

# IC3K 2013 - Keynote Address

## Enterprise Ontology and DEMO Benefits, Core Concepts and a Case study

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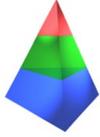
CODE - Center for Organizational Design and Engineering - INESC Lisbon

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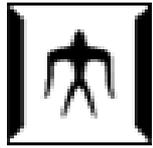
**CIAO!**

**International Research Network:  
Cooperation Interoperability  
Architecture and Ontology**





# The CIAO! Network



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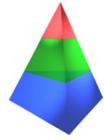
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# Some persistent problems in enterprises

The complexity of organizations has become unmanageable.

The complexity of ICT applications has become unmanageable.

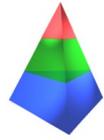
ICT applications do not meet business requirements and expectations.

The maintenance costs of ICT applications are ever increasing.

There is still no (positive) correlation between ICT investments and revenues.

The vast majority of strategic initiatives fail, meaning that enterprises are unable to gain success from their strategy.

Figures reported from various areas: Information Systems Development, Business Process Management, Total Quality Management, Six Sigma ...



# Analysis of the problems

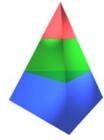
The *information systems professionals* fall short in assisting enterprises to implement change initiatives effectively.

The *key reason* is the low level of professionalism: they are not able to deliver ICT applications that satisfy the *real needs*.

The *organizational professionals* also fall short in assisting enterprises to implement change initiatives effectively.

The *key reason* is their predominant managerial approach (function-orientation, black-box thinking), whereas changing an enterprise requires an engineering approach (construction-orientation, white-box thinking).

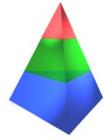
Research indicates that the key reason for strategic failures is the lack of *coherence* and *consistency* among the various components of an enterprise.



# Managerial vs Engineering approach to improve lack of efficiency of a car

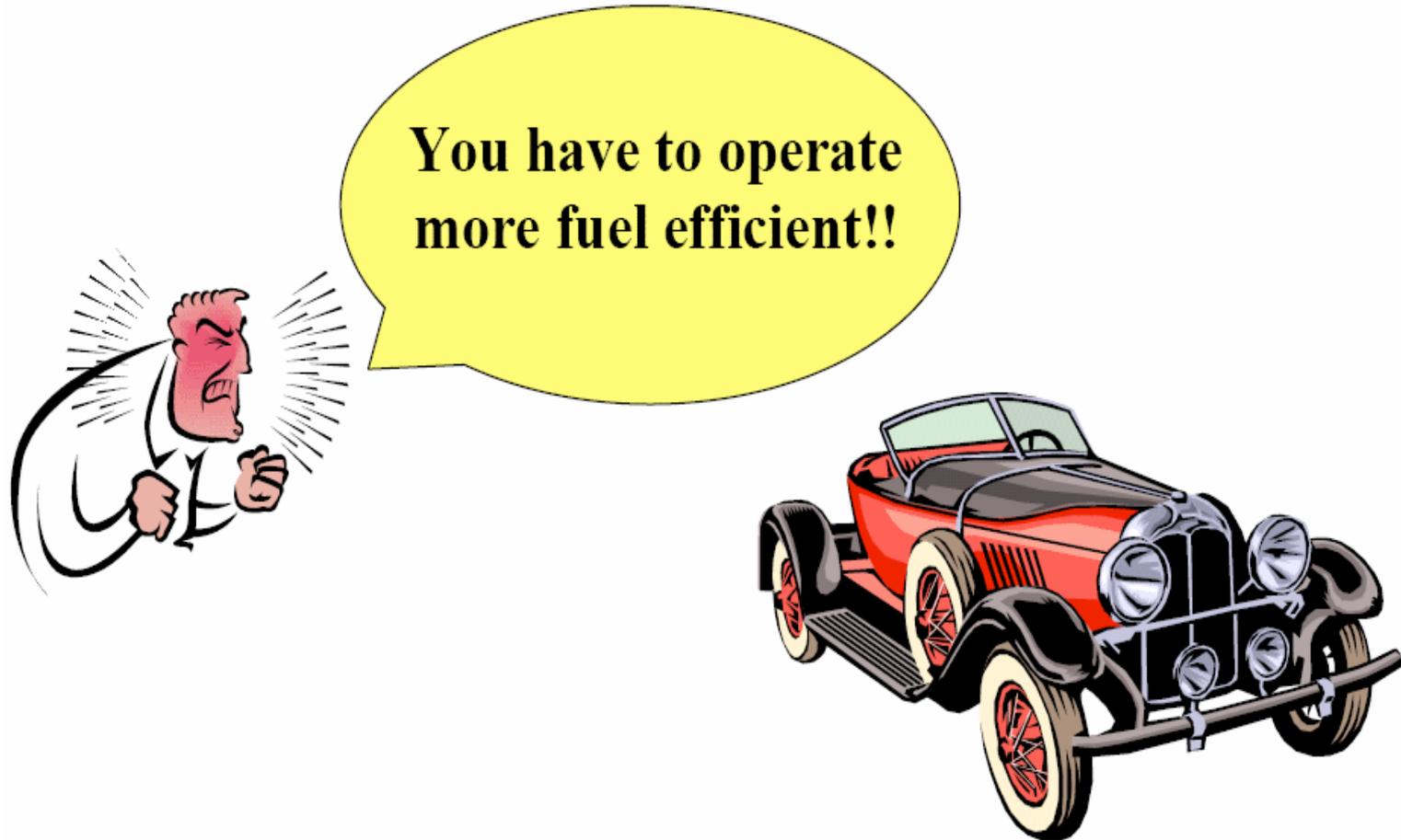
Engineering approach:

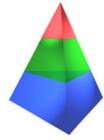




# Managerial vs Engineering approach to improve lack of efficiency of a car

Managerial approach:





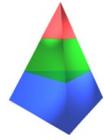
# The mission of Enterprise Engineering

Addressing the challenges mentioned before requires a paradigm shift.

It is the mission of the discipline of Enterprise Engineering to **develop new, appropriate theories, models, methods and other artifacts for the analysis, design, implementation, and governance of enterprises** by combining (relevant parts of) management and organization science, information systems science, and computer science.

The ambition is to address (all) traditional topics in said disciplines from the Enterprise Engineering Paradigm.

In addition, the results of our efforts should be ***theoretically rigorous*** and ***practically adequate***



# What is Enterprise Engineering?

Enterprise Engineering (EE) is the scientific discipline that has enterprises as its object of study.

EE considers enterprises to be designed systems, which consequently can be re-designed. Three foundational pillars are recognised:

**Enterprise Ontology**

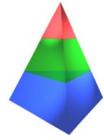
**Enterprise Architecture**

**Enterprise Governance**

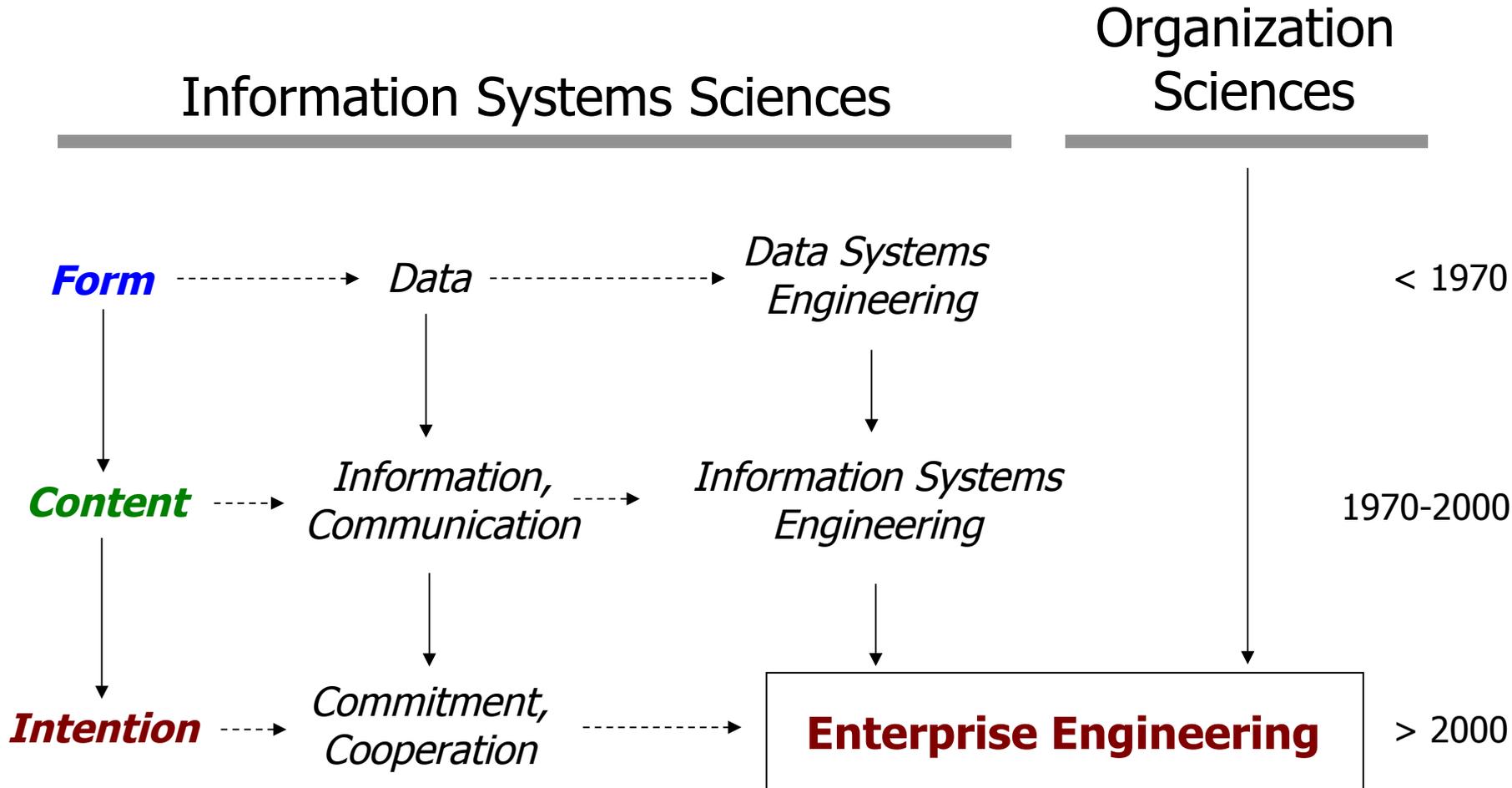
**Enterprise Design**

*Almost all (94%) manifestations of inadequate enterprise performance are the inevitable results of how enterprises are designed.*

William Edwards Deming



# The history of Enterprise Engineering





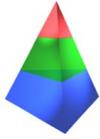
# Theoretical foundations of EE

THEORY CLASS	INSPIRATIONAL SOURCES	EE-THEORY
<b>Ideological</b> <i>devising and choosing things to make ethical, political, etc. ideas</i>	W.E. Deming, P. Drucker R. Likert, D. McGregor, D. Katz & R.L. Kahn J.M. Burns	$\sigma$ -theory
<b>Technological</b> <i>designing and implementing things analysis and synthesis</i>	C. Alexander, H. Simon, L. von Bertalanffy, P. Checkland, E.W. Dijkstra, M.D. McIlroy	$\beta$ -theory $\nu$ -theory
<b>Ontological</b> <i>understanding the nature of things explanation and prediction</i>	J. Austin, J. Searle, J. Habermas, M. Bunge, P. Checkland, B. Langefors J.R. Taylor & E.J. Van Every K.Z. Lewin	$\psi$ -theory
<b>Philosophical</b> <i>theoretical foundations epistemology, mathematics, phenomenology, logic</i>	C.S. Peirce, C.W. Morris, M. Bunge, L. Wittgenstein, J.F. Sowa, P. Simons M. Heidegger, K.H. Marx	$\phi$ -theory $\delta$ -theory $\tau$ -theory

# THEORY



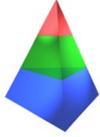
# Enterprise Ontology



# The $\psi$ -theory: organisation

$\psi$  (PSI) stands for Performance in Social Interaction. Primarily rooted in Habermas' social theory and Bunge's systemic ontology.

- The operating principle of organisations is that *human beings* enter into and comply with *commitments* regarding the production of things. They do so in *communication*, and against a shared background of cultural norms and values.
- Commitments occur in processes that follow the *universal transaction pattern*. This is a structure of *coordination acts/facts* between two actors, concerning one *production act/fact*. One is the *initiator* (consumer) and the other one the *executor* (producer).
- An organisation is a network of actors and transactions. Every actor has a particular *authority*, assigned on the basis of *competence*. Actors are assumed to exercise their authority with *responsibility*. They operate *autonomously*.



# Examples of coordination acts

Alicia: *I'd like to have a bouquet of red tulips*

**Alicia** : **request** : **Celestine** : **order 387 is fulfilled**

Celestine: *Just a moment*

**Celestine** : **promise** : **Alicia** : **order 387 is fulfilled**

Celestine: *Here you are*

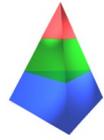
**Celestine** : **state** : **Alicia** : **order 387 is fulfilled**

Alicia: *Thanks*

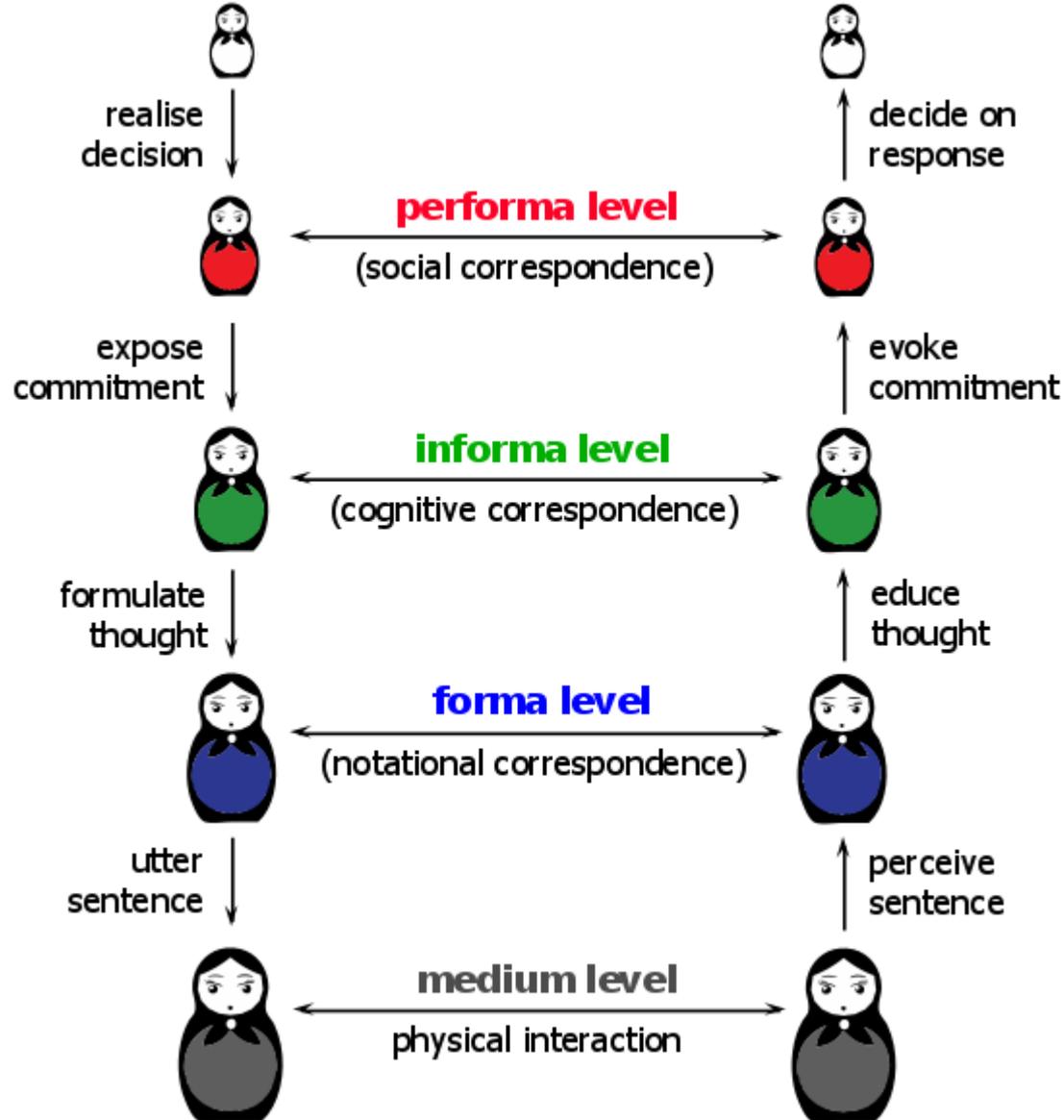
**Alicia** : **accept** : **Celestine** : **order 387 is fulfilled**

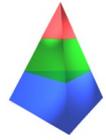
proposition

result

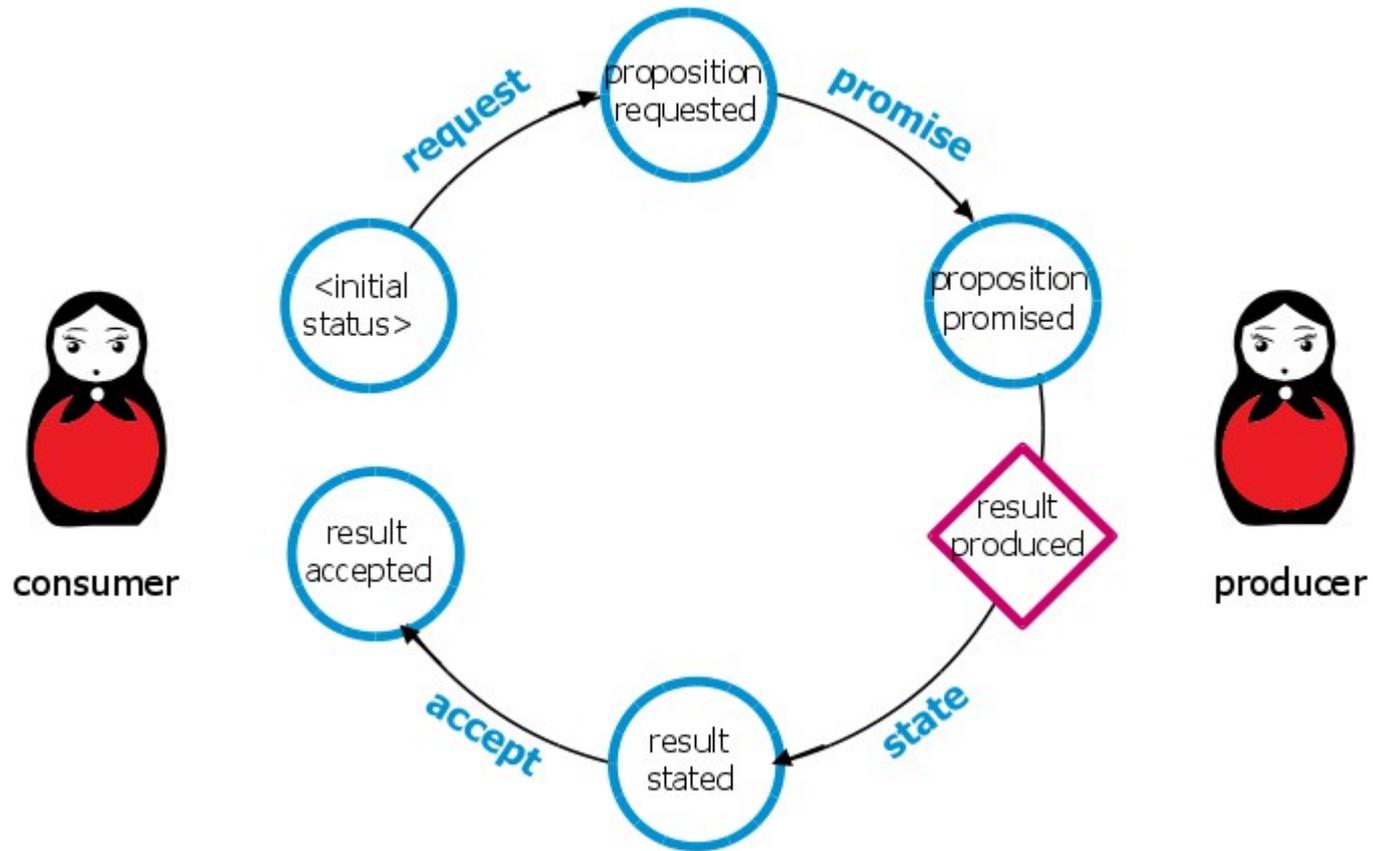


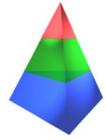
# The $\psi$ -theory: coordination



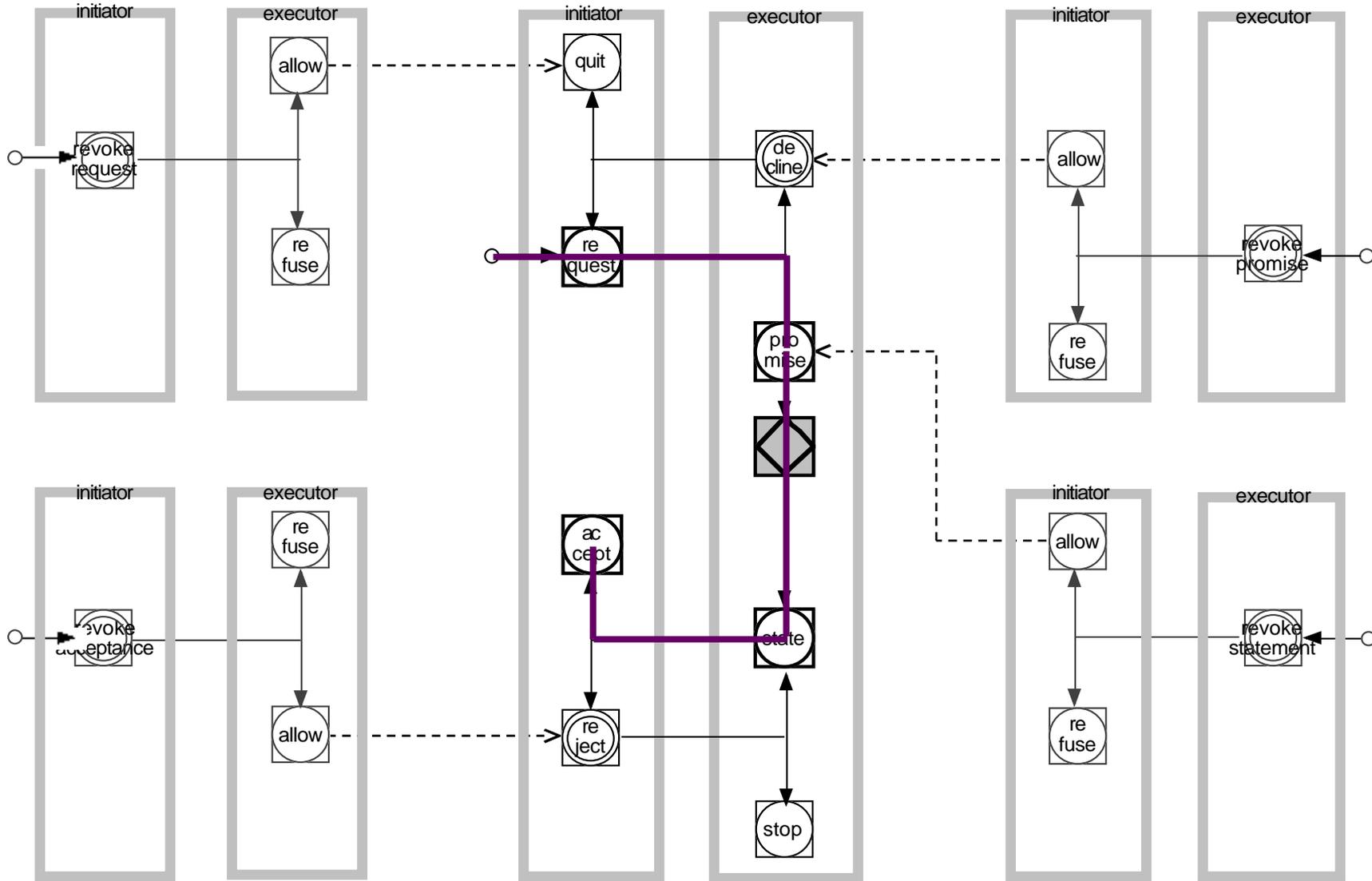


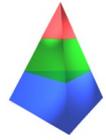
# The basic transaction pattern



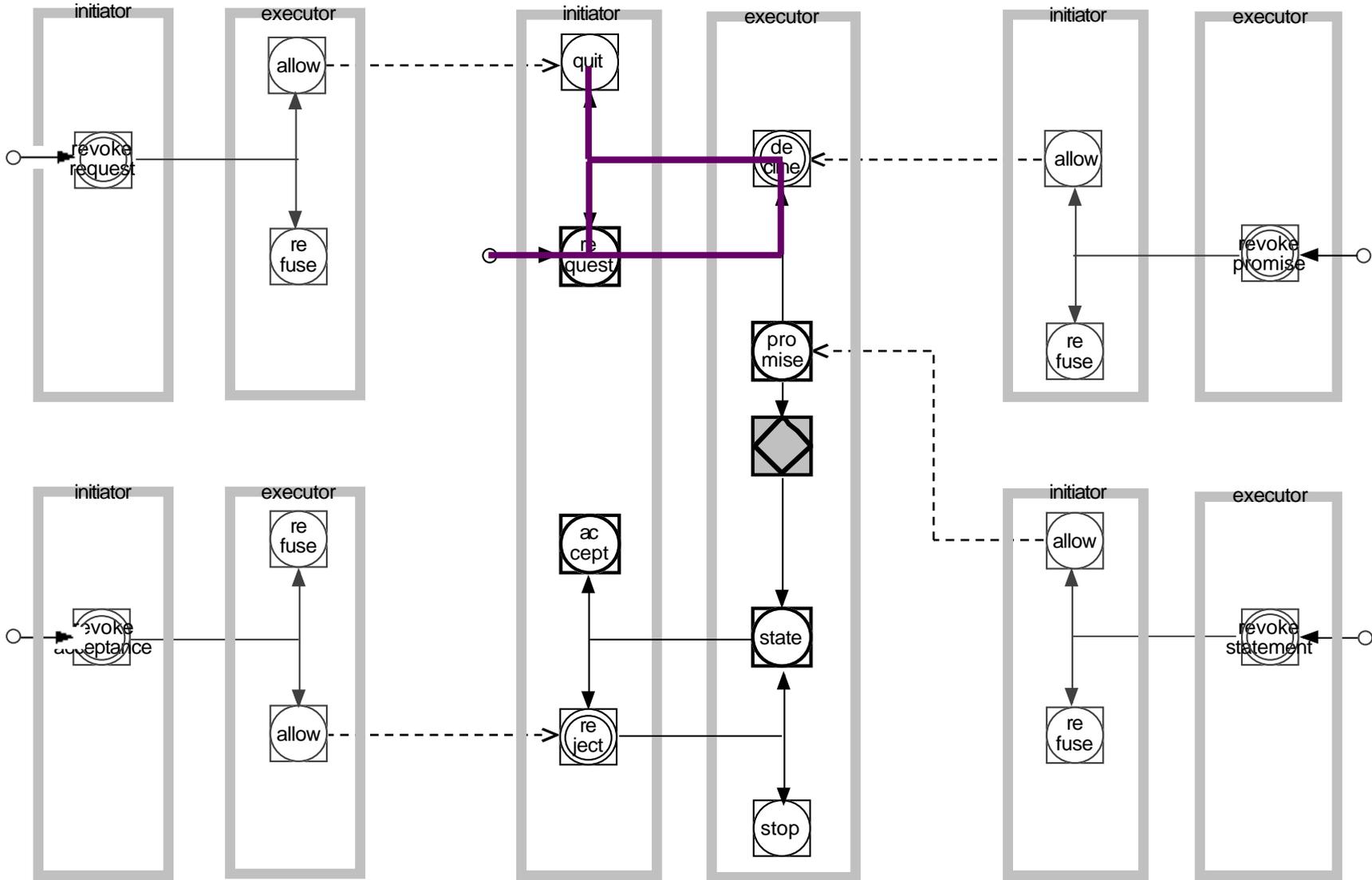


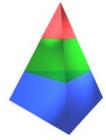
# The complete transaction pattern (1)



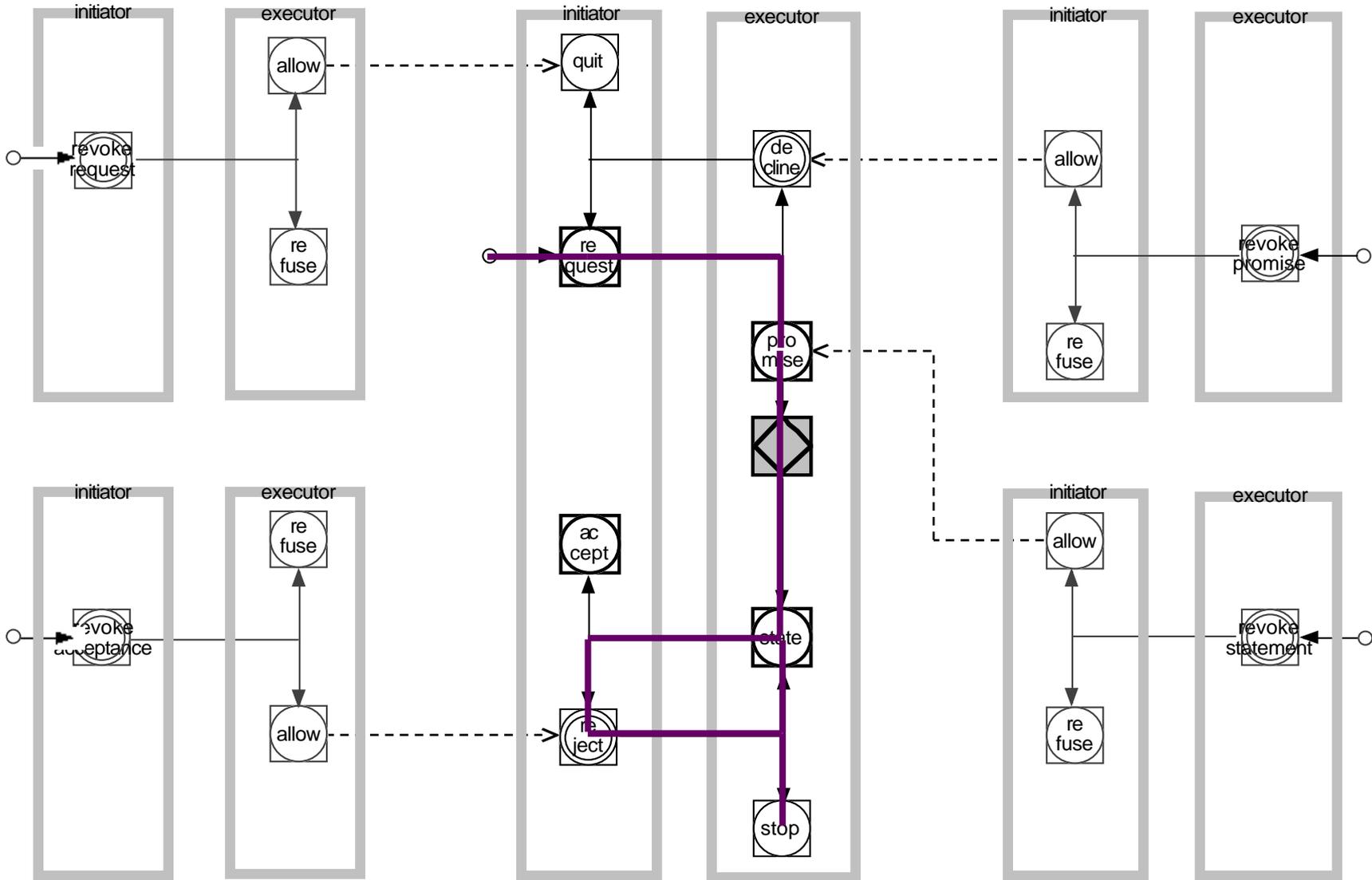


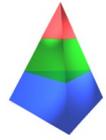
# The complete transaction pattern (2)



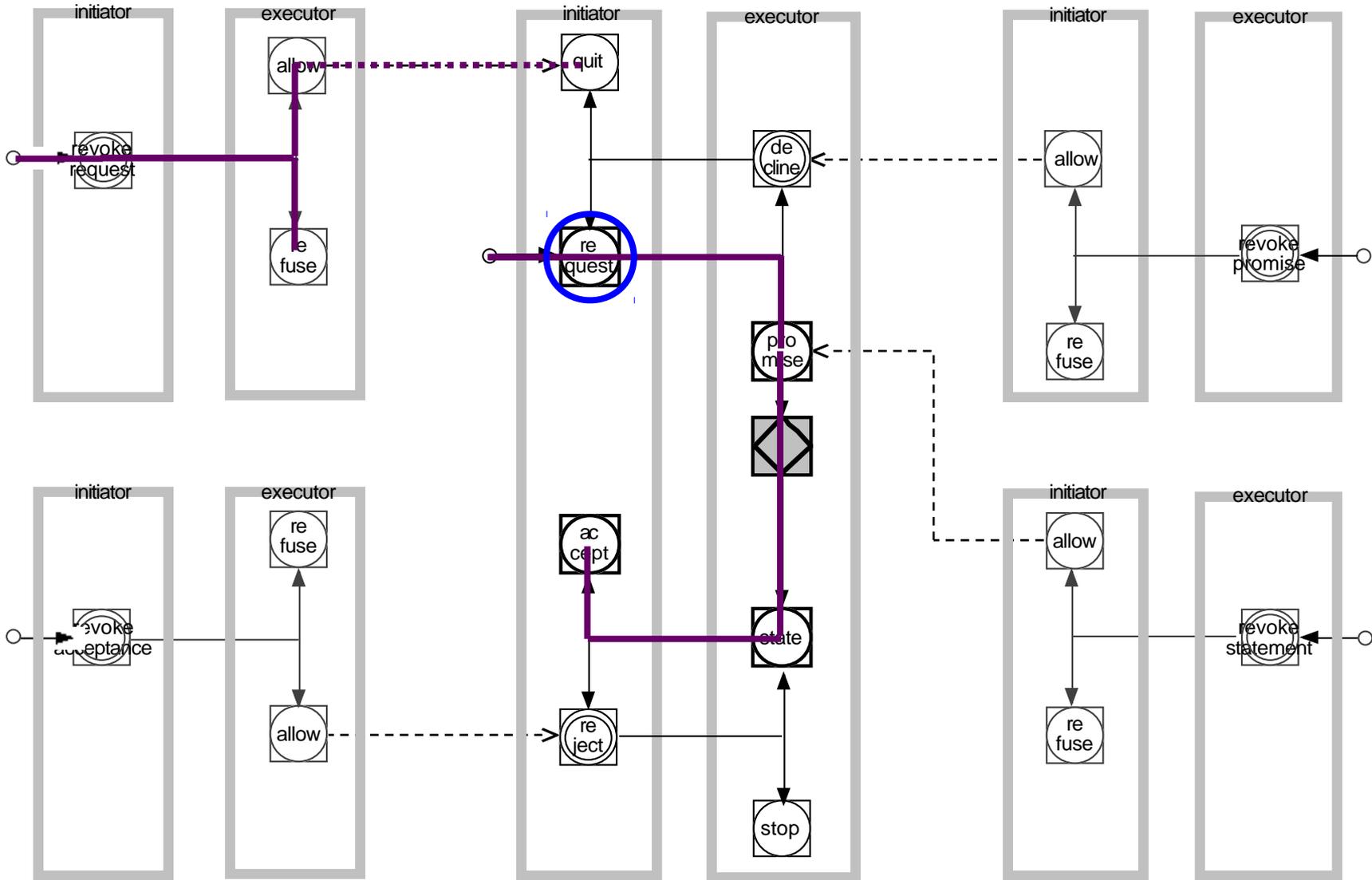


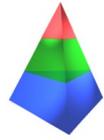
# The complete transaction pattern (3)





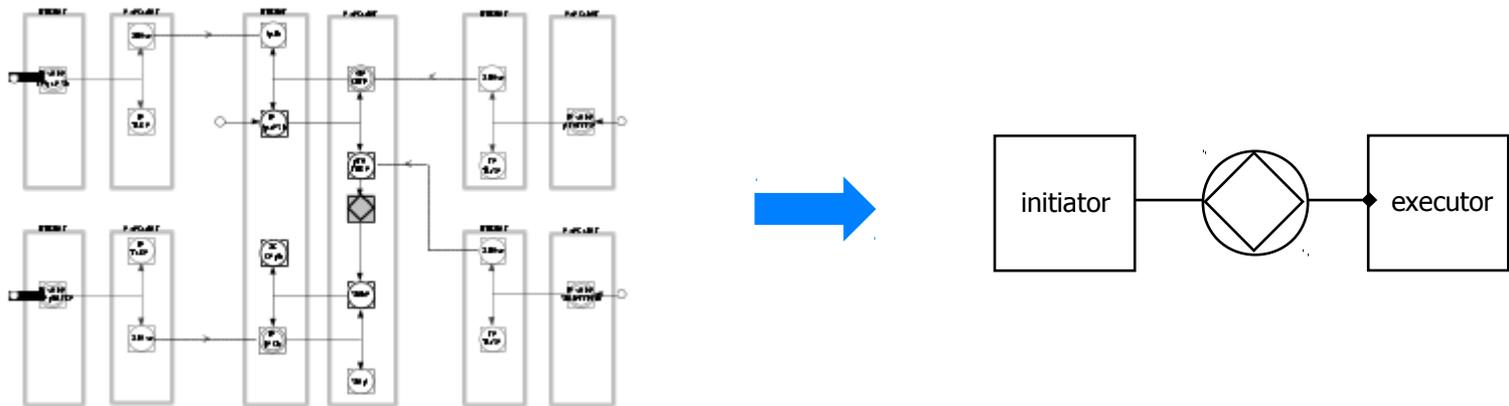
# The complete transaction pattern (4)





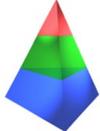
# The organisational building block

Every (elementary) *actor role* is the executor of exactly one transaction kind, and initiator of 0, 1 or more transaction kinds. An *actor* is a person in fulfilling an actor role.

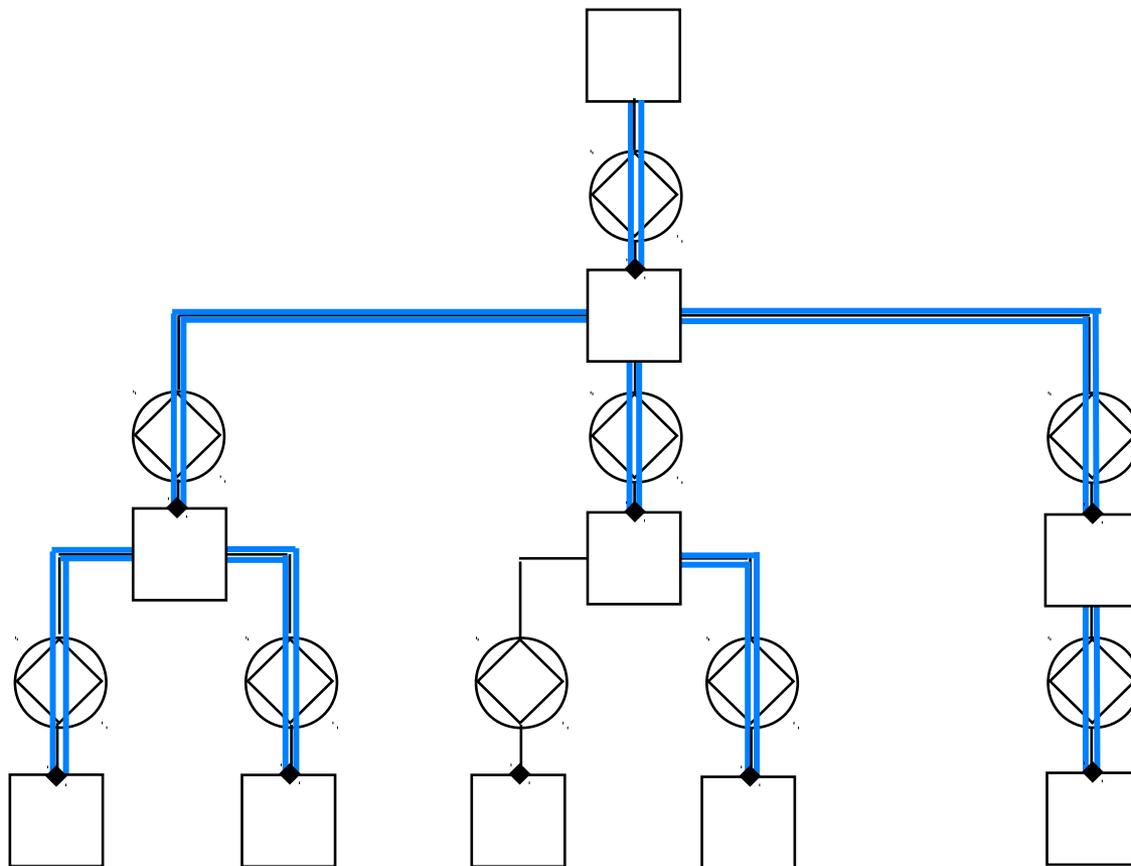


Next to the *process* interpretation of the transaction symbol, there is the *state* interpretation:

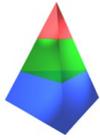
it is the conceptual container of all coordination facts that are created in all transactions up to now. In the state interpretation, the transaction symbol is called a transaction bank.



# A business process is a tree of transactions

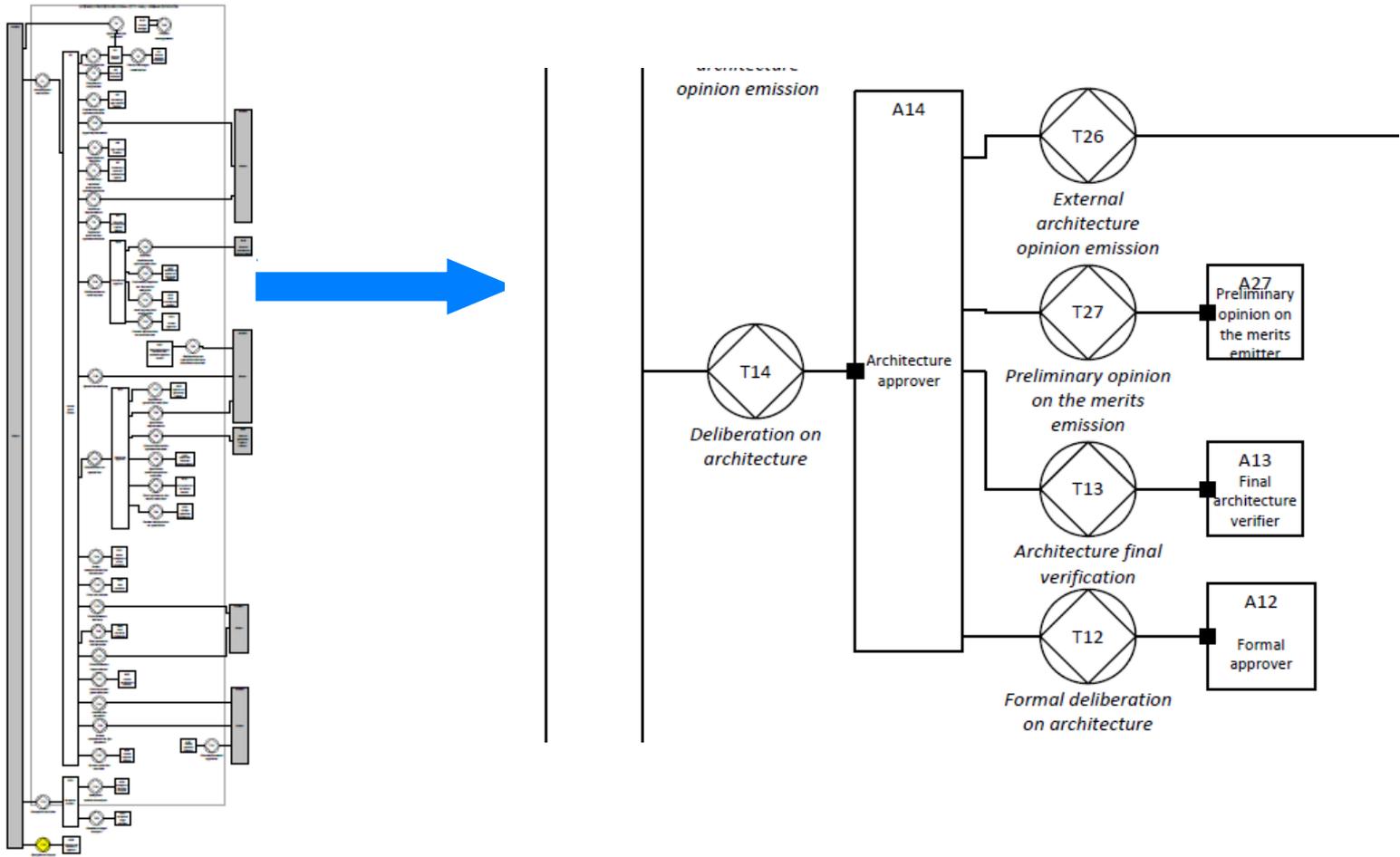


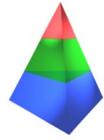
Note. Component transactions may also be carried out in parallel



# A business process is a tree of transactions

- City hall project licencing process case
  - ~ **50 A4 pages** - flowcharts with hundreds of tasks abstracted to:
  - = **2 A3 pages** - 36 transactions





# The indefiniteness of process modeling



Is passing the document from A to B:

Only a **datalogical** act?

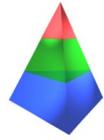
Example: A hands over the document to B to archive it.

Or (also) an **infological** act?

Example: A informs B about the content of the document.

Or (also) an **ontological** act?

Example: A requests B to do something.



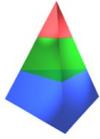
# Violation of the $\psi$ -theory

Current business process modeling approaches, like Flowchart, BPMN, EPC, and Petri Net *reduce* business processes to sequences of (observable) actions and results.

Thereby losing the *essential deep structure* (which is always a tree of transactions) and neglecting all *tacitly* performed coordination acts.

Therefore they are ambiguous (if not dangerous) for business process re-design and re-engineering.

Even worse are the function-oriented techniques (SADT, IDEF0) since by definition they reflect the personal interpretation of the modeler (black-box model)!



# The $\psi$ -theory: production

The three human *abilities* also apply to *production*:

## ***Performa***

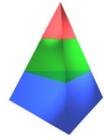
The ability to perform ***original*** production acts, such as to *create (manufacture, transport, observe), decide, judge*.

## ***Informa***

The ability to perform ***informational*** production acts, such as to *remember, recall, compute (facts)*

## ***Forma***

The ability to perform ***documental*** production acts, such as to *store, retrieve, transmit, copy (sentences, documents)*.



# The $\psi$ -theory: summary

## COORDINATION

exposing commitment  
evoking commitment

## HUMAN ABILITY



**performa**

## PRODUCTION

original acts/facts  
(creating, deciding, judging)

formulating thought  
educing thought



**informa**

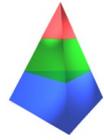
informational acts/facts  
(remembering, recalling, computing)

uttering sentence  
perceiving sentence

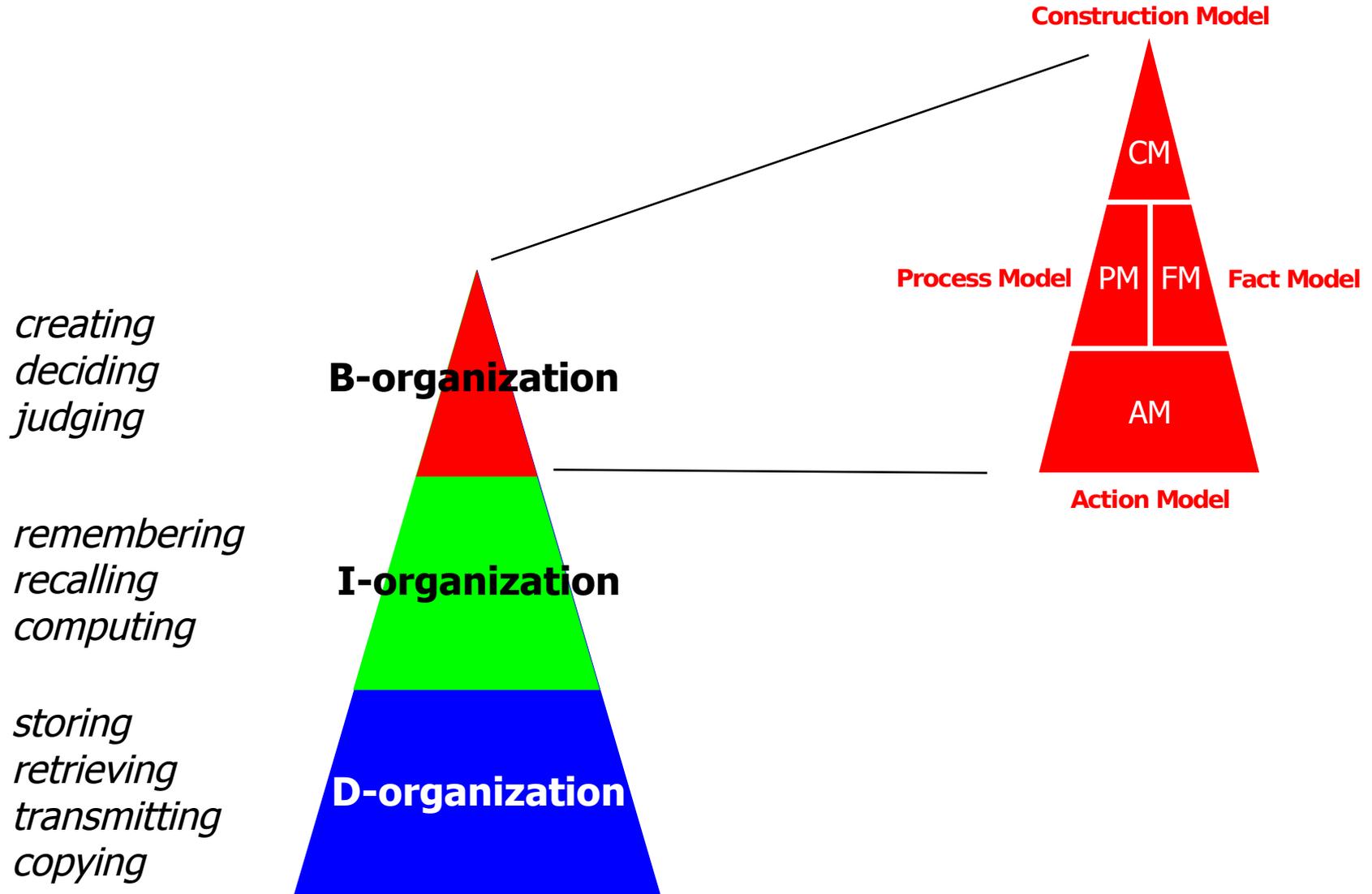


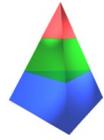
**forma**

documental acts/facts  
(storing, retrieving, transmitting)



# The three aspect organisations

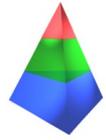




# The essential model of an enterprise (1)

In the huge network of organisations (interacting social individuals), we make the next selections and abstractions:

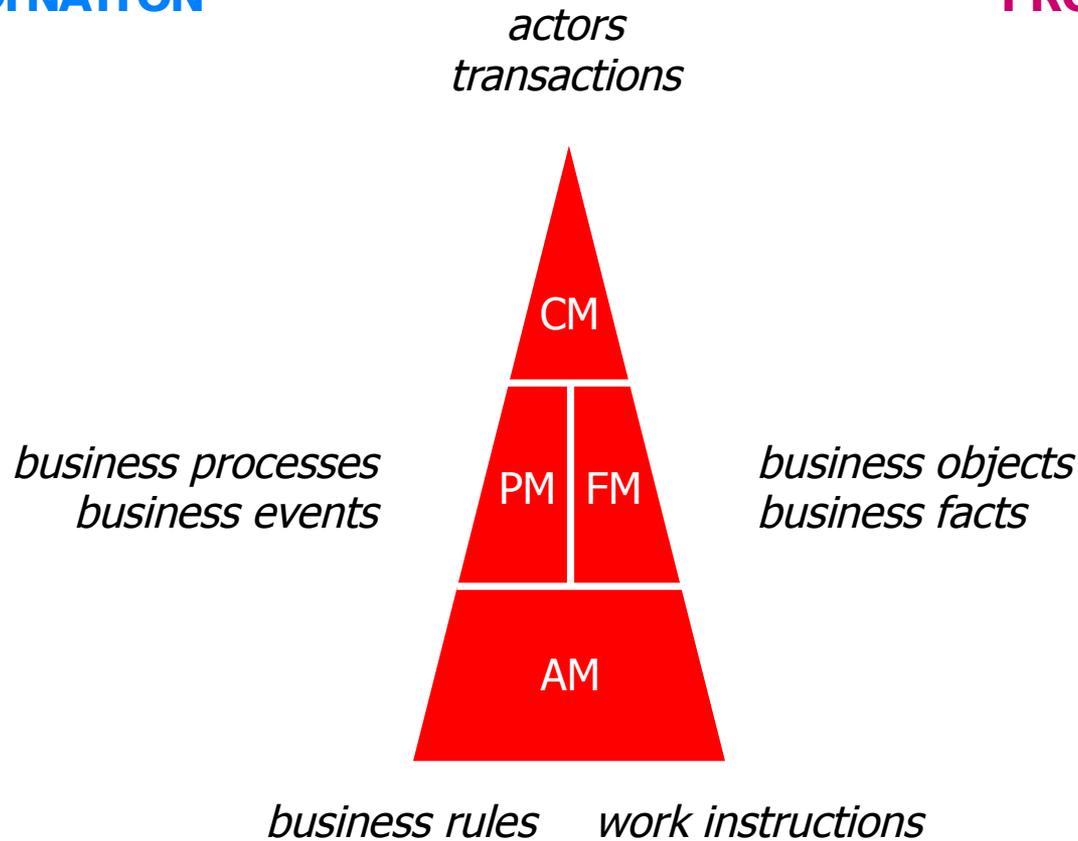
1. We select our scope of interest, so we see only (the part of) the enterprise's *organisation* we want to investigate.
2. We put the building block 'template' on the organisation, so we see a network of *transaction kinds* and connected *actor roles*.
3. We only consider the **performa** level of coordination: we have got the *ontological model* of the enterprise's organisation.
4. We leave out the D-organisation and the I-organisation network: we have got the *ontological model* of the **B-organisation** of the enterprise, which is **the essential model of the enterprise**: concise, coherent, consistent, and comprehensive.



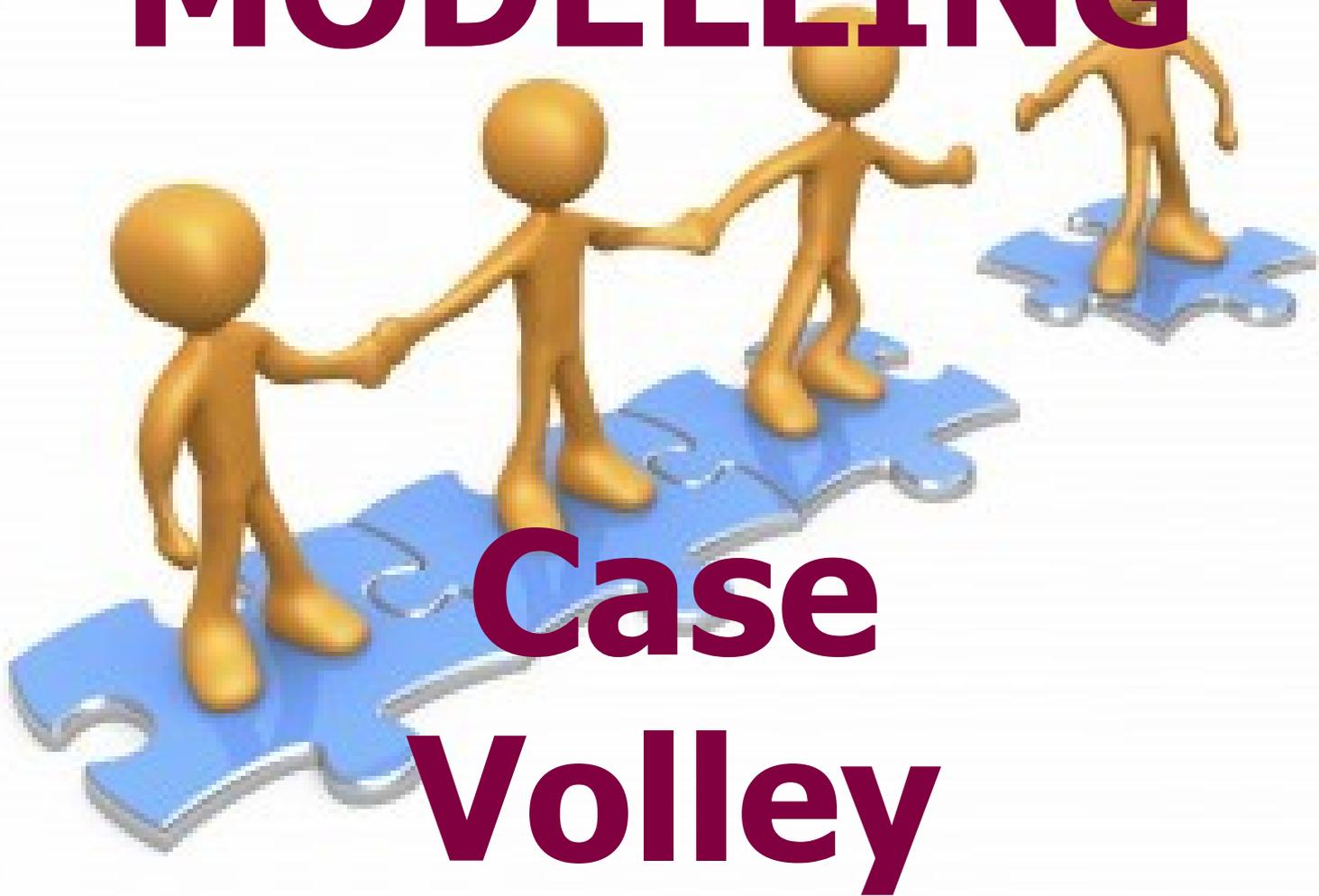
# The essential model of an enterprise (2)

**COORDINATION**

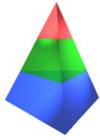
**PRODUCTION**



# MODELLING



**Case  
Volley**



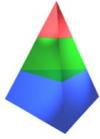
# Volley: analysis (1)

**T1/rq**

One can become member of the tennis club Volley by sending a letter to the club by postal mail. In that letter one has to mention one's surname and first name, birth date, sex, telephone number, and postal mail address (street, house number, zip code, and town). Adam, the administrator of Volley, empties the mailbox daily and checks whether the information provided is complete. If not, he makes a telephone call to the sender in order to complete the data. Once a letter is complete, Adam writes an incoming mail number and the date on the letter, records the letter in the letter book, and puts it in a folder.

**T1/pm**

Every Wednesday evening, Adam takes the folder to Eve, the secretary of Volley. He also takes the member register with him. If Eve decides that an applicant can become member of Volley, she stamps 'new member' on the letter and writes the date below it. She then hands the letter to Adam in order to add the new member to the member register. This is a book with numbered lines. Each new member is entered on a new line. The line number is the number by which the new member is referenced in the administration.



## Volley: analysis (2)

Next, Eve calculates the fee that the new member has to pay for the remaining part of the calendar year. She asks Adam for the annual fee, as decided at the general assembly, which Adam has recorded on a sheet of paper in his files. Then, she asks Adam to write down the amount in the member register.

If Eve does not allow an applicant to become member (e.g., because he or she is too young or because the maximum number of members has been reached), Adam will send a letter in which he explains why the applicant cannot (yet) become member of Volley.

If all applications are processed, Adam takes the letters and the member register home and prepares an invoice to all new members for the payment of the first fee. He sends these invoices by postal mail. Payments have to be performed by bank transfers.

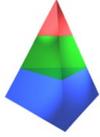
As soon as a bank statement is received, Adam prints a card on which the membership number, the starting date, the name, the date of birth, the sex, and the residence are mentioned. The card is sent to the new member by postal mail.

T1/dc

T2/rq

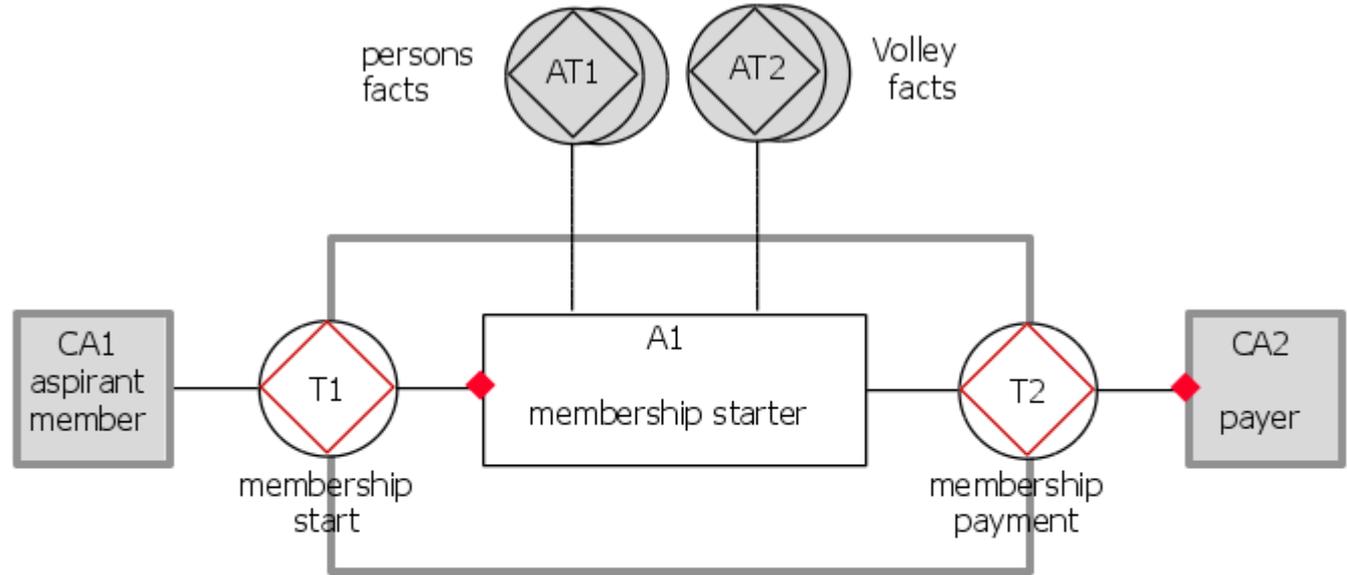
T2/st

T1/st



# Volley: Construction Model (1)

Organisation Construction Diagram

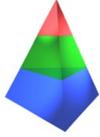


Transaction Product Table

transaction kind	product kind
T1 membership start	P1 Membership <b>is</b> started
T2 membership payment	P2 <b>the first fee of</b> Membership <b>is</b> paid

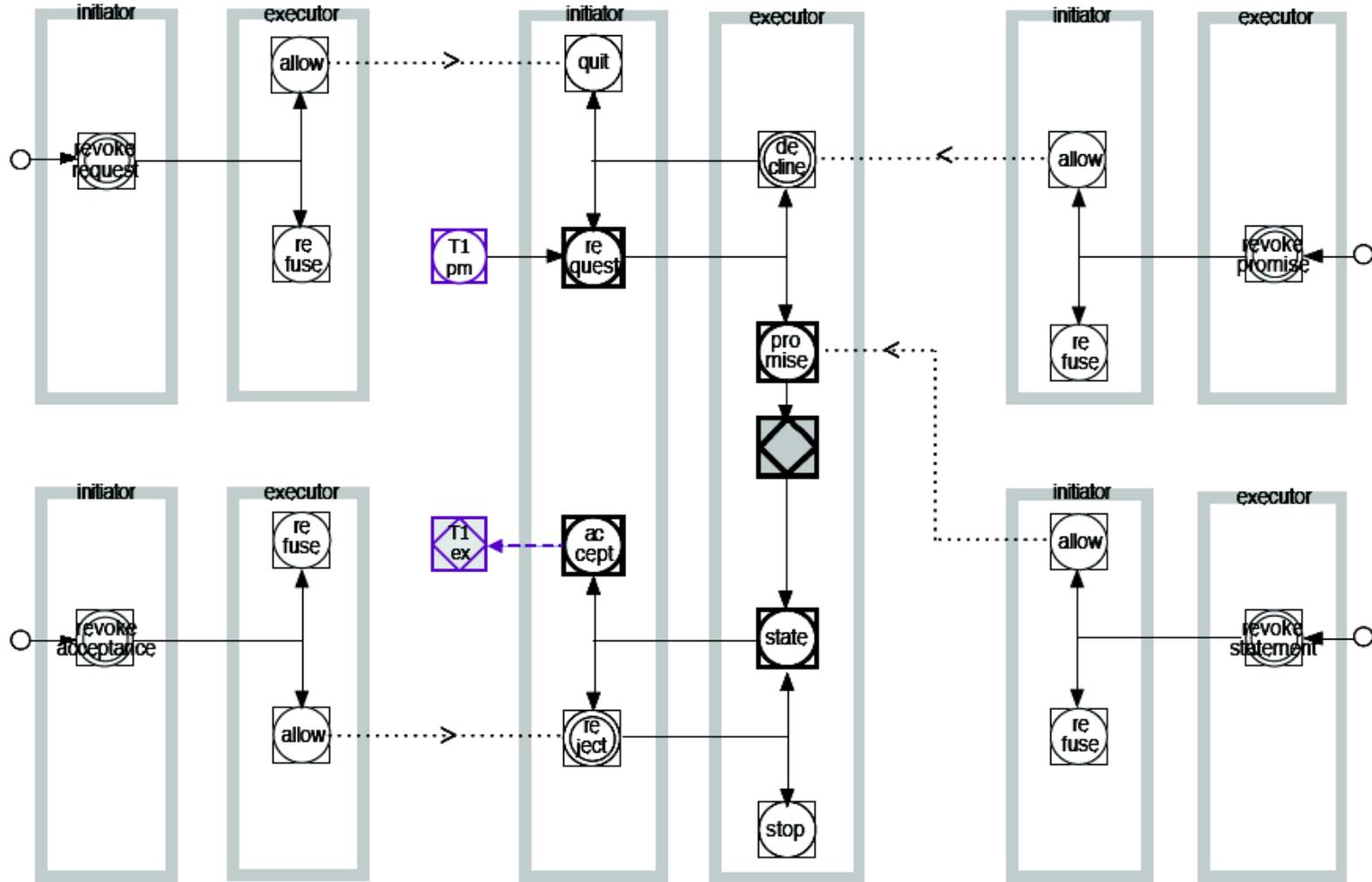


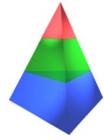




# Volley: Process Model (3)

Transaction Process Diagram of T2



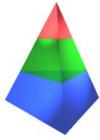


# Example of an action rule

In carrying through a transaction, actors are guided by action rules.

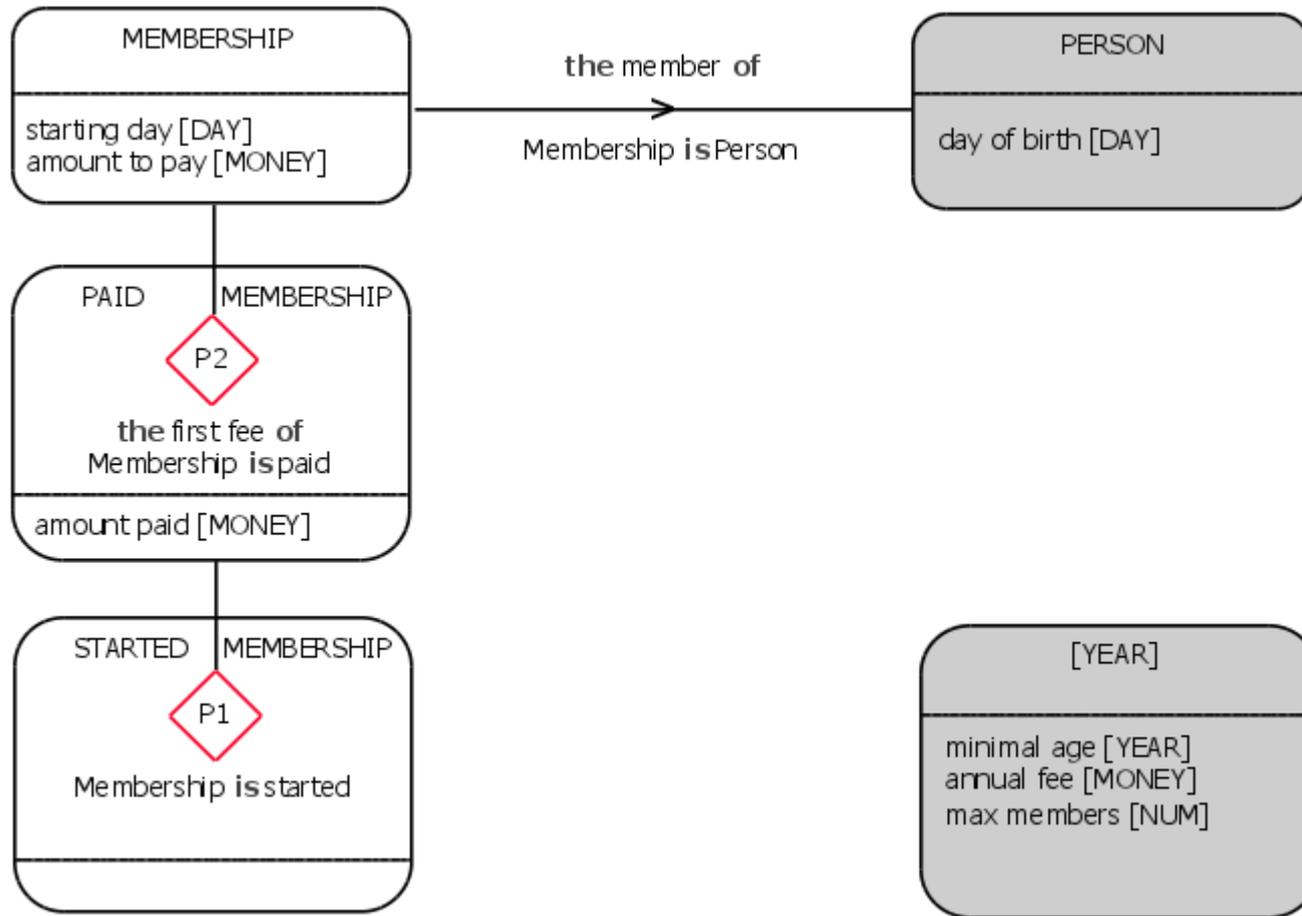
Actors respond to business events autonomously. Therefore, business processes are fundamentally non-deterministic.

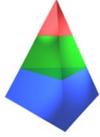
<b>when</b>	membership start for <u>new</u> Membership <u>is requested</u>	(T1/rq)
	<b>with</b> the member of Membership is a Person	
	the starting day of Membership is a Day	
<b>assess</b>	<i>justice:</i> the <u>performer</u> of the <u>request</u> is the (aspirant) member of Membership	
	<i>sincerity:</i> < no specific condition >	
	<i>truth:</i> Day is the first day of some Month;	
	Month is greater than Current Month;	
	the age of Person is equal to or greater than the minimal age in the year of Day;	
	the number of members on Day is less than the max members in the year of Day	
<b>if</b>	<i>complying with request is considered justifiable</i>	
<b>then</b>	<u>promise</u> membership start for Membership	[T1/pm]
<b>else</b>	<u>decline</u> membership start for Membership	[T1/dc]



# Volley: Fact Model

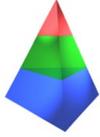
Object  
Fact  
Diagram





# What benefits does DEMO offer you?

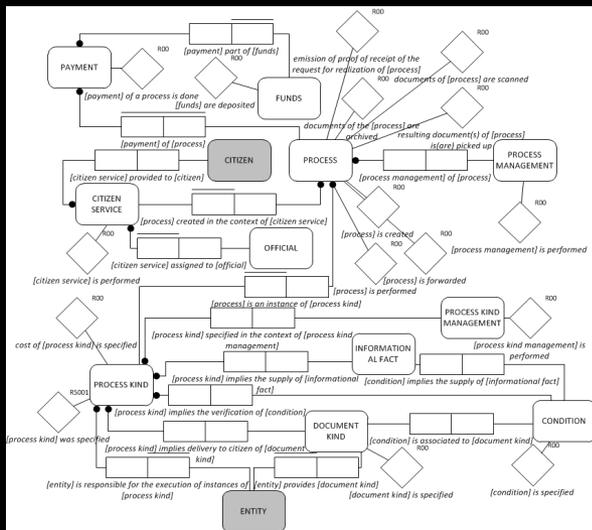
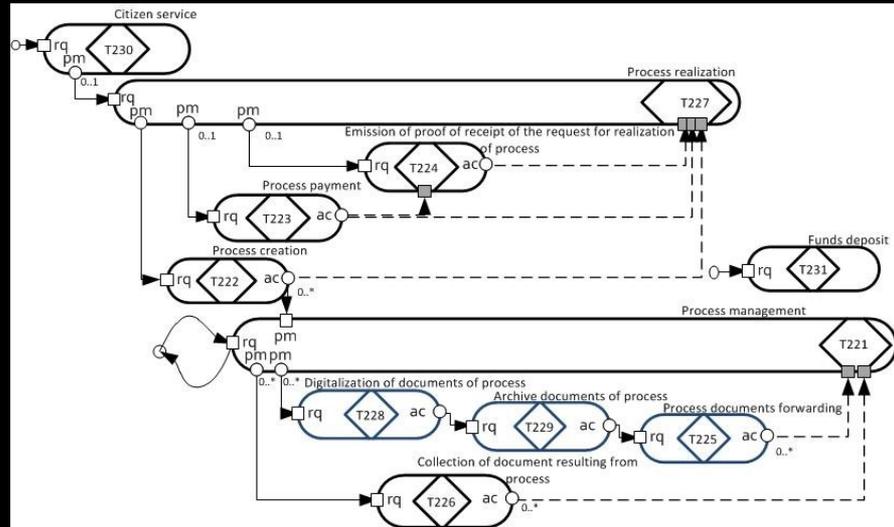
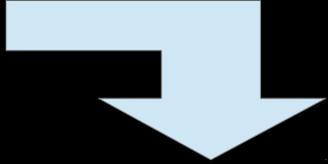
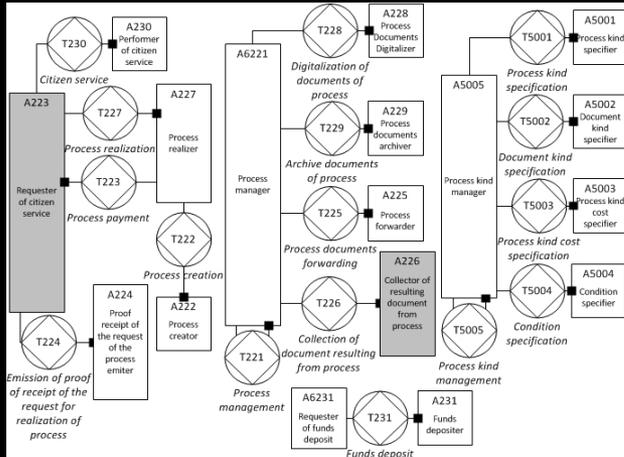
- Re-establishing people as the 'pearls' of your organization
- Unequaled deep and coherent insight in your organization.
- Service-oriented analysis and design of your business processes.
- Full transparency of your (service-based) organization.
- Clear identification of data and process ownership
- Truly objective basis for requirements engineering.
- Unequaled reduction of model complexity (> 95%).
- Unequaled return on modeling effort (5-10 times higher).



# Who needs Enterprise Ontology?

- **Managers** - need to understand the ontological essence of their enterprise because they are held accountable.
- **Architects** - need to understand organizations (and information systems) abstracted from their implementation, for making the right design decisions.
- **Employees** - only the ontology of an enterprise shows the roles they really fulfill, and the relationships with others that really exist.
- **Customers** - why should the operation of an enterprise be fully opaque to its customers? Enterprise Ontology provides them the transparency they deserve!

# An e-government project Case Study



# Context

- **Apply DEMO** to model the **processes, interactions and information flows** occurring in a Small Local Government Administration (SLGA) to elicit requirements to:
  - **Implement a workflow system** - simplify and automate operational processes
  - **Develop online portal** - automate interactions and services provided at a Citizen Service Desk (CSD)
  - **Develop IT integration layer** with other regional/national government entities that execute most processes

# Contributions

- **CSD transaction patterns** (scope of e-government initiative) **applicable in similar projects**;
  - **Abstraction of the management of 164** processes into around **10 transactions**
  - Out of **more than 500 transactions** modeled...
- **Method**, directly **supported by a prototype tool** for:
  - **Propagation of changes in class names** to derived result types and facts
  - Automatic **synchronization of data** from model elements to DEMO diagrams

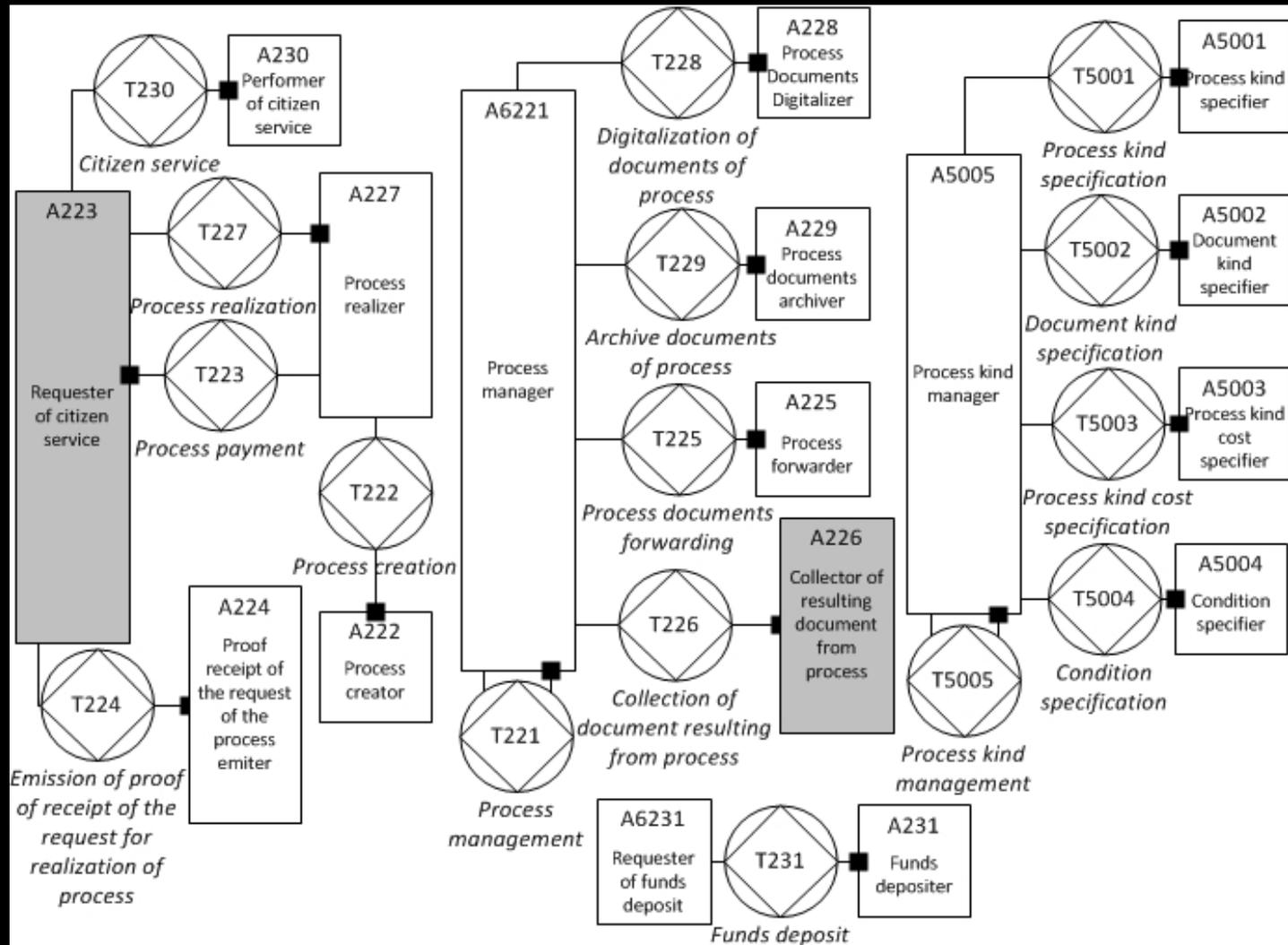
# Some more context

- **Customer Service Desk**
  - 164 distinct processes (in constant change)
  - Interactions with 12 distinct government entities
    - 1 local to the island where CSD is located
    - 1 in the mainland
    - 10 in the main island
  - CSD works as a proxy
    - Processes are requested in CSD
    - Execution takes place at the responsible government entity
    - Documents may return to the CSD for delivery to citizen

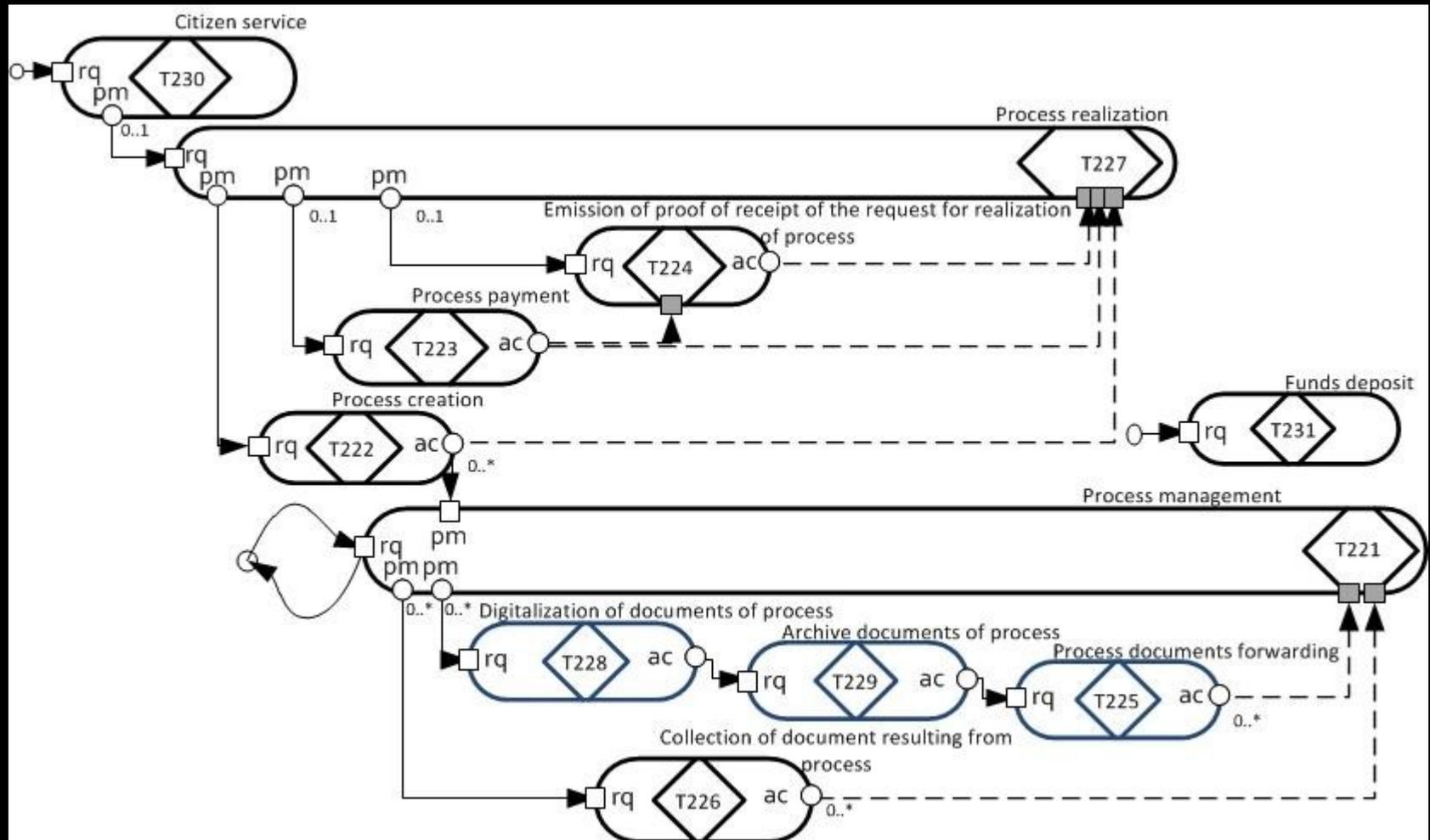
# Customer Service Desk: Actor Transaction Diagram

- **Four clusters/processes identified**
  - **Process realization** – Daily process dealing routine coordination
  - **Process management** – Daily tasks of process archiving and dealing with other government entities
  - **Funds** – funds deposits onto government entities' accounts
  - **Process kind management** – to specify and accomodate future new processes/transactions
    - vital for a **flexible workflow system** obeying CSD specified conditions/constrains (operational and legal)

# Customer Service Desk: Actor Transaction Diagram



# Customer Service Desk: Process Step Diagram





# Customer Service Desk: Object Fact Diagram

- **Two main classes**
  - **Process** – Keeping instances of every day processes
  - **Process Kind** – Keeping instances of process kinds
    - **Constant changes** every couple of months (new processes, process removal, procedural and legal changes)
- **Three key related classes**
  - **Informational Facts**
  - **Conditions**
  - **Document Kinds**

# Supporting Tools

- **Google Spreadsheet** – centralized repository to share knowledge between team members
  - Transactions Worksheet
    - Transactions, Actors, Transaction Steps ...
  - Facts Worksheet
    - Classes, Fact Types and Result Types
- **Microsoft Visio synchronization**
  - Linking and automatic synchronization of diagram data with model data in worksheets

# Visio synchronization

## ■ Advantages

- All diagram names and ids in complete sync with worksheet data
- Diagrams constantly updated in a simple two step process of export and update
- Easy validation so that nothing is missed
- All data in the worksheet available locally in Visio while editing diagrams and selecting model elements
- All sheet row data stored in the respective element

# Visio synchronization

Shape Data - object class.1 x

Class_1	CITIZEN
Type	external
IDA	1
IDB	0
Kind	CL
ID_R	
Class_2	
Result_type	
RT_prefix	

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Kind	IDA	Class_1	Class_2	IDB	Result
CL	1	CITIZEN		0	
FT	2	CITIZEN	CITIZEN SERVICE	0	
CL	3	CITIZEN SERVICE		0	
RT	3	CITIZEN SERVICE		1	[citizen service] is performed
FT	4	CITIZEN SERVICE	OFFICIAL	0	
CL	5	OFFICIAL		0	
FT	6	CITIZEN SERVICE	PROCESS	0	

External Data

Facts

# Relevant results

- **Transaction axiom relevance** in information gathering
  - Distinguishing all the main transaction steps
  - Clarifying organizational functions that fulfill the initiating and executing actor role of each process
  - Delegation of transaction steps
    - Clear and unequivocal identification of the institutions responsible for the execution of each process step
  - Aids in the process of specifying more precise transaction names

# Relevant results

- **Distinction Axiom** to facilitate the implementation effort
  - **Informational Facts** – What facts we really need, opposed to what documents or composite facts are normally asked for
    - Many documents are asked but **only pieces of that information are needed**
    - Most of the needed informational facts may be, in the future, gathered directly from official online government databases through webservice

# Relevant results

## ■ Tooling Solution

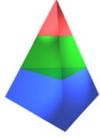
- Allows for effective **collaborative work** in model data gathering and synthesis and coherent and integrated DEMO diagramming
- Immense **time saving** on **change propagation**
- **Coherence** and **completeness** easier to achieve
- **Easy to replicate** in other projects using DEMO

## ■ **Comparison** to other requirements engineering approaches

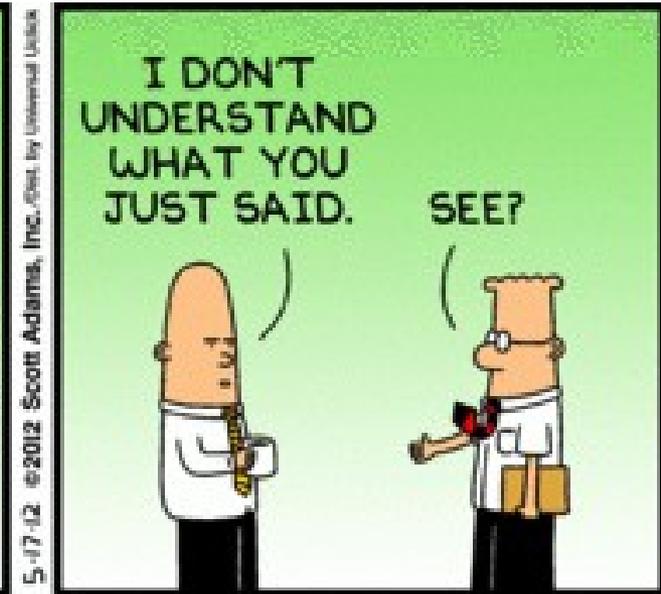
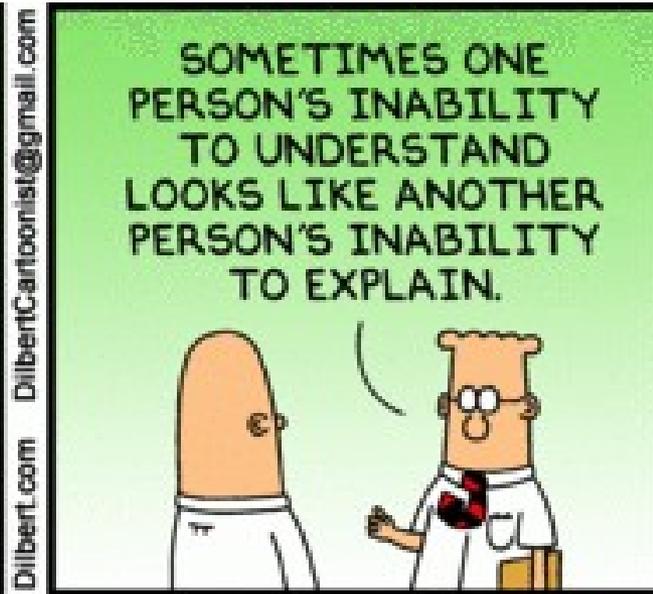
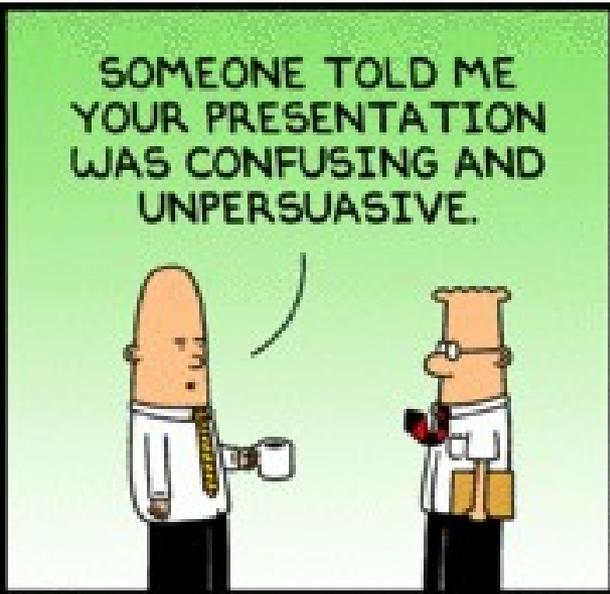
- Much more **quick** and **effective results**

# Conclusions

- **Ψ-theory and DEMO**
  - Can be used to justify
    - Needed organizational changes
    - Information policies
    - Establishment of common data semantics
  - Offer a future implementation road-map with
    - Critical points of interaction
    - Clear responsibility distribution
  - Much less ambiguous than other approaches



# Questions?



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