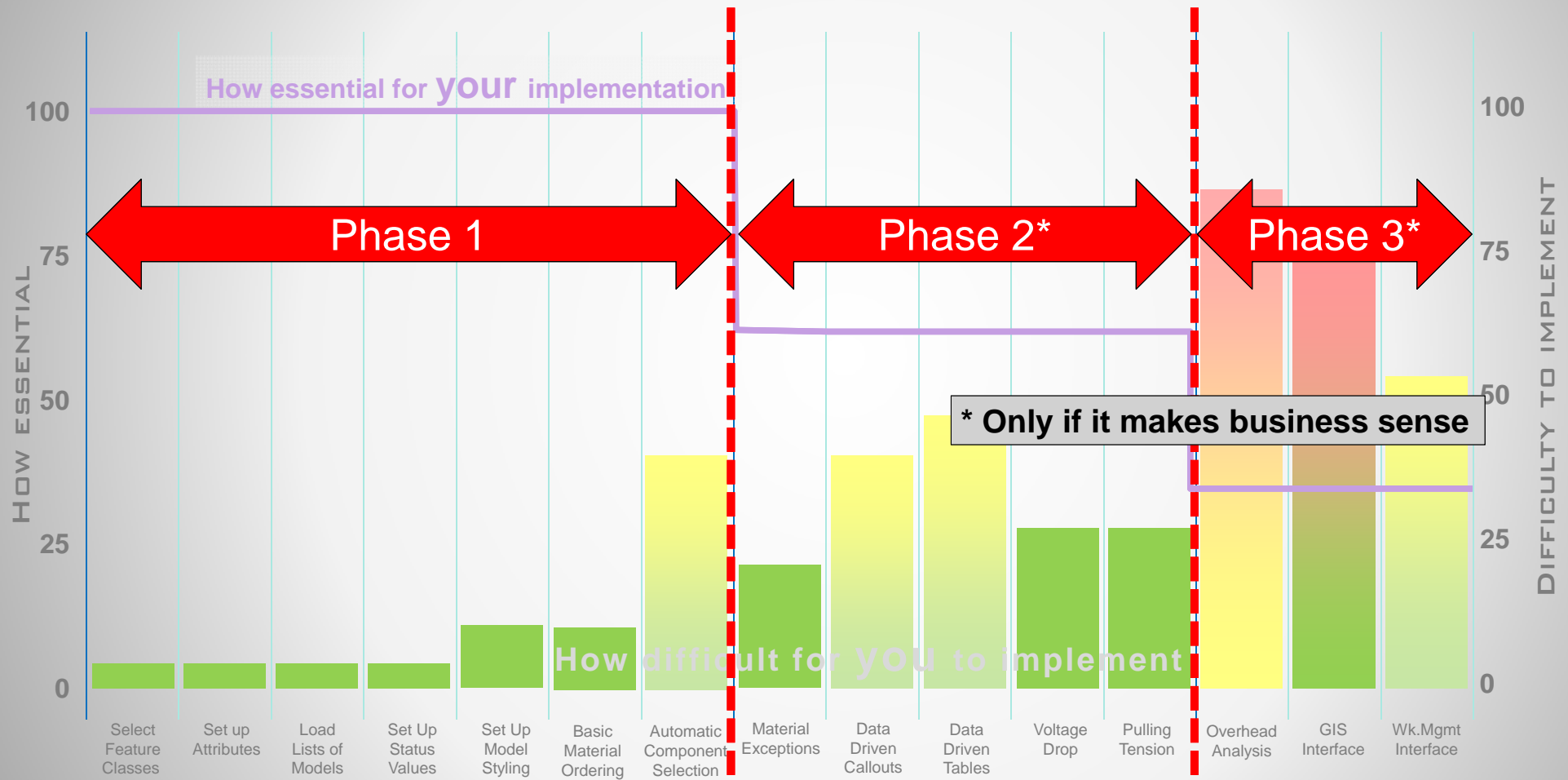
Plan a phased implementation

Phase 1: Top priorities
- Define / load material catalog ⟵ Can be tricky – more info in a moment
- Define priority feature classes ⟵ What components do you always use?
- Configure model attributes ⟵ Only for essential stuff
- Load initial sets of models ⟵ Use simple CSV load for now
- Create blocks / styling for models ⟵ Shortcuts available – more info shortly
- Configure GIS import process ⟵ Maybe the same as you do today?
- Define basic material ordering ⟵ Can you handle exceptions manually?
- Create layouts / title block ⟵ Clean up your existing stuff
- Perform initial deployment
- Plan catalog update process ⟵ Think about support and maintenance

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Plan a phased implementation

And phase 2 (and later phases)?

Getting to a basic implementation in less time

Tips and tricks for faster implementation

- Do a pilot
- Creating the material catalog
- Smart styling
- Smart material ordering
- Comment everything!

Doing a pilot:

Learn enough to have some confidence

Basic, but enough so you have a feel
for many implementation aspects

Use out-of-box
engineering
for the pilot

Use simple
material
ordering

Utility
GIS

Do it the old way
for now

Work order
management
system

Do it the old way
for now

AutoCAD Utility Design

One time transfer
for the sake of the
pilot

Material catalog

Use out of the box reports for now

- One-time transfer of material catalog information

- Representative set of feature classes & models

- Smart styling

- Smart material ordering

- Annotation???

- Engineering???

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The material catalog challenge

- Must be in SQLite format
- Must be the right table structure

We don't really have an IT expert

I don't know SQL

Select what from where?

I just use spreadsheets

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The material catalog challenge

What you've got

CU	RUS Standard I.D.	Item #	Material Description	Qty	Material Cost	Exte P
A1.1	Single Primary Support	a	Insulator, pin type	1	$5.50	
A1.1		b	Pin, pole top, 20"	1	$7.93	
A1.1		c	Bolt, machine, 5/8"x req'd length	2	$1.68	
A1.1		ek	Locknuts	3	$0.00	
A1.1		cm	Spool insulator	1	$1.11	
A1.1		d	Washer, square, 2 1/4"	3	$0.13	
A1.1		bs	Bolt, single upset	1	$2.75	
A1.2	Single Primary Support-Offset Neutral Assembly	a	Insulator, pin type	1	$5.50	
A1.2		b	Pin, pole top, 20"	1	$7.93	
A1.2		c	Bolt, machine, 5/8"x req'd length	2	$1.68	
A1.2		j	Screw, lag, 1/2"x4"	2	$0.40	
A1.2		ek	Locknuts	3	$0.00	
A1.2		cm	Spool insulator	1	$1.11	
A1.2		d	Washer, square, 2 1/4"	3	$0.13	
A1.2		ec	Bracket, offset, neutral	1	$47.88	
A2.1	Double Primary Support	a	Insulator, pin type	2	$5.50	
A2.1		b	Pin, pole top, 20"	2	$7.93	
A2.1		c	Bolt, machine, 5/8"x req'd length	2	$1.68	
A2.1		d	Washer, square, 2 1/4"	1	$0.13	
A2.1		bs	Bolt, single upset	1	$2.75	

What you want

Materials (AUDMAT)
Contains one entry for every individual item that might be included in a design (components and services)

Categories (AUDCategories)
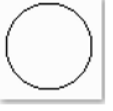Defines available categories
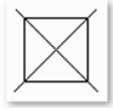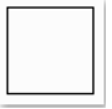
Relations (AUDAssemblyRelation)
Identifies what records in the Materials Table are associated with a given record in the Assembly Table

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Smart styling

- The appearance of most objects is based on 2 things…
  - Status of the object
  - The specific model

Status Dependent					Demolition	Existing	Proposed
	Demolition	Existing	Proposed				
Pad mount Transformers				Pole mount Transformers			
TUT transformers							
Junctions				Poles			

Smart styling

- Add a model definition attribute "Style Prefix"
- Define styles with rigid naming
- Create a single rule that works in all cases

Choose style by name "[Style Prefix] – [Status]"

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Smart material ordering

- Consider material-related model attributes
- Define your "basic material ordering rule" as a subrule
- Create a maintainable approach

Add material CU:[Model Name] <*Add Text...*> Quantity: 1 Status:[Status]
    Set Attributes:
        Material Cost = choose value where [Electric Special Order] equals ▷
        Special Order =[Electric Special Order]

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Comment everything

- What feature classes are you using?
- What models did you add?
- What blocks have you updated?
- What rules have you added?
- What rules have you changed?
- What work remains?

Did you write it down?
Have you created a spreadsheet?
Are you creating your implementation checklists?

AUTODESK.

Considering AUD?
It's time to roll up your sleeves and get to work!