



## Workflow Based e-Governance Applications: Case Study of Wf-Bhulekh

Susanta Kumar Mohapatra<sup>1\*</sup>, Dipak Kumar Das<sup>2</sup>, Bibekananda Das<sup>2</sup>,  
Jagannath Prasad Bakshi<sup>1</sup> and Sushant Kumar Panda<sup>1</sup>

### ABSTRACT

*Today's e-Governance must deal with rising citizen aspiration, reduce the cost of governance, and rapidly develop new services as required. To address these requirements governments must constantly reconsider and optimize the way they implement governance and change their information systems and applications to support evolving needs. Workflow technology could facilitate these by providing methodologies and software to support (i) business process modeling to capture business processes as workflow specifications, (ii) business process reengineering to optimize specified processes, and (iii) workflow automation to generate workflow implementations from workflow specifications. But till now, workflow based development and management has not entered the arena of e-Governance in a significant way. This has, in turn, limited the impact of government process re-engineering, as there is no scope for process monitoring and analysis for continuous quality improvement. Moreover, the non-workflow based approaches are found to be lacking in facilitating the desired level of flexibility which is vital in the context of a dynamic and evolving e-Governance scenario. This paper studies the suitability of usage of workflow based methodologies in the emerging e-Governance paradigm and illustrates the case study of Wf-Bhulekh, which is a workflow based application for land records management in Orissa.*

**Keywords:** BPR, Workflow, WfMS, Land Records Computerization, Data Modeling, Work Flow Management, Workflow Engines, OpenWFE, Total Quality Management

### 1. Introduction

One of the pain areas in the emerging e-Governance scenario of India, is the reformation of the Government which is supposed to be the pre-condition for successful e-Governance. Reformation has also arisen in response to pressure from citizens and other stakeholders towards among other things, (i) improved service quality, (ii) higher internal efficiency, and (iii) leveraging of opportunities (Ojo). The degree of reform required is expected to be radical involving both governance structures and processes. Towards ushering in structural reform, NeGP formulated by Govt. of India has provided the initial impetus and has put thrust on decentralization involving full ownership, accountability and responsibility. A Program Management Structure consisting of Cabinet, Central Apex Committee, Program Secretariat (DIT), Project Owners (Central Ministries & State Govts) etc. has been formulated. E-Governance structure

---

<sup>1</sup> National Informatics Centre, Orissa State Unit, Bhubaneswar, Orissa, India

\* *Corresponding Author:* (Email: skm@ori.nic.in, Telephone: +91-674-2501339)

<sup>2</sup> National Informatics Centre, Board of Revenue, Cuttack, Orissa, India

and institutional framework for the state level has also been worked out. Its implementation and further extension is currently under progress.

Government process reform/ re-engineering, though has been sufficiently acknowledged by e-Governance champions, is yet to make any noteworthy progress. The imperative for process re-engineering has arisen due to the fact that, (i) investments on the computerization and automation of business processes of governments in the past have yielded little benefits, (ii) the quality of internal and external services by a government agency depends on the quality of its governance processes, (iii) increasingly, governments are unable to meet the expectations of the stakeholders, and (iv) there is increasing realization that a fundamental rethinking of the government business process is required (Ojo). Business Process Reengineering (BPR) is a term now firmly established in the management vocabulary due to the contribution by Hammer & Champy. It refers to the attempts to achieve order of magnitude improvements in organization performance by redesigning the processes by which an organization delivers its products and services to its customers. The newly designed processes focus on adding value from the customers perspective and are often enabled by information technology. The most salient feature of business process reengineering is the focus on "process", which is held to reflect a paradigmatic change in the way in which organizations are conceived, a decisive movement away from the traditional functional concept, which stresses vertical differentiation and hierarchical control, to a view which emphasizes horizontal integration across functions. This emphasis on processes puts forth the need for consistent methods and techniques for process modeling, i.e., the capture, representation and performance assessment of business processes. Once an organization captures its business in terms of business processes, it can reengineer each process to improve it or adapt it to changing requirements (Georgakopoulos et al, 1995). In the context of Government, an apt definition of process re-engineering has been provided by the national Academy of Public Administration of USA. "Government business process reengineering is a radical improvement approach that critically examines, rethinks, and redesigns mission product and service processes within a political environment. It achieves dramatic mission performance gains from multiple customer and stakeholder perspectives. It is a key part of a process management approach for optimal performance that continually evaluates, adjusts or removes processes."

Workflow is a concept closely related to reengineering and automating business and information processes in an organization. A workflow may describe business process tasks at a conceptual level necessary for understanding, evaluating, and redesigning the business process (Georgakopoulos et al, 1995). The biggest change brought about by BPR is the orientation toward processes. Workflow, by its very nature, is process oriented. This makes workflow in general an excellent candidate for implementing the results of BPR.

## **2. Relevance of Workflow based Approach for e-Governance Applications**

### **2.1 Study done on the Existing Approaches**

E-Governance is said to be pill of all ills of Governance. However many e-Governance projects are not succeeding or are facing bottlenecks. A number of studies have been done to highlight the critical factors responsible for success in e-Governance.

- (i) As per a study done by Sachdeva, reforming the Government based on process re-engineering happens to be one of the important factors. Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in performance -cost, quality, service, and speed. E-Governance is distinct from computerization as automation by itself will not eliminate all sources of errors, avoidable costs delays. It may even add its share of errors and costs. Therefore process re-engineering must precede the computerization (Sachdeva).

- (ii) The National Knowledge Commission of India was entrusted the task of reviewing the various e-Governance projects undertaken at the central and state levels. As per this review, it was observed that e-governance is more about an opportunity for administrative reforms than merely about electronics and information technology and infrastructure. The major recommendations are summarized in Table 1.

**Table 1:** Recommendation given by National Knowledge Commission

SN	Recommendation	Explanation
1	Government process reengineering before any computerization	At present the e-Governance efforts are primarily based on computerizing age-old processes and compounded by a plethora of new layers and silos by Indian bureaucracy, each working within departmental boundaries and pet-priorities. As a result we are computerizing cumbersome processes and hence not commensurately benefiting from it. Simply digitizing the existing government processes merely adds an additional layer of expense, complexity, delay and confusion. This redesigning of government processes will drastically reduce the numbers and duration of successive steps required to obtain services. It will also provide traceable records; enable enforcement of individual performance, accountability, efficiency, productivity as well as transparency of policies and processes.
2	10 to 20 Important Processes and Services	To make an immediate impact on citizens it is critical to identify and simplify important processes and services, say 10 to 20 to begin with, which are currently cumbersome, bureaucratic and prone to unnecessary delays and even corruption
3	Common Standards	At present various state governments are doing their own thing to selectively computerize their processes and provide e-governance. Many of these programmes are vendor driven and not scalable. It is critical to develop and enforce citizen/business entitlement standards uniformly over all states and central ministries
4	Best Practices and Lessons from the Past	A great deal of work has already been done in various central ministries and in state governments. The key is to learn from these and design best practices that are affordable and applicable nationwide to ensure ease of use and interoperability
5	National Infrastructure	It is important to provide nationwide secure broadband infrastructure and associated hardware, software and hosting facilities with easy access at all levels.
6	Web-based Services	To enforce standards and to keep the governance uniformly responsive and transparent, it is recommended that state governments use templates created by the central government to offer localised data and services in Indian languages. In this model, the private sector can invest in creation of access infrastructure and building relevant business models for user-fee collection and its sharing across all stakeholders, to ensure sustainability and adaptation for future needs. This also implies that all public institutions will make sure that all public data is available on the web.
7	Open Source Software	Because of the enormous size and scope of the e-Governance effort in India and because of the availability of globally recognized software talent of Indians, we must actively encourage wherever possible open source software implementations and open standards.
8	Specialist CITO (chief information technology officer)	Each state and major central government departments must create an empowered chief information technology officer, with relevant expertise and skills in the domain subject and IT usage.
9	New National Programmes	As government plans to spend hundreds of thousands of crores on Bharat Nirman, rural employment guarantee scheme, urban development initiatives etc., it is recommended that we mandate that each of these programmes begin with well engineered e-governance implementation and web-interface that ensures speedy delivery, productivity and efficiency
10	Focused Organization	For national e-governance to succeed it is critical to create an appropriate central organization with structures that can operate in mission mode, with full autonomy and accountability.

(iii) In a related work (Mahapatra & Perumal, 2006), a detailed study and analysis of some of the successful Indian e-government projects was done along with their strengths and weaknesses. They proposed a strategic framework listing the following factors which they felt would meet the objectives of an e-government project:

- Need analysis and expectation management
- Process and workflow definition
- Process and workflow streamlining
- Appropriate delivery mechanism (dependent on smooth workflow)
- Appropriate facility for citizen access.
- Scaling up provisions (Technical upgrading, Public-private partnership for long term ownership and financial viability, Geographical spread, and Functional spread)

From the above studies, it is very much evident that the reform of Government processes do play a key role towards ensuring the success of e-Governance initiatives, thus warranting further exploratory studies on the ways and means for its satisfactory execution.

## 2.2 Workflow based Approach

Workflow Management (WFM) is the technology that supports re-organization of business processes and information processes, including three major aspects: (i) Process modeling, (ii) Business process reengineering, and (iii) Workflow, implementation and automation. From a conceptual perspective, the purpose of a workflow management system is the coordination of all entities involved in the execution of a (business or software) process. Coordination can be defined as the management of dependencies between activities, and workflow management systems address two kinds of coordination problems: Data dependencies between activities (i.e.: one activity relies on the results of one or more other activities), which are managed through control and data flows, and shared resources (i.e.: one resource such as a workflow participant can only perform one task at a time), which are managed through scheduling and staff resolution mechanisms. Through the automation of these coordination functions, workflow management systems support several efficiency goals of the enterprise.

**Table 2:** Efficiency goals and workflow support

Efficiency Goal	Description	WFMS Support
Process efficiency	Optimization of process criteria such as processing time (to be minimized) or faithfulness to deadlines (to be maximized)	Coordination of activities through control flow, deadlines etc.
Resource efficiency	Efficient use of the resources (human resources as well as application systems) available for the execution of processes.	Staff resolution and reminder in case of escalations.
Market efficiency	The proper positioning of the enterprise in its relation to market partners. This includes a reliable prediction of delivery times, transparent communication with suppliers and customers and optimized procurement and distribution processes.	Well defined process interfaces for web services (defined external behavior), predictable internal behavior through standardized processes.
Delegation efficiency	Adequate use of the competencies of superior (greater scope of vision along the process) and subordinate (detailed knowledge about single activities) organizational units.	Coordination of staff assignment, role concepts
Motivation efficiency	Motivation of staff to act in a way congruent to the business goals of the enterprise.	Guidance to perform activities along a workflow model, monitoring of progress and explanation of previous activities

A classification scheme for workflow applications based on specific attributes relating to their implementation is given by Table 3.

**Table 3:** Classification of Workflow Attributes

Attribute	Possible Values		
Participants	Humans	Machines (Hardware)	Software
Process Structure	Ad-hoc process and activities	Pre-defined activities, Ad-hoc process	Pre-defined process
Process Scope	Between Organizations	Within an organization	Within an application
Data Granularity	Documents, Objects	Attributes	
Application Granularity	Process level (e.g Web services)	Application level (e.g Programs)	Function level (e.g method calls)

Using the participant attribute, we can distinguish three major process types, which can be supported through workflow technology, (i) Organizational processes are business processes with a high degree of human involvement. They typically occur in office environments and consist of a number of human participants working autonomously on activities using applications that may or may not be invoked by the workflow system. The overall process structure is typically coarse and well defined (if the process is well understood, the separation of activities may lead to a finer granularity). A typical workflow application within this category is the routing of document images along a workflow model, (ii) Software processes are automated processes within application systems. Within this category, workflow systems are used to “glue” disparate application system components together and to automate the exchange of data between software components, in case they don’t share the same database. Often, the human element in software processes is restricted to the initiation of the process and the presentation of the results, and (iii) Hybrid processes combine the characteristics of organizational and software processes. In this case, the workflow system can work as an intermediary between the human participants and a (functionally oriented) application system, guiding the work of participants within single activities.

**Table 4:** Characteristics of Workflow Applications for three Process Types

	Organizational process	Hybrid process	Software process
<b>Participant Autonomy</b>	High (Independent of WfMS)	Medium	Low (controlled by WfMS)
<b>Activity Assignment</b>	Pull type	Pull-push type	Push type
<b>Data Management</b>	Managed by application	Managed by application & WfMS	Managed by WfMS
<b>Application granularity</b>	Coarse	Medium	Fine

The Workflow Management Coalition exists to increase the value of a user’s investment in workflow technology, decrease the risk of using workflow products, and expand the workflow market by increasing awareness. The workflow standards exist at three levels. The *Reference Model* is the big picture of how the standards fit together. The *Abstract Specifications* identify each of the functions required and what data is involved. The *Bindings* are the details of how the specification is implemented with a particular set of tools, formats, and protocols.

*The workflow reference model has identified five interfaces to the workflow engine:*

- **Process definition.** The procedures that are followed in implementing the workflow, and the resources (people, systems, groups) that perform the work. Sometimes the workflow is defined in separate modeling and simulation tools, and then the workflow is loaded into the engine through Interface 1. This also allows the workflow to be moved from one system to another.

- Client interfaces—the way an application program invokes workflow, such as a request to get the next piece of work, or to complete the existing work.
- Invoked applications—programs that may be invoked by the workflow system (as contrasted to programs that invoke the workflow) The Workflow Application Programming Interface, WAPI, combines the WfMC interface 2, where applications invoke workflow, and WfMC interface 3, where workflow invokes applications. This includes interfaces to and between legacy data systems—EAI or Enterprise Application Integration. It also often includes image systems, document management systems, and mail systems.
- External workflow services—the interoperability between independent workflow systems, whether from one or several vendors, within a single company, or between multiple companies. The WfMC interface 4 initially used a MIME binding—defined the interface for use with e-mail tools and technology. As XML emerged, the Wf/XML binding was created using XML technology.
- Administration and monitoring involves both the history of each case and the monitoring of the total work performed.

### 2.3 Justification of Adopting Workflow based Approach

The need for government process reform and business process re-engineering has been very emphatically pointed by some of the other studies as already established in this paper. The objective of re-engineering methodologies is to optimize business processes. Process optimization strategies depend on the reengineering objectives (e.g., increasing customer satisfaction, reducing the cost of doing business, introducing new products or services). Workflow specification provides a high-level description of a process that facilitates high level reasoning about business process efficiency. Moreover, process re-engineering usually denotes a major one time exercise, where as governance is dynamic and continually evolving. This calls for a need to handle the continuous change & improvement of government processes through a quality exercise called Total Quality Management (TQM). Continuous improvement activities are aimed at improving the efficiency of *existing* products or processes. Such activities typically follow the PDSA (Plan–Do–Study–Act) approach as given by Deming or the Define – Measure – Analyze – Improve and Control (DMAIC) approach of Six Sigma.

**Table 5:** Comparison between BPR and TQM

Business Process Reengineering (BPR)	Total Quality Management (TQM)
BPR, prescribes a radical change that redefines the processes from a fresh perspective. This must be motivated and supported from top	TQM, deals with the details of the process, requiring a intimate knowledge of the process, and is for that reason motivated from bottom up
Proposes dramatic change	Gradual change
Change due to information revolution	Any kind of change
Synonym: Process Innovation	Synonym: Process Improvement

The necessity for both kinds of change is outlined best by Thomas Davenport, who defines two terms: process innovation for major shifts, and process improvement for minor shifts. Process improvement and process innovation go hand in hand (Davenport, 1993). W. Edwards Deming's "Theory of Knowledge" (Latzco & Saunders) stated that management of a system should focus on managing the present and the future. Thus, it is felt that any appropriate strategy for e-Governance systems must address both these needs. Workflow approach successfully integrates the cross-functional requirements of BPR followed by TQM which is very much needed for e-Governance applications. Without workflow, organizations are occupied tracking the status of work efforts that have taken place. In other words they "*still manage based on the results of the last periods work. Little or no attempt is made to actively manage tomorrow (Bath).*" Workflow technology assists management of both today's as well as tomorrow's business processes.

### 3. Wf-Bhulekh: A Workflow based e-Governance initiative for Land Records Management

Computerisation of the land records happens to be one of the mission mode project under the NeGP. With the 100% central assistance provided by Ministry of Rural Development, Govt. of India, under the “Computerisation of Land Records (CLR)” scheme, an application software titled “Bhulekh” has already been developed and in use in almost all the tehsils (171 Nos) of Orissa. This application uses the traditional client-server architecture. Subsequently, considering certain problems such as lack of flexibility, maintainability, logistical problems, dependence on proprietary technology, need to handle geographic variance in procedures arising out of non-standardization, inadequate data security, difficulty in process fine-tuning and evolution and also, taking into account the recommendation of key issues for e-Governance applications by some studies, it has been decided to go for a fully web-enabled application with due importance on process reengineering and adoption of a workflow management approach considering not only the needs of the present, but also of the future. Wf-Bhulekh (Workflow based Bhulekh) is an attempt in this regard. It was decided to develop this project primarily on open source technology. Due to the lack of inadequate literature, it was decided to first make a study of the existing technology options and tools in this area, and select the appropriate technologies for Wf-Bhulekh before proceeding with the actual implementation.

#### Selection of Suitable Framework

Frameworks are abstract, customizable and extensible systems, which entail a specific scope. They can be separated by their operative range (eg. Application or Class Frameworks) and provide a large set of reusable code. Developers can save a huge amount of time by using this code set. It provides a code base (e.g. for a GUI) and is customizable.

**Table 6:** Workflow Engine Selection

SN	Engine Name	C1	C2	C3	C4	C5	C6	C7	Selection
1	ActiveBPEL	High	Very Stable (2.0)	Medium	Medium	Very Good	Yes	Yes (Tomcat)	Yes
2	AgilaBPEL	Low	Beta	Medium	Easy	Poor	Yes	Yes (Tomcat)	No
3	Freeflu	Medium	Beta (0.9)	Medium	Medium	Poor	Yes	Yes (Tomcat)	No
4	jBPM	High	Very Stable (3.0.5)	?	?	Very Good	?	Yes (Tomcat)	Yes
5	Open Symphony OS Work Flow	High	Very Stable (2.8)	Medium	Medium	Good	Yes	Yes (Tomcat)	Yes
6	OpenWFE	High	Stable (1.6.1)	Easy	Easy	Good	Yes	Yes	Yes
7	PXE	Low	Stable (1.0)	Medium to difficult	Medium	Poor	?	Yes (Tomcat)	No
8	XFlow	Low	Stable (1.2.1)	?	Difficult	Poor	Yes	Yes (JBoss)	No

C1: Activity. Is the project community active? Scale: Low, Medium, And High. Where high is preferable.

C2: Stable release. Does the project have a stable software release? Scale: Beta (not stable), Stable, Very stable. Where Very stable is preferable.

C3: Learning curve. Is the engine easy to learn and use? Scale: Easy, Medium, and Difficult. Where Easy is preferable.

C4: Coding. Is coding made simple? Scale: Easy, Medium, and Difficult. Where Easy is preferable.

C5: Documentation. Is the engine well documented? Scale: Poorly Documented, well Documented, very well Documented. Where Very well documented is preferable.

- C6. Web Services. Does the engine support Web Services standards “right out the box”? Scale: Yes. No. Where Yes is preferable.
- C7. Servlet Container. Does the engine support Servlet Container such a TomCat for deployment? Scale: Yes, No. Where yes is preferable.

Based on this this study (Murtagh & Conteras), and considering the other critical needs of Wf-Bhulekh, OpenWFE has been finally selected. OpenWFE is not only a workflow engine, but also a Business Process Management Suite. OpenWFE include: (i) Engine, (ii) Worklist, a store for work items, (iii) Webclient, a web application server, (iv) Droflo, which implement web-based flow designer, and (v) APRE component, which implements automated agents into the work flows.

### 3.3 Wf-Bhulekh System

The Wf-Bhulekh system is to be implemented as an online portal on INTERNET with high end and scalable web server, application server and database server on a Storage Area Network (SAN). The major services to be provided are; (i) Issue of Certified Copy of Khatiyon, (ii) Mutation, (iii) Issue of Miscellaneous Certificates, (iv) Query, (v) Statutory Reports, (vi) Analysis, and (vii) Administration.

All the 171 tehsils, 58 sub-divisions, 30 districts and a number of sites at the state level would connect to this portal for accessing the above mentioned services.

### 3.4 Implementation Status

The implementation of Wf-Bhulekh is in progress under the technical guidance of National Informatics Centre, Orissa State Unit. A listing of the tasks currently being done are; (i) Process definitions, (ii) Worklist stores and their ‘GetStrategies’, (iii) Worklist user management consisting of specification of roles, participants and users; user management web interface, SqlPasswdCodec, (iv) Design of Relational Database, and (v) Dispatchers and listeners.

### 3.5 Anticipated Challenges & Strategies

The Wf-Bhulekh project implementation team anticipates a large number of challenges down the implementation path. The challenges and the planned strategies are given as follows:

**Table 7: Challenges and the planned strategies**

SN	Challenge	Strategies
1	Technical Complexity	Consider using an integrator with a strong background in complex systems integration, workflow and egovernance; consider collaborating with consulting partners including IIT
2	Selection of Appropriate Technology & Tools	Undertake a thorough literature and market survey; Critically scrutinize the features, compatibility issues and future support; Prefer open source vendor-neutral options
3	Standardization and Best Practices	Consider the various international standards on workflow and related areas from day one; Explore the international arena for best practices, also consider Govt of Andhra Pradesh IT Architecture document (GoAP)
4	Lack of Skills in IT Architecture & System Integration	Train internal staff by using external consultants as mentors
5	Lack of Skills in Workflow Tools	Participate in training programs from workflow vendors; consider bringing a workflow expert to assist in the workflow implementation
6	Demanding Time Frames	Undertake qualitative project management; Proactively manage the problems; Use highly skilled and productive workforce
7	User Resistance	Have a senior administrator as project champion; Follow established change management practices

#### 4. Concluding Remarks

Today, governments must face the ever rising citizen aspiration, simplify procedures, reduce cost, develop new and improved services in a rapid way. They must continuously reconsider, optimize administration, renovate information system and improve governance process. In this scenario, it is widely acknowledged to undertake process re-engineering & continuous quality improvement through adoption of suitable and cost-effective workflow based solutions. Ideally, e-Governance application development should follow a full-scale government process reform or re-engineering. But, mostly it is seen to be a very difficult exercise as there is a tremendous resistance to any drastic change as normally happens in any re-engineering exercise. In today's world, application development should not stop because re-engineering has not been done or only partial re-engineering is possible. At the same time, the developed application and the used framework should also not be found wanting to undertake any gradual or drastic changes whenever it is possible to be undertaken. A workflow based framework is precisely suited to cater to this peculiar need. But, any new, developing and not yet stabilized technology has its own set of problems and uncertainties. Thus due caution and a measured step-by-step approach is called for in such cases. Pilot projects provide a lot of guidance through their experiences and lessons. It is hoped that the work presented herein will raise awareness and highlight the critical issues that are of paramount importance for success in workflow based e-Governance applications. It is also expected that this will stimulate good researchers to take up the banner of doing needed research in this fast growing area.

#### References

1. Sachdeva, S, National Institute of Smart Governance, "Twenty Five Steps to Successful e-Governance"
2. Knowledge Commission, Govt. of India, "*National Knowledge Commission Recommendations On E-Governance*"
3. Keith D Swenson, in Fujitsu Open Systems Solutions, Inc. 3055 Orchard Dr., San Jose, CA, 95134 Workflow Technology: Tradeoffs for Business Process Reengineering
4. Thomas H Davenport (1993), *Process Innovation: Re-engineering Work through Information Technology*. Harvard Business School Press, Boston, 1993
5. Jin Chen, Dan He, Wang Anquan College of Management, Zhejiang University, Hangzhou, 3 10027, P.R. China, *e-Commerce and Innovation Business Process Reengineering*
6. Dimitrios Georgakopoulos, Mark Hornick & Amit Sheth (1995), An Overview of Workflow Management: From Process Modeling to Workflow Automation Infrastructure, *Distributed and Parallel Databases*, 3, 119-153 (1995) ©Kluwer Academic Publishers, Boston. Manufactured in The Netherlands.
7. Raghunath Mahapatra & Sinnakrishnan Perumal (2006), E-Governance in India – A Strategic Framework, Measuring e-Business for Development, *International Journal for Infonomics*, January, 2006.
8. Ravi Kant, The Essential 'e' in e-Governance, *The Network Magazine*, August, 2005.
9. Adegboyega Ojo, "Engineering Structures and Processes for e-Governance", *The UN University*, International Institute for Software Technology (UNU-IIST), Macao.
10. Yu, E.S.K. Models for Supporting the Redesign of Organizational Work, Proceedings of the *Conference on Organizational Computing Systems, COOCS '95*, August 13–16, 1995, Milpitas, California, USA, ACM Press, pp. 225–236.
11. Hammer, M. and Champy, J. *Reengineering the Corporation: A Manifesto for Business Revolution*. HarperBusiness, New York, 1993.
12. Book: Davenport, T.H. (1993) *Process Innovation: Reengineering Work through Information Technology*. Boston, MA: Harvard Business School Press.
13. Article: Georgakopoulos, D., Hornick, M. & Sheth, A. (1995) An overview of workflow management: from process modelling to workflow automation infrastructure. *Distributed and Parallel Database*. 3 119–153.
14. Article: Hammer, M. Re-engineering work: don't automate, obliterate. *Harvard Business Review*. (July-August 1990), pp. 104–112.
15. Article: Yu, E. & Mylopoulos, J. (1996) Using goals, rules and methods to support reasoning in business process reengineering. *International Journal of Intelligent Systems in Accounting, Finance and Management*. 5(1).
16. Article: Keith Swenson Chief Architect, Groupware Fujitsu OSSII, The Difference Between Workflow and BPR

17. Book: Latzko & Saunders, Four Days with Dr Deming, Addison Wesley Publishing 1995
18. Article: Harry Bath: The Meta Modeller and Simulator as a Predictive Management Tool, November 2002.
19. Article: Fionn Murtagh, Pedro Contreras, "Web Services Orchestration", Department of Computer Science, Royal Holloway, University of London
20. URL: GoAP, "IT Architecture", Government of Andhra Pradesh, Web Site: [www.e sevaonline.com/htmlpages/downloads/it-architecture.pdf](http://www.e sevaonline.com/htmlpages/downloads/it-architecture.pdf) accessed February, 2007.
21. Article: Swenson, K.D. and Irwin, K., Workflow Technology: Tradeoffs for Business Process Reengineering. in *Proceedings of the Conference*
22. Article: Thomas H Davenport, James E Short, "The New Industrial Engineering: Information Technology and Business Process Redesign", Sloan Management Review, Summer 1990.
23. Book: Hammer, M. *Beyond Reengineering. How the Process-Centered Organization is Changing our Work and our Lives*. HarperBusiness, New York, 1996.
24. Article: Scofield, M. (January/February 1996) Enterprise Models, Anticipating Complexity. *Enterprise Engineering*.

### **About the Authors**

*Susanta Kumar Mohapatra* has done his B.Tech in Mechanical Engineering from I.I.T, Kharagpur in 1985 and M.Tech in Computer & Information Sciences from Hyderabad Central University in 1987. Since 1988 he has been working at National Informatics Centre, Orissa State Unit at Bhubaneswar. He is currently working as a Technical Director and is in charge of a number of initiatives such as the Land records computerisation project and the e\_governance initiatives such as e-Sahayata and Janavani in Orissa. He may be contacted [skm@ori.nic.in](mailto:skm@ori.nic.in) and his phone No is 91-674-2501339

*Dipak Das* has done his MCA from National Institute of Technology, Rourkela in 1990. Since 1992 he has been working in National Informatics Centre, Dept of IT, Govt of India. He worked at Rajasthan State Unit till 1997 and after that he has been working at Orissa State Unit. He has been key person in projects like Treasury Computerisation, Land Records Computerisation etc. He is currently working as Principal Systems Analyst. He may be contacted [dipak.das@nic.in](mailto:dipak.das@nic.in) and his phone No is 91-671-2607266.

*Bibekananda Das* has done his M.Sc (Statistics) from Sambalpur University in 1983, M.Phil(Statistics) from Sambalpur University in 1985 and PG Diploma in EDP & Computer Mangement from Bharatiya Vidya Bhavan in 1986. Since 1988 he has been working at National Informatics Centre, Orissa State Unit at Bhubaneswar. He is currently working as Principal Systems Analyst and is posted at NIC-LRC Division, Cuttack. He is actively involved in the study, design, development and implementation of Land Records Computerisation Project. He may be contacted [bibek@ori.nic.in](mailto:bibek@ori.nic.in) and his phone No is 91-671-2607266.

*Jagannath Prasad Bakshi* has done his Msc in Physics from Utkal University and subsequently done MBA from the same University. Joined NIC in 1997 and since 2001 he has been working at National Informatics Centre, Orissa State Unit at Bhubaneswar. He is currently working as a System Analyst and is involved in projects such as the Land records computerisation project and the e\_Governance initiatives such as e-Sahayata and Janavani in Orissa.

*Susant Kumar Panda* has done his B.Tech in Mechanical Engineering from N.I.T, Calicut in 1982 and M.Tech in Industrial Management from IIT Kharagpur in 1987. Since 1990 he has been working at National Informatics Centre, Orissa State Unit at Bhubaneswar. He is currently working as a Senior Technical Director & Head of Orissa State Unit. He is in charge of all the activities being done by NIC in the state of Orissa.