



WIHIR Research Seminar

Business Processes, Workflow Management, and IT in Healthcare

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BP, WM and IT in Healthcare Presentation Outline

Part 1

- The Nature and Components of Workflow
- Commercial Workflow Packages.
- The Workflow Engine Concept.
- Some New Thinking about Workflow.
- Relevance and Benefits.
- Workflow Analysis and Representation.

Part 2

- Importance of Health Informatics.
- Training of HQP.
- Collaborators.
- Acknowledgements.
- Understanding Consultants.





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Part 1





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The Nature and Components of Workflow



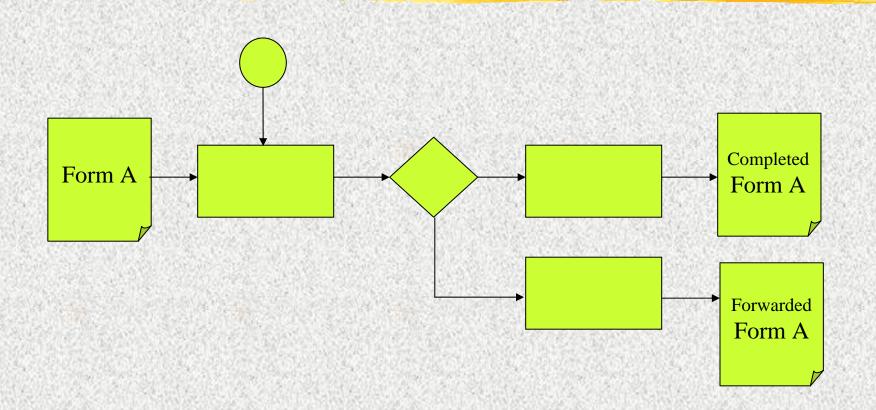
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■ Workflow is everywhere: human processes, clinical protocols, human and machine processes, machine processes, ... Components of workflow: Agents: persons, instruments, software agents. Objects: data, documents, images, physical samples (aliquots). □ Activities: processes, actions, computations. □ Rules: constraints, conditions, limits, boundaries. □ Composites (or Business Process) Process: a composite of workflow components Object Products: data, reports, images, effects generally. Process Initiation: inputs, givens. ■ Workflow: Agents receive objects, perform activities, operating under rules, and transmit objects to agents.





BP, WM and IT in Healthcare A Workflow





□ Example:

■ Receptionist (agent) receives requisition (object), created by physician on ward (agent), checks it for completeness (activity) using diagnostic imaging checklist (object) listing minimum data required (rules) and approves (activity) and schedules (activity) examination (process), producing a scheduled exam time (product object).

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■ Representations of workflow:

- ☐ Flowchart.
- Process map: Flow chart with "geography".
- Graph and variants.
- Description: formal language.



- □ During Design or Re-engineering of a Department :
 - □ Typically we map out existing/exemplar workflow.
 - Process map is standard tool.
 - Visio is common software.
 - Done by process analyst/industrial engineer (internal or external).

- Starting point for consideration.
- Think about how we'd like department to operate.
 - Move components around, add components, delete components, modify components.
- Analyst may try to delete a component: "That's redundant".
 - Department manager says "You can't do that, that activity is required by law!"
 - How could the analyst have known this?
 - Clearly there is a body of knowledge not expressed in the "workflow representation".
 - Also how can we compare or evaluate workflows without that knowledge?



■ Workflows are workflows.

- "Diagnostic Imaging Macro-service" = "Diagnostic Imaging Department".
- □ A macro-service is composed of services:
 - Patient reception service = "business process".
- Each service is composed of micro-services:
 - E.g., verifying the patient's identification.
- Each micro-service is composed of tasks:
 - E.g., reading the requisition form.
- □ Tasks could be composed of sub-tasks, etc.



20 MIN	
	Kinds of workflow:
	☐ Clinical protocol.
	☐ Operational workflow.
	☐ Procedure/task workflow.
	☐ System management workflow.
	Issues:
	☐ They are all executed simultaneously.
	☐ They are independent.
	☐ But they interact.
	☐ Collectively they are the care process.
	☐ They are incredibly detailed.
	☐ Functioning under them, understanding them, evaluating them, and improving them are major challenges.





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Commercial Workflow Packages





BP, WM and IT in Healthcare Commercial Packages and Tools

	Many workflow packages, including:
	☐ Biztalk (Microsoft)
	COSA Workflow (Ley Gmbh).
	☐ FileNET P8 BPM (FileNET) Suite.
	□ FlowMind (Akazi).
	🔲 i-Flow (Fujitsu).
	☐ Symphonia (Orion).
	Staffware Process Suite (Staffware PLC).
	□ TIBCO InConcert (TIBCO Software).
	□ W4 (W4), WebFlow (SAP).
	□ WebSphere MQ Workflow (IBM).
	Few appear to be at all suitable for embedding in systems.
	Many lack robustness to support the complexity of operations in a health setting. □ Livelink-GRH experience.
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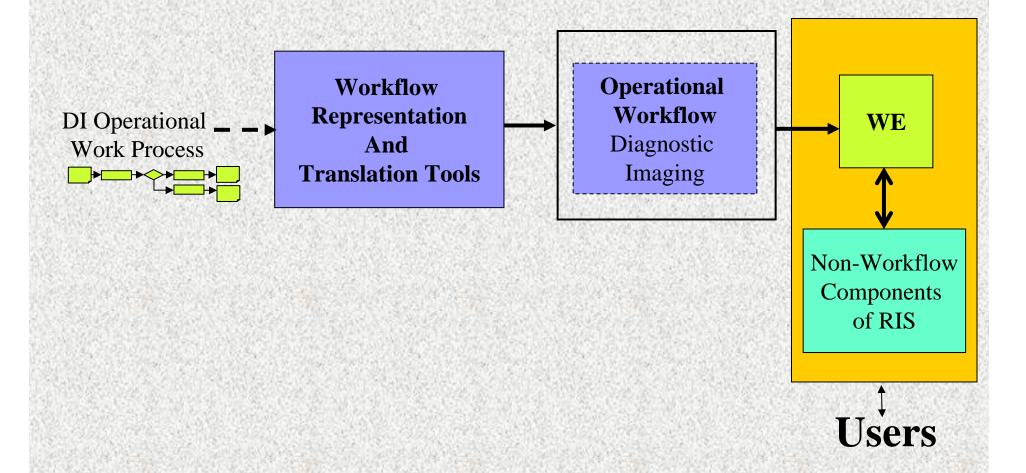
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The Workflow **Engine Concept**





BP, WM and IT in Healthcare Workflow Engine Concept







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Some New Thinking About Workflow

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BP, WM and IT in Healthcare Semantics: What's That?

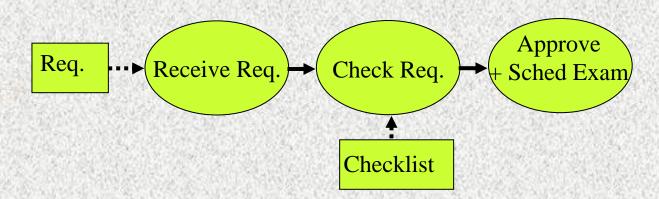
☐ Simplest: meaning; Our: contextual knowledge.
□ OED: The branch of linguistics that deals with meaning; the study or analysis of the relationship between linguistic symbols and their meaning.
☐ Syntax: the order of words/symbols; grammar.
 Classic workflow: Mostly syntax. Agent, activity, object. Time and other constraints are basic semantics.
 Comprehensive Workflow: Coupled semantics. Both classic workflow and semantic flow tightly coupled.





BP, WM and IT in Healthcare Workflow Syntax and Semantics

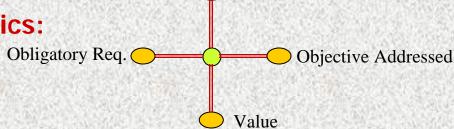
■ Workflow:



☐ Symbolic Representation:



Add semantics:



Cost





BP, WM and IT in Healthcare Workflow Syntax and Semantics

☐ The Real Flow Picture:



- ☐ Healthcare processes are complex.
 - Many possible choices of action.
 - By patient (real-time elections).
 - By care provider (preferences, alterations based on pt. status).

- By department or situation (equipment out of order, busy).
- By protocol (care standards).
- By administration (cost constraints).
- By family or guardian.
- Processes can entail significant morbidity and mortality.



- Processes' details depend on many variables.
 - Choices made by any stakeholder (e.g., patient, provider).
 - Parameters such as:
 - Pre-conditions.
 - Presumptive diagnosis.
 - Patient's clinical state.
 - Potential for beneficial intervention.
 - Previous history (e.g., allergies).
 - Patient real-time choices and consent.
 - Current meds.
 - Facility availability and status.
 - Clinical guidelines.
 - Examination protocol.
 - Diagnostician preferences and choices.
 - Staff availability.
 - Economic, quality, and regulatory constraints.



- Process failures have impacts:
 - □ Inadequate prep:
 - Termination of procedure.
 - Delayed diagnosis.
 - Risk to life.
 - Unnecessary risks: contrast, radiation.
- □ Key question we are trying to address:
 - Can computer-based processes be used to represent, measure, manage, analyze, and evaluate complex healthcare processes, and help to achieve appropriate levels of patient safety, cost, outcome quality, and regulatory compliance?



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□ Factors mean that diagnostic and therapeutic actions and their sequence are chosen: Per patient. Per provider. Per situation. In real time (dynamically). **Implications:** Many real time elections. □ Any attempt to pre-determine a "standard protocol" = unproductive rigidity. Physicians resist "cookbook medicine": non-compliance. Consequence: standard protocol(s) ignored. Or very large number of variants that will be inaccessible and unmanageable.



- Standardized protocols create "straight-jacketed" perception.
 Providers see "cookbook medicine".
 Especially time (sequence, duration, deadlines).
 Dynamic Workflow Concept.
 Processes are composed of services chosen in real time.
 Based on variables like those listed previously.
 Classic concept that "workflow" can be pre-defined not appropriate.
 Actions are executed dependent on dynamic considerations.
 "Workflow" is historic record of real time choices and dynamically adjusted processes.
 - Workflows can be mined.



- How do we manage the complexity of healthcare processes?
 - Current approaches capture and represent only task sequencing, starting time constraints, duration, ending time constraints, and sometimes the types of HR involved and alternatives.

- Even time, however, is inflexibly represented.
- These abstractions do not encompass information needed to specify and manage healthcare processes adequately.
 - Why does a particular business process exist?
 - What business objectives does it address?
 - What are the implications of its not being executed or completed?
 - What is its value?
 - What are its costs?



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Must capture information for process based on multi- dimensional factors:
□ Cost.
□ Purpose.
Time.
□ Competency requirements of HR.
□ Value.
□ Satisfaction of objectives and deliverables.
Implications of non- or incomplete execution.
☐ With this information, we can:
□ Analyze and evaluate a process.
□ Determine its conformance with requirements.
Mine historic repository of workflows: use to predict likely courses of care.

to configure it dynamically.

Analysis and evaluation used to manage the process better and even





BP, WM and IT in Healthcare Deliverables if Semantics Included

Benefits:

- □ Introduction of new methods for health process analysis, representation and evaluation based on specific multidimensional criteria.
 - Co-flows: purpose completion flow, cost flow, value flow.
- Definition of "contracts" that capture requirements and constraints.
- ☐ Techniques to deal with dynamic process customization, reconfiguration and conformance.





BP, WM and IT in Healthcare Real-Time Workflow Concept

Ou	r conceptualization built on a set of definitions:
	Consider ensemble of activities of a department as a "macro-service". • "Diagnostic Imaging Macro-service" = "Diagnostic Imaging Department".
	A macro-service is composed of services, such as patient reception service = "business process".
	Each service is composed of micro-services, e.g., verifying the patient's identification.
	Each micro-service is composed of tasks, e.g., reading the requisition form.
	Etc.
	Workflow is "movement" from service to service, from micro-service to micro-service, and from task to task.
	thin a macro-service, business processes are executed and storic record of these processes is a BP-level workflow.
	e history of micro-services within a BP is a task-level orkflow, etc.





BP, WM and IT in Healthcare Real-Time Workflow Concept

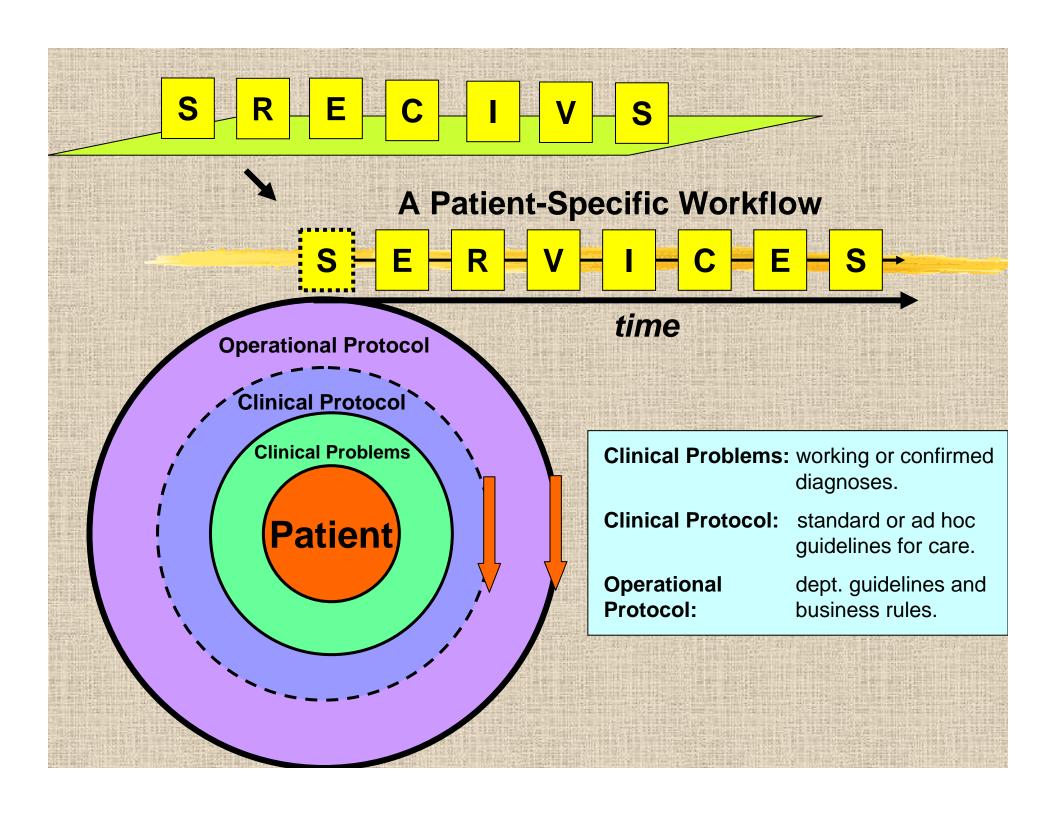
Work to date has only addressed "workflow validation". Determination of continuity and linearity of workflow process representations.
 Little done on evaluation of workflow, services, etc. that comprise a healthcare process, esp. a dynamic process. "Evaluation" = efforts such as determination of efficiency or appropriateness of process or its components. Questions like: "Is this an appropriate process" or "Is this process better than another process" cannot be answered.
 Main goal of our research: □ To produce an approach that will support the detailed representation, execution, analysis, evaluation, and management of healthcare "business processes" (clinical, financial, and operational processes).

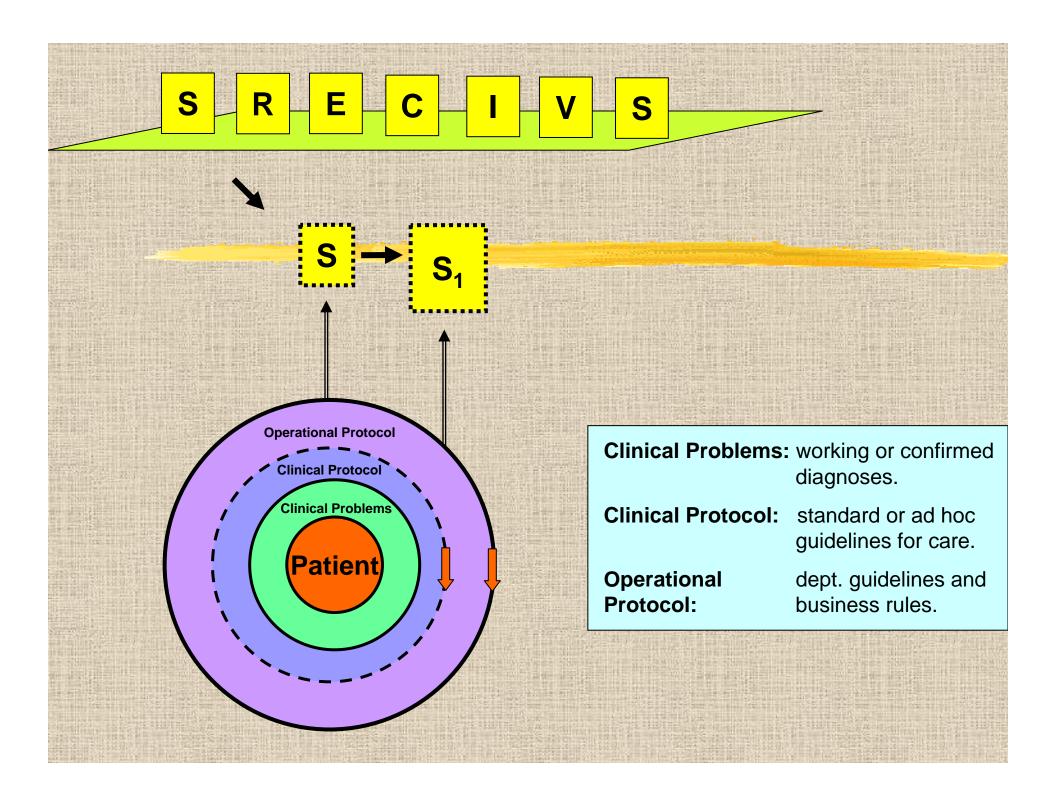




BP, WM and IT in Healthcare Real-Time Workflow Concept

- Workflow representation must be a multidimensional model.
 - Consisting not only of sequence information and procedure parameters.
 - Includes other dimensions related to procedure characteristics.









BP, WM and IT in Healthcare Real-Time Workflow Concept

A 2 component workflow representation:

 Decision Unit.

 Characteristics of services:

 Services have pre-requisites.
 Services have post-requisites.

 Enter a process at any point and proceed based on pre- and post requisites.

 History = workflow instance.





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Relevance And Benefits





BP, WM and IT in Healthcare Relevance and Benefits

Objectives:

- □ Workflow Coupling: being able to customize systems so they support workflow desired by client.
 - Very high % of system code is actually workflow support.
 - Most demand for system customization relates to workflow support.
 - Potential of "externalizing" this workflow-supporting code.
 - Then domain experts can change workflow by altering flowchart or declarative statements.





BP, WM and IT in Healthcare Work Process Impedance Matching

DIS – Work Process Coupling

DIS Functional Capabilities (Functions 1 to 6)

DIS								
F1	F2	F3	F4	F5	F6			

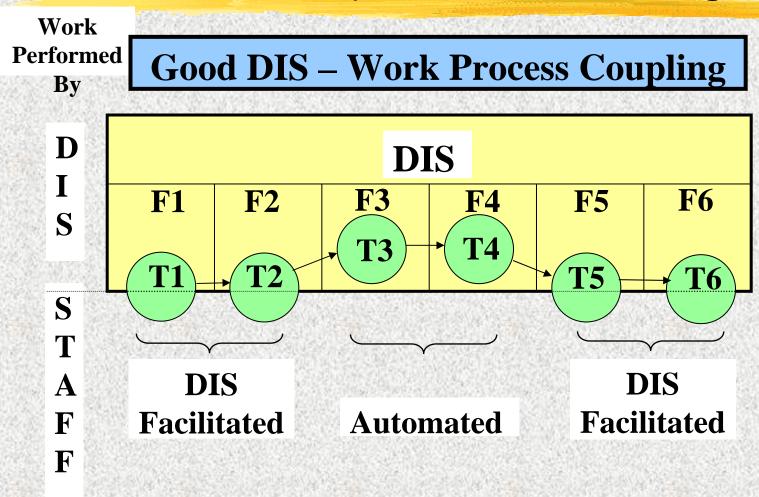
A Work Process (Tasks 1 to 6)

$$\boxed{T1} \longrightarrow \boxed{T2} \longrightarrow \boxed{T3} \longrightarrow \boxed{T4} \longrightarrow \boxed{T5} \longrightarrow \boxed{T6}$$





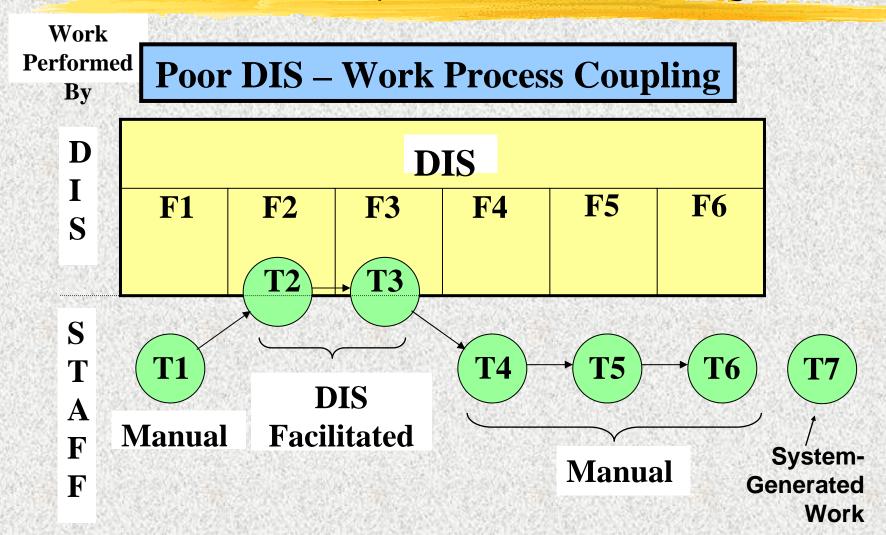
BP, WM and IT in Healthcare Work Process Impedance Matching







BP, WM and IT in Healthcare Work Process Impedance Matching







BP, WM and IT in Healthcare Relevance and Benefits: Workflow

☐ Workflow support:

- Critically-needed capability for adapting systems to client's needs.
- Domain-expert customization instead of programmers.
- □ Self-documenting and easily readable.
- □ Avoids version-per-site (disaster).
- □ Product and services opportunities.
- ☐ Key tool for benefits realization in health settings.





BP, WM and IT in Healthcare Relevance and Benefits: Workflow

- Workflow Customization Value:
 - Vendor:
 - Can customize at attractive \$\$ and win procurements where ability to match to client's workflow is critical.
 - Can offer profitable professional services.
 - Workflow and workflow components library (workflow "products").
 - Less expensive workers than programmers (increased margins).
 - Able to deliver "organizations" not just systems.
 - Professional services companies/consultants:
 - Can offer profitable services.
 - Less expensive workers, less effort, expression of domain expertise.





BP, WM and IT in Healthcare Relevance and Benefits: Workflow

- Workflow Customization Value:
 - ☐ Health organizations:
 - Can derive greater capabilities from systems.
 - Match perceived optimal process: can re-engineer.
 - Greater realization of benefits (e.g., through increased productivity).
 - Internal process alteration and maintenance capability.
 - More autonomy, adaptability, flexibility, options.
 - Less expensive systems support.
 - ▲ Greater ROI.





BP, WM and IT in Healthcare Relevance and Benefits: Workflow

Workflow Products and Services.
Pre-packaged business processes or sub-units (components on the shelf).
Exemplar departments (delivering organizations).
Database of workflows for mining (of units, of typical characteristics, of alternatives).
☐ Simulations.
□ Optimizations.





Workflow Capture



etc.?

BP, WM and IT in Healthcare Research: General Problem Articulation

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■ What needs to be captured during the analysis of a process to fully document workflow?
 □ How can we capture information about the nature of the "business" as it affects (or requires specific) workflow?
 □ How can we capture operational/tactical decisions/elections in how we run the "business"?
 □ How can we document the value of workflow components: their importance in achieving desired effects, their \$ value, etc.?
 □ How do these translate into rules/constraints on the fundamental interactions expressed in the workflow?
 □ What are the "dimensions" of a workflow component, e.g., its value, its quality contribution, its operational importance, its strategic importance,



BP, WM and IT in Healthcare Research: General Problem Articulation

Waterloo

- Is it possible to detect "inappropriate" workflow? Moving from validation to evaluation.
 - □ Detect non-value-adding components.
 - □ Detect inefficient components.
 - Detect unnecessarily complex components.
 - □ Detect anti-operational-standards components.
 - □ Detect anti-strategic-goals/objectives components.
- Is it possible to guide the construction of "appropriate" workflow?





BP, WM and IT in Healthcare SWAP: Structured Workflow Analysis Process

Ex	cam/Test Request Group	(Including	Single	Exams/Tests)	
	Exam/Test Hierarchy				Ü
386	Groups of Exams/Tests		William Towns State of		ä

3236		Exams/ rests in Group
		Relationship(s) Among Exams/Tests in Group
		Relationship(s) between Groups
	23	

	Source Dimension				
KUSA	C-1032377	100	Consultation of the Con-	0.953559	320

□ Evama /Tasta in Croun

- "Legal" Sources for Requests for Group
 Authority Validation for Requests for Group
 - ☐ Comments Re: Dimension

Temporal Dimension

- □ Excluded Times for Group
- Start Time Limit for Group
- Maximum Duration for Group
- ☐ Must be completed by time for Group
- □ Comments Re: Dimension

Resources Dimension

- □ Required Rooms/Facilities
- □ Required Instruments/Equipment for Exam/Test
- Required Staff for Exam/Test

Information Dimension

- ☐ Required Information (e.g., clinical reason) for Group
- Purpose, Objectives for Group
- □ Costs or Cost Computation for Group
- Measures of Value for Group
- Restrictions on Patients for which Group Requested
- Prerequisites (Exams, Prep) for Group
- Overrides for Group
- Exceptions for Group
- Approvals Required for Group
- Comments Re: Dimension





SWAP: Structured W	/orkflo	kflow Analysis Proces			
Individual Exam/Test Exam/Test Component Hierarchy					

Exam/Test Components and their Relationships **Source Dimension** "Legal" Sources for Requests for Exam/Test Authority Validation for Requests for Exam/Test Comments Re: Dimension **Temporal Dimension Excluded Times for Exam/Test** Start Time Limit for Exam/Test Maximum Duration for Exam/Test Must be completed by time for Exam/Test Comments Re: Dimension

Resources Dimension

- Required Rooms/Facilities for Exam/Test
- Required Instruments/Equipment for Exam/Test
- Required Staff for Exam/Test
- **Comments Re: Dimension**

Information Dimension

- Description of Exam/Test
- **Rules for Further Testing Based on Results**
- **Quality Validation**
- Exam/Test Statistics (# per time, max, min; average, SD)
- Required Information (e.g., clinical reason) for Group
- Purpose, Objectives for Exam/Test
- Costs or Cost Computation for Exam/Test
- Measures of Value for Exam/Test
- Restrictions on Patients for which Exam/Test Requested
- Prerequisites (Exams, Prep) for Exam/Test
- Overrides for Exam/Test
- **Exceptions for Exam/Test**
- Approvals Required for Exam/Test
- **Comments Re: Dimension**





BP, WM and IT in Healthcare SWAP: Structured Workflow Analysis Process

Results of Group (Including single Exam/Test)

- Receptor Hierarchy
 - □ Destination Person for Exam(s)/Test(s) Results
 - Destination Location for Exam(s)/Test(s) Results
- Prerequisites Dimension
 - □ Prerequisites for Release of Results
- Postquisites
 - Validation of Reception Required

Note: SWAP is in Development

Not all Dimensions or details are included here





Part 2





Importance of Health Informatics



BP, WM and IT in Healthcare Health Informatics (HI) and Workflow

- Importance:
 - Dependence of all aspects of the health on ICT: Mazankowski, Romanow, Kirby.
 - Not deliver effective, efficient system or research without it (NIH).

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- One of 10 Grand Challenges in HI:
 - "Techniques to ease the incorporation of new information management technologies into the infrastructure of organizations...".
- A critical needed capability is the means of adapting systems to the complex + idiosyncratic work processes of health orgs.
- The need to enable domain experts to create and maintain workflows.
- Major UW initiative with the objective of contributing to the health of our citizens.





BP, WM and IT in Healthcare Measures of Success

- Feasibility of approach.
- Demonstration of applicability to health setting.
- Usability by domain-experts.
- Acceptability and adoption in health setting.
- Reception in literature.
- Incorporation into company's product development tool set.
- Production of HQP.

Addressing a Grand Challenge in Health Informatics





BP, WM and IT in Healthcare Measures of Success

HQP Jobs

- □ CHI and SSHA: Need 2,000 HI professionals in Ontario (NOW!).
- Produce < 100 per year in entire country.</p>
 - Universities and Community Colleges will help (but will take 2 5+ years).







Collaborators





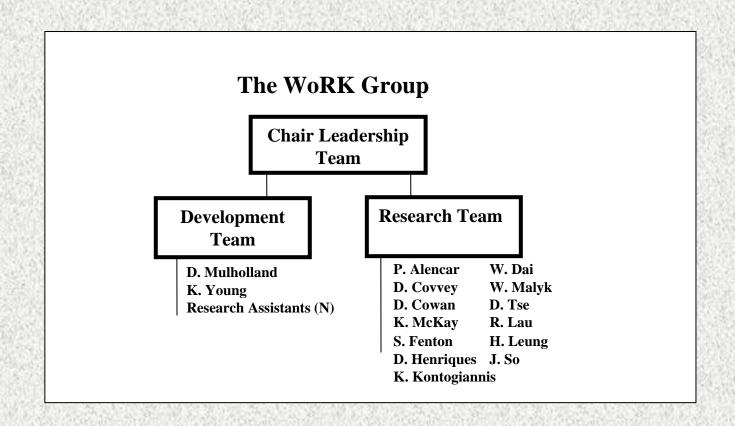
BP, WM and IT in Healthcare Key Collaborators at UW

NS	ERC Workflow (WoRK Group):
	Prof. Dominic Covvey, principal investigator, Science. Health Informatics, health apps, process and product re-engineering.
	Prof. Don Cowan, School of Computer Science. Software Engineering, Workflow, Commercialization.
	Prof. Ken McKay, Department of Management Science Workflow, process engineering, simulation and modelling.
	Prof. Paulo Alencar, School of Computer Science. Workflow, web-based applications, Software Engineering. Prof. Kostas Kontogiannis, Electrical and Computer Engineering.
	□ Workflow, Software Engineering.
	Staff: Ms. Shirley Fenton, SCS; Mr. Douglas Mulholland, SCS; K. Young, SCS.
	Students: M. Al-Shawa, W. Dai, D. Henriques, H. Leung, W. Malyk, D. Tse, J. So.
Pro	oductivity Impacts Team (separate project):
	Prof. Brian Cozzarin, Management Sciences. Management of technology, IT economics.
	Prof. James Brox, Economics. — Applied Economics.
	Prof. Richard Bodell, Economics. Cost-benefit analysis.
	Prof. Christine Fader, Economics. □ Economics of IT, productivity.
	Prof. Efrim Boritz, School of Accountancy. Information systems assurance, cost accounting.
	Prof. Paul Stolee, School of Optometry. Health Informatics, evaluation, adoption.





WoRK Group Structure and Team







Acknowledgements





BP, WM and IT in Healthcare Acknowledgements

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 - □ NSERC (EIRC).
 - Agfa (Chair).
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- For further information:
 - □ http://hi.uwaterloo.ca
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Workflow And Reengineering International Association: http://waria.com			
The Workflow Management Coalition: http://www.wfmc.org			
World Wide Web Consortium: The root website is www.w3.org . There is a Google search available on the page so some workflow articles can be found through it.			
Aalst's Workflow Patterns website URL: <u>www.workflowpatterns.com</u>			
Papers on Mining and Patterns:			
 W.M.P. van der Aalst, A.H.M. ter Hofstede, B. Kiepuszewski, and A.P. Barros. Workflow Patterns (PDF, 718 Kb) Distributed and Parallel Databases, 14(3), pages 5-51, July 2003 			
Aalst's Survey Paper on Workflow Mining:			
W.M.P. van der Aalst, B.F. van Dongen, J. Herbst, J. Maruster, G. Schimm, A.J.M.M. Weijters, Workflow Mining: A Survey of Issues and Approaches, Internal Report, 2002.			
Paper on created a Guideline based Patient Workflow System:			
 L. Dazzi, C. Fassino, R. Saracco, S. Quaglini, M. Stefanelli. A Patient Workflow Management System Built on Guidelines. Proc AMIA Annual Fall Symp. 1997:146-50. 			
Maruster and Aalst's paper on automated workflow mining in healthcare:			
 L. Maruster, W.M.P. van der Aalst, A.J.M.M. Weijters, A. van den Bosch, W. Daelemans, Automated discovery of workflow models from hospital data, in: B. Kroose, M. de Rijke, G. Schreiber, M. van Someren (Eds.), Proceedings of the 13th Belgium-Netherlands Conference on Artificial Intelligence (BNAIC 2001), 2001, pp. 183–190. 			





Questions and Discussion

