CA441: Business Process Management

Class: CAIS 4
Lecturer: Martin Crane
What are Business Processes anyway?

• **Def:** A collection of interrelated work tasks, initiated in response to an event, achieving a specific result for the customer and other stakeholders of the process (Sharp & McDermott)

• No Result – No Process!
  • *Customer Relationship Management* is not a process!
  • *Confirm Market Opportunity* is a process

• **BPM = Management of Business Processes**
Relationship Between Concepts

- **Business Process**
  - Is defined in a
  - (i.e. what is intended to happen)
  - Is managed by

- **Process Definition**
  - (a representation of what is intended to happen)
  - Composed of

- **Workflow Management System**
  - (controls automated aspects of the business process via)

- **Process Instances**
  - (a representation of what is actually happening)
  - Include one or more

- **Activity Instances**
  - Which include
    - And/Or
      - Work Items
        - (tasks allocated to a workflow participant)
      - Invoked Applications
        - (computer tools/applications used to support an activity)

- **Sub-Processes**
  - Activities
    - Which may be
      - Automated Activities
      - Manual Activities
        - (which are not managed as part of the Workflow system)
  - Or
    - During execution are represented by

**SOURCE:** WFMC
Course Objectives

- Examine the main concepts of Business Process Management and Business Process Re-design
- Examine techniques for modelling Business Processes.
- Examine the environmental conditions and the enabling technologies.
- Compare BPR with other management techniques.
Course Structure

Lectures

• Introduction - scope, objectives.
• Workflow Modelling (understanding current WF/ designing new WF)
• Introduction to Business Process Redesign
• Business Process Re-engineering
• Successful Re-engineering Projects
• Socio-Technical Systems
• Workflow Tools
• Workflow Management
• WF Management in Practice: Petri-Nets
Timetable

Lectures
Monday  12 - 1  Q158
Thursday  2 - 3  XG16

Labs
None

Tutorials
Monday  3 - 4  X131  as required
End-of-Semester Mark

- Assignments 50%
- Exam 50%

Assignments

- Essay in form of a research paper
- Details to be announced
Information

See my web page at:
http://www.computing.dcu.ie/~mcrane/CA441/

Research Papers/Lecture Notes on various topics will be put on this page throughout the course
BOOK LIST

Jackson, Michael & Twaddle, Graham *Business Process Implementation* Addison Wesley.

Hammer, Michael & Champy, James *Reengineering the Corporation* Nicholas Brealey.


Other books and articles will be recommended for reading from time to time.
Business Process Redesign.
Introduction

Based on: Malhotra, Business Process Redesign: An Overview,
Processes

Identified in terms of:
- beginning and end points,
- interfaces,
- organisation units involved, particularly the customer unit.

High Impact processes should have process owners.

Examples of processes include:
- developing a new product;
- ordering goods from a supplier;
- creating a marketing plan;
- processing and paying an insurance claim;
- etc.
Processes

Defined based on three dimensions:

• **Entities**: Processes take place between organisational entities. They could be Interorganisational (e.g. EDI), Interfunctional or Interpersonal (e.g. CSCW).

• **Objects**: Processes result in manipulation of objects. These objects could be Physical or Informational.

• **Activities**: Processes could involve two types of activities: Managerial (e.g. develop a budget) and Operational (e.g. fill a customer order).

(Davenport & Short 1990)
Relationship between BPR & Information Technology?

- IT is the key enabler of BPR (Hammer).
- Use IT to challenge the inherent assumptions from before the advent of modern computer and communications technology.
- Core of reengineering is "discontinuous thinking -- or recognising and breaking away from the outdated rules and fundamental assumptions underlying operations... These rules of work design are based on assumptions about technology, people, and organisational goals that no longer hold."
“Principles of reengineering” (Hammer)

(a) Organise around outcomes, not tasks;
(b) Have those who use the output of the process perform the process;
(c) Subsume information processing work into the real work that produces the information;
(d) Treat geographically dispersed resources as though they were centralised;
(e) Link parallel activities instead of integrating their results;
(f) Put the decision point where the work is performed, and build control into the process;
(g) Capture information once and at the source.
“The new industrial engineering” (Davenport & Short)

BPR requires broader view of both IT and business activity, and relationships between them.

- **IT** — more than an automating or mechanising force: to fundamentally reshape the way business is done.
- **Business activities** — more than a collection of individual or even functional tasks.

IT and BPR have a recursive relationship. IT capabilities should support business processes, and business processes should be in terms of the capabilities IT can provide.
Recursive relationship between IT capabilities and BPR

How can IT support business processes?

Information Technology capabilities

Business Process Redesign

How can business processes be transformed using IT?
"The new industrial engineering" (Cont.)

Business processes represent a new approach to coordination across the firm.

IT impact is as a tool for reducing the costs of coordination.
“The new industrial engineering” (Cont.)

Awareness of IT capabilities can – and should – influence process design.

How IT capabilities affect the organisation – 1

**Transactional**  —  can transform unstructured processes into routinised transactions

**Geographical**  —  can transform information with rapidity and ease across large distances

**Automational**  —  can replace or reduce human labour in a process

**Analytical**  —  can bring complex analytical methods to bear on a process
“The new industrial engineering” (Cont.)

How IT capabilities affect the organisation – 2

**Informational** — can bring vast amounts of detailed information into a process

**Sequential** — can enable changes in the sequence of tasks

**Knowledge Management** — allows capture and dissemination of knowledge

**Tracking** — allows detailed tracking of task status

**Disintermediation** — can be used to connect two parties within a process that would otherwise communicate through an intermediary
The way related functions participate in a process (functional coupling of a process) can be differentiated along two dimensions:

- **degree of mediation** - the extent of sequential flow of input and output among participating functions.
- **degree of collaboration** - the extent of information exchange and mutual adjustment among functions when participating in the same process.
Degree of Mediation (Teng)
Degree of Collaboration

Frequency and intensity of information exchange between two functions ranges from *none* (completely insulated) to *extensive* (highly collaborative).

Many process can be improved by increasing the degree of collaboration.
Functional Coupling Framework of Business Processes

Degree of Collaboration

Low  ←  Insulated  →  Collaborative  →  High

Coupling Pattern: Functions participate in the process sequentially with no mutual information exchange.
Environment: Participating functions are sequentially dependent and face low level of uncertainty in I/O requirements.
Example: Sales function (A) sends customer order to inventory function (B) for shipping.

Coupling Pattern: Functions participate in the process sequentially with mutual information exchange.
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Example: Engineering (A) provides manufacturing design specifications to production (B) with frequent consultation between A and B.

Coupling Pattern: Functions participate directly in producing the process outcome with no mutual information exchange.
Environment: Participating functions are sequentially independent and face low level of uncertainty in I/O requirements.
Example: Recruiting workers (A) and equipment requisition (B) participate directly in establishing a new plant with no consultation between A and B.

Coupling Pattern: Functions participate directly in producing the process outcome with mutual information exchange.
Environment: Participating functions are sequentially independent and face high level of uncertainty in I/O requirements.
Example: Advertising (A) and production (B) directly participate in launching a new product with frequent consultation between A and B.
IT reduces the Degree of Mediation and enhances the Degree of Collaboration.

Innovative uses of IT leads many firms to develop new, coordination-intensive structures, enabling them to coordinate their activities in ways that were not possible before. Such coordination-intensive structures may raise the organization's capabilities and responsiveness, leading to potential strategic advantages.
BPR Methodology. (Davenport and Short)

five-step approach to BPR:

- Develop the Business Vision and Process Objectives:
  + prioritise objectives and set stretch targets
- Identify the Processes to be Redesigned:
  + Identify critical or bottleneck processes
- Understand and Measure the Existing Processes:
  + Identify current problems and set baseline
- Identify IT Levers:
  + Brainstorm new process approaches
- Design and Build a Prototype of the New Process:
  + Implement organisational and technical aspects
References - 1


References - 2


References - 3


What is Business Process Redesign?

- "the analysis and design of workflows and processes within and between organisations" (Davenport & Short 1990).

- "the critical analysis and radical redesign of existing business processes to achieve breakthrough improvements in performance measures." Teng et al. (1994)
How Does BPR Differ from TQM?

In recent years, increased attention to business processes is largely due to the TQM. TQM and BPR share a cross-functional orientation. (Teng)

Quality specialists tend to focus on incremental change and gradual improvement of processes, while proponents of reengineering often seek radical redesign and drastic improvement of processes. (Davenport)
BPR vs. TQM

*Quality management* (TQM or continuous improvement), refers to programs and initiatives that emphasise incremental improvement in work processes and outputs over an open-ended period of time.

*Reengineering*, also known as business process redesign or process innovation, refers to discrete initiatives that are intended to achieve radically redesigned and improved work processes in a bounded time frame. (Davenport)
### Process Improvement (TQM) versus Process Innovation (BPR)

From Davenport (1993, p. 11)

<table>
<thead>
<tr>
<th></th>
<th><strong>Improvement</strong></th>
<th><strong>Innovation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of Change</strong></td>
<td>Incremental</td>
<td>Radical</td>
</tr>
<tr>
<td><strong>Starting Point</strong></td>
<td>Existing Process</td>
<td>Clean Slate</td>
</tr>
<tr>
<td><strong>Frequency of Change</strong></td>
<td>One-time/Continuous</td>
<td>One-time</td>
</tr>
<tr>
<td><strong>Time Required</strong></td>
<td>Short</td>
<td>Long</td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td>Bottom-Up</td>
<td>Top-Down</td>
</tr>
<tr>
<td><strong>Typical Scope</strong></td>
<td>Narrow, within functions</td>
<td>Broad, cross-functional</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td><strong>Primary Enabler</strong></td>
<td>Statistical Control</td>
<td>Information Technology</td>
</tr>
<tr>
<td><strong>Type of Change</strong></td>
<td>Cultural</td>
<td>Cultural/Structural</td>
</tr>
</tbody>
</table>
What is a Business Process?

"a set of logically related tasks performed to achieve a defined business outcome."

structured, measured set of activities designed to produce a specified output for a particular customer or market.

Implies a strong emphasis on how work is done within an organisation" (Davenport).

Processes have two important characteristics:

• (i) They have customers (internal or external),
• (ii) They cross organisational boundaries, i.e., they occur across or between organisational subunits.
Business Process Re-engineering

Based on: Teng, Grover & Fiedler, Business Process Reengineering: Charting a Strategic Path for the Information Age,
Facilitators for BPR

IT

- shared databases
- imaging

Telecommunication

- LANs
- e-mail
- groupware

Others

- Quality movement
Degree of Mediation Dimension of Business Processes

HIGH (Indirect)

LOW (Direct)
Reducing Mediation through IT

Ford Motor Corp.

- **Old process** involved 3 functions - purchasing, inventory and accounts payable
- participated *indirectly*
- sequential document flow
- **New process** uses shared database
- every function participates *directly*
- 75% reduction in work-force (500 -> 125)
Functional Coupling Framework of Business Processes

**Insulated**

**Coupling Pattern**: Functions participate in the process sequentially with no mutual information exchange.

**Environment**: Participating functions are sequentially dependent and face low level of uncertainty in I/O requirements.

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**Collaborative**

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Application if IT in Alternative Paths for Process Reengineering

Degree of Collaboration

Path X

Primarily through application of Communication Technologies

Path Z

Application of Communication Technologies and Shared Information Resources

Path Y

Primarily through application of Shared Information Resources

Path X'

Shared Resource

Low

High

Low

High
IT creates a “public good”

Resource that can be accessed by many functions.

- Shared information resource is not “used up” by usage, and retains its value for other users.
- Provides comprehensive information that facilitates accomplishment of process objectives on a more global basis.
Other enablers

Behavioural & organisational techniques:
• self-directed teams
• process generalists
  + Kodak example
  + IBM Credit
IBM Credit

IBM Credit Corporation finances the computers, software, and services that the IBM Corporation sells.

five steps:

1. On a request from an IBM field sales representative an operator in the central office wrote down the request on a piece of paper.

2. The request sent to credit department where a specialist checked the client's creditworthiness, wrote the result on the piece of paper and sent it to the business practices department.

3. The business practices department customised the standard loan covenant to the client. Special terms attached to the request if necessary.

4. Request went to the price department where a pricer determined the appropriate interest rate.

5. Administration department wrote a quote letter for the field sales representative.
IBM Credit – problems

- Process took six days on average.
- In this time the customer could be seduced by another computer vendor.
- Request couldn’t be tracked.
IBM Credit – attempted fixes

- Install a control desk, so they could answer the sale representative's question about the status of the request.
- Instead of forwarding the request to the next step in the chain, each department returned the request to the control desk for logging before sending out the request again.
- Solved tracking problem, but took yet more time.
IBM Credit

Field Sales Rep
- Make financing request
  - Record request
    - Check credit-worthyness
      - Log
      - Go back to customer
      - Log
    - Log
  - Log
- Log

Central Office

Credit Department

Business Practices Department

Price Department

Admin Department

- Log
- Determine interest rate
  - Log
- Write a quote

Quote to customer
IBM Credit - investigation

- Two senior managers at IBM Credit took a request and walked themselves through all five steps.
- Performing the actual work took ninety minutes.
- The problem was not in the tasks and the people performing them, but in the structure of the process.
- IBM Credit replaced its specialists - the credit checkers, pricers and so on - with generalists. Now, a generalist processes the entire request from beginning to end.
IBM Credit - rationale

• How could one generalist replace four specialists?
• Old process design based on the assumption that every bid request was unique and difficult to process.
• Assumption false; most requests simple and straightforward:
  • Find a credit rating in a database
  • Plug numbers into a standard model
  • Pull clauses from a file.
• Easily done by single individual supported by an easy-to-use computer system which IBM Credit developed.
• In most cases, the system provides guidance and data to generalists.
• In hard cases, help available from a small pool of real specialists assigned to work in the same team.
IBM Credit - gains

- Turnaround reduced from six days to four hours.
- Dramatic performance breakthrough by making a radical change to the process - i.e. reengineering.
- IBM Credit did not ask, "how do we improve the calculation of a financing quote? How do we enhance credit checking?" It asked "How do we improve the entire credit issuance process?"
- In making its radical change, IBM Credit shattered the assumption that every request needed specialists.
References - 1


References -


Workflow Modelling

(Sharp & McDermott)
Method

Frame the Process
Understand the current (“as-is”) process
Design the new (“to-be”) process
Develop use-case scenarios
Process Enablers

Workflow design
- Workplan for responding to an event

Information technology
- Focus on information systems

Motivation and measurement
- Explicit and implicit reward systems
- People do what they are measured on

Human resources
- Knowledge, skills and experience
- Training, organisational structure, job definitions ...

Policies and rules
- Internal and external
- May be obsolete

Facilities design
- Workplace design and infrastructure
Context Framework
(aka a FW for putting analysis of Bps in context with analysis of IS Requirements)

Mission, strategy and goals
Business process
Information system
  • Presentation
  • Logic
  • Data management
Modelling techniques

Business process: process workflow models ("swimlane" diagrams)
Presentation: use case scenarios
Application logic: various
Data management: various
Process Workflow Model

Student
- Submit registration by post

Mailroom
- Sort post by department
- Deliver post

Department secretary
- Open post, decide if misdirected
- Sort registrations by advisor
  - yes
  - no

Enrollment assistant
- Decide if form is complete
  - yes
  - Request admission status

Registrar’s office
- Print student summary report
- Batched and run overnight

Department advisor
- etc.

etc.
Workflow-driven Methodology

Frame the process
Understand as-is process
Design to-be process
Develop use cases
Design user interface

Build overall process map

Describe application processes (transactions) and business rules
Develop logical data model
Framing the Process

• Identify a set of related processes, and develop an overall process map.
• Establish the scope of the target process.
• Review or document mission, strategy, goals.
• Initial process assessment.
• Process vision and performance objectives
• Glossary of terms and definitions.
• Observations on culture, core competences, management systems.
A business process is ...

A collection of inter-related work tasks, initiated in response to an event, that achieves a specific result for the customer of the process.

achieves a specific result for the customer of the process
initiated in response to a specific event
work tasks
a collection of inter-related
Framing the Process
(document the scope of the process)

Process name in verb-noun format
Event that triggers the business process
Result achieved by the process
Customer that receives the result
Other stakeholders and the result(s) they expect
5 – 7 major activities or milestones
Actors with a rôle in the process
Mechanisms
Timing and frequency
Related processes
Overall process map

Simply a set of related processes:

- Define Item
- Qualify Vendor
- Establish Supply Agreement
- Procure Item
- Pay Vendor

Overall process map for Supply Management area.
Identifying processes
(bbottom-up)

Identify ‘milestones’ (results from processes)
Link the milestones
Identify cardinality (1:1), (1:m), (m:1)
Set of (1:1)s identifies a process!
Name the process
Identify the triggering event
Identify stakeholders and expected results
“Milestones”

Contract is established
Payment is received
Prospect is identified
Order is shipped
Marketing meeting is conducted
Invoice is issued
Order is assembled
Amount due is calculated
Order is received
Analyse Links

Identify Prospect -> Schedule Meeting -> Conduct Marketing Meeting -> Establish Contract -> Receive Order -> Assemble Order

Ship Order -> Calculate Amount Due -> Issue Invoice -> Receive Payment

(Add extra steps if necessary)
(Add extra steps if necessary)
Form Processes

1:1 Identify Prospect → Schedule Meeting → Conduct Marketing Meeting → Establish Contract → Receive Order → Assemble Order

1:1 Ship Order → Calculate Amount Due → Issue Invoice → Receive Payment → Distribute Payment
Name Processes

Acquire Customer
- Identify Prospect
- Schedule Meeting
- Conduct Marketing Meeting
- Establish Contract

Fulfil Order
- Receive Order
- Assemble Order
- Ship Order

Collect Accounts Receivable
- Calculate Amount Due
- Issue Invoice
- Receive Payment
- Distribute Payment
Identify stakeholders and expected results

Customer may not be the only stakeholder
Results must satisfy customer, but also the organisation
e.g. Customer order is satisfied (customer receives) and paid for (other criteria met)
Initial Assessment

2 Questions:
- What’s wrong with the process anyway?
- What will be better when we’re done?

Perspectives:
- Stakeholders
- Enablers
- Metrics
Metrics

• Give a guide of where to focus efforts - no point in optimising a process that occurs infrequently, or uses few resources.
• Allow us to evaluate success.
• Collect all the metrics available:
  • Volumes
  • Frequencies
  • Effort
  • Exceptions
• Need to be appropriate for the process, not the function
What metrics

How many?
How long?
How much effort?
Who’s involved?
Efficiency
Cost
Assessment by stakeholder

3 essential groups:
- Customers
- Performers
- Owners

May also consider:
- Suppliers
- Government & other regulatory agencies
- General public
- Industry bodies
Assessment 1 - Customer

- Has the product or service got the right characteristics?
- How much effort is required of the customer?
- Does the process require too many interactions?
- Is the customer the only one monitoring the process?
- Are the rules & requirements reasonable?
Assessment 2 - Performers

• Is this how you’d do it if you had a choice?
• Does this process help you meet your goals?

• Remember that the performers are not the customers!
Assessment 3 - Managers & Owners

• Process must be efficient and profitable.
• In a not-for-profit setting, it must be fiscally responsible.
• Consider opportunity cost as well as actual cost.
Assessment 4 - Suppliers

“How easy is it to do business with us as compared to other customers?”

“What errors or actions on our part cause difficulties for you?”
Assessment 5 - Other groups

General public – ethics, safety, environment.
Local community – involvement in local initiatives.
Regulators.

Don't assume - *ask*!
Process Enablers (review)

Workflow design
  • Workplan for responding to an event

Information technology
  • Focus on information systems

Motivation and measurement
  • Explicit and implicit reward systems
  • People do what they are measured on

Human resources
  • Knowledge, skills and experience
  • Training, organisational structure, job definitions ...

Policies and rules
  • Internal and external
  • May be obsolete

Facilities design
  • Workplace design and infrastructure
Enabler perspective

Workflow design:

• Examine
  + steps
  + precedence
  + flow
  + handoffs
  + decision points

• What is the one thing you would do to improve this process?

• What aspect of this process causes you the most problems?
Information Technology

- Primarily manifested as systems. In many cases the system is the business process.
  - What’s old and doesn’t work?
  - What’s new and might work? ... or has become a necessity?
- Not only need to do things right – need to do the right thing. Many application development projects automate the root cause of the problem.
- Work from the bottom up in the framework:
  + Are the right data being maintained, and is the right information being presented to each step?
  + Are the right activities being automated?
  + Are the user interfaces appropriate for the task and the person using them?
  + Is the flow of work automated wherever possible and appropriate?
Motivation and Measurement

- People don’t pay much attention to what management says; they pay attention to what management measures.
- Do the measures of performers support or impede process goals?
- NHS example – waiting lists!
Human Resources

- How do organisational structures, job definition and skills impact the process?
- Will the workforce need to change?
- Will new staff skills and training be required?
- Keep the unions involved.
Policies and Rules

Rules reflect the organisation’s bias. e.g. two possible policies on refunds could be:

• “refunds up to a certain amount can be handled by a sales person on the retail floor, at their discretion, whether or not the customer has a receipt.”

• “all refund requests must be accompanied by a sales receipt and a completed refund reason form; they will be processed by the Customer Service and Accounts departments, and a cheque will be posted.”

The process will be different in each case.
Facilities Design

• Workflow design/physical infrastructure getting more attention

• Design of eg Offices detrimental to work being done
  • Cubicle seems private but can be overheard/disturbs others
  • For highly collaborational Workgroups with meetings etc need a meeting room and usually not enough available.

• Space, quiet, privacy & ability to avoid interruptions are key productivity enablers that are frequently ignored in modern office layouts (open-plan)
Approve customer credit application

<table>
<thead>
<tr>
<th>Event</th>
<th>Subprocesses</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit application is submitted</td>
<td>Complete application</td>
<td>Set up customer</td>
</tr>
<tr>
<td>Evaluate application</td>
<td>Decide on application</td>
<td>Inform customer</td>
</tr>
</tbody>
</table>

**Case for action**
- We’re losing market share to competitors offering fast or instant credit, and our image is declining.
- Our paper-based workflow involves many starts and stops, and involves several departments and job functions.
- We don’t capture the right information on the application, so we need to go back to the Customer repeatedly.
- We can’t answer Customer queries about in-process applications.
- The effort and delay aren’t justified for small Customers who pose minimal risk as a group.
- Credit Representatives spend most of their time on small accounts, not on large ones where their expertise is needed.
- Unless we fix the process, our market share will continue to erode and closure of the operation is likely

**Vision**
- We will offer instant, secured credit to small Customers.
- Applications from large Customers will be handled in two days or less.
- All staff will perform higher-value work, and have more authority – Credit Reps will focus on large clients, and Credit Admin Clerks will handle small applications completely.
- Independent surveys show that Customers perceive us as the Customer Service leader in our industry.
- Once the new process is implemented, our market share decline will slow, and within one year we will again be growing at 12% per year.

**Actors**
- Applicant
- Sales Representative
- Credit Representative
- Credit Administration Clerk
- Credit Bureau
- Word Processing Clerk
- Marketing Administration Clerk
- Customer Data Maintenance Clerk

**Mechanisms**
- Credit Application
- Credit Report
- Notification Letter
- Sales System

**Metrics**
- 1 to 4 hours and up to 7 elapsed days per application
- 6 Credit Representatives
- 150 applications per month, growing 10% per year
- 75% approved, 25% declined
- 85% of applications come from small customers
- 90% of sales volume comes from 10% of customers
- 10% of applications come from previously denied Applicants, and 10% from former Customers
- Small Customer bad debt write-offs are less than .2% of sales, and overall they are approximately 1% of sales

A “poster” summarising the results of framing the process
The Environment

Any redesigned process must fit into the environment and ‘culture’ of the organisation.

Issues:

• Mission and strategy, especially strategic differentiation.
• Organisational culture.
• Core competences.
• Business context and focus.
Mission and strategy.
Organisational culture.
Core competences.
Business context & focus.

**Business mission, strategy and goals**

**Mission:**
- what we do, and who we do it for.

**Strategy:**
- Why would a customer choose us?

**Goals:**
- performance targets, to focus effort and gauge progress.
Strategic discipline

Study by Treacy & Wiersema (in The Discipline of Market Leaders) shows that leading companies choose to excel in one of three disciplines:

- Operational excellence
- Product leadership
- Customer intimacy

“Also rans” make no choice or choose to be good at all three
Mission and strategy.
Organisational culture.
Core competences.
Business context & focus.

## Strategic disciplines

<table>
<thead>
<tr>
<th>Core business processes that...</th>
<th>Operational Excellence</th>
<th>Product Leadership</th>
<th>Customer Intimacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharpen distribution systems and provide no-hassle service</td>
<td>Nurture ideas, translate them into products, and market them successfully</td>
<td>Provide solutions and help customers run their business</td>
<td></td>
</tr>
<tr>
<td>Has strong central authority and a finite level of empowerment</td>
<td>Acts in an ad-hoc, loosely-knit and ever-changing way</td>
<td>Pushes empowerment close to the point of customer contact</td>
<td></td>
</tr>
<tr>
<td>Maintain standard operation procedures</td>
<td>Reward individuals’ innovative capacity and new product successes</td>
<td>Measure the cost of providing service and of maintaining customer loyalty</td>
<td></td>
</tr>
<tr>
<td>Acts predictably and believes “one size fits all”</td>
<td>Experiments and thinks “out of the box”</td>
<td>Is flexible and thinks “have it your way”</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Fortune, Feb. 6 1995, p. 96.
Some process improvement goals...

• Flexible in meeting the needs of individual customers
• Easier for an entry-level workforce to adopt with relatively little training and support
• Fewer customer interactions
• Absolute auditability and adherence to applicable regulations
• Accessible anytime, anywhere, via any medium
• Easier to standardise and maintain at international locations
• Less time and effort to integrate new suppliers or customers into the process
• More suitable for support by commercial off-the-shelf (COTS) software
Beliefs and Culture

Organisational behaviour stems from a few basic beliefs:

• “There’s always a better way”
• “We have a bias towards informed action”
• “Decision-making should be close to the action”
• “Our clients are trying to cheat us, the public misunderstands us and the media are out to get us. (and our employees couldn’t care less)”
Identifying Culture

1. Are there stories or corporate legends that provide examples?
2. What factors continually get in the way?
3. What factors are seen as expediting progress?
4. How are decisions made?
5. Are all employees free to offer opinions or challenge decisions?
6. Is the orientation towards the individual or the group?
7. Whose opinion is valued?
8. Are there any identifiable behaviours that are rewarded or punished?
9. Is there a high tolerance for ambiguity?
10. Does the organisation favour results or following procedure?
11. Is the organisation cautious or will it take risks?
12. Is the emphasis on relationships and social interactions, or on tasks and getting on with the job?
Core Competences

• What are we really good at?

• World-class organisations have up to five or six core competences that their core products or services are based on.
  
  • “Core competence is the collective learning of the organisation, especially the capacity to coordinate diverse production skills and integrate streams of technologies. It is also a commitment to working across organisational boundaries.”

  • “organising around strategic business units is problematic because they under-invest in core competences, imprison resources and bind innovation” (Prahalad & Hamel)

• We can scale down the idea of a Core Competence to the process level - design processes that play to the strengths of the performers.
Scoping questions - 1

1. What is the primary business objective driving this project?
2. What is the current situation?
3. Is this essentially a business process improvement project?
4. What is the technical or project objective?
5. Which business data will or will not be involved?
6. Organisationally who will be impacted by this?
7. What areas outside the process will be impacted, or will require interfaces?
8. Are there other initiatives we should be aware of?
9. What could go wrong?
10. What could go right?
11. Have any significant issues or difficulties arisen?
12. Are there any constraints we need to take into account?
13. Have any important decisions already been made?
14. Have project structure and personnel been identified?
15. Are you really the sponsor?
References


Successful Re-engineering Projects

Based on: Teng, Jeong & Grover, Profiling Successful Reengineering Projects.
The questions

- Are reengineering projects aimed at more radical change resulting in higher implementation success?

- If limited attention and resources must be allocated among the different stages of a reengineering project, which stage (or stages) should receive more emphasis in order to achieve higher implementation success?
Research Model

- Re-engineering Project “Radicalness”
- Re-engineering Project Stage-Efforts Profile

Re-engineering Project Implementation Success
Comparison of variables:

- Re-engineering project radicalness
  - Measured in seven dimensions
- Re-engineering project stage-efforts profile
  - Eight typical stages in a project
- Re-engineering project implementation success
  - Perceived level of success
  - Goal fulfilment.
Project stages and tasks (see Klein)

**Stage 1: Identification of BPR opportunities**
- Establish a steering committee
- Secure management commitment
- Align with corporate and IT strategies
- Identify major business processes with an “business model”
- Understand customers’ requirements
- Prioritise processes and select one for implementation

**Stage 2: Project preparation**
- Plan for organisational change
- Organise a BR team for the selected process
- Train the team members
- Plan the project

**Stage 3: Analysis of existing process**
- Analyse existing process structures and flows
- Identify value-adding activities
- Identify opportunities for process improvement

**Stage 4: Development of a process vision**
- Understand process customers requirements
- Identify process performance measures
- Set process performance goal
- Identify IT that enables process re-design
- Develop a vision for the redesigned process

**Stage 5a: Solution: Technical design**
- Develop and evaluate alternative process designs
- Detailed process modelling
- Design controls for process integrity
- IS analysis and design for the new process
- Prototype and refine the process design

**Stage 5b: Solution: Social design**
- Empower customer contact personnel
- Define jobs and incentives
- Develop and foster shared values
- Define skill requirements and career paths
- Design new organisational structure
- Design employee performance measurement
- Design change management programme

**Stage 6: Process transformation**
- Develop and test rollout plans
- Implement the social and technical design
- Train staff and pilot new process

**Stage 7: Process evaluation**
- Monitor performance
- Continuous improvement
Project Radicalness

Extent of change to:
1. Patterns of process workflow
2. Rôles and responsibilites
3. Measurements and incentives
4. Organisational structure
5. Information technology
6. Shared values
7. Skills
Success

- Perceived level of success
- Goal fulfilment
  - Cost reduction
  - Cycle-time reduction
  - Customer satisfaction level increase
  - Worker productivity increase
  - Defects reduction
Research sample

- Questionnaires sent to members of the Planning Forum, a professional association focussing on strategic management.
- 239 responses out of 853.
- 105 of the 239 had completed at least one BPR project
- 2/3 of respondents were in manufacturing, financial or service industries
- Most were large companies
Research sample

• 3 most popular processes were:
  • Customer service (13.7%)
  • Product development (13.7%)
  • Order management (10.5%)

• Others were:
  • Business planning and analysis (5.7%)
  • Financial systems (4.8%)
  • Accounting processes (3.8%)
# Effort by Stage (averaged from 1 - 5!)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 3</td>
<td>Analysis of existing process</td>
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<td>Stage 1</td>
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<td>Stage 7</td>
<td>Process evaluation</td>
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<tr>
<td>Stage 5b</td>
<td>Solution: Social design</td>
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</table>
Correlation of radicalness with success

<table>
<thead>
<tr>
<th>Project Success</th>
<th>Patterns of process workflows</th>
<th>Rôles and responsibilities</th>
<th>Performance measurements and incentives</th>
<th>Organisational structure</th>
<th>Information technology applications</th>
<th>Shared value (culture)</th>
<th>Skill requirements</th>
<th>Overall extent of change</th>
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<tr>
<td>Overall success level</td>
<td>.427 ***</td>
<td>.324 ***</td>
<td>.351 ***</td>
<td>.102</td>
<td>.280 ***</td>
<td>.173 *</td>
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CA4 BPR - Successful projects
21 Oct 2009
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## Correlation of stage efforts with success

<table>
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<th>Identification of BPR opportunities</th>
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<tr>
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</tbody>
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*Note: * denotes significant at the 0.10 level, ** denotes significant at the 0.05 level, *** denotes significant at the 0.01 level.*
## Correlation of stage efforts with success

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## Stage efforts vs. impact on perceived project success

<table>
<thead>
<tr>
<th>Stage</th>
<th>Avg effort</th>
<th>Correlation with perceived success</th>
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<tr>
<td>Stage 3: Analysis of existing process</td>
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<td>Stage 5b: Solution: Social design</td>
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<td>.390 ***</td>
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</table>
References


Socio-Technical Systems
Information Systems Failure

Study by Lucas (1975) of over 2000 systems in 16 companies found:

“It is our contention that the major reason most information systems have failed is that we have ignored organisational behaviour problems in the design and operation of computer-based information systems.”

Other researchers have made similar findings.

Bostrom & Heinen 1997 (1)
Reasons for failure

Information technology is commonly blamed, because it is seen as inflexible.

However, IT is neutral. What has more effect is System Designers implicit theories.

Most subscribe to “Theory X”.

Bostrom & Heinen 1997 (1)
Rationale for Socio-Technical Design Methodology

System Designers’ frames of reference cause Faulty design choices; and the failure to perceive better design alternatives lead to Bad designs cause Behavioural problems lead to MIS problems and failures

Seven Conditions:

0. “Implicit” theories held by systems designers about organisations, their members, and how to change them.
1. The concept of responsibility held by systems designers.
2. Limited conceptualisations of frameworks for organisational work systems or user systems used by systems designers in the design process, i.e. non-systemic approach.
3. Limited view of the goal of an MIS implementation held by designers.
4. Failure of the system designers to include relevant persons in the design referent group. Who is the user?
5. The rational / static view of the systems development process held by systems designers.
6. The limited set of change technologies available to systems designers who attempt to improve organisations.

Demonstrated the need to:

a. Reframe MIS design methodology within the STS approach; and
b. change systems designers’ frames of reference.

Bostrom & Heinen 1997 (1)
Principles of Socio-Technology

Joint optimisation of Social and Technical system

• Social
  + Attributes of people (attitudes, skills, values, etc.)
  + Relationships among people
  + Reward systems
  + Authority structures

• Technical
  + Processes, tasks, technology

• Optimisation of one at the expense of the other is sub-optimal

Quality of Work Life
Participation
Semi-autonomous work groups

Munkvold (2000)
Quality of Work Life

Historically only included:

- Wages
- Hours
- Physical conditions.

These are still included in the concept, but it is expanding to include other concerns such as:

- Meaningful and satisfying work
- Control and influence
- Opportunities for learning

Working definition: involves an interesting, challenging and responsible job as perceived by the job holder
Example methodology – Pasmore (1988)

1. Define scope of system to be re-designed
2. Determine environmental demands
3. Create vision statement
4. Educate organisational members
5. Create change structure
6. Conduct socio-technical analysis
7. Formulate re-design proposals
8. Implement recommended changes
9. Evaluate changes / re-design

Munkvold (2000)
Applying Socio-Technical Principles

Make the system designer’s frame of reference more explicit
Focus more on the inter-relationship between social and technical design

3 stages:
1. *Strategic design process* - making the goals and responsibility of the project explicit
2. *Socio-technical design process* - joint consideration of technical system requirements and social system requirements
3. *Continuing management process* (action research process) - constant monitoring of the new system to see if it is meeting its goal, with necessary adjustments being made.

Munkvold (2000)
Bostrom & Heinen 1997 (2)
Mumford – ETHICS

(Effective Technical and Human Implementation of Computer-based Work Systems)

1. Essential systems analysis
2. Socio-technical systems design
3. Setting out alternative solutions
4. Setting out compatible solutions
5. Re-working socio-technical solutions
6. Preparing a detailed work design

Munkvold (2000)
Stages of the ETHICS Methodology

1. Identify problem
2. Identify system boundaries
3. Describe existing system
4. Specify key objectives
5. Identify key tasks
6. Identify sets of tasks
7. Identify information needs
8. Identify variance
9. Diagnose job satisfaction needs
10. Forecast future needs
11. Set and rank efficiency and job satisfaction needs
12. Identify technical and business constraints
13. Identify social constraints
14. Identify technical resources available
15. Identify social resources available
16. Specify priority technical and business objective
17. Specify priority social objectives
18. Check that technical and social objectives are compatible
19. Take technical decisions
20. Take social decisions
21. Set out alternative technical solutions
22. Set out alternative social solutions
23. Set out compatible socio-technical solutions
24. Rank compatible pairs of socio-technical solutions
25. Prepare detailed work design

Four fundamental objectives of ETHICS

1. Encourage participation
2. Improve the general conditions of work
3. Produce systems that are “technically efficient and have social characteristics that lead to high job satisfaction”
4. Follow the socio-technical philosophy of trying for joint optimisation

http://www.enid.u-net.com/C1book1.htm#The Design Challenge
Mumford – ETHICS

Specifies the formation of two design teams, focusing on technical and social design.

Facilitator used to overcome obstacles related to:

- lack of trust,
- conflicts of interest,
- time pressure and stress,
- low morale,
- effects of authority,
- communication gaps

Does not seek to increase Quality of Work Life at the expense of economic efficiency – increased QWL will increase quality and efficiency.

Munkvold (2000)
Criticisms of Socio-tech

- Emphasis on balance and consensus ignores political conflicts in organisations
- Participative design will only function when employee numbers are small
Use of STS in Organisational Design

Changed environment in the last two decades:

- Increasing global competition
- Deregulation of markets
- Increasing customer selectivity on price, quality and service
- Environmental protection issues
- Rapid technological development

Munkvold (2000)
Organisational Design

New organisational forms fashionable, e.g.:

- virtual organisations
- dynamic networks

Key characteristics in common

- Focus on business processes instead of traditional functional organisation
- Focus on team organisation
- Decentralised decision-making
- IT as an important enabler

  + Sometimes deflects attention from other important organisational factors such as power and authority.

Munkvold (2000)
Total Quality Management (TQM)

Based on quality theories of W. Edwards Deeming, Joseph Juran and Kaoru Ishikawa. Became very popular in US, initially in industry, but then in other organisations: health care, public service, voluntary organisations, education...

Now fashionable in most of the industrial world.
TQM philosophy

- Primary purpose of an organisation is to stay in business - so that it can:
  - promote the stability of the community
  - generate products and services that are useful to customers
  - provide a setting for the satisfaction and growth of organisation members.
- Focus on preservation and health of the organisation
- 4 interlocking assumptions - about quality, people, organisations and the role of senior management
Assumptions

- Quality is less costly to an organisation than poor workmanship.
- Employees naturally care about the quality of their work, and will take initiatives to improve it.
- Organisations are systems of highly interdependent parts.
  - Cross-functional problems must be addressed collectively by representatives of all relevant functions.
- Quality is ultimately and inescapably the responsibility of senior management.
Change Principles

• Focus on work processes.
• Analyse variability. Identify root causes of variability and control them.
• Management by fact. Collect data, use statistics, test solutions by experiment.
• Learning and continuous improvement.
Interventions

• Explicit identification and measurement of customer requirements.
• Creation of supplier partnerships.
• Use of cross-functional teams to identify and solve problems.
• Use of scientific methods to monitor performance, and to identify points of high value for performance improvement.
  • Control chart
  • Pareto analysis
  • Cost-of-quality analysis
• Use of process-management heuristics to enhance team effectiveness.
  • Flowcharts
  • Brainstorming
  • Cause-and effect diagram
TQM in practice – techniques

• Use of short-term problem-solving teams to simplify and streamline work practices.
• Training in quality practices:
  • Interpersonal skills
  • Quality-improvement processes and problem-solving
  • Team leading and building
  • Running meetings
  • Statistical analysis
  • Supplier qualification
  • Benchmarking
• Top-down implementation.
• Developing relationships with suppliers.
• Obtaining data about customers:
  • Free-phone complaint lines
  • Market research
  • Focus groups
Additional interventions

Competitive benchmarking – gathering information about ‘best practices’ from other organisations. Serves several functions:

• Determining what customers can expect from the competition
• Learning alternative work processes
• Indicating quality-improvement goals

Employee involvement:

• Suggestion schemes
• Quality meetings between managers and employees
• ‘Quality days’
• Self-managing teams
Divergences

- Reduced use of scientific methods
- Relating reward systems to achievement of quality goals
Relating BPR to STS

Similarities:

• (re)design of business processes
• Use of semi-autonomous teams
• Empowerment

Differences:

• Radical change (BPR) vs. continuous change (STS)
• Purpose of team-building and empowerment in BPR is to support business goals, rather than to improve quality of work life.
• While re-engineering has led to improvements in performance, it has failed to produce the number of highly-motivated employees needed to ensure consistently high-performing organisations.
Relating TQM to STS

Key principles:

- Customer focus
- Focus on work processes
- Use of cross-functional teams
- Employee involvement
- Self-management
- Analysis of variability
- Benchmarking
- Learning and continuous improvement

Focus on empowerment conflicts with strong focus on top-down implementation.
References - 1


Step 1: Identify problem
Step 2: Identify system boundaries
Step 3: Describe existing system
Step 4: Specify key objectives
Step 5: Identify key tasks
Step 6: Identify sets of tasks
Step 7: Identify information needs
Step 8: Identify variance
Step 9: Diagnose job satisfaction needs
Step 10: Forecast future needs
Step 11: Set and rank efficiency and job satisfaction needs
Step 12: Identify technical and business constraints
Step 13: Identify social constraints
Step 14: Identify technical resources available
Step 15: Identify social resources available
Step 16: Specify priority technical and business objective
Step 17: Specify priority social objectives
Step 18: Check that technical and social objectives are compatible
Step 19: Take technical decisions
Step 20: Take social decisions
Step 21: Set out alternative technical solutions
Step 22: Set out alternative social solutions
Step 23: Set out compatible socio-technical solutions
Step 24: Rank compatible pairs of socio-technical solutions
Step 25: Prepare detailed work design

Figure 1. Schematic of the Stages of the ETHICS Methodology

Workflow Tools

Workflow Management Coalition Document Number TC00-1003 19-Jan-95
http://www.wfmc.org/standards/docs/tc003v11.pdf
Definitions (from the Workflow Management Coalition)

Workflow:

• “The computerised facilitation or automation of a business process, in whole or part.”

Workflow technology is often an appropriate solution to BPR activities.

Workflow Management System

• A system that completely defines, manages and executes “workflows” through the execution of software whose order of execution is driven by a computer representation of the workflow logic.
Workflow Management Systems provide support in three functional areas.

- **the Build-time functions**, concerned with defining, and possibly modelling, the WF process and its constituent activities.

- **the Run-time control functions** concerned with managing WF processes in an operational environment and sequencing the various activities to be handled as part of each process.

- **the Run-time interactions** with human users and IT application tools for processing the various activity steps.
Workflow System Characteristics

Process Designer

Administrator / Supervisor

Process Design & Definition

Business Process Analysis, Modelling & Definition Tools

Build Time
Run Time

Process Definition

Process Instanciation & Control

Workflow Enactment Service

Interaction with Users & Application Tools

Applications & IT Tools

Process changes
Build-time Functions

• Result in a computerised definition of a business process.

• Business process is translated from the real world into a formal, computer processable definition by the use of one or more analysis, modelling and system definition techniques.

• Resulting definition is sometimes called a process model, a process template, process metadata, or a process definition.
Process Definition

A number of discrete activity steps.
Associated computer and/or human operations.
Rules governing the progression of the process through the various activity steps.
May be expressed in textual or graphical form or in a formal language notation.
Some workflow systems allow dynamic alterations to process definitions at run-time.
Run-time Process Control Functions (1)

Process definition is interpreted by software which is responsible for:

• creating and controlling operational instances of the process
• scheduling the various activities steps within the process
• invoking the appropriate human and IT application resources, etc.

Run-time process control functions link the process as modelled and the process as seen in the real world.
Run-time Process Control Functions (2)

Core component is the basic workflow management control software (or "engine"), responsible for:

- process creation & deletion
- control of the activity scheduling within an operational process
- interaction with application tools or human resources.

Software is often distributed across a number of computer platforms to cope with processes which operate over a wide geographic basis.
Run-time Activity Interactions

Individual activities within a workflow process are typically concerned with:

- human operations, often realised in conjunction with the use of a particular IT tool (e.g. form filling), or
- information processing operations requiring a particular application program to operate on some defined information (e.g. updating an orders database with a new record).

Must interact with the process control software to

- transfer control between activities
- ascertain the operational status of processes
- invoke application tools and pass the appropriate data, etc.

Benefits of a standardised supporting framework include:

- use of a consistent interface to multiple workflow systems
- the ability to develop common application tools to work with different workflow products.
Distribution and System Interfaces

Ability to distribute tasks is a major distinguishing feature of runtime infrastructure. May operate at a variety of levels. May use a variety of communications mechanisms.
WFMS 3 Tier System Structure

Tier 1
- WFMS Client

Tier 2
- WFMS Server
- DBMS Client

Tier 3
- DBMS Server
- Databases

User Interface & Local Desktop Applications
Tiers in Detail

• User Interface Tier
  • Deals with all user interactions & focuses their efficient accessibility
  • Usually a GUI on User's desktop
  • Invokes methods on Business Logic Tier & thus acts as client for it

• Business Logic Tier
  • Server-based code (made up of business objects that perform logical business operations) with which client interacts
  • Resides at a shared server to optimize allocation of system resources

• Data Storage Tier
  • Part of the dist'd application that manages access to data and storage mechanisms eg DBMS.
  • Made up of objects that encapsulate DB routines interacting with DBMS routines directly.
## WFMS-DBMS: Compare & Contrast

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<td><strong>Meta-Model:</strong></td>
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<tr>
<td>Constructs &amp;</td>
<td>with rows &amp; columns &amp; SQL operations</td>
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<td><strong>Build-Time:</strong></td>
<td>Functions provided by DDL</td>
<td>Functions to define process models, organizational structures, applications, servers &amp; networks</td>
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<td><strong>Run-Time:</strong></td>
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<td><strong>Database:</strong></td>
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<td>managed by build &amp;</td>
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<tr>
<td>runtime components</td>
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Workflow Reference Model - Components & Interfaces

- Process Definition Tools
- Interface 1
- Workflow API and Interchange Formats
  - Interface 2
  - Interface 3
- Workflow Enactment Service
  - Interface 4
- Other Workflow Enactment Service(s)
- Interface 5
- Administration & Monitoring Tools
- Workflow Client Applications
- Invoked Applications
- Workflow Engine(s)
WFMS User Types

• End Users
• Process Modellers (Business Analysts)
• Process Administrators
• System Administrators
• Customer Support
Interoperability

Flow of work may involve transfer of tasks between different vendors’ workflow products so that different parts of the business process can be enacted on different platforms.

Flow within the central box passes between two or more workflow products - for example activities 1, 2 and 5 may be executed by one workflow system and 3 and 4 by a different system, with control passed between them at appropriate points within the overall workflow.

Standards to support this transfer of workflow control enable the development of composite workflow applications using several different workflow products operating together as a single logical entity.
Range of interface definitions

- specifications for process definition data and its interchange
- interfaces to support interoperability between different workflow systems
- interfaces to support interaction with a variety of IT application types
- interfaces to support interaction with user interface desktop functions
- interfaces to provide system monitoring and metric functions to facilitate the management of composite workflow application environments
Product Implementation Model

• Despite the variety in WF products, possible to construct a general implementation model of a WF system which can be matched to most products in the marketplace.

• This approach identifies main functional components within a WF system and the interfaces between them as an abstract model.

• Many different concrete implementation variants of this abstract model will exist and therefore the interfaces specified may be realised across a number of different platform and underlying distribution technologies.

• Not all vendors want to expose every interface between the functional components within the model; this is dealt with by having a variety of conformance levels which will identify the particular interworking.
Generic Workflow Product Structure

- System definition and control data used by one or more software components.

Software components - provide support for functions within the workflow system.

Applications and application databases which are not part of the workflow product, but which may be invoked by it as part of the total workflow system.
Workflow Reference model

• Developed from the generic WF application structure by identifying the interfaces that allow products to interoperate at a variety of levels.

• All WF systems contain generic components which interact in a defined set of ways; different products exhibit different levels of capability within each of these generic components.

• Need a standardised set of interfaces and data interchange formats between components.

• Distinct interoperability scenarios can be constructed by reference to the interfaces, - different levels of functional conformance as appropriate.
Workflow System Characteristics

WF Ref Model: All Interfaces Interacting with WF Enactment Service
Workflow Reference Model - Components & Interfaces

- Process Definition Tools
- Interface 1
- Workflow API and Interchange Formats
- Workflow Enactment Service
- Interface 2
- Interface 3
- Workflow Engine(s)
- Interface 4
- Other Workflow Enactment Service(s)
- Interface 5
- Workflow Client Applications
- Invoked Applications
- Administration & Monitoring Tools
Workflow Enactment Service

A software service that may consist of one or more workflow engines in order to create, manage and execute workflow instances. Applications may interface to this service via the workflow application programming interface (WAPI).
Workflow Engine Functions

A software service or "engine" that provides the run time execution environment for a workflow instance.

Typical facilities:

• interpretation of the process definition
• control of process instances - creation, activation, suspension, termination, etc
• navigation between process activities, which may involve sequential or parallel operations, deadline scheduling, interpretation of workflow relevant data, etc
• sign-on and sign-off of specific participants
• identification of workitems for user attention and an interface to support user interactions
• maintenance of WF control data and WF relevant data, passing WF relevant data to/from applications or users
• an interface to invoke external applications and link any WF relevant data
• supervisory actions for control, administration and audit purposes
Homogeneous V Hetero-geneous WF Enactment Services

- Homogeneous:
  - 1/more compatible WF engines (ie support same metamodel) providing the runtime execution envt for WF processes with defined set of process definition attributes.
  - Protocols and interchange formats used are product specific and not standardised.

- Heterogeneous:
  - 2/more homogeneous services, following common standards (ie common denominator needed in terms of interfaces) for interoperability at a defined conformance level - one of:
    - A common naming scheme across the heterogeneous domain
    - Support for common process definition objects & attributes across the domain
    - Support for WF relevant data transfer across the domain
    - Support for process, sub-process or activity transfer btw heterogeneous WF engines
    - Support for common admin & monitoring functions within the domain
Process and Activity State Transitions

The workflow enactment service may be considered as a state transition machine. Individual process or activity instances change states in response to:

- external events (e.g. completion of an activity) or
- specific control decisions taken by a workflow engine (e.g. navigation to the next activity step within a process).
Workflow Application Programming Interface & Interchange (WAPI)

Set of API calls and interchange functions supported by a WF enactment service at its boundary for interaction with other resources and applications.
Workflow Control Data

Definition:

Internal data that are managed by the workflow management system and/or workflow engine.

The workflow enactment service maintains internal control data to identify the state of individual process or activity instances and may support other internal status information. These data are not accessible or interchangeable, but some of the information content may be provided in response to specific commands.
Workflow Relevant Data

Definition

Data that are used by a workflow management system to determine the state transition of a workflow process instance.

- May affect the choice of the next activity to be executed.
- Such data are potentially accessible to WF applications for operations on the data and thus may need to be transferred between activities by the WF enactment software.
- When operating in a heterogeneous environment, such data may need to be transferred between WF engines, where the process execution sequence spans two or more WF engines.
Workflow Application Data

Definition

Data that are application specific and not accessible by the workflow management system.

- Manipulation of application data may be required within each activity of a process.
- WF model must cope with interchange of case data between the various activities.
- May also require transformation of case data between different tool data formats, for example conversion of a document or spreadsheet from one application format to another.
- WF application data are not used by the workflow enactment software.
Workflow System Characteristics
Interface 1: Process Definition

Process Definition Tools

• Variety of tools available. The WF model is not concerned with the particular nature of such tools nor how they interact.

• Process definitions defined within a WF product will normally be held within the WF product domain and may, or may not, be accessible.

• Where separate products are used for defining the process, the process definitions may be transferred between the products as and when required or may be stored in a separate repository, accessible to both products (and possibly other development tools).
Process Definition Tools

- Final output from process modelling and design is proc def which can be interpreted at runtime by the WF engine(s) within the enactment service. Each individual process definition is typically in a form specialised to the particular WFMS for which it was designed. The WF definition interchange interface will enable more flexibility in this area.

- Process analysis, modelling and definition tools may include the ability to model processes in the context of an organisation structure (although this is not a mandatory aspect of the WF reference model). Where an organisation model is incorporated into such tools the process definition will include organisation related objects such as roles. These are related (typically) to system control data such as role: actor relationships (e.g., within an organisational directory) which may be referenced during process execution.
Workflow Definition Interchange (Interface 1)

- Advantages of standardised form of interface:
  - Separation btw buildtime & runtime environments => allows proc def from one modelling tool as input to other runtime products
  - Offers the potential to export a proc def to many WF products to co-operate & provide a distributed service
Interface 4: Interoperability: Java WFMS Implemented in RMI

- Use Remote Message Invocation (RMI) to support WFMS
  - JWFMS uses RMI (more below) as a communication protocol implementing the 3 Tier Architecture between Client and Server.
  - RMI takes advantage of Java's platform independence for simplicity of design and reduction of maintenance demand.
  - Other protocols such as Common Object Request Broker Architecture (CORBA), MS DCOM or Enterprise Java Beans (EJB) offer more functionality at the expense of added complexity.

- Remote Message Invocation (=RPC in Java)
  - Supported by two java packages: java.rmi & java.rmi.server.
  - An application that uses RMI has 3 components:
    + An interface that declares headers for remote methods;
    + A server class that implements the interface; and
    + One or more clients that call the remote methods.
JWFMS Users

• JWFMS supports 3 kinds of users:
  • System Admin (akin to UNIX Root User):
    + with all access privileges to monitor workflows & setup system parameters
    + Can add/delete/modify user info
    + Can create/delete/modify workflow info
  • Workflow Manager
    + Limited privileges Admin using JWFMS mgmt client
    + Can view content & modify structure of WF that (s)he is manages
    + Set transactions’ start time & monitor, retrieve & modify data assoc with WF
  • Users:
    + Perform transactions in the WF
    + Access the system thro the JWFMS user client
    + Have rights to view/manage own info but not other users’ info
Components of JWFMS

- **Clients/Server communicate thro dist'd RMI interface classes**
- **These classes function like C/S APIs & called XYZManager with methods allowing clients access to system objects (eg Wfs, transactions, users etc)**
- **Client**
  - first acquires client instance of relevent manager class thro RMI protocol
  - invokes public method to retrieve java object for info client needs to operate
  - e.g. If client wants to modify WF uses WorkflowManager interface class to retrieve Workflow java object
  - When changes need to be saved, client uses updateWorkflow() method in WorkflowManager interface class
- **Manager Interface classes needed for Server API for WF Mgmt:**
  - WorkflowTableManager Interface (stores info on WF activities in a table)
  - WorkflowManager Interface (executes/automates WF activities)
  - TransactionManager Interface (guarantees atomicity of transactions)
  - Thus each of these export functions thro the various Interface classes
Components of JWFMS: Graphical
References


The web pages (above) now require you to register with the Workflow Management Coalition, and login, before you can gain access. Registration is free, at http://www wfmc org/.


Modelling Workflow with Petri Nets
Workflow Management Issues
Georgakopoulos, Hornick, Sheth

- Process
- Workflow specification
- Workflow Implementation
  - Executable application code
  - Enactment Service/ Run-time Support

Business Process Modelling/ Reengineering (BPM/R)

Workflow specification
Workflow model & specification language

Executable application code
Enactment Service/ Run-time Support
Workflows & Petri Nets (PNs)

- WFMS give an explicit representation of the BP logic thus allowing for computerized support
- PNs are an established tool for modelling & analyzing business processes:
  - Can be used as a design language for the specification of complex WFs
  - PN theory provides for powerful analysis techniques for verifying the correctness of WF procedures.
- PN primarily used to study dynamic concurrent behaviour of n/w-based systems with a discrete flow.
Workflows & Petri Nets (cont'd)

- Workflows are *case-based*, i.e., every piece of work is executed for a specific *case*.
  - **Case**: the subject of operation in a business process execution. E.g. mortgage application, hospital admission, insurance claim, tax declaration, order, request for information...

- A workflow process is designed to handle similar cases. *Cases* are handled by executing tasks in a specific order.
A three-dimensional view of a WF

(W.M.P. van der Aalst)
Basics of Petri Nets

- Petri nets comprise two types of nodes: places and transitions. An arc exists only from a place to a transition or from a transition to a place.
- A place may have zero or more tokens.
- Graphically, places, transitions, arcs, and tokens are represented respectively by: circles, bars, arrows, and dots.
Dynamic modelling with Petri nets

- **Transitions** are the active components.
  - often represent an event, an operation, a transformation or a transportation.

- **Places** are passive.
  - usually represents a medium, a buffer, a geographical location, a state a phase or a condition.
  - depends on how the token is placed is interpreted

- **Tokens** often indicate objects.
  - can play a role as physical object, e.g. a product/person;
  - an info object, e.g. a message;
  - an indicator of state a process is in or state of an object;
  - an indicator of a condition, i.e. the presence of a token indicates whether a certain condition is fulfilled.
Object Life Cycle (OLC) with Petri Nets

- A Petri net attaches to a life cycle of objects of a class
- States correspond to places
- Initial state: state with token, there is only one initial state in an OLC
- Transitions correspond to events, conditions (verify a condition) or processes (or atomic process: method) that changes object state
- Tokens represent objects in this class
Basics of Petri Nets (cont'd)

Place

Transition

Arc

Token
Example – claims process

State: (2,0,0)

(1,0,2)
Basics of Petri Nets (cont'd)

- Below is an example Petri net with two places and one transaction.
- Transition node is ready to fire if & only if there is at least one token at each of its input places.

\[
\begin{align*}
\text{state transition of form } & (1, 0) \rightarrow (0, 1) \\
p_1 & : \text{input place} \\
p_2 & : \text{output place}
\end{align*}
\]
Formal Notation of Petri Nets

- A bipartite graph, PN=(P, T, I, O)

P: finite set of places

T: finite set of transitions

I: \( (P \times T) \rightarrow N \), \( I(p,t) = n \), if \( n > 0 \), \( p \in P \), \( t \in T \), then \( p \) is an input place of \( t \); \( n \) is an input multiplicity (weight) for each input arc \( (p,t) \)

O: \( (T \times P) \rightarrow N \), \( O(t,p) = m \), if \( m > 0 \), \( p \in P \), \( t \in T \), then \( p \) is an output place of \( t \); \( m \) is an output multiplicity (weight) for each output arc \( (t,p) \)

By default, the weight of an arc is equal 1, otherwise it will be noted.

The input multiplicity of an arc between an input place and a transition determines how many tokens have to be present in the place so that the transition is enabled.
A state of a Petri net is a function $s: P \rightarrow N$, assigning to each place $p \in P$ a number of tokens at this place. A state space of a Petri net is a set of all $s(p)$, $p \in P$. (E.g. state space is (2,1, 0, 0, 0))

A transition $t$ is enabled, $t \in T$ in state $s: P \rightarrow N$, if there are enough tokens present in each of the input places of $t$, i.e. if and only if $\forall p \in P, s(p) \geq I(p,t)$

A transition $t$ can fire in a state $s$ whenever it is enabled in this state. When it fires, it consumes $I(p,t)$ tokens from each input place $p$ and produces $O(t,q)$ tokens in each output place $q$. If $t$ fires in state $s$, this leads to a new state $s'$ where $\forall p \in P$, $s'(p)=s(p) - I(p,t) + O(t,p)$
Properties of Petri Nets

• **Sequential Execution**
  Transition $t_2$ can fire only after the firing of $t_1$. This imposes the precedence of constraints "$t_2$ after $t_1".

• **Synchronization**
  Transition $t_1$ will be enabled only when a token is in at least one token at each of its input places.

• **Merging**
  Happens when tokens from several places arrive for service at the same transition.
Properties of Petri Nets (contd)

- *Concurrency*

  $t_1$ and $t_2$ are concurrent.

  With this property, Petri nets can model systems of distributed control with multiple processes executing concurrently in time.
Properties of Petri Nets (contd)

- **Conflict**
  \( t_1 \) and \( t_2 \) are both ready to fire but the firing of one leads to the disabling of the other transitions.
Properties of Petri Nets (contd)

- Conflict - (contd)

  - the resulting conflict may be resolved in a purely non-deterministic way or in a probabilistic way, by assigning appropriate probabilities to the conflicting transitions. e.g:
Example: Patients & a Specialist

Tokens : Specialist

Tokens : Patient

(W.M.P. van der Aalst)
Example: Patients & a Specialist (cont'd)

The process of a specialist treating patients:

If a specialist always treats two patients at the same time?
Example: Patients & a Specialist (cont'd)
Example: In a Restaurant

Customer 1

Waiter free

Take order

Wait

Serve food

eating

Customer 2

Take order

Order taken

Tell kitchen

Serve food

waiting

eating
Example: In a Restaurant (cont'd)
Two Scenarios

• **Scenario 1:**
  • Waiter takes order from customer 1; serves customer 1; takes order from customer 2; serves customer 2.

• **Scenario 2:**
  • Waiter takes order from customer 1; takes order from customer 2; serves customer 2; serves customer 1.
Example: In a Restaurant (Scenario 1)

- Customer 1
  - Waiter free
  - Take order
  - Wait
  - Serve food
  - Eating
- Customer 2
  - Waiter free
  - Take order
  - Wait
  - Serve food
  - Eating
Example: In a Restaurant (Scenario 2)

Customer 1

Waiter free

Take order

Order taken

Serve food

Tell kitchen

Wait

eating

Customer 2

Take order

Serve food

eating

wait
Example: Vending Machine

- Take 15c bar
- Deposit 10c
- Deposit 10c
- Deposit 5c
- Deposit 5c
- Take 20c bar
- Deposit 10c
- Deposit 5c
- Deposit 5c
- Deposit 10c
- Deposit 5c
- Deposit 10c
- Deposit 5c
Example: Vending Machine (3 Scenarios)

• **Scenario 1:**
  - Deposit 5c, deposit 5c, deposit 5c, deposit 5c, take 20c snack bar.

• **Scenario 2:**
  - Deposit 10c, deposit 5c, take 15c snack bar.

• **Scenario 3:**
  - Deposit 5c, deposit 10c, deposit 5c, take 20c snack bar.
Example: Vending Machine (Token Games)
Example: Insurance complaint process

To manage different cases, two solutions:
1. Token is added a value (case identifier or colour) for distinguish different cases
2. Each case corresponds to a unique instance of the Petri nets
Petri Nets over Time

- 1962 - Carl Petri originally proposed Petri Nets without any notion of time. Concept of time was intentionally avoided because addition of time restricts the behavior of the net.
- 1970s ~ - Addition of time has been discussed in order to analyze the performance of modelled system.
- Many properties are still undecided for Petri nets extended with data and time.
References

- http://www.wfmc.org/standards/model.htm
- “Coupling Object-Oriented and Workflow Modelling in Business and Information Process Reengineering”, Gregory N. Mentzas, IOS Press, 1999