Conceptual Modeling for Business

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Conceptual Modeling

- Architects and analysts are used to creating models
- We all create conceptual models to communicate ideas
  - Conceptual architectures
  - Enterprise Information Models
- Are conceptual models more than just a pretty picture?
Typical Model Hierarchy

- **3 Different Concepts**
  - …that we often confuse

- **Abstraction** — the suppression of irrelevant detail
  - “Irrelevant” is respective to the intended audience

- **Scope** — the reach of the model
  - Enterprise scope versus project scope

- **Domain** — the subject area of the model
  - Business, Information, Application, Technology
Guidelines for Architectural Models

1. Know your customer
2. Deliver value that makes their jobs easier
3. Provide a cohesive set of concepts – the view should provide a set of concepts and relationships, which together help to address stakeholder questions and usage scenarios.
4. Have a consistent level of detail - the level of detail should be appropriate for the usage scenarios, and all the concepts in the view should be at a consistent level of detail.
5. Every piece of information is there for a reason – all the concepts, relationships, and details in the view should be there to address the delivery of value to stakeholders through their scenarios.
Some Important Questions

- What is a conceptual model?
  - What are the characteristics, qualities?
  - Who do they communicate to?
  - Can we expand the scope to include business users?

- How do we know what abstractions to use?
  - What are the important concepts?

- How can they be used to improve business alignment?
Conceptual Modeling for Evolving and Chaotic Business

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Outline

- My background
- A brief overview of my presentation
- Conceptual models for business users
- Tying things together
  - Business-IT alignment modeling
  - Organizational actor modeling
- Conclusion and future research
About Carson Woo

- B.Sc., M.Sc., and Ph.D. in Computer Science
- Originally interested in systems programming, but work at Gulf Canada led to interests in understanding business.
- At the Sauder School of Business since 1987
- Research interests: Information systems analysis and design; conceptual modeling; requirements engineering
- Taught many executive programs
- Industry experience: Oil, telecom, financial, utility, and crisis response/management
- Co-founder and director of ModiViz Business System Modeling Solutions Inc.
IT Supporting Business: Challenges

- IT developers do not fully understand business needs
- Business users do not fully understand how IT can support their work
- Not too many people know both business and IT
- Challenging to keep up with changes in business and technologies
- Problems for users and systems analysts in diagrams:
  - Complicated diagrams
  - Consistency of creating (interpreting) them
  - Fuzzy relationships among diagrams
  - Extra workload for business people

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Diagrams: A Proposal

- Instead of producing diagrams just for IT developers, generate diagrams that can also be used by business users
  - Value proposition: business users need them for their work
  - Will provide more context and business needs to IT developers
  - They might not be the same type of diagrams, but we can provide mapping between them
- Instead of attempting to understand a lot of details, focus on the goals (objective or what you hope to accomplish)
  - Goals have been used in business: mission, target, etc.
  - Goals have been used in IT for specifying requirements
How to Provide Values for Business Users?

Experience from extending the use of Conceptual Modeling to include business context
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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 (usually a diagram).
- Note: conceptual $\rightarrow$ logical $\rightarrow$ physical
- Some examples:
  - Entity-relationship (ER) diagrams
  - Business process diagrams
  - Organizational charts
  - Rich pictures (Soft Systems methodology)
Our Experience

- Conceptual modeling is often used in gathering requirements for information systems.
- To better capture requirements, we are extending conceptual models to include more business information and knowledge.
  - E.g., vision and mission of the company.
- When communicating these conceptual models to users, users discovered information they did not know previously.
  - E.g., assumptions used by a co-worker in making a decision.
  - E.g., incorrect interpretation of an assignment by a subordinate.
- Including business context into conceptual models seems to lead to users discovering new information.
Extending Conceptual Model Use

- Traditionally, 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 *users* to digest operations and derive new knowledge through:
  - Documentation
  - Investigation
  - Planning
- That is, “extending” from supporting *systems analysts in their information systems development work* to supporting *managers and users in their organizational activities.*
An Analogy: Business Intelligence

- Traditionally, BI has been used to digest *data* and derive unknown or new information from *data*
  - e.g., consumer’s purchasing patterns
- Need to have an *aggregated and organized view of data* because
  - Lots of separately collected, but inter-related, data sets
  - Movement towards understanding different customer needs
  - Need to support better managerial decision-making
- We propose there is also the need to have *aggregated and organized view of organizational activities* due to
  - Organizational evolution and environmental
Conceptual Modeling

- Weaknesses of most existing conceptual models:
  - Represents the what and how, but lacks the why
  - Mainly developed for design (not really for analysis)
  - Lacks contextual information about the business (e.g., mission and strategy)

- Contextual information is a large part of any firm and contains valuable knowledge that can influence business decisions.

- Extending conceptual models with contextual information can provide understanding of the business and from there to discover emergent behaviours or unknown capabilities.
How to Include Why and Contextual Information?

We propose to represent internal view of organizational roles and relate them through goal alignment.
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Tying Things Together

We view business as consisting of organizational roles (or actors), each of them has a goal, and we represent them using conceptual models:

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

- Internal behaviour of organizational roles
  - To provide an understanding of their beliefs (assumptions), rationale in reasoning, and ability in learning (adaptation).

In the following slides, we will provide examples of these conceptual models and their values to users/management.
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)

- Will not provide the theoretical development of the work.

- Sufficient to say that we worked hard avoiding the biases in our IT background and thinking.
Business-IT Alignment

- At the IT level (from the 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.
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 actors understand the coherence of and congruency among operational, tactical, and strategic goals.
- Identifies critical goals at the operational level that directly contribute to \textit{multiple} strategic-level goals.
- Helps actors to better understand their work.
  - E.g., force the human resources manager to think through the goals in depth, and revise her interpretations to align with the strategic intent.

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Internal Behaviour

We represent an actor’s behaviour to discover the context of the actor’s actions and determine the rationale for their behaviour.

Three behavioural processes are represented:

- 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.

These processes are interconnected and can inform us of the others.
A Pictorial View of Actor Concepts

World
Organizational Actor
Receptor
Perception
Input
Perceiving
Simulator
Belief
Learning
Reasoning
Effector
Intention
Capabilities
Action

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EA Research Meeting at CSC (Feb 15-16)
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

**Level0 Player**
- **Intentions**: *Guessimate*
- **Beliefs**: Best Guess
- **Learning Criteria**: If utility is maximized and price is equal to best guess then (Best guess+) else (Best guess-)
- **Reasoning**: If Best guess != retailer price then *guessimate*
- **Actions**: *Guessimate* all 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 changing the maximize price is more than changing 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)

**Legend**
- \(\triangle\) Actor variable
- \(\ldots\rightarrow\) Specialization Arrow
- \(\rightarrow\) 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).

- **Discovering the details of a professional’s knowledge**
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Conclusion

- Conceptual models can provide organized and aggregated organizational activities to support users in their work.
- The major concept used is organizational roles and their goals:
  - Understanding inter-actor behaviour (business-IT alignment)
  - Understanding actor’s internal behaviour
- Applied the work in 5 different applications and, in all cases, users discovered some useful knowledge.
Future Research Work

We are interested in:

- Knowing the scalability of this approach.
- Studying the usability and usefulness of these frameworks in evolving and chaotic businesses.

Our objective is to:

- Understand the strengths and weaknesses of our work.
- Modify and improve our current work.
- Develop new lines of research work in this area.
Questions and Discussions
Appendix

Understanding dependencies that enable coordination and change.
Dependency Network Diagram

- Viewing resource dependency can help
  - Understanding organizational relationships
  - Designing control and coordination explicitly
  - Diagnosing the impact of IT implementation
- Based on the same concept of organizational roles and goals:
  - Actors lacking in essential resources will seek to establish relationships (*be dependent upon*) others in order to obtain needed resources.
  - Organizations will seek to formalize *agreements that govern the exchange of resources* with others to ensure continuing access to needed resources.
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
  - A motor vehicle insurance company
  - Provincial government
  - Vehicle repair shops
- 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.
Before

Provincial government
- A1. Set public insurance policy
- A2. Adjudicate complaints
- G1. Protect public good

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

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

Vehicle repair shop
- A1. Repair vehicle
- A2. Submit for payment
- A3. Manage repair costs
- G1. Generate revenue

Universal access mandate
- Repair shop service agreement
- Work order

Insurance policy
- Claim resolution
- Complaint resolution

Cost Containment
- Financial justification of operations

Claims payment
- Completed work order
- Cost containment
- Work order
**After**

**Provincial government**
- A1. Set public insurance policy
- G1. Protect public good

**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

**Claimant**
- A1. Submit vehicle for repair
- G1. Restore vehicle function

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

**Justification as public service entity**
- Service to the public
  - InsCo service standards
- Repair authorization
  - InsCo certification
- Claims payment
  - Standardized parts and labor database