

NBA Document Management System an E-Self Assessment Report (E-SAR) and Computing of Attainment Level of POs an API: OLTP—Software Subsystem (JEE and XML based API development: Scientific Approach)

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ABSTRACT

Software systems enable the rapid creation and distribution of documents. Therefore, people replace paper documents with electronic documents, in academic area electronic documents as information sources have increased in number and retrieving the information among huge number of documents become a problem while maintaining accreditation through attainment level. Data collection and analysis that provide information that enables faculty to identify superior performance and opportunities for improvement related to the outcomes is challenge. Hence it is the time for institutes to explore document management system for right kind of data for e-Self-Assessment Report (e-SAR) and faculty of universities are very interested to have a system to manage, retrieve and sharing documents. Document Management System (DMS) wherein faculty can improve efficiency and effectiveness of research and also can improve knowledge sharing among students and get new idea from other researches which will in turn help to attain projected outcomes. We have developed an API document management system for education vertical, and then how e-Self-Assessment Report (e-SAR) can be generated from this NBA DMS and is being demonstrated through this paper as an architecture of this API while developing an algorithm for computing attainment level of POs.

Keywords: E-SAR, Attainment Level Matrix, Program Outcomes, Measurement, Service Oriented Architecture.

INTRODUCTION

In the context of document management system in academics many electronic document systems [4] are available, yet none of the exiting tools and solutions provide the wide range of functionalities required to properly manage these academic resources and particularly there is no functional mapping of most of accreditation [11] (NBA) system's document requirements and in developing managing electronic Self- Assessment Report (e-SAR) [15]. These Enterprise Content Management systems offer the required functionalities to manage resources and knowledge and for better e-governance [8], but are not designed for academics. In this work we propose a new class of document management systems for academic especially in compliance of NBA's e-SAR design, development and for assessment. Moreover, to illustrate our approach we highlight first our system OLTP_[1] e-SAR

which combines various tools and functionalities, including XML, Web2.0 technique, enabling academics to develop, maintain, manipulate documents and generates e-SAR, as well as to manage and share resources and knowledge.

In this paper we describe the design of a distributed DMS services system that uses SOA as a model for deploying, discovering, integrating, implementing, managing, and invoking e-SAR. Such a model could help the educational area to develop cost efficient and dependable learning services. The intended outcome of SOA^[7] adoption as recommended in this paper is to improve interoperability both internal and external to an institution, to realize cost savings over time by adopting reusable and open standard IT services, and to align IT services ever more closely with the other academic services that the institution provides to its ecosystem. In rest of the paper clause II will discuss E-SAR functional and non-functional architectures, in III clause we will explain the service oriented architecture of this e-SAR. And IV clause would conclude with future work scope in this development.

NBA DMS E-SAR ARCHITECTURE

Functional Architecture

Functional architecture has 3 components of this DMS viz., 1. Document repository, 2. e-SAR-design development, maintenance, and 3. Measurement and evaluation.

Document Repository

In support of E-SAR, NBA is expecting well managed sets of supporting documents, and asking to maintain various files. NBA has 2 types of file system i.e. one set for institute level, other for department/program level. In current version 20/25 files need to maintain for college and department respectively. All these files are baseline components of Document Repository of this system. And named as F1, F2, F3, Fn in this system in Figure 1. The verb "baseline" refers

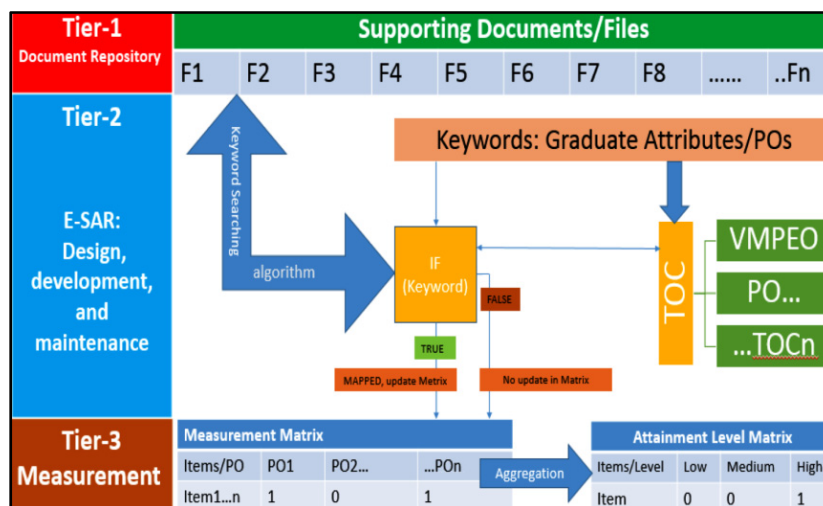


Fig. 1: Functional Architecture of NBA DMS e- SAR

to the act of placing an approved item under formal change control. A baselined item cannot be changed without the approval of its designated approval role based authorities i.e. author, reviewer, and approver. A baseline is a reference point in the document management system (DMS) life cycle marked by the completion and formal approval of a set of predefined work items. A work product (DMS) is referred to as a "baseline" when it has been formally reviewed and agreed upon and can only be changed through formal change control procedures. The purpose of a baseline is to provide:

- Measurable progress points within the system development lifecycle.
- A basis for change control in subsequent academic delivery phases.
- A stable reference for future work.
- Effective baselines have the following characteristics: A baseline must be associated with the production/operation and formal approval of a physical deliverable such as a document (E-SAR) and all items associated with a baseline must be placed under formal change control.

e-SAR

e-SAR is a refined document need to submit to NBA AICTE electronically. Here, in this DMS, it is being auto generated by document repository system and has 3 major components:

1. **Table of contents (TOC):** The table of contents is an important organizational tool in any document management system hence in ours also. It allows the e-SAR developer, reviewer, and approver to easily find what they are looking for item wise, or even just as an easy way to pick up where they left off reading at the end of a documents. In this DMS ToC will be provided by web master, and will be configure for usages. ToC will contain data items of SAR.
2. **Keywords:** Graduate Attributes/Program Outcomes: There has been frequent changes in GAs and POs, hence in this API development we are taking a generic approach by having a keywords/parameters [15] instead of GAs and POs. Keywords are the qualities, skills and understandings a university community agrees its students should develop during their time with the institution. These keywords includes, but go beyond, the disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. They are qualities that also prepare graduates as agents for social good in an unknown future. And further are the academic abilities, personal qualities and transferable skills which all students will have the opportunity to develop as part of their university experience. Keywords, for us are measurable parameters for measurement of various activities of e-SAR. These keywords, we are using to validate the various documents while mapping various data items in different matrix development for measurement.
3. **An algorithm (API):** An algorithm has been developed to validate the relevancy and authenticity of documents in document repository. This algorithm is being used to validate the keywords among files and referred matrices. Validation assessment [11] results are being used to populate matrices, wherein matrix data items are being mapped to program outcomes [12]. These parameters will be used in measurement component of this DMS. If keywords found in document repository it will be weighted to 1, in case of non-matching weight would be 0 in measurement matrices.

Measurement & Evaluation

For each e-SAR's ToC item, there are two matrices i.e. first is measurement matrix, and second is attainment level matrix.

Measurement matrix has the mapping of SAR's published data items to various expected ToC items e.g. POs. Mappings' validations parameters are being populated by an algorithm, which is validating data while processing in document repository and matching POs in back end defined and published data items like POs. Once parameters (i.e. keywords: GAs/POs) are validated, data items and PO will be mapped and value 1 will be set in matrix, and in case of no validation 0 will be put in the matrix. As shown below in matrix for one activity of Course Outcome [13][14] mapping with POs as an example:

Table 1: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

<i>POs/COs</i>	<i>PO1</i>	<i>PO2</i>	<i>PO3</i>	<i>....</i>	<i>PO_n</i>
CO1	1	0	1	0	1
CO2	0	1	0	0	1
CO3	0	0	1	0	0
CO4	1	1	1	1	0
CO5	1	1	0	0	1
CO6	1	0	1	1	1

Attainment Level matrix: This matrix is an aggregation of PO and data item to calculate POs/other published data items' attainment level. There are 3 levels i.e. Low, Medium, High. The base values for these levels are 6, 7, and 8 respectively. In aggregation, we are summing up all values against each data item, and then finally sum of matrix values will become attainment level as:

Table 2: Attainment Level to Attain POs

<i>Attainment Levels/COs</i>	<i>LOW</i>	<i>MEDIUM</i>	<i>HIGH</i>
CO1	6	0	0
CO2	6	0	0
CO3	0	7	0
CO4	0	0	8
CO5	0	0	8
CO6	0	8	0

Attainment Level Matrix Index $ALMI_{CO} = \text{Sum (CO1 to CO6)} / 6$ i.e. $ALMI_{CO} = (6+6+7+8+8+8) / 6 = 7.16$, now this value will be used in evaluation in next clause.

Evaluation: For self-assessment/evaluation [10] of E-SAR's ToC items, there are 3 break up components of maximum marks: Compliance and attainment of GAs/POs in Document Repository

is 60% of total marks for that line item. 10% Marks are reserved for evidence/proof of the documents. Consistence and continuous document management activity is highly recommended activity in any DMS system, hence it has 30% weightage of total marks, which is being managed through maintaining of document versioning system i.e. how frequently and how many times supporting documents are being managed.

Assessment/evaluation is based upon the total marks of the ToC items defined as:

- ToC_i is total number of marks of i^{th} component of E-SAR
- toc_{ik} it is the weight of keyword in DMS
- toc_{id} it is the weight of valid supporting docs
- toc_{iv} = it the document versioning component, the weight/values of these components are as:
 $toc_{ik} = 60\% \text{ of } ToC_i$ $toc_{id} = 10\% \text{ of } ToC_i$ $toc_{iv} = 30\% \text{ of } ToC_i$

Then Total marks $TOC_i = toc_{ik} + toc_{id} + toc_{iv}$

Evaluation - keyword (toc_{ik}): It is being calculated form the values from attainment level matrix (Table 2) as,

Then let $N1=0$; and $N= ToC_i$

If ($ALMI_{co is} \geq 8$) $N1= 100\% N$

Else if ($ALMI_{co is} == 7$) $N1=70\% N$ Else if ($ALMI_{co is} == 6$) $N1=60\% N$

Else $N1=50\% N$

Add $toc_{ik} = N1$ in ToC_i

End

Evaluation—Supporting Docs (toc_{id})—Types of supporting valid documents are considered are - Internal developed/generated docs, i.e. Circulars, Notices, office orders etc. External documents: AICTE, UGS, Government, University, Industry i.e. Syllabus, Calendars, Result sheets, appraisal, prizes, funding etc.

- If number of documents are available for last three years for internal and external category 40 % ToC_{id} will be awarded.
- If all available documents are authentic and authorized 80 % ToC_{id} will be awarded.

Evaluation—Versioning (toc_{iv}): The version of a document or digital content can be defined as the variation within a digital asset or its metadata. In other words, it means updating, editing or change, with respect to a previous version and its metadata. Editing a document means overwriting content in a file. Once that content is overwritten, certainly there is no way to go back to recover the version created before the changes were made. We are giving good weightage (30% ToC item value) for maintaining versioning of e-SAR documents. Three major releases are being considered/created i.e. one is after 1st internal test, second release is after 2nd test, 3rd one is after final examination having weightage of 40%,60%, and 80% of ToC value as toc_{iv} respectively.

SERVICE ORIENTED DESIGN APPROACH OF NBA DMS E-SAR & SOA ARCHITECTURE

The e-SAR DMS services system that we have developed is based on the Service Oriented Architecture (SOA) [5] and uses Web Services. Before designing and developing the service- oriented

system, we have decided that what technology is the best choice to implement the service-oriented e-SAR DMS system. After comparisons and considerations of generic technologies, Java based XML web services are the best choice under our consideration because of some reasons as follows:

Services-Oriented Architecture

The primary goal of Service Oriented Architecture [9] [5] [3] (SOA) is to align the business world with the world of information technology (IT) in a way that makes both more effective. SOA is a bridge that creates a symbiotic and synergistic relationship between the two that is more powerful and valuable than anything that we've experienced in the past.

A Service-Oriented Architecture is an architectural style for creating an Enterprise IT Architecture (like e-SAR DMS OLTP) that exploits the principles of service orientation to achieve a tighter relationship between the business and the information systems that support the business.

The Service Oriented Architecture reinforces basic software architecture principles such as abstraction, encapsulation, modularization and software reuse. It provides well defined interfaces for client applications and separates the interfaces from their implementations. It allows service capabilities and interfaces to be implemented as a collection processes. Each process itself provides a service, one that offers a particular capability as a gross generalization; a *service* is a repeatable task within a business process. Because each process is exposed through a standard interface, the underlying implementation of the individual service is free to change without affecting how the service is consumed. Security and privacy are particularly important issues for education. Personal information is confidential, so access to such information must be restricted to authenticated and authorized users. Secure transmission of such information must be complemented with secure storage of the data. The use of the Service Oriented Architecture is critical for enforcing such policies.

The fundamental design issues of DMS e-SAR in service oriented architecture are:

Components are loosely coupled: A component accessing another component does not require knowledge of the data structures, the calls to other components, transaction management, and so on in that other component.

Components are configurable: Components can be added, deleted and configured in different ways creating new applications.

Components are interoperable: Any one component can interoperate with another component including components created by different vendors' development environments.

Components are location independent: Just as a component does not know or care about the implementation details of another component, it also does not know or care about its location.

Web Services: Web Services^{[2] [9] [5] [3]} in DMS e-SAR are self-contained, modular applications that can be described, published, located, and invoked over a network, generally, the Web. The Web Services architecture is the logical evolution of object-oriented analysis and design, and the logical evolution of components geared towards the architecture, design, implementation, and deployment of e-business solutions. Both approaches have been proven in dealing with the complexity of large

systems like education system. As in object-oriented systems, some of the fundamental concepts in Web Services are encapsulation, message passing, dynamic binding, and service description and querying. Fundamental to Web Services, then, is the notion that everything is a service, publishing an API for use by other services on the network and encapsulating implementation details.

Web service is a technology that has built to provide various types of services. The main advantage of using a web service technology is cross platform communication. There are two major competitor of web service technology in the market that is Microsoft and IBM. From implementation point of view both using common standards and protocols, such as Simple Object Access Protocol (SOAP), Extensible Markup Language (XML), Web Service Description Language (WSDL) and Universal Discovery Description & Integration (UDDI). In OLTP web services we are using IBM web service framework. OLTP's WSDL provides description of a web service. Sample web service I will explain in Clause III with help of Figure 2. Each web service has WSDLfile which is basically an XML file that describes a set of SOAP messages and how the messages are exchanged between web services and clients. UDDI is often called yellow pages of web services. UDDI is a directory of web services that have XML files describes a business and the services it offers. We will use UDDI in our architecture to publish OLTP's educational services so other can take advantages from these services.

Together, with these design principles we have created a flexible architecture shown in Figure 2 able to adapt to and succeed on rapidly changing educational business conditions in next clause-C.

E-SAR DMS SOA based Technical Architecture

The technical architecture of e-SAR DMS is based on service- oriented approach. Using web service technology we can provide educational contents in the form of different services such as e-SAR, document repository, digital library, virtual classrooms, virtual labs, authoring services etc. You can add as many as services by adding your web service layer.

Proposed e-SAR DMS architecture has two parts; one is for client/devices and other is the e-SAR DMS server (OLTP Application Server Figure 2. Both users are connected through internet with common sets of internet protocols such as HTTP, SOAP, RMI and XML. Two important components are Client side devices and server side components as depicted in Figure 2 and described in next clause.

Mobile/Client devices

Accreditation documents should be accessible to an academic community i.e. faculties, researchers, and students for better management of educational delivery. And to provide ease access of these documents mobile devices can play very important as these devices are in scope of today's academic community, hence through this architecture we are providing mobile client interface to access e-SAR DMS as a web service components. On the other hand server-side uses a single platform that must communicate in this heterogeneous environment using internet standard-based protocols and give services in a scalable and robust manner.

In Figure 2, the client-side contains diverse computing devices and platforms. Some users may use desktop PCs or other may use handheld and wireless devices to access DMS services. In this case, we

suggests that JAVA language is appropriate to develop interface agent so it can be run on any computing device whatever its platform may be. We have categorized computing devices to make different versions of user agent for each category. The category of computing devices may be a desktop PC, PDA, tablet PC and mobile phone etc. SOAP is used for communication between user agent and web service based agent. A user agent would query information from server-side agent on the basis of user profile and device profile.

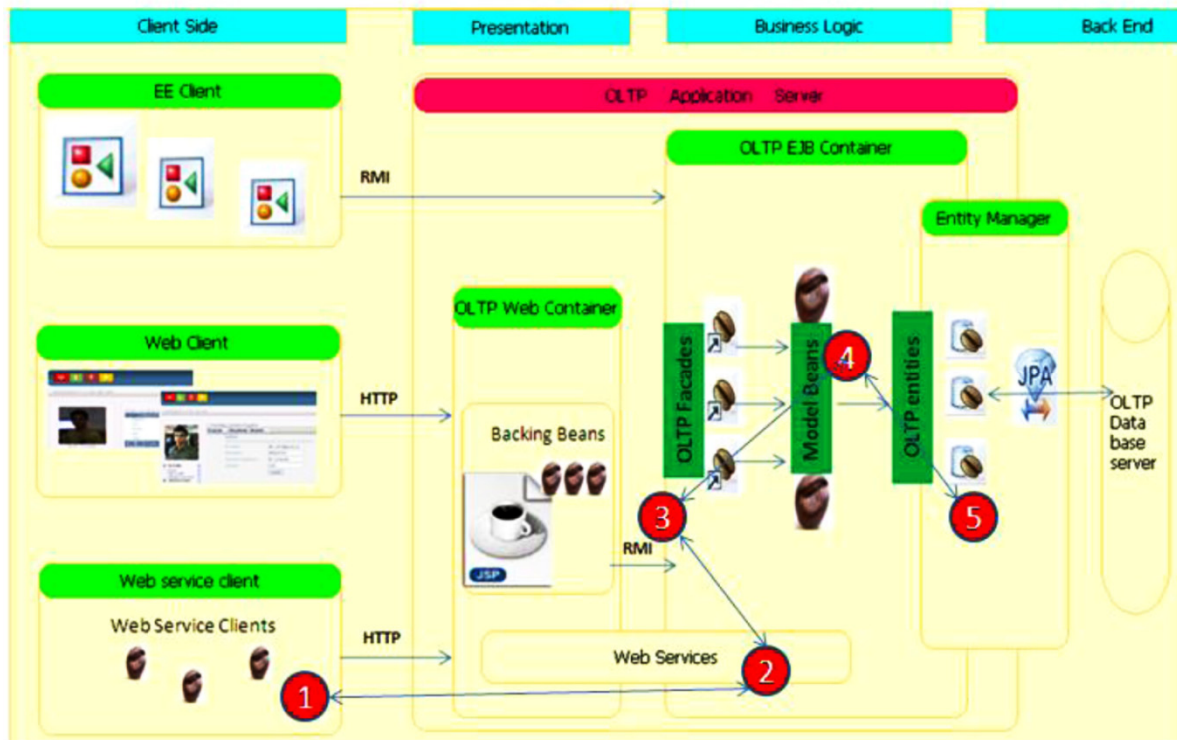


Fig. 2: SOA Based Technical Architecture of NBA DMS e-SAR

E-SAR DMS: OLTP Application Server – E-SAR Server in a Box (ESB)

The E-SAR server in a box (ESB) of our OLTP architecture is composed of several components that include web service, middleware, database, e-SAR services and educational services. The main focus of our architecture is on web service that can make our architecture robust, scalable and interoperable as shown in above Figure 2.

Here we describe how to implement a traditional Java EE Web Service based, a multi-tier application that implements the core Java EE elements of **persistent entities**, **session EJBs (java web services)**, and **JSPs**, supporting both Web browsers and a thin Java client.

1. The persistence layer in an e-SAR DMS OLTP application server that interacts with a relational database has been implemented through Java Persistent API, which provides an object relational mapping facility for managing relational data in Java applications. Java persistence consists of three areas: Java Persistent API, Object Relation Mapping Meta data and Query Language.

2. Figure 2 shows through red encircled no (1) that how web service client can access the OLTP's Java Web Services (JWS) which are in turn facades to OLTP JPA entities red encircled no (5). JPA entity objects, encapsulate data into a record-oriented format. Typically, the application clients should not access JPA entities directly. The answer is a session EJB (OLTP facades) that provides an execution environment for the business logic inform of web services. The OLTP EJB container provides the core services such as transactional support and local remote invocation, allowing the user-written code to focus on the business-level functions.
3. OLTP Facades beans are scalable by injection of one more layer through model beans (POJOs: Plain Old Java Objects), which provides the decoupling between OLTP facades and OLTP entities for more and more scalability of this OLTP Server and also provide manageability of the code at façade level.
4. In this e-SAR DMS OLTP application, an overall Web front end in Java EE usually consists of Web components, which are the actual artifacts that are invoked when a user types a web address into a browser. In an OLTP environment, the addressable web components are: Static content, such as *HTML pages* or image files, *Servlets* - which provide 100% dynamic content, *Java Server Pages* (JSPs) with *JSF UI* controls and *Backing Beans*, which provide server side managed components.

In this paper, we are using RMI, SOAP, XML and HTTP to communicate over a network. They can depict their functionality using WSDL just because these are based on web service. Clients are able to call our agents using standard based SOAP messages and take e-SAR OLTP services.

Service Provider

An E-SAR DMS service provider makes the services of one organization available to others, and vice versa, in a controlled and secure manner. Although the intent of this component is different from the intent of the e-SAR service, which is to provide a service infrastructure within an organization such as student life cycle, training & placement, academic management, transport management, virtualization of labs, video conferencing, digital library and examination assessment manager etc. while preparing e-SAR.

In an e-SAR DMS OLTP service provider web services have been created and publishing its interface and access Information to an OLTP service broker. We have decided which services to expose and how to expose them. There is often a trade-off between security and interoperability; the service provider must make technology decisions based on this trade-off. If the service provider is using a service broker; decisions must be made on how to categorize the service and the service must be registered with the service broker using Agreed-upon protocols.

Service Requestor

The service requester, also known as a service client, as annotated Web Service Client as shown in Figure 2 as part of client side, sometime service requester may be server also discovers services and then uses them as part of its operation. Here, it is a managed bean client to access web services. A service requester uses services provided by service providers. Using an agreed-upon protocol, the requester can find the required information about services using a broker. After the service requester

has the necessary details of the service, it can bind or connect to the service and invoke operations on it.

The interface, binding, and service endpoint of an education service are defined in WSDL files. The Requestor can look up or forward a request through the interface, binding, and service endpoint of an education service defined in WSDL files. The Requestor must support the WS-Inspection specification, and the service requesters can easily locate the WSDL documents of the Web services that are exposed by the Router. The user uses the UDDI registry to obtain WSDL interface definition and implementation definitions of the learning services in virtual organization.

Service Registry

The service registry in e-SAR DMS, also known as the service broker, is responsible for making the service interface and implementation access information available to any potential service requester.

CONCLUSION AND FUTURE WORK

In this paper we have described the design of an DMA e-SAR API for an accreditation of academic institutes, while focusing on *attainment level of POs* services system that uses SOA as a model for designing, deploying, discovering, integrating, implementing, managing, and invoking e-SAR DMS service system. Such a model could help the educational area to develop cost efficient and dependable learning [6][7] services to maintain quality in their academic delivery. Our architecture provides scalable environment where you can grow your services easily without interrupting the core architecture. You can add new educational web service and register your service using UDDI or other directory service. Maintainability of educational services is easier than ever before because educational services are divided with respect to category and functions. Agents are always flexible as they can move in a network to find information; our web services can communicate with other web services in a network using standard-based protocols such as SOAP. Our research continues in the field of architecture neutral implementation. Of e-SAR's attainment level of program outcomes. Our purpose is to develop a prototype that allows the implementation of the functional and technical architecture shown in Figure 2 and in Figure 2 respectively, future scope in this architecture[9] is to develop a standard education gateway from where education, accreditation services can be accessed in form of standard API in compliance of IEEE's LTSA specifications.

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Prof. Anil Chaudhary has 15 years of rich experience with a Copyright of "OLTP an API for educational institutes" in compliance of IEEE Learning Technology Solution Architecture(LTSA), in the field of Computer Science Engineering and Information Technology teaching, research & development which includes 10 years exclusively in the teaching of web related applications using Java and J2EE technologies, self-motivated, strong believer in applied Information technology, research oriented goal achiever personality accustomed to work hard even in an adverse environment. Currently working with SKIT, NBA accredited engineering college affiliated to Rajasthan Technical University in compliance of Washington Accord (ABET) as a Professor.