American International University-Bangladesh (AIUB)
Department of Computer Science
Faculty of Science & Technology (FST)

Artificial Intelligence Driven Transformation of Electricity Supply

A Software Engineering Project Submitted
By

Semester: Summer_21_22		**Section:**	**Group Number:**	
SN	Student Name	Student ID	Contribution (CO3+CO4)	Individual Marks
1	Mohammed Istishad Alam Tishad	22-46130-1	20%	
2	Sheikh Abir Islam	22-46283-1	20%	
3	MD. Mahmudul Hasan	22-46256-1	30%	
4	Afifa Akter Maria	22-46442-1	20%	
5	Khan, Md Maruful Islam	20-42056-1	10%	

The project will be Evaluated for the following Course Outcomes

CO3: *Select* appropriate software engineering models, project management roles and their associated skills for the complex software engineering project and evaluate the sustainability of developed software, taking into consideration the societal and environmental aspects	Total Marks	
Appropriate Process Model Selection and Argumentation with Evidence	[5 Marks]	
Evidence of Argumentation regarding process model selection	[5Marks]	
Analysis the impact of societal, health, safety, legal and cultural issues	[5Marks]	
Submission, Defense, Completeness, Spelling, grammar and Organization of the Project report	[5Marks]	
CO4: *Develop* project management plan to manage software engineering projects following the principles of engineering management and economic decision process	Total Marks	
Develop the project plan, its components of the proposed software products	[5Marks]	
Identify all the activities/tasks related to project management and categorize them within the WBS structure. Perform detailed effort	[5Marks]	

estimation correspond with the WBS and schedule the activities with resources		
Identify all the potential risks in your project and prioritize them to overcome these risk factors.	[5Marks]	

Description of Student's Contribution in the Project work

Student Name: Mohammed Istishad Alam Tishad
Student ID: 22-46130-1
Contribution in Percentage (20%):
Contribution in the Project:

- Project Proposal
- Project background analysis
- Requirement Analysis
- UIUX design
- Test Cases
- Project test planning
- Timeline chart
- Earned Value Analysis
- Risk Management

_____Tishad_____
Signature of the Student

Student Name: Sheikh Abir Islam
Student ID: 22-46283-1
Contribution in Percentage (20%):
Contribution in the Project:

- Project Proposal
- Project background analysis
- Requirement Analysis
- UIUX design
- Test Cases
- Project test planning
- Timeline chart
- Earned Value Analysis
- Risk Management

_____Abir_____
Signature of the Student

Student Name: MD. Mahmudul Hasan
Student ID: 22-46256-1
Contribution in Percentage (30%):
Contribution in the Project:

- Project Proposal
- Project background analysis
- UIUX design
- Test Cases
- Project test planning
- Work Breakdown Structure
- Software Project Estimation
- Timeline chart
- Earned Value Analysis
- Risk Management

_____Mahmudul_____
Signature of the Student

Student Name: Afifa Akter Maria
Student ID: 22-46442-1
Contribution in Percentage (20%):
Contribution in the Project:

- Project background analysis
- UIUX design
- Project test planning
- Software Project Estimation
- Earned Value Analysis
- Risk Management

_____Maria_____
Signature of the Student

Student Name: Khan, Md Maruful Islam
Student ID: 20-42056-1
Contribution in Percentage (10%):
Contribution in the Project:

- Project Proposal
- Project background analysis
- UIUX design
- Test Cases
- Project test planning
- Earned Value Analysis
- Risk Management

_____Maruful_____
Signature of the Student

1. PROJECT PROPOSAL

1.1 Background to the Problem

Electricity is the cornerstone of Bangladesh's economic growth and social development. The nation has made significant progress in expanding its electricity infrastructure over the past few decades. However, challenges such as frequent power outages, inefficiencies in distribution, and high transmission losses persist, hindering sustainable development. The existing electricity grid, largely dependent on outdated technologies and fossil fuels, struggles to meet the rising demand for power. These issues are exacerbated by the lack of real-time data and automated systems, which prevent effective management of the electricity supply chain.

The root cause of these problems lies in the outdated and inefficient management practices of the electricity grid. Traditional methods are inadequate in addressing the complex dynamics of modern energy generation, distribution, and consumption. As a result, the system suffers from significant inefficiencies, leading to frequent blackouts and unreliable power supply. This not only affects the daily lives of millions of citizens but also impedes the nation’s economic progress and its efforts to attract foreign investment.

Addressing these challenges is of paramount importance. In an era where global energy landscapes are rapidly evolving towards renewable sources and smart grid technologies, Bangladesh must embrace these advancements to ensure a sustainable and resilient energy future. Failure to do so will result in continued reliance on fossil fuels, increased carbon emissions, and a bottleneck in economic growth. By integrating Artificial Intelligence (AI) into the electricity supply chain, Bangladesh can revolutionize its energy sector, leading to a more reliable, efficient, and environmentally friendly electricity supply system

1.2 Solution to the Problem

The primary objective of this project is to develop an AI-driven system for optimizing the electricity supply chain in Bangladesh. This system will leverage machine learning algorithms and real-time data analytics to predict demand patterns, optimize energy distribution, reduce transmission losses, and enhance grid resilience. The specific objectives include:

- **Demand Forecasting:** Implement AI algorithms to predict electricity demand with high accuracy, enabling better load management and reducing the likelihood of power outages.
- **Grid Optimization:** Utilize AI to optimize the distribution of electricity, ensuring efficient transmission and reducing losses in the grid.
- **Renewable Energy Integration:** Integrate AI systems to manage the variability of renewable energy sources, facilitating their seamless integration into the national grid.
- **Automated Decision-Making:** Develop AI-based decision-making tools for real-time management of the grid, improving response times to disruptions and enhancing overall grid stability.

2. SOFTWARE DEVELOPMENT LIFE CYCLE

2.1 Process Model: Scrum

Why we are selecting Scrum:

Scrum is a popular Agile framework for managing and completing complex projects. For your "AI Transmitted Electricity Supply" project, using Scrum could be advantageous for several reasons:

1. Flexibility and Adaptability: Scrum is designed to accommodate changes. In a project involving AI and electricity supply, requirements might evolve as new insights are gained or technologies change. Scrum's iterative approach allows for regular reassessment and adaptation, ensuring the project can pivot as needed.

2. Incremental Progress: Scrum focuses on delivering small, usable increments of the product in short cycles (sprints). This allows you to build and refine features progressively. For a complex project like AI-based electricity management, this incremental delivery helps in managing complexity and validating progress early.

3. Continuous Feedback: Scrum promotes frequent feedback from stakeholders and team members through regular meetings (like sprint reviews). This feedback loop is crucial for ensuring that the project aligns with user needs and stakeholder expectations, particularly in innovative fields where requirements can be unclear or evolving.

4. Team Collaboration: Scrum emphasizes collaboration within the team and with stakeholders. For a multidisciplinary project involving AI and electricity supply, effective communication and teamwork are essential for integrating different aspects of the project and addressing any issues that arise.

5. Focus on Deliverables: Scrum provides a clear structure for managing and prioritizing tasks through its product backlog and sprint planning. This helps in focusing on delivering the most valuable features first, which is crucial in complex projects where resources and time may be limited.

6. Risk Management: By breaking the project into manageable sprints and continuously assessing progress, Scrum helps in identifying and addressing risks early. This is particularly important for innovative projects where unknowns can pose significant risks.

Scrum is well-suited for the "AI Transmitted Electricity Supply" project due to its ability to handle complex, evolving requirements and its focus on iterative development and stakeholder collaboration. The iterative nature of Scrum will allow the team to adapt to changes, incorporate feedback, and manage the complexities of integrating AI with electricity supply systems effectively. The evidence from industry practices and Scrum's track record in similar projects supports its selection as the process model for this project. Scrum's iterative process, focus on

collaboration, and adaptability to change make it a strong fit for managing a complex and potentially evolving project like "AI Transmitted Electricity Supply."

Why we are not selecting other models:

Other models might not be as effective if the project requirements are expected to change frequently or if iterative development is needed. Waterfall, for example, is more rigid and best suited for projects with well-defined and stable requirements. Scrum's strengths in handling complexity, facilitating iterative development, and encouraging regular feedback make it a good fit for innovative projects like AI-transmitted electricity supply, where adaptability and frequent reassessment are crucial.

2.2 Project Role Identification and Responsibilities

• **Product Owner:** Product Owner is officially responsible for the project, managing, controlling, and making visible the Product Backlog list. He makes the final decisions of the tasks related to product Backlog.

• **Scrum Master:** Scrum Master interacts with the project team as well as with the customer and the management during the project.

• **Scrum Team:** The scrum team is involved, for example, in effort estimation, creating the Sprint Backlog, reviewing the product Backlog list and suggesting impediments that need to be removed from the project.

• **Stakeholders/Clients:** While not directly part of the Scrum team, stakeholders, including clients and end-users, play a vital role. Their input is essential during sprint reviews and backlog refinement sessions. Regular collaboration with stakeholders ensures that the product aligns with business needs and user expectations.

• **Customer:** Customer participates in the tasks related to product Backlog items for the system being developed or enhanced.

• **Management:** Management is in charge of final decision making, along with the agreements, standards, and conventions to be followed in the project.

3.Requirement Analysis:

3.1: Stakeholder Identification

- **Utilities Companies**: Electricity providers looking to improve efficiency.
- **Consumers**: Residential and commercial users of electricity.

- **Regulatory Bodies**: Government entities overseeing energy supply and regulations.
- **Technology Partners**: Companies providing AI solutions, hardware, and software.
- **Maintenance Teams**: Personnel involved in the upkeep of the electricity supply infrastructure.

3.2: Gathering Requirements

- **Interviews/Surveys**: Conduct interviews with stakeholders to gather insights on their needs and pain points.
- **Workshops**: Organize collaborative sessions with key stakeholders to brainstorm features and functionalities.
- **Existing Systems Analysis**: Review current electricity supply systems to identify gaps and opportunities for improvement.

3.3: Functional Requirements

- **AI Algorithms**: Development of algorithms for demand forecasting, load balancing, and predictive maintenance.
- **Real-time Monitoring**: Dashboard for utilities to monitor electricity usage and system health in real-time.
- **Consumer Engagement**: Mobile app for consumers to track usage patterns, costs, and savings.
- **Automated Outage Management**: AI-driven identification of outages and automatic reporting to maintenance teams.
- **Integration**: Ability to integrate with existing energy management systems and IoT devices.

3.4: Non-Functional Requirements

- **Scalability**: System should handle increasing data loads as usage grows.
- **Reliability**: High availability and fault tolerance to ensure continuous service.
- **Security**: Strong cybersecurity measures to protect sensitive data.
- **Usability**: User-friendly interfaces for both utility operators and consumers.
- **Compliance**: Adherence to regulatory standards and guidelines in the energy sector.

3.5: Technical Requirements

- **Data Sources**: Identification of data sources needed for AI training (e.g., historical usage data, weather data).
- **Infrastructure**: Requirements for cloud vs. on-premises solutions, including server specifications.
- **Software Stack**: Tools and technologies for AI model development, data analytics, and front-end applications.

3.6 Performance Metrics

- **Efficiency Gains**: Measure improvements in energy distribution efficiency.
- **Cost Reduction**: Analyze savings in operational costs due to predictive maintenance.
- **Customer Satisfaction**: Monitor consumer feedback through surveys and app usage analytics.

3.7 Risk Analysis

- **Data Privacy**: Address potential risks related to consumer data handling.
- **Technology Adoption**: Assess challenges in getting stakeholders to adopt new AI-driven technologies.
- **Operational Disruptions**: Evaluate risks of transitioning from current systems to AI-driven solutions.

3.8 Documentation and Validation

- **Requirements Specification Document**: Compile all requirements into a formal document for review.
- **Validation Sessions**: Present findings to stakeholders for feedback and confirmation of requirements.

3.9: Scalability Requirements

- The system must be able to scale to accommodate future increases in data volume and user base without performance degradation.

3.10: Data Privacy and Security

- Implement robust security measures to protect sensitive consumer data and comply with relevant regulations (e.g., GDPR).

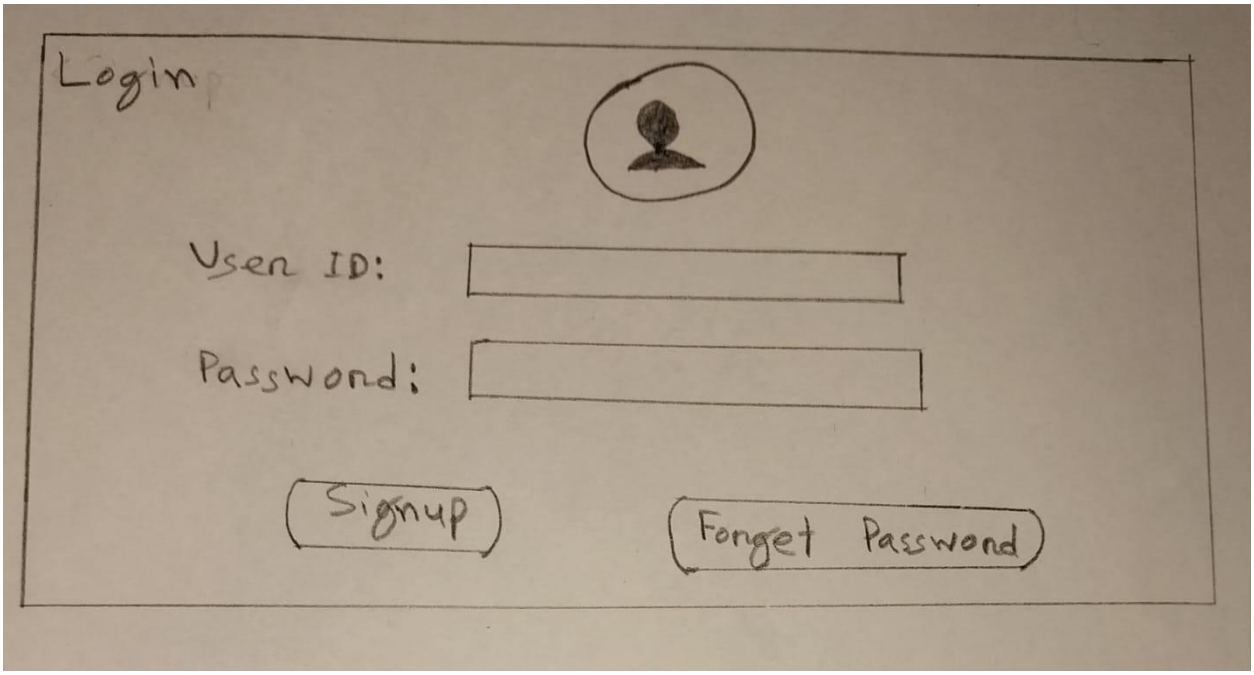
3.11: Predictive Maintenance Capabilities

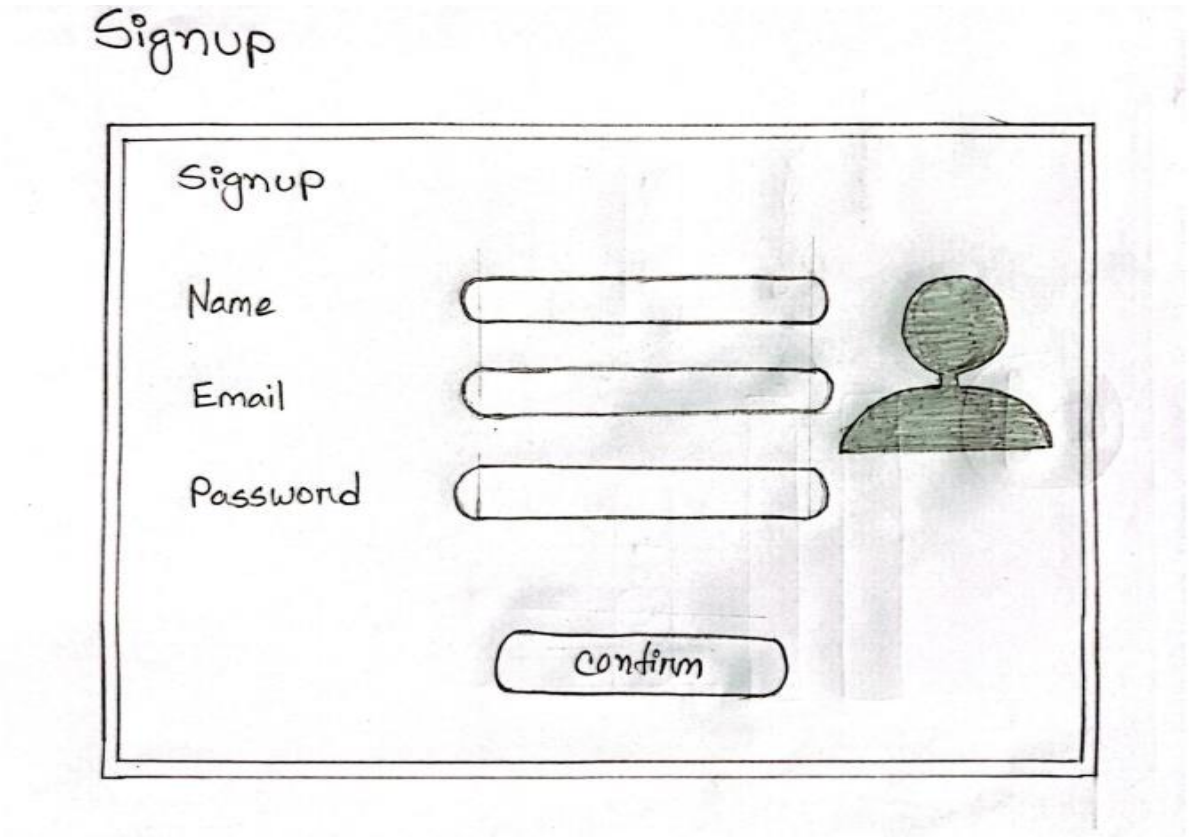
- Utilize AI to analyze equipment performance and predict maintenance needs, minimizing downtime and extending asset life.

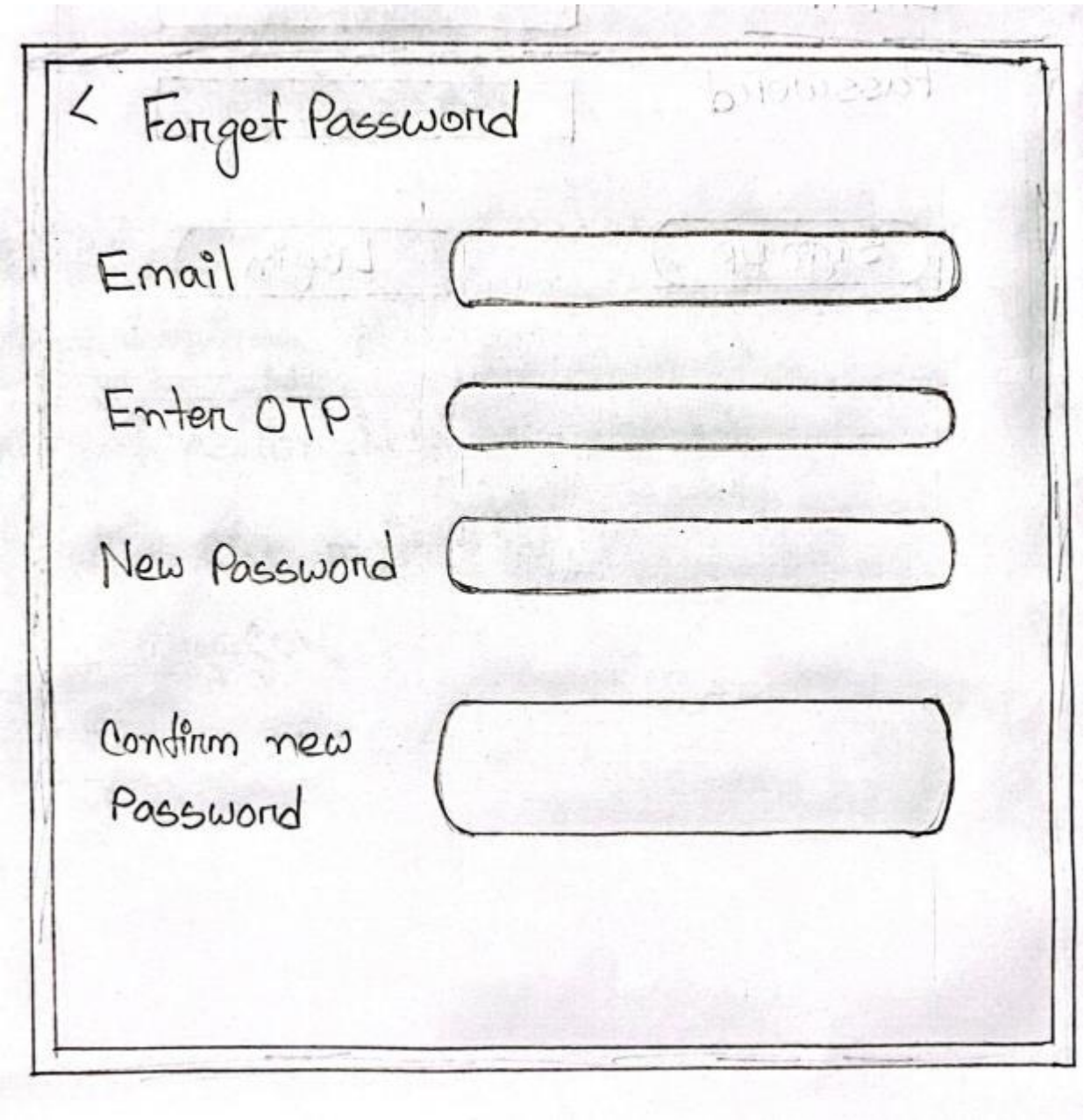
3.12: Regulatory Compliance

- Ensure the system adheres to industry regulations and standards, facilitating audits and reporting as required by authorities.

4.UIUX design:




Signup
Signup
Name
Email
Password
confirm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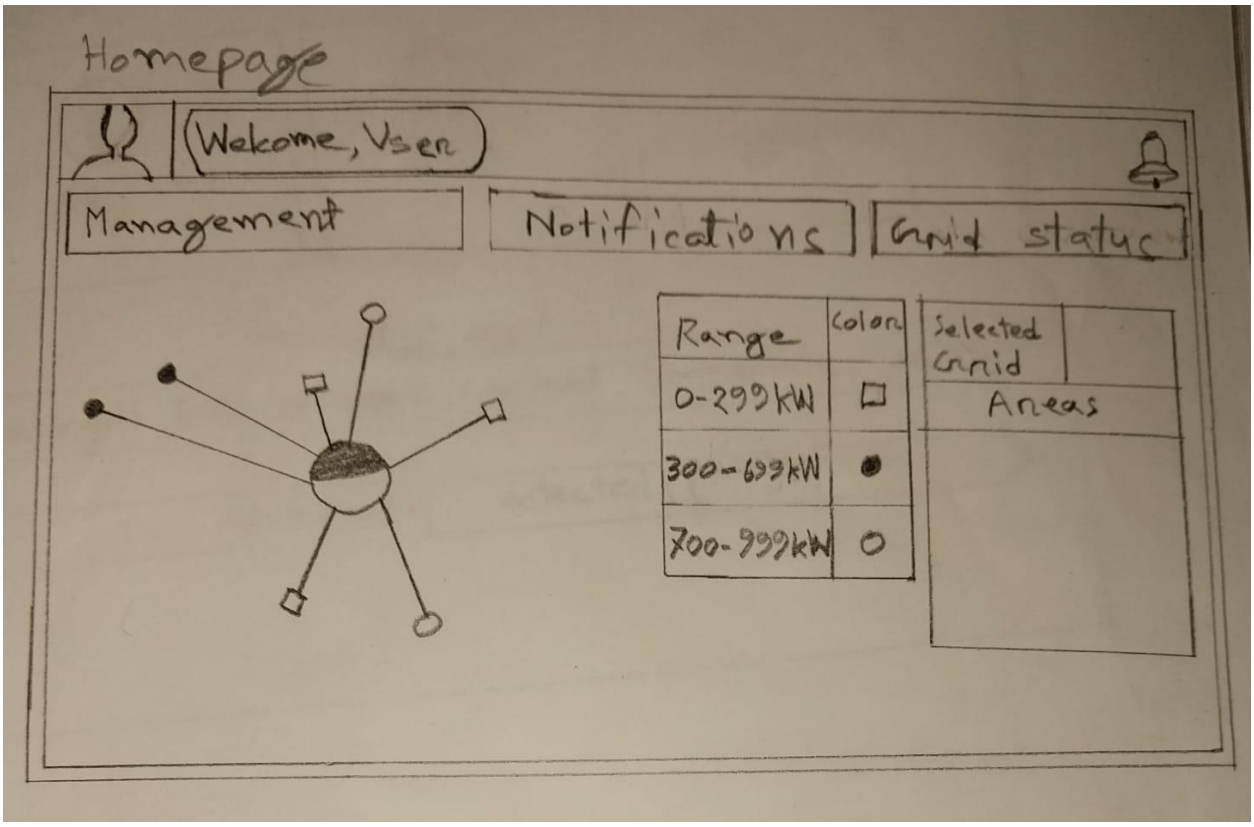
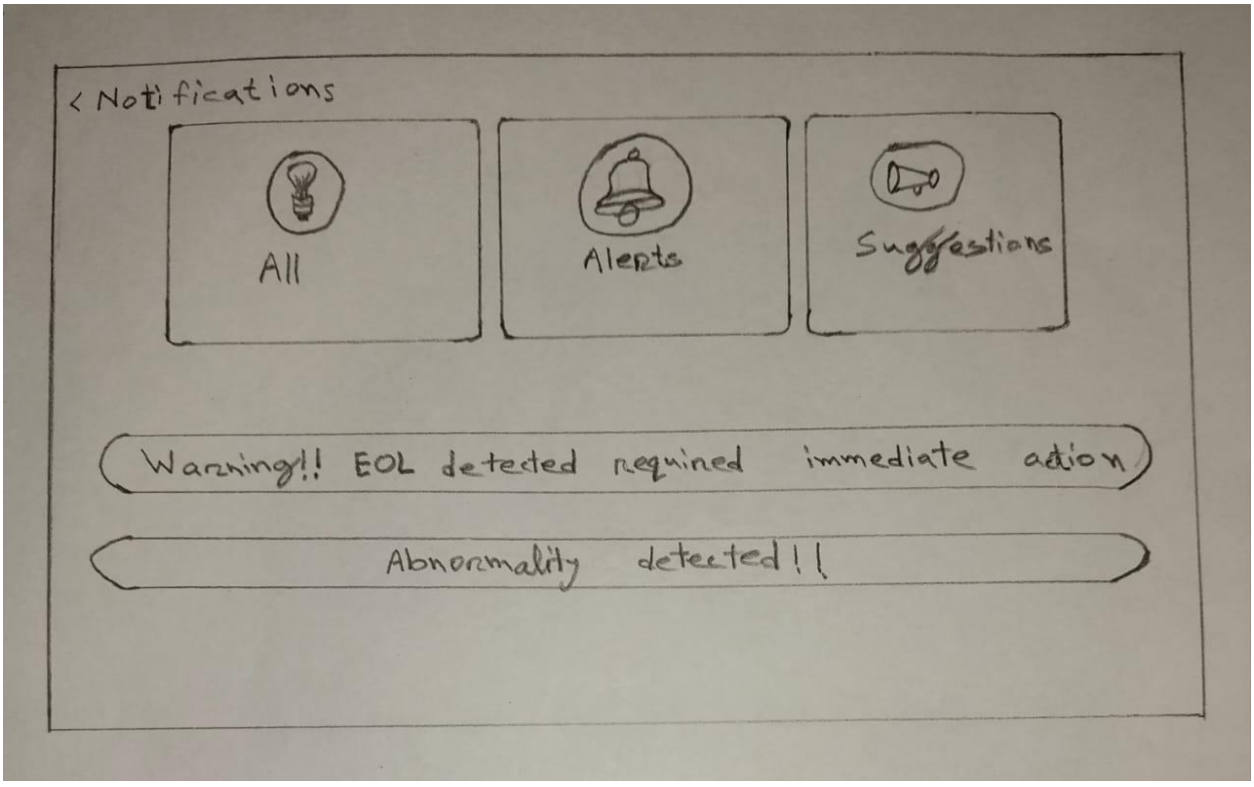
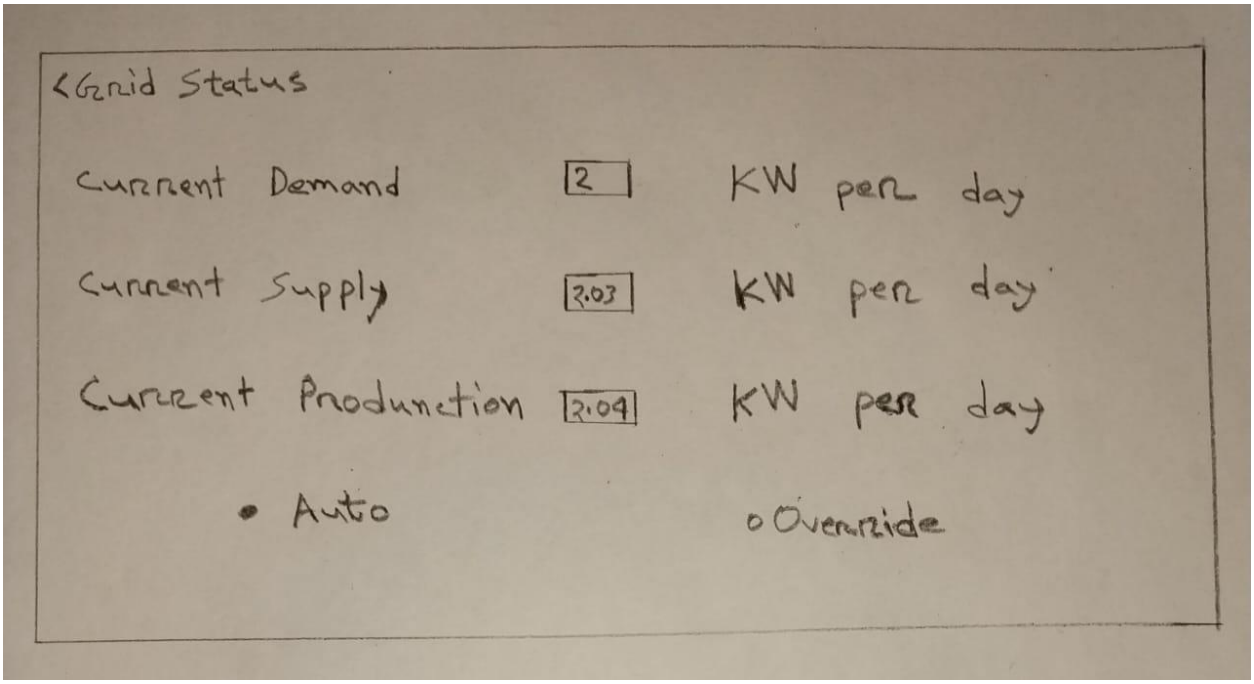
Email
Enter OTP
New Password
Confirm new Password


Homepage
Welcome, User
Management
Notifications
Grid status
Range
Color
0-299kW
300-699kW
700-999kW
Selected Grid Areas


< Notifications
All
Alerts
Suggestions
Warning!! EOL detected required immediate action
Abnormality detected!!



4.Project test planning:

Project Name: Artificial intelligence driven transformation of electricity supply			Test designed by: MD. MAHMUDUL HASAN	
Test Case ID: LO_1 Test Priority (Low, Medium, High): High Module Name: Login			Test Designed date:9/10.2024 Test Executed by: Test Execution Date:	
Test Title: Login with user id and password				
Description: Testing the login page Precondition (If any): User must have valid user id and password				
Test steps	Test data	Expected result	Actual Result	Status
1.Go to the website 2.Enter user id 3.Enter password 4. Click Sign up	User id: 2645 Password:73465	User should login into the application		

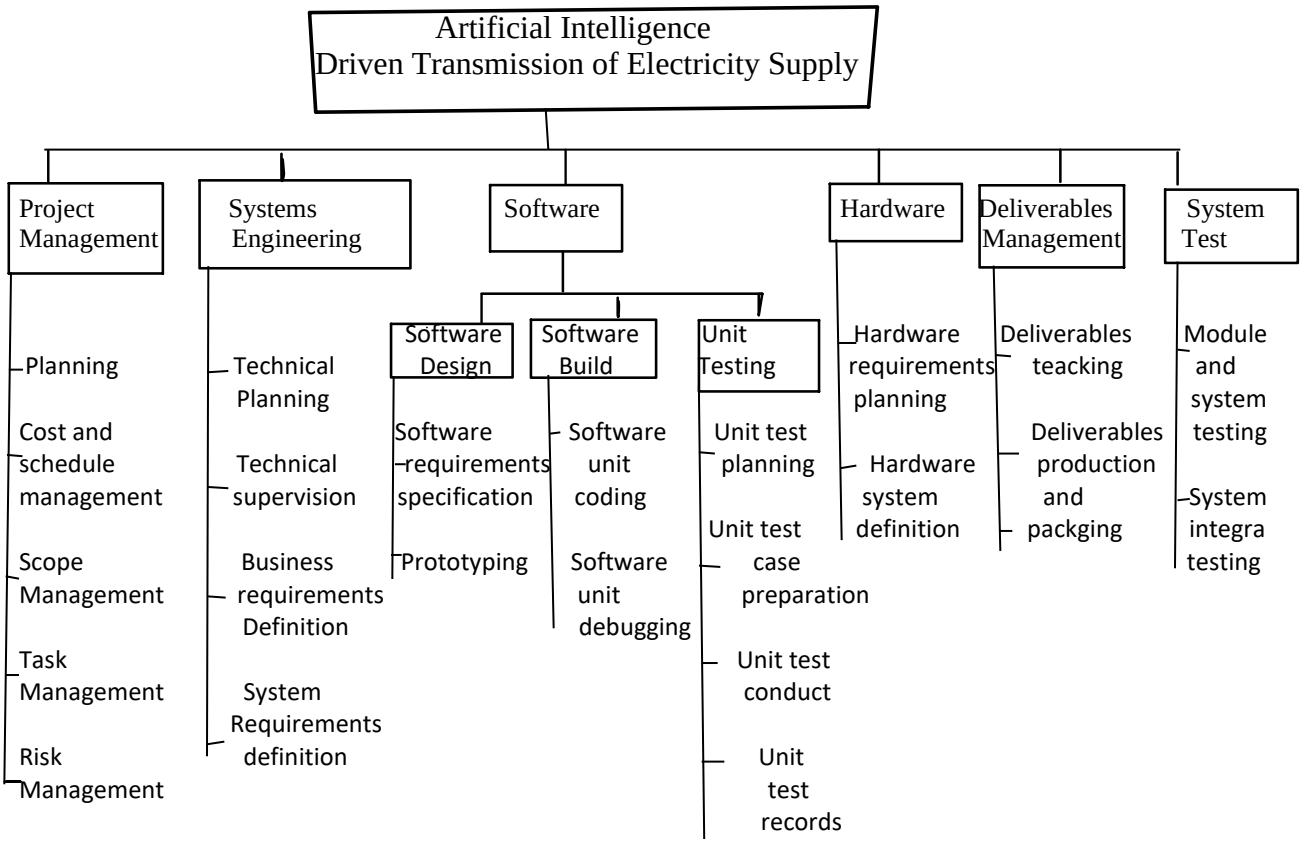
Project Name: Artificial intelligence driven transformation of electricity supply			Test designed by: Mohammed Istishad Alam Tishad	
Test Case ID: LO_2 Test Priority (Low, Medium, High): High Module Name: Reset Password			Test Designed date:9/10.2024 Test Executed by: Test Execution Date:	
Test Title: Reset user password				
Description: Resetting a user password Precondition (If any): User must have valid email id.				
Test steps	Test data	Expected result	Actual Result	Status
1. Go to the website 2. Click forgot password 3. Enter email 4.Enter verification code 5.Reset password	Mahmud@gmail.com OTP: 6734 Password: 57958	User password reset successful		

Project Name: Artificial intelligence driven transformation of electricity supply			Test designed by: Afifa Akter Maria	
Test Case ID: LO_3 Test Priority (Low, Medium, High): High Module Name: Signup			Test Designed date:9/10.2024 Test Executed by: Test Execution Date:	
Test Title: Signup with necessary information				
Description: Testing the Signup page Precondition (If any): User needed to login first				
Test steps	Test data	Expected result	Actual Result	Status
1. Go to the website 2. Click signup 3. Enter Name 4.Enter email Enter password 5.Click on ‘confirm’	Name: Abir abir@gmail.com pass:83456	User will reach the home page		

Project Name: Artificial intelligence driven transformation of electricity supply			Test designed by: Sheikh Abir Islam	
Test Case ID: UN_1 Test Priority (Low, Medium, High): Medium Module Name: User Notification			Test Designed date:9/10.2024 Test Executed by: Test Execution Date:	
Test Title: Verify notification for various faults				
Description: Precondition (If any): User need to sign up into homepage				
Test steps	Test data	Expected result	Actual Result	Status
Go to home page Go to notifications		Automatically give notifications		

Project Name: Artificial intelligence driven transformation of electricity supply			Test designed by: Md. Mahmudul Hasan	
Test Case ID: HP_1 Test Priority (Low, Medium, High): Medium Module Name: Homepage			Test Designed date:9/10.2024 Test Executed by: Test Execution Date:	
Test Title: Homepage testing				
Description: Testing the process of reaching the home page Precondition (If any): User must have valid user id, password, email account				
Test steps	Test data	Expected result	Actual Result	Status
Signup from login page Confirm from signup page	Name: Abir abir@gmail.com pass:83456	The homepage will appear without any error		

6. Work Breakdown Structure:



7.Software Project Estimation:

Using COCOMO(Constructive cost model):

Here the project type is Organic

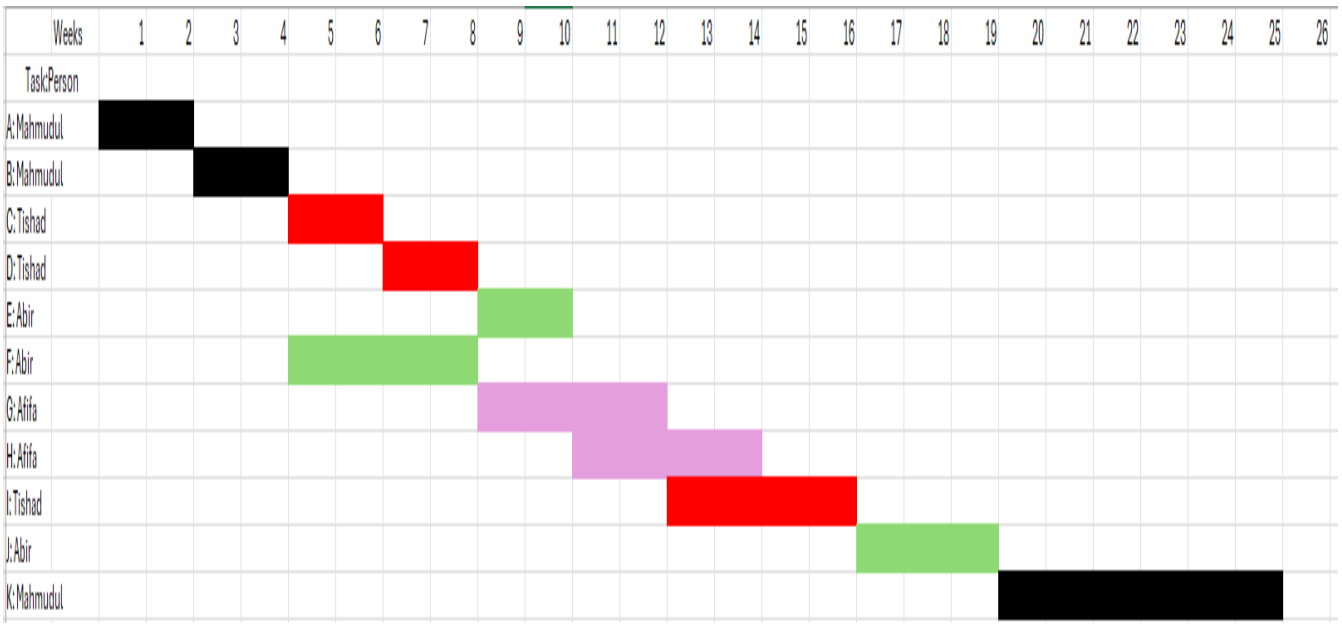
For that,
Coefficient<Effort Factor>= 2.4

P=1.05
T=0.38
SLOC = 6000

Effort = PM = Coefficient<Effort Factor>*(SLOC/1000)^P
= 2.4*(6000/1000) ^1.05
= 15.75
Development time = DM = 2.50*(PM)^T
= 2.50* (15.75) ^0.38
= 7.13
Required number of people = ST = PM/DM
= 15.75/0.38
= 41.45 ~ 42

8.Timeline Chart:

Timeline Chart - 1



Activities Key:

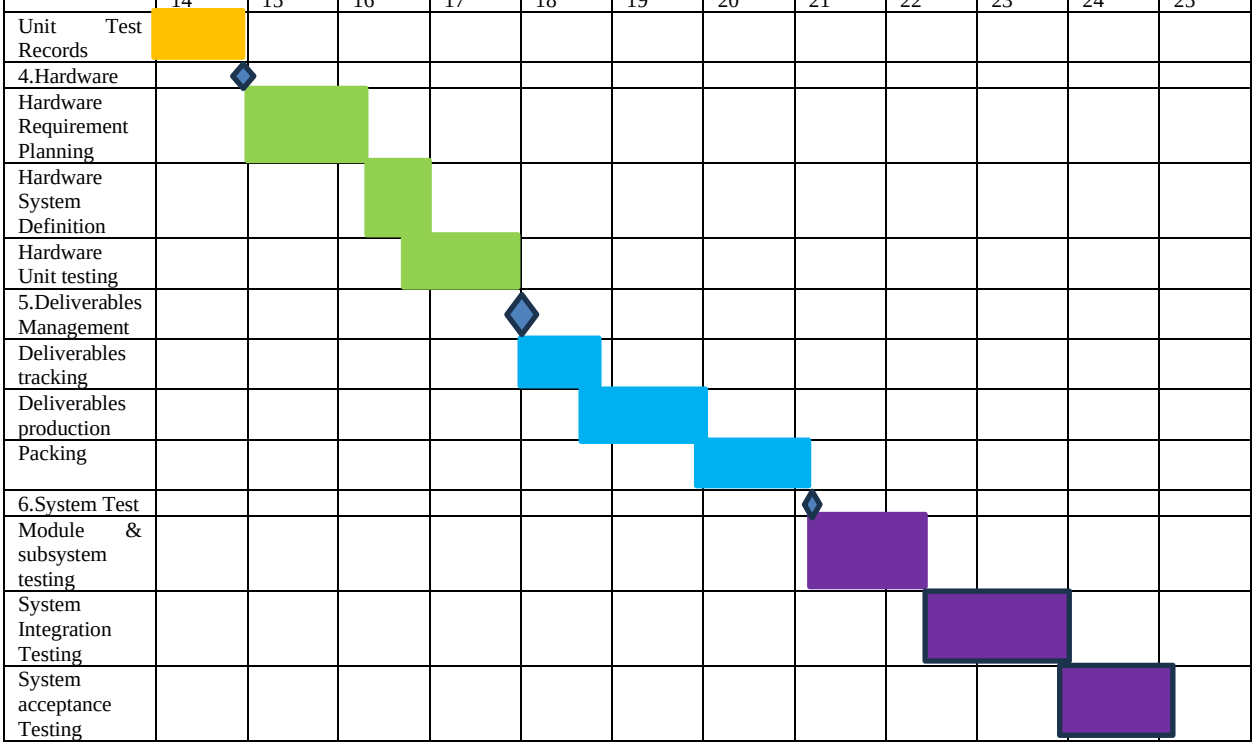
A. Overall Planning
B. Specify Module
C. High Level Architecture Design
D. Code Module
E. Functional Testing

F. Product Backlog Update
G. Integration
H. Integration Testing
I. System Testing
J. Documentation
K. Release

Timeline Chart - 1

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week10	Week11	Week12	week13
1.Project Management													
Planning													
Cost and Schedule management													
Scope management													
Task management													
Risk Management													
2.Systems Engineering													
Technical planning													
Technical Supervision													
Business requirements definition													
System requirements definition													
3.Software													
Software Requirements specification													
Prototyping													
Software unit coding													
Software unit debugging													
Unit test planning													
Unit test case preparation													
Unit test conduct													

	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25
Unit Test Records												
4.Hardware												
Hardware Requirement Planning												
Hardware System Definition												
Hardware Unit testing												
5.Deliverables Management												
Deliverables tracking												
Deliverables production												
Packing												
6.System Test												
Module & subsystem testing												
System Integration Testing												
System acceptance Testing												



9.Earned Value Analysis:

Task	Planned Effort	Actual Effort
1	11	12
2	13	9
3	12	16
4	8	9
5	11	10
6	18	19
7	10	10
8	5	6
9	12	10
10	7	8
11	5	4
12	14	14.5
13	16	-
14	9	-

BCWP

BCWS

ACWP

Given , The total number of tasks = 40
Effort estimated, BAC = PM*20 = 15.75*20 = 315

BCWS = = (11+13+12+8+11+18+10+5+12+7+5+14) = 126
BCWP = (11+13+12+8+11+18+10+5) = 88
ACWP = (12+9+16+9+10+19+10+6) = 91

So,
SPI = BCWP/BCWS = 88/126 = 0.6984
SV = BCWP – BCWS = 88 - 126 = -38 person-day
CPI = BCWP /ACWP = 88/91 = 0.9670
CV = BCWP – ACWP = 88 – 91 = -3 person-day

Schedule for completion = BCWS/BAC = (126/315) *100% = 40%
Completed = BCWP/BAC = (88/315) *100% = 27.94%

Here,
BAC is the budgeted cost of work scheduled.
SPI is schedule performance index,
SV is schedule variance,

CPI is cost performance index,
CV is cost variance.
BCWP is the sum of BCWS for all work tasks that has been completed by a point of time. BCWS effort planned for each task.
ACWP is the actual cost of work performer

10. Risk Management

Risks	Category	Probability	Impact
Size estimate may be significantly low	PS	50%	2
Large number of users than planed	PS	30%	2
Data security	CU	70%	2
Lack of knowledge about system	BE	60%	3
Wrong data collection	BE	10%	1
Less reuse than planned	PS	30%	1
End-users resist system	BU	40%	1
Delivery deadline will be tightened	BU	50%	2
Funding will be lost	CU	30%	1
Customer will change requirements	PS	80%	2
Technology will not meet expectations	TE	40%	1
Lack of training on tools	DE	70%	3
Staff inexperienced	ST	50%	2
Staff turnover will be high	ST	50%	2
Reliability of the model	ST	50%	1
Environmental variability	DE	20%	4

Impact Values:

1 – catastrophic

2- critical

3 – marginal

4 – negligible

Risks	Risks Reduction technique
Size estimate may be significantly low	Review past projects to gather data on size estimates versus actual outcomes. Use this information to refine estimation techniques.

Large number of users than planed	Design the system with scalability in mind, allowing it to handle increased user loads without significant rework and plan flexible infrastructure.
Data security	Use strong encryption for data at rest and in transit to protect sensitive information from unauthorized access.
Lack of knowledge about system	Create detailed documentation for the system architecture, design, and functionality to provide a reference for current and future users.
Wrong data collection	Clear description of data collection requirements and ensure they are understood by all stakeholders before development begins.
Less reuse than planned	Establish and document standard design patterns that promote reuse across different parts of the project.
End-users resist system	Involve end-users early in the development process to gather their input and ensure the system meets their needs.
Delivery deadline will be tightened	Adopt Agile practices to allow for flexibility in prioritizing features and adapting to changing timelines.
Funding will be lost	Develop a detailed and realistic budget that outlines all costs, ensuring transparency and accountability
Customer will change requirements	Use Agile practices, allowing for flexibility and iterative development, which can accommodate changing requirements more easily.
Technology will not meet expectations	To reduce the risk of technology not meeting expectations, ensure thorough assessment, stakeholder involvement, clear communication, realistic goal-setting, adequate training, rigorous testing, continuous improvement, and contingency planning.
Lack of training on tools	To reduce the risk of lack of training on tools, provide comprehensive training sessions, create easy-to-follow user guides, offer ongoing support, encourage hands-on practice, and establish a feedback loop for continuous improvement.
Staff inexperienced	Develop a comprehensive training program that covers the necessary skills and technologies. Include both formal training and

	hands-on sessions to help staff gain practical experience.
Staff turnover will be high	Regularly review and adjust salaries and benefits to ensure they are competitive within the industry. Consider offering flexible work options, health benefits, and other perks.
Reliability of the model	Develop a comprehensive testing strategy that includes unit tests, integration tests, and system tests to validate the model under various conditions.
Environmental variability	Use configuration management tools (e.g., Ansible, Puppet, or Chef) to manage environment settings and dependencies consistently across all environments.

Rubric for Project Assessment (CO3)

Criteria	Marks distribution (Max 3X5= 15)				Acquired Marks
	Inadequate (1-2)	Satisfactory (3)	Good (4)	Excellent (5)	
Selection of Software Engineering Models	Does not articulate a position or argument of choosing appropriate model. Does not present any evidence to support the arguments for the choice of the model	Articulates a position or argument for choosing models that is unfocused or ambiguous. Presents incomplete/vague evidence to support argument for model choice	Articulates a position or argument of choosing models that is limited in scope. Does not present enough evidence to support the argument for the choice of the model	Clearly articulates a position or argument for the choosing software engineering models. Presents sufficient amount of evidence to support argument for the model selection	
Role identification and Responsibility Allocation	The project has poor project management plans for identifying roles and assigning the responsibilities	Identify few roles in the project management where some of the roles are left alone with any project responsibilities	Identify most of the roles in the project management and assign their responsibilities	Well planned project with proper role identification and responsibility allocation in the project management activities	
Impact identification					

Formatting and Submission	Project report is not complete and Several errors in spelling and grammar. Present a Confusing organization of concepts, supporting arguments, and real-life example. Sentences rambling, and details are repeated.	Some errors in spelling and grammar. Some problems of organizing the answer in a logical order of defining, elaborating, and providing real-life examples.	Few errors in spelling and grammar. Presents most of the details in a logical flow of organization in definition, details, and example.	Project report is complete and No errors in spelling and grammar. Consistently presents a logical and effective organization of definition, details, and real-life example of the topic.	
Acquired marks:					
CO Pass / Fail:					

Rubric for Project Assessment (CO4)

Marking Criteria	Marks Distribution (Maximum 3X5=15)				Acquired Marks
	Inadequate (1-2)	Satisfactory (3)	Good (4)	Excellent (5)	
Project Planning	No background information regarding the project is given; project goals and benefits are missing.	Insufficient background information is given; project goals and benefits are poorly stated	Sufficient background information is given; the purpose and goals of the project are explained.	Thorough and relevant background information is given; project goals are clear and easy to identify.	
Effort Estimation and Scheduling	Student vaguely discuss the impact of societal, health, safety, legal and cultural issues in their project	Student provided with partial relevance to the impact of societal, health, safety, legal and cultural issues in their project	Student fairly provided the analysis to the impact of societal, health, safety, legal and cultural issues in their project	Student comprehensively provided the analysis to the impact of societal, health, safety, legal and cultural issues in their project	

Risk Management	Ambiguous representative example.	Partially identify / indicate towards real-life example.	Real-life example is fairly connected towards the definition.	Comprehensively defend with real life example.	
Acquired Marks:					
CO Pass / Fail:					