

STUDENT TRAINING GUIDE

# Variant Management





Welcome to the ACE 2023 Training Session for Aras Variant Management

The objective of this session is to provide a 'practitioners view' of the Variant Management Application through hands-on exercises.

Starting with an interactive tour of the VM Application, we will then extend an existing variable configuration to enable new variant resolutions.

If time allows, we will build a new variable configuration from the ground up.

Let's get started...

# Agenda

Part One

Interactive Tour of the Aras Variant Management Application

Part Two:

- Extending Variability – Ebike conversion for Bicycle structure

Part Three:

- Building a Variable Configuration from Start to Resolution

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Part One is a hands-on, click-along exploration of Aras Variant Management with the intent to familiarize with the functional design of the application 'first-hand'.

Part Two involves making some real modifications to the variability of the familiar Bicycle database, during which we will add an EBike conversion and new Features, Options, Rules and Usage to resolve new variants.

Part Three, if time allows, is an assignment for you to do largely on your own with the detailed information (and pre-added Parts to save time). You will need to understand the provided variability example and relate it to what you learned in Parts One and Two.



As mentioned earlier, Part One is a hands-on click-along exploration of Aras Variant Management with the intent to familiarize with the functional design of the application 'first-hand'.

All aboard!





## Try it:

 Navigate to Variant Management in the TOC. You will see the following Itemtypes:



• Now navigate to Design. Breakdown Items appear here:



# Features and <i>Options

- In Aras VM the meaningful characteristics of a variable configuration are represented as Features; and all possible values for them are represented as Options.
- Features are typically used together to collectively make all of their related Options available for use in defining variability.

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	0070 Pet bike	30
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- Navigate to Dictionary->Features in the TOC
  - Open F013 Bicycle Type which has 3 basic Options, then compare with F005 Frame Size which has a broader range of values.
  - A hierarchy is implied some are constrained by others when Options are used to define variability.
  - For example, the Rule (covered in detail later) shown below combines Options from [Bicycle Type], [Bicycle Size] and [Frame Size] Features to restrict the size of X-Large Mountain Bike frames to 23 inches:



# Breakdown Items

- The **Breakdown Item**, its structure and variability represents a variable configuration in Aras VM. It is analogous to the 150% BOM concept.
- Relationship Tabs found on the Breakdown Item:

Conte	nt i	Breakdown S	Structure Variability Item	Cor	ntent Breakdown Struct	ure Variabili	ty Item	Conte	nt Breakdown St	ructure Variability Ite	em
) ()	onter	nts ∨ ☆		¢.	2	6		🔹 V	′ariability Items   ~	☆	F7 Open
6	10	5 5	Q 🛛 Hidden	N	lumber	Revision	Name	60		Hidden 🗸	/ Edit
		Number	Name	E	B024	А	Control System				: Replace
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		B011	Handlebar Structure		🗈 🔶 C013	J	Handlebar		aV024	Control System	
	•	C013	Handlebar		🖃 🌐 C023	в	Shifter				Add to Pavoint
	0	BC-BELL	Bell		- 🏠 SHF-5877	A	X1 11-Speed Trigger Shifter				
		UM-FT	User Manual - Fat Bike		🔅 SHF-5876	A	11 Speed STI Shifters				
_	-				🖃 🏪 B007	в	Brake System				
					😑 🕂 🌐 C019	А	Brake				
					- 🛟 BR-4069	В	SLX Hydraulic Disc Brake				
						С	BR-CX50 Cantilever Brakes				
						۵	Brake Lever				

- Content tab
  - Components applicable to a Breakdown Item, I.e., the 'scope' of a variable configuration. Includes Variable Components, other Breakdown Items (as a structure), or [Parts | Documents | Requirements].

#### Breakdown Structure tab

- A Tree Grid View of the entire variable configuration (a.k.a. the 150% BOM).
- Variability Item tab
  - Variability Items contain Rules and relevant Features used to constrain Option Selection during the Resolution of a variant

- From the TOC, open **B012 Bicycle** Breakdown Item for viewing. This is the toplevel node in the Bicycle variable configuration.
- Observe the contents of the three relationship tabs described above.
- Under Breakdown Structure, we see the entire variable configuration of the bicycle as a Tree Grid View
- Leave **B012** Bicycle open for the next exercise...

# Breakdown Item Structure - the Variable Configuration

- The Breakdown Item structure contains the permuted variable configuration containing all possible variants under one structure
- We resolve discreet variants from the Breakdown Item by selecting Option combinations



- Expand the Breakdown Structure tab and note that it contains other
   Breakdown Items, Variable Components; which in turn contain a number of Parts
- This is a view of the entire variable configuration (a.k.a. the 150% BOM)

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Breakdown Ite Q	<b>E</b>	Content Breakdown Structu	re Variability	/ Item
🌣 Parts	· ·			
Products	(2)		¥ 16	X
		Number	Revision	Name
			А	Control System
		🖃 🔡 B011	К	Handlebar Structure
		😑 💠 C013	J	Handlebar
		НВ-9456	В	15.7" Aluminum Drop Bar
		🕂 🛟 НВ-1623	С	17.3" Aluminum Drop Bar
		НВ-2303	В	16.5" Aluminum Drop Bar
		НВ-9556	А	30.7" Aluminum Riser Bar
		🛟 HB-8948	В	24.4" Aluminum Flat Bar
		BC-BELL	A	Bell

# Variable Components

**Variable Components** contain all possible items (I.e., Part, Document, or Requirement) that can be resolved for any node in the variable structure.

- For example, Variable Component "C013 Handlebar" has 5 possible resolutions
- These specific (resolvable) items are called Assets
- Usage Conditions use TRUE/FALSE Expressions to determine which Assets are used in a variant result via
- The Sidebar includes a Usage Condition Editor, and the Resolution window where Option combinations are selected to resolve into specific variants



## Try it:

[Bic

 Open the Variable Component 'C013 Handlebar' using the RMB menu:

😑 🛟 C013	Handlebar	F7	Open	
НВ-9456	15.7" Aluminum Drop	ц,	Grow	
НВ-1623	17.3" Aluminum Drop	۲e	Trim	
🗰 HB-2303	16.5" Aluminum Drop	Bar	1	
🔅 НВ-9556	30.7" Aluminum Riser	Bar	1	

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B011

🕂 🌐 C013

**D** HB-9456

🔅 нв-1623

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🔁 НВ-9556

🔁 нв-8948

C BC-BELL

C SHF-5877

5 SHF-5876

C023

Content Breakdown Structure Variability Item

9 YE I 🛛

Control System

Handlebar Structure

15.7" Aluminum Drop Ba

17.3" Aluminum Drop Ba

16.5" Aluminum Dron Bar

30.7" Aluminum Riser Bar

X1 11-Speed Trigger Shifter

9 © 2023 Aras

11 Speed STI Shifters

24.4" Alu

Shifter

• Next open the Usage Condition Editor from the Sidebar:

=	∧ Variable Compon	ent					
	Usage Condition Editor	I	Item	Name	Expression	[	
	C013	0	HB-9456	15.7" Aluminum Drop Bar	[Bicycle Type] = [Road Bike] AND ([Bicycle Size] = [X-Small] OR [Bicycle Si	ר	
	Name	0	HB-1623	17.3" Aluminum Drop Bar	[Bicycle Type] = [Road Bike] AND ([Bicycle Size] = Medium OR [Bicycle Siz		Conditions
	Handlebar	0	HB-2303	16.5" Aluminum Drop Bar	[Bicycle Type] = [Road Bike] AND [Bicycle Size] = [X-Large] AND [Handleba		of Lloogo
		•	HB-9556	30.7" Aluminum Riser Bar	[Bicycle Type] = [Mountain Bike] AND [Handlebar Type] = [Riser Bar]		of Usage
		0	HB-8948	24.4" Aluminum Flat Bar	[Bicycle Type] = [Fat Bike] AND [Handlebar Type] = [Flat Bar]		
		0	BC-BELL	Bell			

• Click on Usage rows to examine the **Expressions** that resolves a specific **Asset**:

I	Item	Name †	Revision	State	Expression
¢	<u>HB-9456</u>	15.7" Aluminum Drop Bar	В	Released	[Bicycle Type] = [Road Bike] AND ([Bicycle Size] = [X-Small] OR [Bicycle Size] = Sm



# Resolving a Variant

- Resolution of a Variant from a variable configuration is done from the Breakdown Item using the 'Resolution' window, accessed from the sidebar menu.
- A graphical interface allows Option selection (as constrained by Rules defined on the related Variability Item(s)

1) Bicycle Type Road Bite Mountain Bike Fat Bike	Gorean Exystem Biosofie Type	Nourse Ske		Control System						
 10 Dicycle Size	Nandelas Tyle			Bicycle Type	Road Bike	• 3		Update Requ	urement	
X0mal Deal Medium Large XLarge	Bolie Type Bolie Lever Type		250	Bicycle Size	X-Large	Number	Name	Revision	State	Quanti
🕆 Handlebar Type			(2)	Handlebar Type	Drop Bar					
Riser lise ✓ Dop lise # Plat lise #				Handlebar Width	17.3 inches	B024	Control System	A	Preliminary	
tij: Handleber Width				Brake Type	Cantilever Brake	🖻 – 🎦 B011	Handlebar Structure	K	Preliminary	1
167 indes 2 16.5 indes 2 17.3 indes 2 26.6 indes 2 20.7 indes 4				Brake Lever Type	Cantilever Brake Lever	E- 4 C013	Handlebar	J	Preliminary	1
1 <mark>()</mark> Druke Type										
Cartilierer Baake 🛫 Disc Baake 🗸						- 🗘 HB-2303	16.5" Aluminum Drop Bar	в	Released	1
t <mark>()</mark> Brake Lever Type						- 🔅 BC-BELL	Bell	A	Released	1
Cartiliever Brake Lever 2 Hydraulic Oto: Brake Lever V						41 C023	Shifter	в	Released	1
						B 🚼 B007	Brake System	в	Released	1
						🖻 - 🛟 C019	Brake	A	Released	1
						- 👸 BR-6319	BR-CX50 Cantilever Brakes	С	Released	1
				Back to (	Intion Selection	E)	Brake Lever	8	Released	1
				Duck to t		🛟 BL-R550	BL-R550 Brake Lever	A	Released	4

## Try it:

- Return to **B024** and open the 'Resolution' window from the sidebar menu
- Experiment with Option selections and click 'Resolve' to see which specific Parts are resolved for each variant.

<b>≣ B024</b> ☆ □	Control System	< Prev
🖍 Edit 🕢 🖉 🖌	(\$) Bicycle Type Boad Rike Mountain Rike Est Rike	
Breakdown Item	i Bicycle Size	
Resolution	X Small Small Medium Large X-Large	
Name	nser bar ↓ Unop bar ↓ Plat bar ↓	
Control System	15.7 inches 2 16.5 inches 2 17.3 inches 2 24.4 inches 2 30.7 inches 4 3	
	Cantilever Brake ≠ Disc Brake ✓	Resolve
	Cantillever Brake Lever 🛫 Hydraulic Disc Brake Lever 🗸	



Usage Conditions on each Variable Component determine which of multiple Assets gets resolved based on Option selections



# Questions:

1. What represents the characteristics of a product, system, or other variable configuration?

🖸 Parts

- 2. Which object contains all possible resolutions for a component in a variant?
- 3. How does Aras VM determine which Asset is resolved?

Resolution

4. What Itemtypes can be added to a Breakdown Item structure?



And how did Resolution know which Options were compatible with each other while making our selections?



While resolving a Variant from **B024**, our Option selections were constrained to certain combinations. These constraints were defined as **Rules** on the related **Variability Item** (per the 'Variability Item' tab on the Breakdown Item).

- Variability Items include:
  - Rules (conditional expressions that constrain Option combinations)
  - And all Relevant Features whose Options are used in its Rules
- Variability Items are modular, reusable and versionable. They are referenced by Breakdown Items, Variable Components, Usage Items as well as other Variability Items in a BOM-like structure:





## Try It:

 From the 'Variability Item' tab on **B024** Breakdown Item use the RMB menu to open **aV024** Variability Item

					🛛 🍪 a	V024 Control Sy	ystem ☆ 🖂
III B	024 1 dit 🕤	★ III ▶ (~°)   ≫ ~)	iii ∨ <b>⊷</b> ∨   •	••	🖍 E	dit 🕑 🕼 🗎	€• ×
<b>•</b>	Conte	nt Breakdown Stru	Icture Variability Iter	n		Relevant Features	Variability Items
) () ()	😵 V	ariability Items 🗸	☆ Hidden ✔	● <	*	IJ ₩ O	1
	=	Number	Name	Revi	$\otimes$		Ourtral Ourtran
		aV024	Control System	2 Open		av024	Control System
				Edit		📋 🎲 F013	Bicycle Type
						• 0057	Road Bike

- View the contents of the 'Relevant Features' and 'Variability Structure' tabs
- We will define our own Feature scope(s) and Rules in later exercises

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<b>:</b>	Relevant Features	Variability Items Variability Structure
.∿. •≣	<ul> <li>€)</li> <li>(4)</li> <li>(5)</li> <li>(4)</li> <li>(5)</li> <li>(4)</li> <li>(5)</li> <li>(4)</li> <li>(5)</li> <li>(4)</li> <li>(5)</li> <li>(5)</li></ul>	1 🐶 🦿 🛛
$\odot$	Number	Item
	🖃 💸 aV024	Control System
	🖃 - 🎊 F013	Bicycle Type
		Road Bike
		Mountain Bike
	• 0098	Fat Bike
	⊞ 🎊 F001	Bicycle Size
	🕀 🕸 F002	Handlebar Type
	🕀 🕸 F028	Handlebar Width
	🕀 🕸 F020	Brake Type
	🕀 🚯 F024	Brake Lever Type

All Options under Relevant Features are available for use as operands in variability expressions (Rules, Usage Expressions)

#### Variability Item – 3 Rules Rules control how Options can be selected and combined to implement variability. They are defined within a Variability Item and will apply variability to any object referencing it. For example: In the case where a Variability Item is used by (related to) a Breakdown Item (a.k.a. 150% BOM), the Rules defined within the related Variability Item control the selection of Options to resolve that Breakdown Structure to a specific variant (a.k.a. 100% BOM). 🔹 aV014 Frame Structure 🏫 🗏 <mark>∕ Edt</mark> Ø (\* | ★~ ≜~ ≮~ | … Road Bike Mountain Bike Fat Bike = cie Type] = [Fat Bike]) AND [Bicycle Size] = Small THEN Bicycle Si Medium Large X-Large Riser Bar 🖌 Drop Bar 🗱 Flat Bar 🕱 15.7 inches # 16 es # 17.3 inches # 24.4 inches # 30.7 inches ✔ Brake Typ Cartilever Brake 2 Disc Brake 🗸 IF (Bicycle Topel + Mountain Bida) OR Bicycle Topel + I Brake Lever Type Cantilever Brake Lever 🚅 Hydraulic Disc Brake Lever 🗸 aras 14 © 2023 Aras

**Rules** contain expressions using IF/THEN <Feature>=<Option> syntax with support for AND/OR/NOT operators.

#### Try it:

Use the 'Rule Editor' sidebar menu on aV024
 Variability Item to view the Rules constraining our selections while resolving B024 in an earlier exercise.



The Table Editor provides an intuitive, visual way to define Rules:

- Open the Table Editor in the Rules Editor window.
- Follow along with your instructor to view various Rule constraints in a table.
  - Review Principal vs. Constrained settings
  - Try 'build table from rules' action
- We will use these tools to create Rules shortly.



#### Variability Item – SValidation Variability Items allows us to preview the effect of the Rules we've defined using the Validation tool, accessed from the sidebar menu. •We can test our Option selections in various combinations to validate the intended variability as implemented in Rules. © 1924 Control System ☆ □ © time ✓ Den © Denate ○ C ☆ ☆ @ ◆ ★ · · · · · © Control System Bicycle Type Road Bike Mountain Bike 🗱 Fat Bike 🚅 Bicycle Size X-Small 코 Small 코 Medium 코 Large 코 X-Large : Handlebar Type Riser Bar 🔹 Drop Bar Flat Bar 韋 : Handlebar Width 15.7 inches 24.4 inches 24.4 inches 2 30.7 inches 🚅 Brake Type Cantilever Brake Disc Brake # Hydraulic Disc Brake Lever aras 15 © 2023 Aras

- From the 'Validation' sidebar menu on avoid av
- Verify Rule behavior by experimentation in the Validation window

🛟 aV024 Control Sys	tem 🕁	
Save Vone 😢 🕻	Discard	0
🔚 \land Variability Item		
Vumber aV024	Revision H	Control System  Prev  Prev Prev
		Riser Bar       Drop Bar 2       Flat Bar 2         (2) Handlebar Width       15.7 inches 2       16.5 inches 2       24.4 inches 2       20.7 inches √         (2) Brake Type       Cantilever Brake 2       Disc Brake √       20.7 inches √       20.7 inches √         (2) Brake Lever Type       Cantilever Brake Lever 2       Hydraulic Disc Brake Lever √

# Variability Item – Saving/Loading a Selection Set

 We can save the Option selections made during Validation to re-load and validate again either in Variability validation –or- to resolve a Breakdown Structure that uses the same variability structure.



# Try it:

- From the 'Validation' sidebar menu on aV024 Variability Item make selections to preview variability
- Save your selections from the Summary Pane (far right). Give the selection set a number and an easily recognized name like "Control Sys Config01"
- Now navigate via "Where Used" (or TOC) to the Breakdown Item **B024** and open the **Resolution** sidebar window.
- Load the saved Selection Set and Resolve to see the Variant Asset results:

Number	Name	Revision
⊟ <b>8</b> B024	Control System	A
	Handlebar Structure	К
Ė	Handlebar	J
🏠 HB-8948	24.4" Aluminum Flat Bar	В
BC-BELL	Bell	A
	Shifter	В
	Brake System	В
Ė	Brake	A
BR-4069	SLX Hydraulic Disc Brake	В
	Brake Lever	A
<b>BL-3757</b>	SLX Hydraulic Disc Brake Lever	A



 $\bigcirc$  We can reload a saved selection set without reselecting Options



To Summarize:

- Variability Items are modular, reusable objects that combine Relevant Features and Rules to apply variability to referencing items like Breakdown Items, Variable Components, and Usage Conditions.
- Rules constrain the selection of Options in combination with other Options when defining and resolving variability.
- Variability Items provide specialized tools to simplify and enhance the definition of Rules: the Rule Editor & Table Editor, the Variant Matrix, and Validation tool.



#### **Forward Progress!**

You should now be able to navigate the Aras Variant Management application with an understanding of its functionality, Object structure.

Quiz:	
1. Rules determine which Asset a Variable Component resolves to… [TRUE/FALSE]	
2. Any Option can be used in a Rule Expression… [TRUE/FALSE]	
3. Rules are Boolean expressions… [TRUE/FALSE]	
4. I can save a set of Option selections to re-use on other VM objects later [TRUE/FALSE]	
5.I can create and edit Rules in the Variant Matrix [TRUE/FALSE]	
Aras	18 © 2023 Aras

Quiz:	
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4. I can save a set of Option selections to re-use on other VM objects later [TRUE/FALSE]	
5.I can create and edit Rules in the Variant Matrix [TRUE/FALSE]	
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#### **Quiz Answers:**

- 1. False, Variable Components determine which Asset (Part/Document/Requirement Item) resolves to a discreet variant via Usage Condition expressions.
- *2. True*, provided the Option's parent Feature was added as a relevant Feature to the Variability Item.
- *3. False*, Rules are actually Conditional Expressions in the IF/THEN= format with support for AND/NOT. Usage condition expressions are Boolean expressions.
- *4. True*, see section 4.2.12.3 in the Variant Management 27 User Guide for details on using the Summary Pane in the Validation window.
- 5. False, Variant Matrix provides a tabular view of valid Option combinations per the Rules configured on a Variability Item but use the Rules Editor to make any changes



In the next Unit, we'll extend the existing variable configuration through hands-on exercises, and resolve a new variant.



Now that we've completed the interactive tour of the VM Application, lets make some modifications to the Bicycle variable configuration. With the popularity of Electric Bikes (EBikes) we will need to add a conversion for the Eat Bike to 'go

need to add a conversion for the Fat Bike to 'go electric'.

Follow along with the instructor to add Features and Options, extend variability, and ultimately resolve new discreet variants with EBike conversions in the 100% BOM.

# Adding an EBike Conversion Feature

- We will first create a new Feature that can be applied to the Bicycle variable configuration
- Then we will use this Feature to configure a variant that enables conversion to EBike

	EF     Sa     Sa     F	Conversion Conversion Conversion Conversion Number E001 E002	Conversion ☆ F © Discard ↔	n v ] [ Sequen_ † 10 20	
Aras					21 © 2023 Aras

- Navigate to *Dictionary->Features* in the TOC
  - Create a new Feature 'EF001 EBike Conversion'
  - Add Options as shown below, and save the Feature:

🕸 EF001 EBike C	onver	rsion 🕁 🗉		
Save Vone	😧 Dis	scard 🗲	¢°   ⊁~	
∧ Feature				
Number EF001 Name ERike Conversion	* 0 6	ptions 🗸 🟠	Г Q (М) (Ні	idden 🗸
Ebike Conversion		Number	Name	Sequen
		E011	Compatible	10
		E012	Not Compatible	20
		E012	Not Compatible	20

# Add Rules to Constrain EBike Conversions

 Next, we will add a new Rule to allow EBike conversions for a specific Bicycle Type (Fat Bikes)



#### Try it:

Work along with the Instructor to add Rules to constrain the EBike conversions:

- 1) Locate the **\*aV012 Bicycle** Variability Item from the TOC (Or navigate to Variability Item tab from Bicycle Breakdown Item). Open it for Editing.
- 2) Add the EF001 EBike Conversion Feature to the 'Relevant Features' tab
- 3) Follow along to configure these 2 Rules in the **Rule Editor** sidebar window and Validate once added:

First rule:	IF       [Bicycle Type]       =       [Fat Bike]       THEN       [EBike Conversion]       =       Compatible         AND       (       [Bicycle Size]       =       Medium       OR       [Bicycle Size]       =       Large       )       parens
Second rule:	IF       [Bicycle Type] = [Road Bike]       OR       [Bicycle Type] = [Mountain Bike]         THEN       [EBike Conversion] = [Not Compatible]
Validate rules:	Road Bike   Mountain Bike   Fat Bike     Bicycle Size     X-Small   Small   Medium   Large   X-Large     K-EBike Conversion     Compatible   Not Compatible



# Try it:

Again, work along with the Instructor to create new Features and Options:

- 1) Feature "EF002 EBike Motor"
  - Option "E002 Hub Drive"
  - Option "E003 Gear Drive
- 2) Feature "EF003 EBike Controller"
  - Option "E004 Controller"
- 3) Feature "EF004 EBike Throttle"
  - Option "E005 Thumb"
  - Option "E006 Twist Grip"
- 4) Feature "EF005 EBike Battery Pack"
  - Option "E008 36v 14Ah"
  - Option "E009 52v 20Ah"

We will use these new Features and Options to extend variability for the new Bicycle Type.



In the next Unit, we'll extend the existing variable configuration through hands-on exercises, and resolve a new variant.

# Configure E-Bike Variability Items 🝀

#### Define new Rules using the EBike Features and Options

We will now apply the new Options we've created in Rules to define variability of EBikes. Steps include:

- Create a New Variability Item
- Add Relevant Features
- Define Rules
- Validate the new Rule set
- Apply the EBike Variability Item to the parent Variability (Bicycle)
- Validate

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## Try it:

- Create a new Variability Item named;
   "eV001 EBike Variability"
- 2) Add Relevant Features as shown below:

~ F	Relevant Fea	tures Variability	ltems Var
🕸 F	eatures 🗸	$\hat{\nabla}$	
ō	6	Q 🛛	Hidden
	Number	Name	Seq 🕇
	F001	Bicycle Size	10
	EF001	EBike Conversion	20
	EF002	EBike Motor	30
	EF003	EBike Controller	40
	EF004	EBike Throttle	50
	EF005	EBike Battery Pack	60

- Next, work with your instructor to configure Rules per the **Table Rule Editor** screenshot shown at right:
- 4) Validate your Rules

_	
Principal	
Bicycle Size	
Medium	~
Large	~
EBike Conversion	
Compatible	<ul><li>✓</li></ul>
Not Compatible	
Constrained	
EBike Battery Pack	
36v 14Ah	~
52v 20Ah	<b>~</b>
EBike Controller	
Controller	<ul><li>✓</li></ul>
EBike Motor	
Hub Drive	<b>~</b>
Gear Drive	<b>~</b>
EBike Throttle	
Thumb	~
Twist Grip	<b>~ ~</b>

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# Include EBike Variability on Bicycle

With EBIke Variability now applied and validated, let's incorporate it into the top-level Bicycle Variability Item

-		Nu	mber	Item 🕇
<ul> <li>Relevant Features</li> </ul>	Variability Items Variability Structure			Biovela
🛟 Variability Items 🗸	<b>☆</b>		- avoiz	Bicycle
	Hidden 🗸 💽 🗸 🞚		E FUUI	Bicycle Size
			🕀 🎊 F013	Bicycle Type
Number	Name		🕂 😪 🛟 aV024	Control System
aV024	Control System		🖃 🛟 eV001	EBike Variability
aV014	Frame Structure		🕂 - 🄯 EF004	Battery Pack
aV002	Seating		🛨 – 🅸 F001	Bicycle Size
aV/003	Wheel System		🕀 🕂 🚯 😥 🕀	Bicycle Type
			🔯 EF002	Controller
aV016	Transmission		🕀 👘 EF001	Motor
aV099	User Manuals		🕀 - 🎊 EF003	Throttle
eV001	EBike Variability			Frame Structure
-				

- 1) With "aV012 Bicycle" Variability Item in edit mode, add "eV001 EBike Variability" to its Variability Items tab.
- 2) Save, and examine Rules. You should see that the Rules and Feature scope from **eV001 EBike Variability** Item have been incorporated in **aV012 Bicycle**.
- 3) Open Validation from the sidebar menu of "**aV012 Bicycle**" Variability Item and verify the Rule logic in the context of the Bicycle parent

🅸 Bicycle Type			
Road Bike	Mountain Bike	Fat Bike	EBike
🅸 Bicycle Size			
X-Small 컱	Small 🔁 🛛 🕴	Vledium Large	X-Large 컱
🅸 Frame Material			
Aluminum Alloy	Carbon Fiber	Titanium	
🕸 Frame Color			
Glossy Black	Matte Black	Black/Yellow	Silver
Orange	Red		
😫 Frame Size			
17 inches 韋	19 inches 韋	21 inches 🗸	23 inches 컱
42cm 컱	46.5cm 🔁 🚦	50cm <b>2</b> 55.5cr	m <b>≵</b>
58.5cm 컱			

# Variability Item – Variant Matrix 🗲

Another useful variability tool is the Variant Matrix view, accessible from the Variability Item Sidebar. It allows you to selectively generate a grid (matrix) of valid Option combinations in the right-side pane for a given selection of Feaure/Options in the left-side pane:

	🛟 aV	7012 Bicycle ☆ ■ ve ✓ Done ② Discard 6	€°   >	<b>€•</b> •	€ <mark>.</mark> 0 ~   ••	•						
	₩ 	+ -   🜌		Export to	Excel 4 Res	ults			1	1		
	4	📬 Fat Bike		Bicycle Type	Bicycle Size	Brake Lever Type	Brake Type	Frame Size	Handlebar	Handlebar	Motor	Throttle 🕇
	$\odot$	EBike		EBike	Medium	Hydraulic Disc Bra	Disc Brake	21 inches	Drop Bar	24.4 inches	Hub Drive	Thumb
		🖽 🕂 🚯 Bottom Bracket Type		EBike	Medium	Hydraulic Disc Bra	Disc Brake	21 inches	Drop Bar	24.4 inches	Hub Drive	Twist Grip
		·	- •	EBike	Large	Hydraulic Disc Bra	Disc Brake	23 inches	Drop Bar	30.7 inches	Gear Drive	Twist Grip
		100 Get Configurations		EBike	Large	Hydraulic Disc Bra	Disc Brake	23 inches	Flat Bar	30.7 inches	Gear Drive	Twist Grip
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# Try it:

- 1) From the Variability Item Sidebar menu, open the Variant Matrix window.
- 2) Make Feature/Option selections as desired, then hit

**Get Configurations** 

Export to Exce	17 Results				
Bicycle Size	Bicycle Type	Brake Lever Type	Brake Type	Frame Size	Handleb
Large	Fat Bike	Hydraulic Disc Brak	Disc Brake	21 inches	Flat Bar
X-Large	Fat Bike	Hydraulic Disc Brak	Disc Brake	23 inches	Flat Bar
Small	Fat Bike	Hydraulic Disc Brak	Disc Brake	17 inches	Flat Bar
Medium	Fat Bike	Hydraulic Disc Brak	Disc Brake	19 inches	Flat Bar
Large	EBike	Hydraulic Disc Brak	Disc Brake	23 inches	Flat Bar
Large	EBike	Hydraulic Disc Brak	Disc Brake	23 inches	Drop Bar



You can optionally export the permuted matrix to Excel.



We have now extended Bicycle Variability to include an EBike conversion with corresponding Features (Motor, Throttle, Battery, etc.) and their Option choices. We now need to define the Breakdown Item structure that will resolve into actual Part items in the variant BOM.

Content Breakdown Structure Variability Item								
	G III C III							
Number	Name	Revision	Sequence					
🖃 👪 EB001	EBike Component Structure	A						
⊟	EBike Motor	A	10					
CP-001	Bafang Gear Hub Motor	A	10					
<b>C</b> EP-002	DNYSYS Gear Motor	А	20					
😑 🕂 静 EC003	EBike Controller	А	20					
<b>C</b> EP-007	EBike System Controller	А	10					
EC004	EBike Throttle	А	30					
<b>C</b> EP-003	DPX Thumb Throttle	А	10					
<b>C</b> EP-004	TNT Twist Grip Throttle	А	20					
<b>C</b> EP-004	TNT Twist Grip Throttle	А	30					
🖃 🔹 🖶 EC005	EBike Battery Pack	А	40					
CP-005	Standard EBike Battery	А	10					
EP-006	Extended Range Battery	А	20					

# Breakdown Structure Updates for EBikes

- In order to resolve discreet variant configurations for EBikes we need to define a Breakdown Item structure to add to the parent Bicycle structure.
- Recall that Breakdown Items use *Variable Components* to contain multiple possible Assets (Parts, Documents, Requirements, etc.) for each Node in the Breakdown Structure.
- We will now add Variable Components to our new Breakdown Item, then add Part Assets to the Component nodes to complete the 150% BOM

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#### Try it:

 Create a new Breakdown Item with the number EB001 named 'EBike Components'. In the 'Content' tab, use the 'New Content' button to add four new Variable Components:

	Select ItemType ×		EC002	EBike Motor
∧ Content Breakdow	Breakdown Item	Ľ.		
Contents	Document		EC003	EBike Controller
	Part  Variable Component		EC004	EBike Throttle
	OK Cancel		EC005	EBike Battery Pack

 Part Assets have been provided to save time. Add them to the Variable Components accordingly:



# Add Usage Conditions for EBike Assets

EB001	EBike Component Struc	·
📄 🛟 EC002	EBike Motor	
🔅 EP-001	Bafang Gear Hub Motor	[Bicycle Size] = Medium AND [EBike Motor] = [Hub Drive]
CP-002	DNYSYS Gear Motor	[EBike Motor] = [Gear Drive] AND [Bicycle Size] = Large
🖃 🛟 EC003	EBike Controller	
EP-007	EBike System Controller	
🖃 🕂 静 EC004	EBike Throttle	
🔅 EP-003	DPX Thumb Throttle	[EBike Conversion] = Compatible AND [Bicycle Size] = Medium AND [EBike Throttle] = Thumb
EP-004	TNT Twist Grip Throttle	[Bicycle Size] = Large AND [EBike Conversion] = Compatible AND [EBike Throttle] = [Twist Grip]
CP-004	TNT Twist Grip Throttle	[Bicycle Size] = Medium AND [EBike Conversion] = Compatible AND [EBike Throttle] = [Twist Grip]
🖃 🛟 EC005	EBike Battery Pack	
🔅 EP-005	Standard EBike Battery	[EBike Conversion] = Compatible AND [Bicycle Size] = Medium
EP-006	Extended Range Battery	[EBike Conversion] = Compatible AND [Bicycle Size] = Large
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# Try it:

1) Open the Usage Condition Editor for each Variable Component.

Variability Item

- 2) Select eV001 EBike Variability here: eV001 EBike Variability
- Select the Asset and enter the text from the right-column below into the 'Expression' column. (The Instructor will show you how to use the Table expression editor as well)
- 4) Test Resolution of **EB001** EBike Breakdown Item

Part	Name	Expression
🛟 EP-001	Bafang Gear Hub Motor	[Bicycle Size] = Medium AND [EBike Motor] = [Hub Drive]
🔅 EP-002	DNYSYS Gear Motor	[EBike Motor] = [Gear Drive] AND [Bicycle Size] = Large
🔅 EP-003	DPX Thumb Throttle	[EBike Conversion] = Compatible AND [Bicycle Size] = Medium AND [EBike Throttle] = Thumb
<b>C</b> EP-004	TNT Twist Grip Throttle	[Bicycle Size] = Large AND [EBike Conversion] = Compatible AND [EBike Throttle] = [Twist Grip]
🔅 EP-005	Standard EBike Battery	[EBike Conversion] = Compatible AND [Bicycle Size] = Medium
🔅 EP-006	Extended Range Battery	[EBike Conversion] = Compatible AND [Bicycle Size] = Large
<b>C</b> EP-007	EBike System Controller	-

# Reusable **K**Usage Conditions

- Rather than hardcoding a Usage Expression into a specific Variable Component's Usage Sidebar pane, we can apply the same Usage Expression for multiple Variable Components -> Asset and/or Breakdown Item -> Component Usage(s)
- Steps:
  - Create an independent **Usage Condition** Item instance.
  - A column for selection of existing Usage Conditions objects is provided on the Usage Condition Window grid (next to Expressions, which are hard-coded)
  - Use search criteria to find and re-use the modular Usage Condition objects

	6	0									
		I	Item	Name	Revision	State	Sequ 🕇	Quantity	Usage Condition	Expression	
	1	8	B024	Control System	A	Preliminary	10	1	Ø		Select Items
											Simple
											Numbe Advanced Name
											Hidden
aras											30 © 2023 Ans



We have not used this new feature in these exercises - but it is well documented in section **5.2** in the **Aras Variant Management 27 User Guide** 

# Add EBike Breakdown Item to Bicycle Parent

Now that EBike Variability is defined, we need to add it to the parent Bicycle structure to allow resolution of variants with the new Options.

Steps:

- Add EB001 EBike Component Structure to Content Tab on B012 Bicycle
- Set Usage Conditions (Sidebar menu) on EB001 to limit Usage of EBike Components when:

[Bicycle Type] = [Fat Bike] AND [EBike Conversion] = Compatible

This instructs the Resolution engine to omit EB001 EBike Components when the variant has not been converted to electric.

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## Try it:

- 1) Edit **B012 Bicycle** Breakdown Item and add **EB001 EBike Components** to the Contents Tab
- 2) From the **Usage Conditions** Sidebar menu, open and assign the Expression below:

[ <u>Bic</u>	<u>ycle 1</u>	[ <u>ype]</u> = [Fat	t Bike] AND [EBike Conversio	n] = Compatible
Vali	d Expre	ession		
ō	•			
	I	Item	Name	Expression 4
	83	EB001	EBike Component Structure	[Bicycle Type] = [Fat Bike] AND [EBike Conversion] = Compatible

This assures that EBike Components will only be included in resolution results when a bicycle is converted.



Now you can resolve discreet variants from the parent Bicycle Breakdown Structure with support for EBike Conversions!

# **Resolve EBike Variants**

From the top-level B012 Bicycle Breakdown Structure, open the Resolution Sidebar window and try configuring variants with/without EBike conversions.

- If you saved a Selection Set in the past during validation etc, you can re-load it here.
- Experiment with various Selection combinations.



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**Kudos!** This concludes the instructor-led portion of this training. In the next section you will build a variable configuration from start to finish on your own with the Instructor's assistance as needed.

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Bicycle		🗲 👫 💿 3 😾 🦟 🕅		
Bicycle Type	Fat Bike			
Bicycle Size	Large	Number	Name	Revision
Bike Conversion	Compatible	⊡ <b>1</b> B012	Bicycle	A
Control System		—————————————————————————————————————	Control System	A
Bicycle Type	Fat Bike		Handlebar Structure	К
Bicycle Size	Large			
landlebar Type	Flat Bar	⊞ — 🌞 C013	Handlebar	J
landlebar Width	24.4 inches	🗄 静 C023	Shifter	в
Brake Type	Disc Brake	E 8007	Brake System	В
Irake Lever Type	Hydraulic Disc Brake Lever		Brake	A
rame Structure				
Bicycle Type	Fat Bike	E C020	Brake Lever	A
licycle Size	Large	🖃 🎦 B014	Frame Structure	A
rame Material	Titanium		Frame	A
rame Color	Black/Yellow	0017	Stem	C
rame Size	21 inches		atem	C
item Material	Aluminum	⊞ 💭 STM-6001	EA90 Aluminum 2.3" Stem	A
tem Length	2.3 inches	Ė	Fork	С
ork Material	Steel	*** FRK-9324	Travel N/A Black Steel Fork	A
ravel	No Travel			_
hocks	Rear Shocks	E	Rear Shocks	В
Seating		🔅 RS-6758	Mountain Bike Air Rear shock	С
licycle Type	Fat Bike		Seating Structure	С
addle Material	Nylon		Saddle	В
Seatpost Material	Aluminum	* ep 7477	CMD Wall Plack Nixles Saddle	P
eatpost Suspension	Mechanical Suspension	SU-7457	SMF Well black hyjon Saudie	D
Mhaal System		E C008	Seatpost	С
licvcle Type	Fat Bike _	\$P-9865	SL Aluminum Switch, dropper, 30.9mm	A
	Torbite V	E	Wheel System	A
Back to	Option Selection	E	Wheelset	Α

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