



## BUSINESS PROCESS MODELING FOR WEB AND SEMANTIC WEB

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**Abstract-** BPM is one of the key technologies to benefit enterprise with higher efficiency and greater business values. Business process modelling is a discipline combining software Compatibilities and business expertise to enable process improvement and facilitate business innovation. BPM is generally a starting of business process management life cycle. Business Process Modeling (BPM) is widely acknowledged as the specific technology to analyze and control workflow with flexibility and convenience. To develop business processes for different application there are different technologies. In this paper we are going to describe the different technologies and organizations which provide these technologies, and will focus on modeling of web application and semantic web application as well we are focusing on flow and codes of these using RDF & OWL considering different examples. As semantic web concepts plays very important role in industry now a days and in future.

**Keywords-** BPM,CBPM, Modeling, web technology, semantic web, RDF,OWL

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### Introduction

Before conceptualization of emerging techniques of BPM, there were techniques to model business process such as the flow chart, functional flow block diagram, control flow diagram, Gantt chart, PERT diagram, and IDEF have emerged since the beginning of the 20th century. The term "business process modelling" itself was coined in the 1960s in the field of systems engineering by S. Williams in his 1967 article "Business Process Modelling Improves Administrative Control". His idea was that techniques for obtaining a better understanding of physical control systems could be used in a similar way for business processes.

Since last few years, enterprise have been undergoing through a transformation in reaction to challenges like globalization, unstable demand and mass customization so the target of BPM is to get abstract representation of business process. The representation can be graphical diagram or can be exported to text format[2]. Business process can be defined as "a set of logically related tasks performed to achieve a define business outcome, a process

is a structural measured set of amenities designed to produce a specified output for a particular cost or a purpose"[1].

Currently enterprises are focusing in setting up a business to business collaboration relationship with their partners in order to be competitive, so here enterprise required a collaboration between heterogeneous and homogeneous or autonomous partner involve in supply chain or a collaborative worldwide, and one of the most challenges in this regards is definition of collaborative business process. Through the execution of collaborative process, enterprise undertakes to jointly carry out decisions to achieve common goal. Coordinate their actions and exchange information. So in order to achieve proper collaboration and to get proper outcome of business process at individual level also, the service orientation is applied to business modeling[1] Business process and activities are related as components providing services to and consuming services from other business components.

For building up collaboration between enterprises, there is need of methodology supporting the composition, design and implementa-

tion of cross organization. Such methods consist of different modeling languages and its conventions.

But these methodologies can often applied with some changes according to different participants to inform BPM and it depend on the size and goal of the project involved organization, their former development process or methodology, its complexity and mainly its need of integration or at individual level[3].

In this work we discuss a categorization framework for classification of modeling language and different approaches used to model collaborative business process. Here the frame work will facilitate and improve the development and adjust methods for collaborative business process.

This work is organized as follows:

- 1) part2: We include standard organization that provides different BPM Tech. And then focusing on diff BPM approaches.
- 2) In part 3 we will be giving explanation of relation between BPM and Software Engineering and challenges of BPM in software engineering. Then we focus on detail look on categorization framework of modeling languages and approaches in part 4.
- 3) In part 5, we provide detail application of categorization framework and how the classification framework and the classification results can be used for methodology Development.
- 4) In part 6, we will explain how the BP model can be developed if the applications are web or Semantic Web, because the most significant issue facing BPM is the integration of business process in a dynamic environment with an IT system in order to adequately represent business operation and needs, for Example: SCM, Value chain management, Relationship Marketing, outsourcing requirement compliance legist ration etc.
- 5) Part 7, here we have done comparison of different techniques according to the characteristics and then we used this BPM for Semantic Web with Protégé and then we have concluded paper with analysis.

information to suggest the best suited application area for different technology. Then we have designed the

**Business Process Modeling & Standardization  
Business Process Modeling (BPM)**

Business Process Modeling (BPM) is the activity of representing processes of an enterprise, so that the current process may be analyzed and improved. BPM is typically performed by business analysts and managers who are seeking to improve process efficiency and quality.

The process improvements identified by BPM may or may not require Information Technology involvement, although that is a common driver for the need to model a business process, by creating a process master.

Table 2.1- Business Standards

Field of applications	Characteristics of a modeling standard
Value chain analysis	Has a meta model
Organization analysis	Has an exchange format
Business Process Automation Analysis	
Execution language for automated processes	

This gives the brief of BPM's standard organizations and efforts. Substantial progress has been made in business process stand-

ards. However it is clear that the wide range of domain covered by BPM requires more than a single connected standard. This standard should be easily adapted for use, by those involved with business analysis. The application fields and characteristics of business standards can be given as [4]:

Table 1- Emerging technologies in Business Process Modeling with it's standard organizations

Name	Standard Organization	Status	Applications	Notations	Exchange Format
XPDL	WFMC	finalized	Execution language	no	yes
BPML	BPMI	finalized	Execution language	no	yes
BPEL	OASIS	Finalized, new version	Execution language	No	yes
UML 1.0	OMG	finalized	Business process automation analysis	yes	yes
UML 2.0	OMG	Being finalized	Business process automation analysis	yes	yes
BPMN1.0	BPMI	finalized	Business process automation analysis	yes	no
BPMN2.0	BPMI	Planning stage	Organization analysis Value chain analysis	yes	
ISO 9000	ISO	finalized	Organization analysis Value chain analysis	no	no
BPDM	OMG	Planning stage	Organization analysis Value chain analysis	yes	yes

**Software Engineering Process and Bpm  
BPM is not a software engineering**

“A business process is not managed by a software engineer.” Business Process Management (BPM) is the management of IT-supported business operations from a business expert's process view rather than from a technical perspective. Recently, the application of SW technologies to BPM has gained interest in both the academic and corporate sector. The most significant issue facing BPM is the integration of Business Processes in a dynamic environment with an IT system in order to adequately represent business operations and needs[26].

A lot of the confusion and difficulty in the BPM community is because some people think that BPM is a kind of Software Engineering. Indeed, superficially it looks like Software Engineering: you start with requirements, you determine the pieces of information that need to be stored and retrieved from variables, you might have a drawing of the relationships, and in the end you have something that can be installed and executed on networked computers. But there is a difference, and that difference is the entire reason that BPM exists.

“Business Process Management/modeling” is, as the name implies, about management and modeling of business processes. A “business process” is not a program, is the goal of the program. It may be supported by a program, but the business process is the thing that the organization wants done. A business process is managed by a business person: someone who understands the “business” and decides upon a strategy for doing that business, evaluates how well the business is going, and decides on how to

change the process in order to meet changing conditions. The software engineer might manage the software, but a business person manages the business process [23].

**BPM and Software Engineering go hand in hand**

Some business processes require some software engineering support to realize their full potential in making organizations efficient. In fact there is a spectrum:

Pure Software Engineering: the entire process is relatively stable and not dependent upon specifics of the particular team, and can be designed and implemented using standard Software Engineering practices.

BPM by business people, followed by Software Engineering: This is what gets talked about most in the press where a business person draws a “high level” diagram, which is then translated to a diagram used by software engineers to design the “integration” with other systems.

Pure BPM: where a business person draws a diagram, and it is implemented without any need for Software Engineering “Most business processes are implemented today directly by business people without any Software Engineering — by using email.” But clearly there exist business processes which need Software Engineering to be fully automated, but there are just as clearly many business processes which have no need for Software Engineering involvement during automation. So BPM and Software Engineering goes together depend on the type of the business and it’s application but the purpose of both is not the same.

“PMN does not exist for the convenience of Software Engineers, because BPM is not Software Engineering”

**Challenges of BPM in software engineering**

Generally workflow model (which gives process flow) used to design analysis and implementation of ICT system. Since it is rarely sufficient to use only one type of model for developing ICT system. Several models describing one ICT system are used. Those models can differ in the point of view from which they are described the phase of modeling in which they are used, the target group of person dealing with model or level of abstraction and granularity of model.

For different purpose of application and variety of objectives, different modeling languages and approaches are used. And for one specific purpose different modeling language and different notations can also be used.

Another challenge is transparency at the lower level i.e. business experts have less knowledge of the low level syntax of business process modeling languages.

In addition to the different model types various development processes comprising tasks like requirements engineering, analysis, design, implementation and deployment exist. In this context the Model-driven Architecture1 (MDA) of the OMG lends itself as a framework for such development processes. Even when the internal development processes of the organizations, aiming to set up their internal business processes, differ, by applying the MDA as framework for software development it is ensured that modeling and development artifacts of the various organizations can be categorized to similar level of abstraction.

Mainly the challenges faced for the developing BPM for software engineering applications are about the collaboration of two differ-

ent independent organizations which are applying different technologies for their individual modeling processes.

We can explain this case with the example, the example in figure 4.1 shows two enterprises A and B, planning to set up CBPs. Therefore they plan to develop a methodology or adjust an existing methodology. Both enterprises, already having their own methodology for developing business processes, have set up their (internal) business processes supported by ICT systems. Since their development processes are based on the MDA as a framework for software development both enterprises have modeled computational independent, platform independent and platform specific models (CIMs, PIMs and PSMs) for their business processes. Model transformations will be specified by the OMG’s emerging Query/View/Transformations standard (QVT). The CBP methodology will naturally also adhere to the MDA framework and define CIMs, PIMs and PSMs. In order to develop a collaborative business process it is necessary that information about the public or external process interfaces of the participating enterprises is made available to the collaborative business process models. This information will be provided by QVT views. After determining the development process for CBPs, appropriate modeling languages and concepts have to be chosen for the models of the CBP methodology. Since this task is similar for all of the three main model types we will only consider CIMs in more detail: For modeling at computation independent level enterprise A uses the modeling language BPMN while enterprises B uses ARIS. Two significant questions arise [1]:

- Which modeling language or modeling approach shall be chosen for modeling the collaborative business processes at computation independent level?
- Which concepts of the BPMN model (enterprise A) and the ARIS model (enterprise B) have to be provided by the participants to the CIM for collaborative business processes in the form of views?

Fig 4.1 gives such a case for developing BPM

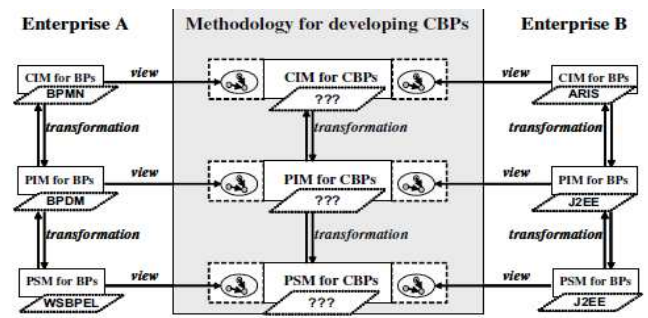


Fig. 3.1- collaborative BPM

So to overcome these challenges, there are some principles to be followed, which are discuss in next chapter. Such information first has to be determined before Appropriate modeling languages, approaches and concepts can be chosen for a CBP methodology. As at platform independent level (enterprise A uses BPDM and enterprise B uses J2EE) as well as at platform specific level (enterprise A uses WSBPEL and enterprise B uses J2EE) similar information has to be gathered, a categorization framework for classifying business process modeling languages and approaches would be an important support for the development and adjust-

ment of CBP methodologies. The next chapter introduces a categorization framework classifying business Process modeling languages and approaches by criteria important for CBP methodologies.

### Categorization Framework

For different organizations the models of ICT system and business process may not be different in vast in what is modeled but can be different in how concepts are modeled, one main challenge while developing methodology is to identify the approximate modeling languages and approaches which can be used for description of different models.

The "How" something is modeled and which modeling concepts are used is determined by modeling language and modeling approaches.

So this part provides a Categorization Framework for modeling languages and approaches in reference to BPM facilitating the comparison and development of methodologies.

### Design of Categorization Framework

Mainly the basis of classification framework is SOA, their business processes and activity is treated as components which provide and consume services to and from other business and in network application conversations are conducted [1].

Modeling languages and approaches are categories by 5 criteria's,

- Level of abstractions
- Modeling of business processes
- Notations
- Standardization
- Tool Support

The first two criteria are core and most importing for developing integrated and adaptable methodology. Firstly they are accordingly level of abstraction for which they are used and which concepts for modeling business process they support. We discuss the different criteria for classification framework.

### Application of The Categorization Framework

In this section the categorization framework is first applied to selected modeling languages and approaches. Second it is described how the results of the classification can be applied to the development of CBP methodologies. The example introduced in chapter 4.2 will be picked up and extended with the new results.

### Classification of Modeling Languages and Approaches In the Framework

The classification of modeling languages and approaches for business process modeling is shown in table 4.2. The columns are divided into the classification criteria of the categorization framework. In the rows we can find the modeling languages and approaches that are classified. In the cells the value(s) of the classification criteria that apply to the modeling language or approach are shown. For the criteria 'Modeling of Business Processes' the process types of the categorization framework which correspond to the concepts of the modeling approach are depicted in brackets.

**ARIS:** ARIS is commonly used for specifying the business view on business processes and therefore for modeling CIMs. ARIS supports a private view on process flow modelled by event-driven process chains. Process modules are used for modeling a public view, while process module chains can be applied for modeling collaborative processes. ARIS provides a graphical notation and large number of enterprises use the ARIS-toolset for modeling their processes with ARIS, though ARIS is not standardized by a standardization organization [17][18].

**BPDM:** BPDM as metamodel specifies concepts for business process modeling at platform independent level. It defines operational, abstract and collaborative processes like in the categorization framework. As a metamodel BPDM does not define a graphical representation of its concepts. Since BPDM is still under submission at the OMG the implementations of BPDM. are still in flux. Tools able to read metamodels like the Eclipse Modeling Framework [9] will enable use of BPDM [19][8].

**BPML:** BPML, as a language for the description of private processes specific to every partner, addresses modeling of abstract and executable processes. It is issued by BPMI.org and its specification Defines XML syntax but no graphical notation. Though some implementations exist, formerly strong supports like SAP decided to support other languages like WSBPEL [5].

**BPMN:** Since the primary goal of BPMN is to provide a notation that is readily understandable by all business users it is used for modeling CIMs BPMN defines concepts corresponding to the private, public and collaboration processes of the categorization framework. Issued by BPMI.org, BPDM also provides a graphical notation[16]. About 20 modeling Tool implementations support BPMN[20].

**ebXML BPSS:** ebXML provides an XMLbased specification addressing collaboration protocol agreements for technology specific infrastructures. Standardized BUN/CEFACT and OASIS it is used at platform specific level. Though the ebXML BPSS specification has also a UML metamodel, it defines only a XML-representation for ebXML BPSS instances. Some of the various tools implementing and supporting the ebXML standard are actually[9].

**WSBPEL:** In WSBPEL executable business processes model actual behavior of a participant in a business interaction. Abstract processes specify the mutually visible message exchange behavior of each of the parties involved in a business protocol. The specification of WSBPEL only defines a notation based on XML but e.g. UML-profiles defining a graphical representation. WSBPEL has been adopted by OASIS and various tool implementing WSBPEL exist.

### Application for Methodology Development

In section 3.2 it was difficult to determine appropriate modeling languages for the models of the CBP methodology. We formulated two questions we would have liked to be answered in order to improve the choices of modeling languages and concepts for the CBP methodology. In this section we take up the example of section 3.2 and show exemplarily how the categorization framework

of chapter 4 and the classification of modeling languages and approaches can help to answer those questions and to developer adjust the CBP methodology.

For the CBP methodology an appropriate modeling language or approach to model CBPs in CIMs is needed. This means for the categorization framework, that the criteria Level of Abstraction must have the value CIM and that an appropriate modeling language or approach needs to provide concepts for collaboration processes. Two modeling languages meet these two criteria in table 1: ARIS and BPMN. Since BPMN is standardized, we chose BPMN for modeling CBPs.

Second the concepts of CIMs, specific to the enterprises A and B and provided by views to the development of the CBP have to be identified. The classification of BPMN and ARIS in the categorization framework shows that in BPMN abstract processes and in ARIS process modules relate to the concept public process and can be provided by views to the development of the CBPs. The views provide a representation of the enterprises public processes, compatible to the representation of public processes of the modeling language or approach used for modeling the CBP. In the case of the CIM process modules of enterprise B's ARIS model would have to be mapped to abstract processes of BPMN representation. Since enterprise a uses the same modeling language as the CBP methodology, providing the view would be an identical mapping of public process representation. (See figure 6.1) Like already mention in chapter 3.2 the proceedings to identify appropriate modeling languages and approaches for PIMs and PSMs, is analogous to the described

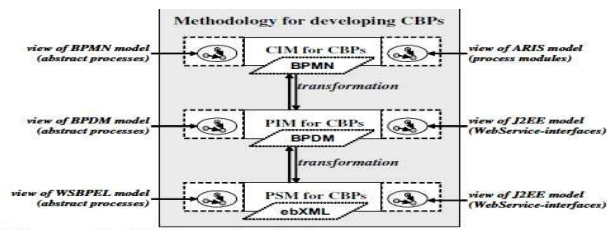


Fig. 6.1- collaborative BPM for above example

**BPM Technologies Forweb and Semantic Web Application**

Web applications have evolved from simple read-only websites to complex data- and operation- intensive systems. The main goal of this kind of application is to provide the users with services that assist them in carrying out activities according to a given set of business rules. The addition of transactions to modern web applications poses new challenges, such as managing the interplay between business process execution and navigation, and improving the user's experience in accessing the services that the web application offers. So here we will try to give the business model for web application.

Semantic web is an effort to enhance current web so that computers can process the information presented on WWW, interpret and connect it, to help humans to find required knowledge. In the same way as WWW is a huge distributed hypertext system, semantic web is intended to form a huge distributed knowledge based system. The focus of semantic web is to share data instead of documents. In other words, it is a project that should provide a common framework that allows data to be shared and reused across application, enterprise, and community boundaries.

**Architecture of Semantic web**

Before going directly to business process for semantic web let's have look at the architecture of semantic web application. The architecture of semantic web is illustrated in the figure below in fig 7.1

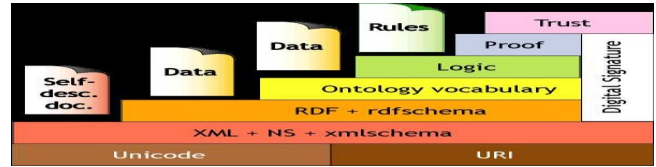


Fig. 7.1- Architecture of Semantic

**What is Ontology and RDF?**

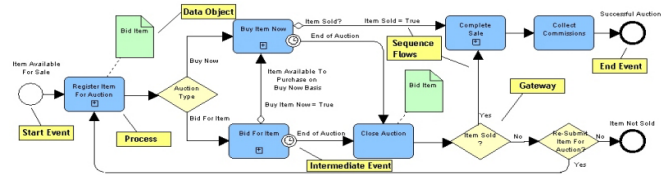
**Ontology**

Ontology defines a common vocabulary for researchers who need to share information in a domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them. In the context of computer and information sciences, ontology defines a set of representational primitives with which to model a domain of knowledge or discourse. Ontology are used for integrating heterogeneous databases, enabling interoperability among disparate systems, and specifying interfaces to independent, knowledge-based services [21].

**RDF**

This is an introduction to RDF ("Resource Description Framework"), which is the standard for encoding metadata and other knowledge on the Semantic Web. In the Semantic Web, computer applications make use of structured information spread in a distributed and decentralized way throughout the current web. RDF is an abstract model, a way to break down knowledge into discrete pieces, and while it is most popularly known for its RDF/XML syntax.

**BPM for web application (Example)**



**BPM for semantic web application**

**Buying and selling used cars**

Suppose a semantic web system was built to administer the selling and buying of used cars over the Internet.

The system would contain two main applications:

- One for people who wanted to buy a car
- One for people who wanted to put up a car for sale

Let's call the Internet applications for BUY, and SELL

**BUY - The Buy Application**

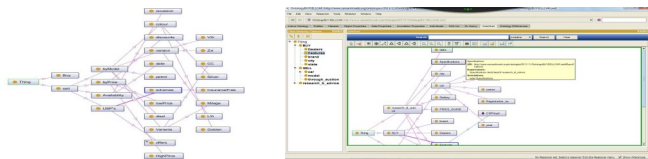
**People who want to buy a car could use an BUY application much like this:**

When you submitted the query, the application would return a list

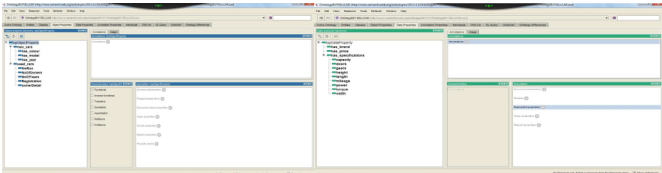
of cars for sale, and the list could be drilled down and sorted by year, price, location and availability. This information would be returned from a web spider continuously searching the web for RDF files.

**SELL - The Sell Application**

People who want to sell a car could use an ISA application much like this: When you submitted the form, the application would ask you for more information and store your ID and the information in an RDF file made available to the web. The RDF file would contain information like:



**Fig. 7.5-** Graphical representation of different classes present in application Representation of super class



Representation of object properties Representation of data properties

**RDF Schema**

```
digraph g {
"byModel" -> "version" [label="has subclass"] "version" ->
"VXi" [label="has subclass"] "sell" -> "byPrice" [label="has subclass"]
"byPrice" -> "HighPrice" [label="has subclass"] "byModel" ->
"colour" [label="has subclass"]
"Availability" -> "occesion" [label="has subclass"]
"byPrice" -> "lowPrice" [label="has subclass"] "Thing" ->
"sell" [label="has subclass"]
"byModel" -> "Varients" [label="has subclass"]
"byPrice" -> "discounts" [label="has subclass"] "sell" ->
"byModel" [label="has subclass"] "colour" -> "Golden" [label="has subclass"]
"Varients" -> "Milege" [label="has subclass"] "version" ->
"Zxi" [label="has subclass"] "byModel" -> "petrol" [label="has subclass"]
"byModel" -> "diesel" [label="has subclass"]
"schemes" -> "insuranceFree" [label="has subclass"] "Thing" ->
"Buy" [label="has subclass"]
"Availability" -> "date" [label="has subclass"]
"version" -> "LXi" [label="has subclass"] "Varients" ->
"CC" [label="has subclass"] "USP"s" -> "schemes" [label="has subclass"]
"colour" -> "Silver" [label="has subclass"] "sell" ->
"USP"s" [label="has subclass"] "USP"s" -> "offers" [label="has subclass"]
"sell" -> "Availability" [label="has subclass"]
}
```

Here The Information Required is  
Your ID: Name, address, email, ID number. Your selling item: type, model, picture, price, description.

Behind the scenes:

Behind the scenes, the "SELL" application creates an RDF file with a lot of RDF pointers. It creates an RDF pointer to a file with information about you, an RDF pointer to information about

Table 6.1-characteristics of BPM technology

Techniques/criteria's	Flexibility	Ease of use	understandability	simulation	scope
Work flow	Less flexible to adapt merge external changes	Easy to learn and use	Keeps the things easy, gives the proper flow between process	Simulation tools available	Can use only To give flow, can't represent services, eventrules
BPMN	Powerful technique for BPM	Uses various flow and control, uses advanced notations also	Can be easily understandable for business persons and stakeholders also if communicate in slandered manner	Support the simulation models	Supports many business process modeling elements
ARIS	As powerful as BPMN	Uses various notations	In addition to diagrammatical representation it gives modeling, calculating, executing, measurement	Support the simulation models	Can be used at many levels
OWL	Adaptable for changes	Not for all stakeholders	Mainly used for defining ontologies	Generally works with RDF	Use for emerging semantic web tech
WS-BPEL	Flexible as used for web application	It's exciution language	Used for web application	Support	Participate in business integration
eBXML	Flexible as used in collaboration	Uses XML,easy to understand	Easy to use for web application	support	Provides business service interface

Volvo and Volvo models, an RDF pointer to Volvo dealers and resellers, about parts, about prices, and much more

**Analysis and Comparison**

In this chapter we have done the analysis of different Business Process Modeling Techniques and comparison in terms of application.

As mentioned above the different techniques are available and which can be categorized as per the level of abstraction, the point which we have consider earlier. So there are different level of abstractions like computational independent, platform independent and platform specific models (CIMs, PIMs and PSMs) and the second criteria used is private process(PrP).Public Process (PuP) and Collaborative Process (CP).

Now we can do comparison for the technologies from the application basis i.e. for customized application, for web application and for semantic web application which technologies can use and why?

For this comparison first we have to decide the characteristics of the different business process modeling technologies. We have consider some criteria's for the same, the different criteria are Flexibility, Ease of use, Understandability, Simulation, Scope etc From the above study and comparison of different business process modeling techniques, we can conclude with suggesting the best suitable techniques for the given mention application.

In general there is no standard single business process modelling

technique for representing the BPM, but one can define it according to the application as the main aim of BPM is to define business process to get the decided goal.

Table 6.2- comparison of BPM technology

Criteria	Description
Flexibility	The extent to which it is possible to realize changes in the business process types and instances by modifying only those parts that need to be changed and keeping other parts stable. A business process model is flexible if it is possible to change it without replacing it completely.
Ease of Use	The extent to which the technique can be readily applied by business stakeholders not having specialist knowledge of the technique.
Understandability	The extent to which the technique can be understood by business stakeholders not having specialist knowledge of the technique.
Simulation	The extent to which the technique is capable of dynamically simulating a business process.
Scope	The extent to which the process modeling elements defined are represented by constructs of the technique.

Table 6.3 Analysis and Conclusion

BPM Technology	Applications		
	Conventional	Web Based	Semantic Web
Workflow	Used for this application as in this technique the business process are pre specified and it is less flexible and efficient as it simply gives flow of processes.	Not useful efficiently for web application.	-----
BPDM/ BPMN	Most efficient for this type as uses flow types	Preferred for this as uses more added notations and as it is flexible to change	-----
WSBPEL	-----	Used for web service as uses XML notations	-----
OWL	-----	-----	Emerging technology for semantic web, used with RDF
ARIS	Besides diagrammatical representation, it gives text and document representation also	Can be used for web application	-----
ebXML	-----	Used for web based	Used for semantic web also but

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