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1.0 Introduction

SmartSense Smart Home Energy Optimization project is a strategic IT-based solution designed to address the growing need for sustainable energy management in residential environments. As utility costs rise and environmental sustainability becomes a global priority, homeowners and property managers face the challenge of accurately monitoring and reducing unnecessary energy consumption. SmartSense addresses these issues by integrating industrial-grade IoT sensors with advanced artificial intelligence to provide real-time monitoring, predictive analytics, and automated appliance control.

This project will be executed over a six-month period, commencing on 1 June 2026 and concluding on 30 November 2026, with a fixed cost baseline of RM300,000. Utilizing an Agile-Scrum framework, the development is structured into eight distinct sprints, ensuring that core features—such as real-time environmental monitoring, AI-driven analytics, and secure user authentication—are delivered incrementally and refined through continuous feedback. By achieving at least 85% prediction accuracy in its AI modules, SmartSense aims to demonstrate a significant reduction in household electricity usage, thereby reinforcing company growth through technological innovation.

2.0 Project Scope Statement

2.1 Project Description

The SmartSense system is a cloud-based energy management platform that provides better opportunities and accessibilities for residents and property administrators to optimize electricity usage through data-driven insights. The project involves the deployment of a centralized Central Hub (Gateway) that aggregates data from 50 industrial-grade IoT sensors—measuring temperature, humidity, and motion—and 20 smart power controllers. This hardware ecosystem, primarily supplied by TechnoMart Malaysia, serves as the foundation for a sophisticated software suite that includes a mobile dashboard for residents and an administrative portal for building managers.

2.1.1 In-scope

a) Development.
   - Distinguish and document each functional and non-functional requirements of the system from the stakeholders. Develop a finalized SRS document to get approval on scope and budget from the stakeholders.
   - Define and develop system design which includes UI and UX for frontend design. System architecture, database, API and business logic design for backend design. Sensor data flow, format and transmission methods for IoT & Sensor Integration. Approve the system design document with the suitable stakeholders.
   - Developments of frontend, backend, database and IoT & sensor integration is initiated. Testing methods are applied throughout each building phase which will produce test plans and test cases.

b) Installation
   - The system will be implemented in a real life environment to make sure that the system operates correctly across the mediums.
   - The software deployment includes setting up the web servers and cloud platforms, configure environment variables and deploy backend API, frontend app and database.
   - Install the sensor and IoT device to selected appliances and finally integrate them with the system. Post installation testing will be run to check major functionalities.

c) Training
    - User role-based training will be carried out to allow end users to adjust themselves to the system. System navigation, UI overview, functionality and features will be highlighted to ease adaptation process. Training materials such as user manuals and video tutorials will be provided.

d) Acquire Supply
    - Few hardware and software components such as temperature, humidity, industrial grade sensors and cloud APIs must be obtained from an external vendor/supplier (TechnoMart Malaysia) .
    - Tools, appliances, mounting kit and cables are also obtained from the same vendor in order to guarantee consistency throughout the installation process.

e) Pre-Deployment
    - During this phase, the maintenance team from Sunway Lakeside will be briefed and trained to maintain the units. This process will then proceed to the installation of the product unit in 3 house units for testing.
    - Post mortem work such as maintenance/repair will be executed if the product unit appears faulty during the testing phase. UAT will be carried out after maintenance works.

2.1.2 Out-of-scope

a) The system will focus only on monitoring, analysis and optimization suggestions. There will be no electrical appliances produced from this project. This highlights that clients must use their existing appliances to be integrated with the system.

b) The system will support integration of sensors only with a predefined list of compatible/selected appliances and it will not guarantee universal compatibility. This ensures project effort to focus on strategic, high-impact appliances rather than attempting exhaustive integration.

c) The system will provide suggestions and alerts to users based on data analysis and is able to automatically adjust or control the electrical appliances. Similarly, it will not be integrated into existing third-party smart home system like Alexa. This avoids technical complexity of direct device control and helps reduce regulatory compliance.

2.1.3 SMART Objective

a. **Specific:**To design and implement Smart Home Energy Optimization system, incorporating authentication, IoT-based environmental monitoring, smart appliance control, smart home artificial intelligence led energy analytics and smart alerts feature to improve energy efficiency and energy management system.

b. **Measurable:**To effectively implement all scheduled system functionality through eight sprints, comprising real-time sensor monitoring, appliance automation, energy usage analytics, and alert notifications, and complete User Acceptance Testing (UAT) in the last phase of the project.

c. **Achievable:**To design and implement the system with the help of the given project team, available IoT devices, and software solutions, according to the principle of Agile Scrum and approved project plan of 1 January 2026 to 17 June 2026

d. **Relevant:**To promote sustainability in energy consumption, optimize operations, and improve the decision-making process among residents and administrators through real-time monitoring and automation and decision-making based on data.

e. **Time-bound:**To complete system development, pilot deployment, UAT and final documentation by 17 June 2026, as per the Gantt chart and sprint timeline approved.

2.1.4 Constraints

This part describes the key issues that will make it challenging to execute the SmartSense Smart Home Energy Optimization project. The constraints relate to finances, time, internal resources, integrating technology, dependence on vendors, and the performance of the system. Recognizing these constraints early on helps the team keep the project on schedule from start to finish.

a. Time Constraint

   The project is strictly limited to a 6-month timeline (1 June 2026 to 30 Nov 2026). Any delay could affect the final deadline for the delivery of the project.

b. Financial Constraint

   The project must be executed within a fixed cost baseline of RM300,000, limited budget leads to the reduction of unnecessary high-end hardware and development costs.

c. Resource Constraint

   All software development and system integration must be carried out independently by the internal team, which limits human resources.

d. Technology & Integration Constraint

   The system integrates only with a predefined list of appliances and will not integrate with third-party smart home systems to avoid complexity.

e. Vendor & Supply Dependency

   The heavy reliance on the sensor supply from TechnoMart Malaysia means that the project progress is strictly influenced by its specific delivery schedule.

f. Data Compliance Constraint

   Collection of household energy and environmental usage data must strictly comply with local data privacy and IoT regulations, requiring data limitations.

g. Performance Constraint

   The system must meet required accuracy levels for monitoring, prediction, and optimization to achieve acceptable performance. The AI module must achieve a minimum prediction accuracy of 85%.

h. Physical Installation Envioronment Constraint

   Household layout, wiring availability, and network coverage can affect final sensor installation, potentially impacting system effectiveness and data processing performance.

2.1.5 Assumptions

This section presents the underlying assumptions that the project team is going by to continue with the development. These are assumptions on the support of the stakeholders, adoption by the users, availability of resources, and issues of compliance. Listing down these assumptions will let everyone understand what the conditions that are to be expected for the SmartSense project to be successful.

a. Stakeholder Commitment and Access

   It is assumed that the client organization (Property Management Company) will provide timely feedback during sprint reviews and grant necessary physical access to the pilot residential units for sensor installation and testing purposes.

b. Availability of Required Hardware

   The availability of high-end IoT sensors, mounting kits, and other physical hardware required for the SmartSense implementation is assumed to be guaranteed by the external vendor (TechnoMart Malaysia) and procured before the critical integration phase.

c. User Readiness to Embrace Technology

It is assumed that the end-users (homeowners and renters) will be open-minded and willing to participate in part in the pilot program. Therefore, they will let monitoring devices be placed in their homes and use the new mobile dashboard to keep track of their energy use.

d. Stable Network Infrastructure

It is assumed that the Wi-Fi of the residential units is stable and there is sufficient bandwidth to support continuous real-time data transmission from IoT sensors to the central system without obvious interruption.

e. Smooth Vendor Integration

It is assumed that the external suppliers of IoT sensors have good documentation records and work perfectly with internal software architecture, allowing data to be exchanged easily without requiring a lot of custom workarounds.

2.1.6 Critical Success Factor

This section highlights the key measurable outcomes that must be achieved for the SmartSense project to be considered successful. These factors focus on delivery performance, system accuracy, user acceptance, and value realization, consistent with the Critical Success Factors writing style in the sample.

a. On-time Delivery (within 6 months):

The SmartSense system should be developed, tested, and ready for pilot deployment within the approved six-month timeline (1 June 2026 to 30 Nov 2026).

b. Cost Baseline Compliance:

The project cost baseline should not exceed RM300,000, ensuring resources are controlled while meeting project objectives.

c. AI Performance Accuracy ≥ 85%:

The AI module must achieve at least 85% prediction accuracy to provide reliable energy optimization recommendations.

d. Energy Reduction Outcome ≥ 25%:

The system should demonstrate at least a 25% reduction in electricity usage within four (4) months after operation, verified through system reports.

e. User Acceptance:

Post-deployment feedback should indicate strong usability and acceptance, targeting ≥80% user satisfaction to support smooth handover and adoption. (Aligned with the sample's satisfaction-style CSF structure.)

2.2 Project Implementation Approach

The Agile-Scrum framework guides the development of *SmartSense* by organising the work into short and controlled cycles. This approach allows the system to be built gradually, which is important when working with real-time IoT data and features that depend on continuous refinement. Each sprint produces a working part of the system, enabling early testing and early correction. The development flow adopted for this project follows the structure shown in *Figure 2.2* below.

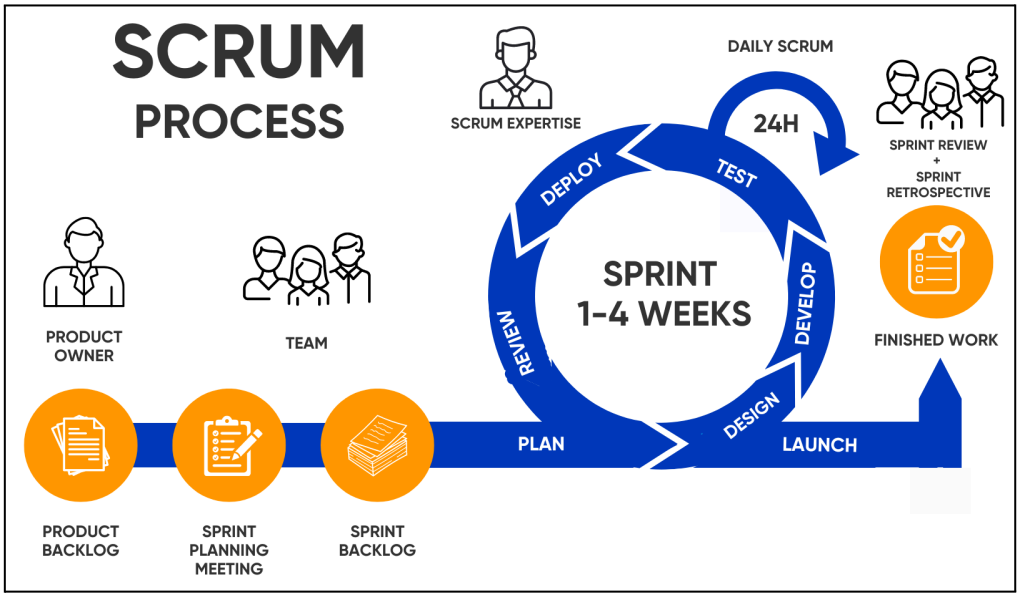


Figure 2.2: SCRUM Process (Scrum Methodology: A Proven Formula for Managing Complex Projects, n.d.)

The left section of *Figure 2.2* focuses on the preparation work required before development begins. It shows the Product Backlog, which contains every planned *SmartSense* feature to be implemented. This area is important because it controls the project direction. The Product Owner decides what goes into the backlog and what becomes a priority. The Sprint Planning Meeting shown beside it ensures that only the most achievable and valuable tasks enter the Sprint Backlog. This prevents the team from handling too many tasks at once and protects the project from unrealistic expectations.

The blue loop in the middle of *Figure 2.2* shows what happens during a sprint. For *SmartSense*, each sprint will plan, design, develop, test, and deploy one feature at a time. For example, one sprint will focus on the authentication feature, while another sprint will focus on IoT sensor monitoring. The loop indicates that development and testing happen closely together. This is important for *SmartSense* because sensor data and API connections need to be checked often to confirm that they work correctly in real time. The Scrum Expertise icon represents the Scrum Master, who guides the team through this loop and helps remove any obstacles that slow down development. This prevents technical problems from accumulating and becoming difficult to fix later.

On the right side, *Figure 2.2* shows the Daily Scrum, Sprint Review, Sprint Retrospective, and Finished Work. In *SmartSense*, a short daily meeting is used to update progress on tasks such as sensor integration. At the end of each sprint, a Sprint Review is held to demonstrate the completed feature, for example showing that the dashboard can display live readings from the sensors. The Sprint Retrospective is then used to discuss what went well and what should change in the next sprint, such as improving test methods or adjusting how sensor data is logged. The orange “Finished Work” icon indicates that each sprint must end with a working part of the system that can be used or tested, so the project grows step by step until all *SmartSense* features and the pilot deployment are completed.

2.2.1 Project Implementation Overview

Our teams has agreed on the timeline for the development and sprint planning as follows:

Table 2.2.1: Project Implementation Overview

Element	**Description**
Project Timeline	1st January 2026 - 30th June 2026
Sprint Duration	3 weeks each
Total Sprint	8 Sprint
Sprint Focus	Sprint 1: Project initialization Sprint 2: Feature 1 Sprint 3: Feature 2 Sprint 4: Feature 3 Sprint 5: Feature 4 Sprint 6: Feature 5

	Sprint 7: Prerelease Sprint 8: Project closure
Sprint Cycle Activity	1. Sprint Planning: Decide & prioritize sprint backlog, and assign roles. 2. Daily Scrum: 15 minutes daily meeting for project update. 3. Sprint Implementation: Develop system by features including testing. 4. Sprint Review: Demonstration of completed features to stakeholders. 5. Sprint Retrospective: Current sprint reflection.

2.2.2 Software Development Phases

This section outlines the software development phases of the *SmartSense* system based on a sprint-based Scrum approach. Each phase represents one sprint with defined timelines, key activities, and expected deliverables, providing a clear view of how the system is developed incrementally from preparation to final acceptance.

Table 2.2.2: Software Development Phases

Phase	Timeline	Activities	Deliverables
Sprint 1	1 Jan 2026 - 21 Jan 2026	**Project Initialization** ● Stakeholder meeting ● Requirement elicitation ● Scope analysis ● Product backlog creation ● Backlog prioritisation ● Initial documentation	SRS, business case and prioritised product backlog
Sprint 2	22 Jan 2026 - 11 Feb 2026	**Authentication Feature** ● Design login and signup flow ● Develop authentication functions ● Configure user roles ● Develop user profile page	Authentication and user profile module
Sprint 3	12 Feb 2026 - 4 Mar 2026	**IoT Monitoring Feature** ● Configure IoT sensors ● Develop monitoring dashboard ● Integrate weather API ● Develop monitoring charts	Real-time monitoring dashboard with sensor and weather data
Sprint 4	5 Mar 2026 - 25 Mar 2026	**Smart Appliance Control Feature** ● Develop device command functions ● Develop smart control interface ● Configure automation rules	Smart appliance control and automation module

Sprint 5	26 Mar 2026 - 15 Apr 2026	**AI Analytics Feature** ● Prepare historical usage data ● Integrate usage analytics functions ● Configure forecasting model ● Integrate AI suggestion module	Analytics dashboard with forecasts and AI recommendations
Sprint 6	16 Apr 2026 - 6 May 2026	**Alerts & Notifications Feature** ● Define alert rules ● Develop notification interface ● Integrate alert trigger logic ● Develop alert history	Alert and notification management module
Sprint 7	7 May 2026 - 27 May 2026	**Pilot Deployment & Training** ● Deploy system to pilot houses ● Configure sensors and environment ● Train maintenance staff	Deployed pilot system and trained support personnel
Sprint 8	28 May 2026 - 17 Jun 2026	**UAT & Final Documentation** ● Conduct user acceptance testing ● Analyse UAT feedback ● Fix high-priority issues ● Compile system guides and final report	UAT report and finalised system documentation

2.3 Work Breakdown Structure

Our Work Breakdown Structure (WBS) is organised into eight sprints, grouped into three key phases: project initialization *(Sprint 1)*, project implementation *(Sprints 2-6)*, and project prerelease and closure *(Sprints 7-8)*. The implementation phase follows a feature-based approach, where each sprint delivers one complete system feature. All sprints run for a fixed duration of three weeks, following the Scrum cycle of planning, structured development work, review, and retrospective. This structure provides a clear and incremental progression from early requirement preparation to final system deployment and acceptance.

1. **Sprint 1: Project Initialization**
    - 1.1. Requirement Elicitation
    - 1.2. Stakeholder Meeting
    - 1.3. Scope Analysis
    - 1.4. Product Backlog Creation
    - 1.5. Backlog Prioritisation
    - 1.6. Initial Documentation
    - 1.7. Sprint Review
    - 1.8. Sprint Retrospective

2. **Sprint 2: Authentication Feature**
    - 2.1. Sprint Planning
    - 2.2. Design Login and Signup Flow
    - 2.3. Develop Authentication Functions
    - 2.4. Configure User Roles
    - 2.5. Develop User Profile Page
    - 2.6. Sprint Review
    - 2.7. Sprint Retrospective

3. **Sprint 3: IoT Monitoring Feature**
    - 3.1. Sprint Planning
    - 3.2. Configure IoT Sensor
    - 3.3. Develop Monitoring Dashboard
    - 3.4. Integrate Weather API
    - 3.5. Develop Monitoring Chart
    - 3.6. Sprint Review
    - 3.7. Sprint Retrospective

4. **Sprint 4: Smart Appliance Control Feature**
    - 4.1. Sprint Planning
    - 4.2. Develop Device Command Functions

4.3. Develop Smart Control User Interface
4.4. Configure Automation Rules
4.5. Sprint Review
4.6. Sprint Retrospective

5. Sprint 5: AI Analytics Feature
5.1. Sprint Planning
5.2. Prepare Historical Usage Data
5.3. Integrate Usage Analytics Functions
5.4. Configure Forecasting Model
5.5. Integrate AI Suggestion Module
5.6. Sprint Review
5.7. Sprint Retrospective

6. Sprint 6: Alerts & Notifications Feature
6.1. Sprint Planning
6.2. Define Alert Rules
6.3. Develop Notification Interface
6.4. Integrate Alert Trigger Logic
6.5. Develop Alert History
6.6. Sprint Review
6.7. Sprint Retrospective

7. Sprint 7: Pilot Deployment & Training
7.1. Sprint Planning
7.2. Deploy System to Pilot Houses
7.3. Configure Sensors and Environment
7.4. Train Maintenance Staff
7.5. Sprint Review
7.6. Sprint Retrospective

8. Sprint 8: UAT & Final Documentation
8.1. Sprint Planning
8.2. Conduct UAT with Pilot Users
8.3. Analyse UAT Feedback
8.4. Fix High-Priority Issues
8.5. Compile System Guides
8.6. Produce Final Project Report
8.7. Sprint Review
8.8. Final Retrospective

2.4 Key Project Milestone

Our project milestones are aligned with the eight sprints defined in the Work Breakdown Structure, with each milestone marking the completion of one major project phase or system feature. These milestones highlight the key outcomes delivered at the end of every sprint, from project preparation and core feature development to pilot deployment and final acceptance. This structure provides a clear view of project progress and ensures that every achievement contributes directly to the readiness of our *SmartSense* system.

Table 2.4: Key Project Milestone

Milestone	Completion Date	Description
Milestone 1: Project Initialization Completed	21 January 2026	The project scope, requirements, and priorities are clearly defined. A structured product backlog is prepared to guide feature development across all implementation sprints.
Milestone 2: Authentication Feature Completed	11 February 2026	A secure access layer is established with login, signup, and role-based permissions. The system now supports authenticated interactions for residents and administrators.
Milestone 3: IoT Monitoring Feature Completed	4 March 2026	Real-time environmental data and weather information are displayed through a functional dashboard. Users gain visibility into home conditions through sensor-driven insights.
Milestone 4: Smart Appliance Control Feature Completed	25 March 2026	Users can remotely control connected appliances and apply basic automation rules. The system transitions from monitoring-only to interactive device management.
Milestone 5: AI Analytics Feature Completed	15 April 2026	Usage trends, forecasts, and AI-generated recommendations are available. Users receive data-driven insights to better understand and optimise energy usage.
Milestone 6: Alerts & Notifications Feature Completed	6 May 2026	A notification system is established to deliver timely alerts on unusual conditions or required actions. Users receive clear and actionable updates.

Milestone 7: Pilot Deployment & Training Completed	27 May 2026	The system is deployed in pilot homes and tested in a real environment. Maintenance staff are trained to operate and support the system effectively.
Milestone 8: UAT & Final Documentation Completed	17 June 2026	User acceptance testing validates system readiness. Final documentation is completed, preparing the system for wider deployment and long-term maintenance.

3.0 Project Time Management

3.1 GANTT Chart

The detailed project timeline is presented in the form of a Gantt chart. It offers a visual overview of the eight sprint schedule, key activities, and major milestones from project initiation to final handover.

A clearer view of the Gantt Chart is available on this link:
https://drive.google.com/drive/folders/1BDcDbaiyAzP2xn-VAQlkqepTvYIjS_k2?usp=sharing

SmartSense Gantt

Chart on the right explicitly shows dependency arrows labeled Dependency (FS) and black milestone diamonds.

ID	WBS	Task Name	Duration	Resource Names	Start	Finish	Predecessors
1	1.0	**Sprint 1: Project Initialization**	21 days		01/01/26	21/01/26	
2	1.1	Requirement Elicitation	5 days	Project Manager	01/01/26	05/01/26	
3	1.2	Stakeholder Meeting	3 days	Project Manager	06/01/26	08/01/26	2.0
4	1.3	Scope Analysis	3 days	Project Manager	09/01/26	11/01/26	3.0
5	1.4	Product Backlog Creation	4 days	Project Manager	12/01/26	15/01/26	4.0
6	1.5	Backlog Prioritisation	3 days	Project Manager	16/01/26	18/01/26	5.0
7	1.6	Initial Documentation	2 days	Documentation Specialist	19/01/26	20/01/26	6.0
8	1.7 &1.8	Sprint Review & Retrospective	1 day	Scrum Master	21/01/26	21/01/26	7.0
9	1.M	*Milestone: Sprint 1: Project Initialization Completed*	0 days		21/01/26	21/01/26	8.0
10	2.0	**Sprint 2: Authentication Feature**	21 days		22/01/26	11/02/26	9.0
11	2.1	Sprint Planning	1 day	Scrum Master	22/01/26	22/01/26	
12	2.2	Design Login & Signup Flow	4 days	UI/UX Engineer	23/01/26	26/01/26	11.0
13	2.3	Develop Authentication Functions	5 days	AI & Backend Developer	27/01/26	31/01/26	12.0
14	2.4	Configure User Roles	4 days	AI & Backend Developer	01/02/26	04/02/26	13.0
15	2.5	Develop User Profile Page	4 days	UI/UX Engineer	05/02/26	08/02/26	14.0
16	2.6 & 2.7	Sprint Review & Retrospective	3 days	Scrum Master	09/02/26	11/02/26	15.0
17	2.M	*Milestone: Sprint 2: Authentication Feature Completed*	0 days		11/02/26	11/02/26	16.0
18	3.0	**Sprint 3: IoT Monitoring Feature**	21 days		12/02/26	04/03/26	17.0
19	3.1	Sprint Planning	1 day	Scrum Master	12/02/26	12/02/26	
20	3.2	Configure IoT Sensor	4 days	IoT & Deployment Specialist	13/02/26	16/02/26	19.0
21	3.3	Develop Monitoring Dashboard	5 days	UI/UX Engineer	17/02/26	21/02/26	20.0
22	3.4	Integrate Weather API	3 days	Technical Lead	22/02/26	24/02/26	21.0
23	3.5	Develop Monitoring Chart	4 days	UI/UX Engineer	25/02/26	28/02/26	22.0
24	3.6 & 3.7	Sprint Review & Retrospective	5 days	Scrum Master	01/03/26	04/03/26	23.0
25	3.M	*Milestone: Sprint 3: IoT Monitoring Feature Completed*	0 days		04/03/26	04/03/26	24.0
26	4.0	**Sprint 4: Smart Appliance Control Feature**	21 days		05/03/26	25/03/26	25.0
27	4.1	Sprint Planning	1 day	Scrum Master	05/03/26	05/03/26	
28	4.2	Develop Device Command Functions	6 days	AI & Backend Developer	06/03/26	11/03/26	27.0
29	4.3	Develop Smart Control User Interface	5 days	UI/UX Engineer	12/03/26	16/03/26	28.0
30	4.4	Configure Automation Rules	4 days	AI & Backend Developer	17/03/26	20/03/26	29.0
31	4.5 & 4.6	Sprint Review & Retrospective	5 days	Scrum Master	21/03/26	25/03/26	30.0
32	4.M	*Milestone: Sprint 4: Smart Appliance Control Feature Completed*	0 days		25/03/26	25/03/26	31.0
33	5.0	**Sprint 5: AI Analytics Feature**	21 days		26/03/26	15/04/26	32.0
34	5.1	Sprint Planning	1 day	Scrum Master	26/03/26	26/03/26	
35	5.2	Prepare Historical Usage Data	4 days	AI & Backend Developer	27/03/26	30/03/26	34.0
36	5.3	Integrate Usage Analytics Functions	5 days	AI & Backend Developer	31/03/26	04/04/26	35.0
37	5.4	Configure Forecasting Model	5 days	AI & Backend Developer	05/04/26	09/04/26	36.0
38	5.5	Integrate AI Suggestion Module	4 days	AI & Backend Developer	10/04/26	13/04/26	37.0
39	5.6 & 5.7	Sprint Review & Retrospective	2 days	Scrum Master	14/04/26	15/04/26	38.0
40	5.M	*Milestone: Sprint 5: AI Analytics Feature Completed*	0 days		15/04/26	15/04/26	39.0
41	6.0	**Sprint 6: Alerts & Notifications Feature**	21 days		16/04/26	06/05/26	40.0
42	6.1	Sprint Planning	1 day	Scrum Master	16/04/26	16/04/26	
43	6.2	Define Alert Rules	4 days	Technical Lead	17/04/26	20/04/26	42.0
44	6.3	Develop Notification Interface	5 days	UI/UX Engineer	21/04/26	25/04/26	43.0
45	6.4	Integrate Alert Trigger Logic	4 days	AI & Backend Developer	26/04/26	29/04/26	44.0
46	6.5	Develop Alert History	3 days	Technical Lead	30/04/26	02/05/26	45.0
47	6.6 & 6.7	Sprint Review & Retrospective	4 days	Scrum Master	03/05/26	06/05/26	46.0
48	6.M	*Milestone: Sprint 6: Alerts & Notifications Feature Completed*	0 days		06/05/26	06/05/26	47.0
49	7.0	**Sprint 7: Pilot Deployment & Training**	21 days		07/05/26	27/05/26	48.0
50	7.1	Sprint Planning	1 day	Scrum Master	07/05/26	07/05/26	
51	7.2	Deploy System to Pilot Houses	6 days	IoT & Deployment Specialist	08/05/26	13/05/26	50.0
52	7.3	Configure Sensors & Environment	4 days	IoT & Deployment Specialist	14/05/26	17/05/26	51.0
53	7.4	Train Maintenance Staff	4 days	Support & Maintenance Lead	18/05/26	21/05/26	52.0
54	7.5 & 7.6	Sprint Review & Retrospective	6 days	Scrum Master	22/05/26	27/05/26	53.0
55	7.M	*Milestone: Sprint 7: Pilot Deployment & Training Completed*	0 days		27/05/26	27/05/26	54.0
56	8.0	**Sprint 8: UAT & Final Documentation**	21 days		28/05/26	17/06/26	55.0
57	8.1	Sprint Planning	1 day	Scrum Master	28/05/26	28/05/26	
58	8.2	Conduct UAT with Pilot Users	6 days	Quality Assurance (QA) Lead	29/05/26	03/06/26	57.0
59	8.3	Analyse UAT Feedback	3 days	Quality Assurance (QA) Lead	04/06/26	06/06/26	58.0
60	8.4	Fix High-Priority Issues	5 days	AI & Backend Developer	07/06/26	11/06/26	59.0
61	8.5	Compile System Guides	3 days	Documentation Specialist	12/06/26	14/06/26	60.0
62	8.6	Produce Final Project Report	3 days	Documentation Specialist	15/06/26	17/06/26	61.0
63	8.7 & 8.8	Sprint Review & Final Retrospective	1 day	Scrum Master	17/06/26	17/06/26	62.0
64	8.M	*Milestone: Sprint 8: UAT & Final Documentation Completed*	0 days		17/06/26	17/06/26	63.0

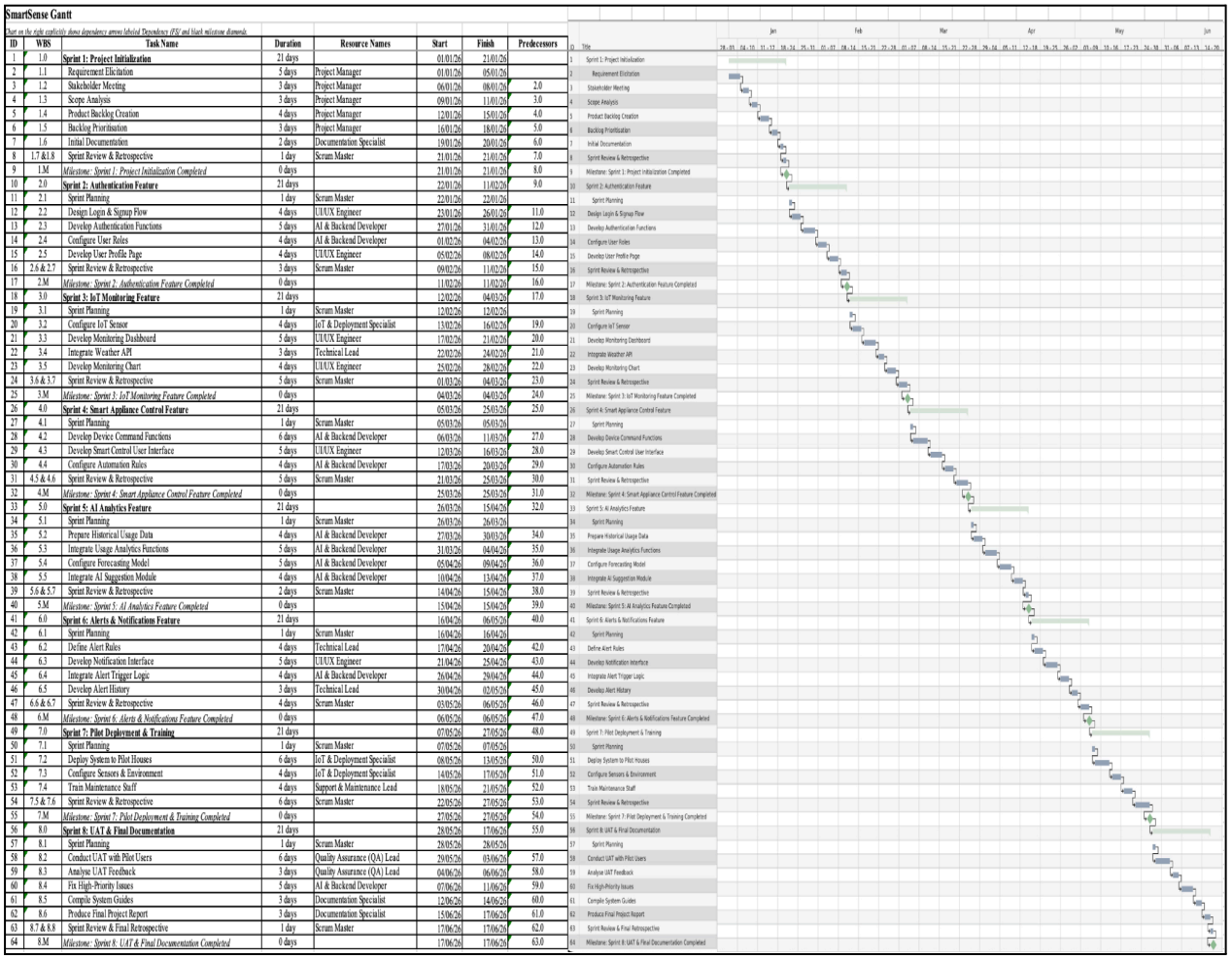


Figure 3.1: SmartSense Project Gantt Chart

4.0 Project Cost Management

Project Cost Management is necessary so that the Smart Home Energy Optimization System can be presented within its approved financial limit. It entails planning, estimating, budgeting, and controlling of project costs in such a way that the whole project activities can be carried out within the budget allocated. An effective cost management will enable the project team to make sound decisions, utilize resources, and minimize financial risks that can be encountered during the inclusion of the IoT sensors, cloud infrastructure, and AI based components. In this project, the cost management is necessary to maintain the affordability and financial stability, particularly when dealing with outside suppliers in terms of providing hardware and technical integration. Thus, this section summarizes the cost baseline and the general cost budget of the project, which will be utilized as the financial control mechanisms in the entire lifecycle of the project development. The project cost baseline will be fixed to RM300,000 maximum, which will comprise essential activities like software development, testing, acquisition of hardware, installation, deployment, and risk mitigation. Moreover, the overall budget may include a management reserve to deal with any unplanned situations, including delays of the vendors, extra hardware requirements, or integration issues, that have been identified in Section 8.0. The completed Project Cost Budget with the management reserve will not be above RM360,000 which will keep the project economically viable at a reasonable level and still with enough flexibility to accommodate occurrence of unforeseen risks.

4.1 Project Cost Baseline (Cost Estimation)

The project cost baseline establishes a time-staged cost allocation of The Smart Home Energy Optimization Project of all the development and implementation of the project between 1 January 2026 and 17 June 2026. It is associated with the project Work Breakdown Structure (WBS) and timeline of the project stages to make sure that every cost is traced to a particular task and a deliverable. The bottom-up estimation methodology was employed, with the initial calculation of costs being done at the task level and then adding up to come up with the total project cost base. This method enhances the accuracy of estimations and offers vivid observation of the distribution of costs in the project components. Cost baseline facilitates proper cost control as it allows continuous monitoring of the expenditures and any deviation may be detected early enough to ensure efficient distribution of resources and project scope, quality and schedule are maintained.

Table 4.1 Project Cost Baseline for The Smart Home Energy Optimization Project

WBS Item / Sprint	Jan' 1	Feb' 1	Mar' 1	Apr' 1	May' 1	Jun' 1	Subtotal
Sprint 1: Project Initialization (1 Jan - 21 Jan)							
1.1 Requirement Elicitation	4,760	-	-	-	-	-	4,760 RM
1.2 Stakeholder Meeting	2,856	-	-	-	-	-	2,856 RM
1.3 Scope Analysis	2,856	-	-	-	-	-	2,856 RM
1.4 Product Backlog Creation	4,808	-	-	-	-	-	4,808 RM
1.5 Backlog Prioritisation	2,856	-	-	-	-	-	2,856 RM
1.6 Initial Documentation	1,904	-	-	-	-	-	1,904 RM
1.7 & 1.8 Sprint Review & Retrospective	952	-	-	-	-	-	952 RM
Sprint 2: Authentication Feature (22 Jan - 11 Feb)							
2.1 Sprint Planning	476	-	-	-	-	-	467 RM
2.2 Design Login & Signup Flow	1,904	-	-	-	-	-	1,904 RM
2.3 Develop Authentication Functions	2,380	-	-	-	-	-	2,380 RM
2.4 Configure User Roles	-	1,904	-	-	-	-	1,904 RM
2.5 Develop User Profile Page	-	1,904	-	-	-	-	1,904 RM
2.6 & 2.7 Sprint Review & Retrospective	-	1,428	-	-	-	-	1,428 RM
Sprint 3: IoT Monitoring Feature (12 Feb - 4 Mar)							
3.1 Sprint Planning	-	682	-	-	-	-	682 RM
3.2 Configure IoT Sensor	-	2,728	-	-	-	-	2,728 RM
3.3 Develop Monitoring Dashboard	-	3,410	-	-	-	-	3,410 RM
3.4 Integrate Weather API	-	2,046	-	-	-	-	2,046 RM
3.5 Develop Monitoring Chart	-	2,728	-	-	-	-	2,728 RM
3.6 & 3.7 Sprint Review & Retrospective	-	-	3,410	-	-	-	3,410 RM
Sprint 4: Smart Appliance Control Feature (5 Mar - 25 Mar)							
4.1 Sprint Planning	-	-	952	-	-	-	952 RM
4.2 Develop Device Command Functions	-	-	5,712	-	-	-	5,712 RM
4.3 Develop Smart Control User Interface	-	-	4,760	-	-	-	4,760 RM
4.4 Configure Automation Rules	-	-	3,808	-	-	-	3,808 RM
4.5 & 4.6 Sprint Review & Retrospective	-	-	4,760	-	-	-	4,760 RM

Sprint 5: AI Analytics Feature (26 Mar - 15 Apr)							
5.1 Sprint Planning	-	-	1,190	-	-	-	1,190 RM
5.2 Prepare Historical Usage Data	-	-	4,760	-	-	-	4,760 RM
5.3 Integrate Usage Analytics Functions	-	-	1,190	4,760	-	-	5,950 RM
5.4 Configure Forecasting Model	-	-	-	5,950	-	-	5,950 RM
5.5 Integrate AI Suggestion Module	-	-	-	4,760	-	-	4,760 RM
5.6 & 5.7 Sprint Review & Retrospective	-	-	-	2,380	-	-	2,380 RM
Sprint 6: Alerts & Notifications Feature (16 Apr - 6 May)							
6.1 Sprint Planning	-	-	-	1,190	-	-	1,190 RM
6.2 Define Alert Rules	-	-	-	4,760	-	-	4,760 RM
6.3 Develop Notification Interface	-	-	-	5,950	-	-	5,950 RM
6.4 Integrate Alert Trigger Logic	-	-	-	4,760	-	-	4,760 RM
6.5 Develop Alert History	-	-	-	1,190	2,380	-	3,570 RM
6.6 & 6.7 Sprint Review & Retrospective	-	-	-	-	4,760	-	4,760 RM
Sprint 7: Pilot Deployment & Training (7 May - 27 May)							
7.1 Sprint Planning	-	-	-	-	714	-	714 RM
7.2 Deploy System to Pilot Houses	-	-	-	-	4,284	-	4,284 RM
7.3 Configure Sensors & Environment	-	-	-	-	2,856	-	2,856 RM
7.4 Train Maintenance Staff	-	-	-	-	2,856	-	2,856 RM
7.5 & 7.6 Sprint Review & Retrospective	-	-	-	-	4,284	-	4,284 RM
Sprint 8: UAT & Final Documentation (28 May - 17 Jun)							
8.1 Sprint Planning	-	-	-	-	909	-	909 RM
8.2 Conduct UAT with Pilot Users	-	-	-	-	2,727	2,727	5454 RM
8.3 Analyse UAT Feedback	-	-	-	-	-	2,727	2,727 RM
8.4 Fix High-Priority Issues	-	-	-	-	-	4,545	4,545 RM
8.5 Compile System Guides	-	-	-	-	-	2,727	2,727 RM
8.6 Produce Final Project Report	-	-	-	-	-	2,727	2,727 RM
8.7 & 8.8 Sprint Review & Final Retrospective	-	-	-	-	-	909	909 RM

January Total	-	-	-	-	-	-	24,752 RM
February Total	-	-	-	-	-	-	16,830 RM
March Total	-	-	-	-	-	-	30,542 RM
April Total	-	-	-	-	-	-	35,700 RM
May Total	-	-	-	-	-	-	25,770 RM
June Total	-	-	-	-	-	-	16,362 RM
Total Sprints Cost							149,956 RM
Contingency Reserve							
Hardware Dependency	-	-	-	-	-	-	18,500 RM
Sensor Compatibility	-	-	-	-	-	-	4,500 RM
Data Collection Accuracy	-	-	-	-	-	-	10,000 RM
Limited Team Resources	-	-	-	-	-	-	7,044 RM
Integration Issues	-	-	-	-	-	-	10,000 RM
Total Contingency Reserve							50,044 RM
Grand Total Baseline							200,000 RM

Calculations steps:

1. Given that the approved budget for the project is (300,000RM >=360,000RM) , the cost baseline spread over time includes :
    - All project costs
    - Contingency reserves
    - management reserve (kept separately)
2. We break the project into major components (Work Breakdown Structure) and timeline of the project stages to make sure that every cost is traced to a particular task and a deliverable.

    For the Smart Home Energy Optimization Project, this includes the sprint distribution for the major components as follows:

    1. 1Project Planning & Management
    2. Hardware (smart meters, sensors, controllers)
    3. Software Development (energy monitoring app, AI optimization)
    4. Installation & Integration
    5. Testing & Commissioning
    6. Training & Documentation

Table 4.1 denotes the estimated cost of labor, materials, software, and services for each sprint with a total of 149,956 RM.

The bottom-up estimation methodology was employed, with the initial calculation of costs being done at the task level and then adding up to come up with the total project cost base. This method enhances the accuracy of estimations and offers vivid observation of the distribution of costs in the project components.

3. Project Cost Baseline = Σ (Cost of all WBS activities) + Contingency Reserve
   149,956 RM + 50,044 RM= 200,000 RM
   Cost baseline facilitates proper cost control as it allows continuous monitoring of the expenditures and any deviation may be detected early enough to ensure efficient distribution of resources and project scope, quality and schedule are maintained.

4.2 Project Cost Budget

According to the project cost baseline established in Section 4.1, a project cost budget was prepared taking into consideration the planned costs as well as unexpected uncertainties that might occur during implementation of The Smart Home Energy Optimization Project. Although the cost baseline will encompass all activities that are identified and planned as planned in the project sprints, the project cost budget will include the cost baseline with the management reserve to accommodate any unexpected incidences and unpredictable risks.

Table 4.2 Project Cost Budget

Component	Amount (RM)	Remarks
Cost Baseline	200,000	Manages all scheduled project activities within specific sprints.
Management Reserve (20%)	40,000	Reserved to unexpected events and risk aversion.
Total Project Budget	240,000	Less than approved budget “360,000RM” limit.

The management reserve will be assigned 20 percent of the cost base, which is RM40,000, and will be used in case of unexpected problems like unexpected technical difficulties, integration problems, system requirements, or delays in deployment and training processes. The management reserve is a flexibility to respond to the unknown unknowns that are not well predictable at the planning stage, unlike contingency reserves which are planned to answer identified risks, and are part of the cost base

This means the overall project cost budget will about RM240,000, which is significantly lower compared to the budget limit (RM360,000) that has been approved by the relevant authorities. This type of budgeting guarantees financial stability and at the same time has a tight rein on cost escalation. The allocated management reserve would help the project to maintain the schedule, scope, and quality goals despite the uncertainty of an IoT- and analytics-driven system.

5.0 Project Quality Management Plan

Quality management is implemented at all the Smart Home Energy Optimization project points to guarantee stable system functionality, proper monitoring, and safe operations. All project phases, starting with development and ending with deployment, have quality activities. It is an Agile-Scrum project with frequent sprint reviews and testing as the way to detect problems and maintain the quality of each feature to the required standards and expectations of the users.

5.1 Quality Tool/Technique

To ensure the quality of Smart Home Energy Optimization project is consistent, the team applies simple quality tools that are used to facilitate the Agile-Scrum approach. Quality checks are carried out within every sprint, to identify problems early and deliverables that comply with the necessary standards. Its principal instruments are the Quality Control Checklist and the Fishbone Diagram. The checklist will guarantee that every sprint output should meet the functional, security, and usability expectations, but the Fishbone Diagram will indicate the root causes of quality problems in case issues are detected. These instruments aid in constant enhancement and stable system building.

5.1.1 Quality Control Checklist

In this project, the quality control checklist will be applied to guarantee that all the planned activities and deliverables meet the established quality standards and functional requirements. It is used during the important project phases such as feature development, system integration, and pre-deployment, to ensure that every sprint result is within its acceptance criterion before moving on to the next step. The checklist is dedicated to important elements of the Smart Home Energy Optimization Project which include Authentication, Real-Time IoT Monitoring, Smart Appliance Control, Analytics, and Alerts and Notifications. The project team can perform consistency checks in the functionality, security, data and usability by matching the checklist items with the sprint specifications and requirements of the system. Structured quality reviews between sprints and the ability to present a good evidence of quality compliance at any given stage is also supported by the checklist as it has been summarized in Table 5.1.1

Table 5.1.1 Quality Control Checklist of The Smart Home Energy Optimization Project

Topic	Yes / No	Comments
SPRINT 2 Authentication		
2.1 Registration of users (sign up) in place.	**Yes / No**	**N/A**
2.2 User login functionality functions appropriately.	**Yes / No**	**N/A**
2.3 The profile page of the resident shows the right user information.	**Yes / No**	**N/A**
2.4 Admin login access verified	**Yes / No**	**N/A**
2.5 Only authorized users can access and modify the profile of the administration	**Yes / No**	**N/A**
SPRINT 3 Real-Time Environmental Monitoring (IoT Sensor)		
3.1 Displayed sensor real time data.	**Yes / No**	**N/A**
3.2 Weather information retrieved successfully on weather API.	**Yes / No**	**N/A**
3.3 Environmental monitoring charts are updated at real time.	**Yes / No**	**N/A**
3.4 Past environmental data trend plotted correctly.	**Yes / No**	**N/A**
3.5 Admin is able to see building/unit-level sensor data.	**Yes / No**	**N/A**
SPRINT 4 Smart Appliance Control (IoT)		
4.1 One can turn on and off the appliances remotely	**Yes / No**	**N/A**
4.2 The automation schedule works properly.	**Yes / No**	**N/A**
4.3 Admin has the ability to enroll devices to housing units	**Yes / No**	**N/A**
4.4 Admin is able to configure and administer appliances.	**Yes / No**	**N/A**
SPRINT 5 Analytics (AI)		
5.1 Use of energy presented in the correct way.	**Yes / No**	**N/A**
5.2 Energy forecast charts that were created on the basis of utilization.	**Yes / No**	**N/A**
5.3 Recommendations on energy saving based on AI.	**Yes / No**	**N/A**
5.4 Correctly constructed building-level analytics summaries built.	**Yes / No**	**N/A**
SPRINT 6 Alerts & Notifications		
6.1 Alerts on energy were raised appropriately.	**Yes / No**	**N/A**
6.2 History of alert that is recorded and available	**Yes / No**	**N/A**
6.3 Admin has the ability to see the alerts on all units of houses.	**Yes / No**	**N/A**
6.4 Teams can be provided with follow-up actions by the admins	**Yes / No**	**N/A**

5.1.1.1 Application in Smart Home Energy Optimization Project

The quality control checklist is implemented at major phases of the project in order to make sure that all requirements related to the functionality and technique are met before the next sprints or deployment.

In the Sprint 2 (Authentication Feature), the checklist is used to ensure that the user registration, the login option, the display of the profile details, and the role-based access control have been properly implemented to the resident and administrator.

In the Sprint 3 (Real-Time Environmental Monitoring) assures proper presentation of real-time sensor information, proper integration of weather API, real-time updates of monitoring charts, and proper monitoring of sensor health status.

In the Sprint 4 (Smart Appliance Control), the checklist will ensure that the appliances can be remotely controlled, automation scheduling is functioning correctly, and the administrators can be able to register, configure, and manage the devices.

In the Sprint 5 (Analytics), the checklist confirms the proper presentation of the energy usage history, generation of predictive energy analytics, generation of building-level summaries, and comparison of usefulness among units and buildings.

In the Sprint 6 (Alerts and Notifications) checklist, the alert is ensured to be triggered properly, abnormal sensor activities, activated, and notified, the history of alerts recorded and available, and the follow-up actions can be assigned to the appropriate teams.

5.1.1.2 Justification of Quality Control Checklist

The quality control checklist is also a good tool that is used to maintain quality in all sprints within an Agile-based project. It minimizes the risks of omitting key requirements of the project and allows to maintain the consistent standards across the course of development by translating requirements into verifiable and understandable items in the checklists.

The checklist in this project aids in following systematic monitoring of complicated aspects like authentication, IoT monitoring, smart appliance control, analytics, and alert management. It allows identifying defects early, enhances the individuals in the team to be more accountable, and each sprint should be able to meet its respective acceptance standards before proceeding. This is a systematic way of increasing the reliability of the entire system, promoting a continuous process of improvement, and standardizing the activities of quality control in accordance with the project scope, schedule, and expectations of stakeholders.

5.1.2 Fishbone Diagram (Cause-and-Effect / Ishikawa Diagram)

The Ishikawa Diagram, also known as the Fishbone Diagram, is a problem analysis tool used to identify and organise possible root causes of quality issues. It supports systematic analysis by grouping causes into logical categories. For the *SmartSense* system, potential causes are classified into People, Process, Tools, Environment, Data, and Technology, allowing quality problems to be analysed in a structured and visual manner.

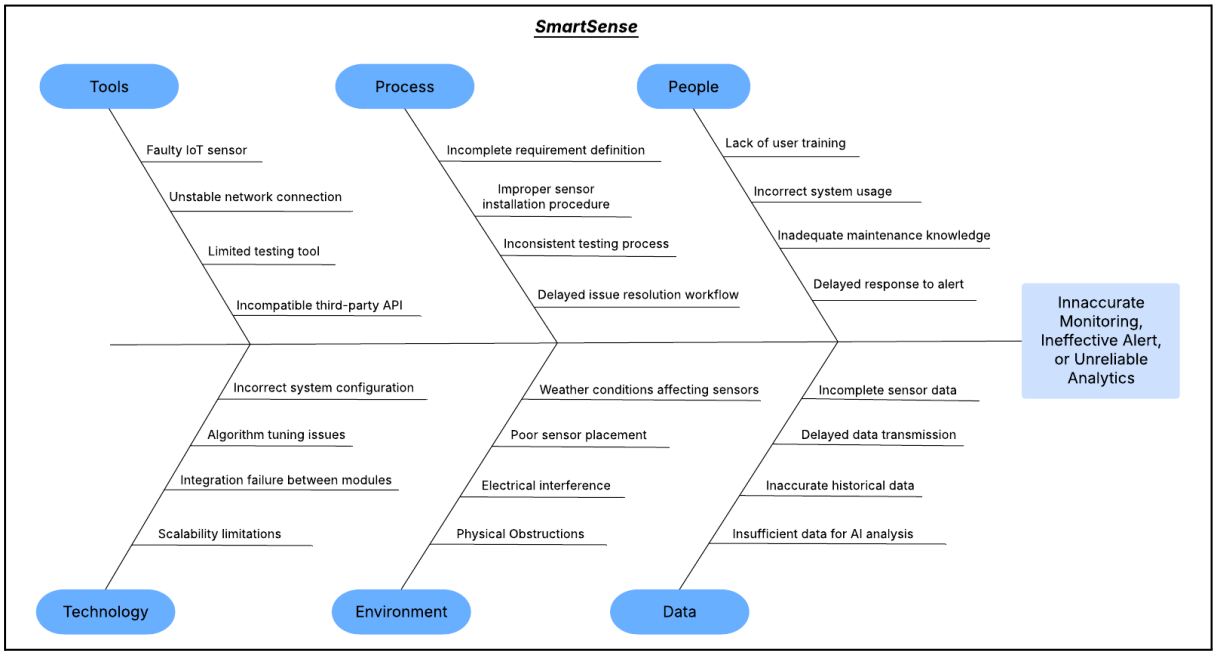


Figure 5.1.2: Fishbone Diagram for SmartSense Project

5.1.2.1 Application in SmartSense Project

The Fishbone Diagram is applied in the *SmartSense* project to analyse root causes of quality issues that may occur during development and deployment. It is especially useful when problems involve multiple factors across hardware, software, and user interaction.

- If inaccurate sensor readings or delayed updates are reported during IoT monitoring, the Fishbone Diagram can be used to examine causes related to sensor calibration, network conditions, data processing, or environmental factors such as weather and placement.
- In cases where alerts or AI-generated insights behave unexpectedly, the diagram helps identify whether the issue originates from data quality, algorithm configuration, system integration, or user-defined rules.

5.1.2.2 Justification of Fishbone Diagram

The Fishbone Diagram is suitable for the SmartSense project because system quality issues often arise from the interaction of multiple components, including IoT devices, analytics functions, and user interfaces. The diagram encourages team discussion and structured thinking during sprint reviews and retrospectives.

By systematically categorising possible causes, the Fishbone Diagram supports continuous improvement and reduces trial-and-error debugging. This aligns with Agile quality management practices by enabling teams to identify root causes efficiently and implement targeted improvements throughout the development lifecycle.

6.0 Project Human Resources Management Plan

6.1 Project Organization Chart

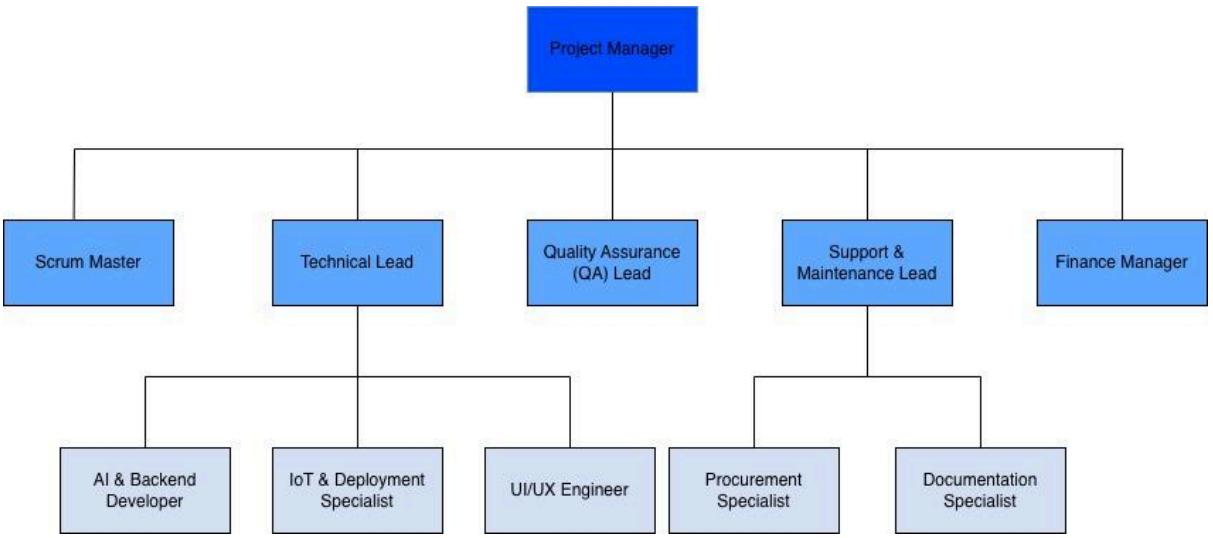


Figure 6.1: Project Organization Structure

URL of Project Organization Chart: https://drive.google.com/file/d/1EAxx7-JCm0jstLXPcRe2KzZvvVL5Em6d/view?usp=sharing

6.2 Roles and responsibilities

Table 6.2: Project team members' Roles and Responsibilities

Role	Responsibility
Project Manager	Manages the entire project plan, scope, and timeline. Acts as the primary point of contact for the client (Property Management Company) and has the final authority on project decisions.
Scrum Master	Facilitates the Agile-SCRUM process by organizing sprint planning, daily stand-ups, and retrospectives. Removes obstacles (blockers) for the team to ensure smooth development cycles.
Technical Lead	Leads the technical development team. Defines the system architecture and oversees the integration between the IoT hardware sensors, cloud backend, and the AI analysis engine.
Quality Assurance (QA) Lead	Manages the comprehensive test plan to ensure system reliability. Specifically validates the accuracy of sensor data readings and the effectiveness of energy optimization algorithms.
Support & Maintenance Lead	Oversees all project support activities, including documentation and procurement logistics. Ensures that the support team provides necessary resources for the technical team and manages post-deployment planning.
Finance Manager	Develops and monitors the financial plan. Manages the RM300,000 budget, tracks expenses for hardware procurement (TechnoMart), and manages contingency reserves.
AI & Backend Developer	Develops the system's core logic and Machine Learning models to analyze energy usage patterns. Responsible for the backend API that processes data from sensors.
IoT & Deployment Specialist	Manages the selection, configuration, and physical installation of IoT sensors (temperature, motion, humidity). Ensures seamless data transmission from physical devices to the cloud server.
UI/UX Engineer	Designs the user interface for the web and mobile dashboard. Focuses on visualizing energy data clearly so homeowners can easily understand their consumption patterns.
Procurement Specialist	Manages the relationship with the external vendor (TechnoMart Malaysia). Responsible for placing orders, tracking hardware deliveries, and processing invoices to avoid project delays.
Documentation Specialist	Manages all project documentation, including technical API manuals, user guides for homeowners, and final project reports. Ensures all documents are accurate and professional.

7.0 Project Communication Plan

7.1 Communication Plan

Table 7.1: Communication Strategy and Deliverables

Objective of Communication	Communication Type	Deliverable	Medium	Audience	Owner	Frequency	Format
To sync on daily progress and identify blockers.	Daily Scrum (Stand-up)	- Daily Task Updates - List of Blockers	Face to Face	- Scrum Master - Technical Team - QA Lead	Scrum Master	Daily (15 mins)	Verbal Update
To plan the work and goals for the upcoming Sprint.	Sprint Planning Meeting	- Approved Sprint Backlog - Sprint Goal Definition	Google Meeting	- Project Manager - Technical Lead - All Developers	Scrum Master	Every 2 Weeks (Start of Sprint)	Discussion
To demonstrate completed features and gather feedback.	Sprint Review	- Functional IoT Product Increment - Functional AI Model	Face to Face	- All Team Members - Client (Optional)	Technical Lead	Every 2 Weeks (End of Sprint)	Live Demo
To align on system architecture, AI models, and sensor integration.	Technical Sync	- Updated System Architecture - API Documentation	Google Meeting	- Technical Lead - AI Developer - Backend Developer - IoT Specialist	Technical Lead	Weekly	Whiteboard Session
To track hardware orders, delivery status, and invoices.	Vendor Coordination	- Procurement Status Report - Delivery Tracking Log	Phone Call	- Procurement Specialist - TechnoMart Rep	Procurement Specialist	Ad-hoc / Bi-Weekly	Verbal Update

To review test results, bugs, and system quality.	QA Review	- Quality Assurance Report - Defect Metrics	Google Meeting	- QA Lead - Technical Team	Quality Assurance (QA) Lead	Weekly	Screen Share Review
To update the client on project milestones and budget usage.	Monthly Progress Meeting	- Monthly Performance Report - Budget Variance Analysis	Face to Face	- Project Manager - Client (Property Mgmt)	Project Manager	Monthly	Presentation Slides
To finalize user manuals and prepare for system handover.	Documentation Sync	- Drafted User Manuals - Maintenance Guides	Google Meeting	- Support Lead - Documentation Specialist	Support Lead	Pre-Release (Milestone 10)	Document Review

8.0 Project Risk Management Plan

Risk management plan is a plan that documents the procedures in order to manage risk throughout the project life cycle. It is a part of the risk management process and can help improve project success by assisting in determining project scopes and developing realistic estimation, may it be in terms of cost or time. This fragment of document will highlight risk management plan processes such as identifying risk which will be documented as risk register, performing qualitative analysis and planning risk response.

8.1 Risk Register

A risk register is a list of identified risks that is logged to be tracked and managed by the team. It supports accountability and audit since the risk is formally assigned to a personnel.

Risk ID	R-001
Name Of Risk	Vendor Hardware Defect
Description	Hardware(s) acquired from external vendor (TechnoMart) such as sensors are faulty when arrive
Risk Type	External
Root Cause	Vendor quality certification issues or possible transit damage
Likelihood	Medium
Justification	IoT hardware manufacturing often has a baseline failure rate
Risk Owner	Procurement Manager
Severity	High
Countermeasure	Transfer

Risk ID	R-002
Name Of Risk	Scope Creep
Description	Constant changes in requirement during analysis phase
Risk Type	Management
Root Cause	Vague, unclear requirement statement
Likelihood	High
Justification	Stakeholders will likely propose changes after the first sprints
Risk Owner	Project manager
Severity	Medium
Countermeasure	Avoid

Risk ID	R-003
Name Of Risk	Integration Failure
Description	SmartSense software cannot be integrated with the sensor firmware
Risk Type	Technical
Root Cause	API mismatch, software bugs or incompatible protocols
Likelihood	High
Justification	Integrating software with sensors are the most error-prone phase of IoT
Risk Owner	Lead Developer
Severity	High
Countermeasure	Mitigate

Risk ID	R-004
Name Of Risk	Unavailable Tenants
Description	Tenants on units chosen for UAT is not available or not willing.
Risk Type	Operational
Root Cause	Conflicts in scheduling with end user or privacy concerns
Likelihood	Medium
Justification	Accessing private residence require cooperation from owner
Risk Owner	Sunway Lakeside Management
Severity	Low
Countermeasure	Contingency

Risk ID	R-005
Name Of Risk	Integration With External System
Description	Failure to sync local data with TNB's existing system
Risk Type	External
Root Cause	External API downtime or security firewall changes made by the external system management
Likelihood	Medium
Justification	We do not have the power to control their utility infrastructure or maintenance scheduling
Risk Owner	Lead Developer
Severity	High
Countermeasure	Contingency

Risk ID	R-006
Name Of Risk	Internet Connectivity
Description	Residents with weak internet connection prevents real-time data visualization
Risk Type	Technical
Root Cause	Low bandwidth in residential area
Likelihood	Medium
Justification	Consumer grade internet providers are not standardized and often congested
Risk Owner	Developer
Severity	Medium
Countermeasure	Mitigate

Risk ID	R-007
Name Of Risk	Third Part Cloud Data & Privacy Breach
Description	Unauthorized access to tenants unit data which expose tenants availability in their unit due to vulnerability in the external cloud infrastructure
Risk Type	External
Root Cause	Configuration errors or non-compliance of the vendor with local law (PDPA Malaysia)
Likelihood	Low
Justification	If the cloud provider has a breach, SmartSense is directly impacted
Risk Owner	Project Manager
Severity	High

Countermeasure	Transfer

8.2 Qualitative Risk Analysis

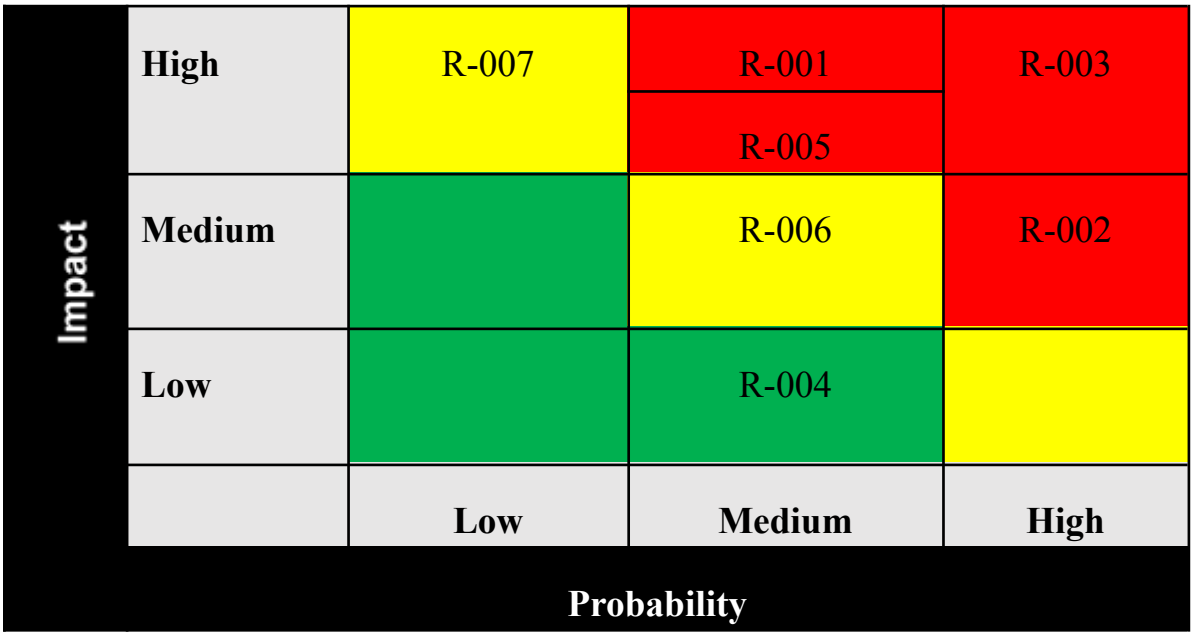


Figure 8.2

Above shows the impact/probability diagram to analyse and prioritize the risks throughout the SmartSense project lifecycle. The risks are plotted based on its likelihood to occur against their potential consequences towards the project. As seen in the diagram, there are 4 risks in the red zone that are categorized as 'High Priority' where these risks are most urgent and typically require an immediate countermeasure plan. Next, there are 2 risks in the yellow zone which is categorized as 'Moderate Risk' where these risks should be monitored closely. Finally, there is only 1 risk in the green zone which is 'Low Priority Risk' where the risk is generally only require routine monitoring. The team will focus on planning the risk response plan to counter the risks in both red and green zones only as it represents the greatest threat to the project's success.

8.3 Risk Response Plan

A risk response plan acts like an action-oriented guidelines to help the team respond to risks. It mainly aims to handle the crisis while helping draw a baseline in reserve contingency in terms of budget. Besides that, it also helps strengthen the stakeholder's trust by convincing them that the team is prepared for setbacks that might occur throughout the project's lifecycle.

Risk ID	Risk Name	Approach	Description
R-001	Vendor Hardware Defect	Transfer	Include a strict Service Level Agreement (SLA) which requires the vendor to replace all faulty unit within 48 hours of report.
R-002	Scope Creep	Avoid	Implement 'Freeze Period' after SRS sign off and make sure any changes demanded after should go through Change Control Board (CCB).
R-003	Integration Failure	Mitigate	Implement Hardware Abstraction Layer (HAL) which acts as a bridge between hardware and software to standardize communication regardless of specific software firmware.
R-005	Integration With External System	Contingency	Develop a mock data service in case connection with TNB is lost to allow the system to function with estimated value.
R-006	Internet Connectivity	Mitigate	Instead of sending the entire state of the smart home every second the system only sends the specific data point that has changed. This reduces the bandwidth consumption.
R-007	Third Part Cloud Data & Privacy Breach	Transfer	Implement Client-Side Encryption, which is encrypting data before it reaches the cloud so that the vendor never sees raw data and conduct penetration testing to identify vulnerabilities.

9.0 Procurement Management Plan

9.1 Procurement Item

No	Item	Category	Quantity	Estimated Unit Price (RM)	Subtotal (RM)	Identified Vendor
1	SmartSense Central Hub (Gateway)	Hardware	5 Units	1,500	7,500	TechnoMart Malaysia
2	Industrial Grade IoT Sensors (Temperature, Humidity, and Motion)	Hardware	50 Units	450	22,500	TechnoMart Malaysia
3	Smart Power Controllers/ Meters	Hardware	20 Units	600	12,000	TechnoMart Malaysia
4	Cloud Infrastructure & AI API Credits	Service	1 Lot	15,000	15,000	AWS or Google Cloud (External)
5	IoT Installation & Mounting Kits	Hardware	1 Lot	3,000	3,000	TechnoMart Malaysia
Total:					**RM 60,000**	

9.2 Supplier Selection Evaluation

Proposal Evaluation Matrix

Criterion	Weightage	Requirement Description
Technical Merit	60% in General *50% for Sensors*	Compatibility with Hardware Abstraction Layer (HAL) and API protocols.
Capability to Deliver	25% in General *30% for Sensors* 20% for Services	Ability to replace faulty units within 48 hours as per Risk Response Plan (R-001)
Value for Money	15% in General *20% for Sensors* *20% for Services*	Long-term cost-effectiveness, including maintenance and licensing fees.
TOTAL	**100%**	

Weighted Scoring Models Per Procurement Item

Item #1 - SmartSense Central Hub/Gateway			
Supplier / Criteria	**TechnoMart MY**	**IoT Core Solutions**	**Industrial Connect**
Technical Merit (60%)	**Rating: 9** **Weighted: 5.4** Supports all 50 sensors and local HAL.	**Rating: 7** **Weighted: 4.2** Limited to 30 concurrent connections.	**Rating: 8** **Weighted: 4.8** High latency in data transmission.
Capability to Deliver (25%)	**Rating: 8** **Weighted: 2.0** Local stock; supports 48-hr replacement.	**Rating: 6** **Weighted: 1.5** International vendor; 2-week lead time.	**Rating: 7** **Weighted: 1.75** 72-hour replacement window.
Value for Money (15%)	**Rating: 7** **Weighted: 1.05** Competitive price for industrial grade.	**Rating: 9** **Weighted: 1.35** Cheapest unit price; poor build quality.	**Rating: 5** **Weighted: 0.75** Expensive proprietary mounting kits.
Total Score	**8.45**	**7.05**	**7.30**
Final Verdict:	TechnoMart Malaysia holds the highest weighted score for the Smartsense Central Hub/Gateway item.		

Item #2 & #3 - Industrial Grade Sensors & Power Meter / Controllers			
Supplier / Criteria	**TechnoMart MY**	**EcoSwitch My**	**Generic Electronics**
Technical Merit (50%)	**Rating: 8** **Weighted: 4.0** High precision tracking; works with TNB systems.	**Rating: 9** **Weighted: 4.5** Superior accuracy but complex API.	**Rating: 5** **Weighted: 2.5** High failure rate under heavy loads.
Capability to Deliver (30%)	**Rating: 9** **Weighted: 2.7** Existing vendor; lower administrative overhead.	**Rating: 6** **Weighted: 1.8** Limited support for automation rules.	**Rating: 5** **Weighted: 1.5** No warranty for commercial use.
Value for Money (20%)	**Rating: 8** **Weighted: 1.6** Bundle discount with sensors.	**Rating: 5** **Weighted: 1.0** Highest per-unit cost on the market.	**Rating: 8** **Weighted: 1.6** Lowest price; high hidden repair costs.
Total Score	**8.30**	**7.30**	**5.60**
Final Verdict:	TechnoMart Malaysia holds the highest weighted score for the Industrial Grade Sensors and Power Meters/Controllers item.		

Item #4 - Cloud Infrastructure & AI API Credits			
Supplier / Criteria	**AWS (Amazon)**	**Google Cloud**	**Microsoft Azure**
Technical Merit (60%)	**Rating: 9** **Weighted: 5.4** Best-in-class IoT Core and AI/ML tools.	**Rating: 9** **Weighted: 5.4** Best data visualization and BigQuery tools.	**Rating: 7** **Weighted: 4.2** Steep learning curve for the team.
Capability to Deliver (20%)	**Rating: 8** **Weighted: 1.6** High availability; global data centers.	**Rating: 7** **Weighted: 1.4** Occasional maintenance downtime.	**Rating: 8** **Weighted: 1.6** Strong enterprise support in Malaysia.
Value for Money (20%)	**Rating: 8** **Weighted: 1.6** Pay-as-you-go; stays within the RM15k budget.	**Rating: 7** **Weighted: 1.4** More expensive ML API calls.	**Rating: 6** **Weighted: 1.2** High data export costs.
Total Score	**8.60**	**8.2**	**7.00**
Final Verdict:	Amazon's AWS Service holds the highest weighted score for the Cloud Infrastructure & AI API Credits item.		

10.0 Stakeholder Registry

10.1 Stakeholder Registry & Management Strategy

Name	Position	Type	Project Role	Contacts	Level of Interest	Level of Influence (Power)	Management Strategy
-	Project Manager	Internal	Oversee, coordinate, and direct the project as a whole.	*Email*, *Mobile No.*	High	High	Coordinate periodic meetings and check-ins to report the latest update on the project and to address any issues/blockages
-	Technical Lead	Internal	Oversee, coordinate, and direct the project technical processes, from the system design to development.	*Email*, *Mobile No.*	High	High	Coordinate periodic technical evaluations and review to take key decisions on possible iterations as well as to keep in check with Project Manager for any updates
-	Quality Assurance (QA) Lead	Internal	Oversee, and manage all activities related to QA processes.	*Email*, *Mobile No.*	High	Medium	Conduct periodical assessment to ensure system, processes, and deliverables meet the expected standards, as well as to give evaluation and reports for project improvement and/or defects identification

-	Support & Maintenance Lead	Internal	Oversee, coordinate, and manage all Support & Maintenance related activities for the project (including but not limited to System Repairs, Maintenances, Customer Service, and Troubleshooting).	*Email*, *Mobile No*	High	Medium	Conduct periodical evaluation of System Support/Maintenance Data to gather insights on analytics of customer concerns and satisfaction.
-	TechnoMart Malaysia (Vendor)	External	Responsible for item (hardware) supplies of sensors, trackers, etc. and to give training on installations, repairs, and/or troubleshooting processes.	*Email*, *Mobile No*	Medium	High	Conduct periodical evaluation of hardware procurement, performance, and usage analysis, as well as to consult for internal system maintenance and troubleshooting training.

10.2 Stakeholders Power & Interest Grid

POWER / INTEREST	High Interest	Medium Interest	Low Interest
High Power	*High Power & High Interest* - Project Manager - Technical Lead	*High Power & Medium Interest* - TechnoMart Malaysia (Vendor)	*High Power & Low Interest*
Medium Power	*Medium Power & High Interest* - Quality Assurance (QA) Lead - Support & Maintenance Lead	*Medium Power & Medium Interest*	*Medium Power & Low Interest*
Low Power	*Low Power & High Interest*	*Low Power & Medium Interest*	*Low Power & Low Interest*

**Note: The following explanatory sections of each stakeholder category MAY NOT reflect the true, relevant stakeholder for this project. Especially for categories with no mentioned parties in the power grid, it is only used to depict stakeholder categorization in general.*

10.2.1 High Power & High Interest

Stakeholders with the highest power and interests are at stake of determining the general flow and execution of the project. These stakeholders, among others may include the Project Manager, the Technical Lead of the project which oversees all development processes, until some major external parties such as the Steering Committees (SCs), and/or Executive Boards.

10.2.2 High Power & Medium Interests

Stakeholders residing in this category hold a moderate interest in the project itself but nevertheless influences it greatly. Among others, this category includes vendors/suppliers which directly feed the required hardwares, services, and/or equipment. While these parties do not necessarily impose any external influence or interest to the project, the quality and/or product being supplied may significantly affect the project.

10.2.3 High Power & Low Interests

The stakeholders within this category are generally not included and hold minimum interests on the project itself. However, stakeholders included within this category may hold considerable power to release or grant resources for the project to run. As such, some of the parties that may fall within this category are Senior Executives, Institutional Shareholders, and/or even Application Stores (Distribution Platform) which holds the power to remove an app while never being included in the project itself.

10.2.4 Medium Power & High Interest

Stakeholders that hold considerable power and high interests most often fall into the category of parties which are directly involved in the project development, although holding less power than primary executives. Quality Assurance (QA) and Maintenance & Support Leads are some of the example of parties which are directly involved in the project activities and development, although they hold less power in terms of making decisions and giving directions.

10.2.5 Medium Power & Medium Interest

Those with a considerable ability to alter/influence the project and are also somewhat involved may fall into this categorization of stakeholders. Some of the examples of parties falling under this category would be the Early Access Users, Employees, or Middle Managers. As such, the aforementioned parties may not be directly involved in project decision-making, however they still inhibit a considerable amount of power in terms of shaping the project’s flow and are still a part of the project in some way.

10.2.6 Medium Power & Low Interest

In this categorization of stakeholders, some parties such as Consulted parties, Subject/Matter Experts, and/or Legal Departments fall directly under the hood of this category. Generally, these parties (stakeholders) doesn't hold much interest into the project development but they are somewhat kept informed for certain reasons (e.g. Experts to be consulted). Additionally, some parties which may affect the project considerably but holds no direct relation whatsoever with the project development also fall under this umbrella, such as Legal/Compliance Departments.

10.2.7 Low Power & High Interest

End-Users (Customers) and General Staff/Employees working on the project may be considered stakeholders which hold low power yet a significant amount of interest. In this case, these parties are required to be kept informed at all times as they have a direct relationship with the project, although lacking the power itself to create any decision.

10.2.8 Low Power & Medium Interest

Departments and/or parties which hold some interest/relation with the project, although with no decisive/executive power would fall under this category. Parties such as the Marketing Team will hold some interest in the project execution, however they will have no power for any kind of decision-making in the project, and holds no significant/major interest in the outcome.

10.2.9 Low Power & Low Interest

General Public, Minor Shareholders, and General Staff/Employees outside of the project but still within the organization can be considered within this category of stakeholder. These stakeholders are characterized by their inability to influence or make any kind of decisions and/or to alter the project in any way.

11.0 Conclusion

The Project Management Plan for SmartSense provides a documented plan for the successful delivery of a smart home energy optimization platform within the predefined constraints of time, scope, and budget. By adopting an Agile-Scrum approach, the project is expected to remain flexible to technical complexities while maintaining a steady delivery of high-value features across eight sprints. The detailed risk management and quality control strategies, including the use of Fishbone Diagrams and a dedicated Hardware Abstraction Layer provide the necessary safeguards to mitigate technical integration failures and vendor-related risks.

Ultimately, the successful implementation of SmartSense will not only result in a functional IoT product but will also serve as a benchmark for sustainable residential technology. With a total project budget of RM240,000 (inclusive of a 20% management reserve), the project remains well within the approved financial limits while providing the necessary resources to achieve a target 25% reduction in electricity usage for pilot participants. This plan ensures that all stakeholders, from the internal development team to external hardware vendors like TechnoMart Malaysia, are aligned to deliver a high-quality system that promotes long-term energy efficiency and operational excellence.

12.0 References

Scrum Methodology: A proven formula for managing complex projects. (n.d.). Rabiloo. https://rabiloo.com/blog/scrum-methodology-a-proven-formula-for-managing-complex-projects