

Reference ontology and framework for mass customization

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Related Paper: Giovannini Antonio, Aubry Alexis, Panetto Hervé, El Haouzi-Bril Hind, Pierrel Ludovic, Dassisti Michele.

Approach for the Rationalisation of Product Lines Variety.

IFAC World Congress, Cape Town, South Africa (2014).

Agenda

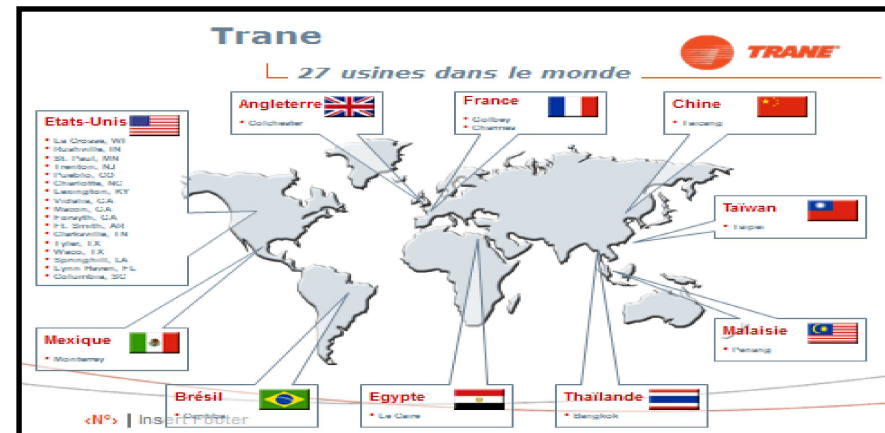
- 1. Problem statement**
2. Research questions
3. Research work
4. Expected results

Problem statement (1/2): **Trane introduction**

- Trane designs, manufactures and sells **customisable** air heating and cooling systems



- The focus is on the configuration system



Trane configuration system

1. 1 customer → N product variants

- Too much variety? Which one is the best? The “right” level of variety?

2. ETO for each “special” order

- Really needed?

3. Customer & processes heterogeneity

- How to model the product?

4. Dynamism of the network

- Can the model be flexible?

Problem statement (3/3):

effect of product variety issues

- ***Too much (+) product variety* →**
 - More complexity in manufacturing, scheduling, planning systems
 - Customer confusion
- ***Not enough (-) product variety* →**
 - Less added value vis-à-vis the customers
 - Competition risk

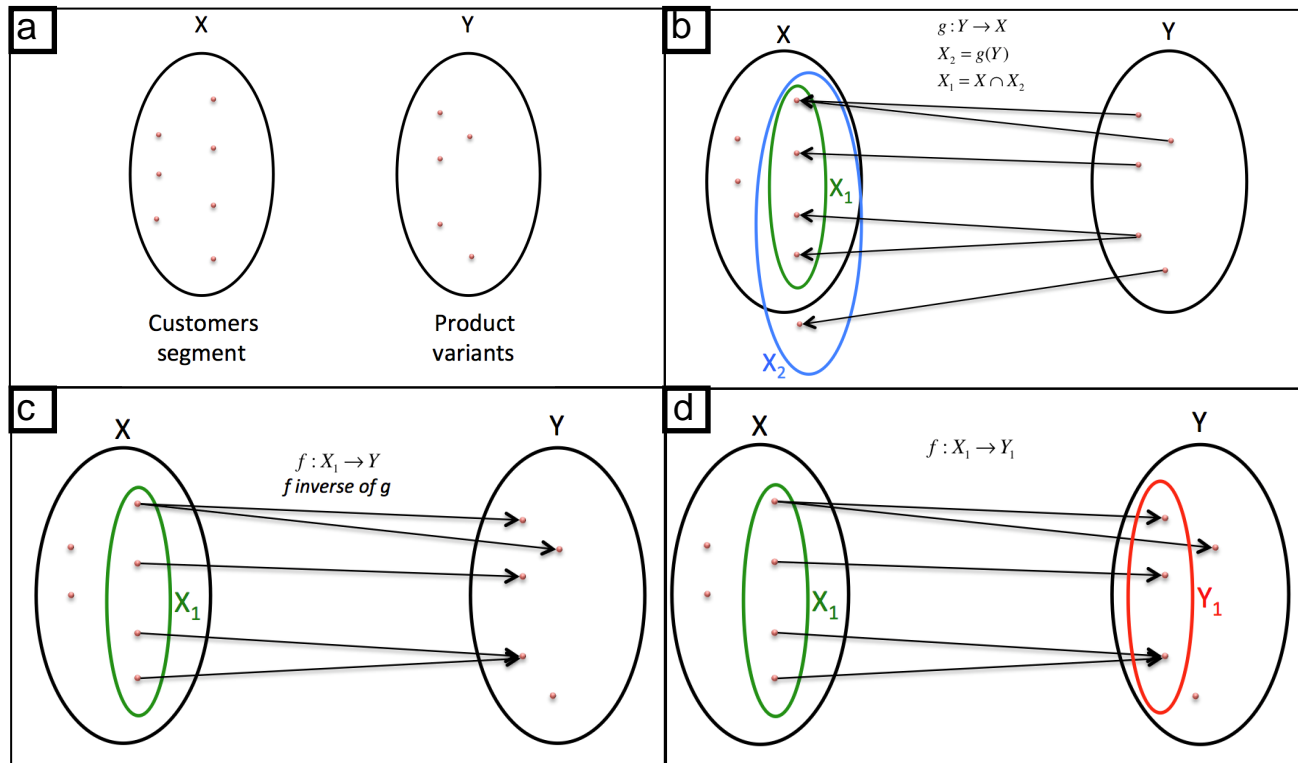
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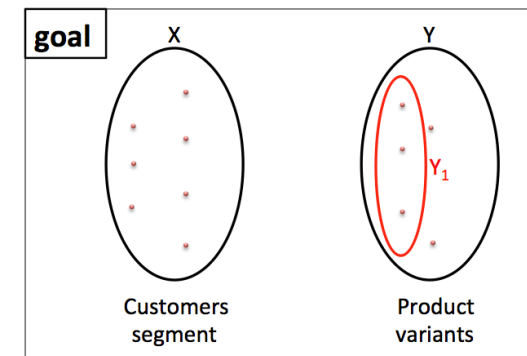
Research questions (1):
Scientific context

- Mass Customization (*Davis, 1987*)
- Variety management (*El Maraghy et al., 2013*)
- Product families design (*Simpson et al., 2006*)

Research questions (2): the *right variety*

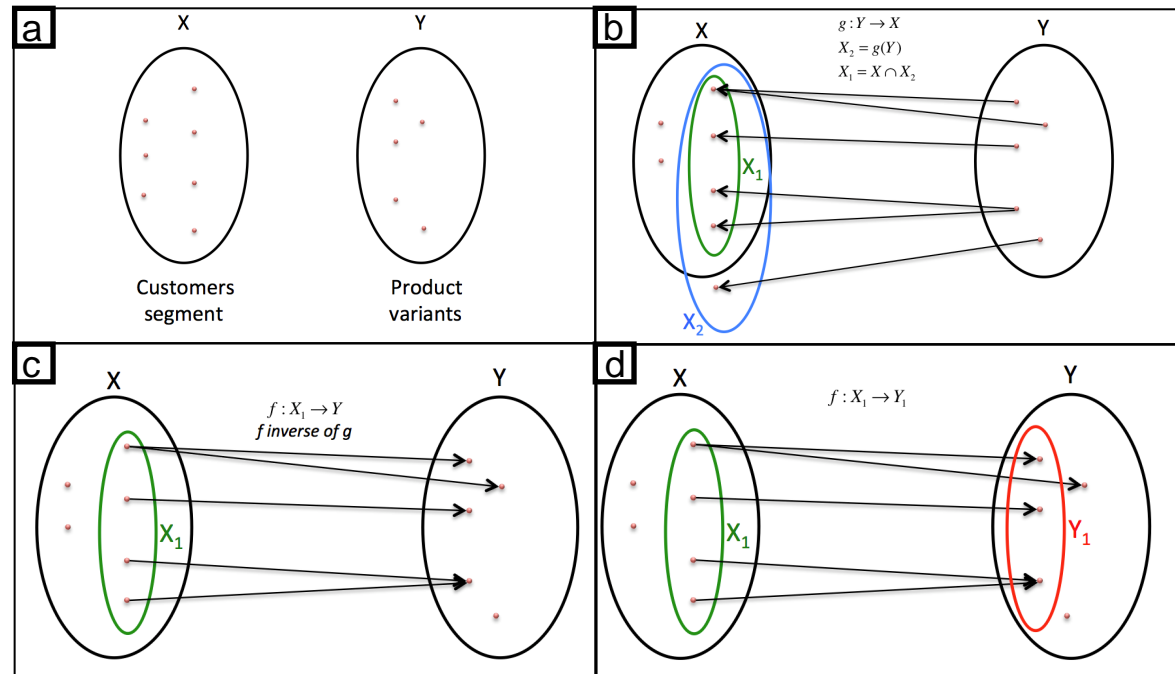


- X : customers we want to fulfill
- X_2 : customers we are able to fulfill
- X_1 : domain of the configuration function f
- **Y_1 : right variety**



Research questions (3): **modeling issues**

- How to find Y_1 ?
- How to model X , Y , f and g ?



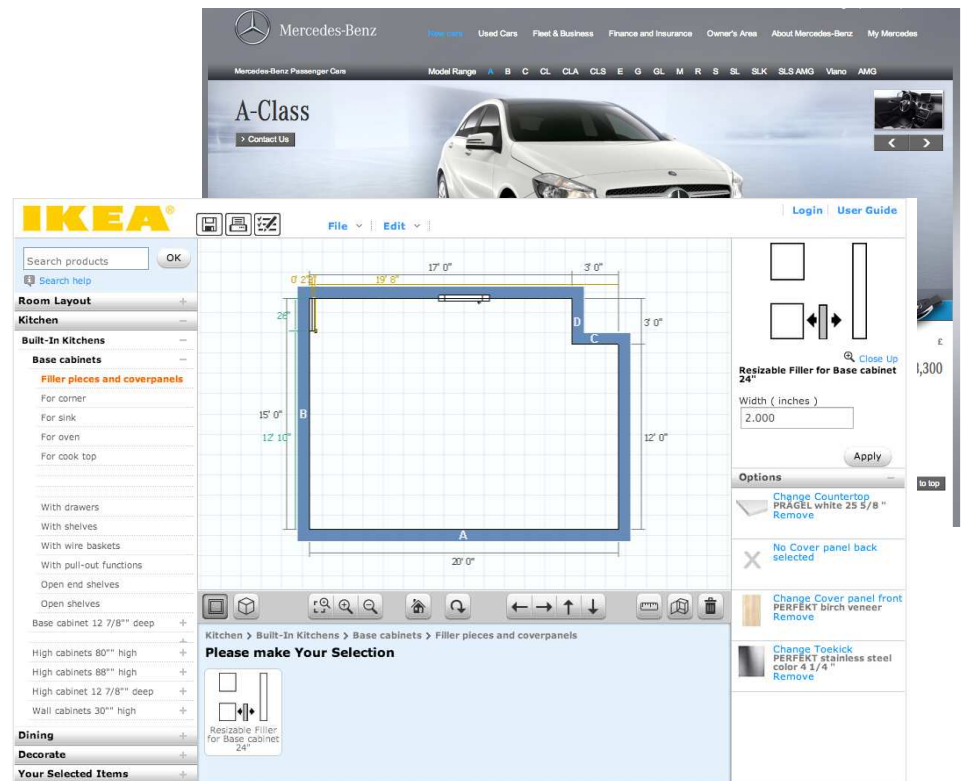
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Research work (1): product variety (set Y) in literature

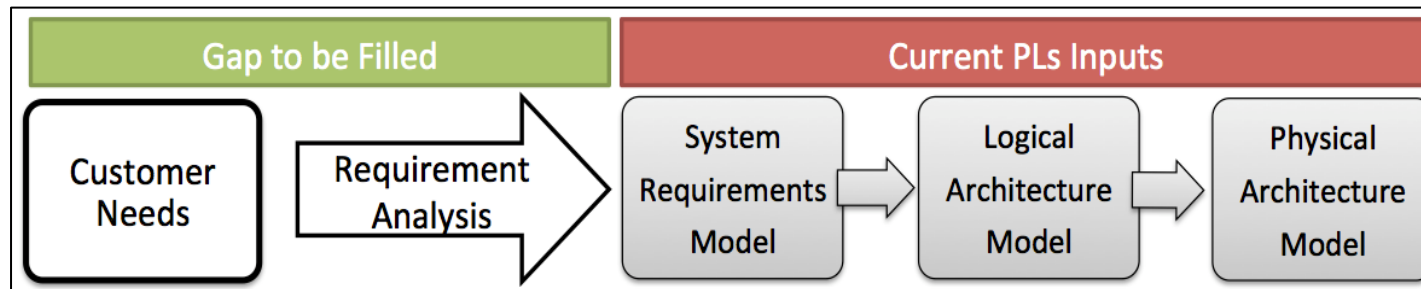
- Product families (and / or lines, platforms) are **parametric models** describing the product variety

- **parameters** are
 - Product functions
 - Product specifications
 - Components specifications
- Used for **prod configuration**



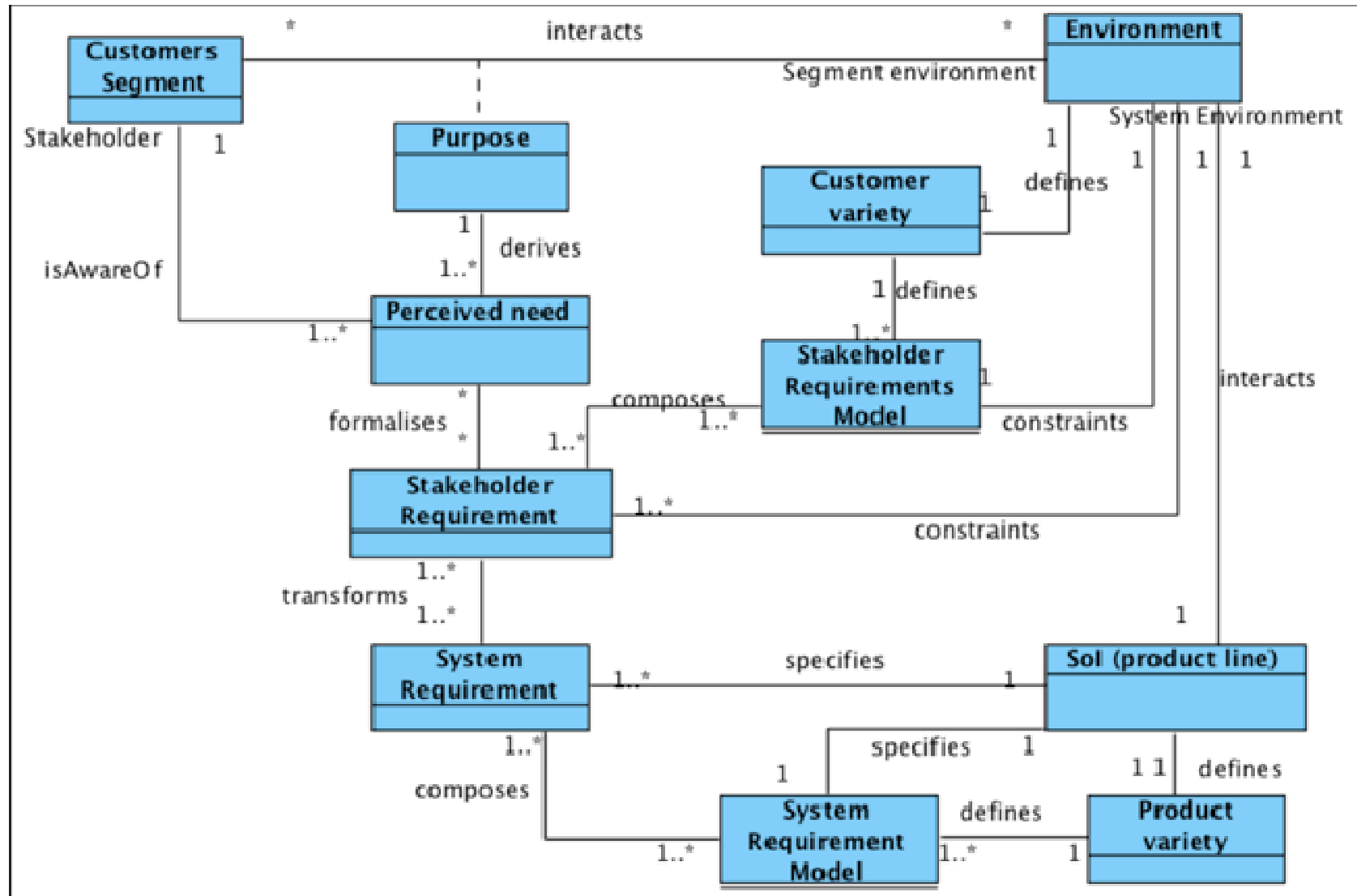
Research work (2):
customer variety (set X) in literature

- Current configuration systems do not represent the set X



- Most engineering approach are based on QFD
 - No consistent model of the customer
- **System engineering (SE) → defines a consistent model of the customer (but not the variety)**

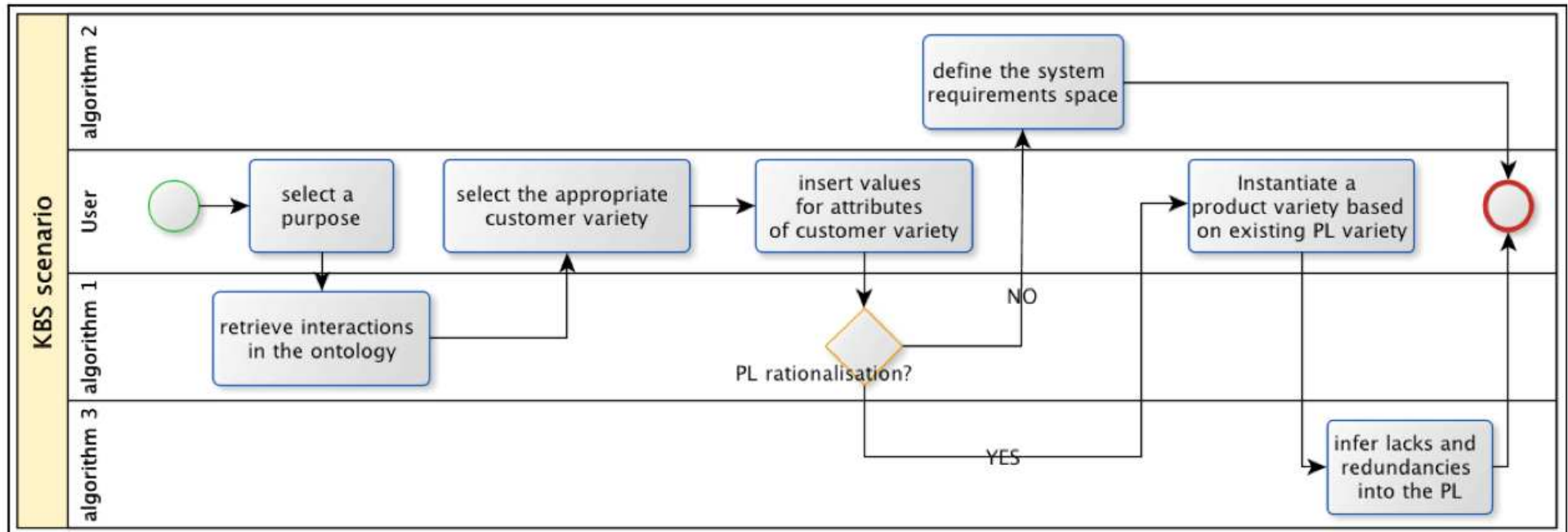
Ontology for mass customisation



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Expected results (2): KBS for PL definition

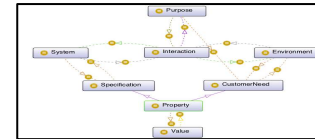


- Ontology for formalising $X \leftrightarrow Y$ knowledge
- Algorithm 1 for retrieving the knowledge
- Users for describing X,Y costs and PL purpose
- Algorithm 2 and 3 for formalising the mathematical problem

Our vision: needs2specs (1/2)

Formalise the link between customer needs and technical domain

- Ontology of terms from cybernetics/system theory



Method for product line design

- Variety rationalisation
- Innovation discovery
- Customer-oriented configuration

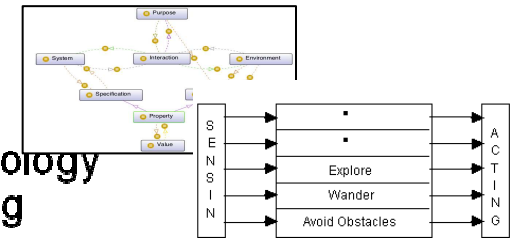
industrial case : fan-coils product line



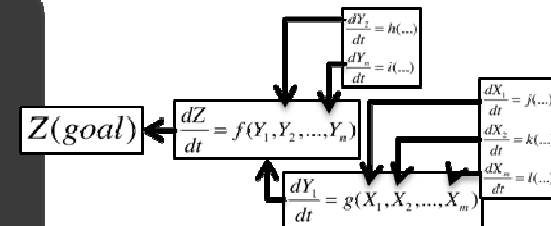
Our vision: needs2manufacturing (2/2)

Formalise the link between customer needs and manufacturing process variants

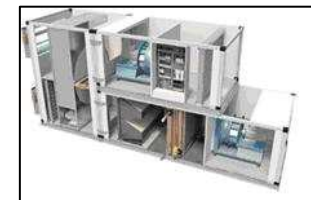
- Extending the ontology with manufacturing domain



Method for product line design in enterprise network



Application on *multinational product*





...remarks, questions?

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