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> The concept of metatransformations: modify the common transformations prior to their execution

> Challenges: comprehensibility and maintainability, non-exclusive application, complex feature models, practical adoption, and changes as transformations

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Feature Model Driven Generation of Software Artifacts

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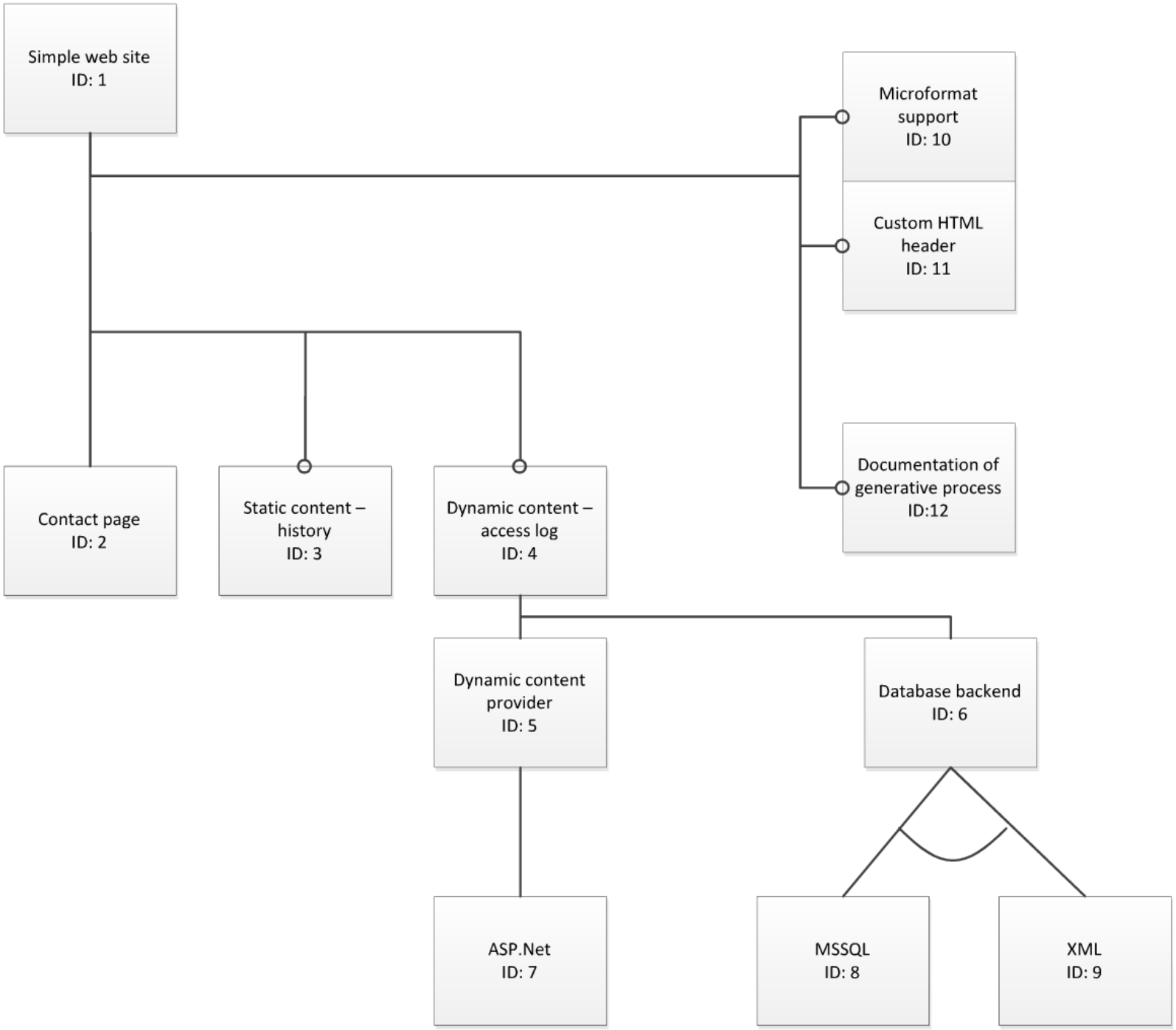
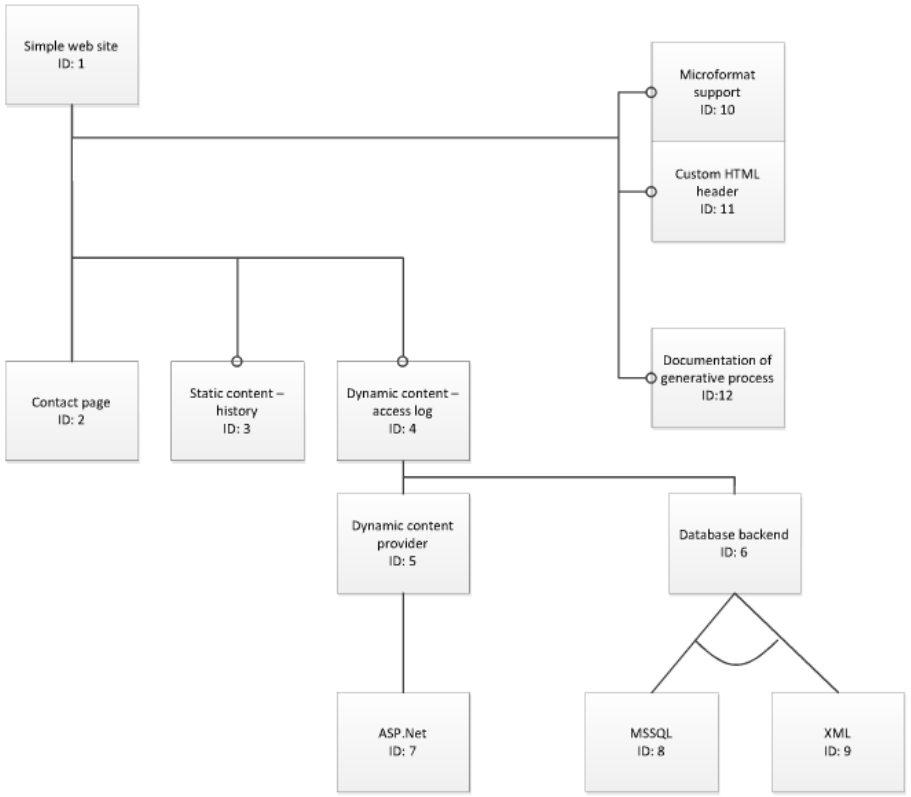
WAPL 2015 @ FedCSIS 2015

Łódź, September 13, 2015

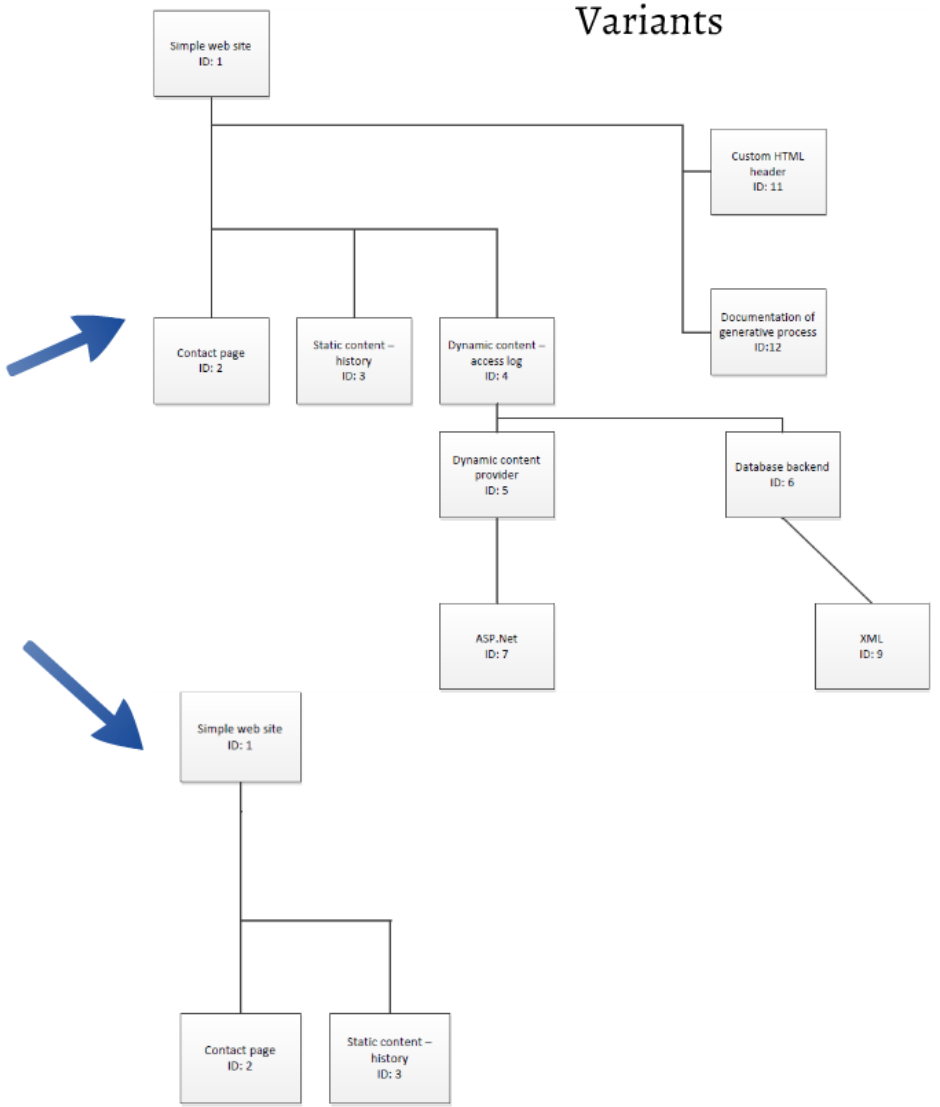
Feature Modeling



Feature Modeling



Variants



> A feature model defines variants in a structured way

> Domain engineering / software product lines

> Configurability first; appropriate implementation mechanisms selected accordingly

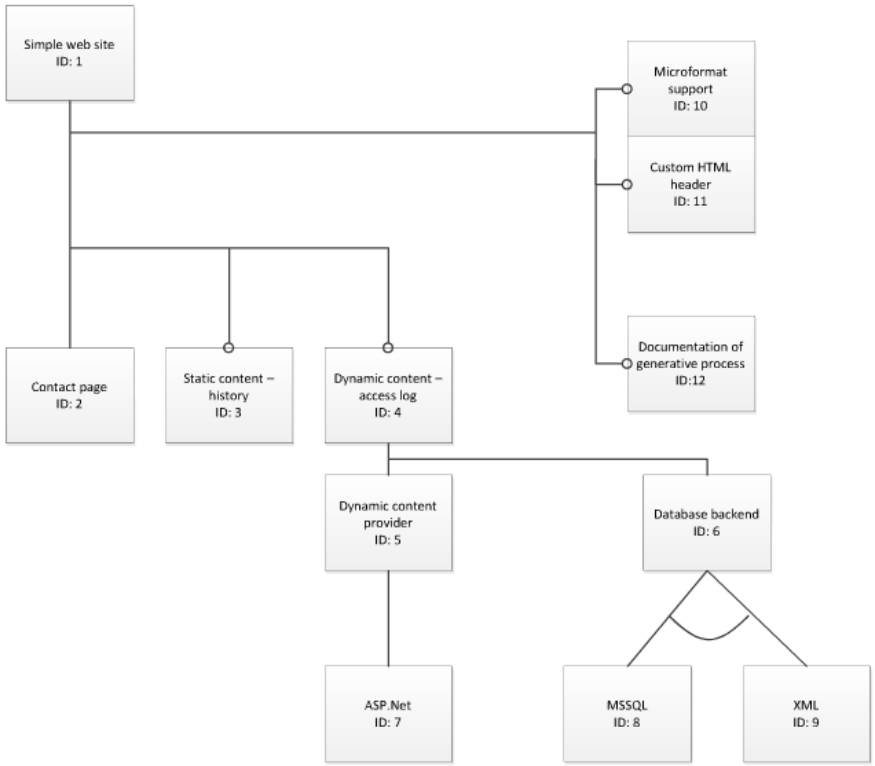
> Need not necessarily involve *any* academic feature modeling notation

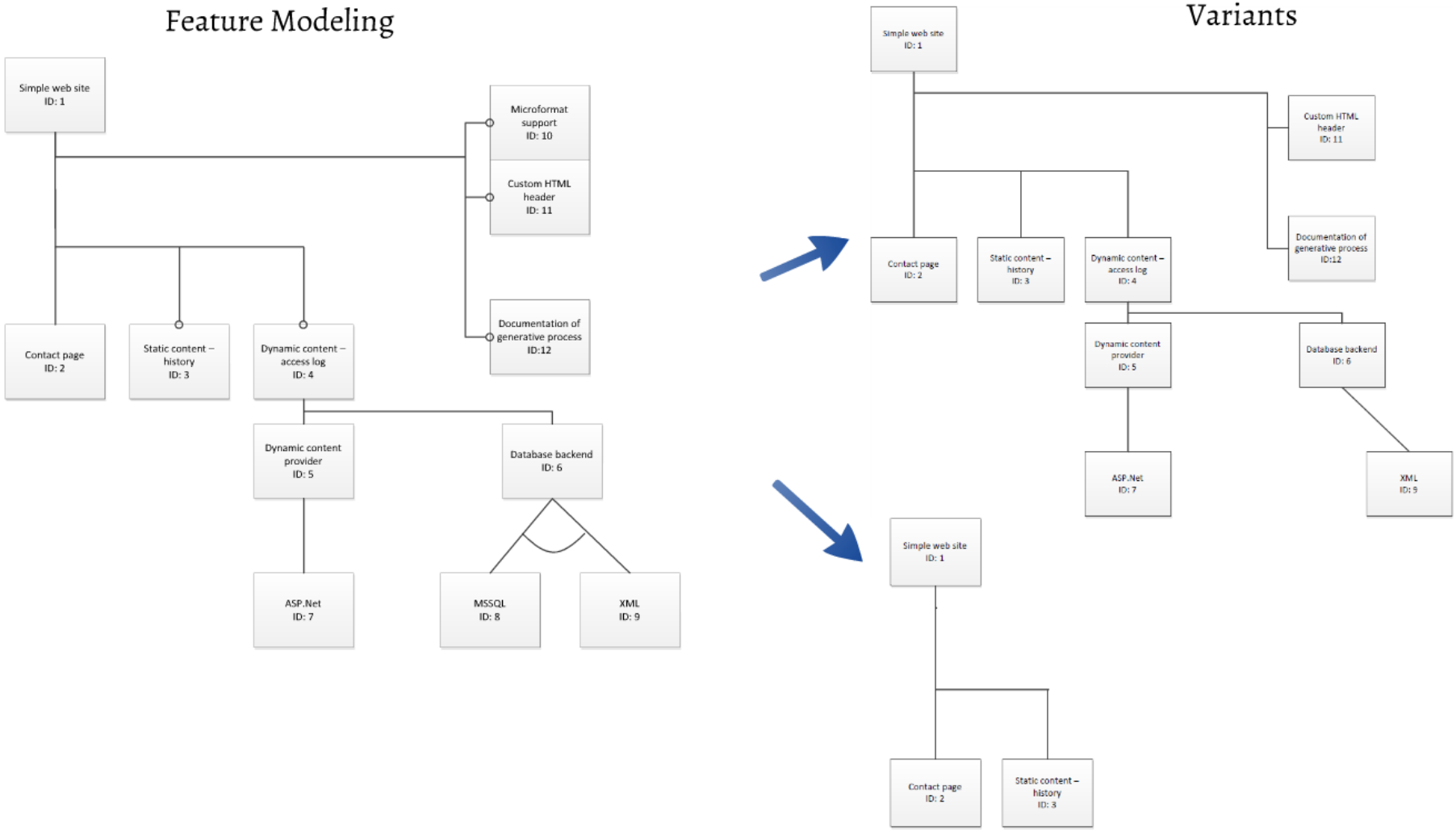
A. Hubaux, A. Classen, M. Mendonca, and P. Heymans: A Preliminary Review on the Application of Feature Diagrams in Practice, VaMoS 2010

> A simple FODA-like style used here

> Abstracting from advanced concepts like binding time, additional constraints among features, feature cardinality...

Feature Modeling





But how exactly to implement features?

What are they in code?

> Features sometimes can be implemented as well localized components

> But often the realization of one feature is spread over several components

> Sometimes this involves crosscutting: a case for aspect-oriented programming

> Features sometimes can be implemented as well localized components

> But often the realization of one feature is spread over several components

> Sometimes this involves crosscutting: a case for aspect-oriented programming

> A simple conditional compilation can cope with this, but the code of crosscutting features would be scattered

> Generative approaches rely on the set of selected features to generate highly specialized code

> Generators can be external, but also metaprogramming based

> In either case, features are understood as the structure and behavior to be added, adapted, or removed

> Our idea: make each feature's realization a transformation

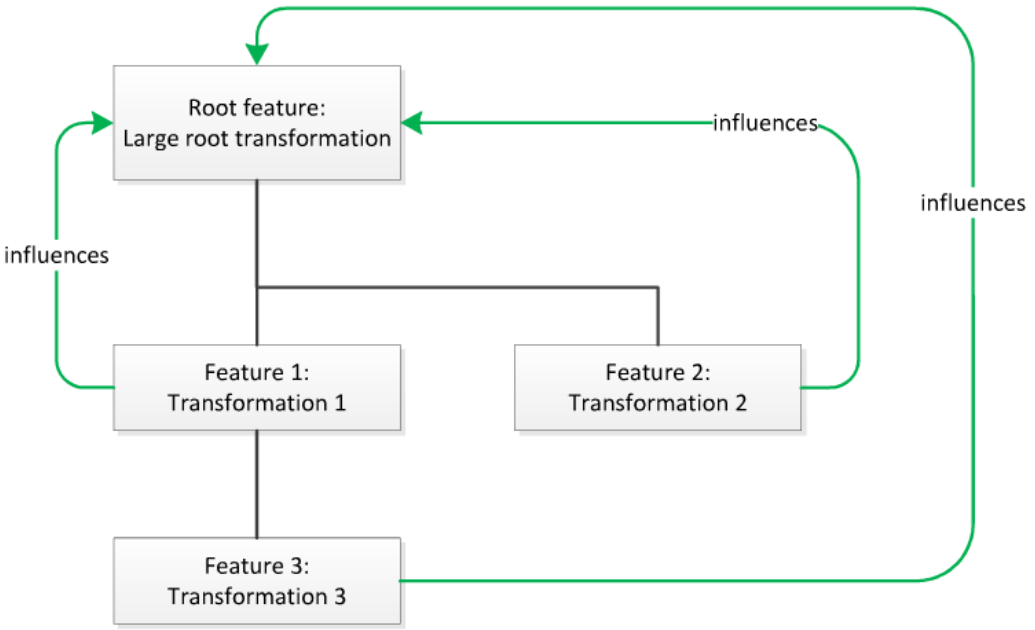
> Selecting a feature activates the corresponding transformation

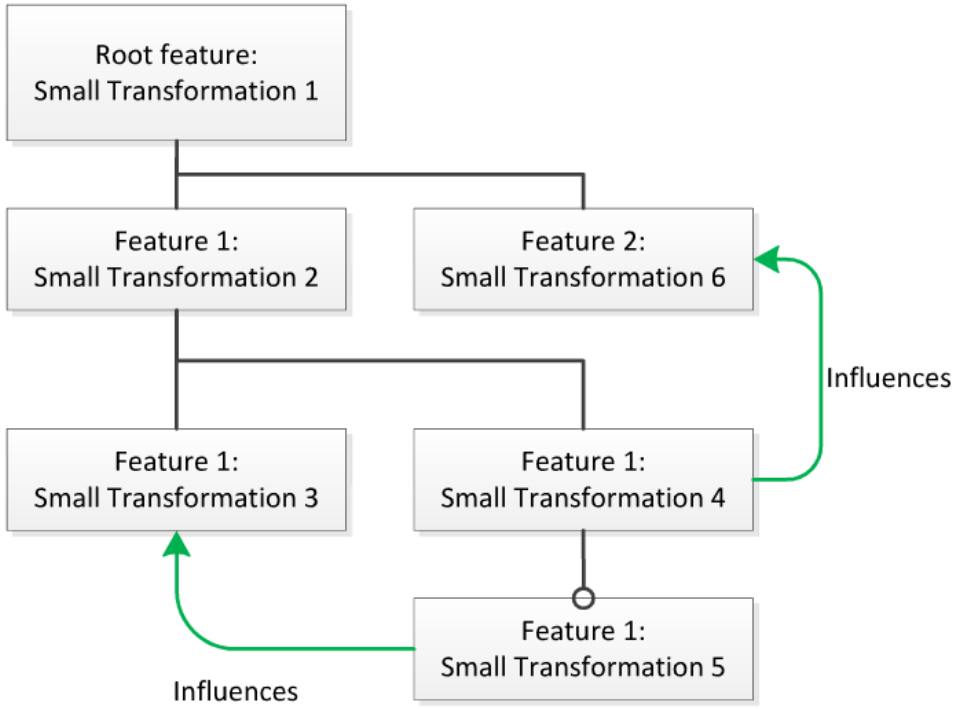
> A transformation can affect all code, including the other transformations

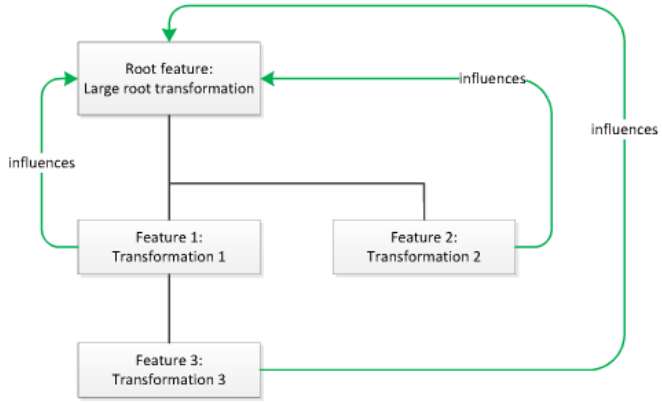
> Virtually, this is a distributed generator embedded into a feature model

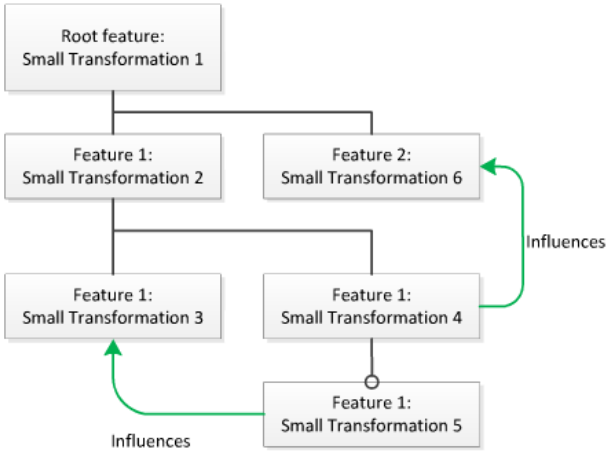
> The actual generator is then simple and generic

> This raises a number of issues...


Root feature:
Large root transformation
influences
influences
influences
Feature 1:
Transformation 1
Feature 2:
Transformation 2
Feature 3:
Transformation 3


Root feature:
Small Transformation 1
Feature 1:
Small Transformation 2
Feature 2:
Small Transformation 6
Influences
Feature 1:
Small Transformation 3
Feature 1:
Small Transformation 4
Feature 1:
Small Transformation 5
Influences





> Metatransformations

> Complexity of transformations

> Where to keep the transformations?

> One way is to attach them directly to the feature model that may conveniently be kept in the XML format

```
<feature>
  <feature>
    <transformation>
      <!-- Transformation information including
      the event chain, metatransformation
      information, requirements, etc. -->
    </transformation>
  </feature>
</feature>
```

> Another way is to keep only references to transformations in the feature model (this is what we did)

> The actual code of the transformations is in the corresponding files

```
<?xml version="1.0" encoding="utf-8" ?>
<featuremodel>
 <feature name="SimpleWeb" ID="1"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.CreateFolder"
FolderName="Site" >
   <feature name="StaticContent-History" ID="2"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.CreateStaticHTMLPage"
htmlContent="&lt;h1&gt;History&lt;/h1&gt;&lt;p&gt;Lorem Ipsum&lt;/p&gt;" htmlTitle="StaticPage- History" PageName="Site\\History.html" /
>
   <feature name="ContactPage" ID="3"

Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.CreateStaticHTMLPage_Cre
ateContact_Composite"
        street="Ulica 29. Augusta 4" city="Bratislava" Folder="Site"/>

   <feature name="DynamicContent-AccessLog" ID="4"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.DynamicContent"
htmlTitle="Dynamic page - Access log" PageName="Site\\log.html"/>
    <feature name="DynamicContentProvider" ID="5"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.Empty" >
     <feature name="ASP.Net" ID="7"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.ASP" />
    </feature>
    <feature name="DatabaseBackend" ID="6"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.Empty" >
     <feature name="MSSQL" ID="8"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.MSSQL" />
      <feature name="XML" ID="9"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.XML" />
    </feature>
   <feature name="MicroformatSupport" ID="10"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.MicroformatSupport"/>
   <feature name="CustomHTMLHeader" ID="11"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.CustomHtmlHeaders"/>
   <feature name="GeneratorDoc" ID="12"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.MetaDoc" />
 </feature>
</featuremodel>
```

Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.CreateStatic
ateContact_Composite"
        street="Ulica 29. Augusta 4" city="Bratislava" Folder="Site"/>

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Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.DynamicCon
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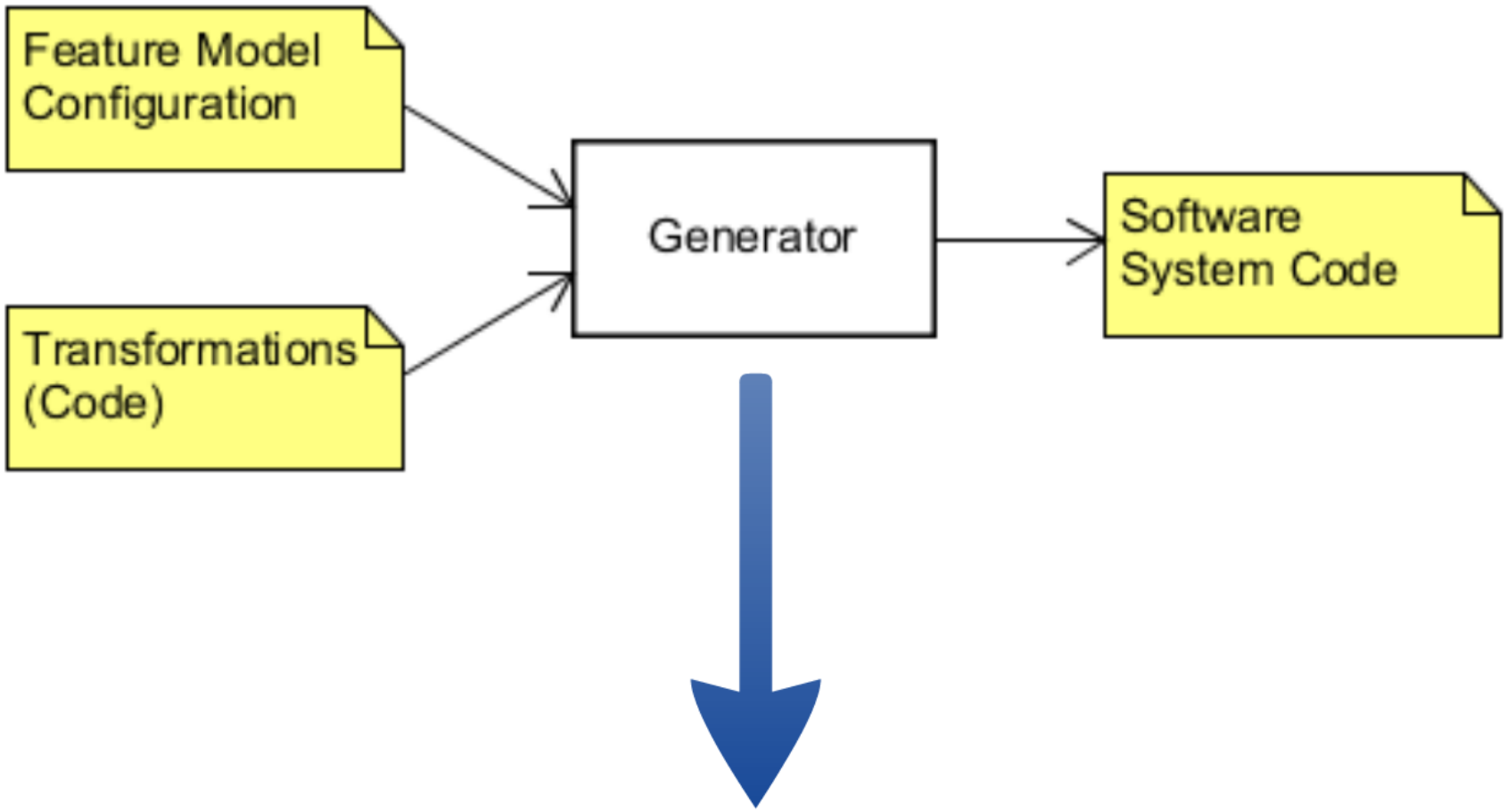
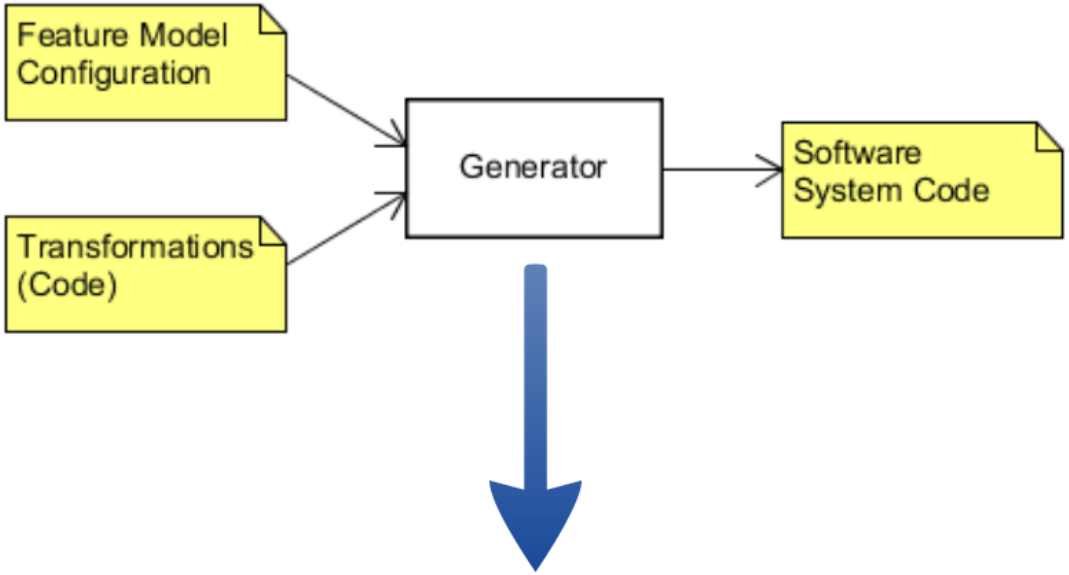
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.MSSQL" />
     <feature name="XML" ID="9"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.XML" />
    </feature>
  <feature name="MicroformatSupport" ID="10"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.Microformat
  <feature name="CustomHTMLHeader" ID="11"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.CustomHtml
  <feature name="GeneratorDoc" ID="12"
Transformation="org.crd.dp.CaseStudy.SimpleWebFinal,org.crd.dp.CaseStudy.SimpleWebFinal.Transformations.MetaDoc" />
 </feature>
</featuremodel>


Feature Model
Configuration
Transformations
(Code)
Generator
Software
System Code



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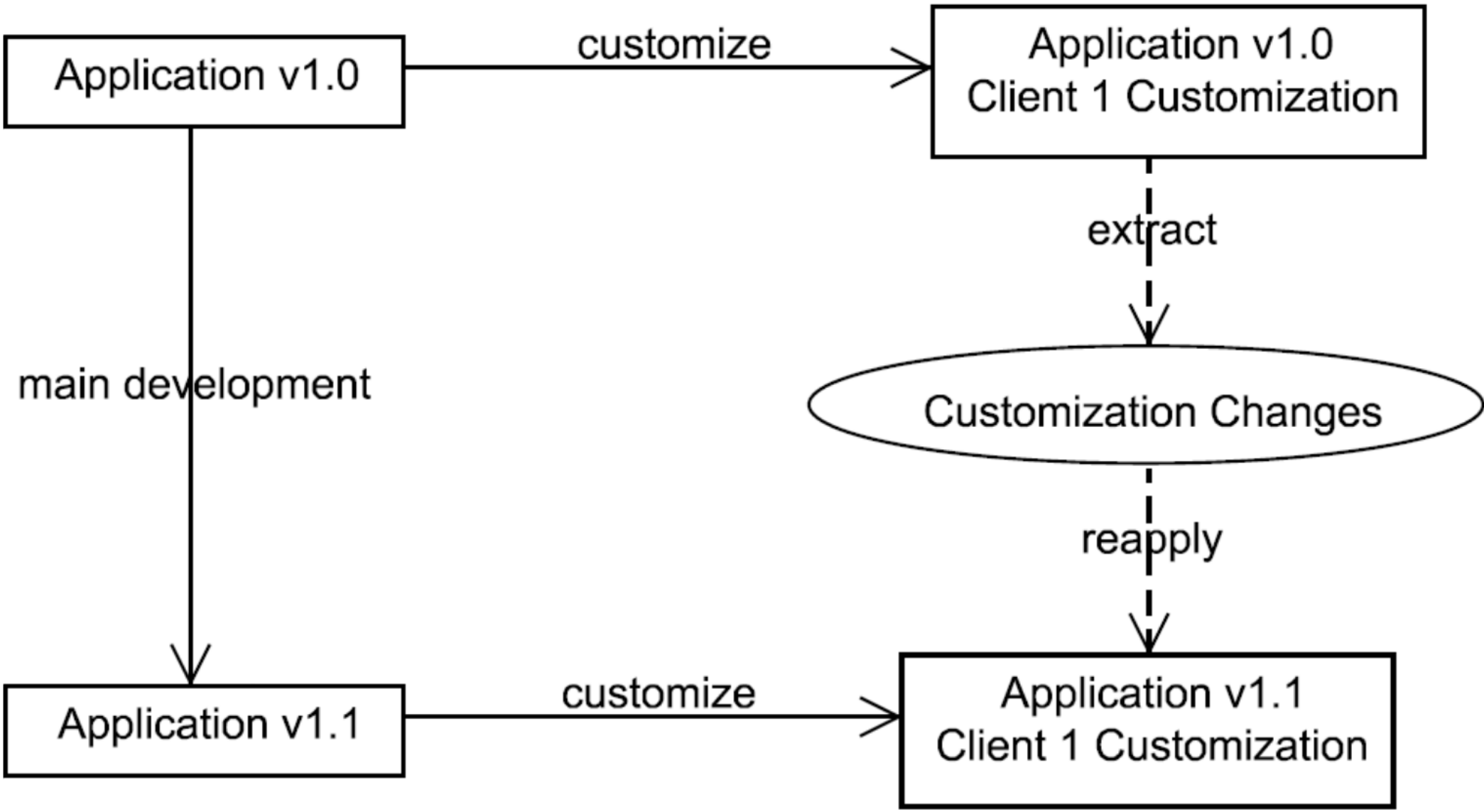
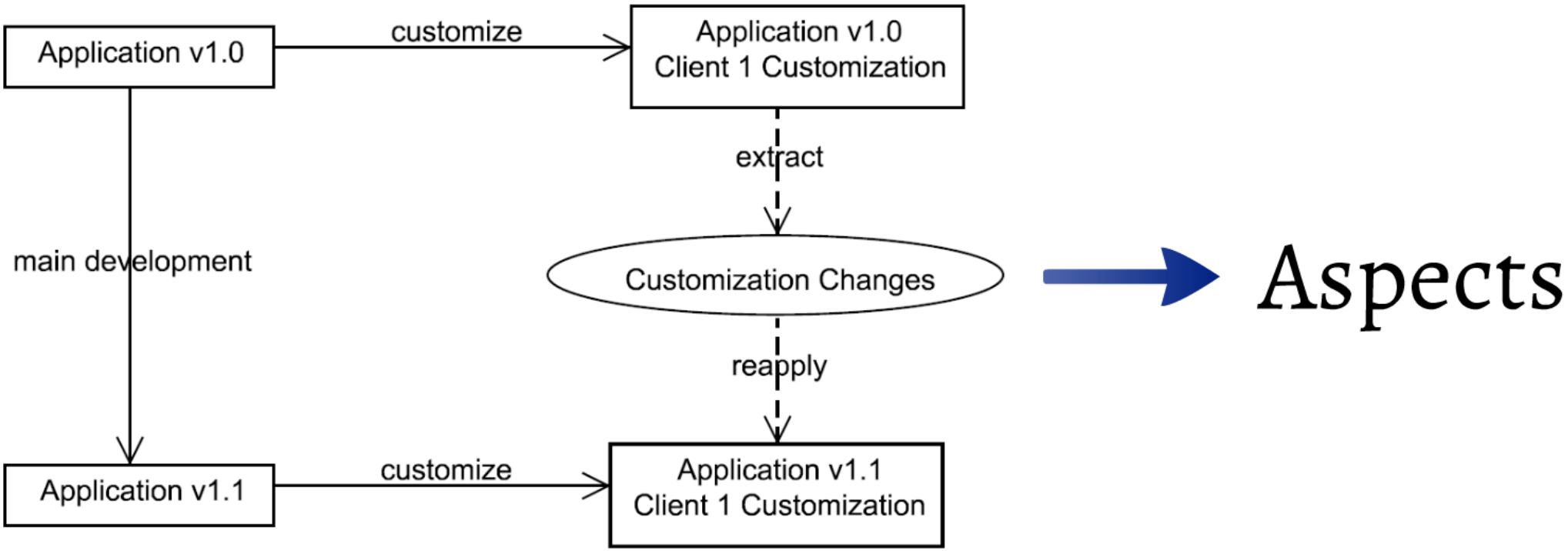
> Digression:

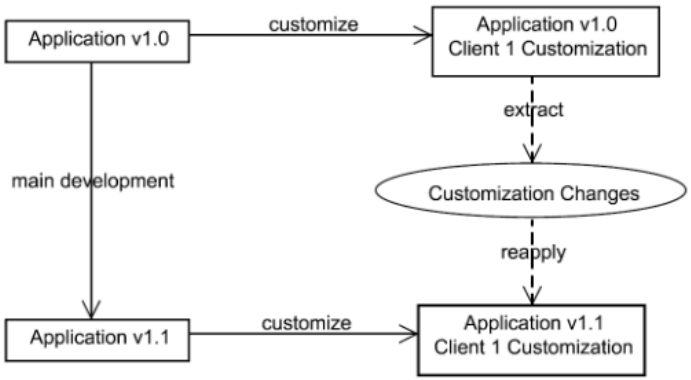
Transformations as changes

> Aspect-oriented change realization

V. Vranić. Aspect-Oriented Change Realization. Habilitation thesis, Slovak University of Technology in Bratislava, April 2010. http://fiit.sk/~vranic/pub/AOCR.pdf

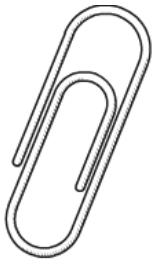

Application v1.0
customize
Application v1.0
Client 1 Customization
extract
main development
Customization Changes
reapply
Application v1.1
customize
Application v1.1
Client 1 Customization


Application v1.0
customize
Application v1.0
Client 1 Customization
extract
main development
Customization Changes
Aspects
reapply
Application v1.1
customize
Application v1.1
Client 1 Customization



Aspects

Features
Transformations



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