Analyzing Impact of AI Tools on Traditional Workflow Systems

Ashish Bishnoi
Associate Professor
Dept of Computer Applications
CCSIT, TMU, Moradabad

Rupal Gupta
Associate Professor
Dept of Computer Applications
CCSIT, TMU, Moradabad

ABSTRACT

Business enterprises employs wide array of processes to achieve an overall business goal. Automation of these processes either fully or partially called workflow. In today's world Workflow systems are the backbone of any commercial organization which manages the specification, modeling and implementation of work processes of the organization. Workflow systems provide edge to organization over its rivals in dynamic business environment who still using static model for fulfilling their information processing needs.

Workflow systems become more complex in order to manage business processes with required amount of reactivity and flexibility in unpredictable business environment. Artificial Intelligence, one of the emerging areas in computer science addresses different technical challenges of workflow system. Artificial Intelligence technologies can be incorporated with existing workflow systems to enhance their efficiency and effectiveness or used to develop altogether new intelligent workflow system architecture. In this paper, usage of AI techniques in the design of efficient and fault tolerant model for workflow systems is identified, and specifically using Agent technology in workflow execution to improve productivity, efficiency and error free processing of different activities. At the end of paper, author focuses on a new architecture for workflow system.

Keywords
Artificial Intelligence, Workflow, Intelligent Agents, Workflow System (WFS), WFM.

1. INTRODUCTION
To achieve the business goals, various processes are used according to defined set of rules for passing documents, information or task in almost every business organisations. These well-defined processes are implicitly used in the working of the organisation and can't be explicitly represented as a result it becomes difficult to monitor progress of the process. Addition of new or modification of an existing business process in current system is complex and tedious task to achieve. To fulfil new goals, standards or quality level organisations had to make changes in their working by adopting new technologies. Business goals are achieved by organisation using standard methods or procedures to produce or design the product or services which fulfils customer requirement and obtain their satisfaction. [1, 2]

Automation of business processes, partially or fully to achieve business goals represents the workflow in business enterprise. Not the availability of cheaper computer hardware and software, but above it goal to beat business rivals, forces the business organisation to automate the management of business processes. Automation provides for better management of processes by having deeper insight into current and planned operation using tools to monitor status and progress of the processes. Automation provides adaptive capabilities that ensure agility of processes and optimize use of resources. The automation of business process management leads to emergence of the field of "Workflow Management" (WFM). Workflow management proposes different models, architectures and specifications for the development of automated systems for business community, such systems are known as Workflow Systems. The objective of Workflow System to represent different business processes using appropriate models and dynamically manage the business processes using tools and techniques of information technology. These tools are used to provide better control, coordination and communication between business processes of the system (Joosten, 1996). Business processes are used to control the workflow in organisation to achieve business goals and Workflow Systems provides automation of these processes. Workflow systems are commonly used for document management, Image processing, Groupware Applications, Project Support Software and Structured System Design Tools, Transactional Workflow etc.

Though the foundation of Artificial Intelligence is laid thousands of years ago, still it is emerging and found its usage in almost every domain. Winston defines the Artificial Intelligence as "the study of computations that make it possible to perceive reason and act". [3] The objective of Artificial Intelligence community to develop Intelligent Systems which are capable enough to achieve complex tasks in dynamic and uncertain environments. These systems have the ability to learn user preferences and modify themselves to fulfil those preferences. Artificial Intelligence models and techniques are employed in domains such as robotics, satellites, computer science, medical science etc. Workflow Systems are focused on business and manufacturing processes whereas Artificial Intelligence community works in domain that involves active controls of computational entities and physical devices. Despite of difference with workflow technology, Artificial Intelligence techniques provides action or knowledge representation schemes which form basis for development of efficient and reliable reasoning models or engines. These engines in turn generate process for repairing other business processes in workflow systems to fulfil requirements of dynamic business environment. [4]

Workflow models developed earlier are static in nature due to which it is difficult to match the changing business requirements and these systems provide a limited support. To incorporate changes in static workflow systems is a tedious task and resource intensive. It is highly required that workflow systems have rich representation schemes and powerful reasoning engines for dynamic generation and repairing of business process. In last decade researchers from both community comes together to use the Artificial Intelligence techniques in development and maintenance of

Workflow Systems. This paper provides an overview of this exciting research area i.e. "how Artificial Intelligence techniques can be combined with workflow technology to develop robust, reactive and adaptive workflow engines that manage complex process". This paper discusses the intelligent workflow management in business organisation using AI techniques and trends in near future.

2. BUSINESS PROCESS MGMT

System that helps organizations to specify, execute, monitor and coordinate the flow of work within a distributed business environment referred as workflow [Bul 92]. It can mainly

used for performing administrative, production and manufacturing processes in a business enterprise. A system that manages workflow process for a business organisation with the help of softwares is called workflow management system.

With conceptual architecture of workflow system, we can easily describe different components of system and how they are associated with each other. Implementation of workflow system defines what services or components will be provided to user by machine, with the help of concrete architecture of workflow systems.
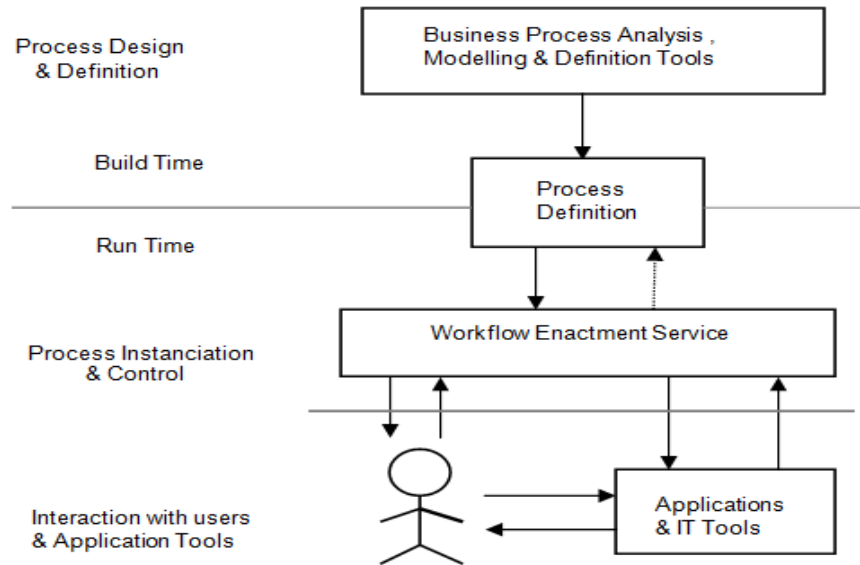

Fig.1: Workflow system architecture

In business arena, there are organisations with structured and unstructured business processes due to which no one model of workflow systems can address all the needs of the organizations. Therefore different models are required for specifying different type of resources and different levels of structure in any organisation.

Workflow Systems requires co-ordination between user and system to achieve desired goals in given time frame. This helps the components of system to transfer job or task in

specified order to other component or agent for execution. In case of exceptions (run time errors), system operators are informed so that actions required to resolve the problem can be triggered.

Workflow models must not restrict employees from performing any specific task but they should be flexible enough to provide different ways of doing the same job. Any workflow model will fail due to its inability to recognize the unstructured nature of the work.
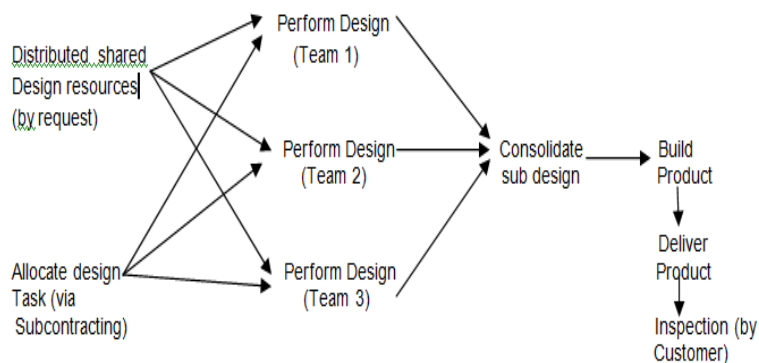

Fig.2: Workflow Process

3. ISSUES BEFORE WORKFLOW SYSTEMS

Workflow systems implemented in various organizations must have the ability to adapt themselves with the changing requirements and remain operational with previous performance and efficiency. Workflow system must have the ability to dynamically configure business processes, to interrogate the relevant system for information and to reengineers the business process. The major challenges faced by the different workflow models are in the areas of exception handling and dynamic organizational challenge.

3.1 Exception Handling

In a study of workflow processes used by organizations it has been found that handling run time errors becomes tedious task for employees of the organization. Exceptions cannot be solved by the computer alone but it requires the experience of people to solve it. Thus, to create a successful workflow design it is required that computer is used as a collaborator and communication tool in solving exception. When a workflow system is designed it must have the ability to handle any kind of exceptions occurred in the work environment. From the study of workflow systems, it has been found that exceptions are main hindrance in the development of good workflow systems.

3.2 Dynamic *Change*

To full-fill new requirements, meet new challenges and providing cutting edge services to customer, business organizations had to change their structure. Therefore, workflow systems provide support for these changes in structure or procedure of business organization. Another major problem faced in designing good workflow systems is support for dynamic changes because it is not an easy task for designers or administrators have to make large scale changes in the workflow systems. The process making changes in the workflow system is an error prone, time consuming, ineffective and unproductive. In current scenario, instead of solving the problem in workflow system, most of the organizations either cope with it or evade it.

The performance and efficiency of a workflow system can be measured on criteria's of functionality, reliability, usability, maintenance and portability etc. By evaluating these criteria's performance of existing workflow system can be improved. The result of quality measures effecting workflow system is described in table 1. [5]

4. INSIGHT TO AI

John McCarthy, one of the founders of AI, defines it as "the science and engineering of making intelligent machines". Various researchers provides different definition of AI but all definitions says more or less the same thing, which includes the use of heuristic techniques to solve the complex problems with the help of different computational models, the art of creating intelligent machines which can learn, think and reason like human being. In current era, impact of AI can be felt around us as it is used in domains such as expert system, robotics, computer games, space research, automobile industry, defence etc. The ability of AI systems to take decisions like an human expert of the domain and in certain cases ability to learn from environment makes them useful in different domains [6].

The areas of AI research include learning, representation of knowledge, and manipulation of knowledge for generating reasoning and planning e ability to move and manipulate

objects [7]. AI is divided into subfields on the basis of factors like social, technical, specialised use. Due to its technical and specialised nature, subfields of AI often fail to communicate with each other [8]. AI Community constantly explores the areas where AI techniques can be used to improve the performance, behaviour and decision making capabilities of application or system. Intelligent Agent is commonly used AI technique and easily employed in different areas.

Table 1. Performance Finding of Workflow System.

Characteristics ISO/IEC 9126	Good (%)	Weak (%)	Strong (%)	Cannot Assess (%)	Score Result
Reliability			75	25	4.5
Usability	50		12.5	37.5	
Functionality	20	20	60		4.8
Efficiency	67		20	20	2.68
Maintainability	60		20	20	3.6
Portability	20		60	20	4.4

Header spanning Good, Weak, Strong, Cannot Assess, Score columns: Workflow System

5. INTELLIGENT AGENT

An intelligent agent is a set of independent software tools or components linked with other applications and database running on one or several computer environments. [9] Hewitt in 1977, describes the agent for the first time in its Actor Model. According to Hewitt, agent is a self-contained, interactive and concurrently executing object having some internal state and communication capability.

Agents are linked with research areas like robotics, Artificial Intelligence, distributed systems and computer graphics. In simple words, an agent can be described as an entity that is able to carry out some task, usually to help a human user. [10] Agent (IA) is an autonomous entity which observes i.e. learn from its environment and use their knowledge to acts upon an environment and directs its activity towards achieving goals. [11] Intelligent agents are often described schematically as an abstract functional system similar to a computer program. In computer science, the term intelligent agent may be used to refer to a software agent that has some intelligence, regardless if it is not a rational agent by Russell and Norvig's definition. [12] An Artificial Intelligent agent should have the properties like: Intelligence, Autonomy, Mobility, Reliability, Ability to learn, Cooperation, Versatility etc.

6. AI AND WORKFLOW

Reactive control, scheduling and planning are three subfields of AI which are directly related to workflow management. (WFM) These fields are used for developing techniques and tools for managing processes, allocation of resources and task, synthesizing new process and modifying existing one, in workflow systems intelligently. Besides them, knowledge acquisition and distributed AI are used to improve coordination between multiple layers of workflow systems. Syntactic and semantic inconsistencies that may exist in workflow systems are identified with the help of knowledge acquisition technique of AI. Workflow systems with reactive

control strategies are more adaptive to their changing environment as a result they respond dynamically whenever problem occurs in the system. Above mentioned system uses forward recovery methods to identify the actions that achieve a safe state from a failed state.

AI scheduler is another technique developed for resource and task allocation in workflow systems with ease. They have the ability to change their behaviour with changing requirement in workflow system to meet new standards and modified criteria's of business organization. Constraint directed and

constraint iterative repair are two algorithms commonly used in prioritization of problems and identifying important modifications and goals for workflow systems. It also estimates the possibilities for efficient and non disruptive schedule for modifications in workflow system.

Intelligent agents can also be used as an alternative of AI schedulers and manages the task in workflow systems. Agent uses distributed approach to complete tasks in workflow system where each agent compete and coordinate with other agents present in system.
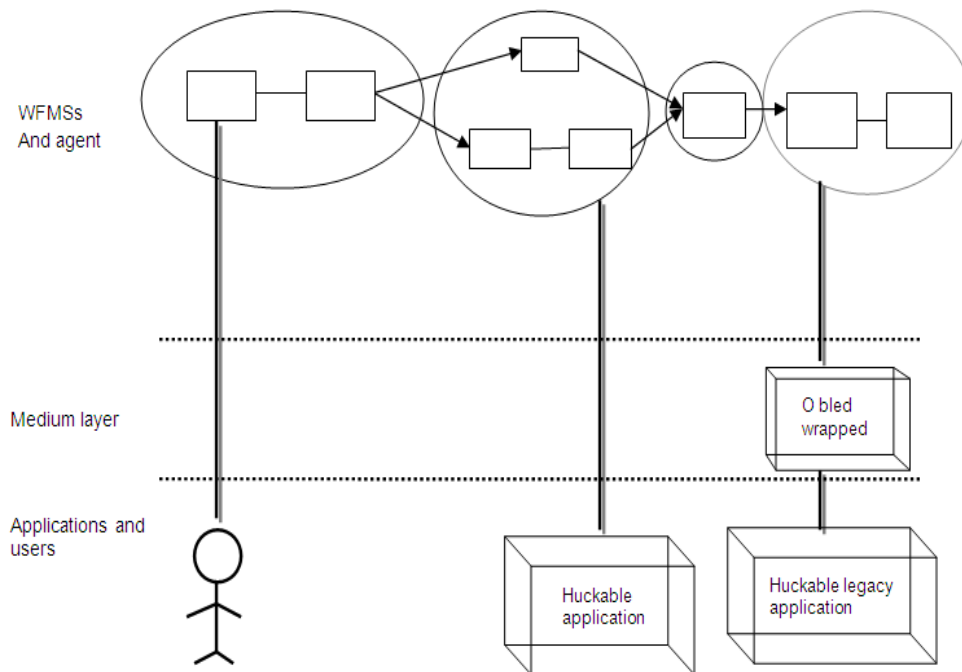
Fig.3: Agent based workflow system [13]

Intelligent agent based frameworks are developed in last decade which can manage complex tasks and execute the same in dynamic and uncertain events. Continuous Planning & Execution Framework (CPEF) [13] and Smart Workflow for ISR Management (SWIM) are two agent based frameworks commonly used with workflow systems.

6.1 WARP Architecture
E-commerce in recent years adds a new dimension to workflow systems as every business organisation use this medium to increase their profit. Business transactions occurring over the internet commonly known as e-transactions follows workflow system both in distribution and manufacturing process. For this workflow systems must have modular components with less interdependency and more coordination, as components may be placed on same or different server. Workflow system requires method to designate policy information and architecture to involve the required components to handle e-transaction. Workflow Activity Recognition and Proactive Assistance System is developed for handling distributive nature of online workflow systems.[14] Workflow systems based on WARP architecture works in two phases:- In phase-I interaction between user and workflow manager agents occur during the design of workflow schema; In phase-II multiple work flow agents coordinate to manage different components of online workflow system.

7. CONCLUSION
AI community working rigorously to develop intelligent systems and tools for work flow management with cooperation of people associated with workflow management. WARP architecture discussed above is one of the many tools developed for workflow system. AI techniques can be very useful for developing efficient, reliable and adaptive workflow systems. Workflow systems cover a wide domain of business organisations having different issues and priorities with different working models, so no one framework or approach resolves all those issues. AI techniques are very useful for resolving issues in WFM and more areas of linkage between two should be identified. AI techniques should be used for load balancing, better reach or work delivery across geographically separated sites, quality assurance, flexibility etc.

8. REFERENCES
[1] Davenport, T. and Short, J. The New Industrial Engineering; Information Technology and Business Process Redesign. Sloan Management Review, pp 11-27, 1990.

[2] M. Hammer and J. Champy. Reengineering the Corporation. Harper Business Press, New York, 1993.

[3] Winston P. H., Artificial Intelligence, 3rd (repr. with corrections, 1993) ed. Reading, Mass.: Addison – Wesley, ISBN: 0-201-53377-4, 1993.

[4] Bishnoi A. and Kumar H. (2012), A Novel Designing Methodologies for Artificial Intelligent Agents, In proceedings of International Conference on Resurging India Myths and Realities, pp. 45-48, TMU Moradabad, INDIA.

[5] Krasimira Stoilova ,Todor Stoilov, Comparison of workflow software products, International Conference on Computer Systems and Technologies - CompSysTech'2006

[6] Joseph P. Bigus& Jennifer Bigus, Constructing Intelligent Agents using java, 2nd edition, wiley

[7] Luger & Stubblefield 2004, Nilsson 1998, Intelligent Traits

[8] Yuhong Yan, Zakaria Maamar, Weiming Shen (July 2001), Integration of Workflow and Agent Technology for Business Process Management, Proc. 6th , Int. Conf. on CSCW, London, Ontario, Canada

[9] Nick M. M., Building and Running Long-Lived Experience-Based Systems, PhD thesis, Dept. of Computer Science, University of Kaiserslautern, Kaiserslautern, 2004.

[10] Russel and Norvig, Dartmouth Conference, 2003, pp. 17.

[11] Pamela McCorduck, Rough shattering of AI fields, 2004, pp. 424

[12] Myers, K. L. 1998. Towards a framework for continuous planning and execution. In proceedings of the AAAI 1998, fall symposium on distributed continual planning. Mento Park, CA: AAAI Press.

[13] Thomas, S. R. (1993). PLACA, an Agent Oriented Programming Language. PhD thesis, Computer Science Department, Stanford University, Stanford, CA 94305. (Available as technical report STAN-CS-93-1487).

[14] Blake, M. B. (May 2001), WARP: Workflow Automation through Agent based Reflective process, Proc. 5th , Int. Conf. on Autonomous Agents, Montreal, Canada.

[15] Bishnoi A. & Kumar H. (NOV 2015), "Using Artificial Intelligence Techniques in Workflow Systems", Proc., SMART IV, International Conference, CCSIT, Moradabad, India