A Brief Overview of the
State-of-the-Art of Commercial Technology
and Research in Workflow Management

DARPA/ISO Workshop on Collective Action Tools
April 10, 1996

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Origins of Workflow

Ten years ago, a team of engineers conceived the idea that computer software could be used to automate paper-driven business processes. They called it “workflow software.” [Smith93]

- Imaging
- Document flow
- Enhanced emails
- Workgroup support
- Multi-system apps.
Definition of Workflow Management
(some samples)

- “Workflow refers to a new set of software and tools for automating and improving business processes.”[Dyson]
- “Workflow is a process by which individual tasks come together to complete a ‘transaction’ - a clearly defined business process - within an enterprise.”[Silver]
- “Workflow is the sequence of actions or steps used in business process. Automated workflow applies technology to process, though not necessary to every action.”[Marshak]
- “Workflow management is an important tool for structuring and optimizing business processing... and for supporting the practical implementation of business process re-engineering.”[Fritz]
Why Workflow technology?

To streamline, coordinate and monitor a process or an activity involving human and automated tasks spread across multiple enterprises with heterogeneous (existing and new) computing environments.

- Organize, schedule, control and monitor tasks
- Support on-line data entry where data originates; support data exchange and transactions across independent enterprises (EDI); reduce paper work
- Use standard interface for database access and updates
- help understand/improve process (reengineering)
- Can be seen as programming-in-the-large
Trade Press Characterization of Workflows

- Administrative
- Ad-Hoc
- Production

- Simple
- Complex

- Press Releases
- Expenses, Travel requests,
  Purchase Requests
- Messages

- Product Documentation
- Insurance Claims
- Loan Applications

- Multi-System Applications & Transactional Workflows
Another Characterization

- Human-oriented
- System-oriented

- CSCW
- Transactional Workflows
- Commercial WMS
- Commercial TP systems
Workflow Automation Software: Example Products

- WorkFlo (Filenet)
- InConcert (XSoft), FloWare (Plexis), StaffWare
- KI-Shell (UES),
- AWS (Action Tech)
- WorkManager (HP)
- LinkWorks, ProcessIT, ObjectFlow (DEC)
- SAP Business Workflow (SAP AG)
- FlowMark (IBM Vienna)

About 250 products claim to support workflow features and/or workflow management with market size of over $1B
A Workflow Model for the METEOR System

METEOR: Managing End-To-End Operations
Overview of the Current Commercial State-of-the-Art

- Emphasis on office processes: imaging, document flow, enhanced mail
- Reasonable support for administrative and ad-hoc workflows
- Many products are little more than fancy diagramming tools (Dataflow, Digraph, Flowchart, Network, Orgchart, Pertchart, ...) with layout support, capture/import/export of data from/to databases, spreadsheets, simulation tools
- Some are specialized electronic data management systems: e-mail, imaging, databases, electronic forms, text, engineering drawing, ...
Limitations of today’s commercial workflow products

- Limitations in dealing with heterogeneity and existing infrastructure
- Significant demands on computing infrastructures for providers and organizers
- Significant effort from design to implementation
- ...

Maturing Infrastructure: A Driving Force

- e-mail
- Work-group (Notes)
- Distributed Object Management
- WWW (simple C/S, CGI)
- Current Generation Transaction Processing Monitors
- Agents, Distributed WWW + Java
- Wireless

- Early 90s - already mature
- 1993 - already mature
- 1995 - very active
- 1996 ?
- 1996 or 1997 ?
- 1997 ?
- 1998 ?
Workflow Management System: Conceptual Architecture
(system components)

**BPM Toolkit**
- process view
- org. view
- data view
- re-engineering analyzer
- TQM advisor
- ...

**Workflow Development Toolkit**
- graphical design tool
- developer’s workbench
  - -> testing tool
  - -> simulation tool
  - ...

**WMS run-time system and tools**
- scheduler
- task manager/interfaces
- processing entities
- monitoring tool
- tracking tool
- reporting tool
- ...

The diagram illustrates the components and tools involved in a workflow management system, emphasizing the conceptual architecture and the interconnections between different tools and systems.
SDOH and CHREF maintain databases, support EDI transactions

Hospitals and clinics update central databases after encounters

Health providers can obtain up-to-date clinical and eligibility information

Hospitals and case workers can reach out to the population

HMOs can keep track of performance

Health agencies can use reports generated to track population’s needs

State and HMO’s can update patient’s eligibility data

Reports to state

Reminders to parents

Generates:
- alerts to identify patient’s needs.
- contraindications to caution providers.

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Clinical Workflow
Admit Clerk’s Task

Map Designer

Enter Patient Info → Generate Alerts → Update Local DBs → Check Eligibility → Update Personal Data → STOP

File Edit Specify Help
Admit Clerk’s Interface in Hospital/Clinic

Verify patient’s eligibility
Generate Medical Alerts
Insert into clinic/hospital’s encounter database
Web-based Implementation

How does it work?

Components

- CGI Scripts implement Task and Task Manager functions
- HTML Forms are used for data entry and display
  - Data is passed between CGI Scripts using Hidden Fields and data entry fields.

Execution Scenario (Partial)

- Simple CGI script outputs Enter Patient Info. form
- Admit Clerk enters Patient Information
- Clicking submit button initiates Generate Alerts CGI script
- This script accesses MPI and Immunization databases
- Outputs are displayed in the Alert Results form
- User controls the flow by clicking 1 of 3 submit buttons
Web-based Implementation

**Admit Clerk Task**

1. Start
2. Enter Patient Info.
3. Generate Alerts
4. Update Personal Data
5. Update Local Database
6. Check Eligibility
7. Update Local Database
8. Eligibility Results
9. Display Worklist
10. STOP

**Triage Nurse Task**

1. Start
2. Collect Vitals
3. Generate Triage Nurse’s Page
4. Generate Triage Nurse’s Page

**Workflow Design**

**Implementation**

- Enter Patient Info.
- Generate Alerts
- Update Personal Data
- Update Local Database
- Check Eligibility
- Eligibility Results
- Display Worklist
- Web-based Implementation
CORBA-based Implementation:  
*How does it work?*

**Components**
- **CORBA Task Objects** implement Task/TM functions
- **CORBA Data Objects** store Patient information
- **CGI Scripts** implement Task and Task Manager functions
- **HTML Forms** are used for data entry and display

**Execution Scenario**
- Clicking submit button initiates Generate Alerts CGI script (CORBA Client)
- Calls a CORBA Server method which uses http to talk to remote CGI Script
- CGI Script accesses MPI and Immunization databases
- Outputs are returned to the Generate Alerts script via the CORBA Server
- Outputs are displayed in the Alert Results HTML form
  ...

...
CORBA-based Implementation

Admit Clerk Task

Workflow Design

Implementation

Triage Nurse Task

Control Flow
Web Page
Submit Button

CORBA-based Implementation

Admit Clerk Task

Workflow Design

Implementation

Triage Nurse Task

Control Flow
Web Page
Submit Button
Implementation Testbed

**CHREF**

Om (SunSparc 20 / Solaris)

Illustra DBMS

MPI, MEI, Immunization Db

Optimus (SunSparc 2 / Solaris)

Web Server

**CHREF/SDOH**

Om (SunSparc 20 / Solaris)

Illustra DBMS

Insurance Eligibility Db

Network File System

Internet

**Hospital**

Admit Clerk

Triage Nurse

Doctor/NP

Maternity Ward

Oracle7 DBMS

Detailed Encounter Db

CORBA (ORBeline)*

Iris (Pentium/ Windows NT)

Ra (SunSparc 20 / Solaris)

Web Server

Om (SunSparc 20 / Solaris)

Web Server

**Clinic**

Admit Clerk

Triage Nurse

Doctor/NP

POMS

Files

Detailed Encounter Data

* PostModern’s ORBeline2.0
Run-time Model

WORKFLOW MODEL REPOSITORY

DESIGNER

MONITOR

AUTOMATIC CODE GENERATION

TASK MANAGER

TASK

TASK MANAGER

TASK

DB

AND

TASK MANAGER

TASK

WEB

TASK

WEB
Capabilities of Research Prototypes

- Supports a variety of task types: Application and User
- Use of single paradigm for human involvement (WWW, Web-browser based GUI, HTML documents)
- Graphical workflow design and semi-automated translation to run-time code for coordination component
- Support for variety of computing infrastructures: WWW, Distributed Object Management (CORBA), Notes (Groupware)
- Integrated access to (or use of) multiple web servers, various DBMSs/databases, Internet resources and capabilities (incl. Java)

(continued...)
Capabilities of Research Prototypes
(contd...)

- Variety of C/S and distributed environments; different scheduling/control strategies

- Support for and use of transactions of different types: database (ACID/2-PC) transactions, DTP (transactional RPC, DE-Light), EDI, and domain-specific (e.g., HL7); customizable transactions

- Ability to monitor/track/report workflows/tasks

- Some support for dynamic workflows (e.g., handling of task outputs)
Work-in-progress & Future Work

- exception handling, fault-tolerance/recovery, scalability, auditing, security/confidentiality/authorization
- integrated what-if analysis, simulation, reengineering capabilities; lifecycle support
- integral support for collaboration (not just coordination); video+data conferencing and decision support
- wireless infrastructure; more multimedia data
- more dynamic features (new tasks, new constraints/dependencies)
- Dynamic and virtual enterprises, react/reconfigure/respond to changes
Workflow automation technology supports

- Fast design to implementation
- (Legacy) Heterogeneous computing environments
- Existing and new tasks in independent/autonomous enterprises
- Multiple communication infrastructures and support for standards
- Reengineering (ease of modification, extension), robust and reliable execution, scalability, security