Evolution of the workflow management systems

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Abstract—**In this paper a short chronology of evolution of workflow management systems is given. Classifications according to different criteria of software tools supporting modeling and execution functionalities of workflow management systems are presented.**

Keywords—**Automation systems, business processes, web services**

I. INTRODUCTION

Workflow Management Systems are a mature technology for automating and controlling business processes [1], [2]. One widely accepted definition of workflow comes from the Workflow Management Coalition [3]: "Workflow is the computerized facilitation or automation of a business process, in whole or part". With the rise of the Web as the major platform for making data and services available for both, humans and applications, a new challenge has become prevalent requiring support of workflows within and crossing organizational boundaries [4], [5].

A general task of the workflow system in the current business activities is the implementation of principles of the automatic control in business systems. The lasts don't consist pure technical components, but they integrate both human and human-computer activities and non-automatic interactions. The paper presents an overview about the evolution of the workflow systems. A critical study is performed, addressing workflow standards and modeling languages. Software products, supporting modeling and execution functionalities of workflow management systems are discussed.

II. IMPORTANCE OF WORKFLOW AUTOMATION

To implement automation in the business processes it is necessary to apply modeling techniques for the non-technical, organizational systems. Over the last decade there has been increasing interest in information systems that are used to control, and/or monitor business processes. Examples of them are Enterprise Resource Planning (ERP) systems, Work Flow Management Systems (WFMS) and Customer Relationship Management (CRM) systems. These systems are implemented to specific business processes. A set of formal languages have been worked out in the context of web services (BPEL4WS,

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BPML, WSCI, etc.). The support of leading firms as IBM, Microsoft, HP and SAP for a language like BPEL4WS (Business Process Execution Language for Web Services), [6] [6]   T. Andrews, F. Curbera, H. Dholakia, Y. Goland, J. Klein, F. Leymann, K. Liu, D. Roller, D. Smith, S. Thatte, I. Trickovic, S. Weerawarana, Business Process Execution Language for Web Services Version 1.1, 2003. Technical report, http://xml.coverpages.org/ BPELv11-May052003Final.pdf proves that workflows have become important for development. As a result workflow systems are well addressed in standards: BPEL4WS, XPDL, WfMC [7].

III. THE EVOLUTION OF BUSINESS PROCESS MANAGEMENT

In [8] a history review of the workflow technology is given. Till nineties a more fundamental approach is missing. "The aim of workflow management technology is the separation of process logic from application logic in order to enable flexible and highly configurable applications" [9]. In [10] seven fields of importance of workflow management technology are given: office automation, database management, e-mail, document management, software process management, business process modeling. The office automation targets "to reduce the complexity of the user's interface to the (office information) system, control the flow of information, and enhance the overall efficiency of the office" [11]. An overview of the historical development of office automation systems and workflows is given in [9]. The understanding of workflow management has been determined by the terminology of the Workflow Management Coalition [3]. The workflow system consists of a modeling component, functionality for the creation of workflow instances from these workflow models, and functionality for the execution of the workflow instances. The products, which implement workflow technologies, have this functional consistence.

In the sixties information systems were built for small operating system with limited functionality. These systems mainly consisted of particular applications. New software tools added new functionalities like database management. This trend leads to the emphasis from programming to assembling of complex software systems. The coding of individual modules is an old approach now [8]. The challenge now is orchestrating and combining pieces of software [8].

A. Workflow Management Systems

Workflow systems use a variety of languages based on different concepts. Most of the products use a proprietary language rather than independent one. Some workflow systems are based on Petri nets but typically add product specific extensions and restrictions. The differences between the various tools are considerable. The reasons for the lack of consensus of what constitutes a workflow specification are the variety of the business processes. The absence of standard

business process modelling concepts is the reason for the diversity in workflow languages. Respectively the comparison of different workflow products looks to be more as a dissemination of products then a critique of workflow language capabilities. An example of model of a collaborative workflow system is given in Fig. 1.

B. Web Services Composition Languages

There are two trends in the world of E-business that are creating opportunities to automate business processes across organizations. The first is the technology taking XML-based standards and the Internet as a starting point. The other trend is the need to improve the efficiency of processes from a business perspective. There is a need to utilize the potential of Internet for automating business processes. The goal of web services is to exploit XML technology and to integrate applications that can be invoked over the Web.

Developments of web services composition languages have been mainly driven by software vendors like IBM, Microsoft, Sun, BEA, SAP. This resulted in an abundance of standards with overlapping functionality. The efforts of specialists are directed to narrow the software workflow tools by ignoring standardization proposals that are not using well-established process modeling techniques.

The first standardization effort was the Workflow Management Coalition (WfMC), http://wfmc.org/ . The reference model which is applied, interfaces between a workflow management system and other actors are defined. The standardization efforts try to extend the application area of e-Business solutions.

IV. SUITS FOR WORKFLOW SOFTWARE

Workflow models identify: how tasks are structured, who performs them, what their relative order is, how they are synchronized, how information flows support the tasks and how tasks are tracked. Workflows can be modeled using Petri nets [12], [13]. Distinction can be made between "scientific" and "business" workflow models. The "scientific" is mostly concerned with throughput of data through algorithms, applications and services, the business concentrates on scheduling and task executions.
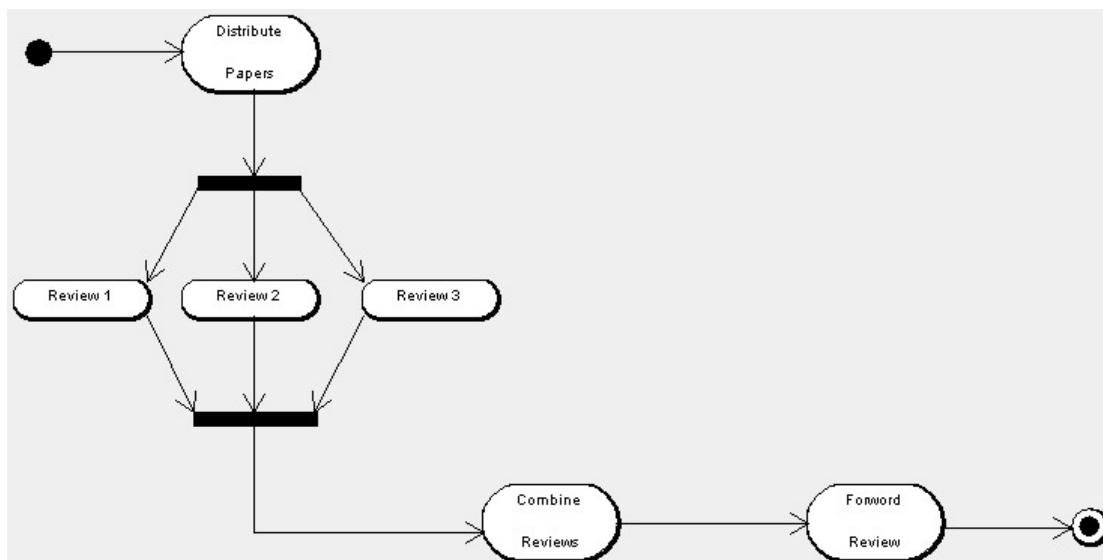

Figure 1. - Collaborative workflow

V. CLASSIFICATIONS OF SOFTWARE TOOLS FOR BUSINESS AND SCIENTIFIC WORKFLOWS

The list of products for modeling and execution of workflow systems is long. The products now have different level of maturity and they are presented as market available an open source software suits. Here are presented classifications of these software tools:

- Software for business and scientific workflows.
- Tools according to their software language design.
- Tools according to their supported standard.

- Open Source and Commercial tools.

The scientific Workflows systems receive wide acceptance particularly in bioinformatics in 2000s. They are successful to perform interconnections between tools, to handle different data formats and volumes http://en.wikipedia.org/wiki/ Workflow.

The business workflow represents the set of business tasks in the organizations, perform the time scheduling between the processes, coordinate software applications, and manage the paper flow documentation. Workflow are "systems that help organization to specify, execute, monitor, and coordinate the works within a distributed office" http://en.wikipedia.org/wiki/ Workflow. The Workflow

diagrams use standardized graphical notations to describe workflow.

The software tools for business and scientific workflow systems are presented below:

- Tools for business workflow

@enterprise	Aegeanet System
Agentflow	Amazonas Worflow
Bonita	Captaris
Business Process Management	Business Integration Engine
COLOSA	CoMo-Kit
EmeriCon	Enhydra Shark
EventStudio	FlowRunner
infoRouter	iKE
Ils/process	IngTech Corporation
Intella	Interstage BPM
MyControl Workflow Server	K2.net Enterprise Workflow
Jboss	OpenFlow
OpenSymphony	OpenWFE
OracleBPEL Process Manager.	Skelta Workflow.NET
Ring Pro	PL/FLOW
VivTek	W4
Web and Flo Kontinuum	WebSphere MQ Workflow
YAWL	

- Tools for scientific workflow

Taverna	Kepler
GridNexus	SPA
Triana	Jopera

VI. TOOLS ACCORDING TO THE SOFTWARE LANGUAGE DESIGN

A review of an open source workflow project is www.manageability.org/blog/stuff/workflow_in_java/view. A classification is performed according to program language, used for the design of the software tool: Java based; other Java; non-Java; for specific application servers or environment.

A. Open Source Workflow Engines Written in Java

The review list consists:

ActiveBPEL	Antflow
Apache Agila	Beexee
Bigbross Bossa	Codehaus Workflow
con:cern	Dalma
Enhydra Shark	Freefluo
jBpm	Jfolder
MidOffice BPEL Engine	Micro-Workflow
ObjectWeb Bonita	OFBiz
OpenWFE	OpenSymphony OSWorkflow
Pi Calculus for SOA	PXE

Syrup	Taverna
Twister	wfmOpen
Xflow2	YAWL
Zbuilder	Zebra

An extended description of each product is available from http://www.gripopprocessen.nl/index.php?id=35&no_cache=1. Currently available tools are:

- Generic J2EE

Apache Agila	Bonita
Imixs	Jboss jBpm
Jfolder	Open Business Engine
wfmOpen	XFLow

- Other Java based products

Bossa	Enhydra Shark
OpenWFE	Syrup
Werkflow	Twister
Open Symphony Workflow	Yet Another Workflow Language engine
Zebra	

- Other: Non-Java tools

wftk (workflow toolkit)	

- For specific application servers or environment

ActionWorks	BizFlow
Galaxia Tikiwiki	OpenFlow
Grid-based computing workflow – Taverna	Open for Business (OfBiz)
WebAsyst Issue Tracking	WebAsyst Workflow Management Software
webMethods Business Process Management	

VII. SOFTWARE TOOLS ACCORDING TO THEIR SUPPORTED STANDARD

- XPDL based

Aspose.Workflow	Open Business Engine
Agentflow	Aspose Workflow
Enhydra JaWE	ObjectWeb BONITA
Enhydra Shark	Fuego BPM
Interstage BPM	Newgen
OFBiz Workflow Engine	Vignette Process Workflow Modeler
wfmOpen	YAWL

- BPEL based

iGrafx BPEL	Apache Agila
ActiveBPEL Engine	Bexee
ActiveWebflow Standard	Cape Clear
Biztalk Server	IBM BPWS4J
Oracle BPEL Process Manager	JOpera
PXE	MidOffice

Parasoft BPEL Maestro	Twister
SAP NetWeaver Exchange Infrastructure	

- BPMN based

Borland Together Desidner	ITpearls Process Modeler
IntalioDesigner	AXway Process Manager™
Fujitsu: Interstage Business Process Manager 7.1	Kaisha-Tec: ActiveModeler
Lanner: Witness™	Mega International: Mega Suite™

VIII. OPEN SOURCE AND COMMERCIAL TOOLS

- Open Source Workflow Tools

Additional information can be found in http://java-source.net/open-source/workflow-engines

Twister	jBPM
Enhydra Shark	OpenSymphony OSWorkflow
con:cern	Codehaus Werkflow
ObjectWeb Bonita	Bigbross Bossa
Open Business Engine	The Open for Business Workflow Engine
OpenWFE	WfMOpen
XFlow	Jfolder
Taverna	Freefluo
Micro-Flow	Jflower
YAWL	Syrup
PXE	ActiveBPEL
Antflow	Swish

- Commercial Workflow Tools

Active Endpoints ActiveWebflow Server	ActiveWebflow Designer
ADONIS	Biztalk Server
Cape Clear Orchestrator	Digité Process Composer
Fiorano SOA Platform	FiveSight PXE
FuegoBPM	IBM BPWS4J
IBM WebSphere Business Integration Server Foundation	OpenLink Virtuoso Universal Server
OpenStorm ChoreoServer	Oracle BPEL Process Manager
Parasoft BPEL Maestro	PolarLake Integration Suite
SAP NetWeaver Exchange Infrastructure	SeeBeyond eInsight BPM

IX. CONCLUSION

This survey of products, available for workflow modeling and execution describes a huge amount of products. It is difficult for a common user to make a choice of appropriate software tool, which have to be applied in user applications. Thus the problem of evaluation and assessing this class of software becomes quite important. It is firmly related to the functionalities of the products to support common standards, related to the workflow management. But the implementation of the workflow management systems is assumed to be the most prospective domain where automation and information technology overlap in business management applications.

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