The Role of Conceptual Modeling in Managing and Changing the Business

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Five Minutes Summary

- Conceptual modeling main use: IS development
  - Better than no conceptual models
  - Limitations → requirements problems
- To gather more accurate requirements, moving toward to also representing the business context.
  - E.g., Enterprise Architecture, business UML, etc.
- Our research in including business context led us to discover a region that interest organizational workers.

Five Minutes (the Where Part)

Business needs

IS needs

An under explored area

Business as considered by IT people
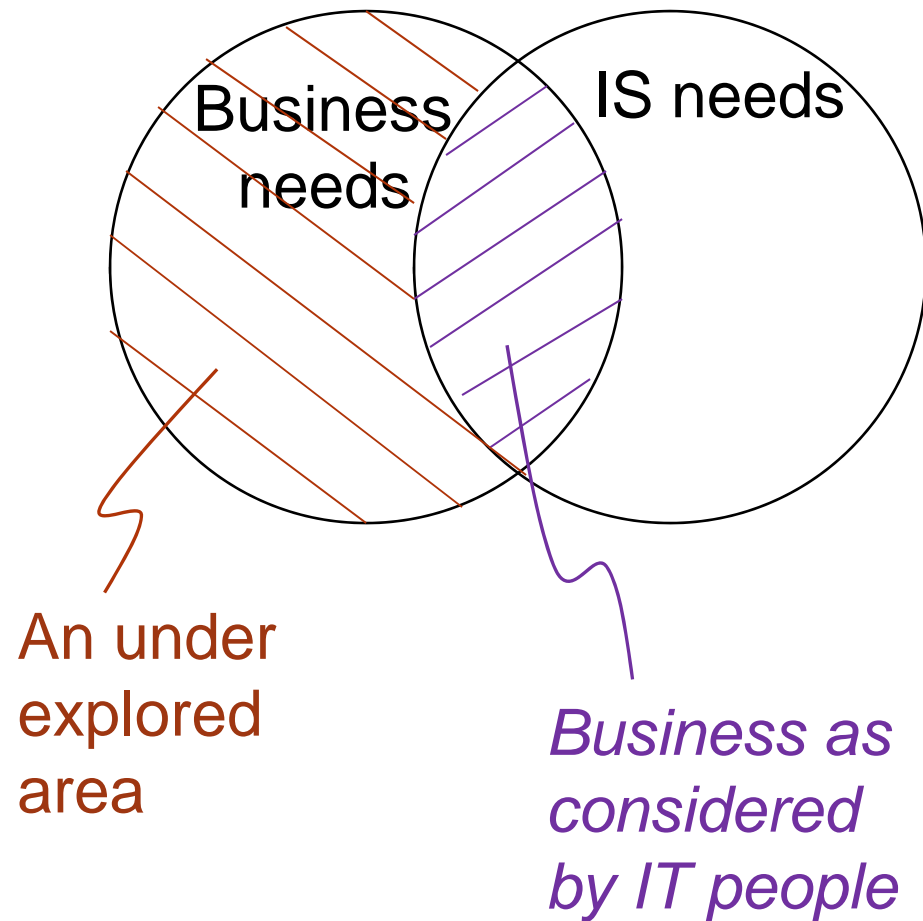
Five Minutes (the Why/How Part)

- Why are we doing this?
  - We are (supposed to be) good in concretization.

- How?
  - Stop thinking about IT (e.g., database; steps)
  - Derive concepts from Management.

- We propose the use of organizational actor
  - Who plays a role, has a goal (and a thought process).

- Can add concepts depending on needs.
  - E.g., interactions and tasks → business process

Five Minutes (the So What Part)

- Diagrams that can be used by org workers
  - Value proposition: *Org workers need them for their work*
  - Will provide more context to IS developers

- Some future work:

  - Others can build more concepts based on organizational actors who have a goal (and a thought process).

  - Generate work for mapping this type of conceptual models to implementation needs.

Outline

- Conceptual modeling experience
- Existing work for modeling the business
- Example conceptual models for organizational workers
  - Business-IT alignment modeling
  - Organizational actor modeling
  - Role and Request modeling
- Conclusion and perspective
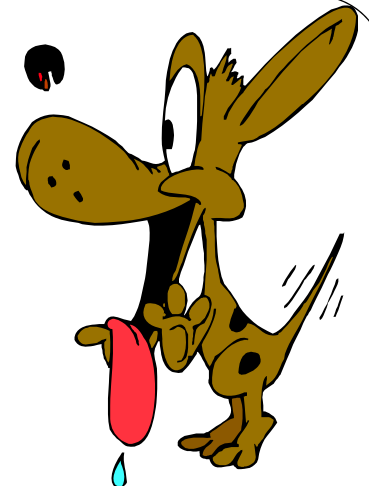
Conceptual Modeling

- A definition from Mylopoulos (1992):
  - The activity of formally describing some aspects of the physical and social world around us for the purposes of understanding and communication.
- The product is a conceptual model (a diagram).
- Some examples:
  - Entity-relationship (ER) diagrams
  - Business process diagrams
  - Organizational charts
 - Rich pictures (Soft Systems methodology)

Our Experience

- To better understand requirements, we need to understand the business
- We have been extending conceptual modeling to include more *business context*
  - E.g., vision and mission of the company
- Including business context seems to lead to users *discovering information they did not know previously*
  - E.g., assumptions used in making a decision
  - E.g., incorrect interpretation of an assignment by a subordinate

Extending Conceptual Model Use

- Conceptual models have been used by *systems analysts* to communicate with users and developers.

- We are proposing that conceptual models are also valuable for allowing *organizational workers* to understand operations, support decision-making, and derive new knowledge

ER'2011 (October 31, 2011)
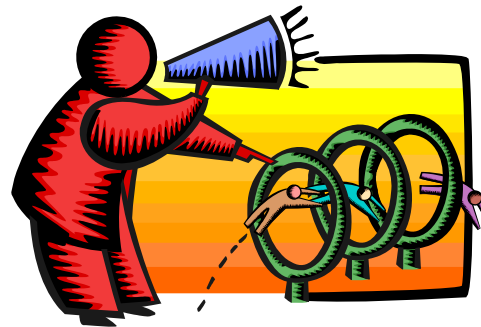
An Analogy: Business Intelligence

- An aggregated and organized view of data
- We propose an aggregated and organized view of organizational activities.
    - Identify patterns inside the organization to understand its operation.
- Why this need? Examples:
    - Organizational evolution and environmental changes
    - Turn over in management and employees

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Modeling the Business – Current

- Existing approaches:
  - Business process modeling, enterprise architecture, i*, e^3 Value, work systems, business UML, etc.

- Some problems for using existing diagrams:
  - Complicated diagrams – large amount of details
  - Consistency of creating (interpreting) them
  - Fuzzy relationships among diagrams
  - Extra workload for business people
  - Focus too much on the IT side

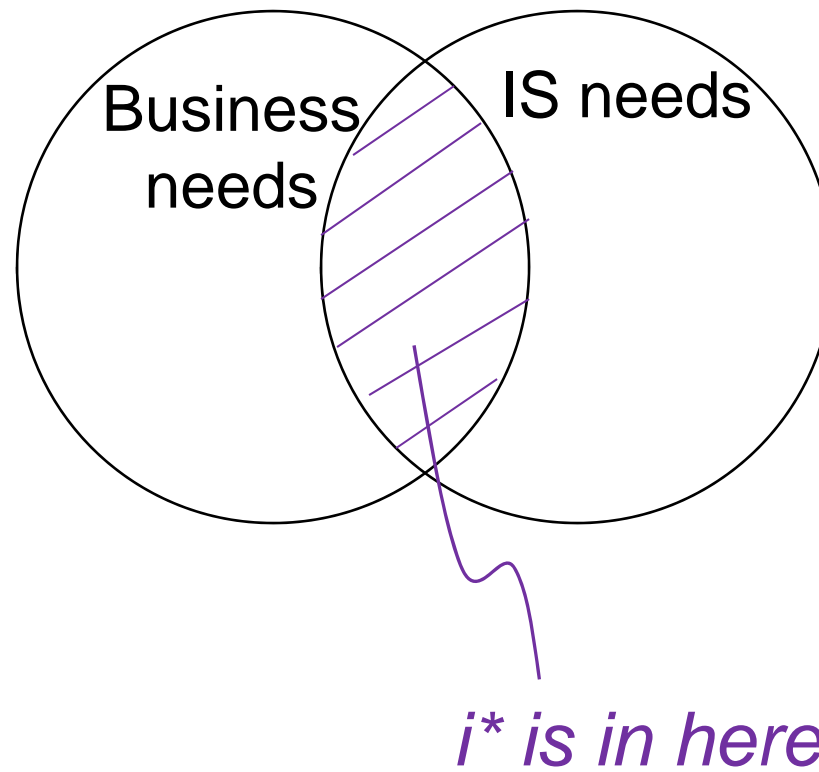# Example: Enterprise Architecture
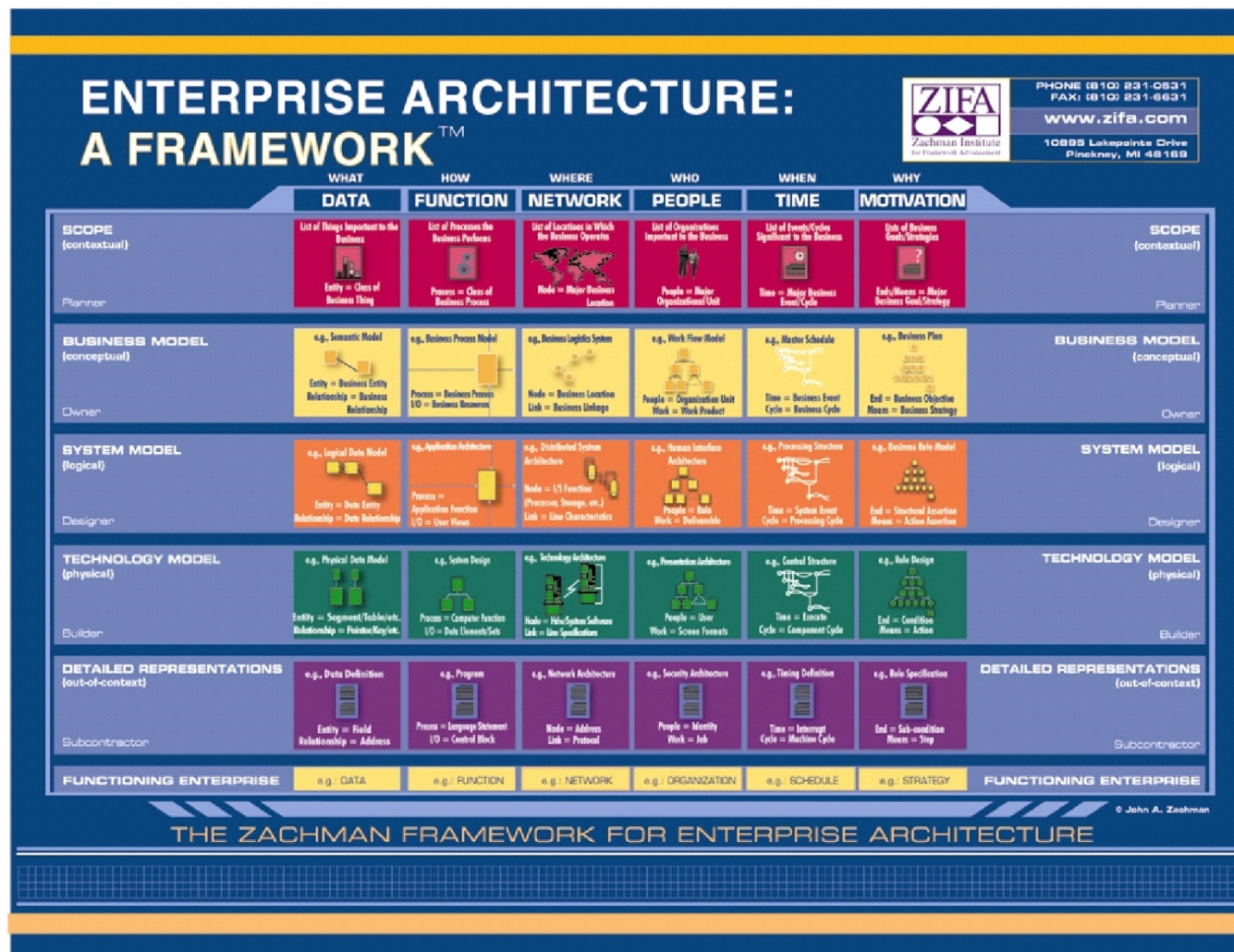
Zachman's EA Framework

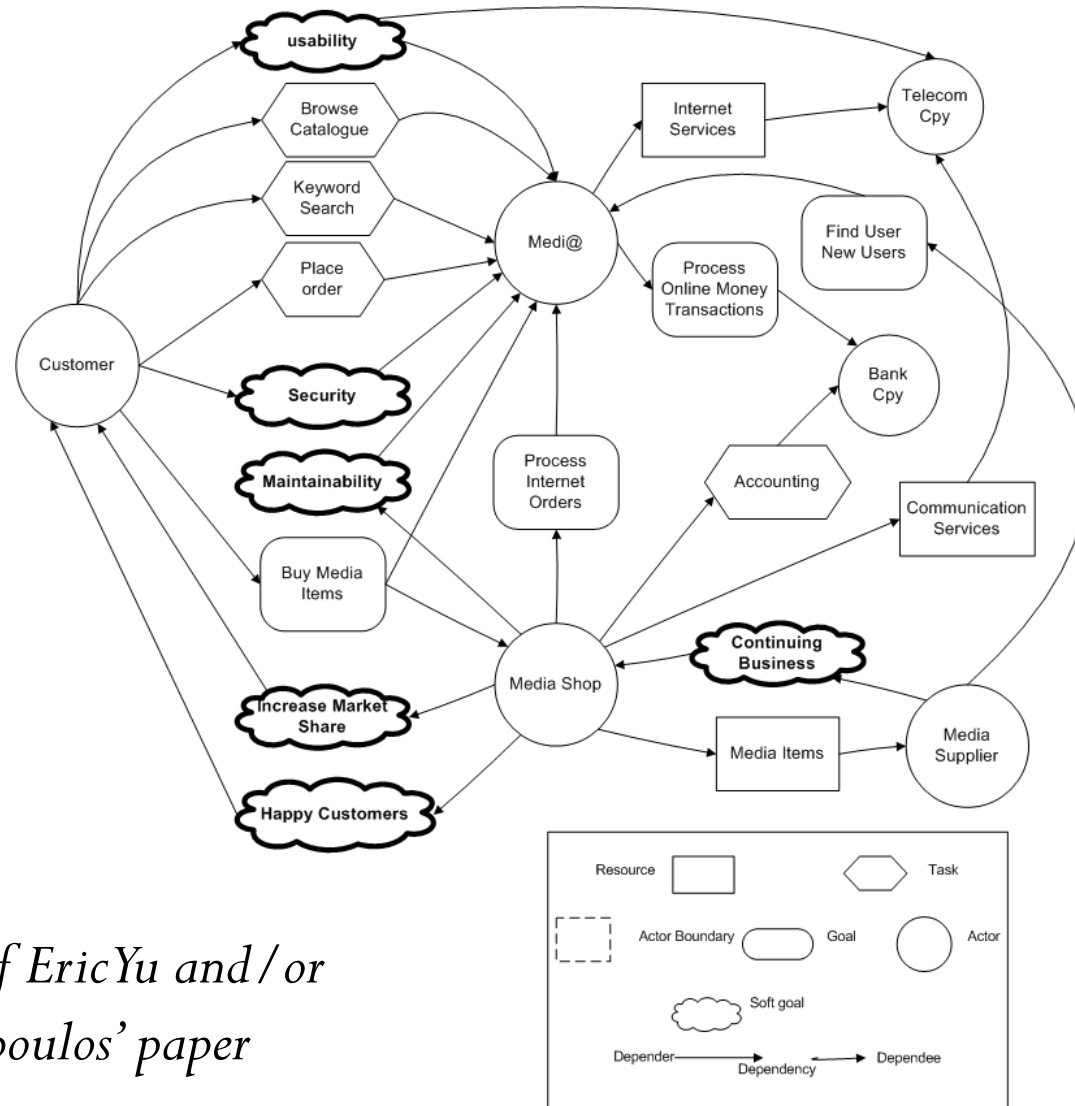(From an Enterprise Architecture Meeting)

- Too many diagrams
- Do not know where and how to start
- Only a framework
  - No methodology
  - No grammar
  - Current: Zackman + TOGAF + DoDAF
- Connections between diagrams unclear
- Org workers are not interested in using them
- *Great difficulty in using it to justify IT investments*

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What About i*?

Business needs

IS needs

i is in here

An Example i* Diagram

usability

Browse Catalogue

Keyword Search

Place order

Internet Services

Telecom Cpy

Find User New Users

Medi@

Process Online Money Transactions

Customer

Security

Bank Cpy

Maintainability

Process Internet Orders

Accounting

Communication Services

Buy Media Items

Media Shop

Continuing Business

Increase Market Share

Media Items

Media Supplier

Happy Customers

Resource | Task
Actor Boundary | Goal | Actor
Soft goal
Depender — Dependency → Dependee

From one of EricYu and/or
John Mylopoulos' paper

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What is i* Missing?

Business needs

IS needs

What is in here then?

A Foundation of i*

- Based on Resource Dependency Theory
- Resource dependency theory states:

  i* took this
  - Actors lacking in essential resources will seek to establish relationships (*be dependent upon*) others in order to obtain needed resources.
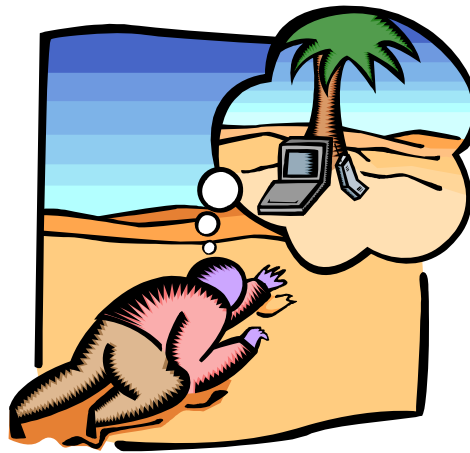
  But not this
  - Organizations will seek to formalize *agreements that govern the exchange of resources* with others to ensure continuing access to needed resources

No direct relevance to developing information systems?

Dependency Network Diagram

- Tillquist, King, and Woo (2002)
- Viewing resource dependency can help
  - Understanding organizational relationships
  - Designing control and coordination explicitly
  - Diagnosing the impact of IT implementation

A Pictorial View of DND Concepts

Role 1

Activities

Goal

Dependency 1

Governance Control 1

Role 2

Activities

Goal

Dependency 2

Governance Control 2

Role 3

Activities

Goal
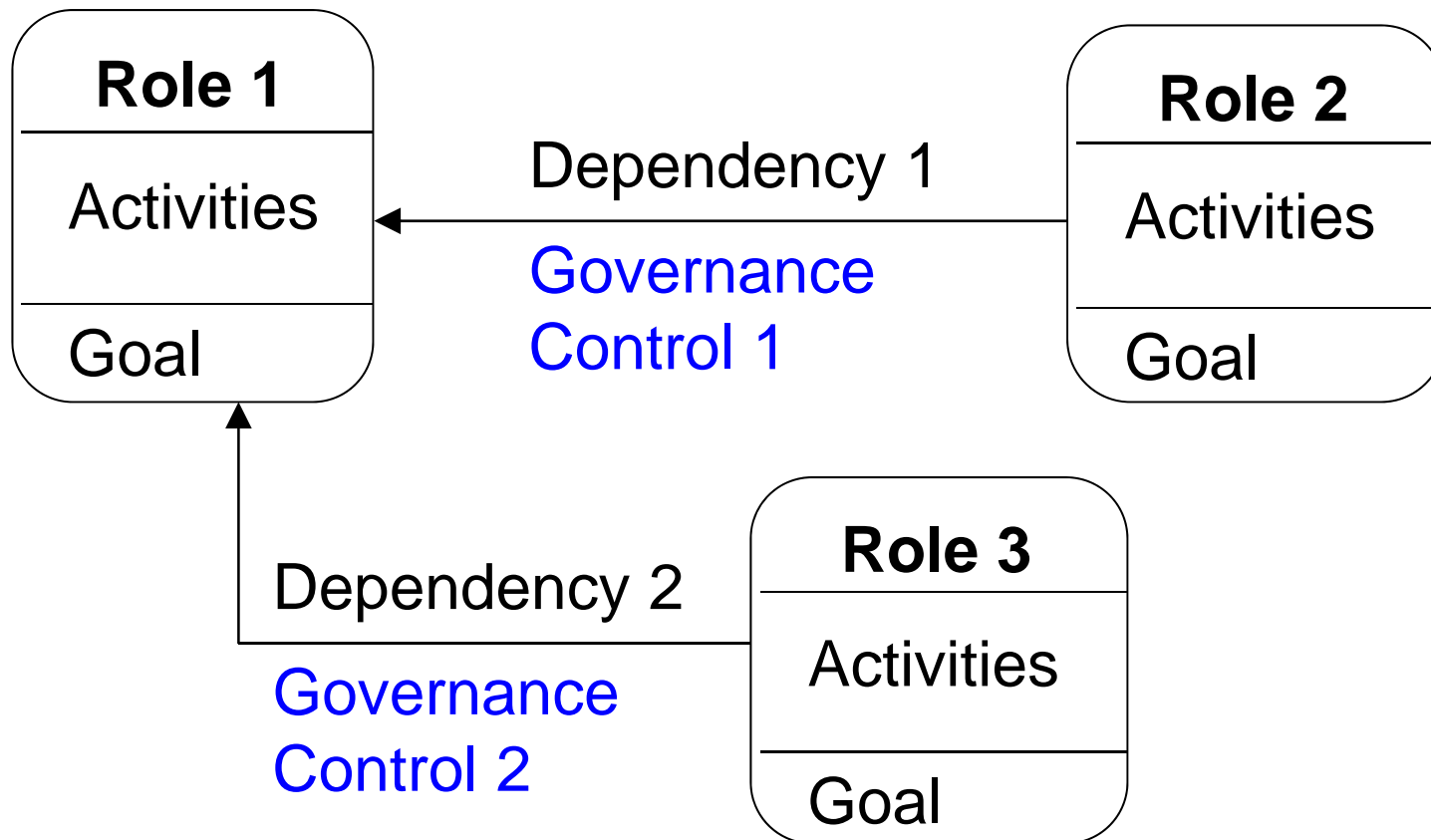
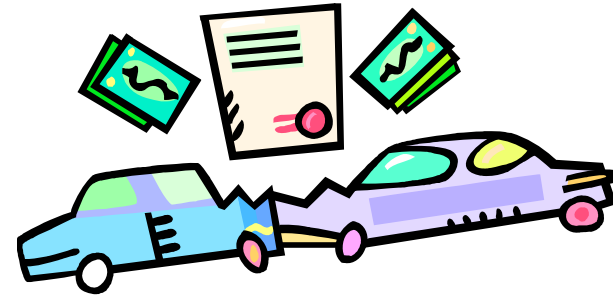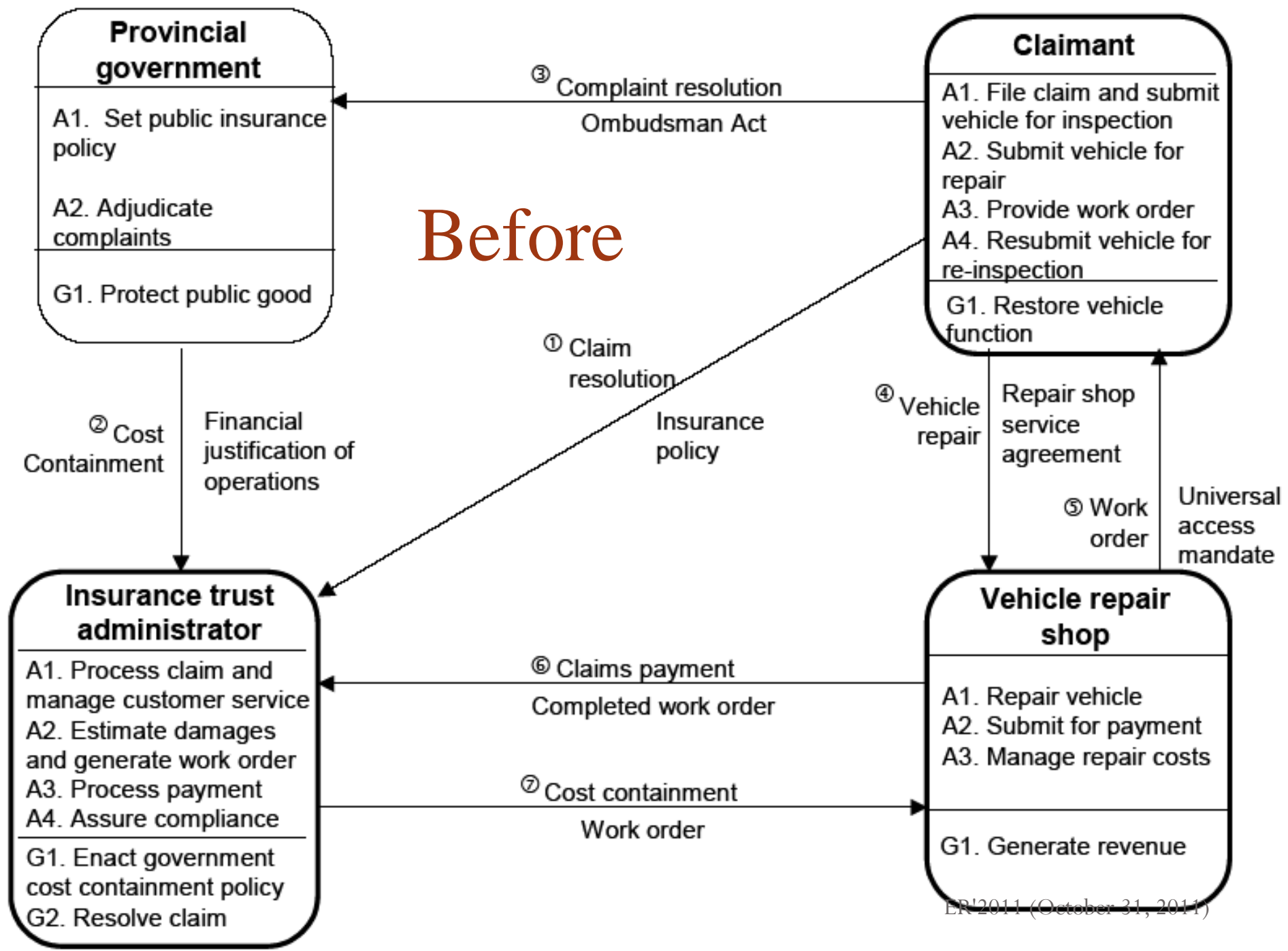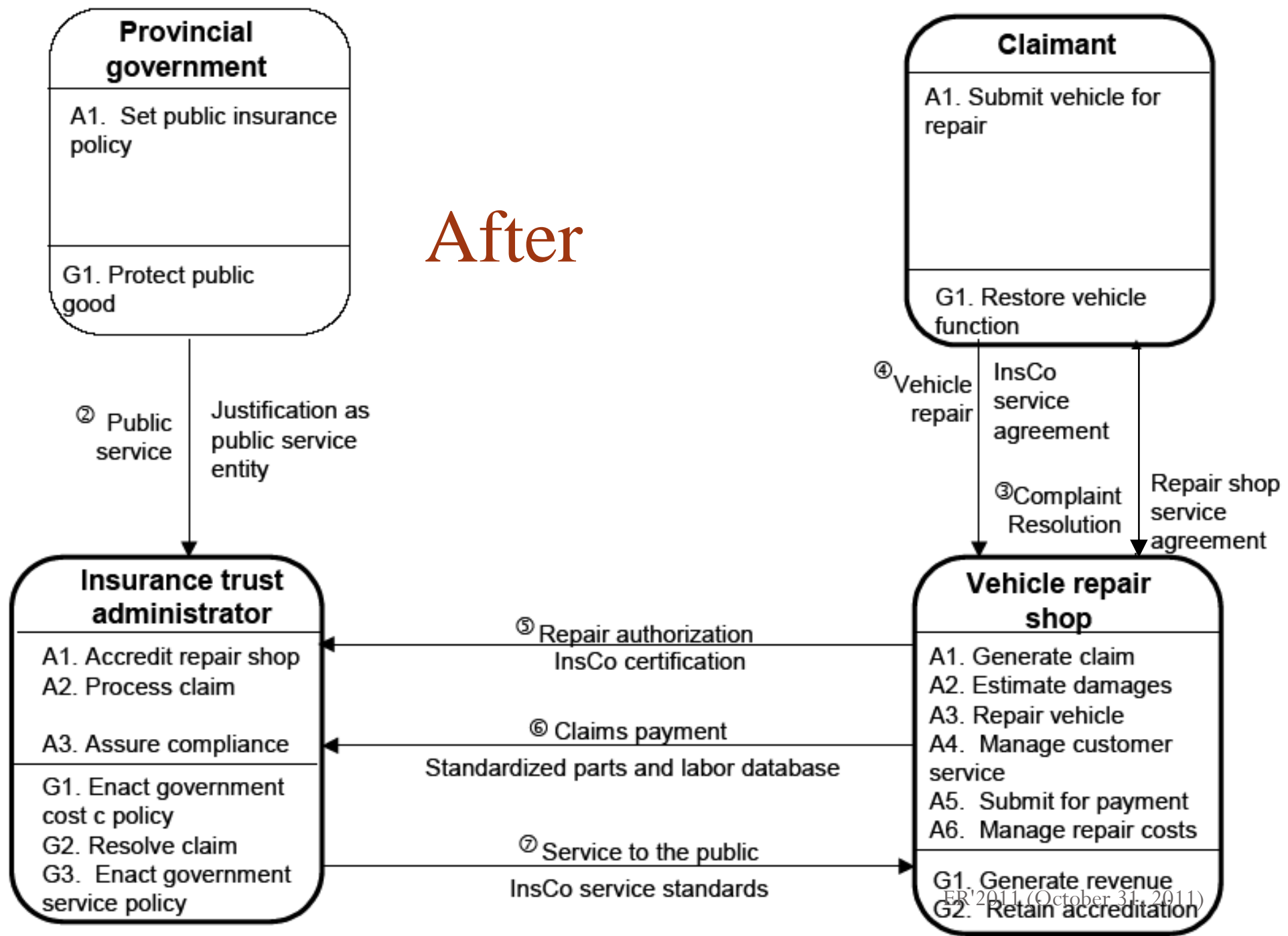# Experience

- The insurance claim process of a Canadian insured vehicle repair industry
- Board of directors have no discussion about
  - The restructuring of the repair shop market
  - The realignment of complaints
- Using the dependency network diagram, the nature of changes being undertaken becomes quite intuitive.

Provincial government

A1. Set public insurance policy

A2. Adjudicate complaints

G1. Protect public good

Claimant

A1. File claim and submit vehicle for inspection
A2. Submit vehicle for repair
A3. Provide work order
A4. Resubmit vehicle for re-inspection

G1. Restore vehicle function

Insurance trust administrator

A1. Process claim and manage customer service
A2. Estimate damages and generate work order
A3. Process payment
A4. Assure compliance

G1. Enact government cost containment policy
G2. Resolve claim

Vehicle repair shop

A1. Repair vehicle
A2. Submit for payment
A3. Manage repair costs

G1. Generate revenue

③ Complaint resolution
Ombudsman Act

Before

① Claim resolution

Insurance policy

② Cost Containment
Financial justification of operations

④ Vehicle repair
Repair shop service agreement

⑤ Work order
Universal access mandate

⑥ Claims payment
Completed work order

⑦ Cost containment
Work order

ER'2011 (October 31, 2011)

After

Provincial government

A1. Set public insurance policy

G1. Protect public good

Claimant

A1. Submit vehicle for repair

G1. Restore vehicle function

② Public service

Justification as public service entity

④ Vehicle repair

InsCo service agreement

③ Complaint Resolution

Repair shop service agreement

Insurance trust administrator

A1. Accredit repair shop
A2. Process claim

A3. Assure compliance

G1. Enact government cost c policy
G2. Resolve claim
G3. Enact government service policy

⑤ Repair authorization
InsCo certification

⑥ Claims payment
Standardized parts and labor database

⑦ Service to the public
InsCo service standards

Vehicle repair shop

A1. Generate claim
A2. Estimate damages
A3. Repair vehicle
A4. Manage customer service
A5. Submit for payment
A6. Manage repair costs

G1. Generate revenue
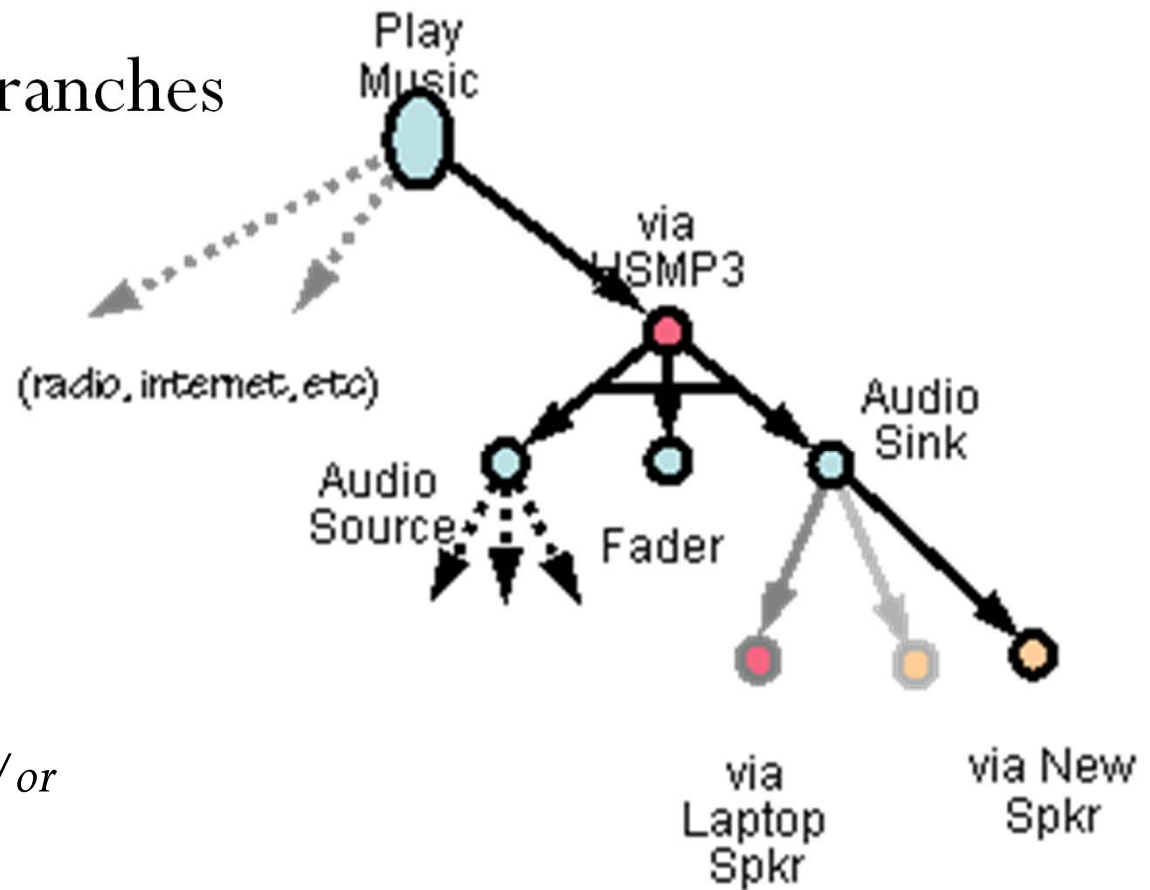G2. Retain accreditation

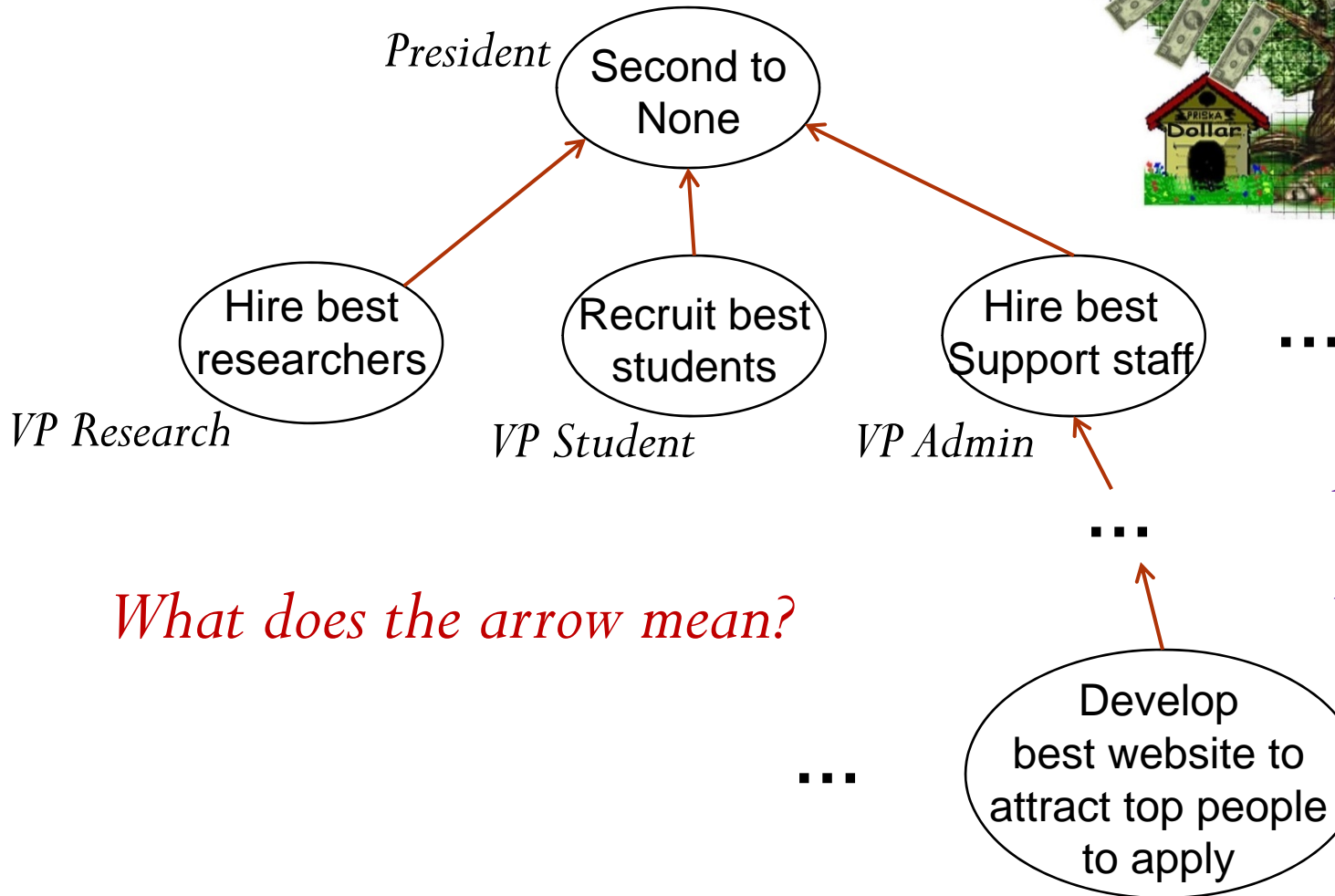ER'2011 (October 31, 2011)

Goals in Artificial Intelligence

- AND and OR branches

- Meaning of branches

From one of EricYu and/or
John Mylopoulos' paper

Goals in Business?

President **Second to None**

VP Research — **Hire best researchers**

VP Student — **Recruit best students**

VP Admin — **Hire best Support staff** ...

...

What does the arrow mean?

Are you going to invest in this IT project ?

Develop best website to attract top people to apply

...

How to Provide Values for Organizational Workers?

Experience from extending the use of Conceptual Modeling to include business context

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An Example – Our Work

We view business as consisting of organizational actors (or roles), each of them has a goal and a thought process:

- An actor is not a static thing (e.g., a book), not a computer program, and not any conceptual thing (e.g., a course).

- An actor is a (group of) human being (can be with a machine) who has

  - Independent behaviour (rationale, but may not be predictable).
  - The ability to fulfill certain responsibilities.
  - Can handle situations not encountered previously.
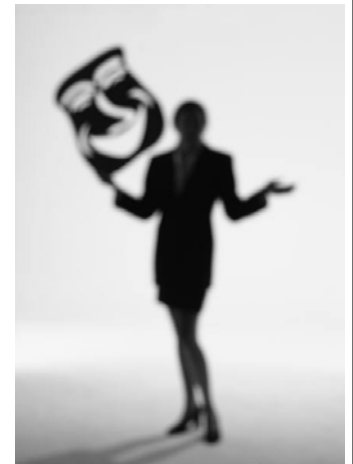
Organizational Actor (cont ...)
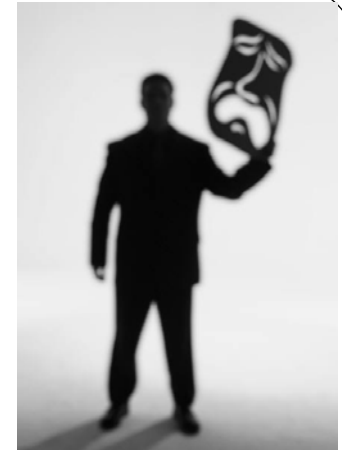
- A goal is some desirable state of the actor or its environment.
  - Goal is defined depending on which level of the organization the actor works in.

- Thought process: internal behaviour of org actors
  - To provide an understanding of their beliefs (assumptions), rationale in reasoning, and ability in learning (adaptation).

- Relationship between organizational roles
  - To provide an understanding of Business-IT alignment.

Next, conceptual model examples and values to users.

What About ERD, BPMN, … ?

- <u>Claim</u>: if done properly, additional concepts can be incorporated into organizational actors so that you get
  - Organizational Chart
  - Business Process Diagram
  - …

Yet Another Approach?

- To avoid bias in our IT background and thinking, we developed this approach based on:
    - Strategic management literature
    - Human resource management literature
    - Personnel psychology literature
    - Theory of affordances (Psychology)
    - Systems theory (Engineering) – e.g., feedback systems
    - Ontology (Philosophy)
- The theoretical development of the work:
    - Sufficient to say that we worked hard avoiding the biases in our IT background and thinking.

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Business-IT Alignment

- At the IT level (requirements engineering field):
  - Use "goals" to specify requirements and leave the details of accomplishing the goals to IT developers
- At the business level (need to distinguish different goals):
  - Strategic Goals
    - For supporting the realization of the organizational vision;
    - Set by and for top management.
  - Assigned Goals (*operational goals* as seen by top management)
    - Decomposed from a higher order strategic goal;
    - Executives and middle managers set these goals.
  - Interpreted Goals
    - Actor's interpretation of the assigned goals.

Singh and Woo (2009)

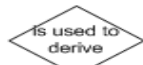# Relationship of the Different Goals
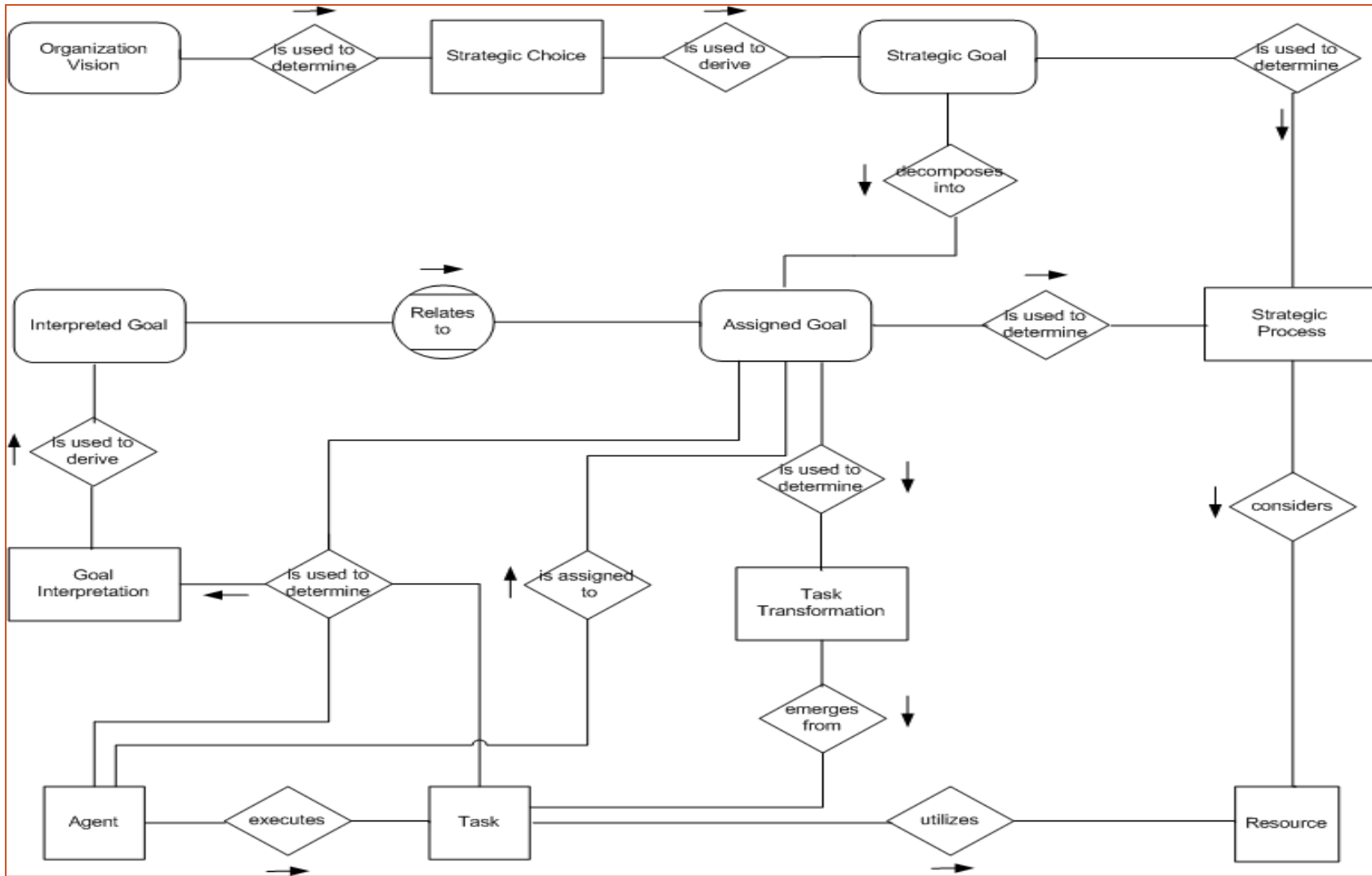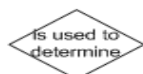
ER'2011 (October 31, 2011)
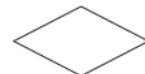
Example of mapping "aligned" Operational level goals to Tactical and Strategic level goals
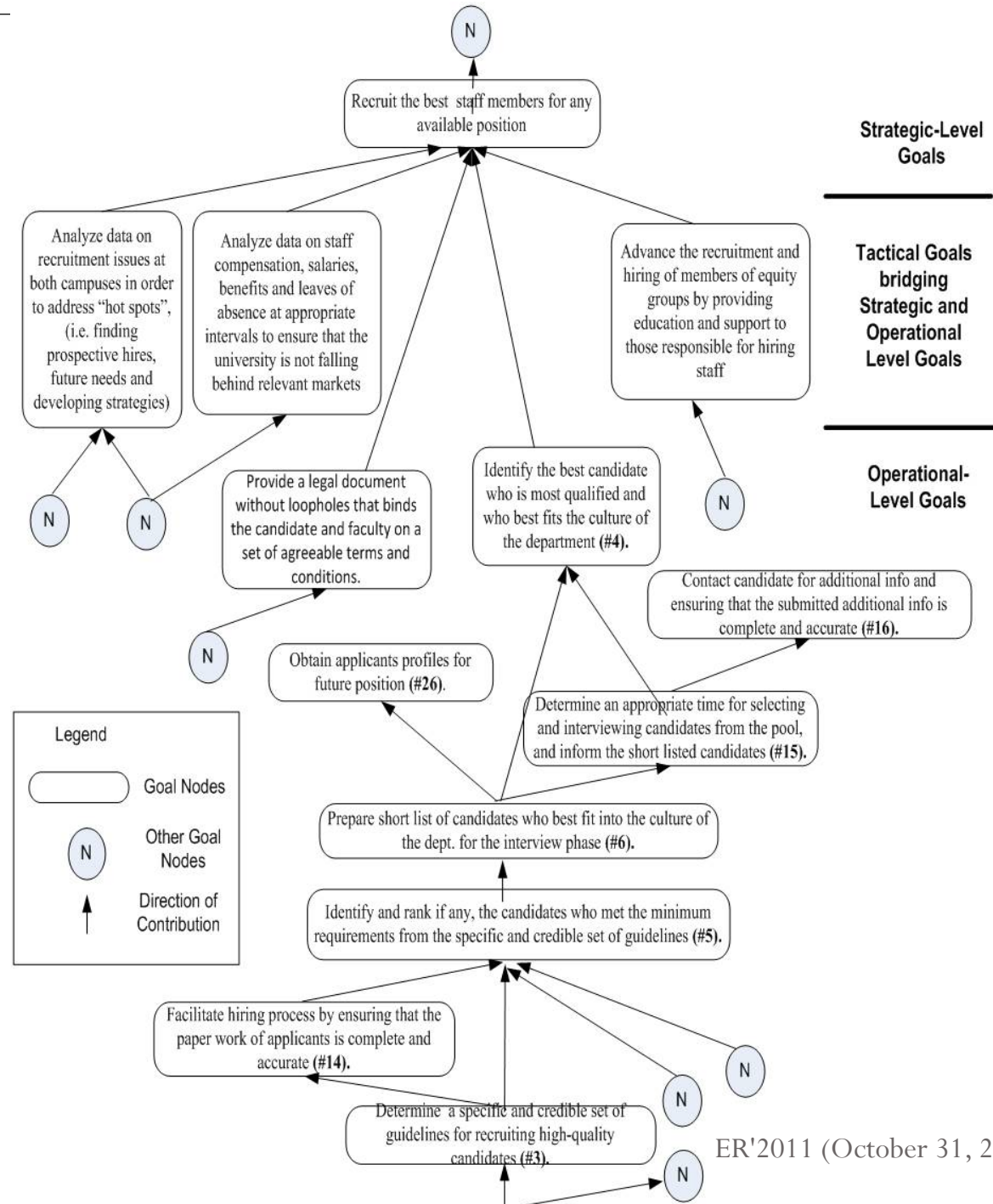
Business-IT Alignment: Experience

Conducted two case studies and discovered that the conceptual model:

- Helps organizational workers understand the coherence of and congruency among operational, tactical, and strategic goals.

  - E.g., force a HR manager to think through the goals in depth, and revise her interpretations to align with the strategic intent.

- Identifies critical goals at the operational level that directly contribute to *multiple* strategic-level goals.

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Thought Process
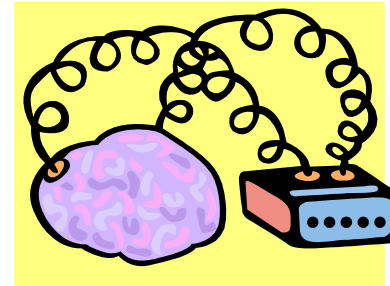
Represent an actor's behaviour to discover the context of his actions and determine the rationale for their behaviour:

- Interpreting the world
  - Actors make sense of the world by learning through their perceptions to form beliefs (assumptions) about the world.

- Making decisions
  - Actors use their model of the world to reason about their intentions to change their world based on their goals.

- Performing actions
  - Using their resources and capabilities, actors perform actions to change their environment.

Monu and Woo (2009)

A Pictorial View of Actor Concepts
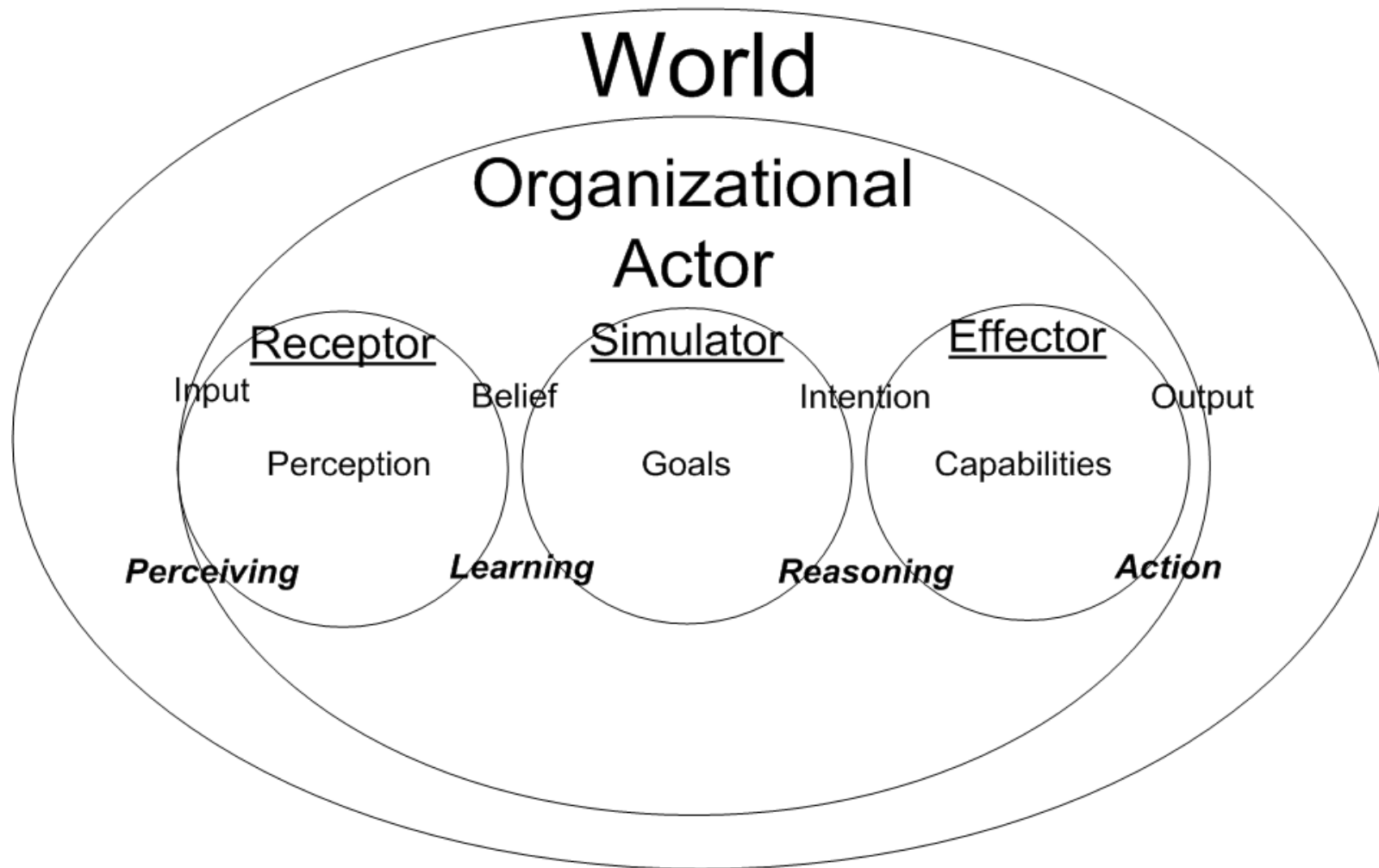
Internal Behaviour (An Example)

Consumer

Goal
Consume a good product every "turn" for a reasonable price

Intentions
purchase

Beliefs
Brand loyalty
Reservation Price
Chosen Retailer

Reasoning
if Retail Price of Chosen Retailer is <= reservation price *then* **purchase**

Actions
purchase
Buy (Market share of chosen retailer = number of retailers customer + 1 / all customers)

Retailer

Goal
Maximize utility based on how much it cares about profit or market share

Beliefs
Importance of Market Share
Importance of Profit

Market share of retailers

Level0 Player

Intentions
Guesstimate

Beliefs
Best Guess

Learning Criteria
if utility is maximized and price is equal to best guess then (best guess+) else (best gues -)

Reasoning
if Best guess *!= retailer price then* **guesstimate**

Actions
Guesstimate
alter price (Retailer price = Best Guess)

Level1 Player

Intentions
Outprice, Charge Maximum

Beliefs
Best Guess of opponent's price

Learning Criteria
if opponent maximizes their revenue and their price = best guess of opponent's price then (Best Guess of opponent's price+) else (Best Guess of opponent's price -)

Reasoning
if the utility of charging the maximize price is more than charging my opponent's price then
charge maximum
else **outprice**

Actions
Outprice
undercut opponent (Retailer price = best guess of opponent's price- 1)

Charge Maximum
charge reservation price (Retailer price = maximum)

Loyal Consumer

Learning Criteria
Chosen retailer is the brand that it is loyal to

Switcher

Learning Criteria
if the retailer has the lowest price then chosen retailer is that retailer

Price of retailers

Legend
△ Actor variable
····▶ Specialisation Arrow
──▶ Interaction Arrow

Internal Behaviour – 3 Applications

- Discovering the cause of behaviour in a simulation
  - Represented a price war between two companies and used the conceptual model to create a simulation of the situation.
  - Able to discover that how the actors interpret the world (and learn about it) had a greater effect on their behaviour than their goal.

- Discovering the hidden assumptions of a disaster plan
  - Able to discover the rationale of the actions found in a disaster plan, and also able to discover assumptions in the plan (e.g., key actors would always be able to interact during the disaster).

Third Application

- Discovering the details of a professional's knowledge
  - Discovered that despite a disaster management professional expert's training as an engineer, he acted mostly as a facilitator.
 - This made his supervisor alter his job description.
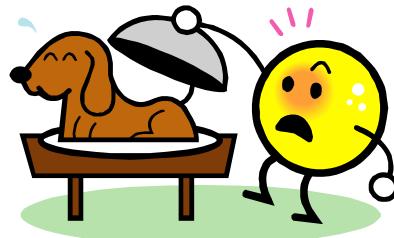
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Role and Request (R^{2}M) Modeling

- Joint work with Yair Wand

- Started with object-oriented analysis, but based on Bunge's Ontology as a foundation

- Basic concepts:
  - Roles interact with each other via requests
  - Roles also have responsibilities, goals, …

- A methodology:
  - Rules to guide the systems analysis

A Realistic R^{2}M Diagram

What Managers Want
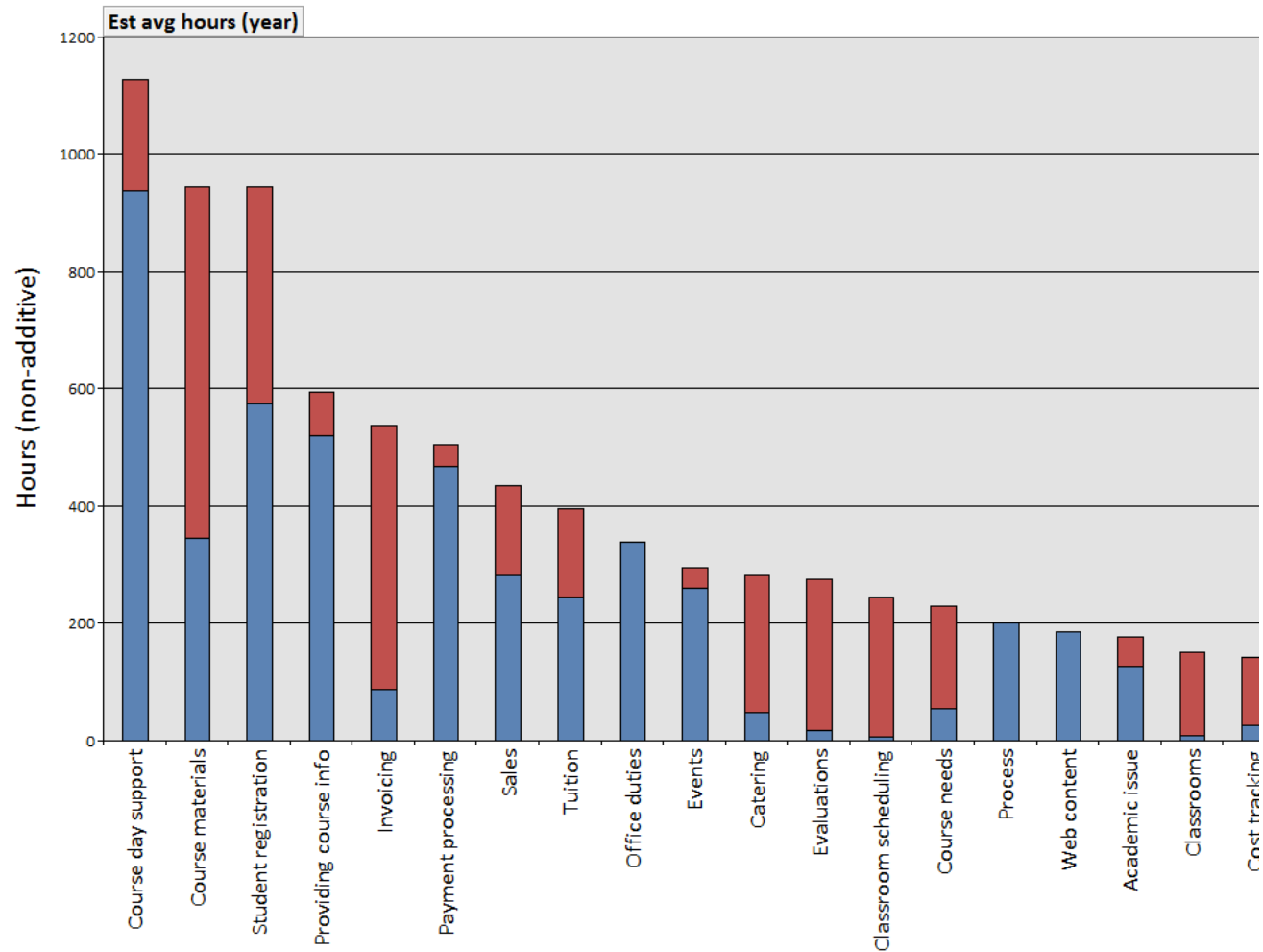
Managers Want To

- Have cost savings without hurting services or operations
- Eliminate duplication of work
- Reduce unnecessary coordination
- Know what people are doing
  - Including job description for HR department
- Deliver valuable services
  - Including business-IT alignment

What is Needed

- To store conceptual models, we need a database
  - Can support users querying the database (e.g., who else perform task A)

- Challenge: ensure consistency
  - Capturing requirements by different analysts
    - Need very clear rules and guidelines for systems analysis
    - Also need a standard set of questions to ask users
  - Meaning used by different users
    - We cannot resolve this issue for users, but conceptual models can help users to understand what each others are doing.

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Conclusion

- Conceptual modeling started in the database area. Then
  - Realize can be used to develop requirements
  - Now realize can move away from just IT
- Conceptual models can provide organized and aggregated org activities to support users in their work.
- Explore business needs (not bias by IT background)
- Provided examples and case studies from our work:
  - In all cases, *organizational workers* (not us) discovered some useful knowledge

Our Perspective

Business needs

IS needs
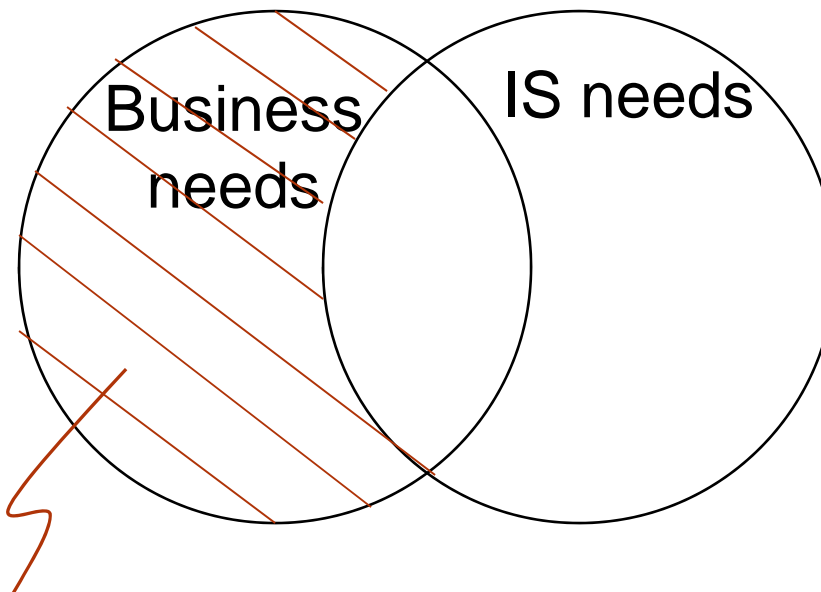
A lot more
to explore
here

*Welcome suggestions
of what else to explore?*

Questions and Discussions