# Enterprises as model-driven systems

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# My research interests

The science, practice, and art of domain modelling

In particular: model-driven systems in an enterprise context

*Return on Modelling Effort (RoME)*

# Agenda

- Enterprises & models
- Models in enterprises
- Models & enterprises in the digital age

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- Enterprises & models
- Models in enterprises
- Models & enterprises in the digital age

# What is an enterprise?

Companies

voestalpine

ING

Universities

TU WIEN

UNIVERSITÉ DU LUXEMBOURG

Agencies

EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH

ABA Invest in Austria

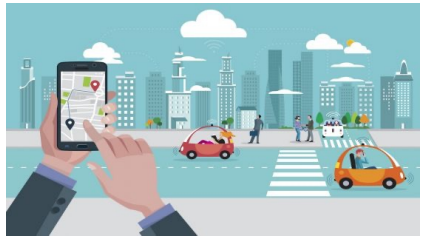
A purpose-driven system

The purpose being its enterprise

Factories

Logistics networks

Mobility networks




Hospitals

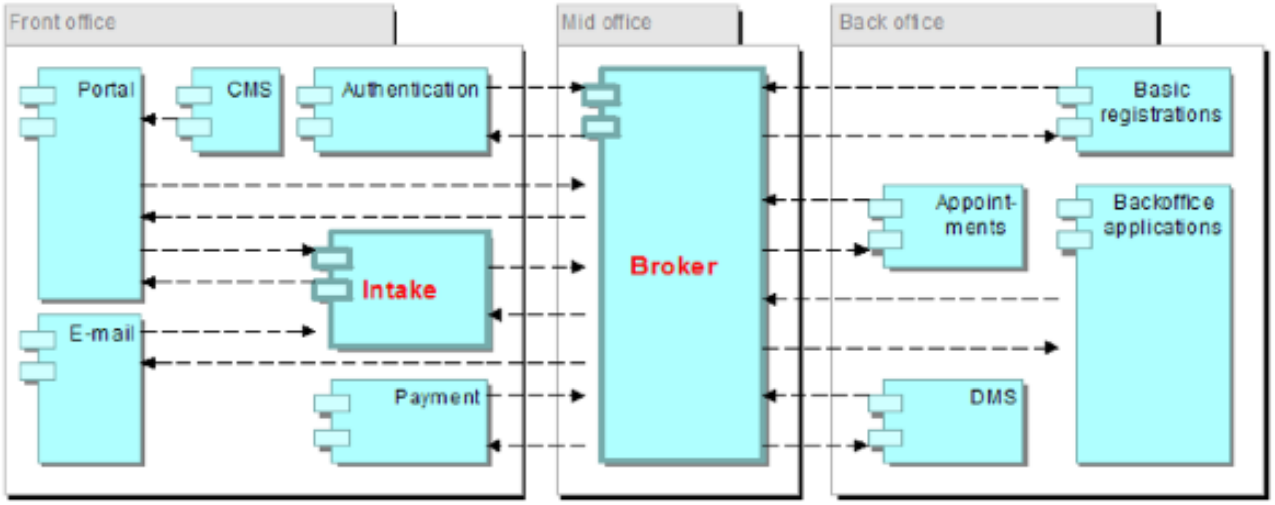
# What is a model?

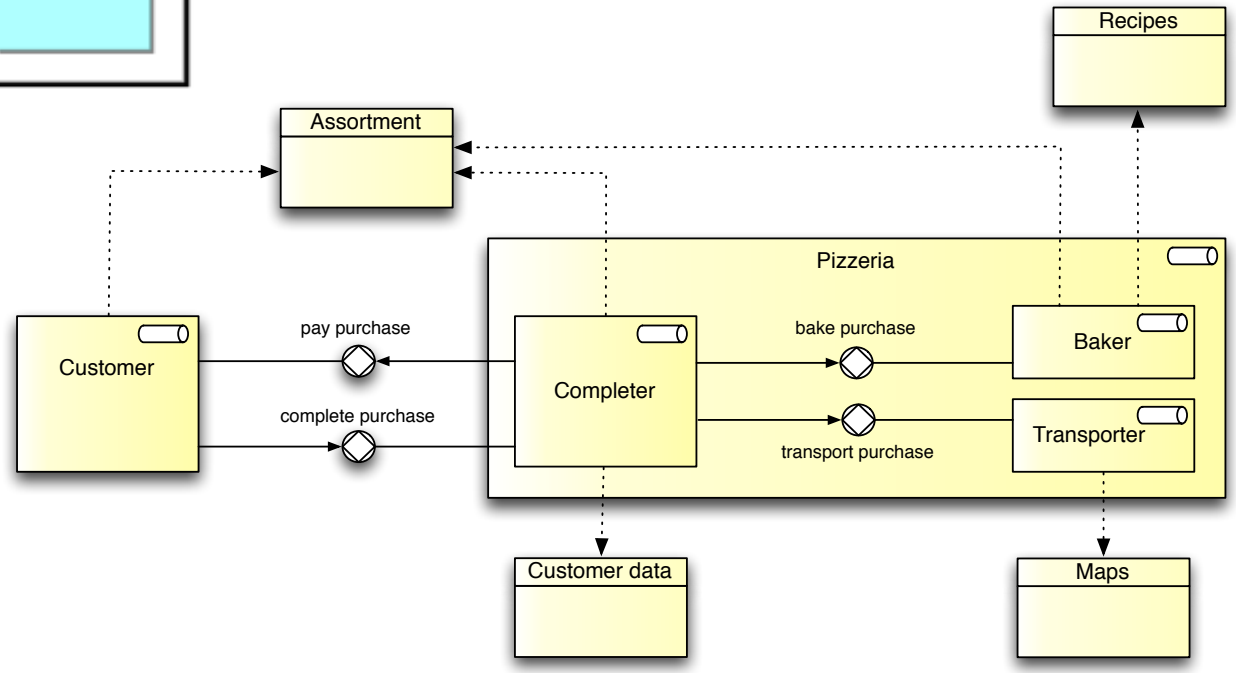
# What is a domain model?

"*Naturally, they [ engineers ] are looking for forms and practices of design they are familiar with*"

S. Junginger. Organizational Design Legacies & Service Design. Design Journal, 2015. Special Issue: Emerging Issues in Service Design.

# What is a domain model?



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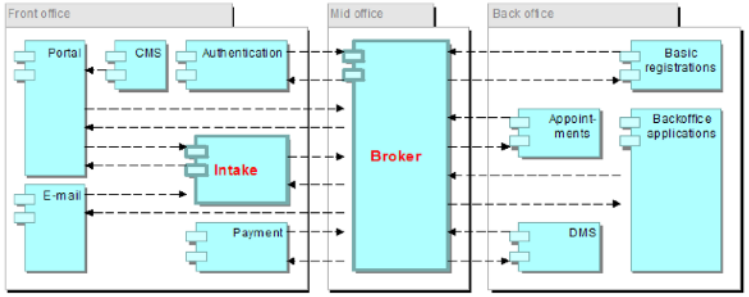


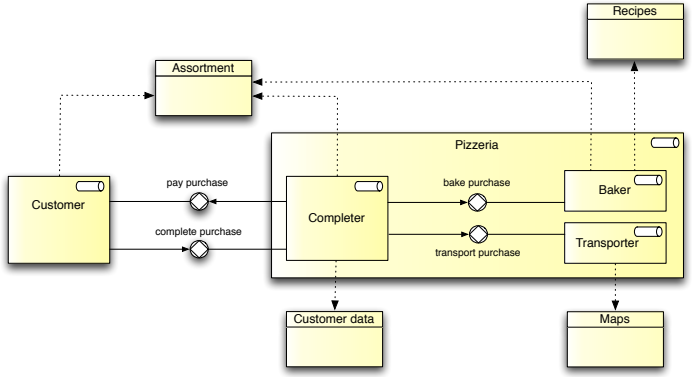


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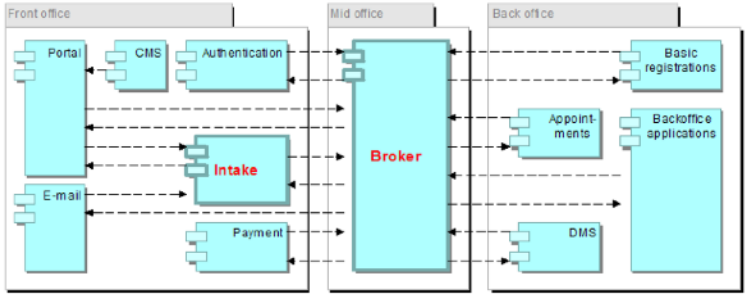


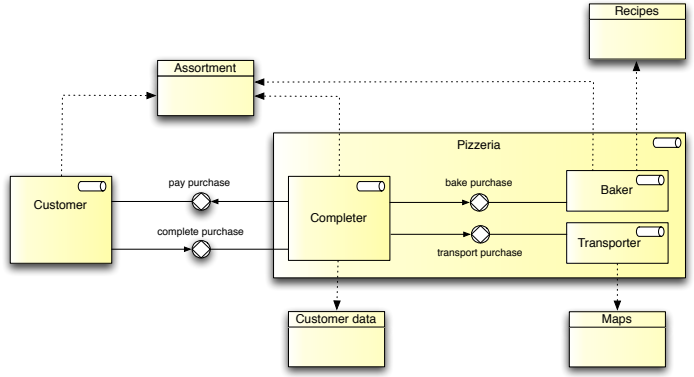


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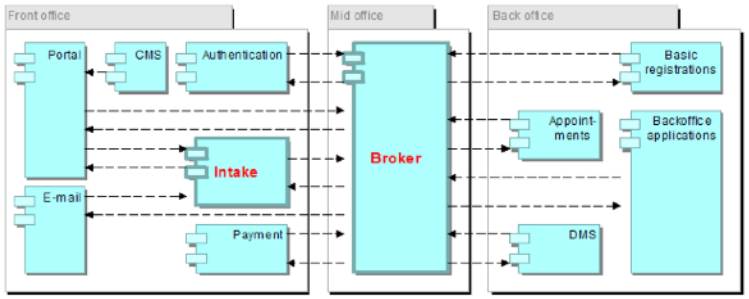
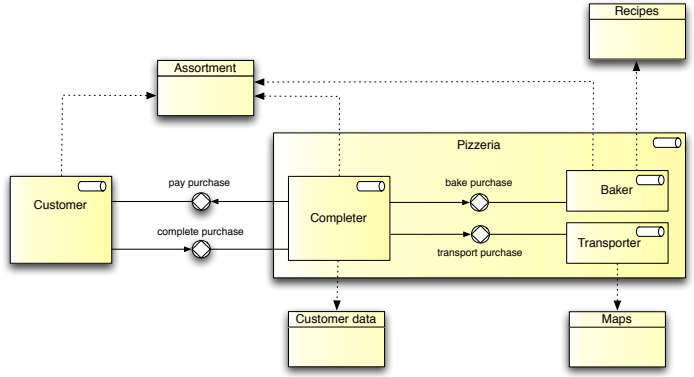



**8. Develop Product Concept**

Based on the product requirements and specifications, multiple product concepts are developed that can potentially satisfy those requirements. Brainstorming and other creativity techniques are used to generate a range of concept alternatives. These concepts are analyzed with respect to the product requirements as well as the existing technology portfolio, company capabilities, and business strategy in order to select the most promising architecture. The architecture is refined and the best aspects of other concepts are synthesized into the concept.

**Tasks**

1. Brainstorm and develop top-level product or system concepts to satisfy product requirements.
2. Analyze, evaluate and select a preferred product concept considering product requirements, company technology and capabilities, development risks, and business strategy.
3. Partition the system into subsystems or modules (and derive subsystem requirements
4. Brainstorm and develop subsystem concepts to satisfy lower-level requirements.
5. Analyze, evaluate and select subsystem concepts considering requirements, company technology and capabilities, development risks, and business strategy.
6. Identify need for risk-reduction development or investigation and launch effort.
7. Document the concept.

**Inputs**

1. Product requirements document

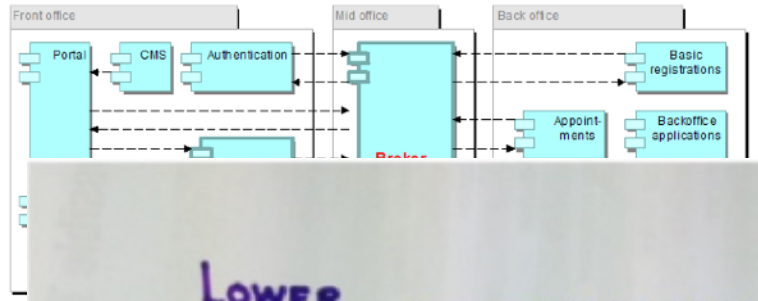
**Outputs/Deliverables**

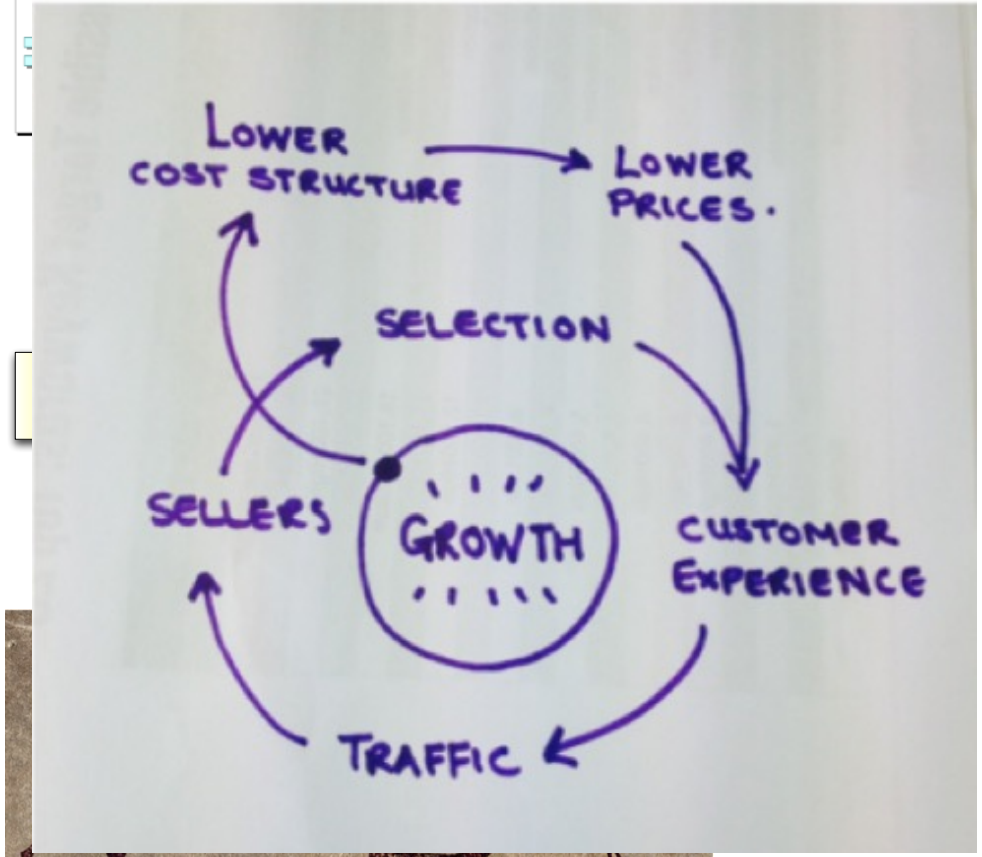
1. Product concept block diagram
2. Layout drawing
3. Concept selection matrix

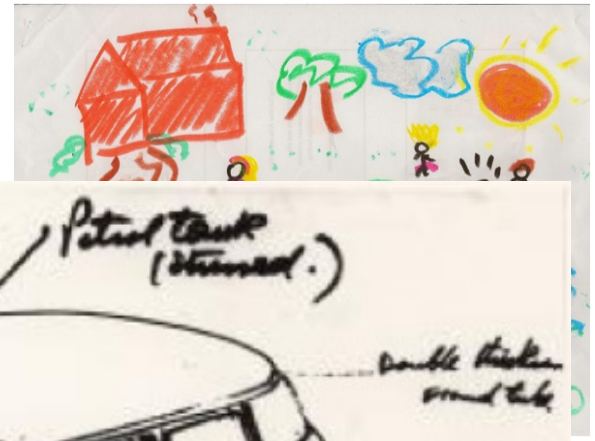
**Personnel Involved**

Marketing
Project Manager
Design Engineers
Manufacturing Engineer
Test Engineer
Supply Management

# What is a domain model?



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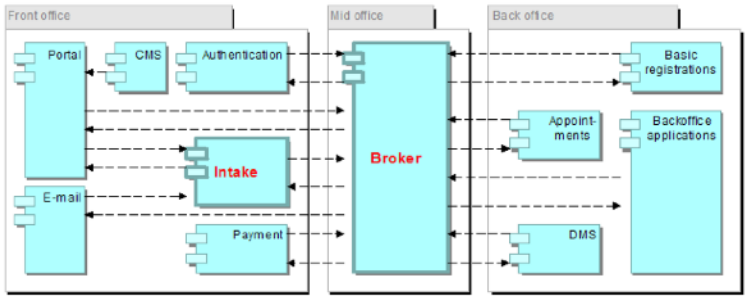


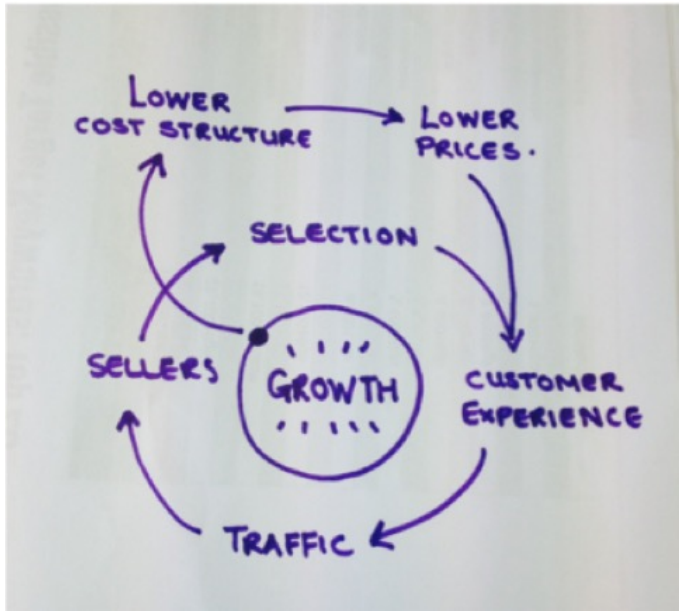


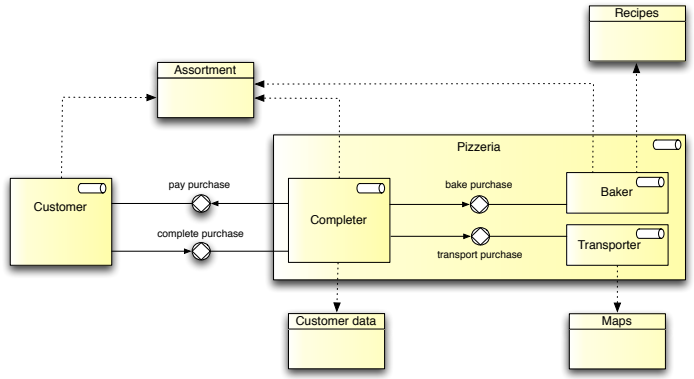


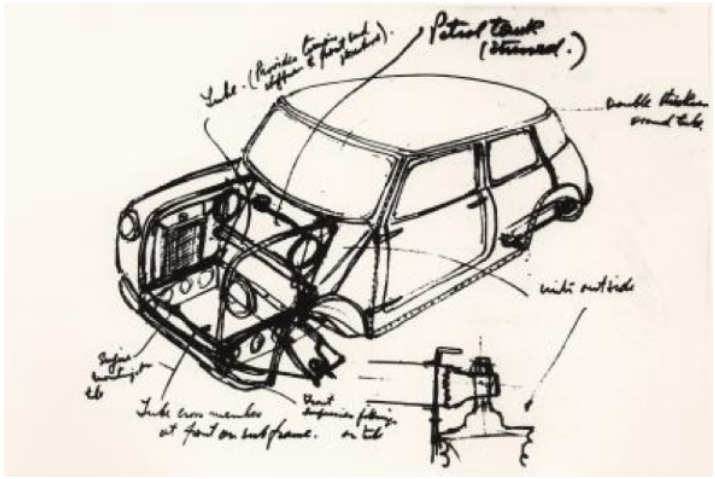

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# What is a domain model?

*a social artifact that is:*

*acknowledged by an observer*

*as representing*

*an abstraction*

*of some domain*

*for a particular purpose*

Based on Peirce, Ogden & Richards, Apostel, Stachowiak, FRISCO, …

And our own work 😇

*H. A. Proper and G. Guizzardi. On Domain Concept… …d H. A. Proper, editors, Advances in Enterprise Engineering XIV - 10th Enter… …EWC 2020, Bozen-Bolzano, Italy, September 28, October 19, and November 9-10, … …olume 411 of Lecture Notes in Business Information Processing, pages 49-69. Springe… …021.*

# Conceptual versus utilisation-design

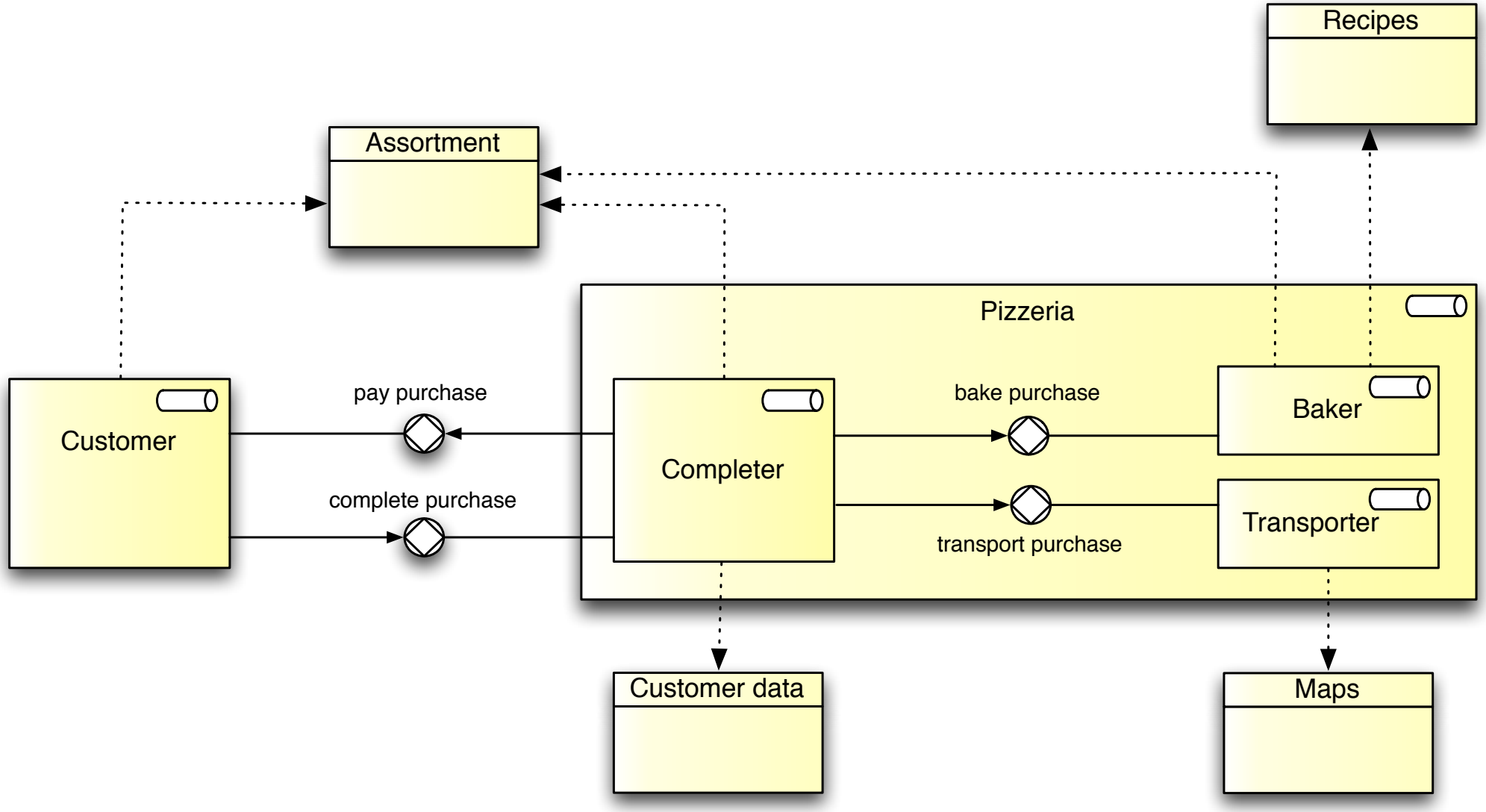
Conceptual domain model:

- A domain model that aims to be an as true as possible representation of the concepts and relations as identified in the domain

Utilisation-design domain model:

- A domain model that has a representation that is suitable for some computational or experiential purpose, which may compromise the conceptual truefulness

# Conceptual versus utilisation-design



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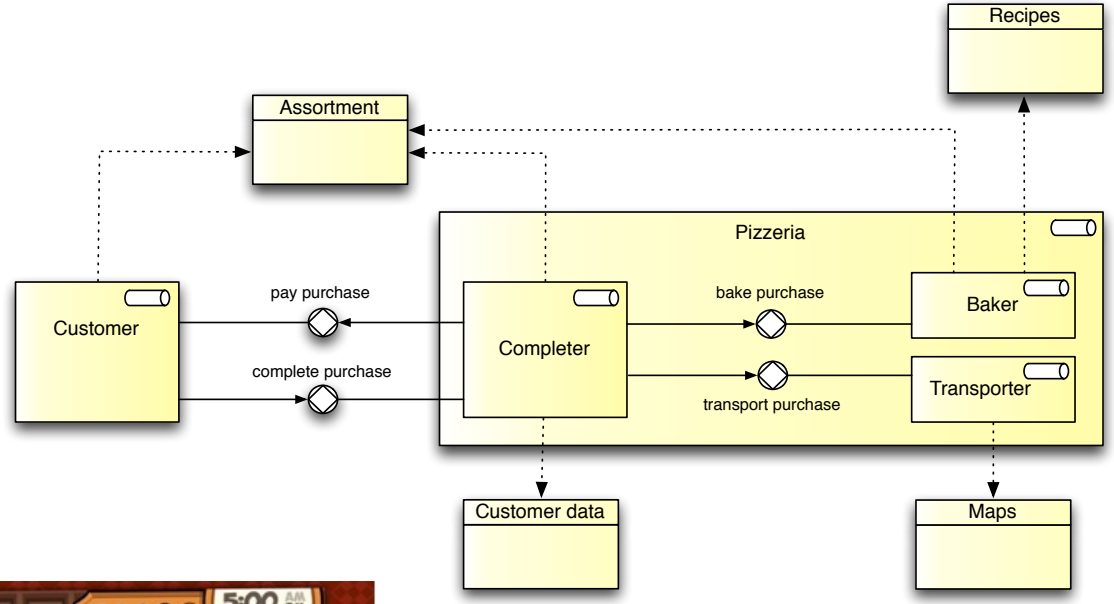




# Agenda

- Enterprises & models
- Models in enterprises
- Models & enterprises in the digital age

# Role of models in enterprises

Understand

Assess

Diagnose

Design

Realise

Operate

Regulate

# Role of models in enterprises

Understand

Assess

Diagnose

Design

Realise

Operate

Regulate

Understand the working of an existing enterprise and / or its environment

# Role of models in enterprises

Understand

Assess

Diagnose

Design

Realise

Operate

Regulate

Assess an existing enterprise in relation to e.g. a benchmark or a reference model

# Role of models in enterprises

Understand

Assess

Diagnose

Design

Realise

Operate

Regulate

Diagnose the causes of an identified problem in an enterprise and / or its environment

# Role of models in enterprises

Understand

Assess

Diagnose

Design

Realise

Operate

Regulate

Express different design alternatives, and analyse properties of the desired design of an enterprise

# Role of models in enterprises

Understand

Assess

Diagnose

Design

Realise

Operate

Regulate

Guidance, specification, or explanation during the realisation of a (future) design of an enterprise

# Role of models in enterprises

Understand

Assess

Diagnose

Design

Realise

Operate

Regulate

Guidance, specification, or explanation for the actors involved *in* the operations of an enterprise

# Role of models in enterprises

Understand

Assess

Diagnose

Design

Realise

Operate

Regulate

Externally formulated regulation on the operational behaviour of an enterprise

# Engineering in context

"*Naturally, they [ engineers ] are looking for forms and practices of design they are familiar with*"

"*design conversations*"

S. Junginger. Organizational Design Legacies & Service Design. Design Journal, 2015. Special Issue: Emerging Issues in Service Design.

# Engineering in context

## “*design conversations*”

S. Junginger. Organizational Design Legacies & Service Design. Design Journal, 2015. Special Issue: Emerging Issues in Service Design.

## “*authoring the organisation*”

J. R. Taylor and E. J. Van Every. When Organization Fails: Why Authority Matters. Routledge, London, United Kingdom, 2004.

## “*boundary objects*”

R. Abraham, H. Niemietz, S. de Kinderen, and S. Aier. Can boundary objects mitigate communication defects in enterprise transformation? Findings from expert interviews. In R. Jung and M. Reichert, editors, Proceedings of the 5th International Workshop on Enterprise Modelling and Information Systems Architectures, EMISA 2013, St. Gallen, Switzerland, September 5-6, 2013, volume 222 of Lecture Notes in Informatics, pages 27-40. Gesellschaft für Informatik, Bonn, Germany, 2013.

# Engineering in context

Coherent

Continuous

Coordinated

Evidence-enabled

# Engineering in context

Coherent

Continuous

Coordinated

Evidence-enabled

Models to ensure alignment & integration of all relevant aspects

# Engineering in context

Coherent

Continuous

Coordinated

Evidence-enabled

Models to report / plan / design
all changes; not just by projects

# Engineering in context

Coherent

Continuous

Coordinated

Evidence-enabled

Coordination in terms of models among relevant stakeholders and change efforts

# Engineering in context

Coherent

Continuous

Coordinated

Evidence-enabled Models to enable informed decision making, based on evidence

# Engineering in context

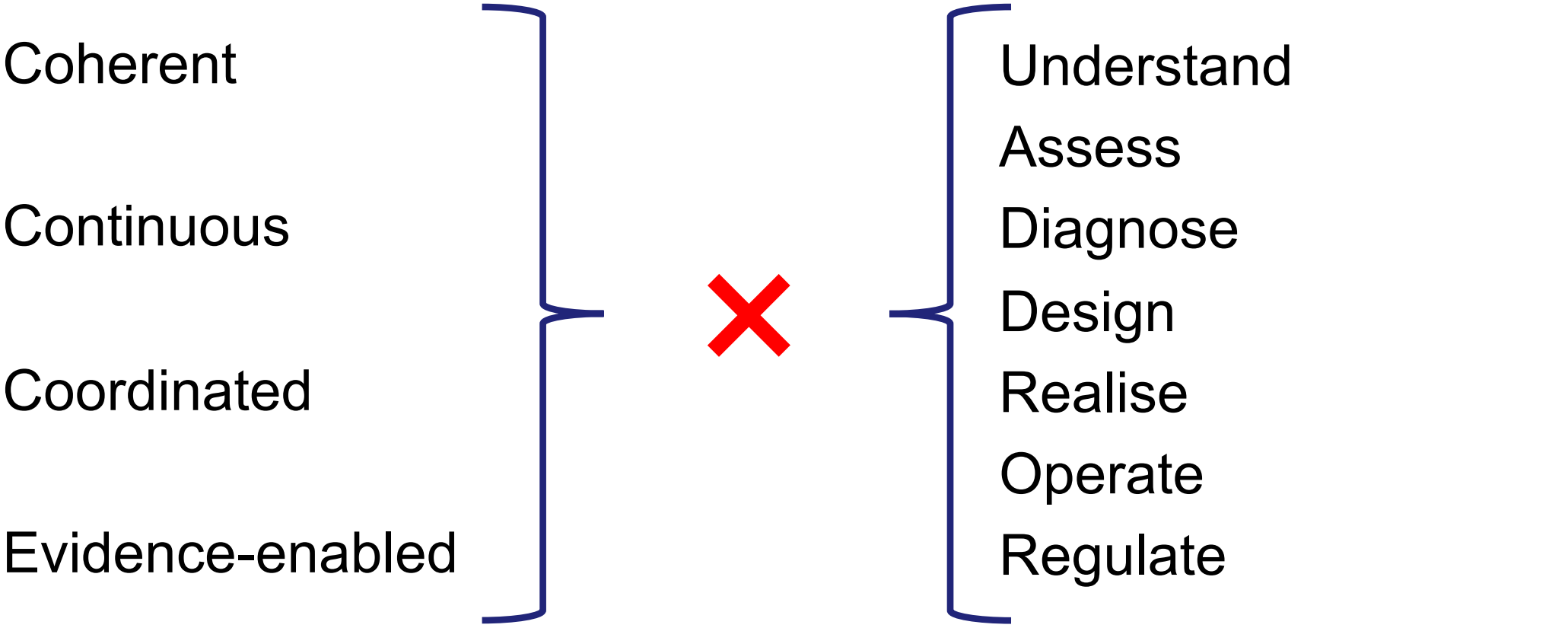
Coherent

Continuous

Coordinated

Evidence-enabled Models to enable informed decision making, based on evidence

# The role of domain models



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# An increasing role for IT

From

*automation of information processing*

via

*automation of business processes*


to being an

*integral part of the business model*

# Challenges in the digital age

Agility

Compliance

Anti-fragility

Robustness

Efficiency

# Challenges in the digital age

Agility

Robustness

Compliance

Efficiency

Anti-fragility

Design-time = run-time

Agile enterprise

Real-time enterprise

DevOps

Continuous engineering

# Increasing role of model-driven systems

Agility
Robustness
Compliance
Efficiency
Anti-fragility

BP Management

xAI

Model-driven engineering

Low code; High models

DevOps
Agile enterprise
Real-time enterprise
Continuous engineering
Design-time = run-time

Digital twins

Enterprise analytics

EA Management

# Opportunities for model-driven systems

Agility
Robustness
Compliance
Efficiency
Anti-fragility

Process & rule engines

AI assistance

Enterprise mining

Model-driven engineering
Low code; High models
BP Management
Enterprise analytics
EA Management
Digital twins
xAI

DevOps
Agile enterprise
Real-time enterprise
Continuous engineering
Design-time = run-time

Simulation & animation

Collaboration engineering

Advanced UIs

# Towards an integrated concept

Agility
Robustness
Compliance
Efficiency
Anti-fragility

DevOps
Agile enterprise
Real-time enterprise
Continuous engineering
Design-time = run-time

Model-driven engineering
Low code; High models
BP Management
Enterprise analytics
EA Management
Digital twins
xAI

Enterprise mining
Process & rule engines
Advanced UIs
AI assistance
Collaboration engineering
Simulation & animation

*Model-driven enterprises*

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