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

Business Strategy
- "Be more green"
- "Use our differentiators"

High Executive

Operations need to be
- ❖ Faithful
- ❖ Measurable
- ❖ Flexible

High Manager
Business Architect
Solution Designer

**Business Goals
Business Architecture
Business Optimization**

Speak in terms of
- ▸ "Functional Decomposition"
- ▸ "Business Components"

Customers

Employees

Business Operations

Hard to Communicate !!

Partners

Resources

IT

Speak in terms of
- ▸ "Workflow"
- ▸ "Process centric"
- ▸ "Activity-flow"

A Representative "Model" at Biz Manager Level

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

"Business Component": part of enterprise that has potential to operate independently
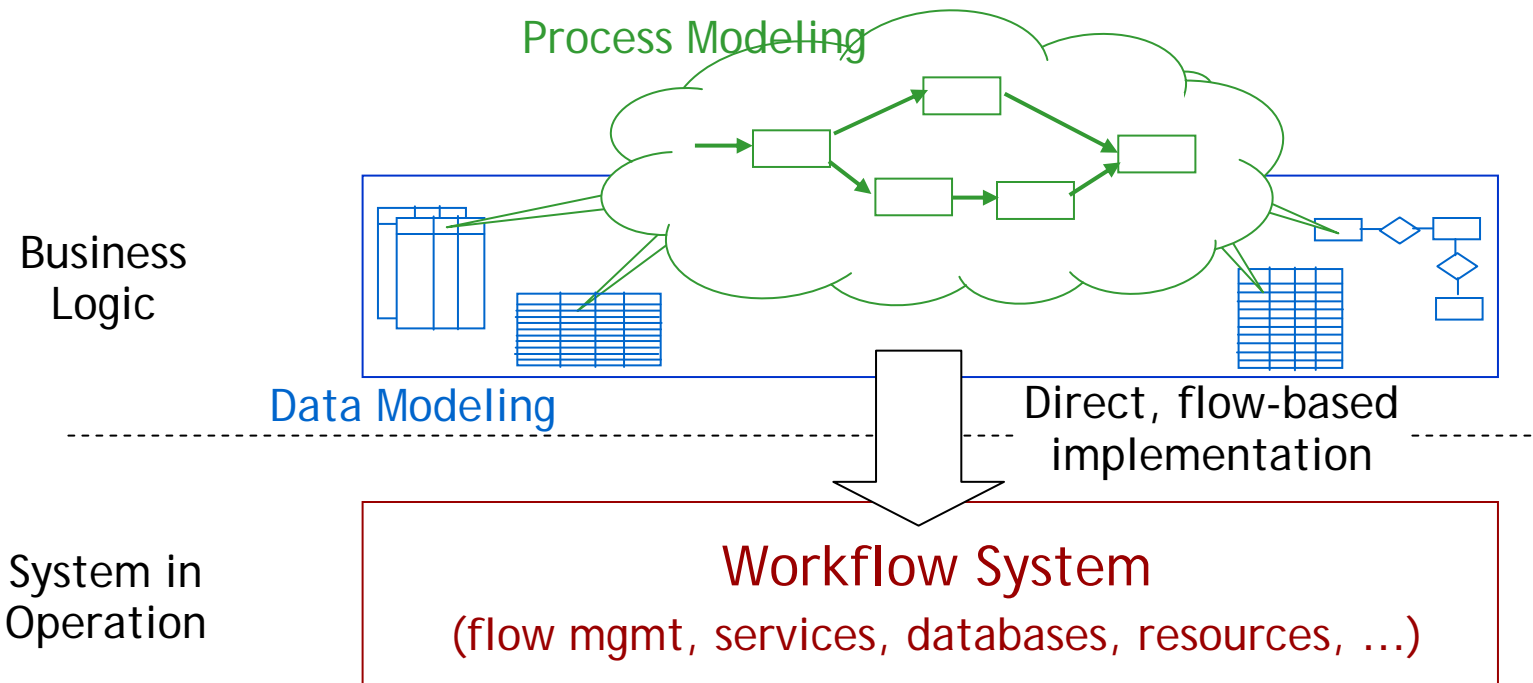
"Business Competencies": large biz area with characteristic skills and capabilities

"Accountability Level": scope and intent of activity and decision-making

	Business Administration	New Business Development	Relationship Management	Servicing & Sales	Product Fulfillment	Financial Control and Accounting
directing	Business Planning	Sector Planning	Account Planning	Sales Planning	Fulfillment Planning	Portfolio Planning
controlling	Business Unit Tracking	Sector Management	Relationship Management	Sales Management	Fulfillment Planning	Compliance
	Staff Appraisals	Product Management	Credit Assessment			Reconciliation
executing	Staff Administration	Product Directory	Credit Administration	Sales	Product Fulfillment	Customer Accounts
		Marketing Campaigns		Customer Dialogue	Document Management	General Ledger
	Production Administration			Contact Routing		

Common "Model" at IT Level:

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

Process Modeling

Business Logic

Data Modeling

Direct, flow-based implementation

System in Operation

Workflow System
(flow mgmt, services, databases, resources, …)

- Data and business objects are typically an afterthought
- Hard for stake-holders 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!

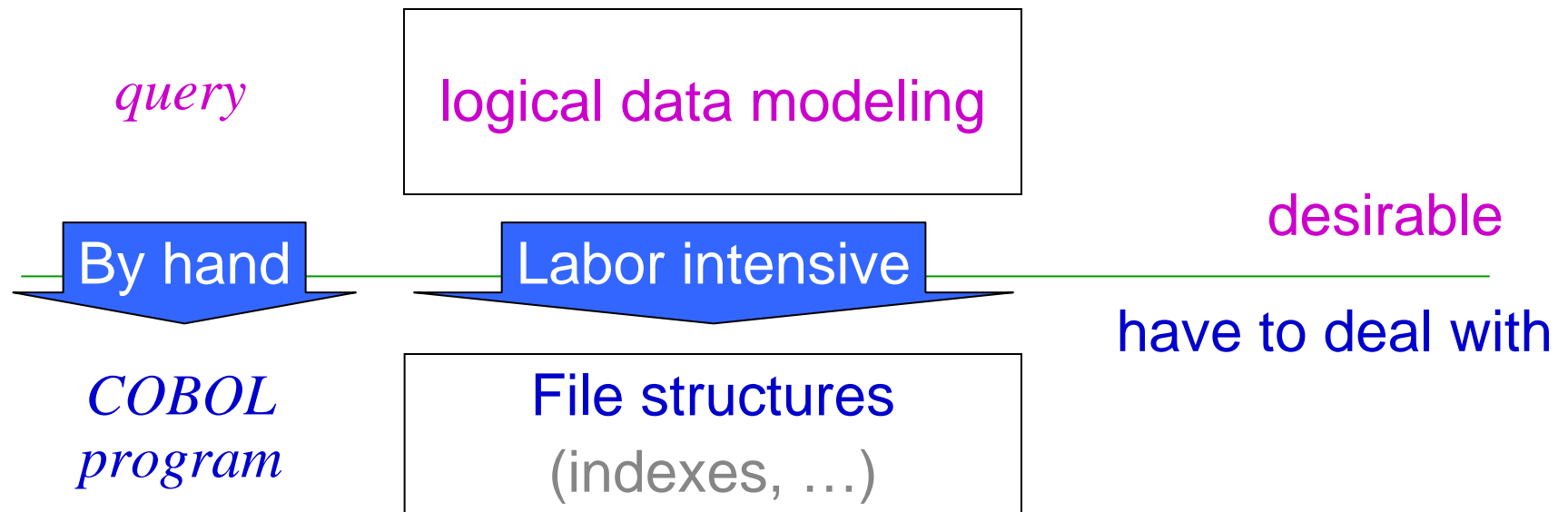Can we find a "model" of business operations that is
- Useful & natural for the business level stake-holders to use
- Useful & natural for mapping to the IT infrastructure

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
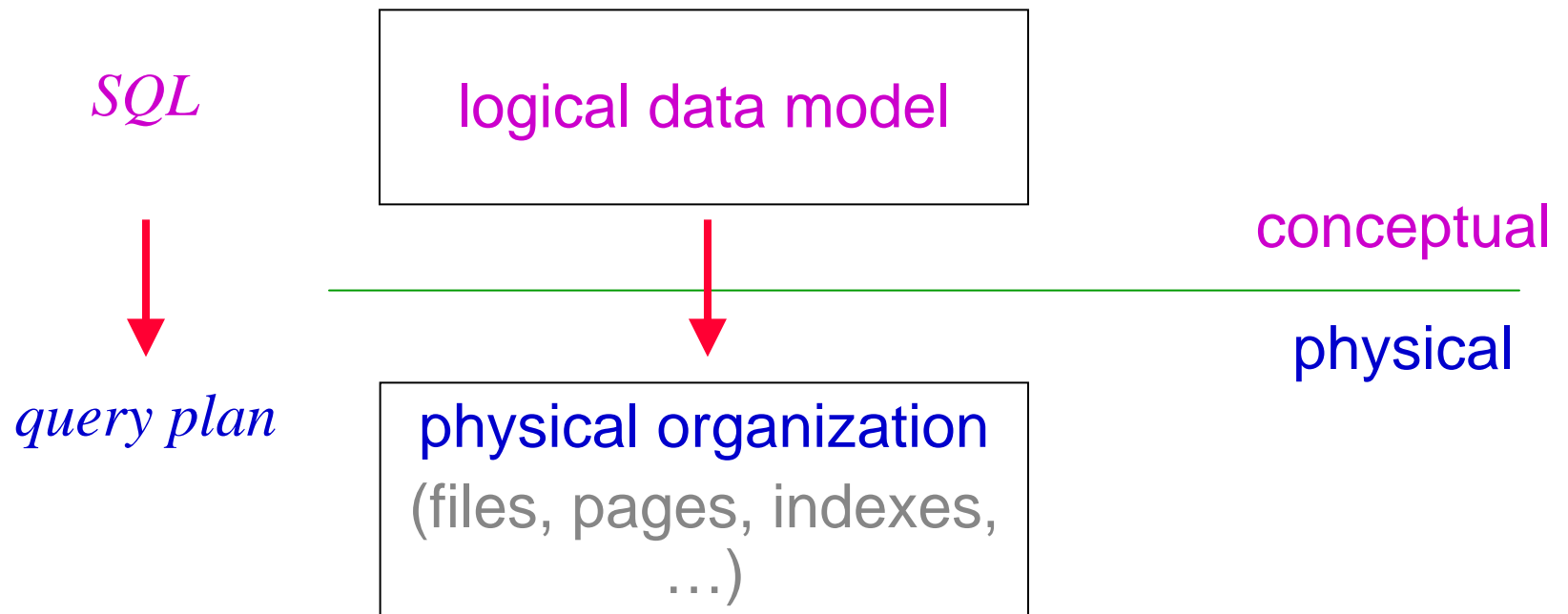
Data Management In the Infancy (60's)

- Driving applications: inventory control, financial data management

query

logical data modeling

*COBOL program*

By hand

Labor intensive

desirable

have to deal with

File structures
(indexes, …)

- The key to the success: automation

Fundamental "Theorem" of Databases

■ Physical data independence allows us to focus only data management issues

SQL

logical data model

conceptual

physical

query plan

physical organization
(files, pages, indexes, …)
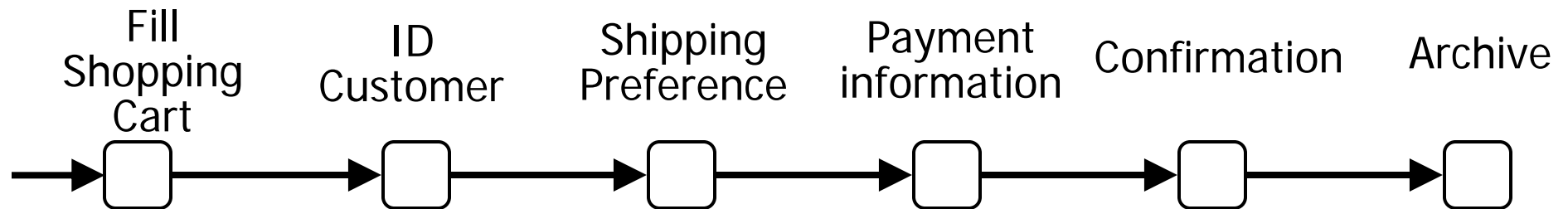
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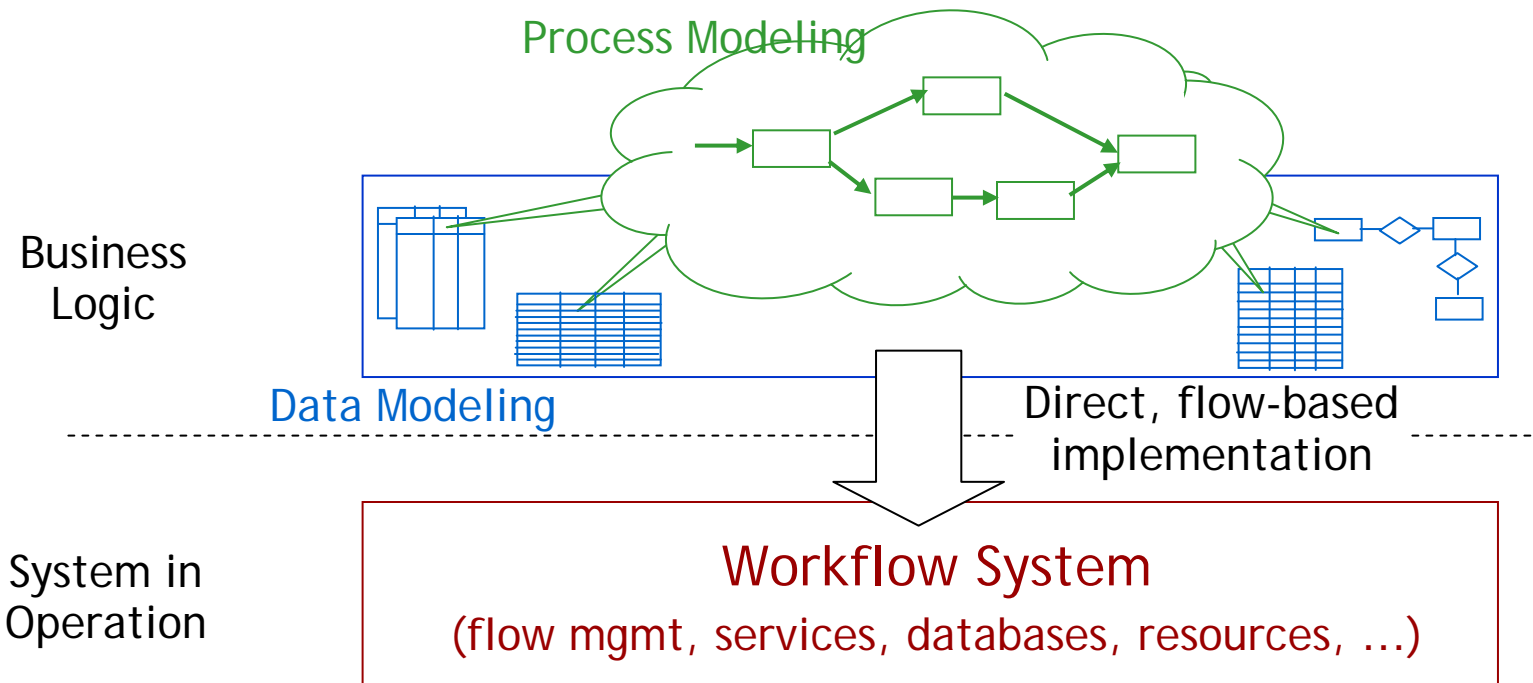
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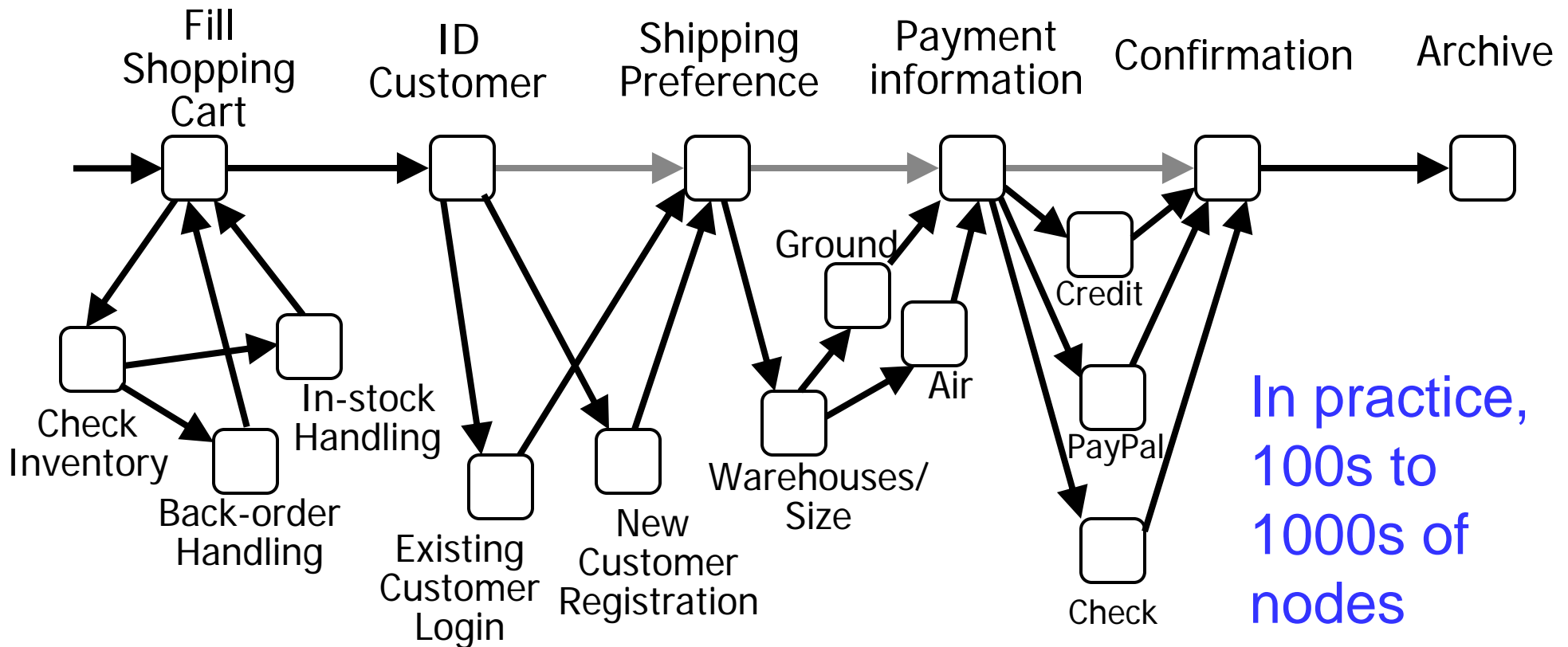   - E.g., evolution, re-use, generic workflow with numerous specializations

Workflow (Business Process)

- A bookseller example: Traditional control-centric models

Fill Shopping Cart → ID Customer → Shipping Preference → Payment information → Confirmation → Archive

Workflow (Business Process)

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

Fill Shopping Cart · ID Customer · Shipping Preference · Payment information · Confirmation · Archive

Check Inventory · In-stock Handling · Back-order Handling · Existing Customer Login · New Customer Registration · Ground · Air · Warehouses/Size · Credit · PayPal · Check

In practice, 100s to 1000s of nodes

Hard to reason, find useful views: missing data

Business Intelligence: Data View

- Extract-Transform-Load
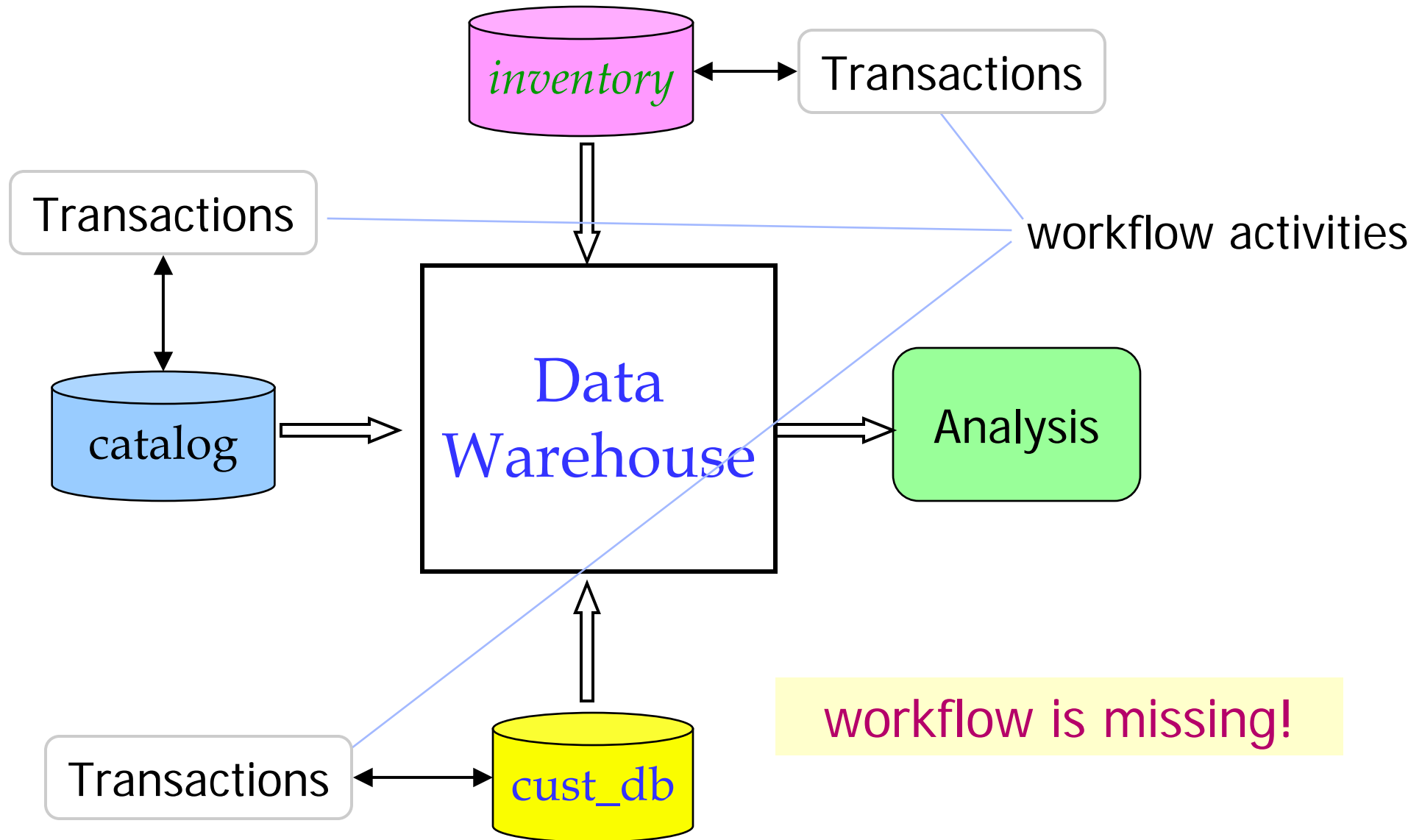
Business Artifacts !

- 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:
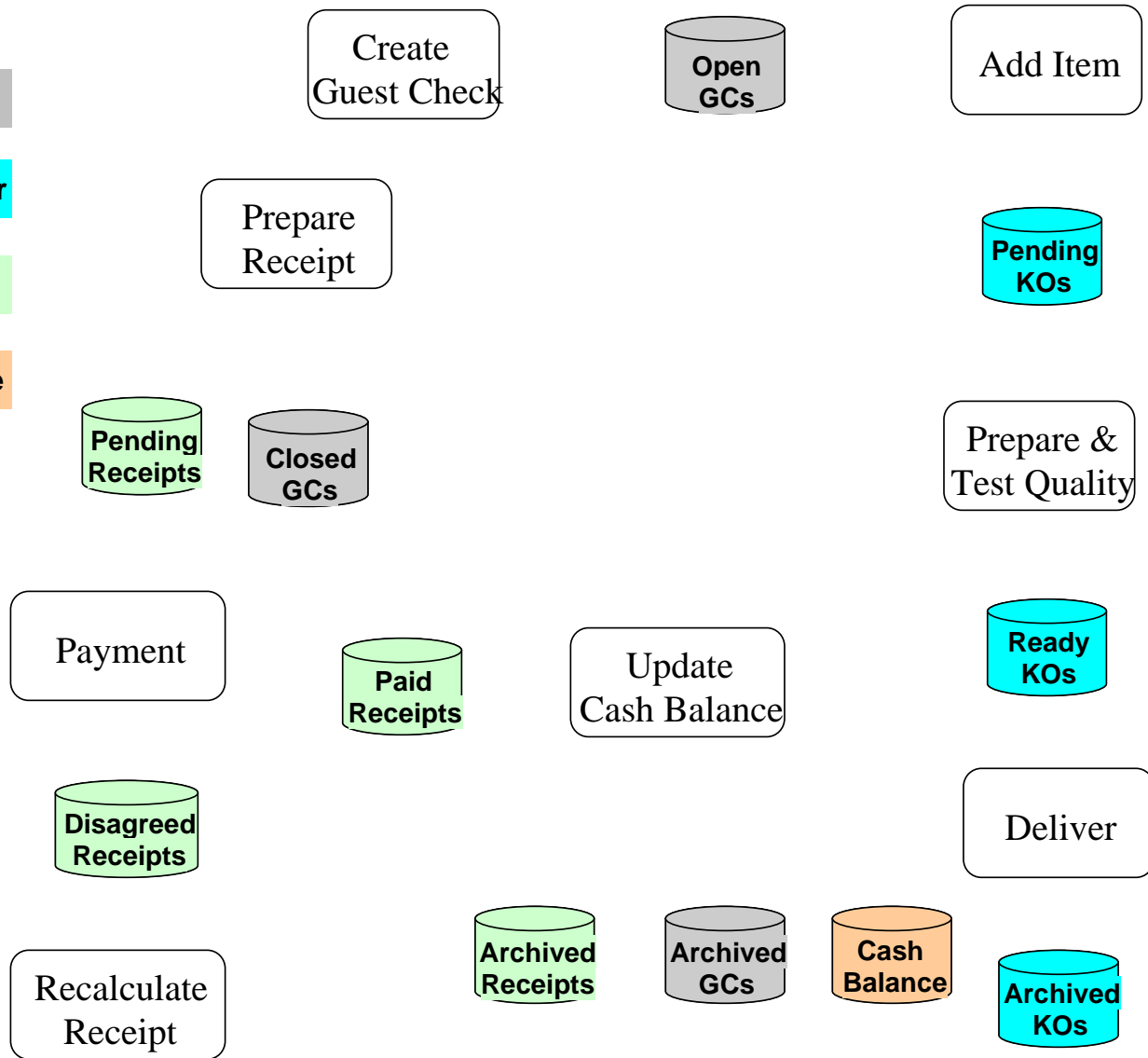   possible ways to evolve

Example: Restaurant

Artifacts

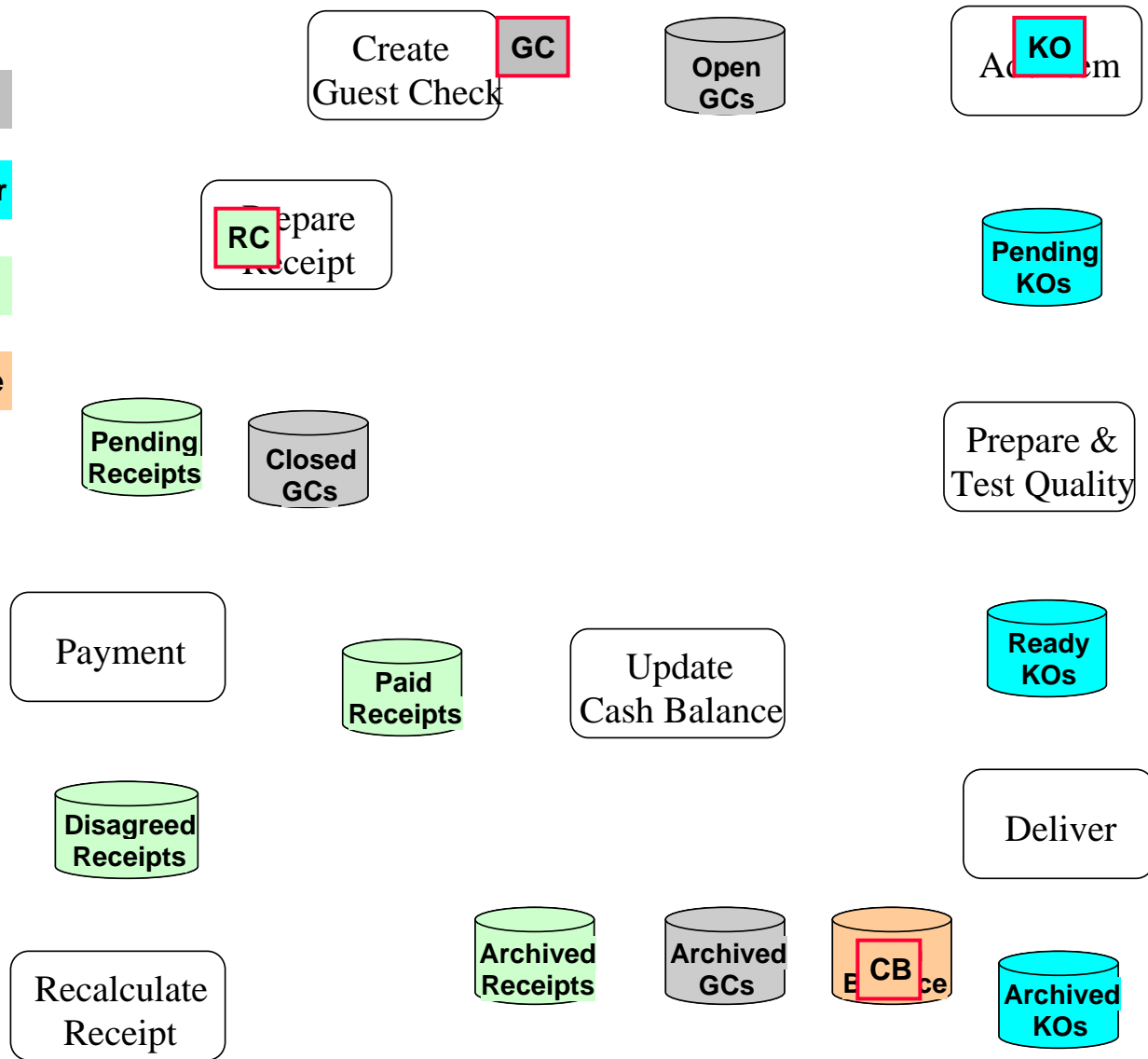| Guest Check |
| Kitchen Order |
| Receipt |
| Cash Balance |

Create Guest Check

Open GCs

Add Item

Prepare Receipt

Pending KOs

Pending Receipts

Closed GCs

Prepare & Test Quality

Payment

Paid Receipts

Update Cash Balance

Ready KOs

Disagreed Receipts

Deliver

Recalculate Receipt

Archived Receipts

Archived GCs

Cash Balance

Archived KOs

Example: Restaurant

Artifacts

Guest Check	
Kitchen Order	
Receipt	
Cash Balance	

Create Guest Check — **GC**

Open GCs

Add Item — **KO**

Prepare Receipt — **RC**

Pending KOs

Pending Receipts

Closed GCs

Prepare & Test Quality

Payment

Paid Receipts

Update Cash Balance

Ready KOs

Disagreed Receipts

Deliver

Recalculate Receipt

Archived Receipts

Archived GCs

Balance — **CB**

Archived KOs

Emerging Artifact-Centric BPs

customer
info

cart

. . .

Artifacts (Info models)

+
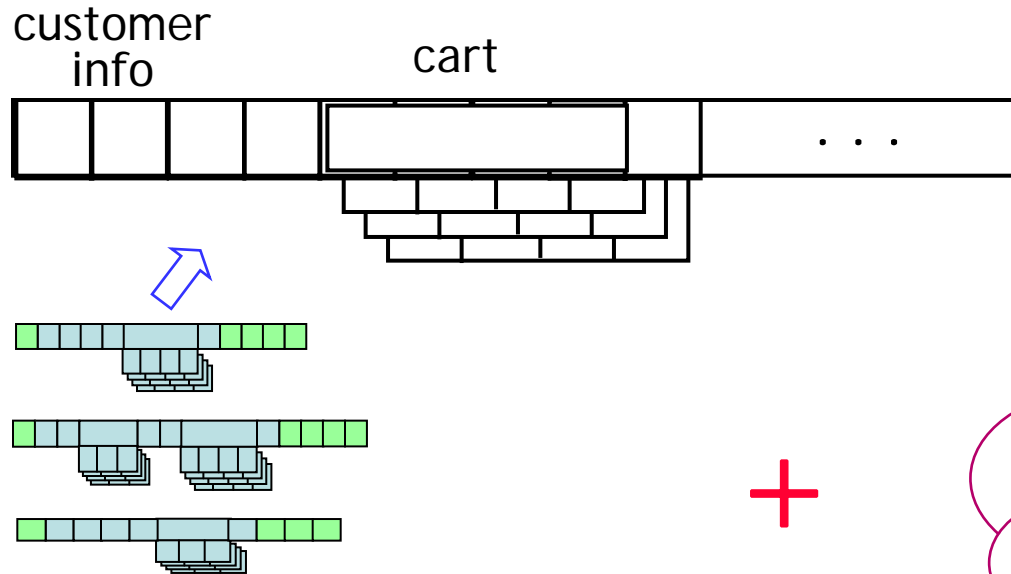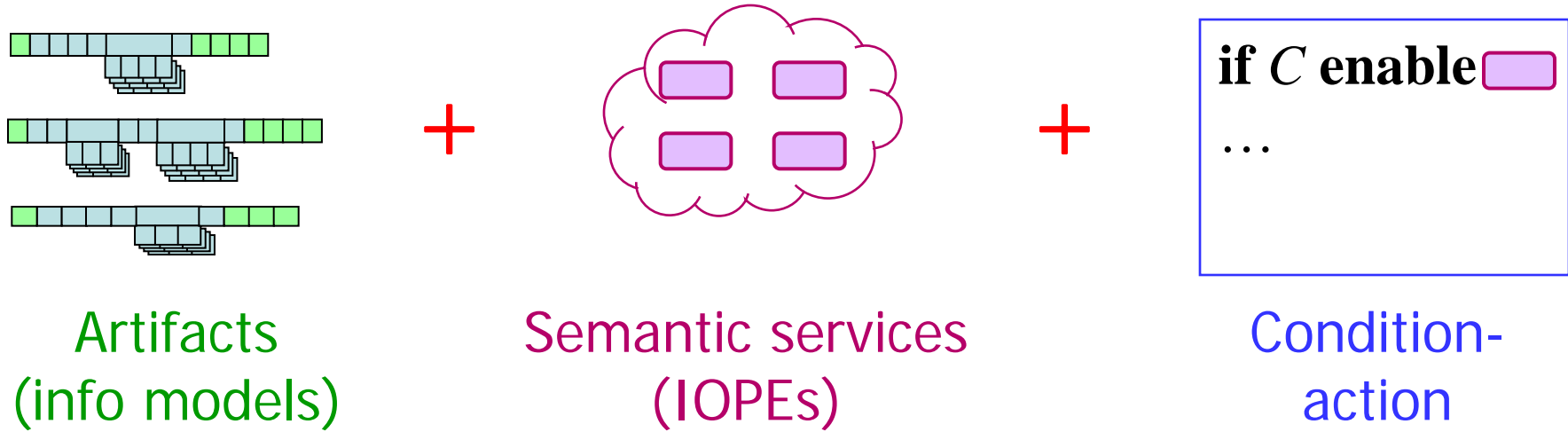
Specification of artifact lifecycles

- **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]
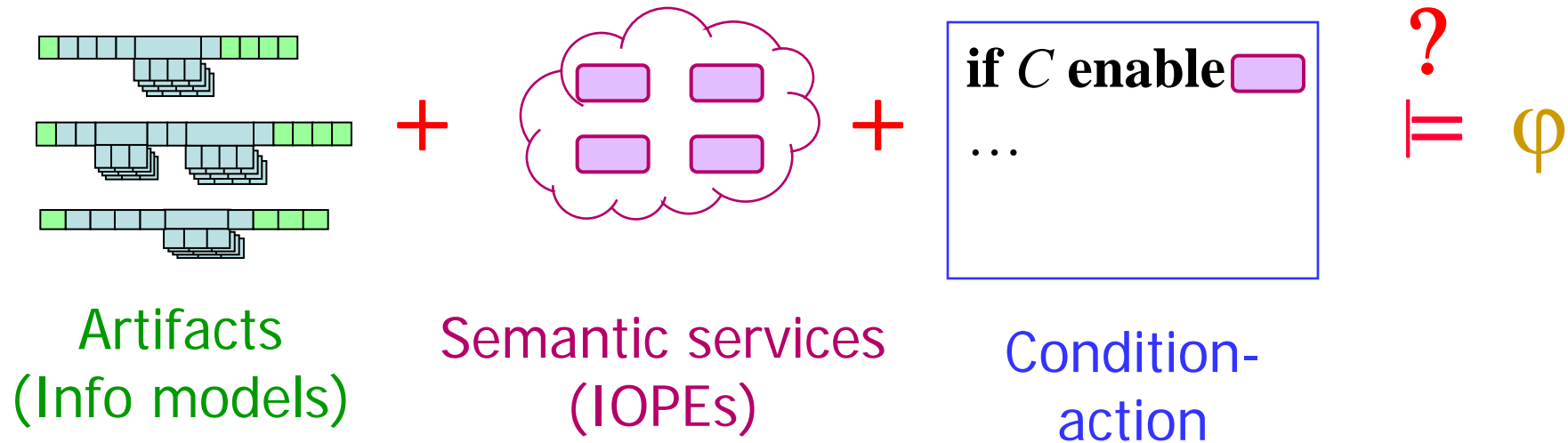 - ❖ Rules [Bhattacharya-Gerede-Hull-Liu-S. BPM 07]

A Logical Artifact Model for BPs

Artifacts
(info models)

+

Semantic services
(IOPEs)

+

if C enable [ ]
…

**Condition-
action**

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

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 ▭
…

? ⊨ φ

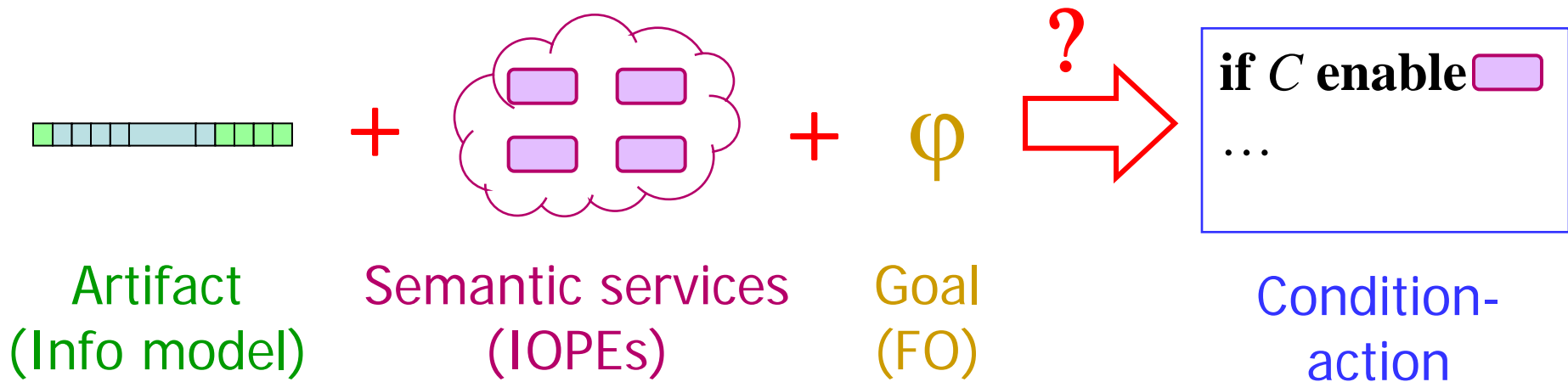[Bhattacharya-Gerede-S. SOCA 07] [Gerede-S. ICSOC 07]

[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)   + φ Goal
(FO)   ?   if C enable ...   Condition-action

[Fritz-Hull-S. ICDT 09]
(restricted to 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