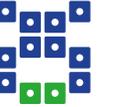


プロダクトライン開発 バリエーション管理支援ツールから習う賢人の知恵

Managing Variability in System and SW Architecture

第7回 オートモーティブ・ソフトウェア・フロンティア 2022

富士設備工業（株）電子機器事業部 浅野 義雄



はじめに、
バリエーション管理支援ツールや、
それに関する用語を説明します

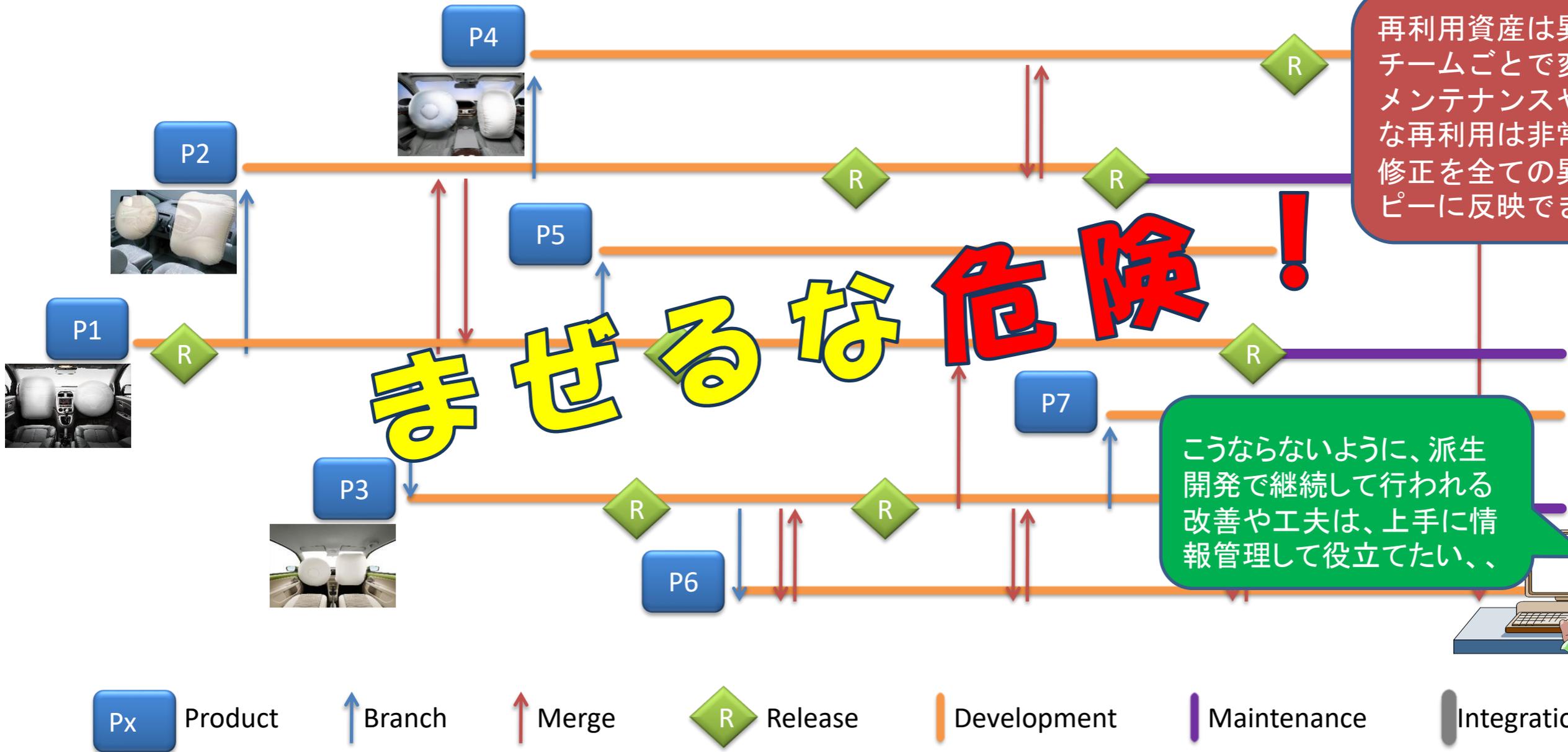


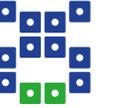
複数の派生製品からなる一連の製品群
プロダクトライン = 製品系列



プロダクトライン開発では
各製品のことをバリエーション
バリエーション間の違いはバリエーション
バージョンとバリエーションを混同しないこと

なぜ、混同してはいけないか？





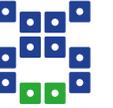
そこで登場するのが、
プロダクトライン開発です



Product Line Engineering (PLE) は、
再利用資産を運用する技術的な取り組みであり

製品(バリエーション)の進化に柔軟に応じることのできる、
開発プロセスや手法を伴う全体的なアプローチが求められる

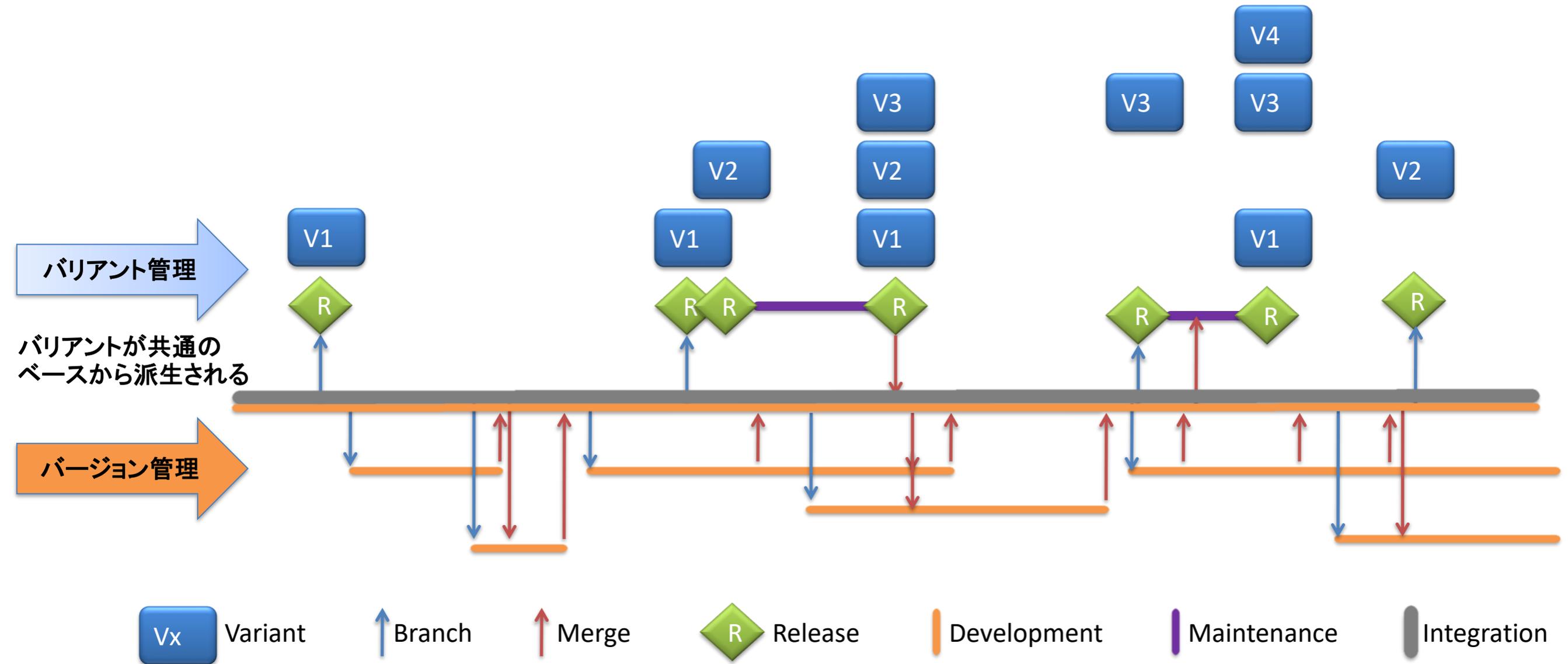




そのために必要なことは、



適正なバリエーション管理支援ツールを統合





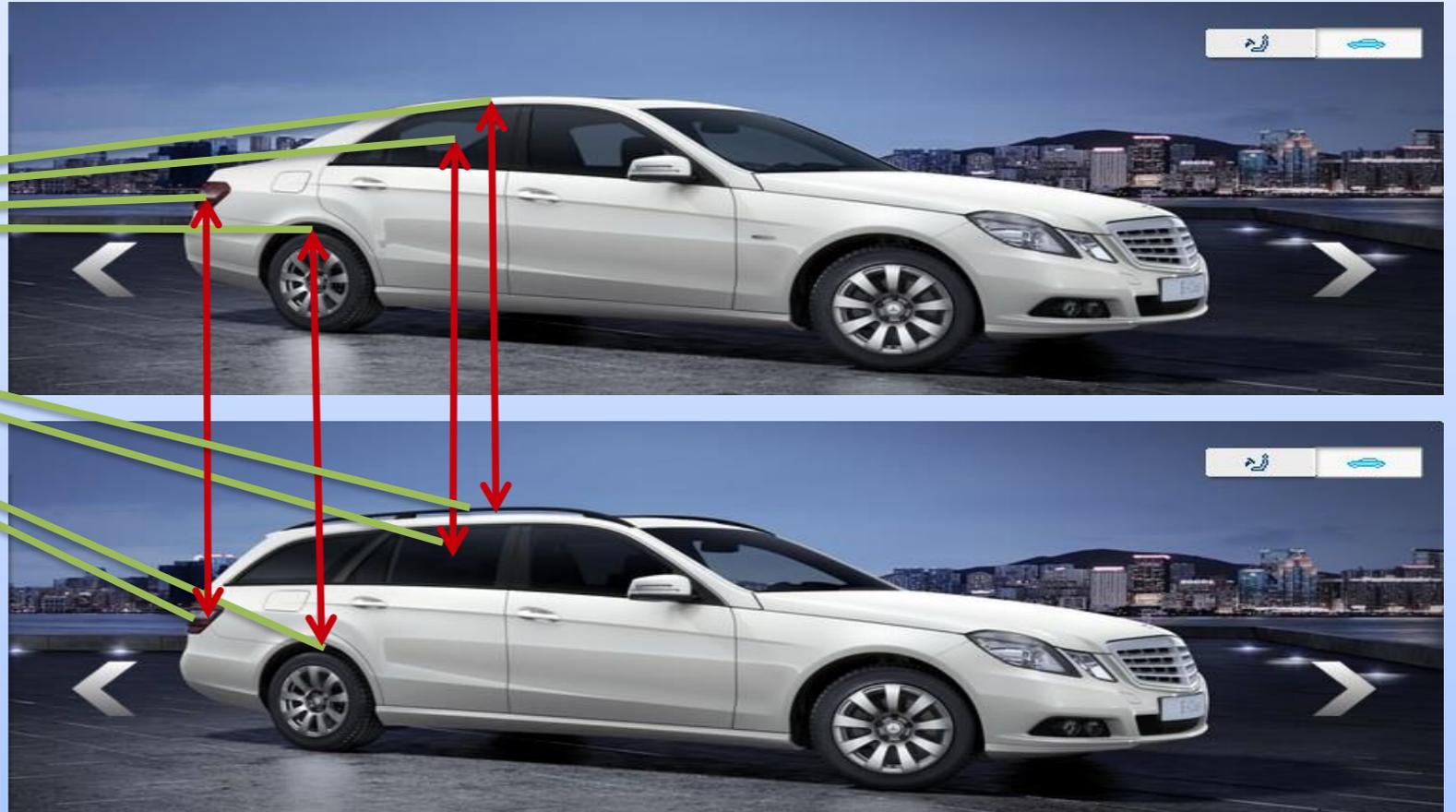
バリエーション管理支援ツールについて

バリエーションポイント

問題空間



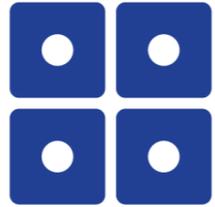
解決空間



- ・バリエーションポイントは問題空間と解決空間の両方に存在する
- ・双方に結び付くのでバリエーションの決定項目の複雑さを軽減できる

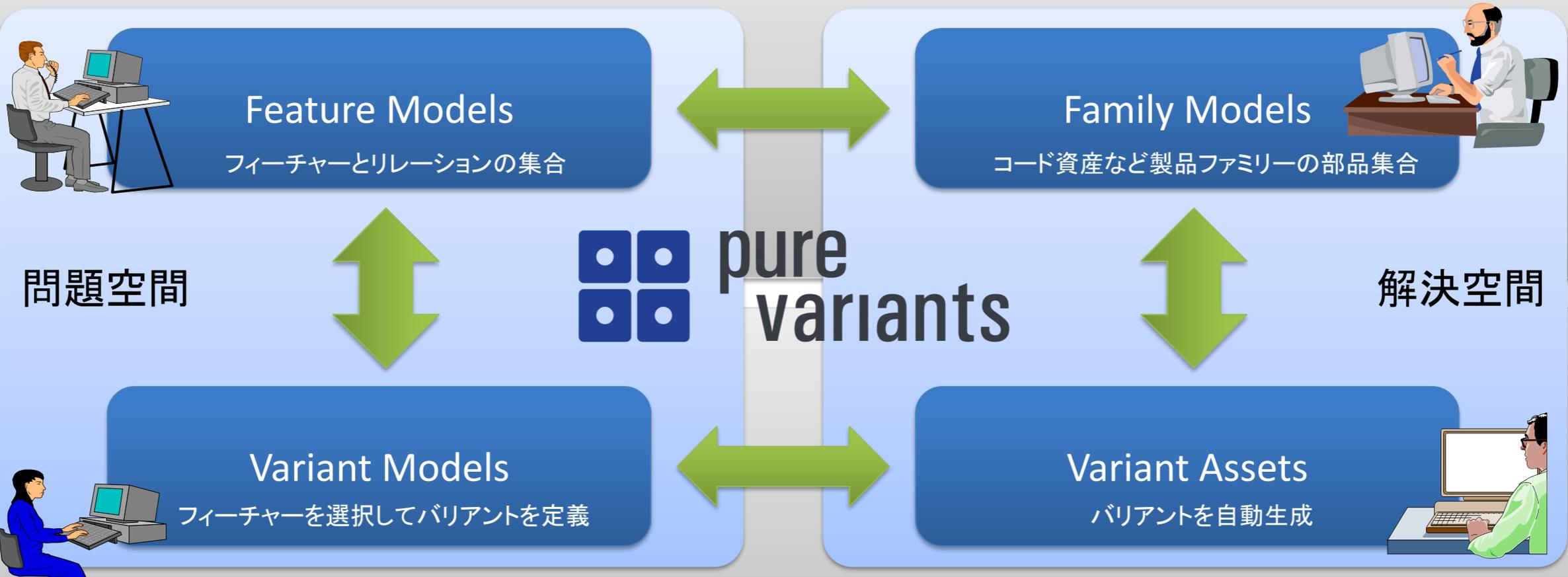
バリエント管理支援ツール



 pure
variants

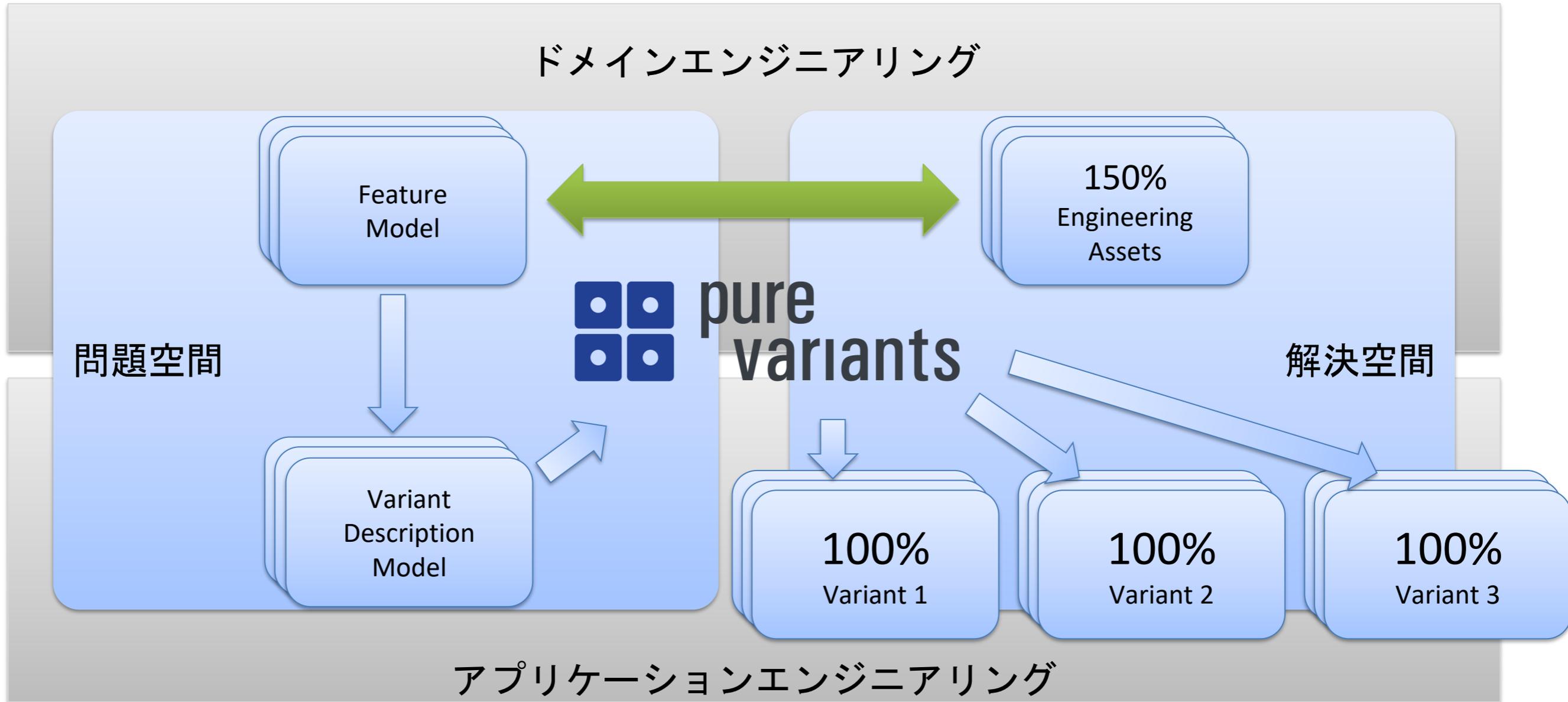
PLEの戦略＝関心事の分離

ドメインエンジニアリング

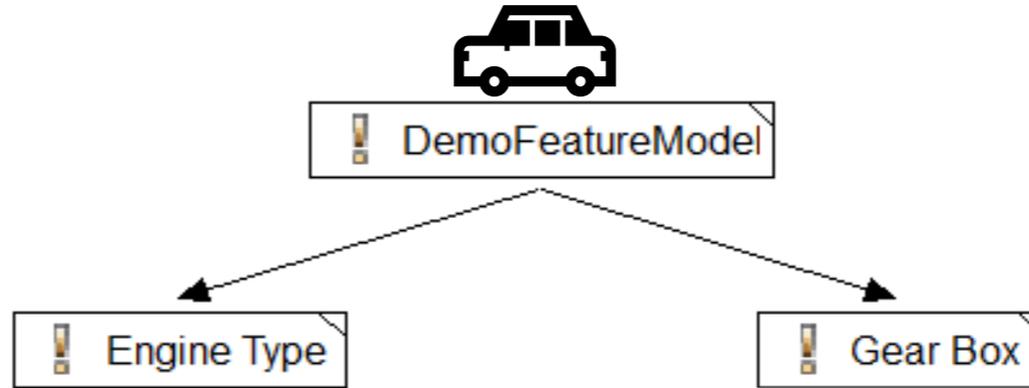


アプリケーションエンジニアリング

フィーチャモデルでバリエーションを管理

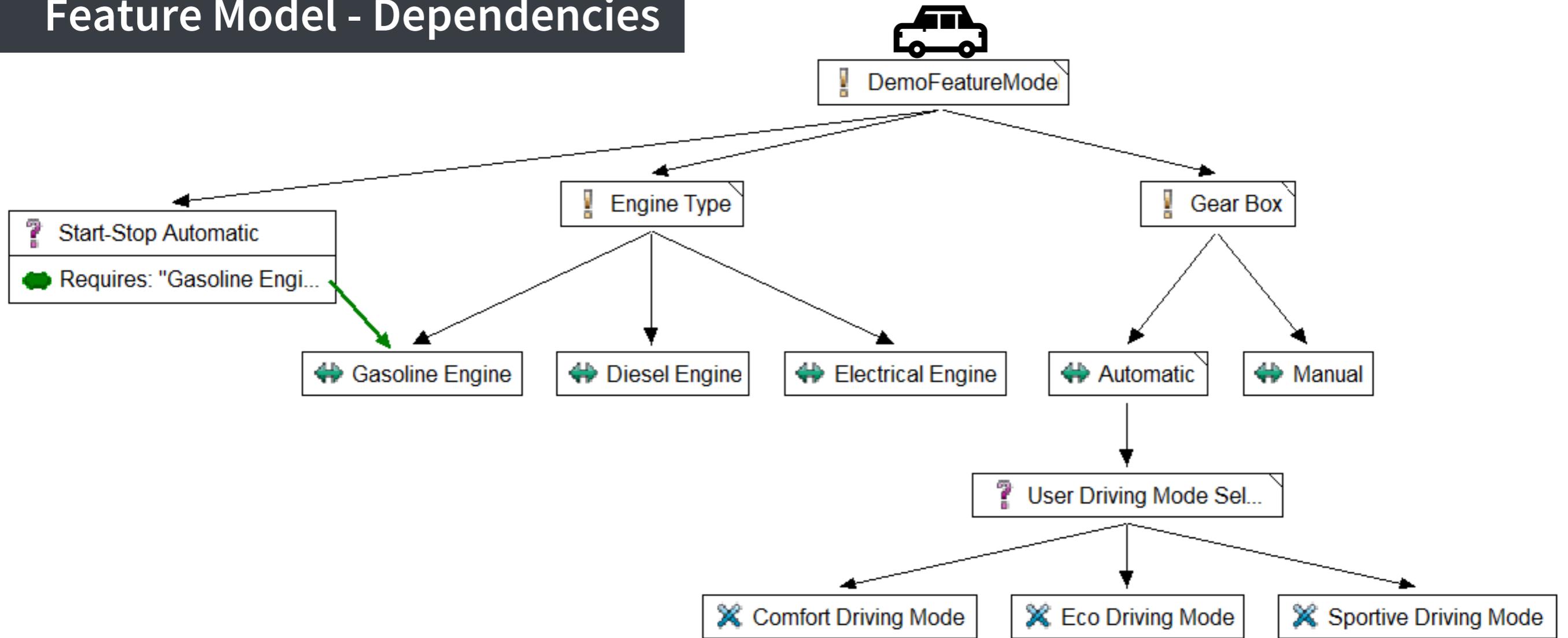


Feature Model



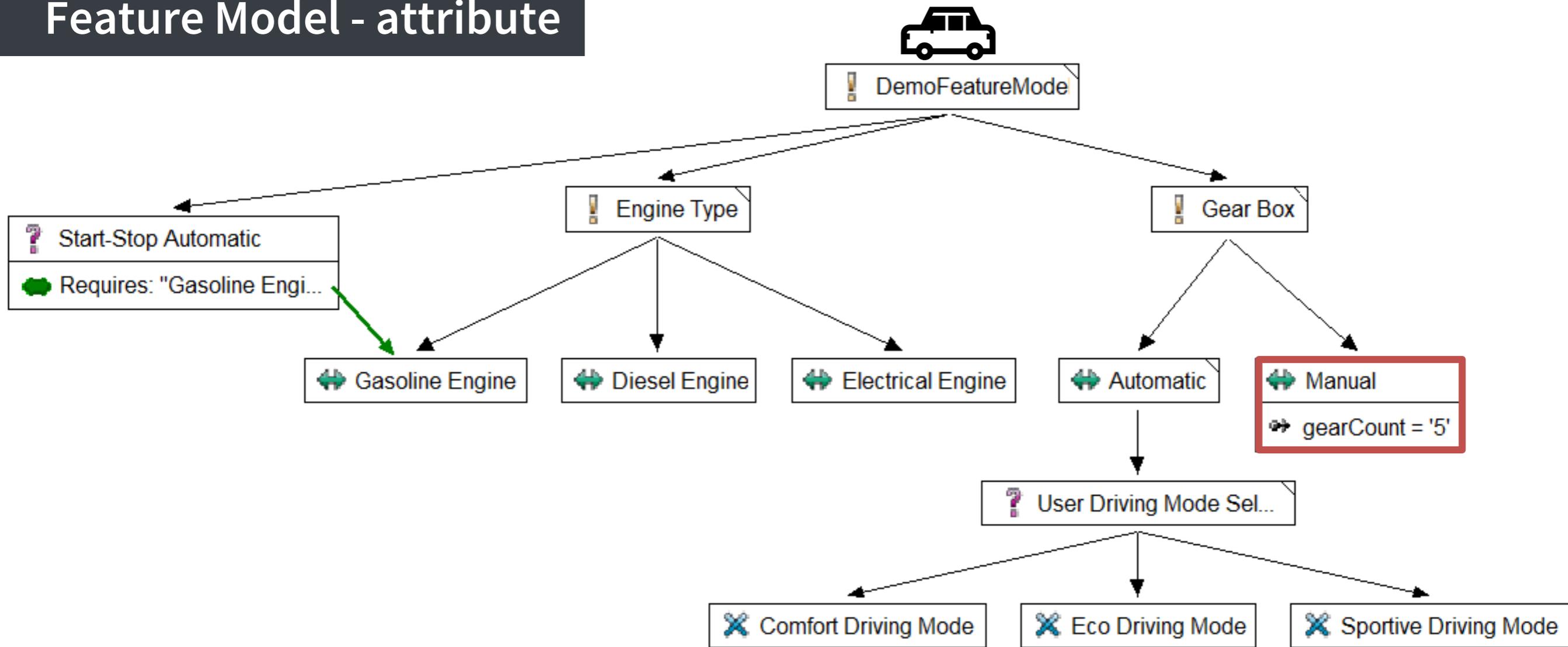
タイプ : ! = Mandatory (必須) ? = Optional (選択自由) ↔ = Alternative (どれか一つ) ✕ = Or (少なくとも一つ)

Feature Model - Dependencies



タイプ : ! = Mandatory (必須) ? = Optional (選択自由) ↔ = Alternative (どれか一つ) ✕ = Or (少なくとも一つ)

Feature Model - attribute



タイプ : ! = Mandatory (必須) ? = Optional (選択自由) ↔ = Alternative (どれか一つ) ✕ = Or (少なくとも一つ)

Variant Modeling

- Office
- pictures
- Quality Manager
- Reports
- Rhapsody
- SCADE
- TopCased
- Config
 - BaseLight.vdm
 - BaseLight.vrm
 - BaseLight_Denmark.vdm
 - BaseLight_EMEA.vdm
 - BaseLight_Inheritance.vdm
 - BaseLight_Sweden.vdm
 - BaseLight_USA_Canada.vdm
 - HighLight.vdm
 - HighLight_Canada.vdm
 - HighLight_EMEA.vdm
 - HighLight_US.vdm
 - HighLight_US.vrm
- output
 - AutomotiveDemoCarLight.typemodel
- Functional_Features.xfm
- Regions.xfm
- Car Light Code
- EA Weather Station Example
- Excel Carlight Example

External Car Lights Features

- safety = "Automatic Hazard Warning" -> safety + "Adaptive Forward Lighting" -> safety + "Automatic High/Low Beam" -> safety + ...
- Beam Configuration
 - Low Beam
 - High Beam
- Fog Lights
- Daytime Running Light
 - Reduced Low Beam
 - Separate DRL Lights
 - LED
 - Standard Bulb
- Driver Assistance
 - Automatic Light
 - Automatic High/Low Beam
 - Cornering Lights
 - Adaptive Forward Lighting
 - Static Cornering Lights
 - Automatic Hazard Warning

Relations

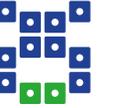
- Children (4)
 - Functional_Features (4)
 - Beam Configuration
 - Daytime Running Light
 - Driver Assistance
 - Fog Lights
 - Simple Constraint Language (5)
 - References (5)
 - Functional_Features (5)
 - Adaptive Forward Lighting
 - Automatic Hazard Warning
 - Automatic High/Low Beam
 - Automatic Light
 - Static Cornering Lights

! = mandatory 必須
? = optional 選択自由
<-> = alternative どれか1つ
X = or 少なくとも1つ

自動車のヘッドライトのフィーチャーモデル

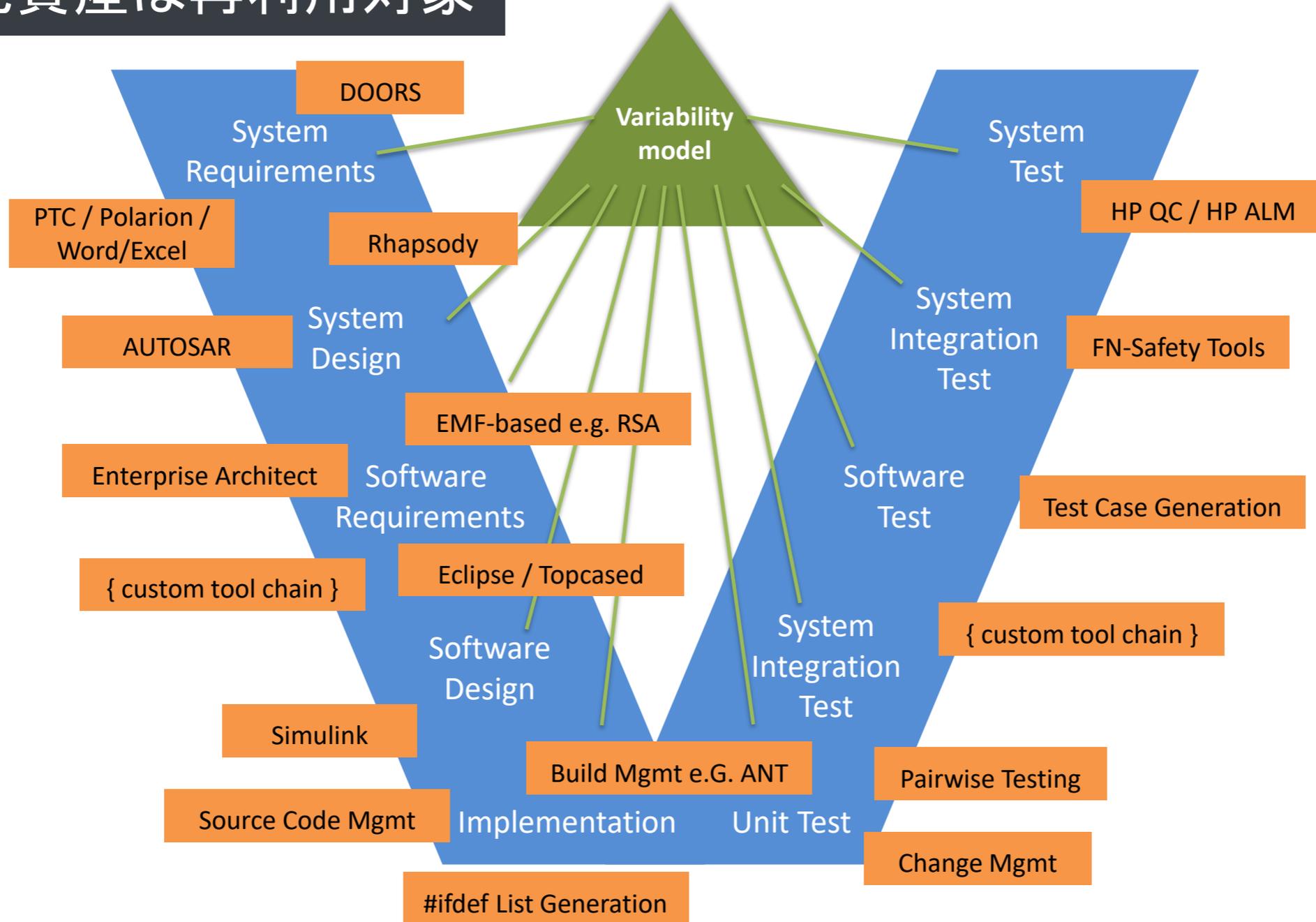
バリエーション管理支援ツール

賢人の知恵と工夫



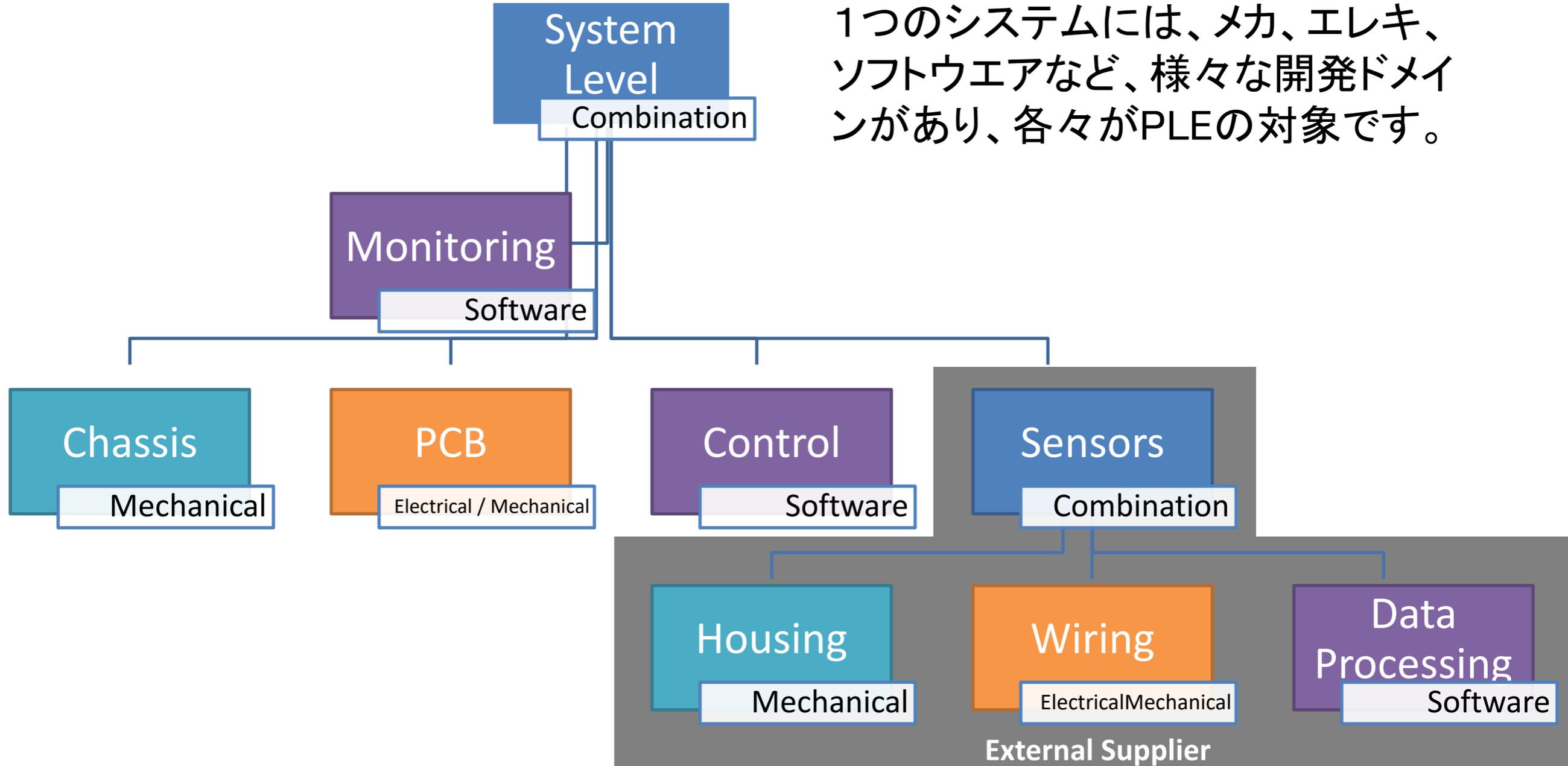
様々な開発支援ツールがある

全ての開発資産は再利用対象



Multi-Domain Building Blocks

1つのシステムには、メカ、エレキ、ソフトウェアなど、様々な開発ドメインがあり、各々がPLEの対象です。



Holistic variant management



プロダクトラインのライフサイクル全体にわたってエンジニアリングツールと管理システムを統合

DOORS 9

DOORS Next

Polarion Requirements

Rhapsody

RTC

Rational Quality Manager

C/C++/Java

MS Word, Excel

AUTOSAR

EMF

Enterprise Architect

Simulink

MagicDraw

...

Zuken

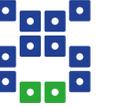
medini analyze

pure::variants

Holistic variant management

Requirements	MBSE	Testing and QA	File Processing	Change & Configuration Management	Analysis & Reporting	Simulation & Code Gener.	ECAD MCAD
DOORS 9	Cameo Systems Modeler, MagicDraw*	IBM Rational Quality Manager	Code Assets: C/C++/Java/...	RTC, Git, SVN, CVS, and more	MS Excel	Matlab Simulink	ZUKEN CR-8000
DOORS NG	Rhapsody, RMM	Microfocus Quality Center	XML Assets	IBM Jazz Streams & Global Configurations	BIRT	SCADE*	Zuken E3 (experimental)
PTC Integrity	Capella (Polarsys.org)	Medini Analyze*	CSV Assets	NoMagic Teamwork Cloud	HTML Report		CREO (in development)
Polarion Variants*	Papyrus		Plain Text Assets	Jira	MS Word		CATIA (on roadmap)
Microsoft TFS	Enterprise Architect						
JAMA	Artop Autosar						

* Developed or distributed by or in collaboration with a 3rd vendor



様々な開発支援ツールがある

個性に合わせた拡張

テキスト変換

```
// PVSCL:IFCOND(IntermediateResults)
#include <stdio.h>
// PVSCL:ENDCOND
```

```
static int factorialOf(int x);
```

```
int factorial(int n)
{
    return factorialOf(n);
}
```

```
static int factorialOf(int x)
{
    int result;

    if (x <= 1) {
        result = 1;
    } else {
        result = x * factorialOf(x-1);
    }
}
```

フィーチャ IntermediateResults が選択されている時、この条件がtrueとなり、以下 PVSCL:ENDCONDまでの部分の内容が結果ファイルに出力されます

条件はネストできます

```
// PVSCL:IFCOND(IntermediateResults)
// PVSCL:IFCOND(IntermediateResults->Format='number')
printf("%d¥n", result);
// PVSCL:ELSEIFCOND(IntermediateResults->Format='sentence')
printf("Factorial of %d is %d.¥n", x, result);
// PVSCL:ELSECOND
printf("%d != %d¥n", x, result);
// PVSCL:ENDCOND
// PVSCL:ENDCOND
```

```
return result;
};
```

ソースコード内のフラグの管理

```
*WebinarFamily.ccfm *WebinarConfig.vdm Temperature.cc *WebinarFea

#include <Sensors/Temperature.h>

Temperature::Temperature () {
    srand(clock());
    m_Value = 20;
    m_Dx = 0.1;
}

void Temperature::getNextValue () {
    if( m_Value > 45 || m_Value < -45 ) { m_Dx = -m_Dx; }
    m_Value += m_Dx;
}

std::string Temperature::getName () {
    return "Temperature";
}

std::string Temperature::getUnit () {
    #ifdef FAHRENHEIT
        return "-F";
    #else
        return "-C";
    #endif
}
```

The screenshot shows the WSC++ IDE interface. The project tree on the right is expanded to show the configuration for the 'WebinarFamily.ccfm' project. The tree structure is as follows:

- ! WSC++
 - ? WSC++
 - srcdir = 'WSC++'
 - dir = 'WSC++'
 - Display
 - ps:class: WeatherStation
 - Sensors
 - ps:class: main
 - ps:makefile: Makefile
 - ps:variable: CPPFLAGS_SPEED
 - ps:variable: CPPFLAGS_TEMP** (highlighted with a red box)
 - Value = '-D FAHRENHEIT' (highlighted with a red box)
 - ps:makefile: Config.mk
 - srcdir = 'WSC++'
 - dir = 'WSC++'
 - file = 'Config.mk'** (highlighted with a red box)
 - variable = 'CPPFLAGS'

pure::variants

AutomotiveDemoCarLight/Config

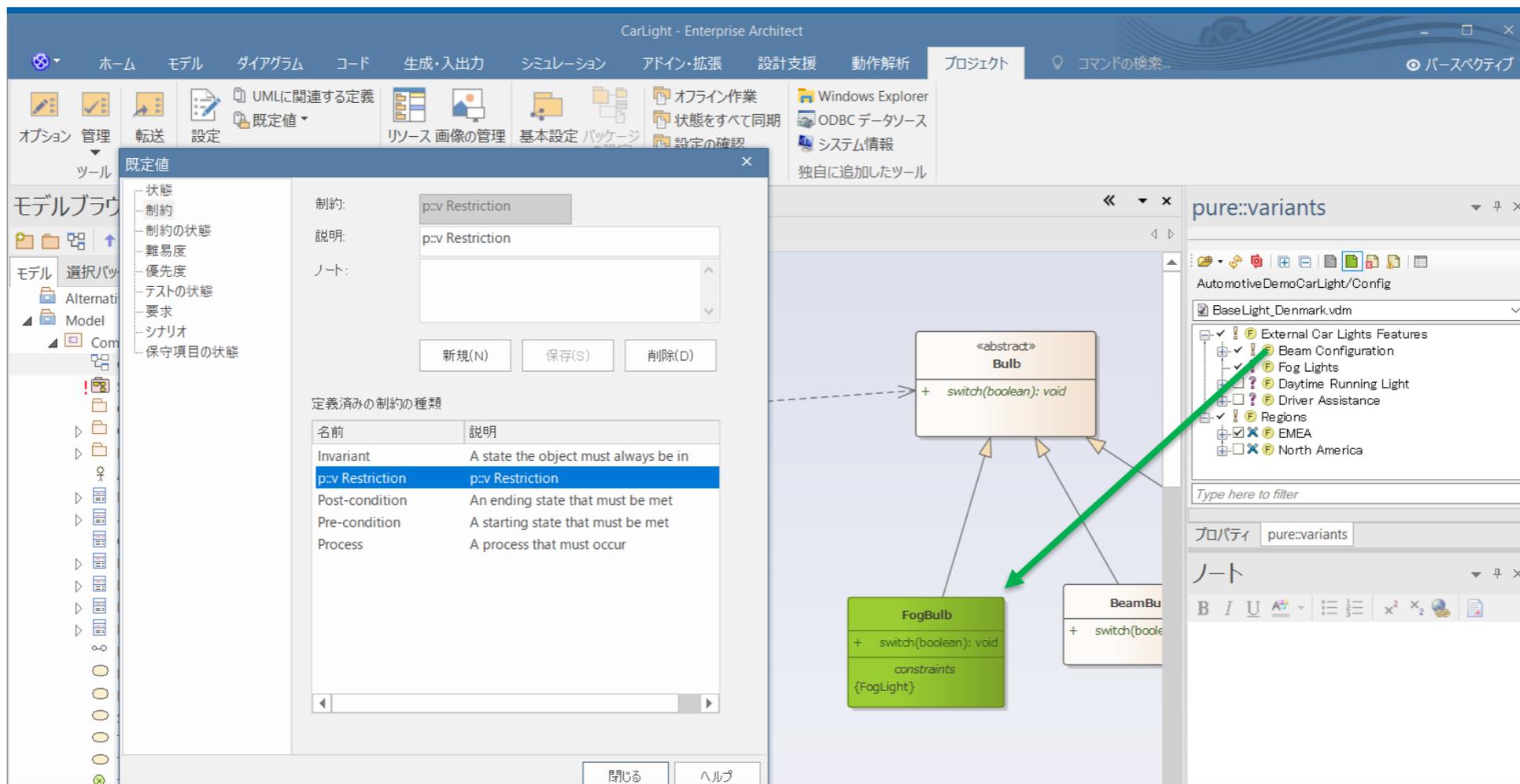
BaseLight.vdm

- External Car Lights Features
 - Beam Configuration
 - Low Beam
 - Xenon
 - Halogen
 - High Beam
 - Xenon
 - Halogen
 - Dynamic High Beam Adjustments
 - Fog Lights
 - Daytime Running Light
 - Reduced Low Beam
 - Separate DRL Lights
 - LED
 - Standard Bulb
 - Driver Assistance
 - Automatic Light
 - Automatic High/Low Beam
 - Cornering Lights
 - Adaptive Forward Lighting
 - Static Cornering Lights
 - Automatic Hazard Warning
 - Regions
 - EMEA
 - EU
 - Austria
 - Denmark
 - UK
 - Sweden
 - North America
 - Canada
 - Mexiko
 - USA

	A	B	C	D	E	F
11					6	Low Beam
12			LowBeamXenon AND not(USA OR Canada)		20	The beam pattern must conform to R98 – Headlamps equipped with gas-discharge light source
13		LowBeamHalogen AND not(USA OR Canada)			19	The beam must conform to R112 – Headlamps emitting an asymmetrical passing beam and/or a driving beam and equipped with filament bulbs
14		FogLight AND BeamConfiguration			7	Fog Lights
15					32	Front fog lamps have to provide a wide, bar-shaped beam of light with a sharp cutoff at the top, and are generally aimed and mounted low.
16					34	They may be either white or selective yellow.
17	LightAssistance				2	Assistance Systems
18		CorneringLights			11	Cornering Light
19			AdaptiveForwardLighting		26	Adaptive Forward Lighting
20					27	The adaptive forward lighting system is activated only when high or low beam is operating in full light mode.
21			CorneringStaticLights		12	Static Cornering Light
22				DR	13	The day running light on the side of the car is activated when the steering angle is above $-/+15^{\circ}$, the vehicle is moving, and the vehicle speed is at least 10m/s.
23					14	The fog light on the side of the car is activated when the steering angle is above $-/+15^{\circ}$, the vehicle is moving, and the vehicle speed is at least 10m/s.
24					3	Indicator Lights
25					4	Turn Lights
26						When lights on a side are present, the hazard lights with a frequency of 1.5 Hz when the indicator for the respective side is activated.
27						All turn lights must blink simultaneously as long as the hazard blinking switch is activated. The blinking frequency is 1.5 hz.
28						Daytime Running Light

・各フィーチャとバリエーションポイントを紐付ける
 ・プレビュー機能: 未選択バリエーションをグレーアウト

Enterprise Architect



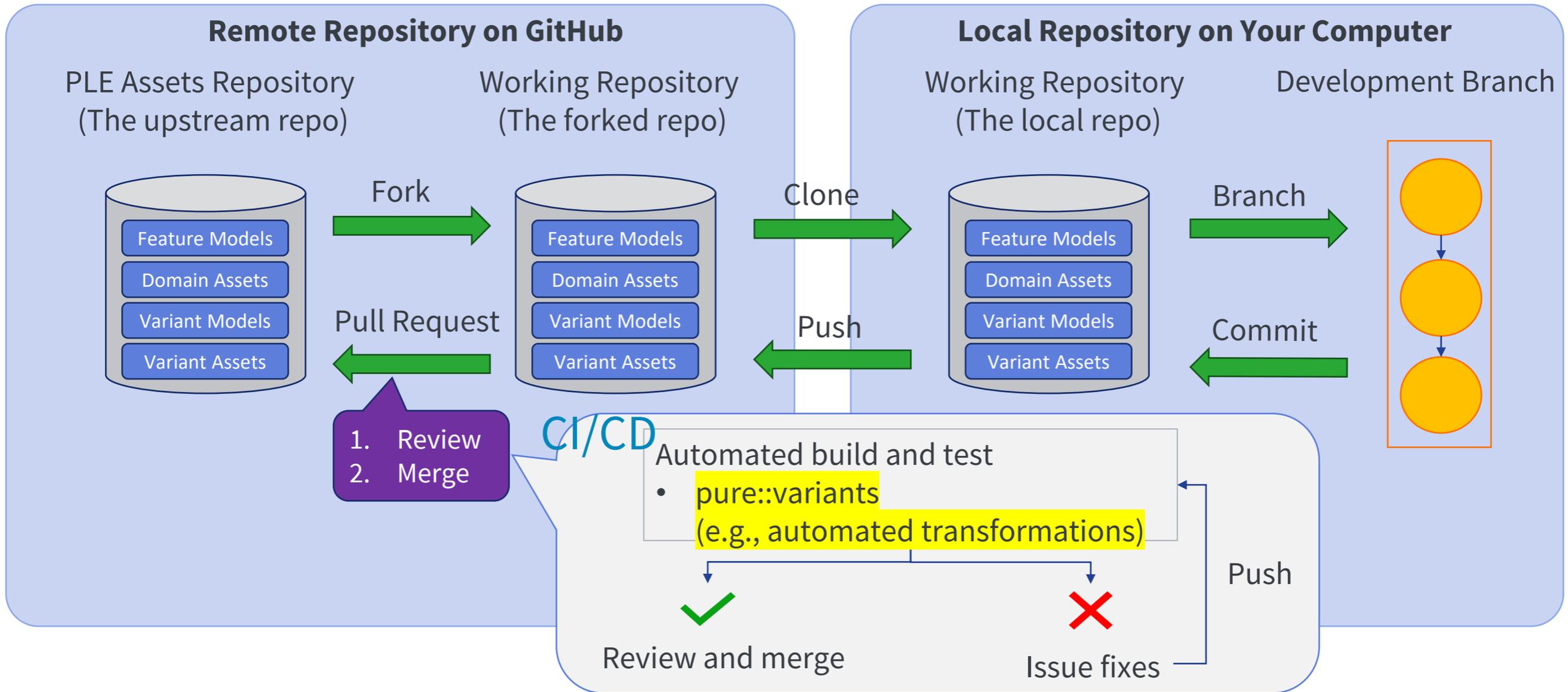
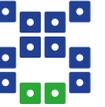
- ・制約でフィーチャとバリエーションポイントを紐付ける
- ・プレビュー機能: 選択されたバリエーションをハイライト



様々な開発支援ツールがある

変更管理、構成管理との連携

構成管理ツールとの統合例：GitHub



構成管理ツールとの統合例: GitHub

The screenshot displays the Eclipse IDE interface with a Pull Request (PR) for a new feature 'HazardWarning' in the 'AutomotiveDemoCarLight' project. The PR is titled 'New feature HazardWarning added to the functional feature model' and is in a 'closed' status. It shows the source branch 'pvgithubdemo-engineer/dev_branch' and the destination 'pvgithubdemo-maintainer/master'. The description states: 'I have added a new feature HazardWarning to the functional feature model. Please review the changes.' A comment from 'pvgithubdemo-maintainer' on Nov 1, 2021, at 4:53 PM says: '> I have added a new feature HazardWarning to the functional feature model. Please review the changes. The changes have been reviewed, and then merged.'

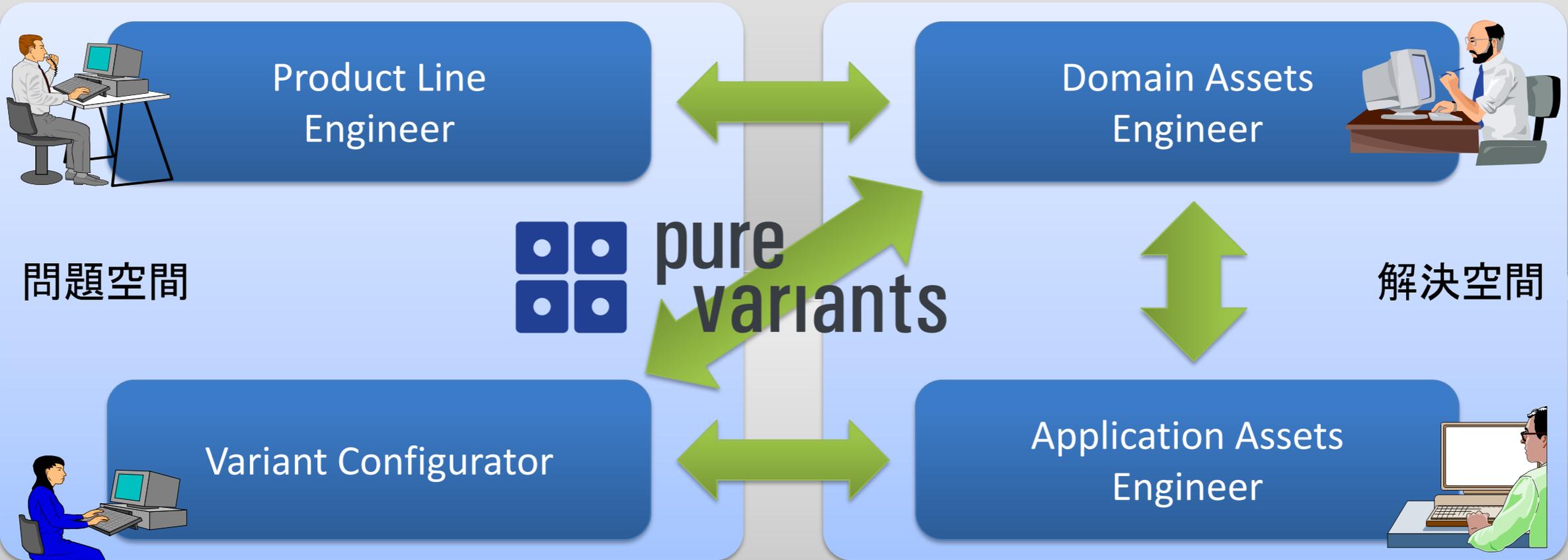
Below the PR details, a commit history table is shown for the project 'AutomotiveDemoCarLight [AutomotiveDemoCarLight]':

Id	Message	Author	Authored Date	Committer	Committed Date
4b6cba2	[Version_1.1.0] master origin/master HEAD Merge remote-tracking branch 'pvgithubdemo-engineer/dev_branch'	PLE Assets Maintainer	22 hours ago	PLE Assets Maintainer	22 hours ago
e667e45	[Version_1.1.0] New feature HazardWarning added to the functional feature model	PLE Assets Engineer	24 hours ago	PLE Assets Engineer	24 hours ago
59555e6	[Version_1.0.0] pvgithubdemo-en... project file	PLE Assets Maintainer	25 hours ago	PLE Assets Maintainer	25 hours ago
b8caa30	Initial commit	PLE Assets Maintainer	4 days ago	PLE Assets Maintainer	4 days ago

Below the table, the commit details for the selected commit (4b6cba2) are shown:

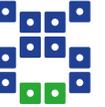
```
commit 4b6cba289597f80b08c200d90bbff53cad511464
Author: PLE Assets Maintainer <pleasests_maintainer@pure-systems.com> 2021-11-01 15:30:17
Committer: PLE Assets Maintainer <pleasests_maintainer@pure-systems.com> 2021-11-01 15:30:17
Parent: 59555e6bf6cc3bf644462ca4998e66781c15fd36 (project file)
Parent: e667e45f8fa14da1dc463aaf927f2a9c19518b (New feature HazardWarning added to the functional feature model)
Branches: master, origin/master
Tags: Version_1.1.0
Merge remote-tracking branch 'pvgithubdemo-engineer/dev_branch'
```

ドメインエンジニアリング

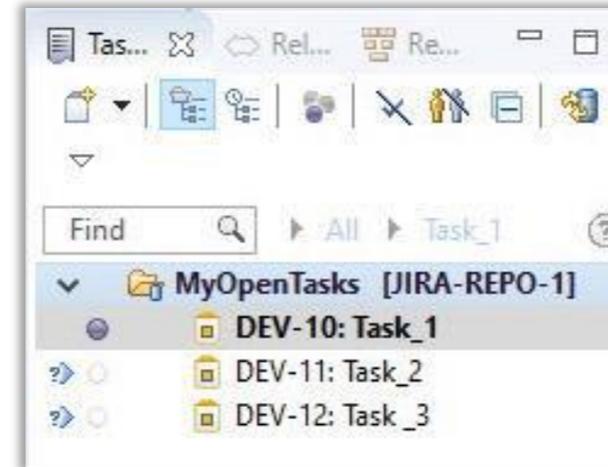
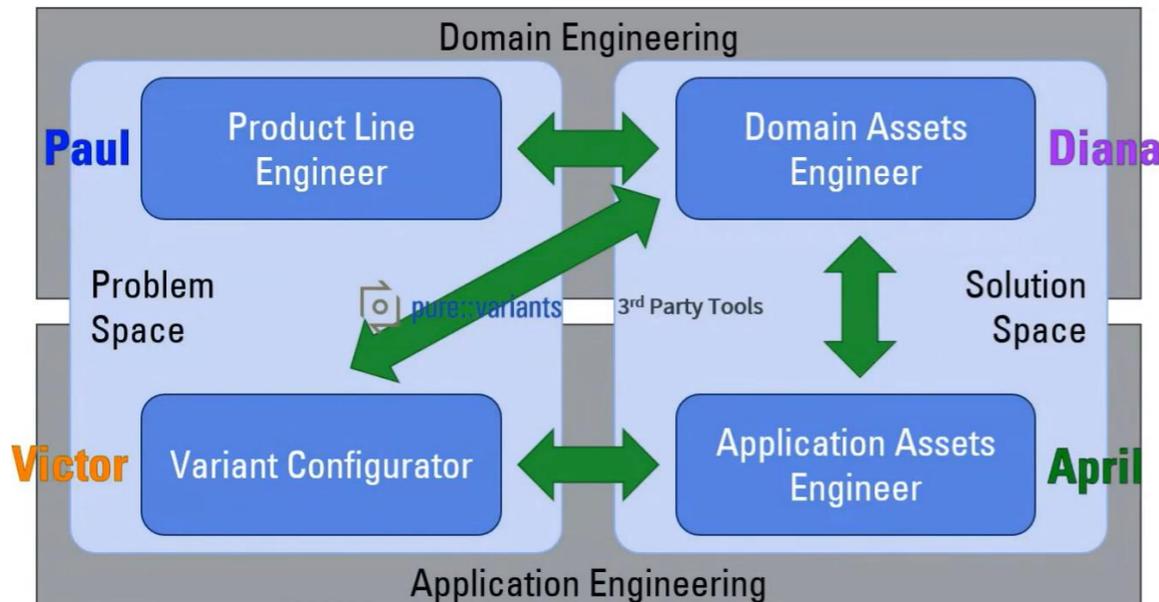


アプリケーションエンジニアリング

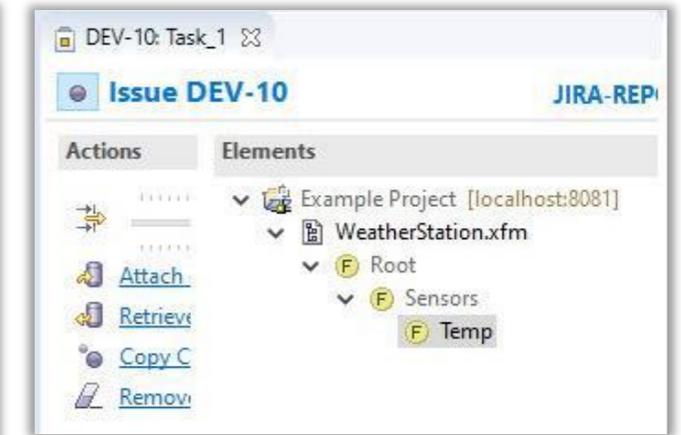
変更管理ツールとの統合例：JIRA



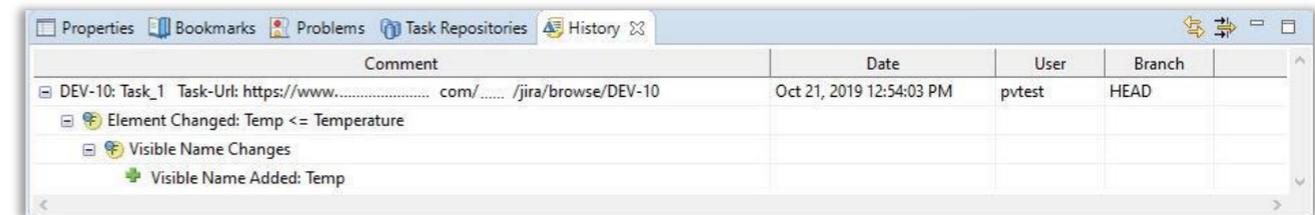
- 変更管理とバリアビリティモデルの改変を密に統合して、pure::variantsモデルへの変更を直接キャプチャする手段を提供
- JIRAの課題とpure::variantsモデルサーバーに保存される変更履歴を、アクティブなJIRA課題番号で拡張して完全なトレーサビリティ



Task view :
JIRA課題を全てリストし、作業するもの1つをアクティベートする



Context view :
アクティブな課題に対して、変更されたモデル要素を素早く確認

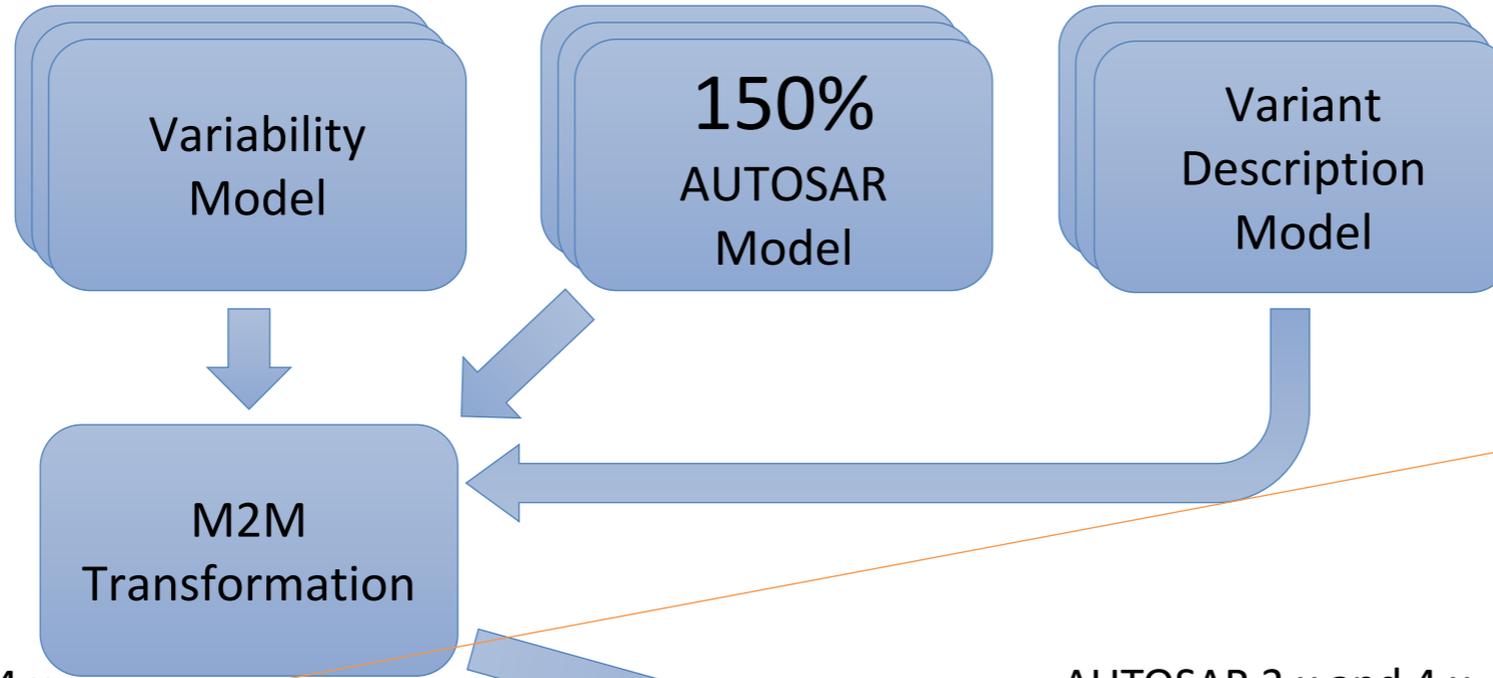


History view :
モデルの変更履歴に、自動的にアクティブな課題番号が追加される



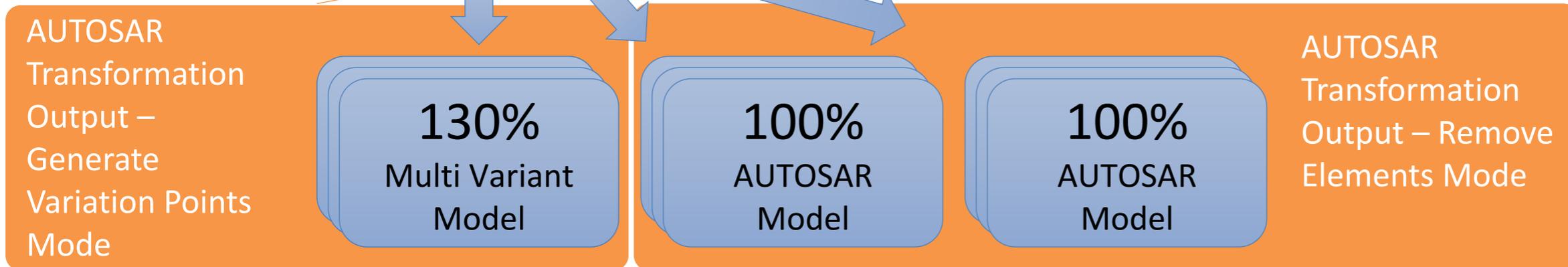
様々な開発支援ツールがある

更なる効率化を求めて

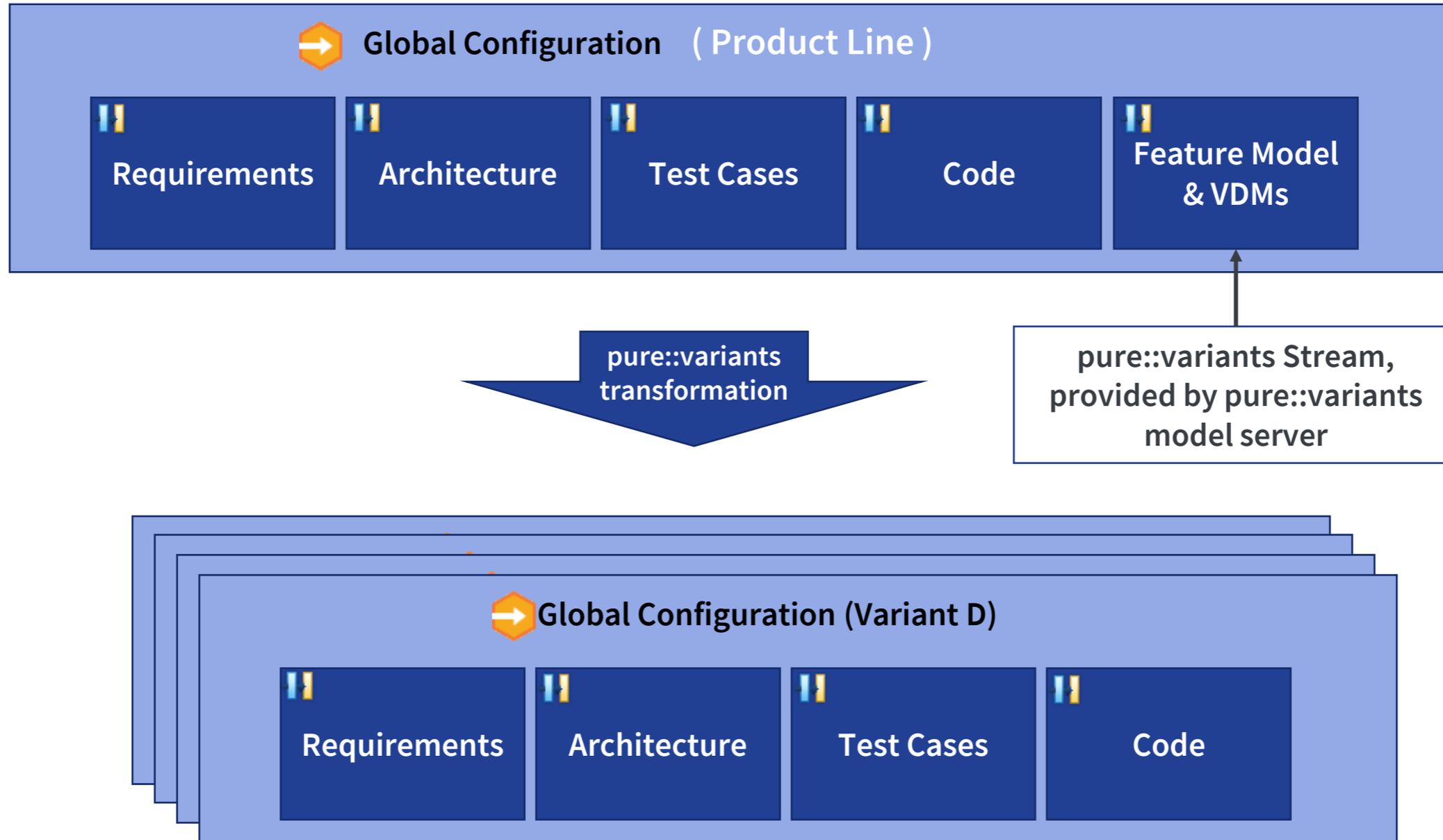


Benefits:

- Binding times
- Flexibility gain
- IP protection

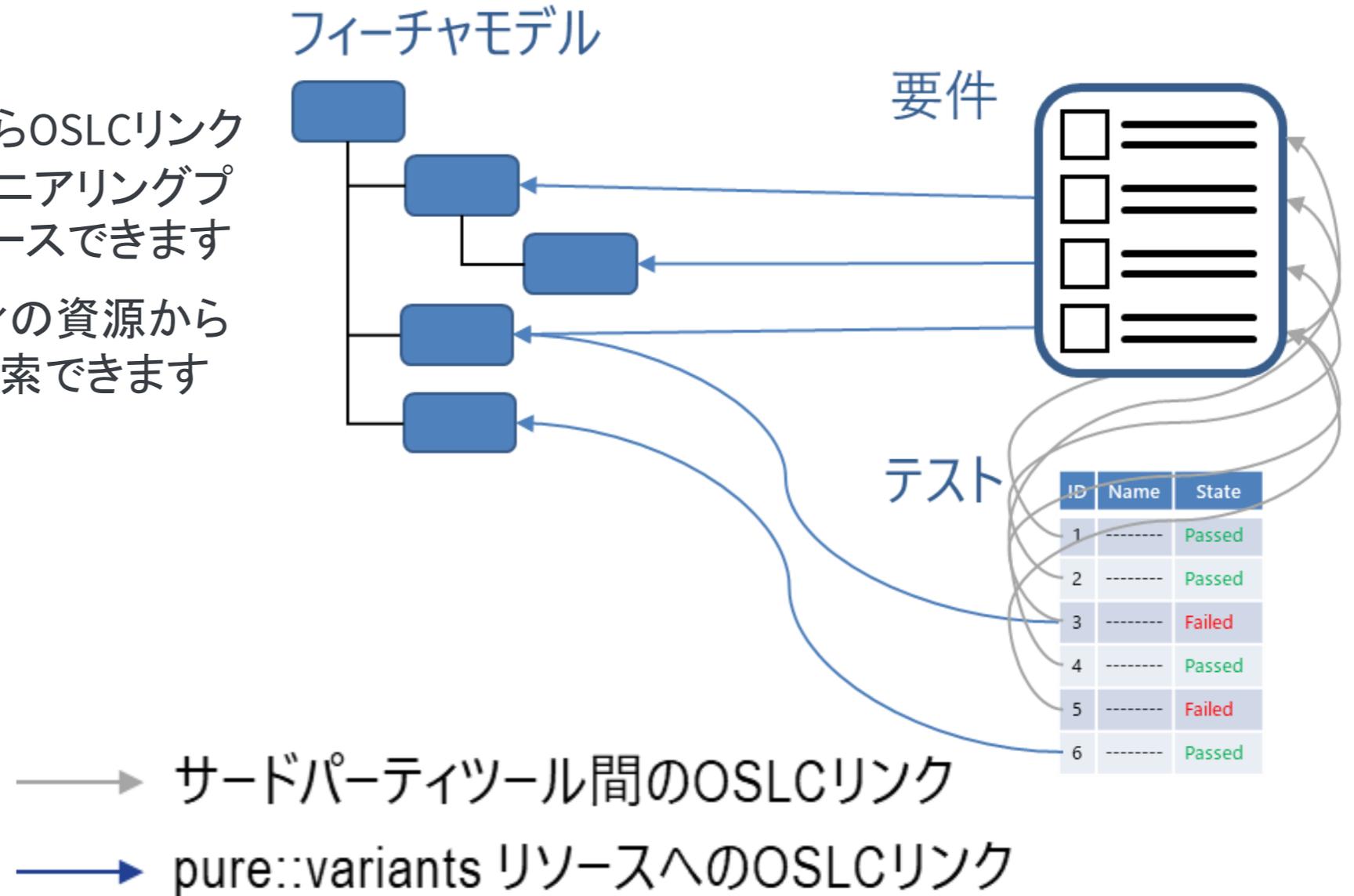


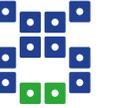
OSLC: グローバル構成管理



OSLC: フィーチャと資産間でトレーサビリティ

- OSLC によるトレーサビリティを強化
- pure::variantsモデルとフィーチャからOSLCリンクを確立し、すべてのレベルのエンジニアリングプロセスを通じてバリアビリティをトレースできます
- デリゲートされたUIでサードパーティの資源からリンクされたフィーチャとモデルを探索できます





効率良く、間違いなく
バリエーションを構成したい

Excel ?

こう複雑になると手が負えません。
数百、数千ものフィーチャーと、それらの依存・排他関係があるなか、
数十、数百ものバリエーションを正しく管理することは容易ではありません。
ルールや制約を上手に用いることが必要です。

フィーチャ間の依存・排他関係

The screenshot displays two feature trees: 'Functional_Features.xfm' on the left and 'Regions.xfm' on the right. In 'Functional_Features.xfm', 'HazardWarning' is a child of 'Driver Assistance' and has a dependency on 'Fog Lights'. In 'Regions.xfm', 'Sweden' is a child of 'EU' and has a dependency on 'HazardWarning'. A red arrow points from the 'Requires: "HazardWarning"' label under 'Sweden' to the 'Requires: "Fog Lights"' label under 'HazardWarning'.

Functional_Features.xfm

- External Car Lights Features
 - Beam Configuration
 - Fog Lights
 - Daytime Running Light
- Driver Assistance
 - Automatic Light
 - Automatic High/Low Beam
 - Cornering Lights
 - Adaptive Forward Lighting
 - Static Cornering Lights
 - Requires: "Fog Lights"
 - HazardWarning

Regions.xfm

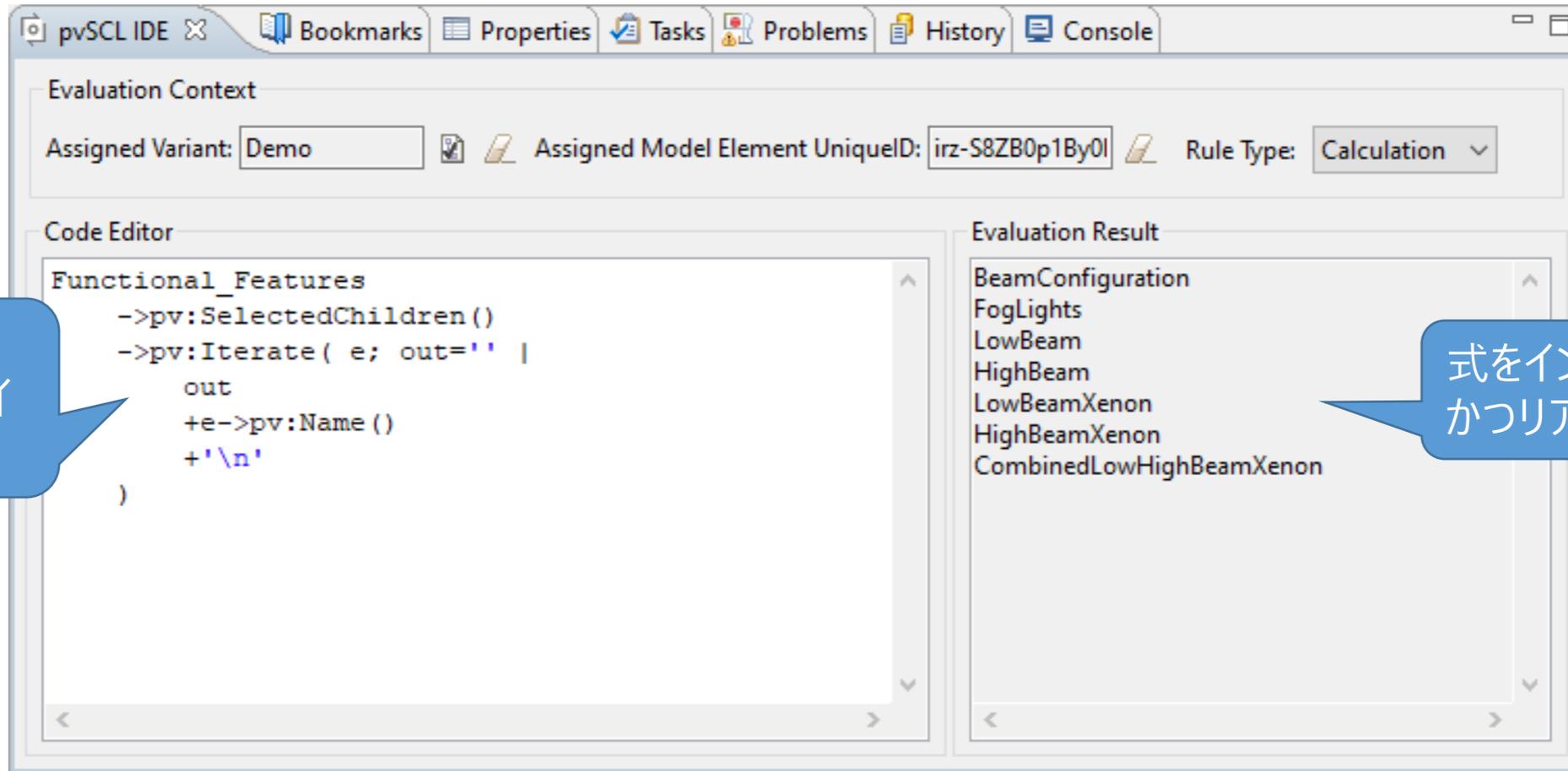
- Regions
 - EMEA
 - EU
 - Austria
 - Denmark
 - Sweden
 - Requires: "HazardWarning"
 - UK
 - North America
 - Canada
 - Mexiko
 - USA

Edit 'Sweden'

Edit Relations...

General	Relations	Attributes	Restrictions	Constraints
	Type			
	ps:requires		"HazardWarning"	
	ps:defaultProvider			
	ps:discourages			
	ps:discouragesAny			
	ps:equalsAll			
	ps:equalsAny			
	ps:exclusiveProvider			
	ps:expansionProvider			
	ps:influences			
	ps:provides			
	ps:recommendedFor			
	ps:recommendedForAll			
	ps:recommends			
	ps:recommendsAll			
	ps:requestsProvider			
	ps:requiredFor			
	ps:requiredForAll			
	ps:requires			

制約言語IDE



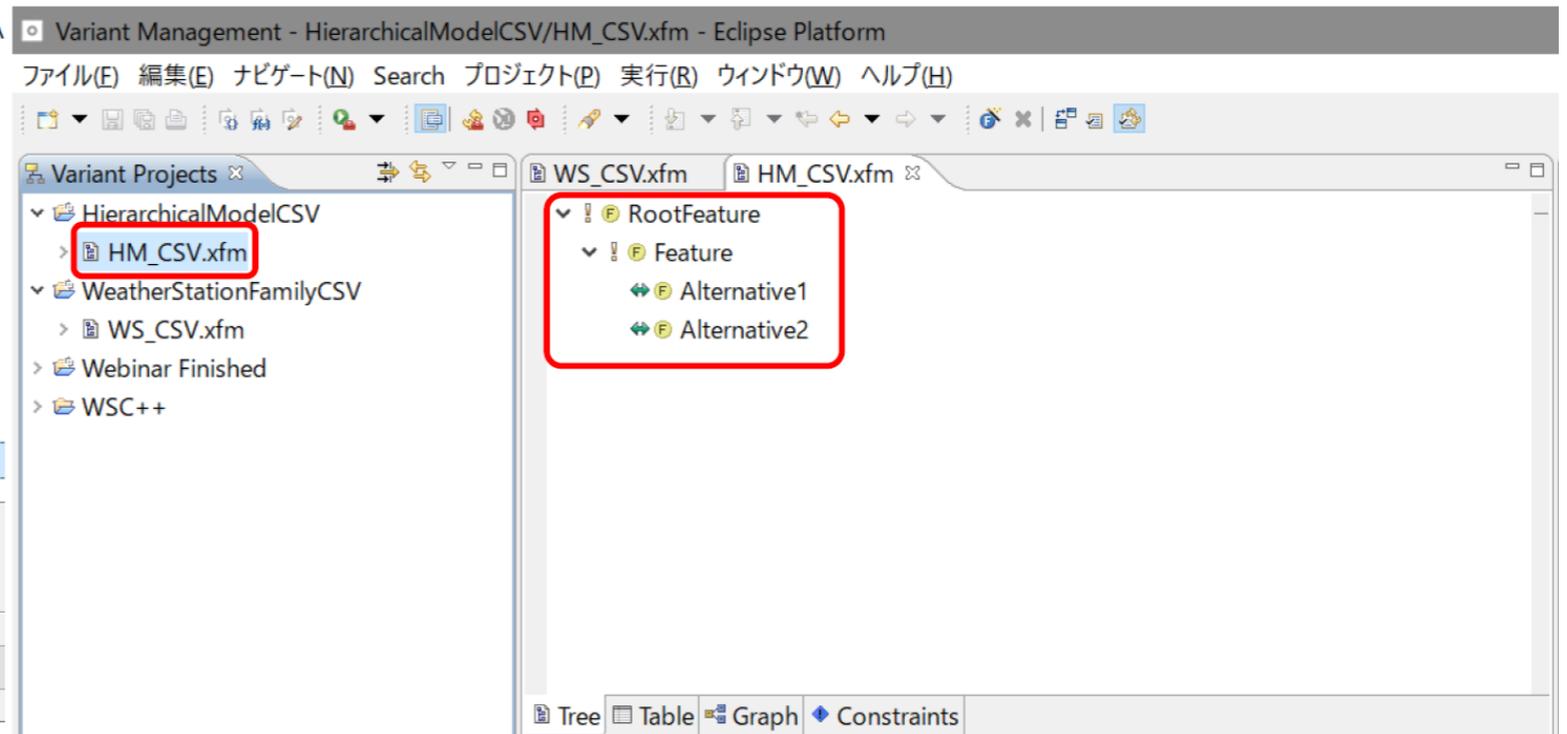
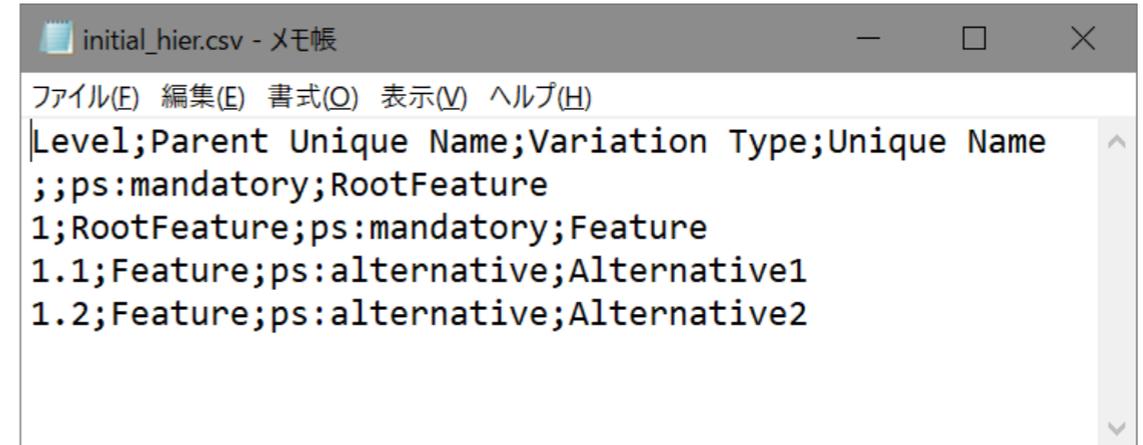
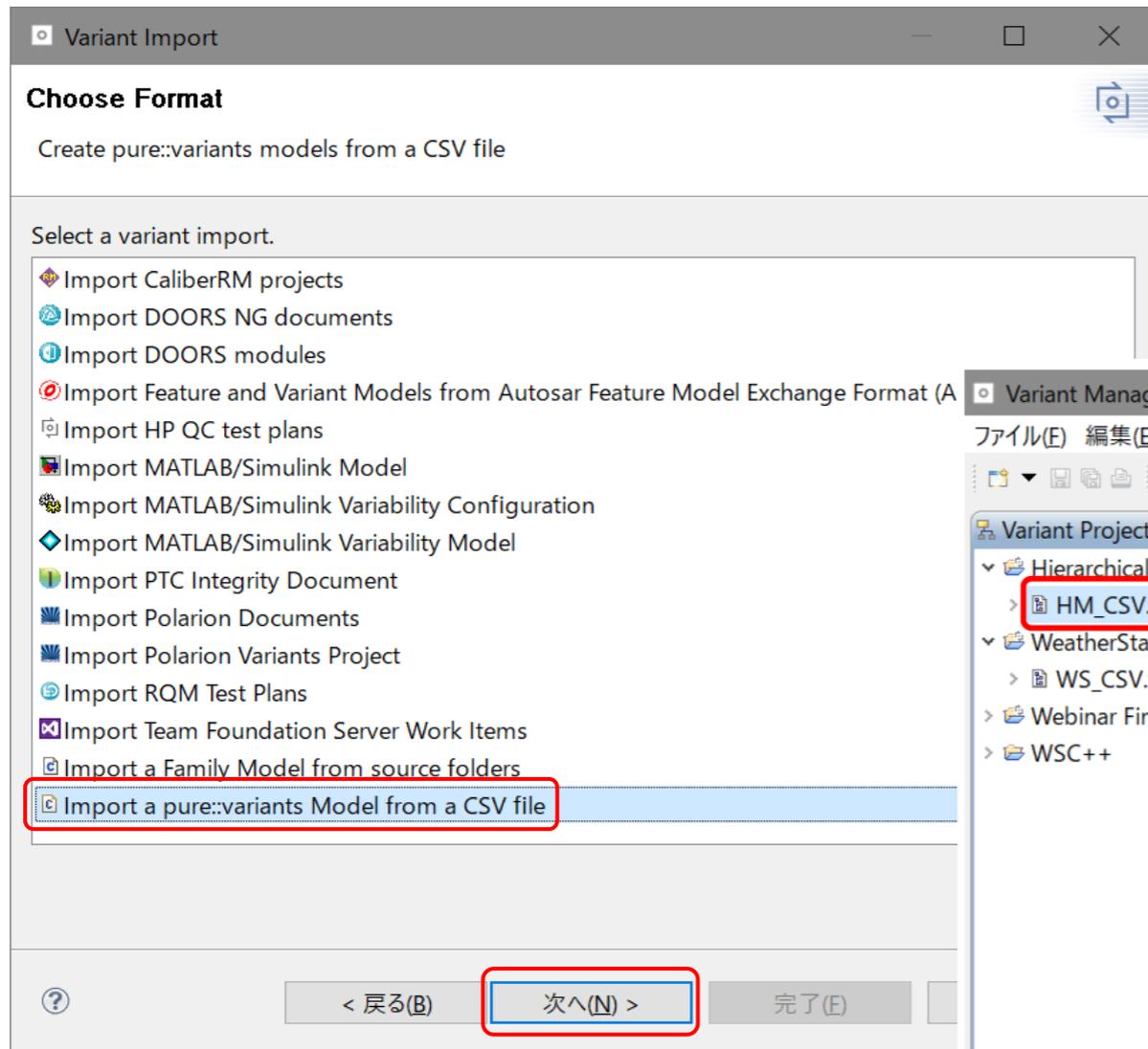
- 更に複雑な制約やルールもインタラクティブに作成できる
- バリエーション管理モデルの編集・テスト・デバッグサイクルを加速

クローン、インヘリタンス

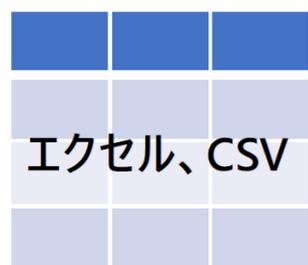
The screenshot shows the Eclipse IDE interface with the 'New Variant Model' dialog open. The dialog is titled 'New Variant Model' and has the 'Inheritance' tab selected. It contains two tables: 'Available Models' and 'Inherited Models'. The 'Available Models' table lists various models like 'BaseLight_Denmark', 'BaseLight_EMEA', etc. The 'Inherited Models' table currently contains 'BaseLight'. Below the tables are 'Move up' and 'Move down' buttons. At the bottom of the dialog are buttons for '< 戻る(B)', '次へ(N) >', '終了(E)', and 'キャンセル'.

In the background, the Eclipse IDE shows the 'BaseLight_Inheritance.vdm' model in the project explorer. A red arrow points from the 'Inheritance' tab in the dialog to this model. The model tree shows a hierarchy of features, with 'Adaptive Forward Lighting' selected. A red box highlights this selection. Another red box highlights a 'Selection change failed' dialog box that appears over the model tree, with the message: 'Selection change not allowed. Reason(s): Inherited selections can not be changed.' The dialog has a 'Do not show this dialog again' checkbox and an 'OK' button.

CSV インポーター機能



JavaScriptによるモデルの操作(自動化)



エクセル、CSV

インポート/エクスポート



pure
variants

フィーチャ
選択や値の
指定

設定

JavaScriptに
よる操作

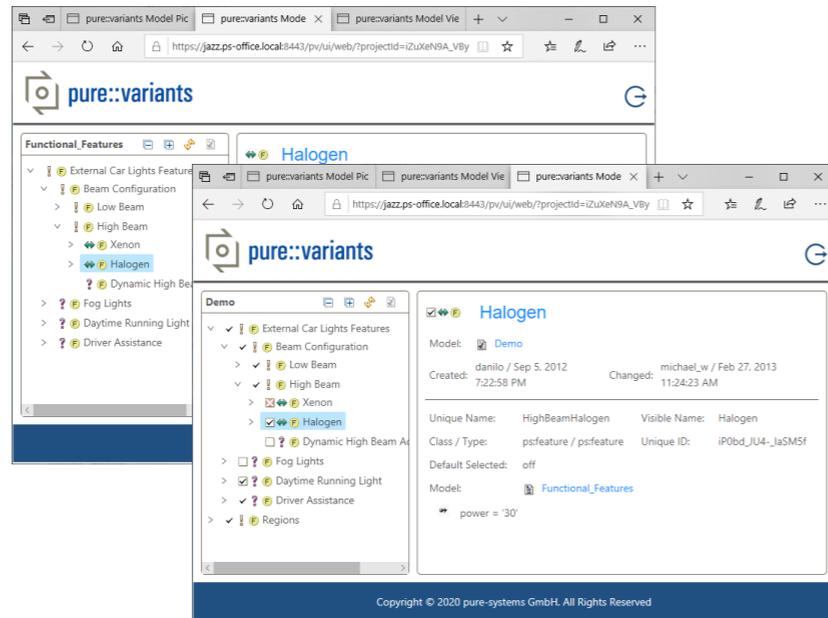
The screenshot shows an IDE interface with the following components:

- Variant Projects:** A tree view showing a project named 'DemoVDM' with sub-items: 'ConfigSpace' (containing 'Var1.vdm' and 'Var1.vdm.json'), 'build.xml', 'DemoVDM build.xml.launch', and 'FM.xfm'.
- Var1.vdm.json:** A file view showing a configuration for 'FM' with two options: 'Opt1' (selected) and 'Opt2' (excluded). The attribute for 'Opt1' is set to '123'.
- プロパティ (Properties):** A panel showing 'Table Layouts', 'Matrix Variant Filters', 'Tree Layouts', and 'Filters'.
- コンソール (Console):** A terminal window showing the output of an Ant build process. The output includes:

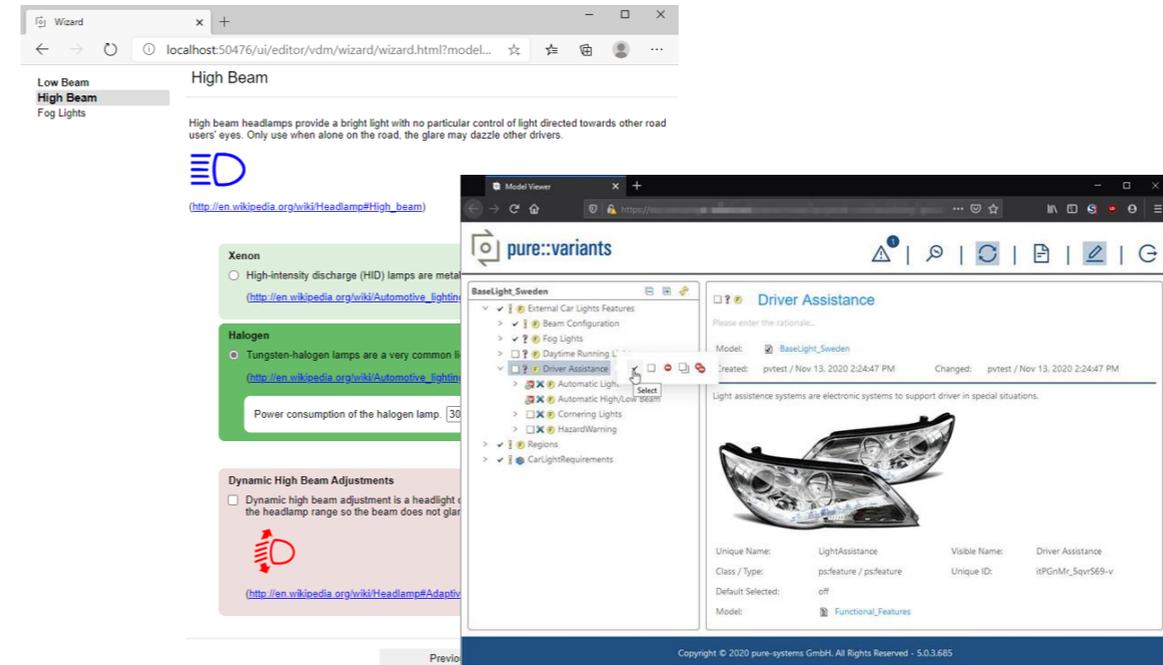
```
<終了> DemoVDM build.xml [Antビルド] C:\Users\toyama-k\pure-variants-workspace-4.  
Buildfile: C:\Users\toyama-k\pure-variants-workspace-4.  
dist:  
  [pv.import] C:\Users\toyama-k\pure-variants-workspace-4.  
  [pv.javascript] Opt1  
  [pv.javascript] Opt1 selected  
  [pv.javascript] Setting Attribute Value  
  [pv.javascript] Found property attr  
  [pv.javascript] Opt2  
  [pv.javascript] Opt2 excluded  
  [pv.javascript] Done.  
  [pv.evaluate] DemoVDM\ConfigSpace\Var1.vdm  
BUILD SUCCESSFUL.
```

ウェブベースのバリエーションモデルビューアとエディタ

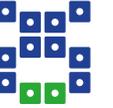
(1) モデルの閲覧



(2) バリエーションの構成

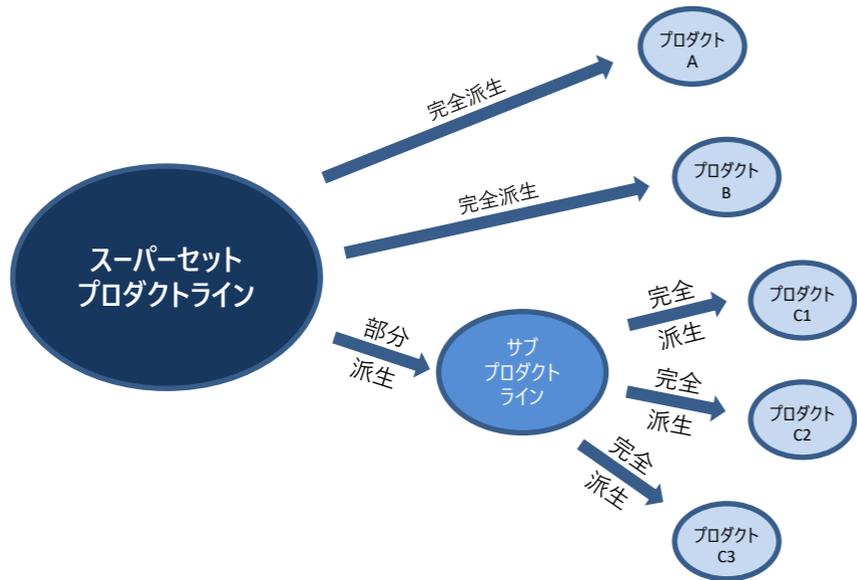


- ツールをインストールする必要なく様々な関係者がアクセスできる
例：OEMとサプライヤー、営業担当が、容易に構成プロセスに参加できる
- カスタマイズできる構成プロセスによってユーザーをガイドできる
- マルチサイト等のライセンス制約も無く協調作業を効率化

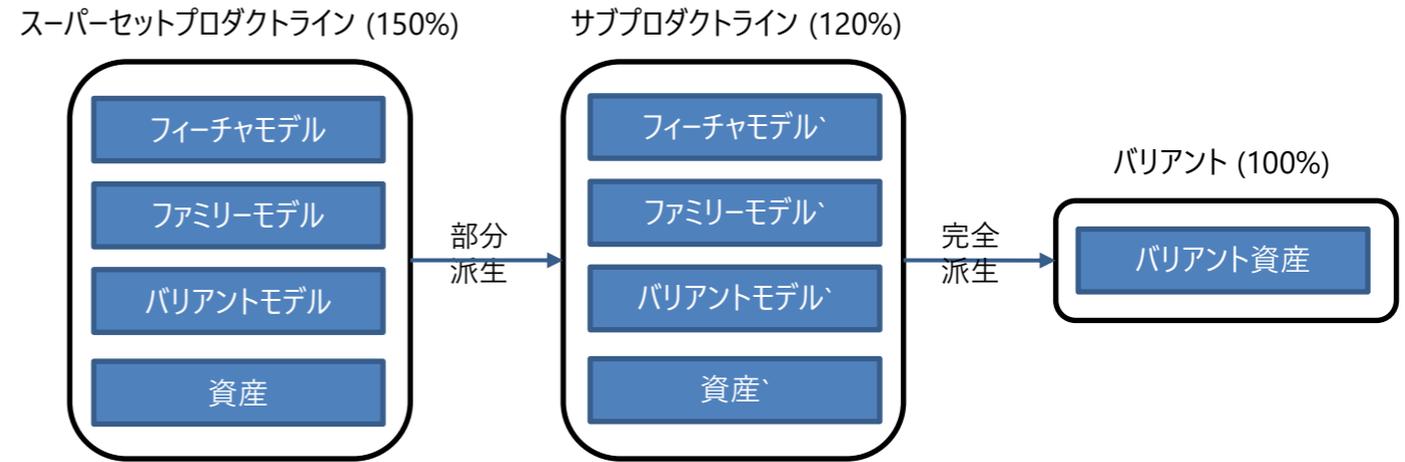


スーパーセットのPLEを
複数のプロジェクトで共有したい

サブPLEのサポート

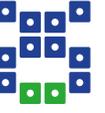


部分派生によるサブプロダクトライン



バリエント管理情報と資産の両方を部分的に派生できる

- 機密機能やライセンスされない資産へのアクセスを制限できる
- 他のチームや顧客へサブプロダクトラインを配布できる
- 複数の関係者間で、製品構成と派生物を分離できる
- サプライヤーが複数のOEM用に
- OEMが車のタイプ別に



分析機能

バリエーションごとに搭載する機能を比較

バリエーション		BaseLight	BaseLight_Denmark	BaseLight_EMEA	BaseLight_Inheritance	BaseLight_Japan	BaseLight_Sweden	BaseLight_USA_Canada	HighLight	HighLight_Canada	HighLight_EMEA	HighLight_US
フィーチャー	Level											
Model Elements												
Functional_Features												
External Car Lights Features		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
safety		'20'	'20'	'20'	'20'	'0'	'40'	'20'	'20'	'30'	'30'	'20'
Fog Lights	2	✓	✓	✓	✓	✓	✓	✓	☑	☑	☑	☑
Driver Assistance	4	✓	✓	✓	✓	☐	✓	✓	✓	✓	✓	✓
Cornering Lights	4.3	✓	✓	✓	✓	☐	✓	✓	☑	☑	☑	☑
Automatic Light	4.1	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑
Automatic High/Low Beam	4.2	☑	☑	☑	☑	☐	☑	☑	☐	☑	☑	☐
Automatic Hazard Warning	4.4	☐	☐	☐	☐	☐	✓	☐	☐	☐	☐	☐
Daytime Running Light	3	☐	☐	✓	☐	☐	☐	☐	✓	✓	✓	✓
Separate DRL Lights	3.2	☐	☐	✗	☐	☐	☐	☐	✓	✓	✓	✓
Standard Bulb	3.2.2	☐	☐	✗	☐	☐	☐	☐	✗	✗	✗	✗
LED	3.2.1	☐	☐	✗	☐	☐	☐	☐	☑	☑	☑	☑
Reduced Low Beam	3.1	☐	☐	☑	☐	☐	☐	☐	✗	✗	✗	✗
Beam Configuration	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Low Beam	1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High Beam	1.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regions												
Regions		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
North America	2	☐	☐	☐	☐	☐	☐	✓	☐	✓	☐	✓
EMEA	1	✓	☑	☑	✓	☑	✓	✓	✓	✓	☑	✓
EU	1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	☑	✓
UK	1.1.3	☐	☐	☑	☐	☐	☐	☐	☑	☑	☑	☑

フィルターでバリエーション間の違いや同一性を分析

Model Elements	Level	BaseLight	BaseLight_Denma	BaseLight_EMEA	BaseLight_Inherita	BaseLight_Japan	BaseLight_Sweder	BaseLight_USA_Ca	HighLight	HighLight_Canada	HighLight_EMEA	HighLight_US
Functional_Features												
External Car Lights Features		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fog Lights	2	✓	✓	✓	✓	✓	✓	✓	☑	☑	☑	☑
Driver Assistance	4	✓	✓	✓	✓	☐	✓	✓	✓	✓	✓	✓
Daytime Running Light	3	☐	☐	✓	☐	☐	☐	☐	✓	✓	✓	✓
Separate DRL Lights	3.2	☐	☐	✗	☐	☐	☐	☐	✓	✓	✓	✓
Standard Bulb	3.2.2	☐	☐	✗	☐	☐	☐	☐	✗	✗	✗	✗
wattage		'25'	'25'	'25'	'25'	'25'	'25'	'25'	'25'	'25'	'25'	'25'
LED	3.2.1	☐	☐	✗	☐	☐	☐	☐	☑	☑	☑	☑
Beam Configuration	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Low Beam	1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High Beam	1.2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regions												
Regions		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
North America	2	☐	☐	☐	☐	☐	☐	✓	☐	☐	☐	☐
EMEA	1	✓	☑	☑	✓	☑	✓	✓	✓	✓	☑	✓
CarLightCode												
Architecture												
CarLightRequirements												
CarLightRequirements		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
doors:requirement: Indicator Li...	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
doors:requirement: Head Lights	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
doors:requirement: Assistance ...	3	✓	✓	✓	✓	☐	✓	✓	✓	✓	✓	✓

Open variant model 'HighLight'.

- Visualize >
- 検証
- Export Matrix...
- Delete 削除
- Filter...
- Create Matrix Variant Filter
- Clear Filter
- Quick Filter >
 - Commonalities
 - Differences
 - Uniqueness
 - Errors
- Show Variants >
- Collapse All
- Expand All
- Table Layout >
- Visualize >

フィルターで分析

The screenshot shows a software interface with a table of model elements and a 'Filter Properties' dialog box. The table has columns for 'Model Elements', 'Level', and various regional light requirements. The 'Automatic Hazard Warning' row is highlighted with a red box. The 'Filter Properties' dialog box is open, showing a 'Define Filter' section with a 'Named Filters' dropdown set to 'Hazard'. The 'Define condition' section is highlighted with an orange box, showing a table with columns 'Field', 'Operator', and 'Value'. The 'Field' is 'Visible Name', the 'Operator' is 'contains', and the 'Value' is 'Haz'. There are also 'Case sensitive' and 'More >>' options. At the bottom of the dialog are 'Realtime', 'Preview', 'OK', and 'キャンセル' buttons.

Model Elements	Level	BaseLight	BaseLight_Denmark	BaseLight_EMEA	BaseLight_Inheritance	BaseLight_Japan	BaseLight_Sweden	BaseLight_USA_Canada	HighLight	HighLight_Canada	HighLight_EMEA	HighLight_US
Functional_Features												
External Car Lights Features		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Driver Assistance	4											
Automatic Hazard Warning	4.4	☐	☐	☐	☐	☐	✓	☐	☐	☐	☐	☐

Filter Properties

Define Filter

Define conditions and add them to the boolean filter expression

Named Filters

Hazard

Define condition

Field	Operator	Value
Visible Name	contains	Haz

Case sensitive

More >>

Realtime

Preview

OK

キャンセル

バリエーションの分析

The screenshot displays a software interface for variant analysis. On the left, a project tree shows the structure of 'AutomotiveDemoCarLight', including an 'auxiliary' folder and a 'Config' folder. A context menu is open over the 'Config' folder, with 'Model and Variant Analysis' selected. A sub-menu is open over 'Model and Variant Analysis', with 'Open Similarity Matrix' selected. On the right, a 'Similarity Matrix' window is open, showing a table of similarity percentages between various variants.

	BaseLight	BaseLight_Denmark	BaseLight_EMEA	BaseLight_Inheritance	BaseLight_Japan	BaseLight_Sweden	BaseLight_USA_Canada	HighLight	HighLight_Canada	HighLight_EMEA	HighLight_US
BaseLight		100%	86%	100%	80%	93%	86%	71%	64%	73%	62%
BaseLight_Denmark	100%		86%	100%	80%	93%	86%	71%	64%	73%	62%
BaseLight_EMEA	86%	86%		86%	66%	79%	72%	71%	64%	82%	62%
BaseLight_Inheritance	100%	100%	86%		80%	93%	86%	71%	64%	73%	62%
BaseLight_Japan	80%	80%	66%	80%		73%	66%	73%	62%	71%	64%
BaseLight_Sweden	93%	93%	79%	93%	73%		79%	64%	57%	66%	55%
BaseLight_USA_Canada	86%	86%	72%	86%	66%	79%		57%	68%	59%	66%
HighLight	71%	71%	71%	71%	73%	64%	57%		88%	88%	90%
HighLight_Canada	64%	64%	64%	64%	62%	57%	68%	88%		81%	88%
HighLight_EMEA	73%	73%	82%	73%	71%	66%	59%	88%	81%		79%
HighLight_US	62%	62%	62%	62%	64%	55%	66%	90%	88%	79%	

バリエーション間の比較や旧バージョンとの比較

The screenshot displays a software interface for comparing variant models. The top window, titled 'Similarity Matrix', shows a list of changes under the heading 'Model Meta Information Changed'. The first change is 'Automatic High/Low Beam: Selection State Changed (Not Selected <- User Selected)', which is highlighted. The second change is 'Mexiko: Selection State Changed (User Selected <- Not Selected)'. The bottom window, titled 'Variant Model Compare', shows a side-by-side comparison of two variant models: '/AutomotiveDemoCarLig...eLight_USA_Canada.vdm' and '/AutomotiveDemoCarLig.../HighLight_Canada.vdm'. The tree view on the left shows the following structure:

- External Car Lights Features
 - Beam Configuration
 - Fog Lights
 - Daytime Running Light
 - Driver Assistance
 - Automatic Light
 - Automatic High/Low Beam
 - Cornering Lights
 - Automatic Hazard Warning
- Regions
- Code/src

The right window shows the same structure for the 'HighLight_Canada.vdm' variant, with the 'Automatic High/Low Beam' feature checked, indicating a difference from the left variant.

変更の影響分析

*Functional_Features.xfm

- External Car Lights Features
 - Beam Configuration
 - Fog Lights
 - Daytime
 - Driver As

Unique Name

Change Unique Name ...

Please enter the new name

Unique Name: FogLight_Japan

Scope of models to process

Same Project Referenced Projects Workspace

< 戻る(B) 次へ(N) > 終了(E) キャンセル

Properties

Unique Name

リファクタリングを実行するには、以下の変更が必要です。

実行される変更

- The following artefacts need to be updated:
 - Functional_Features.xfm - /AutomotiveDemoCarLight
 - CarLightCode.ccfm - /AutomotiveDemoCarLight/auxiliary/Code
 - CarLightRequirements.ccfm - /AutomotiveDemoCarLight/auxiliary/Doors/Car Light
 - CarLightRequirements.ccfm - /AutomotiveDemoCarLight/auxiliary/Doors NG
 - SimulinkVariabilityModel.ccfm - /AutomotiveDemoCarLight/auxiliary/Matlab
 - CarLightRequirements.ccfm - /AutomotiveDemoCarLight/auxiliary/TFS
 - pictures.ccfm - /AutomotiveDemoCarLight/auxiliary/pictures

SimulinkVariabilityModel.ccfm

Original Model	Refactored Model
> ! UP sl:variationpoint: VAR_DayLight	> ! UP sl:variationpoint: VAR_DayLight
> ! UP sl:variationpoint: VAR_DriveAssistance	> ! UP sl:variationpoint: VAR_DriveAssistance
∨ ! UP sl:variationpoint: VAR_FogLight <ul style="list-style-type: none">↔ U sl:variation: VAR_FogLight = 0 (Off)∨ ↔ U sl:variation: VAR_FogLight = 1 (On)<ul style="list-style-type: none">◆ (FogLight) REQUIRES SELF	∨ ! UP sl:variationpoint: VAR_FogLight <ul style="list-style-type: none">↔ U sl:variation: VAR_FogLight = 0 (Off)∨ ↔ U sl:variation: VAR_FogLight = 1 (On)<ul style="list-style-type: none">◆ (FogLight_Japan) REQUIRES SELF
> ⚙ Label = 'On'	> ⚙ Label = 'On'
> ⚙ Value = '1'	> ⚙ Value = '1'
> ! UP sl:variationpoint: VAR_StaticCorneringLight	> ! UP sl:variationpoint: VAR_StaticCorneringLight
> ! sl:baseworkspace: Base Workspace	> ! sl:baseworkspace: Base Workspace

pure::variants について:

<https://www.fuji-setsu.co.jp/products/purevariants/>

Dr.Danilo Beuche の実践的なプロダクトライン開発について

https://www.fuji-setsu.co.jp/products/purevariants/Danilo_Blog.html#PLE

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<https://www.fuji-setsu.co.jp>

