
CSEP 545 Transaction Processing
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Outline

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10.1 Introduction

• Business process - a partially ordered set of a steps, where each step performs an administrative function usually by accessing a shared database.

• Examples – place an order, reserve a trip, buy a house, adjust an insurance claim

• Each step may be a transaction, an execution of a program that is not a transaction, or a manual activity performed by a person.

• Examples – debit an account, approve a large debit
Business Process Management

• Business process management is the activity of creating, managing, adapting, and monitoring business processes.

• Most of this is business management, not necessarily a technical activity
  – Analyzing business processes
  – Defining improved processes
  – Which eventually affects requirements for transactions and other TP mechanisms.
Business Process Specification

- Flowgraph language for describing processes consisting of steps, with preconditions for moving between steps
  - Some people recommend state machines, but imperative languages are more popular.

- Representation of organizational structure and roles
  - A step can be performed by a person in a role, with a (possibly complex) role resolution procedure

- Choreography - a message protocol between independent business processes
Business Process → Many ACID Txns

• Some requests cannot execute as one transaction because
  – It executes too long (causing lock contention) or
  – Resources don’t support a compatible 2-phase commit protocol.

• A transaction may run too long because
  – it requires display I/O with user
  – people or machines are unavailable (a step that includes manager approval, or a billing step that runs in batch)
  – it requires long-running real-world actions
    (get two estimates before settling an insurance claim)

• Steps may require independent ACID transactions in different subsystems (capture an order, schedule a shipment, report commission, send an invoice)
Workflow

• Workflow - A technology to enable the execution of long running, multi-transaction requests.
  – Long running $\rightarrow$ manage process state recoverably
  – Multi-txn $\rightarrow$ mechanisms for isolation and atomicity

• Textbook says BPM and workflow are synonyms

• But often, BPM refers to the business activity and workflow to the technical implementation
  – This terminology distinction isn’t universally used
10.2 Managing Process State

• Since processes can execute for a long time (weeks), you need state management
  – Save state persistently (when process is idle) and restore it later (when it becomes active again)
  – Find the state of process (which might be inactive)

• Process state – data and control state

• User wants to know which steps ran (with what inputs and outputs) and which are next to run
  – Log all interesting events and make them queryable

• Usually requires a workflow-specific run time
Managing Workflow with Queues

- Each workflow step is a request. Send the request to the queue of the server that can process the request.
- Server outputs request(s) for the next step(s) of the workflow.
- May be hard to answer a query about workflow state.
Pseudo-conversations

• Simple solution to manage state in early TP systems
• A conversational transaction interacts with its user during its execution
• This is a sequential workflow between user & server.
• Since this is long-running, run it as multiple requests
• Since there are exactly two participants, just pass the request back and forth
  – request carries all workflow context
  – request is recoverable, e.g. send/receive is logged or request is stored in stable storage
• This simple mechanism has been superseded by queues and general-purpose workflow systems.
Other Approaches to State Mgmt

• Queue elements and pseudo-conversation requests are places for persistent workflow state. Other examples:
  – Browser cookies (files that are read/written by http requests), containing user profile information
  – Shopping cart (in web server cache or database)

• Such state management arises within a transaction too
  – Server scans a file. Each time it hits a relevant record, return it.
  – Issue: later calls must go to the same server, since it knows where the transaction’s last call left off.
  – Sol’n 1: keep state in the message (like pseudo-conversation)
  – Sol’n 2: first call gets a binding handle to the server, so later calls go to it. Server needs to release state when client disappears
10.3 Making a Workflow ACID

- If a workflow runs as many transactions,
  - it may not be serializable relative to other workflows (i.e., not isolated)
  - it may not be all-or-nothing (i.e., not atomic)
- Suppose a workflow auto-pays a credit card
  - $T_1$ debits checking and $T_2$ credits the card
  - Not Isolated - A query could run in between, looking for accounts where card debit exceeds checking balance.
  - Not atomic - A failure after $T_1$ might prevent $T_2$ from running.
Making a Workflow ACID (cont’d)

• These problems require app-specific logic.
• Isolation – App must understand that some money could be in flight.
• Atomicity - \(T_2\) sends ack to \(T_1\)’s node. If \(T_1\)’s node times out waiting for the ack, it takes action, possibly compensating for \(T_1\).
Automated Compensation

• Each step in a workflow program identifies a compensation. This is called a saga.
• If a workflow stops making progress, the workflow system runs compensations for all committed steps, in reverse order (like transaction abort).
• Need to ensure that each compensation’s input is available (e.g. log it) and that it definitely can run (enforce constraints until workflow completes).
10.4 Other Workflow Models

- Scientific workflow
  - Use a workflow definition to drive an experiment
  - Review history of executions (provenance)
  - Capture sequence of steps for replay

- Configuration management
  - Check-out and Check-in of engineering docs or code
  - Can include customizable engineering process
  - Similar functions for managing system configuration tasks (e.g., how to provision a server)
Products

- IBM MQSeries Workflow
- MS BizTalk Orchestration
- MS SQL Server Service Broker
- JetForm
- TIBCO
- Oracle WebLogic Process Manager

See also www.wfmc.org