

An Executable and Changeable Reference Model for the Health Insurance Industry



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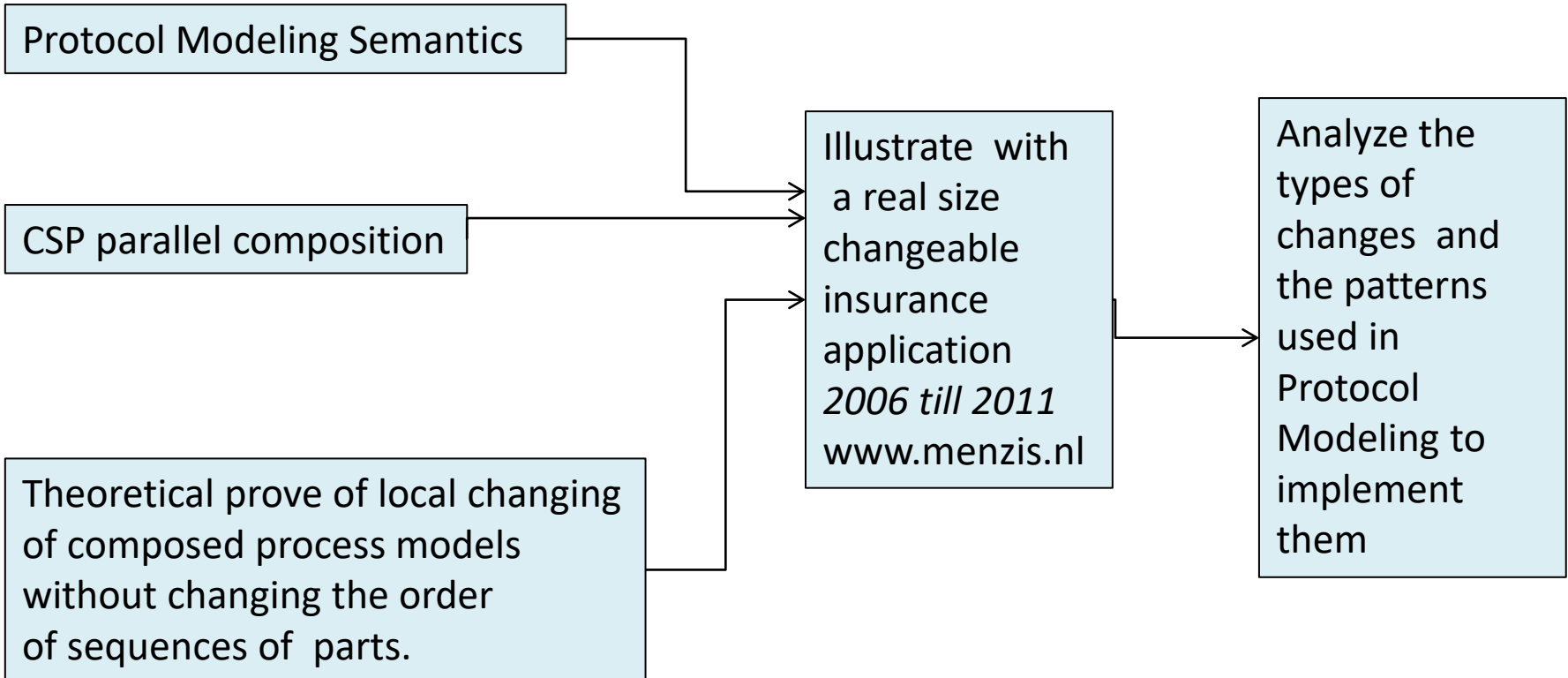
Outline

- Motivation
- Base Health Insurance in the Netherlands
- Protocol Model of the Base Health Insurance in 2006
- Analysis of changes introduced from 2006 till 2011
- Types of Model Modification
- Conclusion

Motivation

- Growing cost of the health care
- New rules and regulations are built into insurance applications every year
- **Stress for software developers**
- **Stress for consumers:** In 2011 eight percent of customers in the Netherlands were not satisfied with their insurances and decided to change their insurance provider
- **Growth of administrative costs for insurance business**

Model Idea

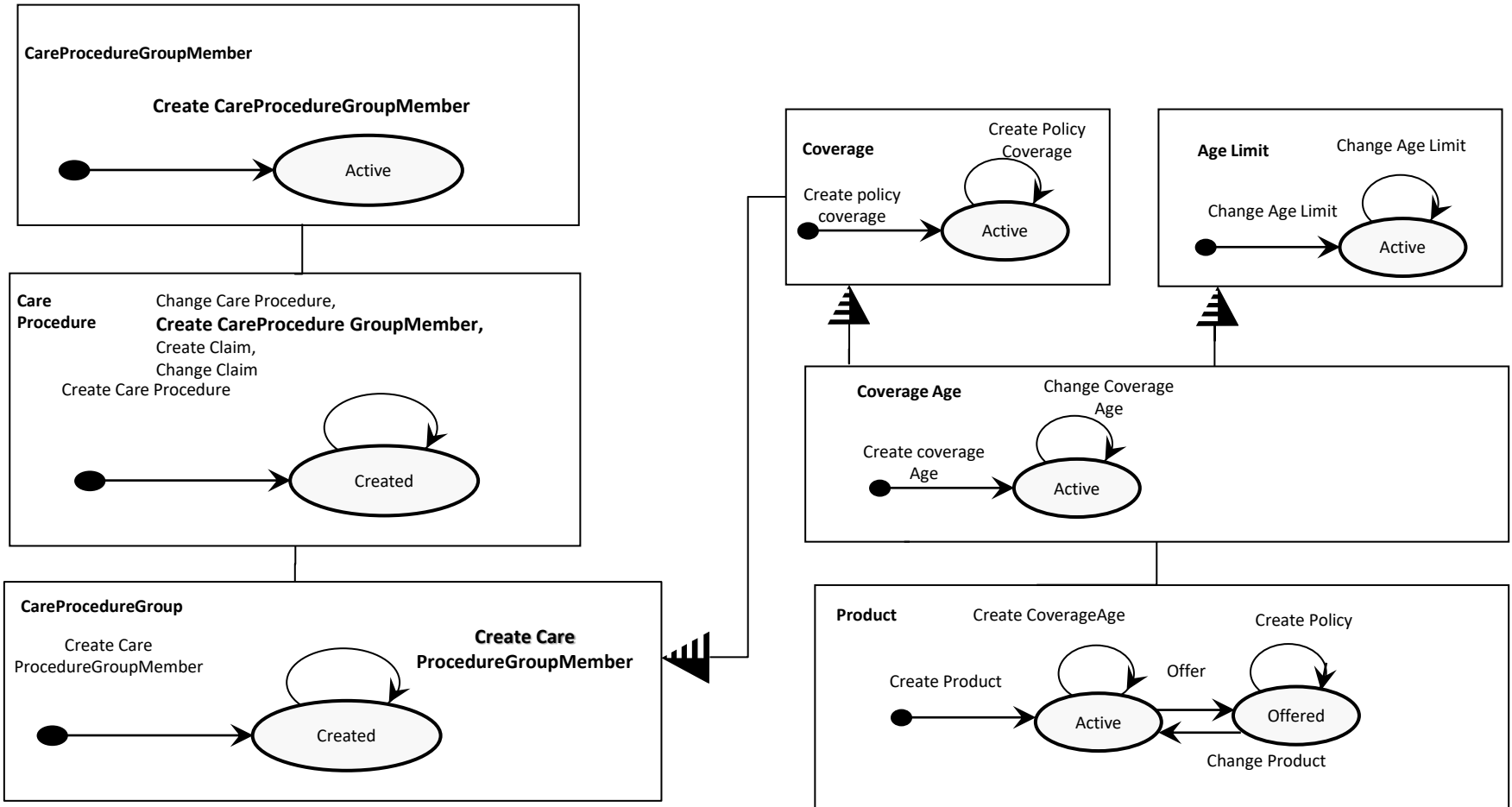


Sub-domains

Three sub-domains are relevant to annual changes of insurance products.

- The **Functional Management** domain concerns creating of new insurance products.
- The **Relation Management** domain presents registration of customers and buying policies.
- The **Member** domain presents handling claims of a policy owner taking into account the history of claim handling.

Functional Management



Data in the model

BEHAVIOUR AgeLimit

ATTRIBUTES Age From : Integer, Age To : Integer

STATES Created

TRANSITIONS @new * Change AgeLimit = Created,
Created * Change AgeLimit = Created

EVENT Change AgeLimit

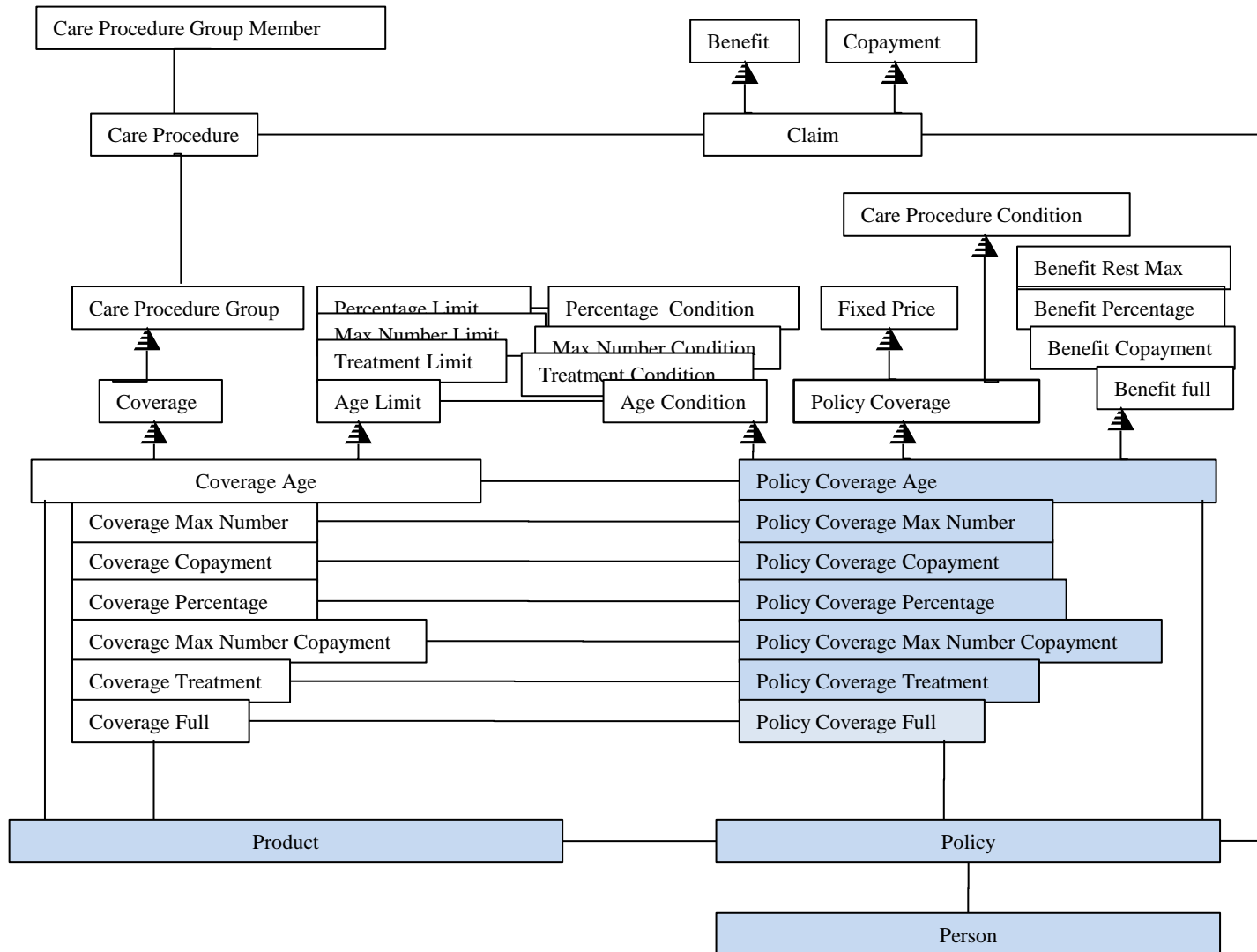
ATTRIBUTES

AgeLimit: AgeLimit, Age From: Integer, Age To: Integer

Model Validation

- From the metamodel the Modelscope tool generates the interface. This interface allows submitting events if the protocol model can accept them.
- If the model is correct then its execution in Modelscope supports interactive submission of events in the order presented in usecases.

Relation Management in the Structure of the Protocol Model of Base Health Insurance



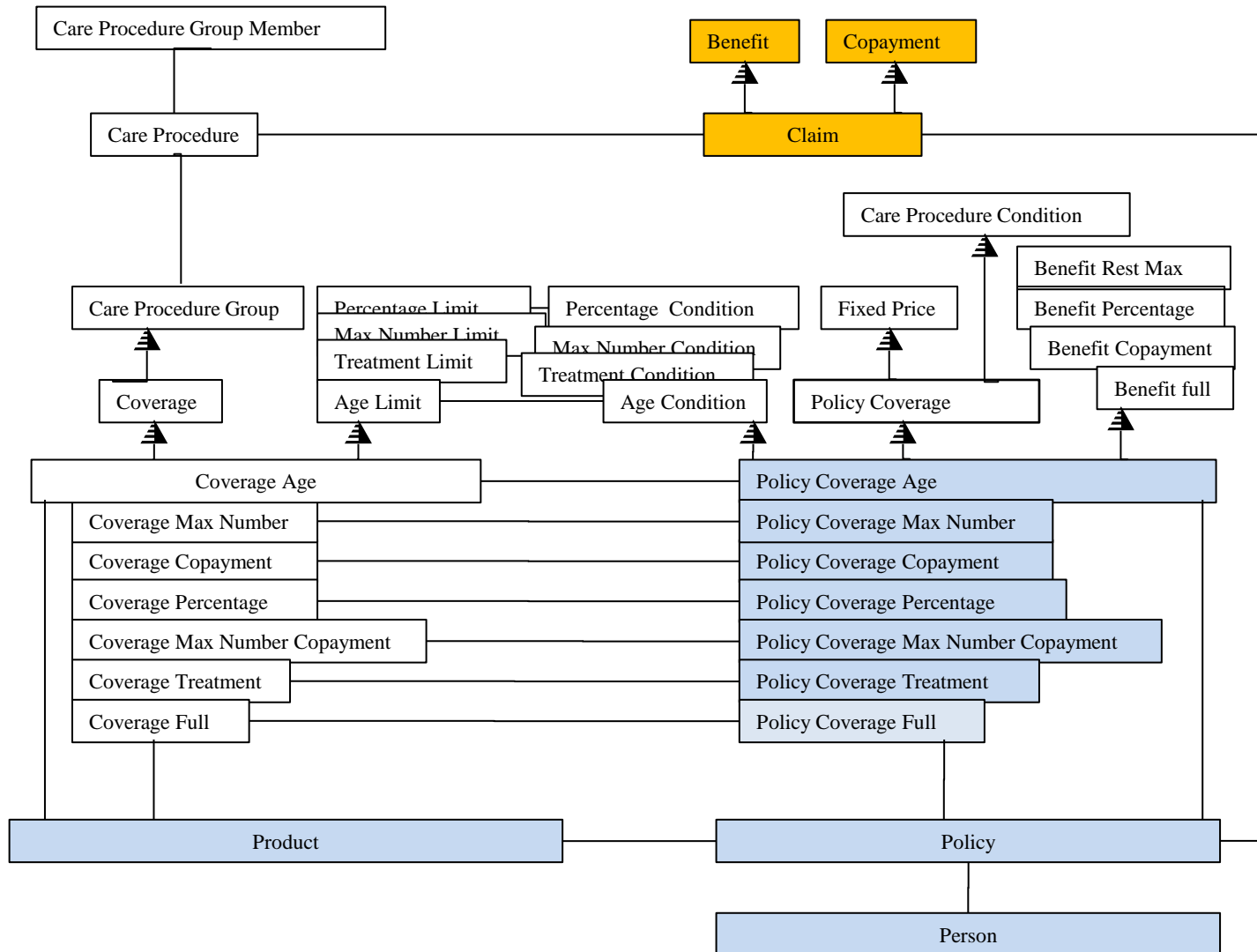
Relation Management

```
public class CreatePolicy extends Event {
    public void handleEvent() {
        this.submitToModel();

        Instance product = this.getInstance("Product");
        Instance policy=this.getInstance("Policy");

        Instance[] coverages = product.selectByRef("Coverage", "Product");
        for (Instance coverage: coverages) {
            //Generate a create policy coverage event
            objectType = coverage.getObjectType();
            Event event = this.createEvent("Create PolicyCoverage");
            event.setNewInstance("PolicyCoverage","Policy" + objectType);
            event.setInstance("Coverage", coverage);
            event.setInstance("Policy", policy);
            event.submitToModel();
        }
    }
}
```

“Member” in the Structure of the Protocol Model of Base Health Insurance



Member

Attribute	Description	Example
<i>Policy</i>	The policy used to claim.	123-456-789
<i>Customer Reference</i>	A label that Customer assigns to the claim	Dentist visit
<i>Care Procedure</i>	The received medical treatment	01/12002
<i>Number</i>	Number of units	2
<i>Service Date</i>	Date of medical treatment	1 februari 2011
<i>Treatment</i>	Sequence number of treatment	2

Model Structure

- *Product = C1, C2, C3..., Cn,*
- *Policy = PC1, PC2, PC3..., PCn,*
- *PCi = (CP, CN, B)*
- *CP = {cp1, cp2, cp3..., cpm} care procedures*
- *CN = {cn1, cn2, ...cnk},*
- *B ∈ BC is a benefit to be paid.*

BC = {full, full or the rest of Max, percentage, co-payment }

Changes 2006-2011

Year	Change in Covered Care Procedures		Condition Changed	Change in Benefit Calculation	Other change
	Coverage Added	Coverage Removed			
2007	Prenatal screening for congenital defects		First IVF treatment also covered		
	Abdominoplasty				Personal Budget for visual aids
2008	Mental Healthcare		Age limit for Birth Control removed	Mandatory Yearly Deductible	
			Dental Care age limit set to 21		
			Maximum number of hours maternity care increased with five.		
2009	Diagnosis and treatment of severe dyslexia	Lift Chair		Increase of Mandatory Yearly Deductible	
		Hypnotics and tranquilizers			
2010	Mandibular advancement devices	Mucolytic Agent Acetylcysteine	Organ transplantation outside EU	Increase of Mandatory Yearly Deductible	
2011		Durable Medical Equipment	Birth Control age limit set to 21		
		Simple extractions by oral surgeons	Dental Care age limit set to 18.		

Changes in covered care procedures and conditions

- *Occur every year.*
- Impact the initial settings of the model:
- Having events of types *Change Limit or Create CareProcedureGroupMember* are sufficient to make changes of these types without changing the model.

Change in calculation of benefits

- 2008 “mandatory deductible”
 1. *Deductible* into the Product object for changes of the Deduction Amount. $Product = \{C1, C2, C3..., Cn, D\}$. Machine *Deductible* includes the *AgeLimit* machine because deductible depends on the age of the insured person.
 2. *Policy Deductible* $Policy = \{PC1, PC2, PC3..., PCn, PD\}$
 3. Behaviour *Deductible Consumption* is added to the Member sub-domain for claim processing.

Policy Deductible

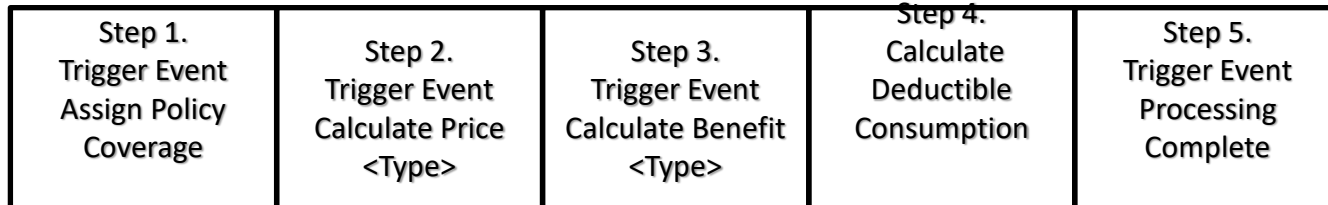
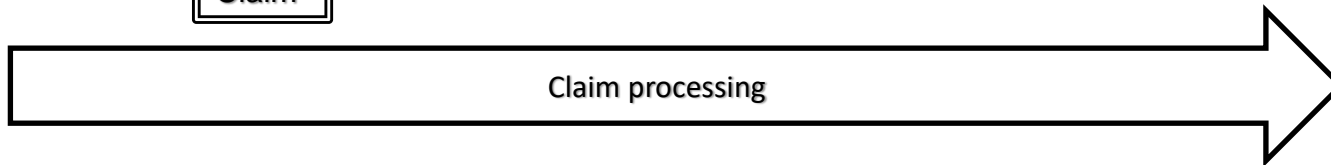
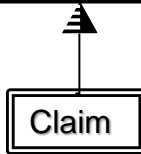
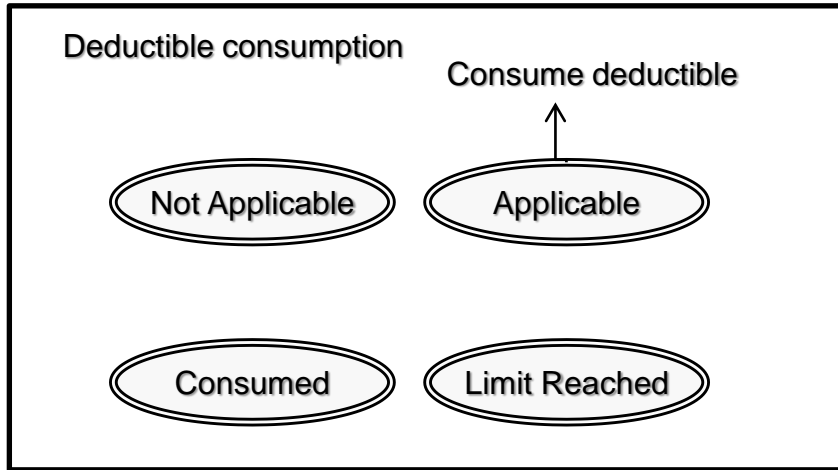
ATTRIBUTES

- **Deductible Amount:** the deductible amount applicable for the policy, depending on product and member age.
- **Consumed Amount:** the total consumed mandatory deductible of the policy, calculated as DeductibleConsumption. Deductible Amount of all claims of the policy.
- **Unconsumed Amount:**
Deductible Amount - ConsumedAmount.

A new derived attribute Reimbursed Amount is added to the claim machine:

$$\text{ReimbursedAmount} = \text{BenefitAmount} - \text{DeductibleAmount}.$$

Deductible Consumption



Change introducing new workflows

- 2007 “*personal budget for visual aids*” introduced a completely new workflow for a particular category of client.
- The personal budget is given to the client in advance and does not demand claim submission.
- This change is modelled as a pair of new protocol machines: one that sorts the clients and other that provides the *Personal Budget service*.

Conclusions

- The insurance case study shows that the changes of the model are implemented as new protocol machines, that are CSP || composed with other machines.
- The changes remain local for all real changes

Conclusions

- The result of the study is an executable and evolvable reference model of the Health Insurance Applications that combines the types of Insurance Products available at the moment:
 - abstract,
 - technology independent,
 - represents entities, relationships and business processes,
 - embodies the basic goals and ideas of insuranceApplications.