Strategies for Achieving Unification in Developing Information Systems

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Abstract – Nowadays the information system is the heart of every successful project in disciplines of business, technology, engineering and management. Whole members of team can properly coordinate only if they can share right information at right time. But designing an information system which can satisfy the needs of each member of project is very ridicule task. This is due to the diversity of disciplines of project team members which have great variations in terminology. Another problem is due to growing of new technologies as young members accept the new techniques and methods very easily where as old ones rely more on previous methods. Also, there is lack of universality rules for design of information systems but preliminary studies conclude that it is better to use process oriented approach for information system design [1]. This paper discusses the different approaches for design of information systems with their merits and demerits. Finally, it concludes that the recent method i.e. networked information systems with complete or partial virtualization is better for unification of development of information systems. It is based on SOA and WEB-oriented tools.

Index Terms – Functional Modelling, SOA (Service Oriented Architecture), Object Oriented Modelling, Process Oriented Approach, MES (Manufacturing Execution Systems)

1. INTRODUCTION

In these days, nobody can work well without flexibility. Managers should have flexible attitude towards their employees for better creativity for their products. As the projects growing larger and larger, they become more complex to design and implement successfully. Persons are involved from various disciplines having different roles in projects, so, they have different needs from information systems. Information grows at very fast pace and it becomes very difficult to manage an efficient and effective information system. Information technology provides a large number of information systems for various types of industrial projects but when the need arises for enterprise resource planning (ERP) and manufacturing execution system (MES) designing, the consolidated information system is not available. The main fact is their complex nature. ERP systems have to deal with all types of management bodies' i.e. human resource, financial, asset, sales and service, production process etc. and hence needs a higher level of information system that can support all types of functions of an enterprise.

The scene is same for MES but in opposite sense. MES deals with plant production system and IT field has scarcity of tools to represent such systems perfectly. MES needs an information system of lowest level. Existing information systems can support for Planning, designing, optimization, monitoring and documentation phases of production but unable to fulfil the information needs for full life cycle of production.

So, it is the need of the hour to understand the approaches which can be used during modelling and designing of information systems with their applications along merits and demerits which is discussed in next section. Section 3 discusses the main aim of paper. Section 4 discusses the recently proposed approach.

2. GIVE AND TAKE OF EXISTING APPROACHES USED DURING INFORMATION SYSTEMS DESIGN

There are many approaches available for information system design but no one of them is universal. Many reasons exist:

- Each organisation has its own needs.
- Persons involved are from different streams i.e. management, technical, professional etc.
- With new research old strategies becomes obsolete which are not acceptable by old persons.
- Strategies have not strong relationship between them. Each work on different view.
- Each strategy has its own tools which can't be understandable by all professionals.

Strategy	Techniques used	Tools used	Advantages	Limitations
Functional Design	Divide and conquer, hierarchical ordering, abstraction, formalization, consistency, and data structures	SADT (Structured Analysis and Design Technique), Decision tree, decision tables, DFD (Data Flow Diagrams), ERD (Entity-Relationship Diagrams)	Easy to design and implement by technical person.	Less user oriented, problems arise during integration, up gradation, less reusable, hard to understand by non technical persons.
Object-Oriented Design	UML modelling, classification of objects, inheritance, polymorphism, abstraction, encapsulation.	Class and object diagrams, state transition diagrams, activity diagrams, association and inheritance diagrams, use-case diagrams	Reusable as same objects can be used at various places, start from components in the form of objects so no problem during integration, easy to design.	Difficult to understand by non technical persons, lot of diagrams involved, time consuming during use case analysis, need special languages and software.
Process-Oriented Design	analysis and management of information flows, business process design, work flow design, identification of use cases and information flows	DSL (domain specification languages), UML diagrams, ERD and DFD, state transition and sequence diagrams for event modelling, activity diagrams.	Event driven technology make it easy for execution as users are not required to learn and run a typical user interface, each process can be executed by just clicking on a button so easily understandable by non technical persons	Need DSLs to fully describe information systems, somewhat rigid to design, also need new tools for complete specifications.

Table 1 Existing Strategies for Information System Development

Functional modelling approach:

It is the very first and most popular approach. It is based on function design what an information system is expected to perform. Mainly a top-down approach follows i.e. first, main aim is defined, and it is partitioned into sub-functions and then each sub- function into different tasks and so on. Finally, a hierarchical structure is available whose end nodes can be easily designed. To integrate all finally, bottom up approach follows. Tools and techniques are discussed in Table 1.

Object Oriented modelling approach:

UML[2] gives a new bend to modelling by providing tools to describe object oriented approach. UML provides a lot of tools for use case description, event handling, scheduling of tasks as shown in Table 1. But this is not too much popular as it is complex to design. Also, the main emphasis is given towards entities i.e. objects and data rather than information flow between them.

Process Oriented approach:

This strategy is more general and informative as it involves the features of both approaches discussed above. Like object oriented approach, it reuses the existing information systems according to domain specifications but by making changes in them as required by end users. New techniques and tools are being designed for managing business processes[3] and creating workflows between entities involved in projects. Also, new DSL are being designed for modelling[4]. Business process defines what should be done where as workflow describe how it can be achieved for a specific purpose[5] as shown in Figure 1. The structure of business process may include further components which can use any type of resources[6][7].

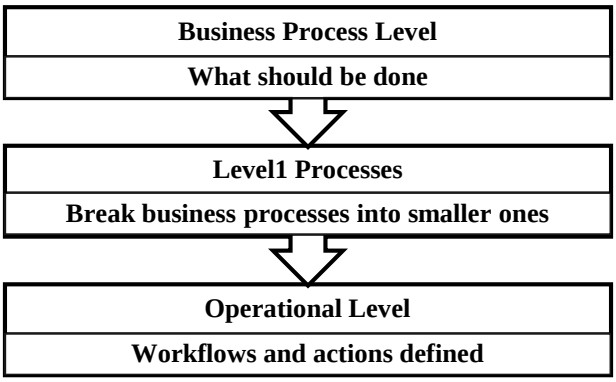

Figure1. Process Execution Model

3. GOAL OF RESEARCH

Due to lack of universality of standardized techniques and tools, functional modelling moves towards process oriented modelling. But in this approach also, one cannot achieve universality as existing IS can't be directly used with same type of enterprise activity in another organisation. The networked IS are also designed on principle of virtualization, so need full or partial imposition for adoption. To overcome the shortcomings, the process of IS design must be revised and its various phases should be analyzed for universality. It is not only mandatory to choose a new better approach to design IS as selection of standards and standardized tools are equally important.

4. ENHANCED PROCESS ORIENTED APPROACH

It is better to use the term service oriented approach rather than process oriented approach as it is based on SOA of the IS. It is more close to functional modelling as it first determines the functional elements of SOA services as later on these elements synthesise the business processes. As OASIS (Organisation for the Advancement of Structured Information Standards) defines "SOA is a paradigm of distributed organizational and utilitarian opportunities, which works under the management of domains that belong to different owners" [8]. SOA provides an architect style or creating IT structure of an enterprise. SOA considers business enterprises as integration of small, unified, interconnected services which can be designed by standardized tools and software. New business tools are also needed to create new business functions. These tools also relate the new function with existing functions and hence reorganize the business processes and workflows. So, this approach is an evolutionary approach and it also ensures to comply the existing standards for previously installed software and systems.

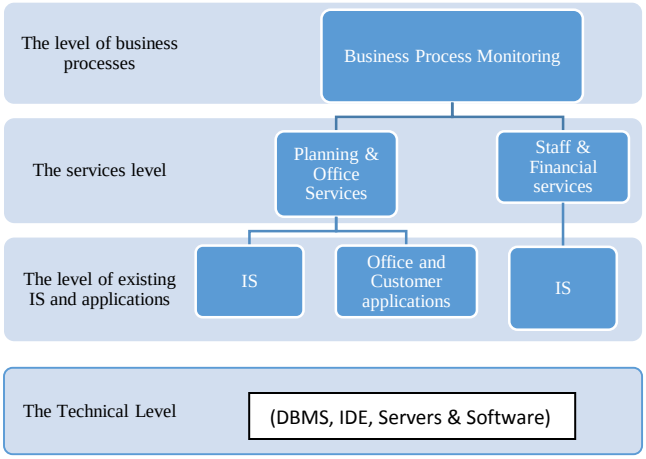

Figure 2 General SOA for Business enterprises

Business enterprises have used SOA for functional approach which is extended later on with CORBA concept and Java tools [9]. But this technique is not widely accepted as different applications have different GUI interfaces, different DBMS, incompatible functions for different processes. So, it has become very complex task to implement such a system where different business processes directly deal with technical level and information gets exchanged between those components whose functionality is identical but design is different. So, to solve the problem of incompatibility an additional service layer is induced in SOA architecture. Now, the business processes do not depend on technology platforms, as they can choose services from services layer. So, this layer hide the technical incompatibility from process layer and processes can only focus on functional design rather than their technical details.

Standardized set of services can be designed in services layer of SOA to achieve unification of processes. But today there is no common body, which regulates unified set of standards for SOA. MES information systems have various options for applying standards:

- OASIS
- W3C (World Wide Web Consortium)
- WS-I (Web Services Interoperability Organization)
- IETF (Internet Engineering Task Force)
- OMG (Object Management Group)
- The ISA-95 Standard, the ISA-88 Standard
- OAG (Open Applications Group)
- SCOR (Supply-Chain Operations Reference)

These standards are used during different tasks from functional requirements gathering to regulation of implementation of network components of IS. Also as new technical advancements occurs, new CASE- tools are designed which are adopted later on e.g. the integration of Web-services and cloud technologies the necessary condition is becoming the use such complex series of standards as BPEL (Business Process Execution Language), WSDL (Web Services Design Language), WSFL (Web Services Flow Language, developed by the corporation IBM, and XLANG created by Microsoft. Language notation is based on XML), SOAP (Simple Object Access Protocol, is a protocol specification for exchanging structured information in the implementation of web services in computer networks), UDDI (Universal Description, Discovery, and Integration, is a platform-independent, extensible markup language protocol which is meant for XML-based registry for businesses worldwide to list themselves on the Internet).

5. CONCLUSIONS

There is a lack of universal standards, tools and methodologies for building efficient and effective information systems. Also, same type of information system can't serve for each need of all enterprises. So, for unification purpose this paper fist discusses the existing methodologies with their merits and demerits. Later on, it introduces a new method for functional modelling and designing of information system. This method is based on SOA and provide unified services layer to different business processes. Any process can choose required services from this layer for implementation of its functions. This paper has also discussed some standard languages and platforms for implementation purposes of information systems of the lowest level.

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