



YENEPOYA

(DEEMED TO BE UNIVERSITY)

Recognized under Sec 3(A) of the UGC Act 1956

Accredited by NAAC with 'A' Grade

2.5.5 Status of automation of the Examination division, using Examination Management System (EMS) along with an approved online Examination Manual

**Any additional information
(Software architecture document for EMS)**

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Information and Communication Technology

Software Architecture Document
for
Examination Management System.

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1. Introduction

This document outlines the architecture adapted by Examination Management Software used by the Examination department for managing the student examination procedures. The software manages the complete exam lifecycle right from student management from active courses, IA entries, attendance, eligibility criteria, hall ticket generation, examination management, result generation and marks/degree certificate processing.

The software architecture will typically perform eight major steps to define a global architecture. Each time an activity is completed, a specific section of the SAD is enriched accordingly.

Architectural activities	Software Architecture Document
Step 1 - Identify and prioritize significant Use-Cases	Section 4
Step 2 - Define the candidate architecture	Section 3, 5.1, 10, 11
Step 3 - Define the initial Deployment Model	Section 7
Step 4 - Identify key abstractions	Section 9
Step 5 - Create an Analysis Model	Section 5
Step 6 - Create the Design Model	Section 5
Step 7 - Document concurrency mechanisms	Section 6, 7
Step 8 - Create the Implementation Model	Section 8

1.1 Purpose

The Software Architecture Document (SAD) provides a comprehensive architectural overview of the Examination Management Software designed by the IT Department of Yenepoya (Deemed to be University). It presents several different architectural views to depict various aspects of the system. It is intended to capture and convey the significant architectural decisions which have been made on the system.

In order to depict the software as accurately as possible, the structure of this document is based on the "4+1" model view of architecture.

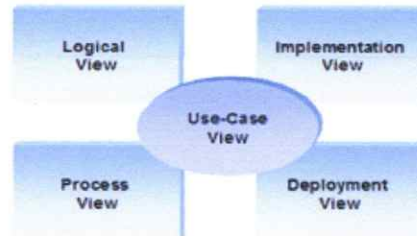
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The "4+1" View Model allows various stakeholders to find what they need in the software architecture.

1.2 Scope

The scope of this SAD is to depict the architecture of the Examination Management Software developed and maintained by the IT Department of Yenepoya (Deemed to be University)

1.3 Definitions, Acronyms, and Abbreviations

RUP: Rational Unified Process

UML: Unified Modeling Language

SAD: Software Architecture Document

RDBMS: Relational Database Management System

SMS: Student Management System.

OTP: One-time password.

IA: Internal Assessment

1.4 References

[KRU41]: The "4+1" view model of software architecture, Philippe Kruchten, November 1995,
<http://www3.software.ibm.com/ibmdl/pub/software/rational/web/whitepapers/2003/Pbk4p1.pdf>

[RSA]: IBM Rational Software Architect
<http://www-306.ibm.com/software/awdtools/architect/swarchitect/index.html>

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[RUP]: The IBM Rational Unified Process: <http://www-306.ibm.com/software/awdtools/rup/index.html>

1.5 Overview

To fully document all the aspects of the architecture, the Software Architecture Document contains the following subsections.

Section 2: describes the use of each view

Section 3: describes the architectural constraints of the system

Section 4: describes the functional requirements with a significant impact on the architecture

Section 5: describes the most important use-case realization. Will contain the Analysis Model and the Design Model

Section 6: describes the design's concurrency aspects

Section 7: describes how the system will be deployed. Will contain the Deployment Model

Section 8: describes the layers and subsystems of the application

Section 9: describes any significant persistent element. Will contain the Data Model

Section 10: describes any performance issues and constraints

Section 11: describes any aspects related to the quality of service (QoS) attributes

2. Architectural Representation

This document details the architecture using the views defined in the "4+1" model [KRU41] but using the RUP naming convention. The views used to document the Examination Management System application are:

Logical view

Audience: Designers.

Area: Functional Requirements: describes the design's object model. It also describes the most important use-case realizations.

Related Artifacts: Design model


Process view

Audience: Integrators.

Area: Non-functional requirements: describes the design's concurrency and synchronization aspects.

Related Artifacts: (no specific artefact).

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Implementation view

Audience: Programmers.

Area: Software components: describes the layers and subsystems of the application.

Related Artifacts: Implementation model, components

Deployment view

Audience: Deployment managers.

Area: Topology: describes the mapping of the software onto the hardware and shows the system's distributed aspects.

Related Artifacts: Deployment model.

Use Case view

Audience: all the stakeholders of the system, including the end-users.

Area: describes the set of scenarios and/or use cases that represent some significant, central functionality of the system.

Related Artifacts: Use-Case Model, Use-Case documents

Data view (optional)

Audience: Data specialists, Database administrators

Area: Persistence: describes the architecturally significant persistent elements in the data model

Related Artifacts: Data model.

3. Architectural Goals and Constraints

This section describes the software requirements and objectives that have some significant impact on the architecture

3.1 Technical Platform

The Examination Management System will be deployed onto an application server 192.168.5.25; the database will be on a clustered MS SQL hosted on 192.168.5.23, the update server is 192.168.100.100

Application designed on Visual Studio DotNet Version 8 and MS SQL Server 2012

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3.2 Transaction

The Examination Management Software is transactional, leveraging the technical platform capabilities.

3.3 Security

The system must be secured so that various examination related data entries can be performed.

The application must implement basic security behaviours:

- Authentication: Log in using a user name and a password
- Authorization: according to their role, the users should be granted access to specific modules
- For modules accessing the internet, the following requirements are mandatory
- Confidentiality: sensitive data must be encrypted
- Data integrity: Data sent across the network cannot be modified by a tier
- Auditing: Every sensitive action can be logged

3.4 Persistence

Data persistence will be addressed using a relational database.

3.5 Reliability/Availability (failover)

The Availability of the system is a key requirement by nature, as it is an exam Management System. The candidate architecture must ensure failover capabilities.

Targeted Availability is 24 hours a day, 7 days a week

3.6 Performance

Any data operation should be under 10 seconds.

4. Use-Case View

This section lists use cases or scenarios from the use-case model to represent some significant, central functionality of the final system.

4.1 Use-Case Realizations

Refers to section 5.2 to see how design elements provide the functionalities identified in the significant use-cases.

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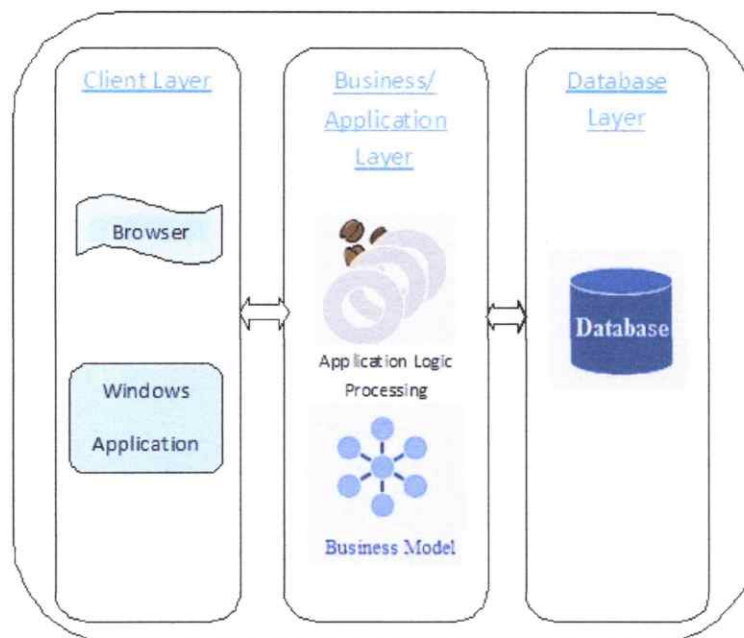
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5. Logical View

5.1 Overview

The Examination Management System is divided into layers based on the N-tier architecture



The layering model of the Examination Management System is based on a responsibility layering strategy that associates each layer with a particular responsibility.

This strategy has been chosen because it isolates various system responsibilities from one another so that it improves both system development and maintenance.

Each layer has specific responsibilities.

- The **presentation layer** deals with the presentation logic and forms rendering; the presentation layer is also integrated into reporting mechanism using crystal reports.
- The **application layer** is provided by the windows service, which acts as a listener service for all database operations. The application layer also has database rules and fine-tuning settings. The application layer is mounted on one of the secure servers.
- **Database layer**, A MS SQL Server-based RDBMS hosted on a secure windows server. Clustering is done to support any failovers.

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- 5.2 Architecturally Significant Design Packages
 - 5.2.1 Creation of course details of the students
 - 5.2.2 The subject setup for each course
 - 5.2.3 Students promotion – Promoting the students to the next batch as per the carry-over system
 - 5.2.4 Subject assignment for the students of each course
 - 5.2.5 Evaluation setup – Setting up of maximum Marks for Internal Assessment, written examinations, Practical and Viva
 - 5.2.6 Student Eligibility – Eligibility to appear for the examination and reports
 - 5.2.7 Exam Subject eligibility – Eligibility to appear the exam in a subject by a student and reports
 - 5.2.8 Student list by course
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 - 5.2.12 Exam practical marks entry setup – setting for online marks entry which includes generation of Password and OTP for online entry
 - 5.2.13 Answer paper Barcoder
 - 5.2.14 Evaluation of the Answer scripts – Digital evaluation
 - 5.2.15 Exam Marks entry
 - 5.2.16 Examination results – Summary of the result, result withheld, detailed report on results, marks statement, email result publication (result and marks statement sent through email to individual student and parents
 - 5.2.17 Master creation for the above
 - Course Master
 - degrees
 - result criteria
 - Subject creation
 - Scholastic details and Master for Grade cards
 - promotion criteria
 - 5.2.18 Exam Reports in Student Demographics
 - Exam marks statement of all the years of a student
 - Exam alerts – gives a report of a student's previous exam pending subjects and next exam details
 - Exam History – reports on all the previous exams in detail of a student
 - 5.2.19 Auto-generation and printing of various certificates and uploading of all the below Certificates to NAD (National Academic Depository)
 - Marks card

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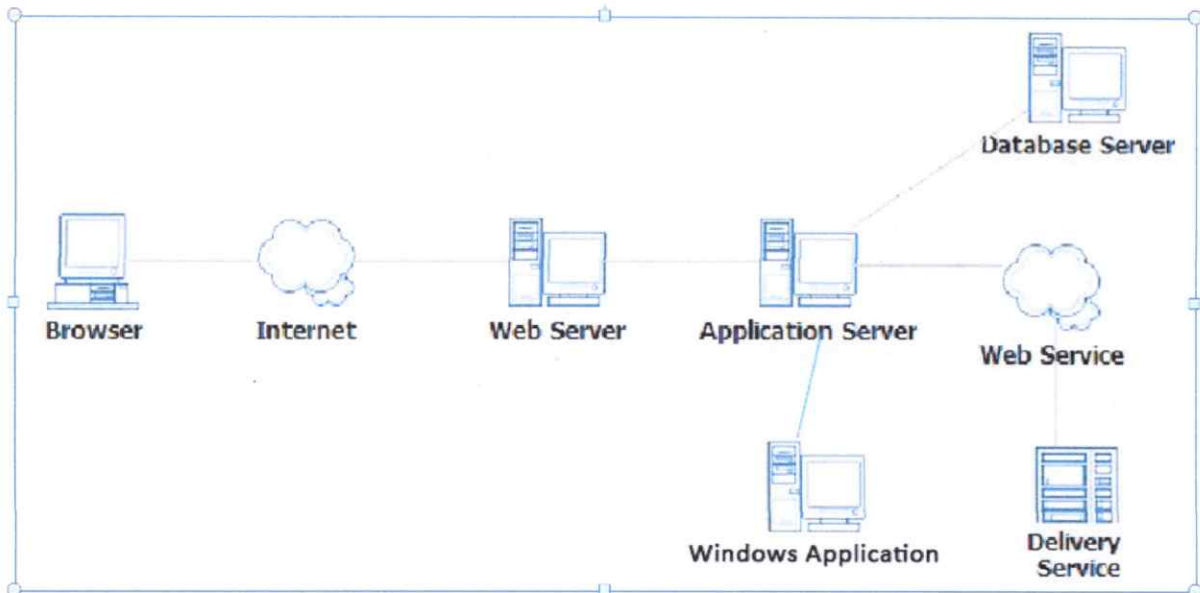
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- Grade card
- Provisional Degree Certificate
- Degree Certificate

6. Process View

There's only one process to take into account. The Dotnet 2.1 environment automatically handles threads which are instances of this process.



7. Detailed deployment model with clustering

- One windows server will host the application layer; this server has clustering support for failovers.
- One windows server hosts the MS SQL server database and is mounted in a clustered environment.
- One windows server works as an update server that hosts the one-click deployment of Examination Management Software on client computers.

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8. Implementation View

8.1 Overview

The Implementation view depicts the physical composition of the implementation in terms of Implementation Subsystems and Implementation Elements (directories and files, including source code, data, and executable files).

Usually, the layers of the Implementation view do fit the layering defined in the Logical view

It is unnecessary to document the Implementation view in great detail in this document. For further information, refer to the Online Catering Service 1.0 workspace in Rational Software Architect.

8.2 Layers

8.2.1 The **presentation layer** deals with the presentation logic and forms rendering; the presentation layer is also integrated into reporting mechanism using crystal reports.

8.2.2 The **application layer** is provided by the windows service, which acts as a listener service for all database operations. The application layer also has database rules and fine-tuning settings. The application layer is mounted on one of the secure servers.

8.2.3 **Database layer**, A MS SQL Server-based RDBMS hosted on a secure windows server. Clustering is done to support any failovers.

Quality

As far as the Examination Management System application is concerned, the following quality goals have been identified:

Scalability:

- **Description:** System's reaction when user demands increase
- **Solution:** The database can be scaled out as needed.

Reliability, Availability:

- **Description:** Transparent failover mechanism, mean-time-between-failure
- **Solution:** Application is hosted on clustered servers any failovers would be taken over by the standby server automatically

Portability:

- **Description:** Ability to be reused in another environment
- **Solution:** The client systems can be deployed in a matter of minutes using the Microsoft one-click deployment from the browser.

Security:

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- **Description:** Authentication and authorization mechanisms
- **Solution:** Dotnetnative security mechanisms will be reused, SMS based OTP authentication used where required.

Software updates

Date	Item	Note
7.10.2012	Installation of the first version	Student data entry, course assignments, evaluation setup, marks entry. Result Generation
11.02.2013	Daily Attendance Recording and Notifications.	Portable device-based biometric data capture in classrooms. Automated notification to parents and students about the absence. Monthly summary reports email to parents.
11.02.2013	CGPA based marks entry and marks card printing	Deployed new logic for capturing the CGPA based marks entry and the marks card printing.
01.04.2013	Examiner Profile	Setting up examiner profile.
19.12.2013	Examination Evaluation Data maintenance	Module to update and manage the change in examination data schemes.
23.12.2014	Add marks card support for MHA	New marks card format to support for MHA course.
22.03.2015	New Marks Card format	Additional marks card format for courses having more than 10 subjects.

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16.04.2015	New results criteria, based on paper minimum marks requirement	Support for new result criteria where a student needs to have minimum marks per paper to be eligible to pass.
18.01.2018	Withholding results	Logic to withhold the results and restrict access to such cases by all stakeholders. Update to summary report.
02.02.2018	Pharmacy, Degree Exam Pattern	Updates to support Pharmacy college and Degree college exam patterns.
13.03.2018	New marks card setting	New marks card format to support Pharmacy and Degree college exam patterns.
01.03.2018	Meritrac Data Import	Import facility to import the data from digital evaluation platform into the system for generation of final results.
01.04.2018	Exam Promotion Automation	Automated promotion logic deployment across all colleges based on course year subject numbers and previous years data.
01.04.2018	Exam Eligibility Automation	Automated examination eligibility deployment across all colleges based on the previous exam data.
04.10.2018	Degree Certificate Printing	Printing of in-house degree certificate printing.
06.10.2018	NAD Data and marks card generation	Generation of data for deployment of NAD.
02.01.2019	IA online data submission	Deployment of internal assessment data entry and eligibility generation in online mode.

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22.01.2019	Attendance online data submission	Deployment of attendance data finalization and eligibility generation in online mode.
15.02.2019	Practical Exam online form	Online practical exam marks entry and validation same day of the examination. Secure sign-in using OTP to the examiner.
28.02.2019	Result Summary	Comprehensive results summary with all examination statistics.
26.03.2019	Grade Card implementation	Deployment of grade card system and configurations.
04.04.2019	Exam History Report	New report to display students complete examination history.
06.01.2020	OBE Report	Data export facility to support OBE implementation.
05.02.2020	IA Entry Scheduler	Time-bound internal assessment data capture from colleges.
10.02.2020	Automated Exam subject entry	Automated process to update students data with failed subjects only.
28.02.2020	Exam Eligibility add on	Added new configurations to support automated exam eligibilities.
16.02.2020	Student Promotion add on	Added a new configuration to support automated promotion logic.
08.03.2020	MBBS examination CBME Module	Deployment of logic to the entry of exam data as per MBBS – CBME curriculum. Corresponding result criteria and marks cards.

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15.10.2020	Automated subject allotment for repeater batches	Deployed the process to setup automated repeater courses.
06.01.2021	Best of two IA	Deployed the logic to support best of two IA logic for marks processing.
09.04.2020	OBE data report	Added functionality for OBE data report.
20.10.2020	Update to evaluation Maintenance	New enhancements for maintenance of evaluation setups.
02.04.2021	Allow colleges to manage the exam eligibility report printing.	New logic to create institutional admins with privileged access. Availability of the eligibility data at the college level.

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