rmAgro

Linked Open Data in Agriculture,
September 27-28th 2017, Berlin, Germany.

daan Goense. ( daan@pragmaas.com )
Daan Goense

- Retired from Wageningen University & Research (WUR)
- Research in Farm Machinery Management, Precision Agriculture and ICT in Agriculture.
- Consultant under the name Pragmaas.
- Hired by WUR to maintain the reference model for agriculture
Already 30 years efforts to standardise data communication in agriculture

- 1984: A project to stimulate information technology in the Netherlands.
- 1987: Ad hoc Arbeitsgruppe Busch-Schnittstelle
- 1991; ISO/TC23/SC19
- 2000: AgroXML (D), EDAPLOS (F)
- ...

Now:

- AgroConnect (NL)
- UNCEFACT (International)
- AgGateway (USA → International)
## Technologies vary during time

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMOT:</td>
<td>relational database &amp; process</td>
</tr>
<tr>
<td>EDI-Teelt 1-3:</td>
<td>ADIS – Edifact - XML</td>
</tr>
<tr>
<td>CIA:</td>
<td>Object Orientation</td>
</tr>
<tr>
<td>ISO11783-part10:</td>
<td>(ADIS) - XML</td>
</tr>
<tr>
<td>AgroXML:</td>
<td>XML</td>
</tr>
<tr>
<td>EDAPLOS → UNCEFACT:</td>
<td>XML</td>
</tr>
<tr>
<td>EDI-Teelt 4:</td>
<td>XML</td>
</tr>
<tr>
<td>drmCrop → EDI_Teelt4:</td>
<td>domain (Object Orientation) → XML</td>
</tr>
<tr>
<td>AgroXML -&gt; AgroRDF</td>
<td>XML → RDF</td>
</tr>
<tr>
<td>ADAPT:</td>
<td>API / Plugin in C#</td>
</tr>
</tbody>
</table>
What triggered rmCrop?

- Change in technologies over time. (ADIS, (EDIFACT), XML, JSON, API, RDF)
  - Domain reference model should be independent from implementations.
- Additional scopes in crop production.
  - Precision Agriculture, Guidance, Tracking and tracing, etc.

- One common basis that defines the whole Crop Production Domain.
Why change to rmAgro?

- Other branches of agriculture **share objects** with crop production.
- **Share applications** like tracking and tracing.
- There are **mixed farm enterprises** (Crop production and animal production) where resources are shared.

→ **rmCrop → rmAgro**
  - Include Greenhouse production, Animal husbandry
  - **rmAgro is a project in progress**
    - Identify common classes
    - Add classes from other branches of agriculture
  - Nieuwe inzichten
What are sources for rmAgro

- Informatie model open teelten.
- ISO11783-10
- AgroXML
- Edaplos
- Data dictionary for plant protection products
- Dutch class model for fertilizers
- Frugicom (Horticulture)
- INSPIRE
- Dutch software houses and users of data
- Research projects from Wageningen UR
  - Crop growth models, scheduling of farm operations
- and recently ADAPT

we think we might cover quite some requirements
rmAgro; a model suite in EA

- **Business Process Model** *(BPMN)*, mainly for FIspace
- **Use case** model, mainly for ISO/TC23/SC19WG5
- Domain Reference Model *(drmAgro)*
- **Dynamic view** *(sequence diagrams)* for Fispace and Edi-Teelt
- **DDL model** *(transformed from drmAgro)*
- External models *(ISO19107, Fertilizer, Crop Protection)*
- External Informative XSD’s *(ISO11783, AgroXML)*
- External Used XSD’s *(XSD,GML,GMLCOV,SWE,UDT/UNCEFACT)*
- **Java Model** *(interface model & implementation model transformed from drmAgro)*
- Mapping *(drmAgro/drmCrop to other models)*
- **WSDL** *(defines messages for FISpace and Edi-Teelt)*
- **XSD model** *(transformed from drmAgro)*
- **ORF model** *(In development, transformed from drmAgro)*
Base is a Platform Independent Model (PIM)
rmAgro; a model suite in EA

- **Business Process Model (BPMN)**, mainly for **FISpace**
- **Use case model**, mainly for ISO/TC23/SC19WG5
- **Domain Reference Model (drmAgro)**
- **Dynamic view** (sequence diagrams for Fispace and Edi-Teelt)
- **DDL model** (transformed from drmAgro)
- **External models** (ISO19107, Fertilizer, Crop Protection)
- **External Informative XSD’s** (ISO11783, AgroXML)
- **External Used XSD’s** (XSD,GML,GMLCOV,SWE,UDT/UNCEFACT)
- **Java Model** (interface model & implementation model transformed from drmAgro)
- **Mapping** (drmAgro/drmCrop to other models)
- **WSDL** (defines messages for FISpace and Edi-Teelt)
- **XSD model** (transformed from drmAgro)
- **ORF model** (In development, transformed from drmAgro)
Modelling conventions for the domain model drmAgro

- It is a platform (computation) independent model!
- No id’s or keys, except for global identifiers as attributes.
- No foreign keys.
- Generic datatypes (*no language specific datatypes*)
- Many to many relations stay as they are, no association class (*except when it has attributes*)
Naming conventions used in drmAgro

- Camel based names for classes (i.e. `CropField`) and attributes (`CropYear`)

- **Type** is only used for data types!
  - Not for classification of objects!
  - *Use Classification or Category or Group, etc.*

- Designator in stead of Name. (from ISO11783)
Starting points

- Use existing standards when appropriate
  - ISO19107 and GML
  - SensorML
  - GMLCOV
  - UNCEFACT Unqualified Data Types
    - CodeType
    - IdentifierType
Some aspects that require(d) attention (1)

- **A class ↔ data type.**
  - When the object can be identified by the value of its attributes and needs no identifier, it is a data-type.

- **Enumerations ↔ Coding tables**
  - Be aware that a change in an enumeration list requires recompiling of code.

- **CodingList ↔ IdentifierList**
  - UNCEFACT differentiates between them, but when to use what is not always clear.
Some aspects that require attention (2)

**Identifiers**
- Initially only a Global Unique Identifier based on ISO15459 in the Netherlands
- ➔ generic Identifier based on UNCEFACT

**Level of abstraction**
- When to use a subclass?
Example of a **too** abstract class

- **DeviceElement** in ISO11783 stands for all functional components of an implement.
  - Bin
  - Section
  - Nozzle
  - Valve
  - Etc......

- *When is the reciprocal relation valid?*
Level of abstraction

- When to use a subclass?
  - As soon as one has to specify for which types of a class a relation to another class is valid, the class is too abstract.
Geografic information

- ISO19107 and GML
  - ISO19107 is an interface model
  - GML is an XML model based on ISO19107
    - There is no common, platform independent, model!
    - GML deviates sometimes from ISO19107
      - Polygon has boundary in ISO, not in GLM
      - Gridpoint does not exist in GLM
  - Geometries in the reference model are not transformed. For the XML model use GML. For the (Java) Interface Model use ISO19107.
Region specific attributes

- Ackerzahl in Germany
- Regulatory soil type in the Netherlands
- EPA number in the USA

- A country specific package where country specific classes are a sub-class from the class in the main package
Example of Region specific attribute

class drmCrop_NL

- CropField
  - RegulatorySoilType: RegulatorySoilTypeCodeEnumeration
  - Plot

  drmCrop::CropField
  - Status: StatusEnumeration
  - CropYear: Integer
  - CropSeason: String
  - Organic: Boolean [0..1]
  - CropProductionSequence: CroppingSequenceEnumeration [0..1]
  - CropProductionPeriodCode: CodeType
  - GrowthEnvironmentCode: CodeType
  - LocationDesignator: String

  ProductionType
  - ProductionTypeCode: CodeType
  - ProductionTypeDesignator: String

  0..*

  1

CropField
  - RegulatorySoilType: RegulatorySoilTypeCodeEnumeration
Structure of the domain model (1)

- drmAgro
  - DataTypes
  - Enumerations
  - Geometries (→ GML and GMLCOV or → ISO19107)
  - SWE types (→ SWE)
    - DataArrayType
  - XSD types (→ XMLSchema)
    - token, ncName, anyURI
  - ............
Structure of the domain model (2)

- drmAgro
  - ............
  - *All common classes* (i.e. Party, Organization, ..)
  - ....
  - ....
  - drmCrop
  - drmAnimal
  - drmGreenHouse
  - drmInfrastructure (yards, trees, roads, etc)
  - drmPostharvest
  - *(drmStyleGuide)*
In drmCrop

- drmCrop_NL
- ISO11783
  - DeviceClass
  - DeviceElement
  - ECU
  - ImplementECU
  - TaskController
Diagrams for different scopes of the model
Example for Batch
All classes have definitions, evt. remarks and examples

**Definition.**
*CropField* describes the continuous surface of land which is used during a period of time by a certain *CropProductionUnit*.

**Remark.**
The surface of the *CropField* is always within the borders of a Field.

As a *CropProductionUnit* applies to only one *CropType*, a *CropField* is grown by one *CropType*.

It is the farmer who decides when to split up to different *CropFields*. That can be a different *Variety*, a different purpose for which the crop is grown, a different class in seed production, the need to keep it separate for tracking and tracing purposes etc.
Background information

- rmAgroGuideline.docx (on the ftp server)

- Describes
  - Structure of the model suite
  - Modelling and naming conventions
  - Issues
  - Design patterns
Scopes covered by drmAgro

- **Parties**
  - Party, Organization, Person, Department, Farm, etc.

- **Fields**
  - Plot, Field, CropField, ActivityField, KadastralField

- **Activities on the farm**
  - Job, Task, Operation

- **Data processing**
  - DataSet, DataAggregation, Algorithm, DataProcess
Scopes covered by drmAgro (2)

- **Handling of products and produce**
  - ProductAllocation, Product, Batch, TreatmentZone

- **Sampling and analyses**
  - Sample, Analyses, PropertyValue, Laboratory, Container, VerticalLayer

- **CropRecording**
  - CropProductionUnit, CropField, Operation, AbsoluteTiming, CulturalPractise, OperationTechnique, SpatialDataset, ProductAllocation, TreatmentZone, Batch, etc.
Scopes covered by drmAgro (3)

- **Farm machinery**
  - Equipment, Implement, Tractor, ManMachineSystem

- **Ordering**
  - Order, OrderItem, Delivery, Invoice, Customer, Supplier

- **Product composition**
  - Product, ProductAllocation, Batch, ProductElement
Availability of the model

- **rmAgro snapshot:**
  ftp://pragmaas.com/rmCrop/rmAgro_SNAPSHOT/
  (Fails sometimes for dubious reasons)

- Enterprise Architect model
- Description of background as word document.
- Read only version of Enterprise Architect
Use of drmAgro/drmCrop as reference for

- EDI_Teelt messages (SOAP – XML based web services)
  - CropField data to the Dutch government
  - CropField data to advisors
  - Recommendations from advisors to FMIS
  - Orders from farmers to contractors
  - CropField records to processors

- UNCEFACT messages
  - Conversion to UNCEFACT naming conventions.
  - Crop and produce data to processors (Greenhouse)
  - Sample data to laboratories
  - Laboratory results
Coding tables

- CropClasses (3x)
- OperationTechniques
- CulturalPractises
- Products
  - CropProtectionProducts
  - Nutrients
- Produce
- Weather variables

- Between 50 and 100 coding lists
Coding tables & Identifier lists

- Leave that **as much as possible** to the authorities who can be made responsible for that.

- CropClasses (3x) → ??? Breeders ????
- OperationTechniques AEF ???
- CulturalPractises ????
- Products
  - CropProtectionProducts → Legislative Authorities
  - Nutrients → ??? Fertilizer industry ???
- Produce → GS1
- Weather variables → WMO
- Physical and Chemical soil variables → Soil science society
Is it ready?

- **No!** And it never will be!

- There are several loose ends
  - One is only sure when it is successfully implemented
    - Some parts are!

- There are issues to solve
  - When generating the XML model, Choice/SelectionOff is not separated as element yet.