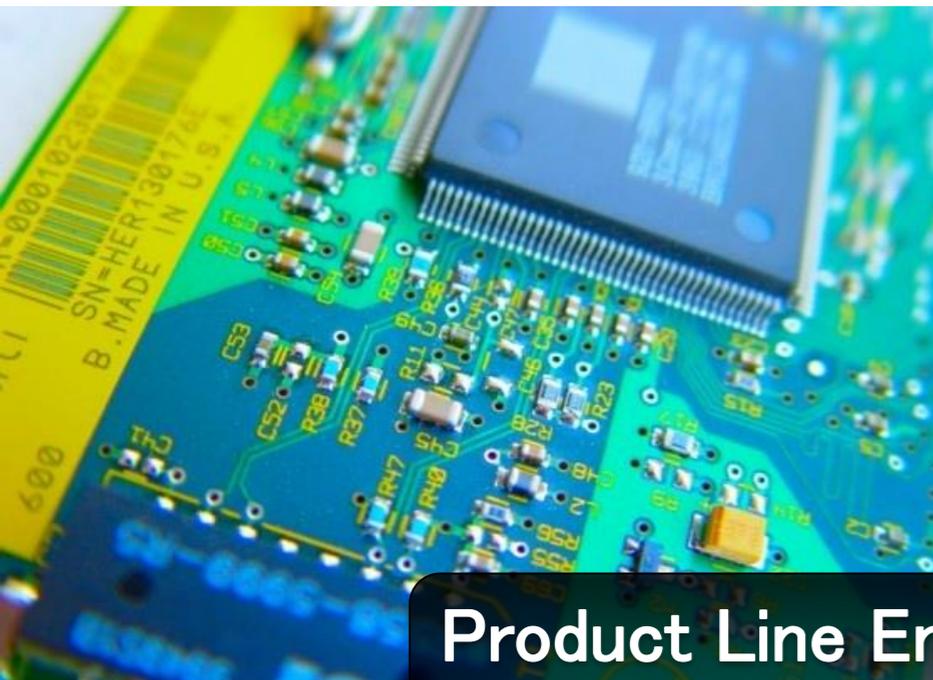


# Product Line Engineering

## pure::variants

バリエーション管理支援ツール

# プロダクトライン開発にバリエーション管理ツール pure::variants を活用



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、継続的に変化する市場要求や技術革新に伴う製品（バリエーション）の進化に柔軟に応じることができる、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ます



# Product Line Engineering Variation Dimensions

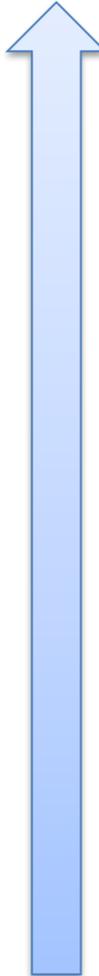
製品間の違い  
Technical Dimension



プロダクトライン開発の課題として同時に対応すべき2つのバリエーション(変化)がある

この例では、一番上のみ右ハンドルで、下の3つは同様に見えるが違いもある

ここでは製品間の違いのみ



# Product Line Engineering Variation Dimensions

製品間の違い  
Technical Dimension

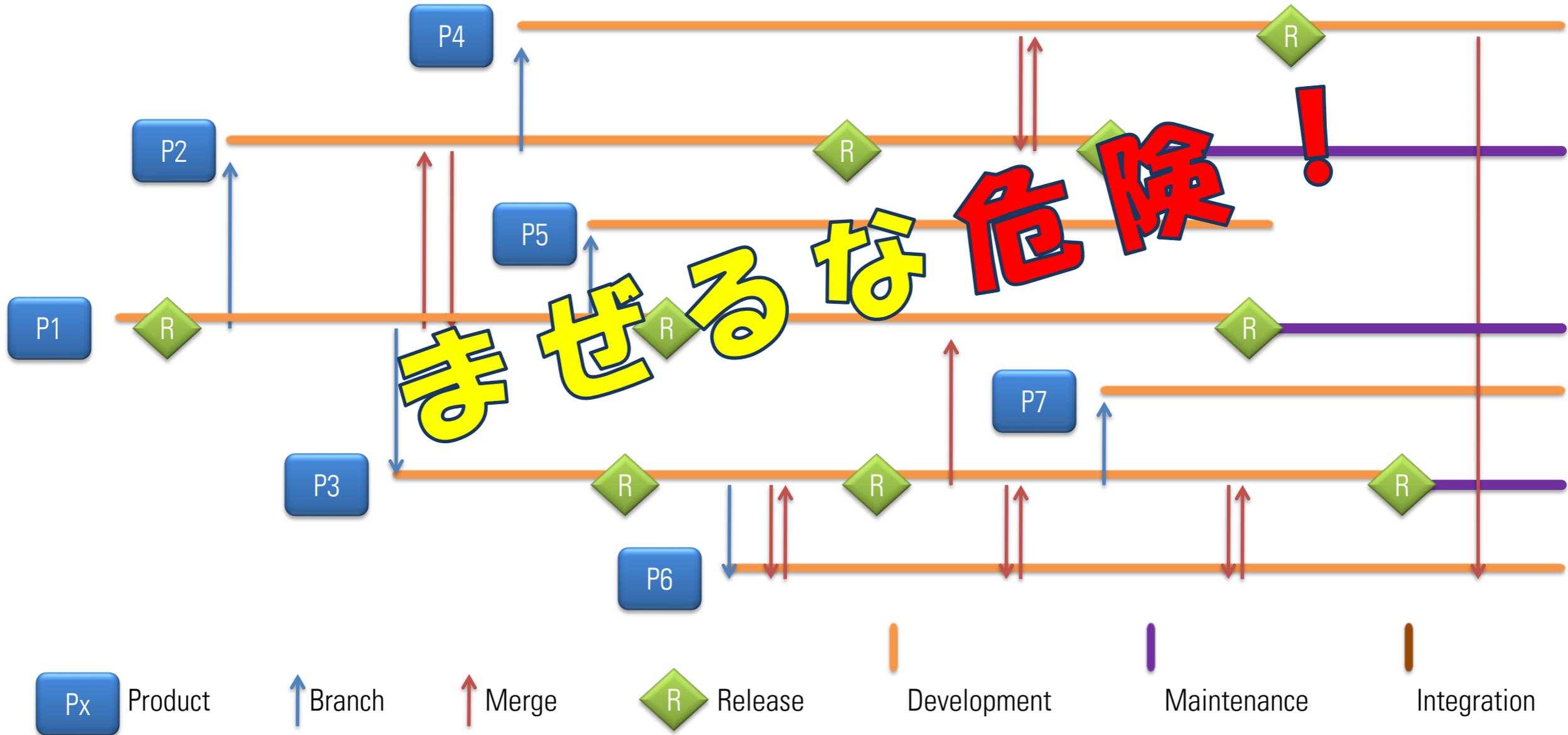


これら製品(バリエーション)は、継続的に変化する市場要求や技術革新を受けて進化する  
備えはいるが、どうなるか予測はできない

同時進行で発生するバリエーション(製品間の違い)とバージョンの両方の管理が必要

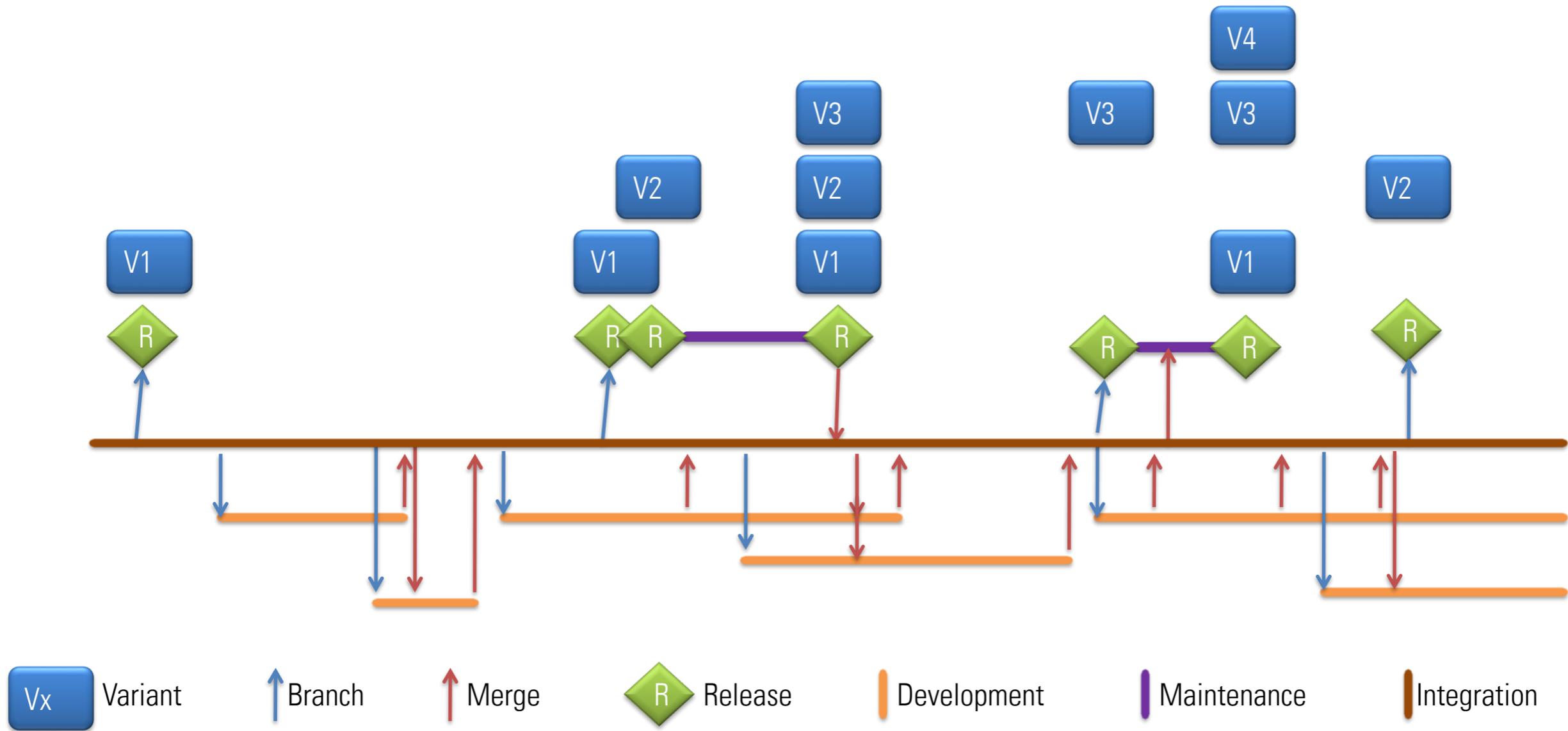
バージョン  
Time Dimension

バージョン管理とバリエーション管理を混同すると、



まぜるな危険





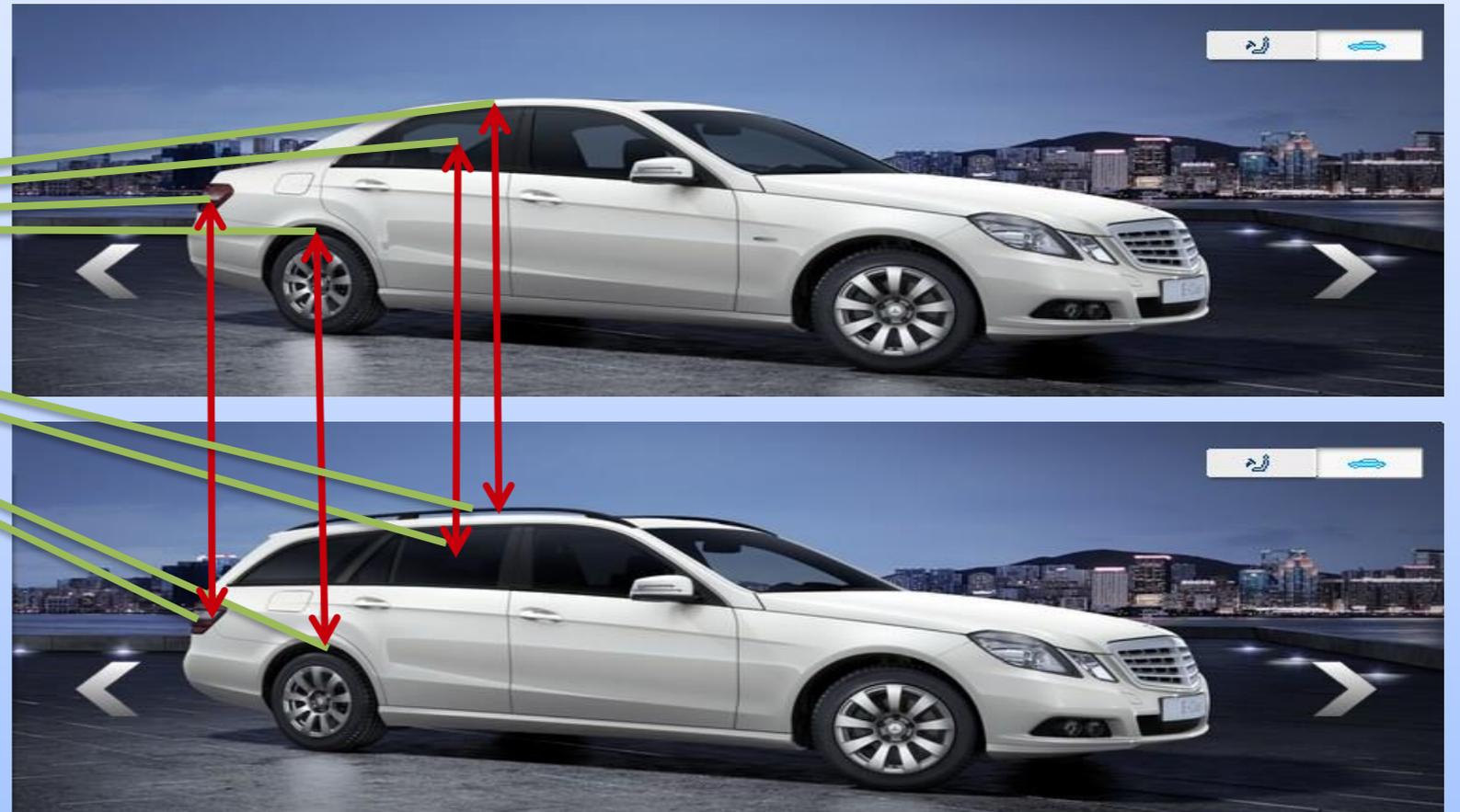
バージョン管理に適正なバリエーション管理ツールを統合することで  
 プロダクトラインの持続的な進化と保守を支援して体系的な再利用を実現できる

# バリエーションポイント

## 問題空間



## 解決空間



問題空間上のバリエーションポイントは、解決空間上のテクニカルなそれと結びつき、バリエーションの複雑さを軽減してバリエーションの決定項目を削減できる

# Variant Management Solution for Systems & Software Engineering



# PLEの戦略＝関心事の分離

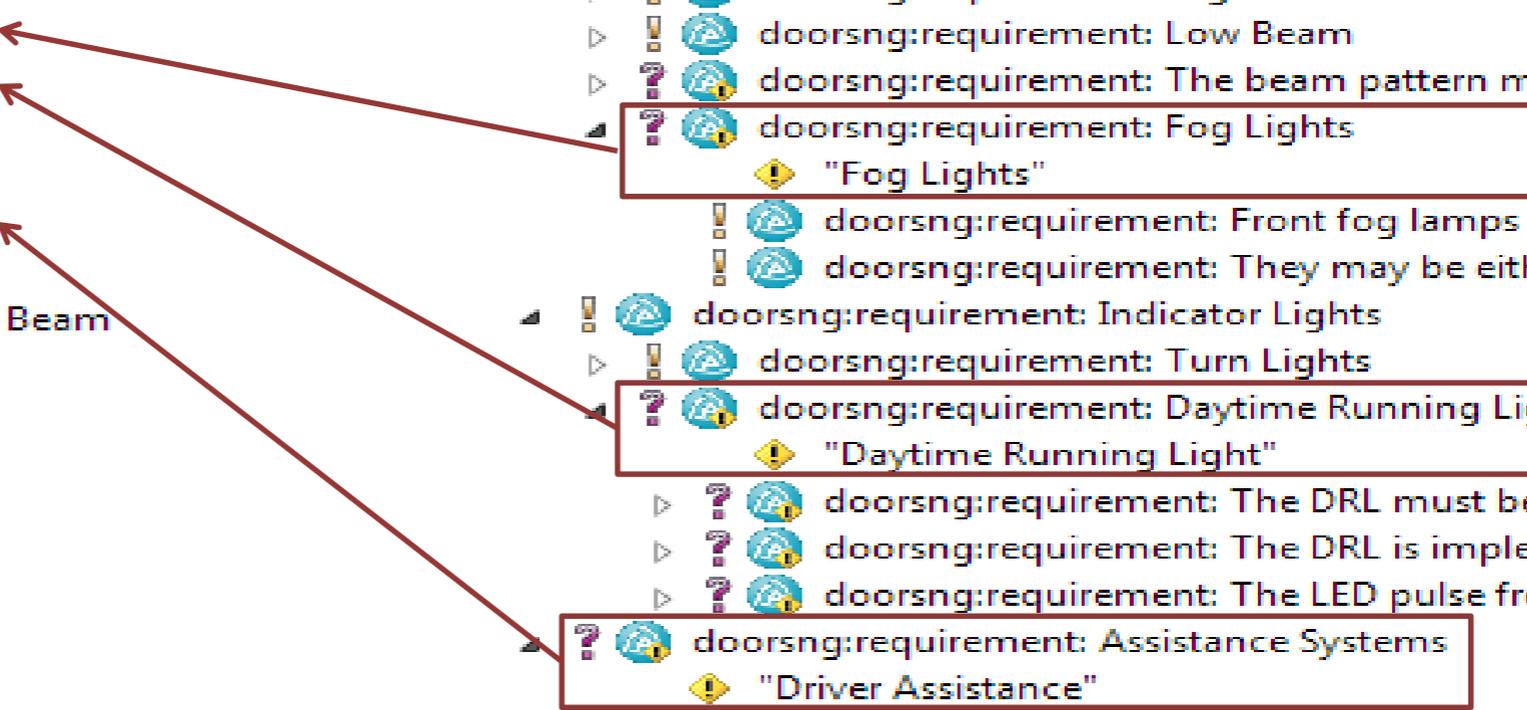
ドメインエンジニアリング



アプリケーションエンジニアリング

- Car Lights Features
  - Regions
  - Beam Configuration
  - Fog Lights
  - Daytime Running Light
  - Reduced Low Beam
  - Separate DRL Lights
  - Driver Assistance
    - Automatic Light
    - Automatic High/Low Beam
    - Cornering Lights

- CarLightRequirements
  - doorsng:requirement: Head Lights
  - doorsng:requirement: High Beam
  - doorsng:requirement: Low Beam
  - doorsng:requirement: The beam pattern must f
  - doorsng:requirement: Fog Lights
    - "Fog Lights"
    - doorsng:requirement: Front fog lamps have
    - doorsng:requirement: They may be either w
  - doorsng:requirement: Indicator Lights
  - doorsng:requirement: Turn Lights
  - doorsng:requirement: Daytime Running Light
    - "Daytime Running Light"
    - doorsng:requirement: The DRL must be con
    - doorsng:requirement: The DRL is implemen
    - doorsng:requirement: The LED pulse frequer
  - doorsng:requirement: Assistance Systems
    - "Driver Assistance"
    - doorsng:requirement: Cornering Light

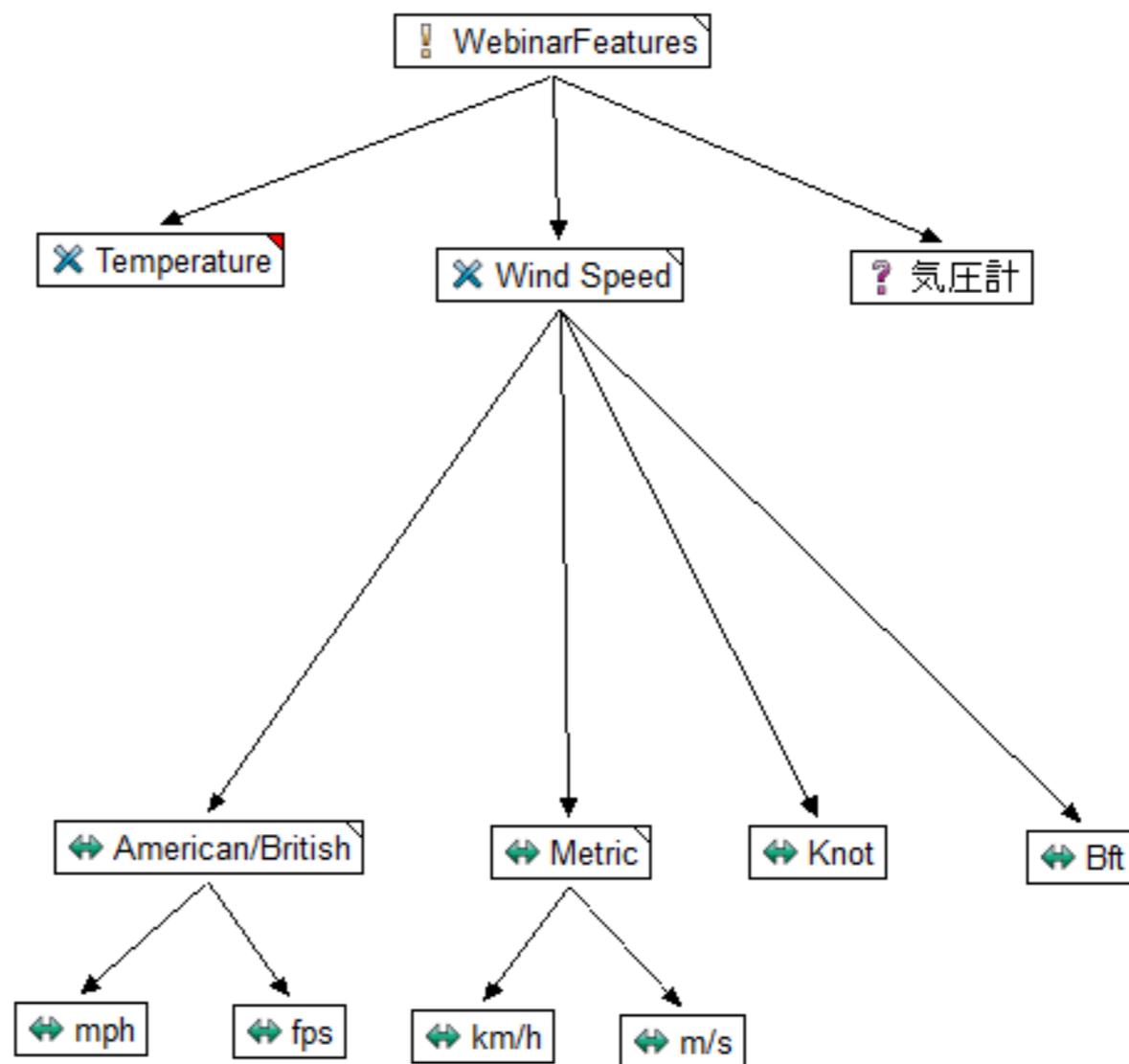


問題空間上の各フィーチャに解決空間内のバリエーションポイントを紐付ける

# フィーチャモデル: ツリー構造とグラフ表示

\*WebinarFeatures.xfm

- WebinarFeatures
  - Temperature
  - Wind Speed
    - Metric
      - km/h
      - m/s
    - American/British
      - mph
      - fps
    - Knot
    - Bft
  - 気圧計

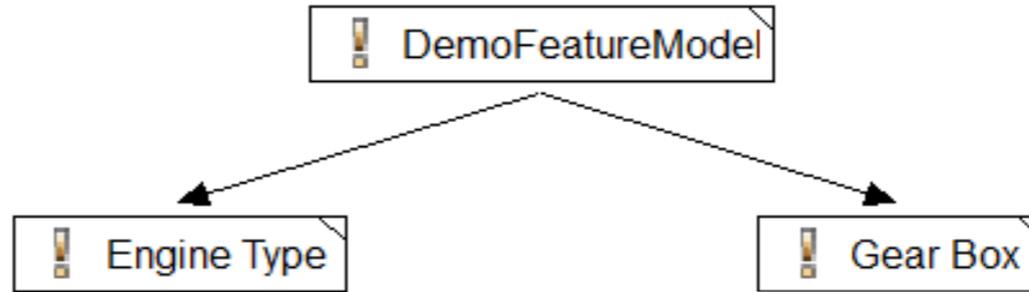


# フィーチャ間の依存・排他関係

The image displays two windows from a software application. The left window, titled 'WebinarFeatures.xfm', shows a hierarchical tree of features. Under 'Temperature', there are sub-features '°C' and '°F'. '°C' has a red arrow pointing to it with the text 'Conflicts: "American/British"'. '°F' has a red arrow pointing to it with the text 'Conflicts: "Metric"'. Other features include 'Wind Speed', 'Metric', 'km/h', 'm/s', 'American/British', 'mph', 'fps', 'Knot', and 'Bft'. The right window, titled 'Edit Feature', is open for the feature '°C'. It has tabs for 'General', 'Relations', 'Attributes', 'Restrictions', and 'Constraints'. The 'Relations' tab is active, showing a table with 'Type' and 'Targets' columns. The 'ps:conflicts' type is selected, and the target is 'American/British'. A red arrow points from the conflict label in the tree to the 'ps:conflicts' entry in the relations list.

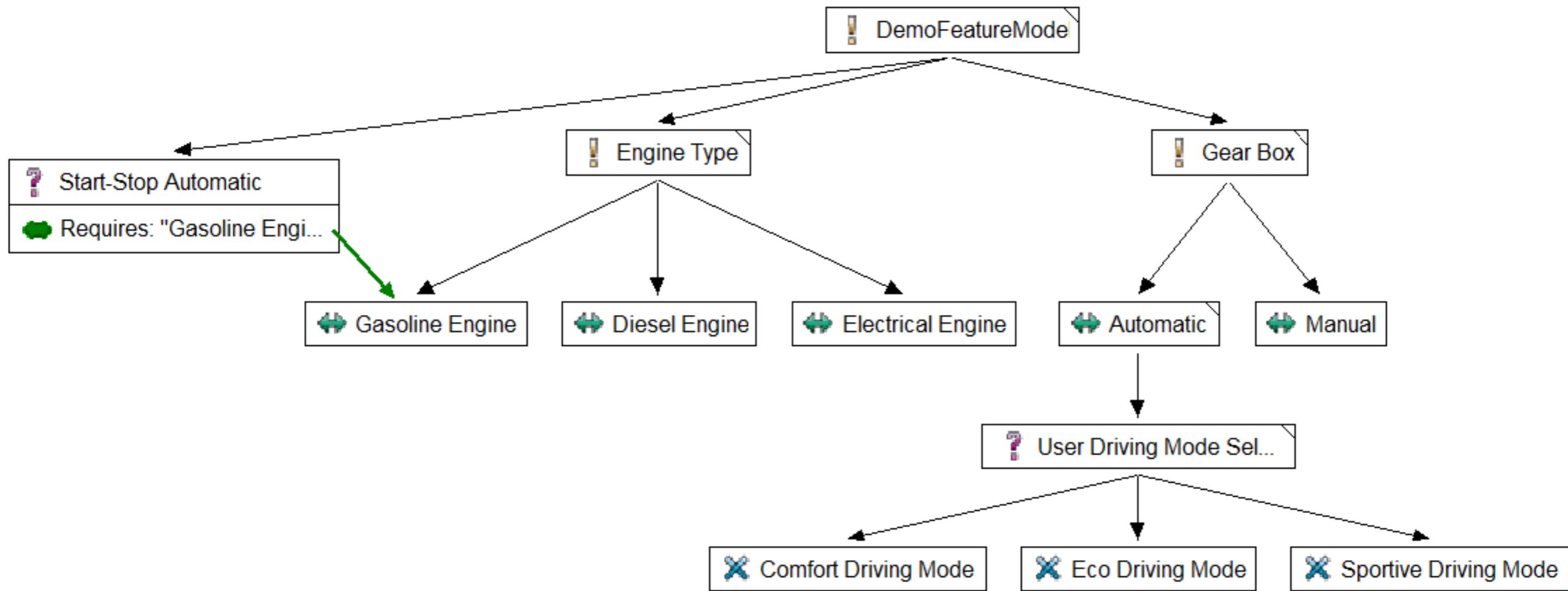
Type	Targets
ps:conflicts	"American/British"
ps:conditionalRequires	
ps:conflicts	
ps:conflictsAny	
ps:defaultProvider	
ps:discourages	
ps:discouragesAny	
ps:exclusiveProvider	
ps:expansionProvider	
ps:influences	
ps:provides	
ps:recommendedFor	
ps:recommendedForAll	
ps:recommends	

# Feature Model



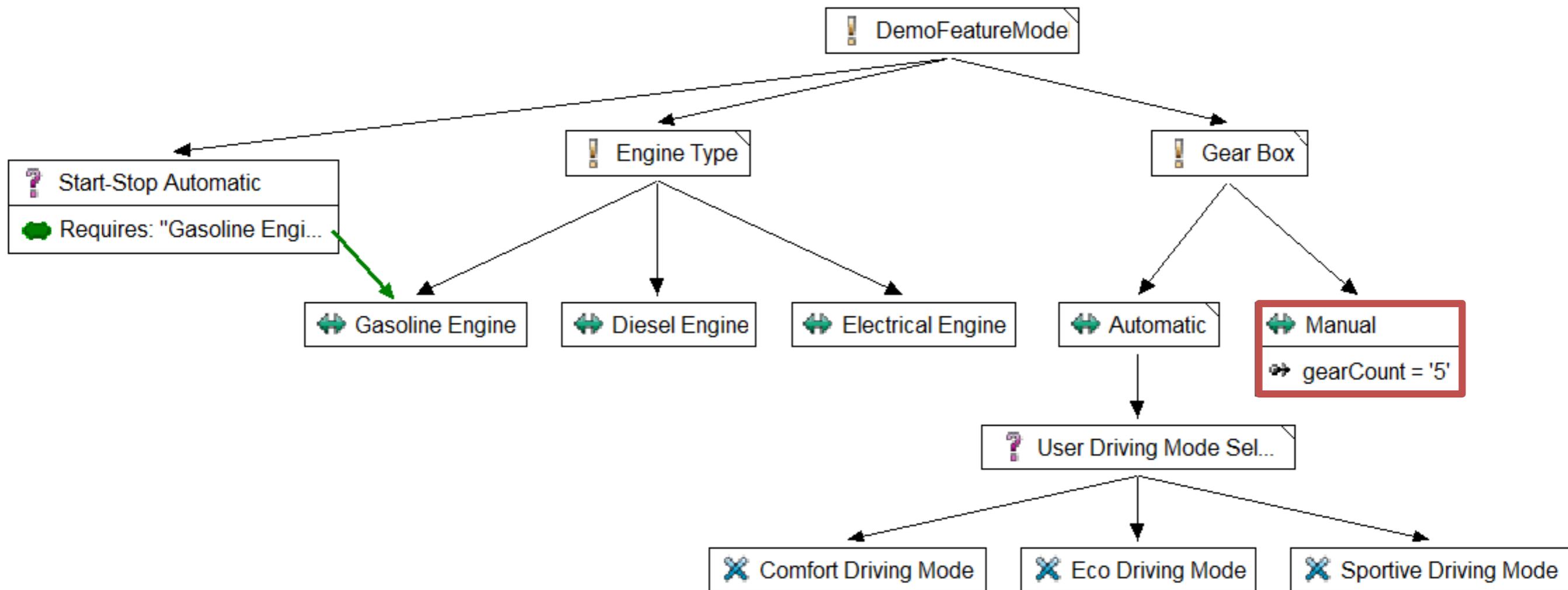
**Legend:**  = Mandatory (必須)  = Optional (選択自由)  = Alternative (どれか一つ)  = Or (少なくとも一つ)

# Feature Model - Dependencies



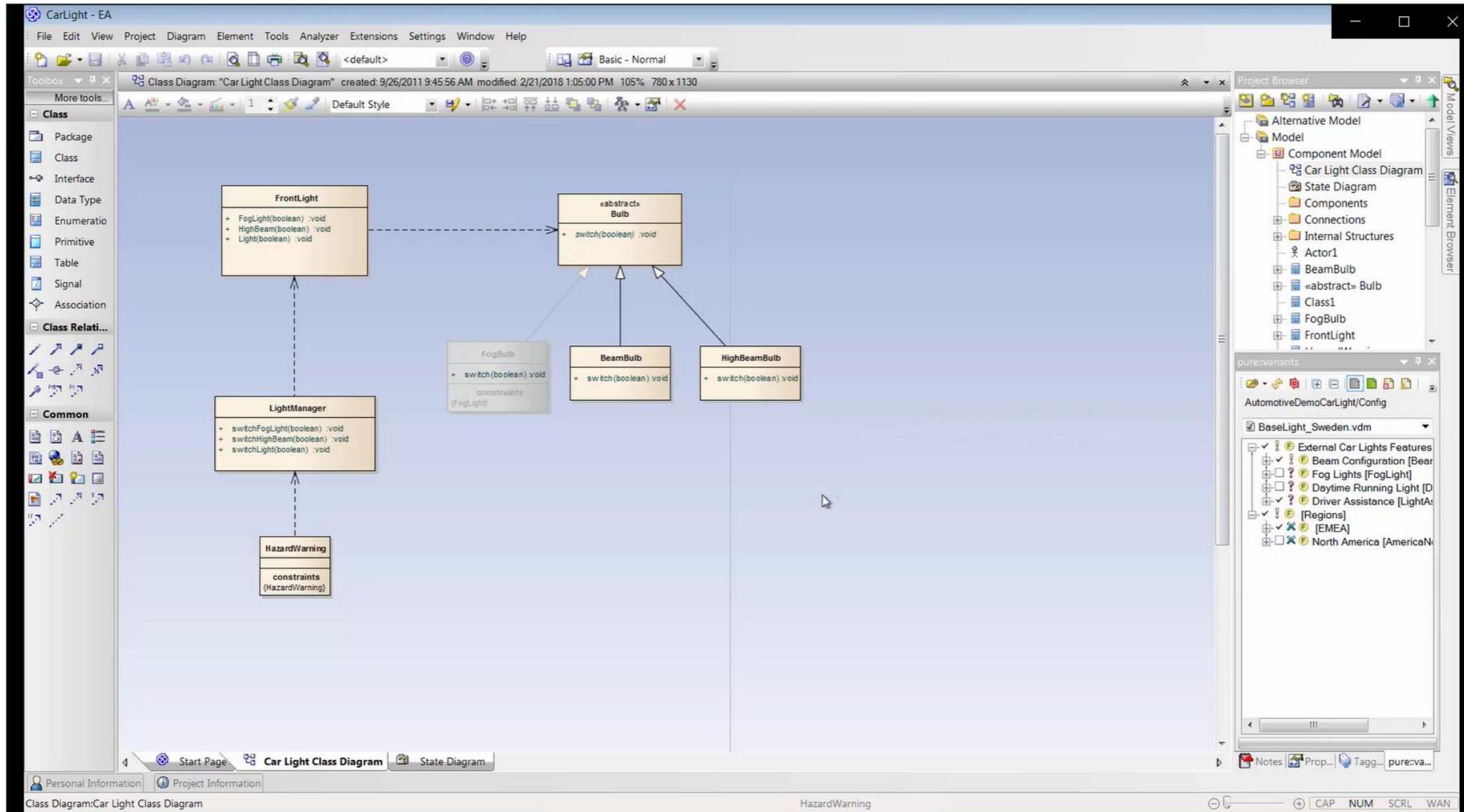
Legend: ! = Mandatory (必須) ? = Optional (選択自由) ↔ = Alternative (どれか一つ) ✕ = Or (少なくとも一つ)

# Feature Model - attribute



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

# UML連携: Enterprise Architect 動画デモ



[https://www.fuji-setsu.co.jp/products/purevariants/EnterpriseArchitect.html#SPL\\_EAdemo](https://www.fuji-setsu.co.jp/products/purevariants/EnterpriseArchitect.html#SPL_EAdemo)

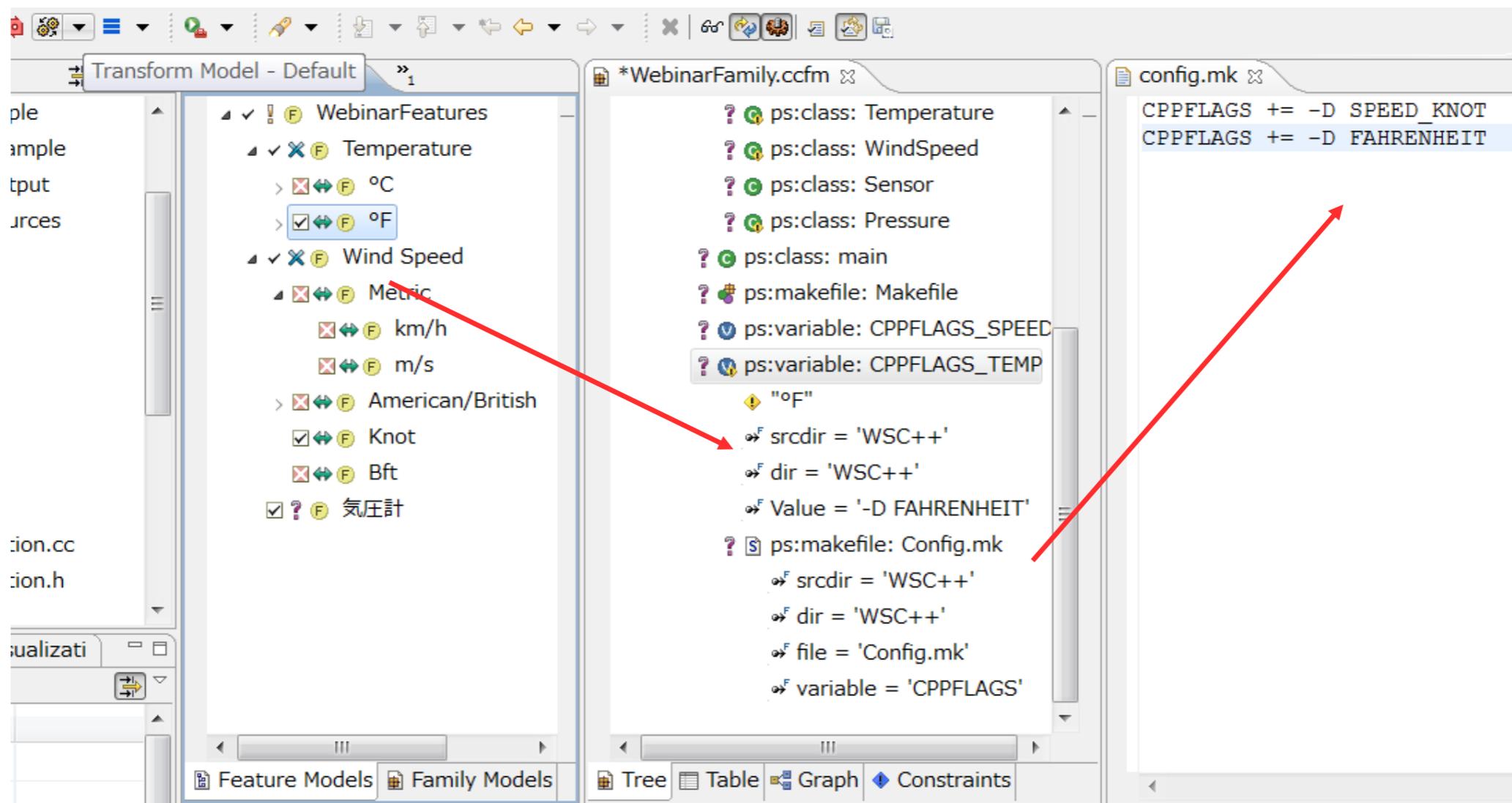
# Excel連携：仕様・ケースの管理など

The screenshot displays the Eclipse Platform Variant Management (VDM) tool interface. On the left, a tree view shows project structures like 'Conditional Documents Example', 'EA Weather Station Example', and 'Excel Transformation Example'. The main area shows a feature model tree for 'DemoFeatureModel' with nodes for 'Engine Type' (Gasoline Engine, Diesel Engine, Electrical Engine) and 'Gear Box' (Automatic, Manual). An Excel spreadsheet window is overlaid, showing a table with test cases T2 and T4. The table columns are labeled A, B, C, and D. The content in the cells is as follows:

	A	B	C	D	
2	T2	Automatic	Start-Stop Test for Combustion Engines with automatic gear box	StartStop AND AutomaticGearBox AND (GasolineEngine OR DieselEngine)	Test to stoppe automa
3	T4	Automatic	Fuel Efficiency Test	NOT(ElectricalEngine)	Test to whole s consum
4					

<https://www.fuji-setsu.co.jp/products/purevariants/tutorials.html#office>

# フィーチャ選択によりmakeファイルにフラグを設定



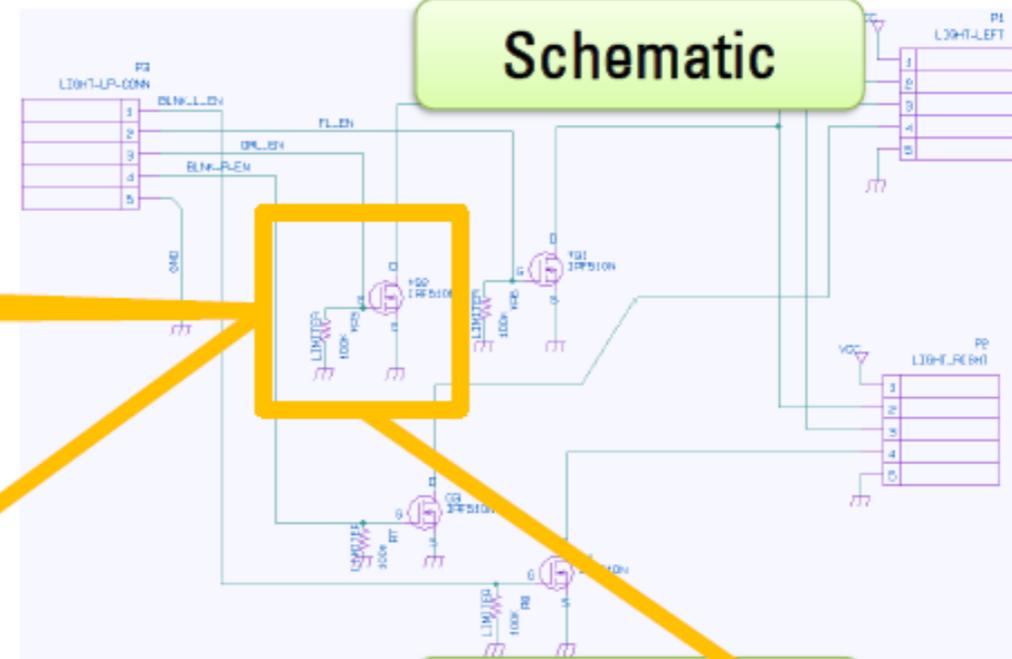
[https://www.fuji-setsu.co.jp/files/pure\\_variants\\_demo.pdf](https://www.fuji-setsu.co.jp/files/pure_variants_demo.pdf)

# pure::variants

# CR-8000

### Feature Model

- External Car Lights Feature
  - safety = "Automatic Hazard Warning" -> safety + "Adaptive Forward Lighting" -> safety + "Automatic Forward Lighting"
  - Beam Configuration
    - Fog Lights
      - Daytime Running Light
        - Reduced Low Beam
        - Separate DRL Lights
          - LED
          - Standard Bulb



### VP Mapping

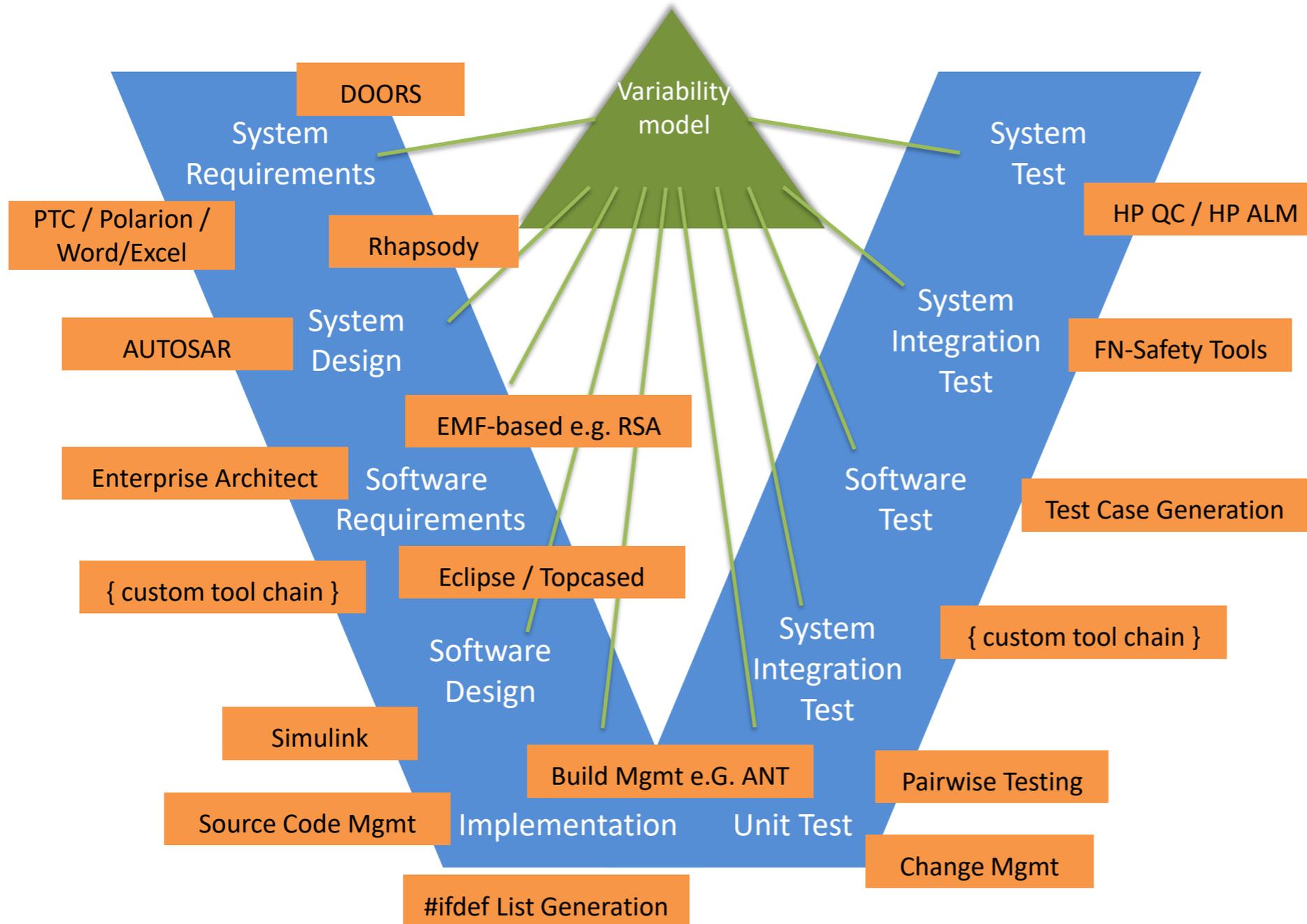
Variability Model	
Daytime Running Light	
DRL Supported	"Daytime Running Light" AND NOT("Reduced Low Beam")
DRL Not Supported	
Foglight Support	
Foglight Supported	"Fog Lights"
Foglight Not Supported	

### Design Variation

Reference Designator	Variation Type	Foglight Suppo...	Foglight Suppo...	Daytime Runnin...	Daytime Runnin...
1 Q1	Foglight Support	NO	YES	Not mount on PCB	Not mount on PCB
2 Q2	Daytime Running Light			NO	YES
3 Q3					
4 Q4					
5 R2	Foglight Support	NO	YES		
6 R3	Daytime Running Light			NO	YES
7 R4					
8 R6					
P1					
10 P2					
11 P3					



# pure::variants Enterprise Integrations



フィーチャモデルに  
プロダクトラインの問題空間のバリエーションを表現して、解決空間上のあらゆる資産と紐付けられる

# pure::variants プロダクトラインライフサイクルをサポート



<b>DOORS 9</b>	<b>DOORS Next</b>	<b>Polarion Requirements</b>		
<b>Rhapsody</b>	<b>RTC</b>	<b>Rational Quality Manager</b>	<b>C/C++/Java</b>	
<b>MS Word, Excel</b>	<b>AUTOSAR</b>	<b>EMF</b>	<b>Enterprise Architect</b>	
<b>Simulink</b>	<b>MagicDraw</b>	<b>...</b>	<b>Zuken</b>	<b>medini analyze</b>

Model Elements	Level	BaseLight	BaseLight_EMEA	BaseLight_USA_C...	Demo	HighLight	HighLight_Canada	HighLight_EMEA	HighLight_US
CarLightFeatures									
Car Lights Features		✓	✓	✓	✓	✓	✓	✓	✓
Regions	1	✓	✓	✓	✓	✓	✓	✓	✓
EMEA	1.1	<input type="checkbox"/>	✓	✗	<input type="checkbox"/>	<input type="checkbox"/>	✗	✓	✗
EU	1.1.1	<input type="checkbox"/>	✓	✗	<input type="checkbox"/>	<input type="checkbox"/>	✗	✓	✗
Austria	1.1.1.1	<input type="checkbox"/>	✓	✗	<input type="checkbox"/>	<input type="checkbox"/>	✗	<input type="checkbox"/>	✗
Denmark	1.1.1.2	<input type="checkbox"/>	✓	✗	<input type="checkbox"/>	<input type="checkbox"/>	✗	✓	✗
UK	1.1.1.3	<input type="checkbox"/>	✓	✗	<input type="checkbox"/>	<input type="checkbox"/>	✗	✓	✗
North America	1.2	<input type="checkbox"/>	✗	✓	<input type="checkbox"/>	<input type="checkbox"/>	✓	✗	✓
Canada	1.2.1	<input type="checkbox"/>	✗	✓	<input type="checkbox"/>	<input type="checkbox"/>	✓	✗	<input type="checkbox"/>
Mexico	1.2.2	<input type="checkbox"/>	✗	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	✗	<input type="checkbox"/>
USA	1.2.3	<input type="checkbox"/>	✗	✓	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	✗	✓
Beam Configuration	2	✓	✓	✓	✓	✓	✓	✓	✓
Low Beam	2.1	✓	✓	✓	✓	✓	✓	✓	✓
Xenon	2.1.1	<input type="checkbox"/>	✗	✗	<input type="checkbox"/>	✓	<input type="checkbox"/>	✗	✗
Halogen	2.1.2	<input type="checkbox"/>	✗	✗	<input type="checkbox"/>	✓	✗	✗	✗
High Beam	2.2	✓	✓	✓	✓	✓	✓	✓	✓

バリエーションごとで搭載する機能を比較  
 フィルターやソートでバリエーション間の違いや同一性を分析できる

Variant Management - Similarity Matrix - Eclipse Platform

ファイル(F) 編集(E) ナビゲート(N) Search プロジェクト(P) 実行(R) ウィンドウ(W) ヘルプ(H)

Variant Projects

- AutomotiveDemoCarLight
  - auxiliary
  - Config
    - BaseLight
    - BaseLight\_Denmark
    - BaseLight\_EMEA
    - BaseLight\_Sweden
    - BaseLight\_USA\_Canada
    - HighLight
    - HighLight\_Canada
    - HighLight\_EMEA
    - HighLight\_US

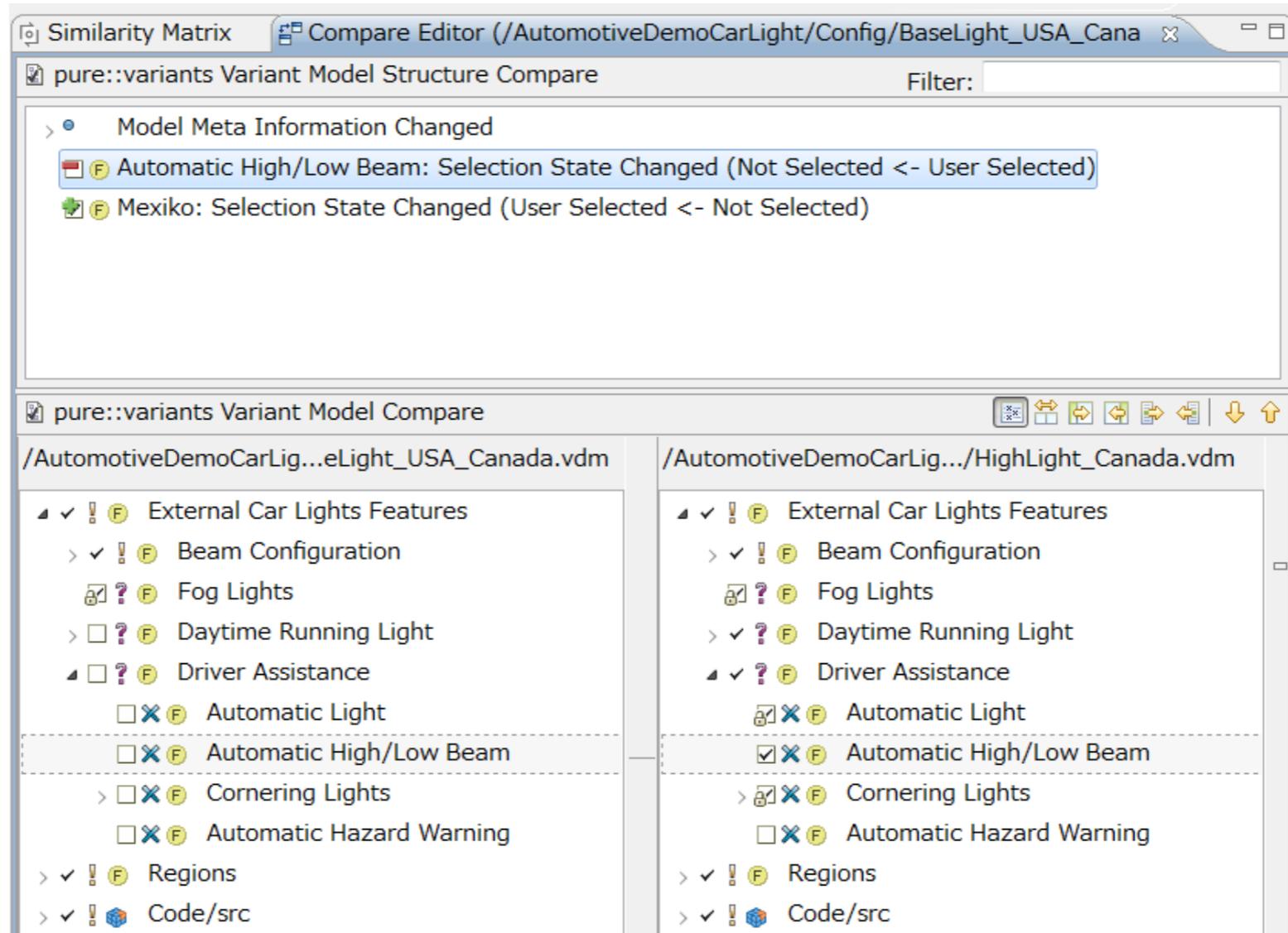
Similarity Matrix

	BaseLight	BaseLight_Denmark	BaseLight_EMEA	BaseLight_Sweden	BaseLight_USA_C...	HighLight	HighLight_Canada	HighLight_EMEA	HighLight_US
BaseLight		100%	91%	96%	93%	72%	69%	72%	67%
BaseLight_Denmark	100%		91%	96%	93%	72%	69%	72%	67%
BaseLight_EMEA	91%	91%		88%	85%	71%	67%	78%	67%
BaseLight_Sweden	96%	96%	88%		90%	71%	68%	71%	66%
BaseLight_USA_Canada	93%	93%	85%	90%		68%	72%	68%	69%
HighLight	72%	72%	71%	71%	68%		92%	90%	95%
HighLight_Canada	69%	69%	67%	68%	72%	92%		87%	91%
HighLight_EMEA	72%	72%	78%	71%	68%	90%	87%		85%
HighLight_US	67%	67%	67%	66%	69%	95%	91%	85%	

Context Menu:

- New
- Open
- Open in Matrix
- Delete
- Refactor
- インポート(I)...
- エクスポート(O)...
- 更新(F)
- Synchronize Models...
- Migrate...
- 実行(R)
- デバッグ(D)
- チーム(E)
- 比較対象(A)
- ローカル履歴から復元(Y)...
- Model and Variant Analysis
  - Selection State Analysis
  - Element Cluster Analysis
  - Open Similarity Matrix
- Variant
- プロパティ(R)

# バリエーション間の比較や旧バージョンとの比較もできる

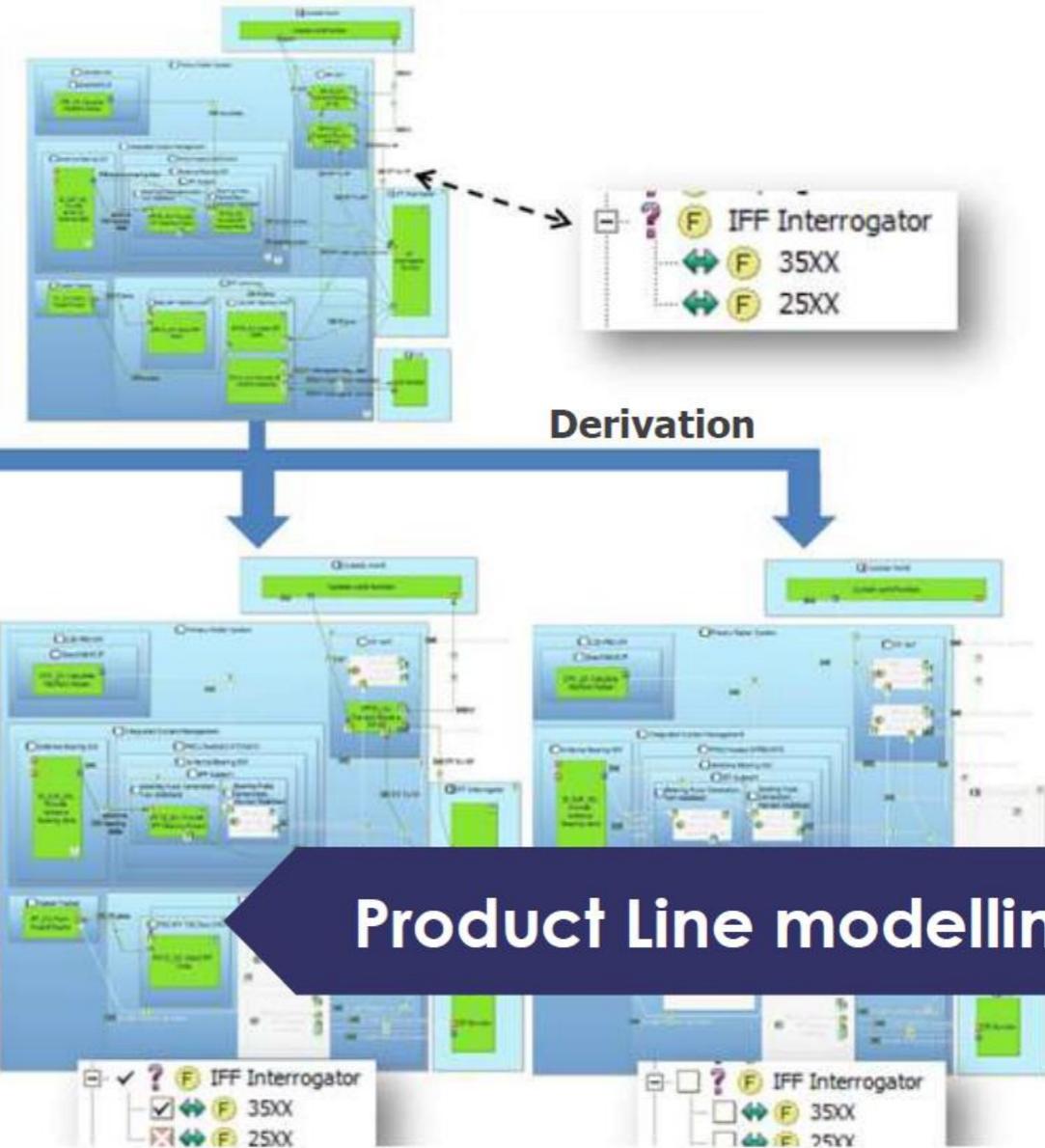
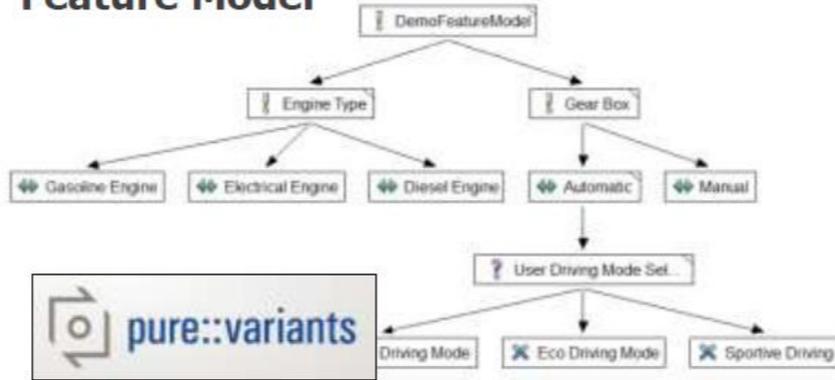


<http://www.fuji-setsu.co.jp/demo/pvIBM/pv3CompareMatrix.wmv>

THALES は全社のPLE  
に pure::variants を採用

参考データ:  
22000人のR&Dエンジニア

### Feature Model



Product Line modelling

Source: MBSE Symposium,  
“MBSE, Backbone of the  
Thales Engineering Manifesto”,

Olivier Flous

VP Engineering THALES,

October 27<sup>th</sup>, 2014 Canberra, Australia

[http://download.polarsys.org/capella/publis/MBSE\\_Canberra-](http://download.polarsys.org/capella/publis/MBSE_Canberra-Backbone_of_the_Thales_Engineering_Manifesto.pdf)

[Backbone of the Thales Engineering Manifesto.pdf](http://download.polarsys.org/capella/publis/MBSE_Canberra-Backbone_of_the_Thales_Engineering_Manifesto.pdf)



pure::variants について:

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

Dr.Danilo の実践的 ソフトウェアプロダクトライン開発

[https://www.fuji-setsu.co.jp/products/purevariants/Danilo\\_Blog.html](https://www.fuji-setsu.co.jp/products/purevariants/Danilo_Blog.html)

