CS595D
Seminar on BPM:
Models, Process Mining, and BI

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What is a Business Process?

- Wikipedia: a BP is a collection of related, structured activities or tasks that produce a specific service or product (serve a particular goal) for a particular customer or customers

  - Examples: a passport application, a fedex package delivery, a graduate school application, hospital visits for an illness, an online shopping tranx, ...

  - Typically, transactional property, partially automated

- A.k.a. workflow
What is BPM?

Management of a set of interrelated BPs

- BPs: design, realization, executions (many instances), optimization, modifications (on the fly), constraints, interoperations, transactions, …

- Resources: facilities and equipment (complex!), buildings, utilities, human(!)

- Auditing and compliances (laws, policies, …)

- …

This is biz school stuff!

What does CS have anything to do with this?
The “digital” and “e-“ Prefixes

- D··· library, classroom, government, health care, …
  - e-mail, -tailer, -book, …

- Impact on BPs:
  - Documents → e-doc
  - BPs → workflow systems

- Software support becomes critical!

- Some of the relevant technologies:
  - Web services, SOA, SAAS, cloud computing (?), …

Biz school/MIS: qualitative approaches insufficient for relating the sw development and biz operations
Research Challenges

- Models: process, data, messages, actors

- Analysis and verification

- Integration/interoperation

- Improvements
  (biz intelligence, operation optimization, …)

- Management of workflows and executions
The Challenge of Business Process Management

Operations need to be
- Faithful
- Measurable
- Flexible

Business Strategy
- “Be more green”
- “Use our differentiators”

High Executive

Business Goals
- Business Architecture
- Business Optimization

Speak in terms of
- “Functional Decomposition”
- “Business Components”

Hard to Communicate!!

Speak in terms of
- “Workflow”
- “Process centric”
- “Activity-flow”

Customers

Employees

Partners

Resources

IT

Business Operations

High Manager
Business Architect
Solution Designer
## A Representative “Model” at Biz Manager Level

### A Business Component Map

A Business Component Map is a tabular view of the business components in the scope of interest.

### Business Competencies

“Business Competencies”: large biz area with characteristic skills and capabilities.

### Accountability Level

“Accountability Level”: scope and intent of activity and decision-making.

### Business Component

“Business Component”: part of enterprise that has potential to operate independently.

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**Notes:**
- **Business Administration**
- **New Business Development**
- **Relationship Management**
- **Servicing & Sales**
- **Product Fulfillment**
- **Financial Control and Accounting**

**Acronyms:**
- CS595D Fall 2009
Common “Model” at IT Level:

An Activity Flow is a (typically) graph-based specification of how activities/processes are to be sequenced

- Data and business objects are typically an afterthought
- Hard for stakeholders to communicate about the big picture
  - People “see the trees but not the forest”
  - Overall process can be chaotic -- Cf. “staple yourself to a customer order”
- Hard to manage versions
  - E.g., evolution, re-use, generic workflow with numerous specializations
Why We Should Look for a Unifying Model

Good models go beyond description – they support action

- Selecting the right model for the job matters

Example: “Game of 15”
Winner: First one to reach exactly 15 with any 3 chips

First model - A is and B is - what is B’s move?
Second model - - B’s move is 6!

Can we find a “model” of business operations that is
- Useful & natural for the business level stake-holders to use
- Useful & natural for mapping to the IT infrastructure
Fundamental Elements

- **Process**: a collection of actions to be taken in a meaningful manner (sequential, parallel, conditional, …)

- Communication or **messages**: different software systems need to cooperate, collaborate

- **Data**: guide the actions to be taken and processes to follow

- **Actors** (human, external environment): their reasoning for making decisions may not be captured in the logic specification/running systems
Data Management In the Infancy (60's)

- Driving applications: inventory control, financial data management

- The key to the success: automation
Fundamental “Theorem” of Databases

- Physical data independence allows us to focus only data management issues.
**Common “Model” at IT Level:**

An **Activity Flow** is a (typically) graph-based specification of how activities/processes are to be sequenced

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**Diagram:**

- **Process Modeling**
- **Data Modeling**
- **Business Logic**
- **Workflow System**
  - Direct, flow-based implementation
  - (flow mgmt, services, databases, resources, …)
Workflow (Business Process)

- A bookseller example: Traditional control-centric models
Workflow (Business Process)

- A bookseller example: Traditional control-centric models
- Multiple steps needed for each activity

In practice, 100s to 1000s of nodes

Hard to reason, find useful views: missing data
Business Intelligence: Data View

- Extract-Transform-Load

![Diagram showing data flow and workflow activities]

- Data Warehouse
  - inventory
  - catalog
  - cust_db
  - Analysis

- Workflow activities

- workflow is missing!
A business artifact is a key conceptual business entity that is used in guiding the operation of the business.

- *fedex package delivery, patient visit, application form, insurance claim, order, financial deal, registration, …*
- Both “information carrier” and “road-maps”

Very natural to business managers and BP modelers

Includes two parts:
- **Information model:**
  - Data needed to move through workflow
- **Lifecycle:**
  - Possible ways to evolve
Example: Restaurant

Artifacts

Guest Check
- Create Guest Check
- Open GCs
- Add Item

Kitchen Order
- Prepare Receipt
- Pending KOs
- Prepare & Test Quality

Receipt
- Update Cash Balance
- Ready KOs
- Deliver

Cash Balance
- Payment
- Recalculate Receipt
- Closed GCs
- Archived Receipts
- Archived GCs
- Archived KOs
- Archived Receipts
- Cash Balance
Example: Restaurant

**Artifacts**

- **Guest Check**
- **Kitchen Order**
- **Receipt**
- **Cash Balance**

**Processes**

- Create Guest Check
- Open GCs
- Add KOs
- Pending KO
- Closed GCs
- Archived KO
- Prepare Receipt
- Ready Kos
- Payment
- Update Cash Balance
- Disagreed Receipts
- Recalculate Receipt
- Deliver
- Archived Receipts
- Archived GCs
- Archived KOs
- CB
Emerging Artifact-Centric BPs

Artifacts (Info models)

- **Informal model** [Nigam-Caswell IBM Sys J 03]
- **Systems:** BELA (IBM 2005), Siena (IBM 2007)
- **Formal models**
  - **State machines** [Bhattacharya-Gerede-S. SOCA 07] [Gerede-S. ICSOC 07]
  - **Rules** [Bhattacharya-Gerede-Hull-Liu-S. BPM 07]
A Logical Artifact Model for BPs

- A variation of [Bhattacharya-Gerede-Hull-Liu-S. BPM 07]
- [Hull-S. 09] (in preparation)

Artifacts (info models) + Semantic services (IOPEs) + if C enable...

Condition-action
Verification Problem

- Given a workflow and a goal, do all executions of the workflow satisfy the goal?

[Artifacts (Info models)] + [Semantic services (IOPEs)] + [Condition-action]

if $C$ enable $\ldots$ $\models \emptyset$

[Bhattacharya-Gerede-S. SOCA 07] [Gerede-S. ICSOC 07]
[Bhattacharya-Gerede-Hull-Liu-S. BPM 07]
[Deutsch-Hull-Patrizi-Vianu ICDT 09]
[Vianu ICDT 09]
Synthesis Problem

Given a goal and a set of services, construct a set of rules so that every execution satisfies the goal.

Artifact (Info model) + Semantic services (IOPEs) + Goal (FO) \rightarrow \text{if } C \text{ enable...}

[Fritz-Hull-S. ICDT 09]
(restricted to \textit{single artifact, first-order goals})
Focus of this Seminar

- BP models, data centric ones
- Process mining
- Biz intelligence

References

- This seminar
  http://www.cs.ucsb.edu/~xyan/classes/CS595D2009fall.htm
- IEEE DE Bulletin Special Issue on Data & BPM
  http://sites.computer.org/debull/A09SEP-CD.pdf
- 2009 NSF Workshop on Data Centric Workflows
  http://dcw2009.cs.ucsb.edu