Workflow Management – Business Engineering

Workflows and Web Services
Kapitel 7

The Notion of Business (Re)Engineering

FACHBEREICH INFORMATIK

Business Reengineering =

The fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed.

M.Hammer and J.Champy, Reengineering the corporation, HarperCollins Pub.Inc., 1993.

So, What Is BPR All About?

- Business Process (Re-)Engineering (BPR) one of the most important topics on many company's agenda
- Recall, that very often: Process Model = Product
- Goal is to make company more flexible, react faster to change
  - outsourcing of processes, supply-chains, virtual enterprises,...
- Criteria for success include
  - minimize process execution time/cost, maximize executed number
    - Eliminate unnecessary tasks, perform as many tasks as possible in parallel, parallel tasks performed by different resources (personnel, equipment, program,...)
- New processes are defined, existing are changed or abandoned
- Scope is not only intra-enterprise but also inter-enterprise
  - Business-to-Business, Consumer-to-Business, Business-to-Administration,...
- Reengineered processes supported by distributed and heterogeneous computing environment

What Has To Be Done

- Existing business processes must be
  - Analyzed
  - Specified
  - Modeled
  - Optimized
    - this includes simulation
- Important to include resources used to perform processes
  - Organizations
  - Roles
  - People
  - IT resources
- Huge number of BPR methods have been proposed!
  - ...and many tools accompany these methods!

Business Modeling Output

- Process Goals
- Business Processes
- Number of Process Instances
- Organizational Structure
- Business Objects
- Number of Business Objects
- Critical Success Factors
- ...

Deliverables of Business Modeling

- Process goals
  - Strategic targets like
    - growth of company over period of time
      - Number of customers, products sold, employees,...
    - profit level
    - customer satisfaction
  - Agreement on these goals is vital for success of any BPR project!
- Business processes ("Ablauf-Organisation")
  - High-level view only
    - major activities, organizational units involved, goods/materials/... required, computer (sub)systems used, data processed,...
  - Activities will be refined later on
    - typically, at this level activities are often processes itself
      - will be refined into subprocesses later on (top down / bottom up)
  - Data often is just name of database to be used
    - customer database, product definition database,...

Deliverables of Business Modeling (cont.)

- Number of process instances
  - Reflects one of the strategic targets
  - Used for simulation later on
    - determines number of people needed, cost of the business process,....
- Organizational structure ("Aufbau-Organisation")
  - Very important aspect of business modeling
  - Includes specification of
    - broad areas of responsibilities, span of control, reporting structures
  - Typically, organizations are hierarchically structured, crisp responsibility
    - result: crossing organizational boundaries become "barriers"
    - negotiations about responsibilities, funding, revenue sharing,...
    - delays in performing activities of business processes
  - Hierarchical structures are obstructions in business process efficiency
  - Imperative to change organization

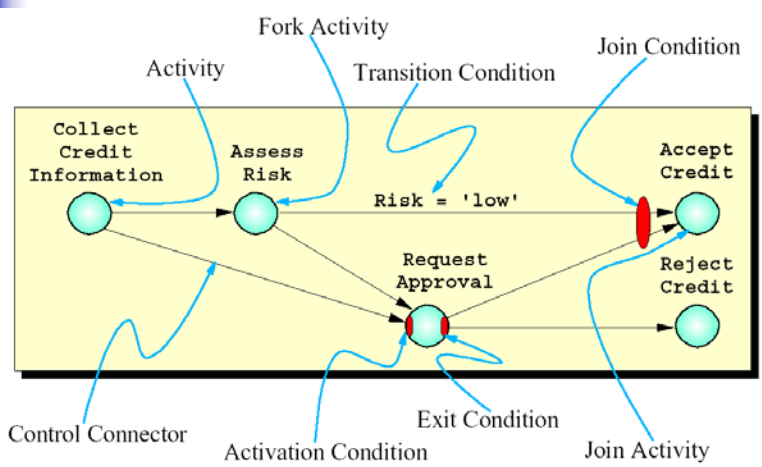
Deliverables of Business Modeling (cont.)

- Business objects
  - Activities of business processes work with/on business objects
    - not necessarily an "object" in the OO-sense
    - activities work with it, get as input, produce as output
      - customer address, credit history, actual stock price, risk assessment,...
    - used to determine actual control flow between activities
      - amount of a loan, severity of an accident, risk assessment,...
    - used to determine access rights people need to perform a task
      - nobody must see salary of managers in own reporting chain,...
  - Needed when implementations of the activities are build
    - database structure required to support the activity when executed
    - kernel entities for conceptional database design
- Number of business objects
  - Reflects one of the strategic targets
  - Used to derive required storage space,...
    - when combined with access frequencies used for physical database design

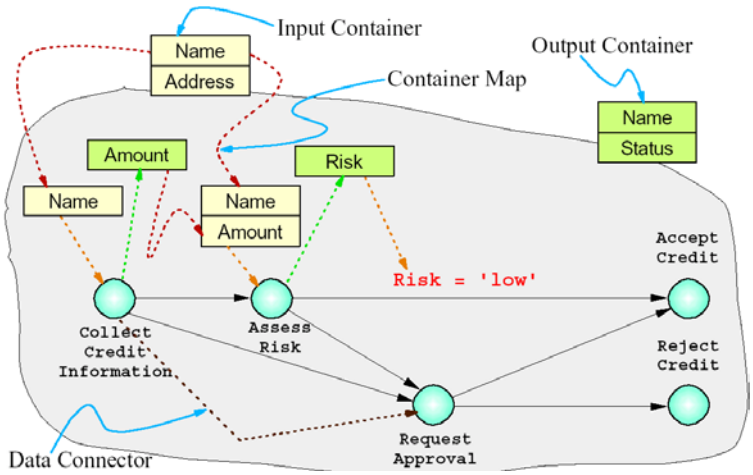
Deliverables of Business Modeling (cont.)

- Critical success factors (CSF)
  - Prerequisites to successfully execute a business process
  - Crucial for achieving all the goals set during the other modeling actions
  - CFS include
    - skills of people
      - hands-on experiences with tools
      - knowledge in application areas
    - properties of IT infrastructure
      - power of workstations used by personel
      - power of servers used to run automatic activities

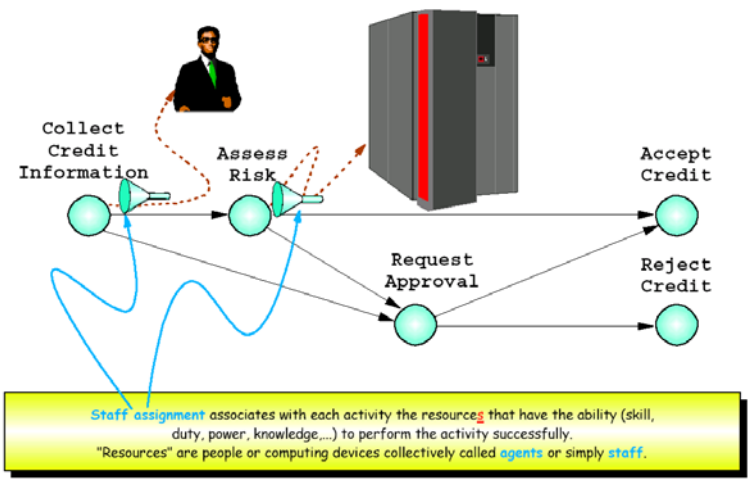
Business Process: Control Flow



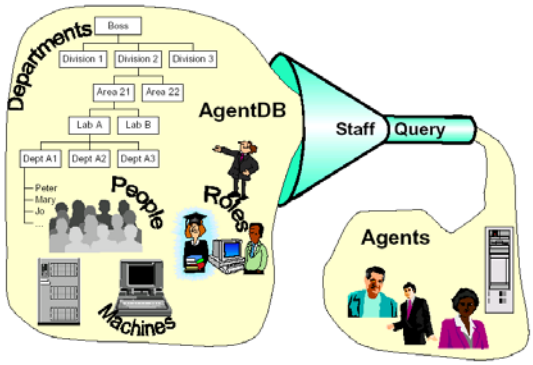
Business Process: Data Flow



Business Process: Staff Assignment

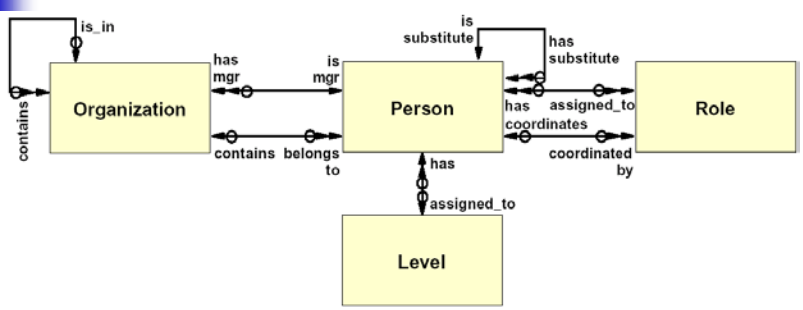


Staff Resolution: Flexibility in Staff Assignments



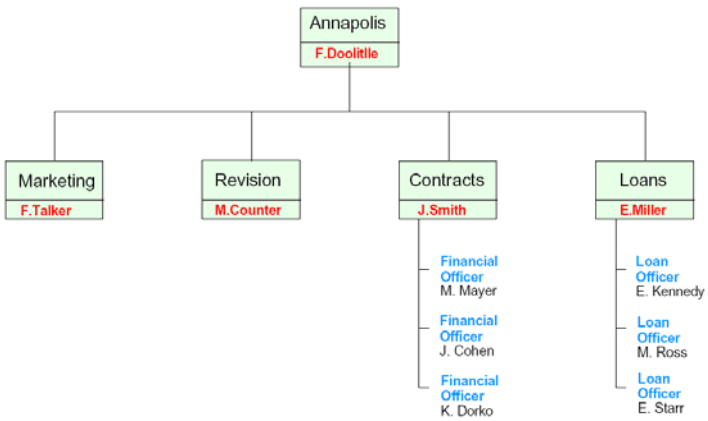
Staff assignment is done by attaching a declarative query to each activity, i.e. no fixed agents are associated with an activity leaving flexibility to exchange agents without having to modify all affected process models and instances!

Org Database: The "Base" For Staff Assignment

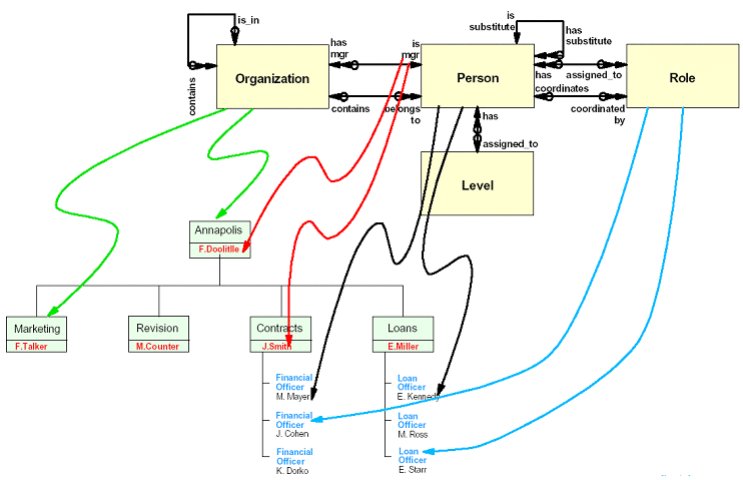


- WFMS has integrated org-db or can access external one (e.g. custom or standard HR-systems [SAP R/3, Peoplesoft,...])
- Org-DB can have simple structure (like the one shown) or very complex/rich
- Populating the org-db schema is called organization modeling (often, unload HR-DB and load into WFMS Org-DB)
- Modeling the org-db schema is called organizational meta modeling

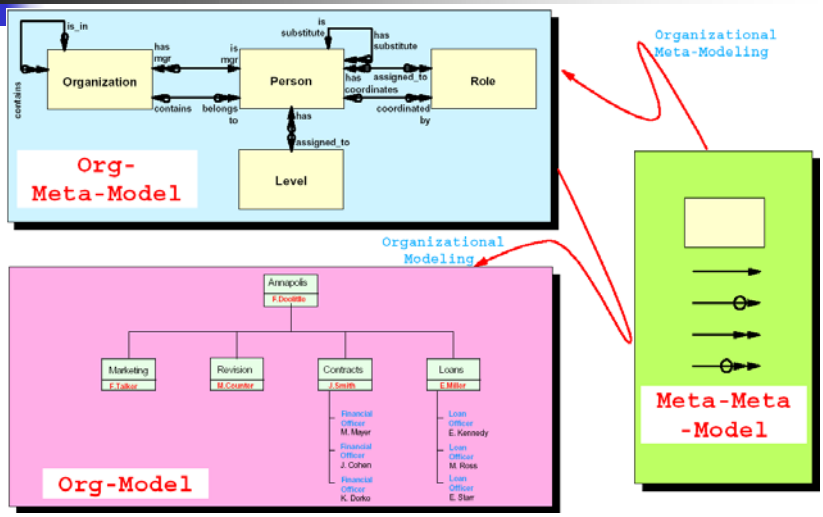
A Sample Organizational Model



Organizational Modeling



Intension/Extension Pairs



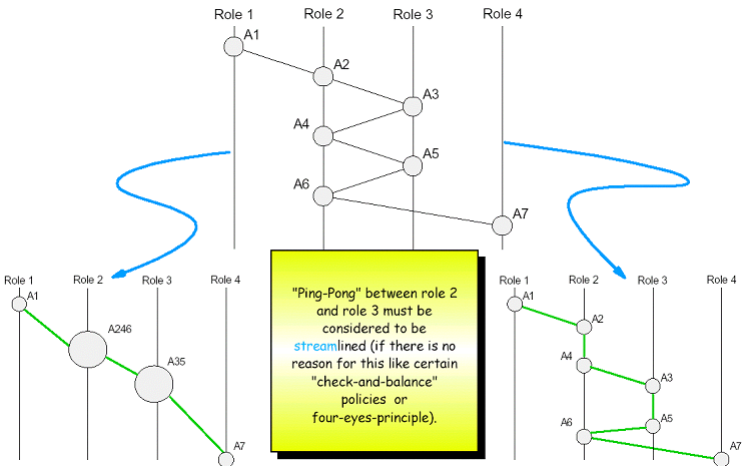
Simple Steps Towards Process Optimization

- Characteristics of optimized process:
  - Minimal number of crossing organization boundaries
  - High level of parallelism

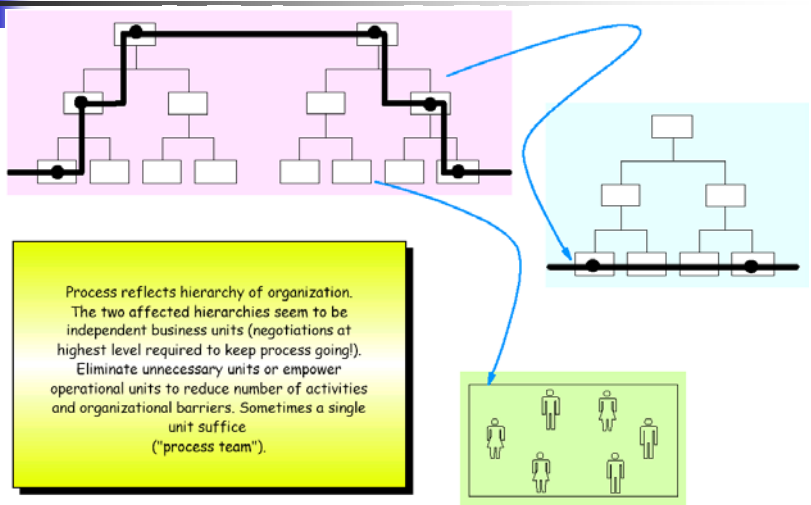
  Often, simple static analysis of flows through organization result in big improvements!

- This allows processes to be performed fast
  - ...but does not guarantee it
  - Duration/deadline management of WFMS helps further
    - Specify maximum time
      - an activity must be worked on (with/without interrupts or idle time)
      - an activity must be started once scheduled by the WFMS
      - an escalation may take (notification of manager,... if time threshold is exceeded)

Process Optimization: Streaming Activities



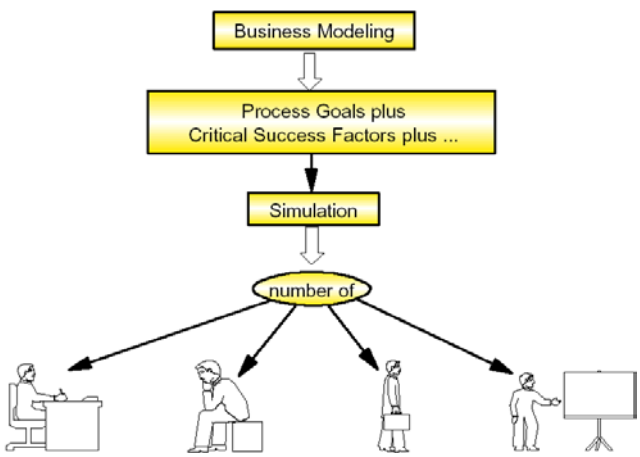
Process Optimization: Restructuring Organizations



Process Analysis

- Dynamic analysis...
  - takes into account quantitative aspects
    - number of processes per time unit, probabilities that certain paths are taken,...
  - produces quantitative aspects
    - resources consumed to perform certain activities, to carry out business process,...
- Simulation generates information about...
  - human resources needed to execute business process
    - impact on hiring strategy
  - skills needed to handle business process
    - impact on skill planning
  - time and cost for performing business process
    - indicator for outsourcing
- Used to compare and select from alternative models of a given business process the "optimal" one
    - optimal in terms of metrics like cost, duration,...

Skill Planning and Management

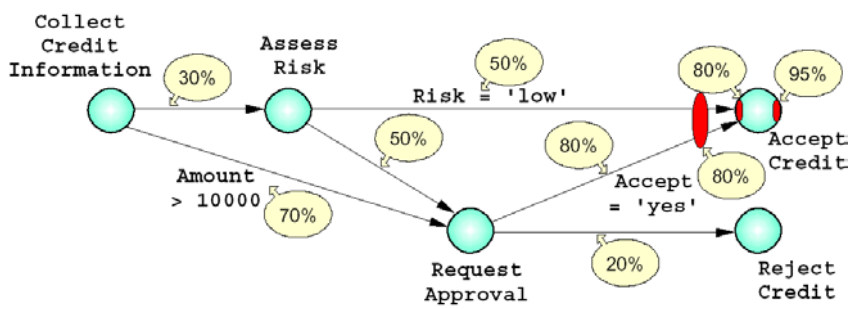


Purpose of Simulation

Verify capability of organization to support expected workload

- Performed based on metrical information ("instrumentation")
- Instrumentation requires to specify
  - Number of processes started per time intervall, i.e. distribution patterns of starts - for example:
    - constant: same number for each time intervall
    - exponential: smaller numbers more frequent than large numbers
    - uniform: numbers random within lower and upper bound
    - customer defined: 57 between 9AM and 11AM, 341 between 11AM and noon,...
  - Probability of transition conditions (likelihood of different branches taken)
  - Probability of activation-, join- and exit conditions (likelihood of repetitions)
  - Average duration of activities (work time, idle time,...), i.e. their distribution patterns
  - Processing power of resources, availability (based on calendar, shifts,...)

Sample Instrumentation Of Control Flow



Analytical Simulation

- Calculates
  - ...how often each activity has to be performed
    - based on instrumentation of control flow and probability theory
    - no automatic association of activities with individual resources
    - simply association with corresponding "staff assignment" statement
  - ...different paths taken through process model and their probability
  - ...corresponding durations for performing process and their probability
- Advantages
  - limited instrumentation needed
  - no huge compute power required
  - if result shows that workload cannot be handled, deadline cannot be met,... no further sophisticated discrete simulation needed
- Disadvantage:
  - does not consider
    - resources and their availability
    - resource competition by concurrent processes

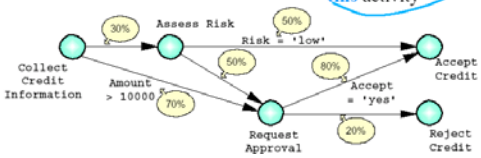
Discrete (Event) Simulation

- Calculates...
  - for each individual resource
    - activities to be performed
    - required time for executing each activity
    - considers availability and processing power of each resource (time schedule, vacation, shifts, experience level,...)
- Considers...
  - impacts of concurrent processes competing for same resources (people,...)
  - probability distributions for start and execution times
- Ideally,
  - navigation engine of target WFMS is used (to avoid mismatch in interpretation semantics)
  - staff resolution is performed based on organizational database

Sample Activity Execution Frequency

	Collect Credit Info	Assess Risk	Request Approval	Total
Collect Credit Information				1000
Assess Risk	300			300
Request Approval	700	150		850
Reject Credit			170	170
Accept Credit		150	680	830

How often executes this activity after this activity

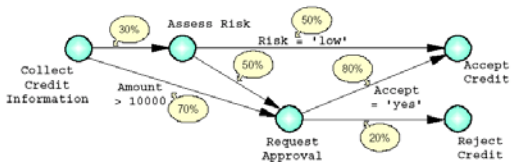


- Assume 1000 processes are started.
- Instrumentation results in frequencies.
- For simplicity, probabilities of join-, exit-,... not considered
- Thus, 83% accepted, 17% rejected
- If these numbers do not match experience, probabilities must be checked!
- Exact probabilities can be derived from audit trail (later)

Sample Execution Paths

Rank	%	Number	Process Instance
1	56	560	Collect Credit Information -> Request Approval -> Accept Credit
2	15	150	Collect Credit Information -> Assess Risk -> Accept Credit
3	14	140	Collect Credit Information -> Request Approval -> Reject Credit
4	12	120	Collect Credit Information -> Assess Risk -> Request Approval -> Accept Credit
5	3	30	Collect Credit Information -> Assess Risk -> Request Approval -> Reject Credit

Multiply probabilities along path



Sample Staff Assignments & Efforts

Activity	Amount of Time	Performing Role
Collect Credit Information	10	Loan Officer
Assess Risk	5	Loan Officer
Request Approval	20	Financial Officer
Accept Credit	5	Loan Officer
Reject Credit	5	Loan Officer

- Staff assignment specifies the resources having required skills,... to perform activity
- Avarage duration for execution by appropriate staff is specified during instrumentation

Sample Processing Time Per Path

Computed probabilities per path

Rank	Time	Process Instance
1	20	Collect Credit Information -> Assess Risk -> Accept Credit
2	35	Collect Credit Information -> Request Approval -> Accept Credit
3	35	Collect Credit Information -> Request Approval -> Reject Credit
4	40	Collect Credit Information -> Assess Risk -> Request Approval -> Accept Credit
5	40	Collect Credit Information -> Assess Risk -> Request Approval -> Reject Credit

Activity	Amount of Time	Performing Role
Collect Credit Information	10	Loan Officer
Assess Risk	5	Loan Officer
Request Approval	20	Financial Officer
Accept Credit	5	Loan Officer
Reject Credit	5	Loan Officer

Sample Activity Processing Time Per Role

Activity	Number of Executions	Loan Officer Time (min)	Financial Officer Time (min)
Collect Credit Information	1000	10000	
Assess Risk	300	1500	
Request Approval	850		17000
Accept Credit	830	4150	
Reject Credit	170	850	
Total Processes/Time	1000	16500	17000
Average Per Process		16.5	17

Assuming a 40-hour-week, 7 Financial Officers and 7 Loan Officers are needed to perform resulting workload

	Collect Credit Info	Assess Risk	Request Approval	Total
Collect Credit Information				1000
Assess Risk	300			300
Request Approval	700	150		850
Reject Credit			170	170
Accept Credit		150	680	830

Activity	Amount of Time	Performing Role
Collect Credit Information	10	Loan Officer
Assess Risk	5	Loan Officer
Request Approval	20	Financial Officer
Accept Credit	5	Loan Officer
Reject Credit	5	Loan Officer

Sample Processing Costs

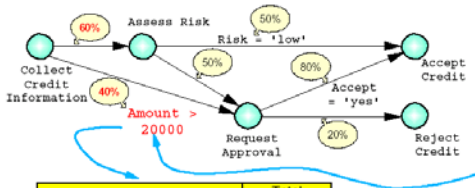
Activity	Individual Cost [$]	Total Cost [$]
Collect Credit Information	6	6000
Assess Risk	3	900
Request Approval	18	15300
Accept Credit	3	2490
Reject Credit	3	510
Total		25200

Assuming costs of 54$/hour [0.9$/min] for a Financial Officer and 36$/hour [0.6$/min] for a Loan Officer the following (total) activity costs result

Activity	Number of Executions	Loan Officer Time (min)	Financial Officer Time (min)
Collect Credit Information	1000	10000	
Assess Risk	300	1500	
Request Approval	850		17000
Accept Credit	830	4150	
Reject Credit	170	850	
Total Processes/Time	1000	16500	17000
Average Per Process		16.5	17

Sample Cost Optimization

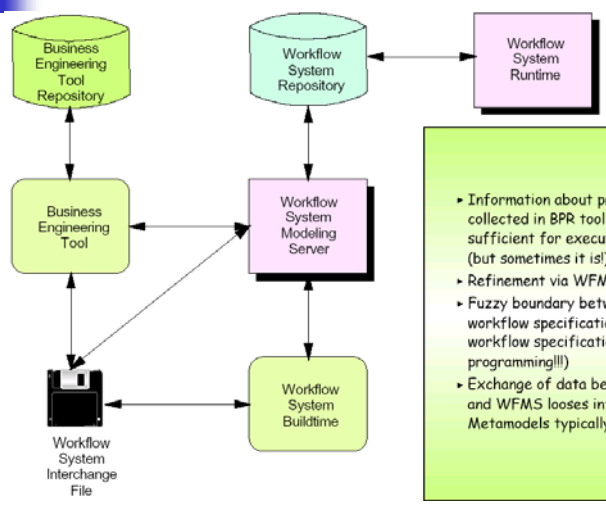
Activity	Total Cost [$]
Collect Credit Information	6000
Assess Risk	900
Request Approval	15300
Accept Credit	2490
Reject Credit	510
Total	25200



Activity	Total Cost [$]
Collect Credit Information	6000
Assess Risk	1800
Request Approval	12600
Accept Credit	2580
Reject Credit	420
Total	23400

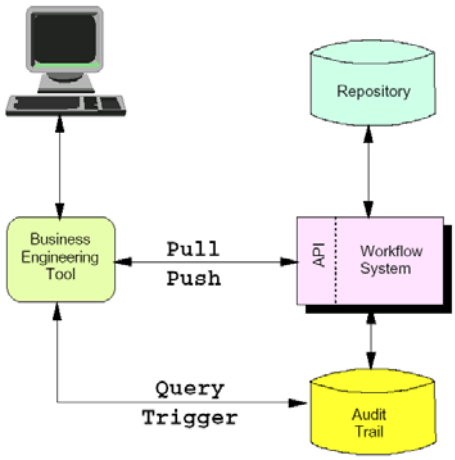
- More than half of the costs due to approval by financial officer
- Number of necessary approvals reduced by adapting transition condition (i.e. loan officers get more responsibility!) and adapting affected probabilities
- Result: Costs reduced from $25.20/proc to $23.40/proc !!!

BPR-WFMS Exchange Of Information



- Information about process model collected in BPR tool often not sufficient for execution in WFMS (but sometimes it is!)
- Refinement via WFMS buildtime
- Fuzzy boundary between BPR and workflow specification (similar to workflow specification and programming!!!)
- Exchange of data between BPR tool and WFMS looses information: Metamodels typically different

Monitoring And Auditing

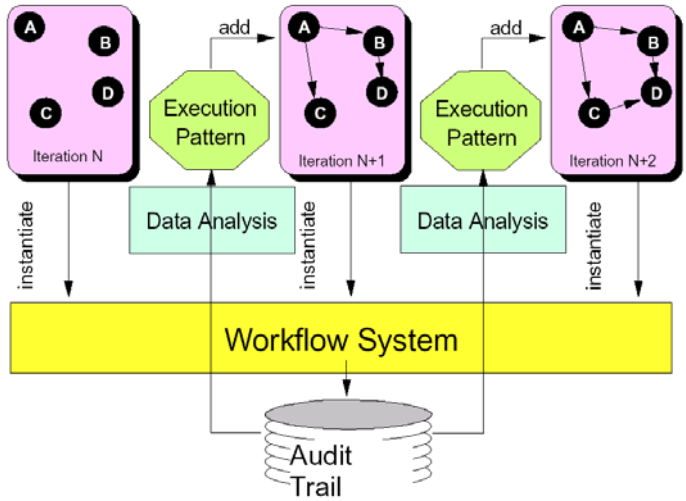


- Business modeling based on assumptions about cardinalities, duration, etc.
- Based on these assumption process characteristics are derived (costs,...) which trigger optimizations
- Thus, incorrect assumptions result in non-optimal process models
- WFMS allows to access actual state (monitoring) as well as history (auditing) of each workflow
- Analyzing audit trail ("vanilla" SQL, OLAP, mining) derives "real data" for optimizing process models (re-engineering)
- Monitoring (manually or automatically) individual processes or instances of the same model allows to detect out-of-line situations and to react accordingly (re-assignment of work,...): Leitstand

Obstructions To Process Modeling

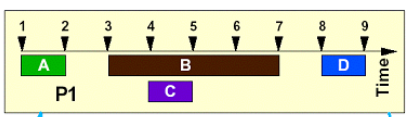
- Business process modeling is often costly because it might be time consuming and error-prone
  - In general, no single person knows/understands a particular business process
    - many people must be interviewed to get as much details as possible
      - usually, process participants only have local knowledge of the process (often they know what they are doing, the tools they use, sometimes who gets involved next or who got involved before)
    - details must be combined/inferred to get full picture
      - sequence of activities must be derived/determined (control flow and data flow)
      - inconsistencies must be detected, analyzed and resolved (similar to "view integration")
- Reducing this cost is highly desirable
- Simple idea: Allow to put partial models into production
  - First iteration uses local knowledge only
    - Time reduction: No need to specify large and complex model
    - Error-reduction: "View integration" reduced/avoided
  - Use execution history (WFMS **audit trail**) to find template of the "real" business process

Process Discovery: Main Idea



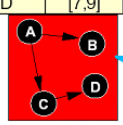
Sample: Activity Sequences

Process Model	Process	Activity	Interval
P	P1	A	[1,2]
P	P1	B	[3,7]
P	P1	C	[4,5]
P	P1	D	[8,9]
P	P2	A	[1,3]
P	P2	B	[5,6]
P	P2	C	[4,6]
P	P2	D	[7,8]
P	P3	A	[1,3]
P	P3	B	[4,5]
P	P3	C	[5,6]
P	P3	D	[7,8]
P	P4	A	[2,3]
P	P4	B	[4,6]
P	P4	C	[5,6]
P	P4	D	[7,9]



Process Name	Instance	Precedence Relations
P	P1	A->{B,C} {B,C}->D
P	P2	A->{B,C} {B,C}->D
P	P3	A->B B->C C->D
P	P4	A->{B,C} {B,C}->D

Derived from audit trail



Mining