Table of Contents

List of Figures

List of Tables

1. Introduction

The growing need for eco-friendly transportation solutions has made electric vehicles (EVs) an essential part of urban mobility. Electric scooters are a part of this trend, offering a sustainable and efficient alternative for short distance commuting in urban areas. This project aims to design, develop, and test an innovative self-balancing electric scooter that can meet urban transportation demands. The scooter will combine several cutting-edge technologies, including a gyroscopic balance control system, lithium-ion battery, and lightweight composite frame. These features ensure not only environmental sustainability but also optimal energy efficiency and user comfort. The goal of this report is to provide a comprehensive project management plan (PMP) for the Electric Scooter Development project. The PMP will include detailed plans for the project's scope, schedule, budget, resources, risk management, and communication. Additionally, it will adhere to internationally recognized project management standards such as those established by the Project Management Institute (PMI), ensuring that the project is managed efficiently and effectively.

The PMI's framework involves five process groups: Initiation, Planning, Execution, Monitoring & Controlling, and Closing. This report will follow this structure, ensuring that the project is executed systematically, with all stakeholders aligned and all risks managed proactively. The electric scooter project will focus on creating a functional prototype that addresses key urban mobility challenges. This prototype will integrate various technologies such as gyroscopic balance control, ensuring automatic stability while riding, and a battery system that offers an operational range of at least 20 kilometers per charge. The prototype will also be tested under real-world conditions to evaluate its performance, user safety, and efficiency in various environments. In summary, the Electric Scooter Development Project is designed to provide a sustainable and practical urban mobility solution that will help address climate change and traffic congestion in cities. The project plan details all aspects of the project lifecycle, ensuring that it will be completed within the stipulated time, budget, and quality requirements.

2. Project Charter

2.1. Objectives

The project objectives are clear and centered around the development of a functional prototype that addresses key mobility needs while incorporating the latest technological advancements in electric scooter design. The primary objectives of the project are as follows:

1. **Prototype Development**:

    - The first key objective is to design and construct a fully functional electric scooter prototype. This prototype will integrate critical components such as gyroscopic sensors, motors, and control systems to maintain stability and ensure smooth operation.
    - The goal is to create a working model that serves as a foundation for user testing and further refinement. This prototype will be used to gather valuable feedback for improving the design.

2. **Safety and Stability Enhancement**:

    - The gyroscopic balance control system will be implemented to ensure the scooter's automatic stability during operation. Additionally, the scooter will be equipped with emergency braking mechanisms to improve rider safety, preventing accidents in case of system failure or critical situations.
    - Load and stress testing will be conducted to ensure the scooter performs safely under different weight loads and at various speeds.

3. **Battery Optimization and Energy Efficiency**:

    - The battery system will be optimized to ensure maximum range per charge, with a target of 20 km. This will be achieved using a high-capacity lithium-ion battery and implementing efficient power management techniques to prolong battery life and reduce charging frequency.
    - The battery design will ensure that it is both lightweight and capable of delivering optimal performance for urban commuting.

4. **Lightweight and Durable Structural Design**:

   - The frame will be made from lightweight yet durable materials such as aluminum or reinforced composites, ensuring the scooter is strong enough to withstand everyday use, yet light enough for users to easily carry and transport.
   - The scooter will also feature a foldable design, making it convenient to store and carry when not in use, a crucial factor for urban mobility.

5. **Real-World Testing and Validation**:

   - The prototype will undergo extensive field testing in different urban environments, including smooth roads, inclines, and uneven surfaces. This testing will help identify performance issues, gather user feedback, and make necessary adjustments before the scooter is ready for commercial use.
   - Compliance with industry safety standards will be ensured through these tests, and any safety issues will be addressed immediately.

2.2. Scope

The project scope defines the boundaries of the project, outlining what is included and excluded from the development process. This ensures that the project team stays focused on delivering the expected results while managing risks associated with scope creep.

In-Scope Activities:

Table 1: Defined Project Activities and Descriptions

Activity	Description
Design and Manufacturing the Scooter Frame	Development of a lightweight, yet durable frame that supports all scooter components, ensuring durability and ease of use.
Balance Control System	Design and integration of a gyroscopic system for automatic balance and emergency braking mechanisms to enhance safety.
Battery and Power System Design	Design of a high-capacity lithium-ion battery that ensures a range of at least 20 km per charge, optimizing energy efficiency.

Safety Testing	Rigorous testing for stability, braking, and overall safety to meet all safety standards required for electric scooters.

Out-of-Scope Activities:

Table 2: Excluded Project Activities and Descriptions

Activity	Description
Mass Production	The project will focus solely on creating a prototype. Large-scale manufacturing and distribution are not part of this project.
Advanced AI Features	Integration of advanced AI features (such as self-driving or autonomous functionalities) is not included in the current project scope.

2.3. Stakeholders

Identifying and managing stakeholders is crucial for project success. Stakeholders are individuals or groups who have a vested interest in the project's outcome. Effective stakeholder management ensures that all parties are aligned with the project's objectives and progress.

Table 3: Stakeholder Overview Summary

Stakeholder	Role	Interest	Influence	Communication Method
Hassan	Project Sponsor	High	High	Meetings, Reports
Mohammed	Project Manager	High	High	Reports, Email
Ali	Lead Engineer	High	Medium	Meetings, Slack
Mousa	End Users	Medium	Medium	Surveys, Feedback
Reda	Supplier	Medium	Low	Contracts, Calls

- **Hassan (Project Sponsor):** As the project sponsor, Hassan is responsible for providing the necessary funding and ensuring the project receives the required resources. His high level of interest and influence ensures he is kept informed through regular reports and meetings.
- **Mohammed (Project Manager):** Mohammed, as the project manager, will oversee the day-to-day operations of the project. His role is to ensure that the project meets its goals on time, within scope, and within budget. Regular reports and emails will be exchanged with stakeholders to keep everyone updated on progress.
- **Ali (Lead Engineer):** Ali will oversee the technical aspects of the project, including the design and integration of the scooter's frame, control system, and motor. He will be actively involved in project meetings and communication through Slack to ensure smooth collaboration.
- **Mousa (End Users):** End users are the testers and consumers of the electric scooter. Their feedback will be essential to refine the design and ensure the scooter meets user needs. Feedback will be collected through surveys and testing trials.
- **Reda (Suppliers):** Suppliers will provide the necessary components such as batteries, motors, and gyroscopic sensors. They will communicate through contracts and calls to ensure timely delivery of materials.

2.4. Assumptions, Dependencies, and Constraint

This section outlines the assumptions made for the project, the dependencies between tasks, and the constraints that could affect the project.

1. **Assumptions**:
    - The necessary components (batteries, sensors, etc.) will be available and delivered on time.
    - Sufficient funding will be provided throughout the project to cover all expenses related to prototyping, testing, and materials.
    - Skilled labor and engineering expertise will be available for the duration of the project.
2. **Dependencies**:

- **Battery Supply Chain:** The timely delivery of battery components is critical for keeping the schedule intact. Delays in receiving the batteries would delay other tasks such as motor integration and power system testing.
- **Software Development:** The software development for the balance control system is dependent on the successful integration of hardware components such as gyroscopic sensors and motors. Any delay in this process will push back the testing phase.

3. **Constraints**:
   - **Budget:** The project has a budget of 2000 BHD, which constrains the ability to purchase high-end materials or allocate excessive resources to any one area of the project.
   - **Time:** The project must be completed within a specific timeline, ensuring all milestones are met. This will involve tight cooperation among all team members to avoid delays.
   - **Regulations:** The electric scooter must adhere to safety standards and regulatory requirements, which could affect design choices and additional testing.

3. Work Breakdown Structure (WBS)

The Work Breakdown Structure (WBS) is one of the most crucial tools in project management. It allows the project team to break down the entire project into smaller, manageable tasks. By doing so, the WBS provides clear definitions of each task and its deliverables, ensuring no part of the project is overlooked. Each task is assigned to the responsible team members, which helps improve organization, clarity, and accountability throughout the project lifecycle. This structured approach enhances the efficiency of the project management process and ensures that all stakeholders understand their roles and responsibilities.

The WBS for this electric scooter project is divided into two categories:

- **Deliverable-Based WBS**, which focuses on the key deliveries of the project.
- **Phase-Based WBS**, which outlines the main project phases and their associated activities.

3.1. Deliverable-Based WBS

This Deliverable-Based WBS focuses on the critical deliverables of the Electric Scooter project. These deliverables are essential milestones in the project's lifecycle and ensure that each part of the project is completed in a structured manner. The deliverables are divided into smaller components, making it easier to monitor and control each phase of the project.

Table 4: WBS Table

ID	Activity/Deliverable	Description
1	Scooter Frame Design	Design a lightweight and durable frame that supports key components such as the motor, battery, and balance system.
2	Balance Control System	Implement gyroscopic sensors and control algorithms to maintain automatic balance and ensure safety.
3	Electric Motor Integration	Select and integrate an efficient electric motor to meet power and speed requirements for urban commuting.
4	Battery & Power System	Design a high-capacity lithium-ion battery to ensure a minimum range of 20 km per charge.
5	Safety Testing	Conduct stability and safety tests to ensure the scooter is reliable and meets safety standards.

Each deliverable is designed to contribute to the overall functionality and safety of the scooter, with a focus on both performance and user experience.

3.2. Phase-Based WBS

The Phase-Based WBS organizes the project into its main phases, providing a clear structure for activities across the project lifecycle.

Table 5: Phase band WBS Table

Phase	Activities

Initiation	Define scope, identify stakeholders, approve project charter.
Planning	Develop project plan, schedule, budget, and procurement strategy.
Execution	Assemble prototype, integrate systems, test motor/battery, gather feedback.
Closure	Final testing, evaluate results, reassign resources, prepare for closure.

The table outlines the four phases of the project lifecycle, each with its associated activities and a brief explanation.

1. **Initiation:** This phase sets the foundation for the project. It involves defining the project's scope, identifying the key stakeholders, and approving the project charter to formally start the project.
2. **Planning:** In this phase, a detailed project plan is created, which includes the development of the schedule and budget. It ensures that the project is well-organized, and all resources are properly allocated.
3. **Execution:** This phase focuses on assembling the prototype and integrating the balance control system, motor, and battery. Testing is conducted to ensure the systems function correctly, and user feedback is gathered to refine the design.
4. **Closure:** The final phase involves testing the completed product, evaluating the results, and reassigning resources. It marks the formal end of the project, ensuring all objectives are met and the project is closed.

4. Project Schedule

The Project Schedule is a critical aspect of project management as it outlines the timeline for completing tasks and ensures that the project stays on track. The schedule includes a detailed timeline with dependencies, milestones, and the Gantt Chart, which helps visualize the project's progress and timeline. The schedule also provides clarity on the activity durations and when each task will begin and end, ensuring the project's phases align with overall goals.

4.1. Gantt Chart

The Gantt Chart is a crucial tool in project management, providing a visual representation of the schedule, task durations, and dependencies. Below is the updated Gantt chart for the project, with tasks and their respective timelines.

Table 6: Gantt Chart Table

Task ID	Task Name	Start Date	End Date	Duration	Dependencies
1	Scooter Frame Design	14-02-25	27-02-25	14 days	None
2	Balance Control System Design	28-02-25	13-03-25	14 days	Frame Design
3	Motor Integration	14-03-25	27-03-25	14 days	Battery System Design
4	Battery System Design	14-02-25	27-02-25	14 days	None
5	Safety Testing	28-03-25	10-04-25	14 days	Motor Integration

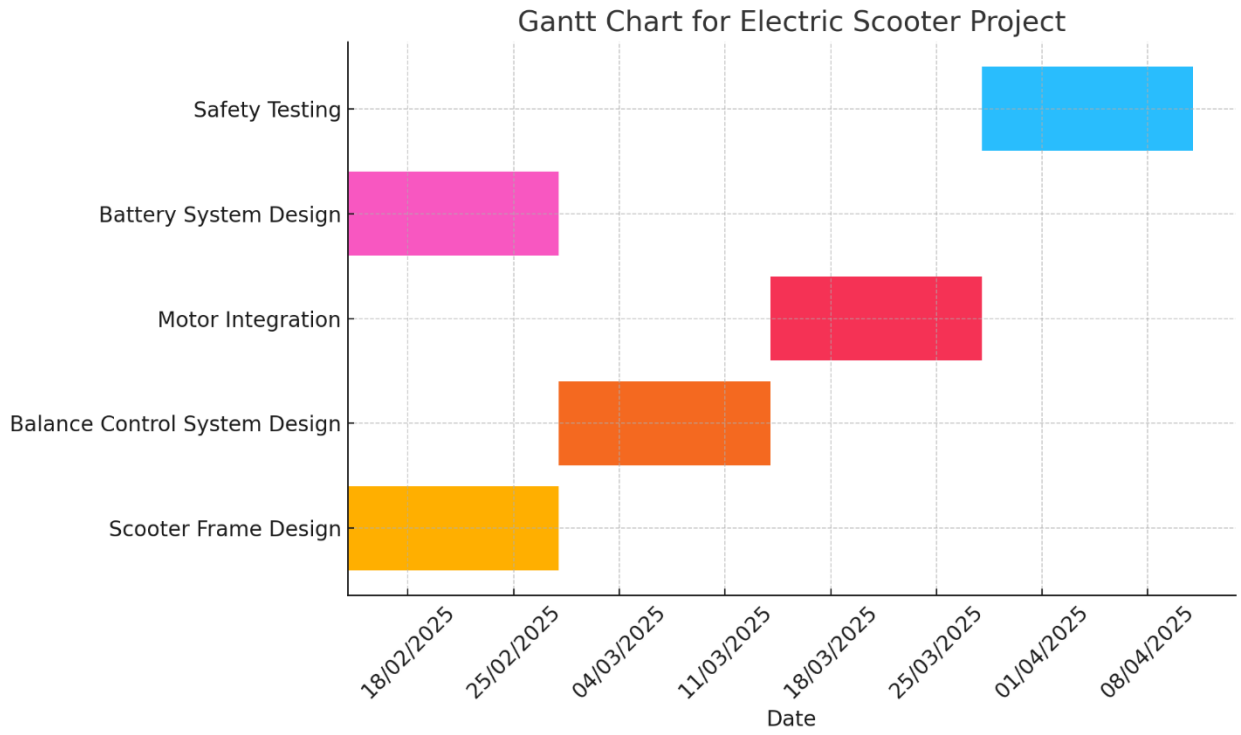

Figure 1: Gantt Chart

4.2. Milestones

Milestones are critical checkpoints in the project that mark the completion of significant phases or deliverables. They allow the project team and stakeholders to assess progress and ensure that the project is proceeding according to plan. Below are the key milestones for this project:

Table 7: Milestone Table

Milestone	Start Date	End Date	Duration
Design Completion	14-02-25	14-02-25	1 day
Prototype Assembly	15-02-25	28-02-25	14 days
Initial Testing	01-03-25	14-03-25	14 days
Final Testing & Review	15-03-25	28-03-25	14 days
Project Submission	01-04-25	15-04-25	15 days

The milestones listed above represent major project achievements that will serve as key markers for project success. These milestones align with the tasks outlined in the Gantt chart

and ensure that all stakeholders are aware of the progress made in the project. By focusing on these key milestones, the team can measure the completion of significant tasks and prepare for the next steps. These milestones also provide a basis for stakeholder meetings and progress updates.

5. Project Budget

A clear understanding of the project's budget is essential for the proper allocation of resources. Below is the detailed budget breakdown for the project.

5.1. Budget Breakdown

The project budget outlines the total financial resources required for the project. This includes costs for materials, labor, testing, and other essential expenses. The breakdown is as follows:

Table 8: Budget Breakdown

Item	Cost (BHD)
Frame Materials	500
Gyroscopic Sensors	300
Electric Motor	400
Battery & Charger	600
Miscellaneous	200
Total	2000

The budget is allocated across key components of the scooter, including the frame materials, gyroscopic sensors, motor, and battery. The total project cost is 2000 BHD, with most of the budget allocated to components that directly affect the scooter's performance and functionality. The miscellaneous category accounts for unforeseen expenses, such as shipping or minor adjustments during testing.

The budget breakdown is crucial for managing financial resources and ensuring that the project remains within the defined cost limits.

5.2. Cost Categories

Understanding the cost categories ensures better financial tracking throughout the project lifecycle. Below are the types of costs involved in the project:

Table 9: Cost Categories

Cost Category	Description
Direct Costs	Costs related directly to labor, materials, and equipment used in the production of the scooter.
Fixed Costs	Recurring expenses like rent, insurance, and other operational costs not tied to production.
Indirect Costs	Costs that indirectly affect the project, such as utilities or quality control measures.
Sunk Costs	Costs already incurred and irrecoverable, such as initial prototyping expenses.
Variable Costs	Costs that fluctuate based on the project's scale or production needs, such as material purchases or labor hours.

Categorizing costs ensures financial control and allows the project team to better track expenditures throughout the lifecycle.

6. Risk Management

Effective risk management is critical to the success of any project. Identifying potential risks early allows for the development of strategies to mitigate them before they impact the project. This section outlines how risks will be assessed, tracked, and mitigated throughout the project lifecycle, ensuring smooth progress and timely delivery.

6.1. Risk Breakdown Structure (RBS)

The Risk Breakdown Structure (RBS) is a hierarchical framework used to categorize risks based on their potential impact on the project. By grouping risks into different categories, the project team can easily identify and prioritize the most critical risks. The RBS provides a structured approach to addressing risks, ensuring that no risk type is overlooked.

Table 10: RBS Table

Risk Category	Examples
Scope Risks	Unclear project objectives, scope creep, failure to define project boundaries, misalignment with stakeholder expectations.
Technical Risks	Failure of gyroscopic sensors, battery malfunction, integration issues between hardware and software, technological limitations in materials.
Operational Risks	Delays in hardware delivery, workforce shortages, insufficient resource allocation, poor project management or coordination, lack of required skill sets.
Environmental Risks	Regulatory changes, market competition, adverse weather conditions affecting testing, site unavailability, political instability in the region.
Financial Risks	Budget overruns, unexpected costs, supplier price increases, inadequate funding to complete the project, economic downturns affecting project resources.
Schedule Risks	Project delays due to unforeseen technical challenges, unexpected holidays or downtime, issues with supplier timelines, tight project deadlines causing rushed decisions.
Legal and Compliance Risks	Failure to meet safety standards, non-compliance with regulations for electric vehicles, potential legal challenges due to intellectual property disputes, data privacy concerns in user feedback.

Each risk category is designed to ensure that the project team is aware of all potential risk factors that could derail the project. By addressing these risk types early on, mitigation strategies can be developed to minimize their impact on the project timeline, budget, and overall success.

6.2. Risk Register

The Risk Register is a document used to track all identified risks throughout the project. It is an important tool for the project manager, providing a structured way to assess, monitor, and mitigate risks. The register typically includes a description of the risk, the probability and impact of the risk occurring, and the risk response that outlines the actions to mitigate the risk.

Below is an expanded Risk Register for the Electric Scooter Development project, including additional risks and their respective probabilities, impacts, and responses:

Table 11: Risk Register for the Electric Scooter Development

Risk ID	Description	Probability	Impact	Risk Response
1	Delay in battery delivery	High	High	Identify alternative suppliers, develop a backup plan for delayed components.
2	Software integration issues	Medium	High	Conduct additional testing, improve collaboration between hardware and software teams.
3	Component quality issues	Low	Medium	Implement rigorous quality checks, verify suppliers' quality certifications.
4	Scope creep	Medium	High	Set clear project objectives, maintain tight control over project scope and change requests.
5	Regulatory changes	Medium	High	Monitor regulatory trends, engage with legal experts to ensure compliance with evolving standards.
6	Delays in hardware delivery	High	High	Establish firm delivery deadlines with suppliers, track progress regularly, and have alternative suppliers in place.
7	Workforce shortages	Medium	Medium	Hire temporary workers or subcontract critical tasks, train in-house staff to mitigate gaps.

8	Battery malfunction during testing	Medium	High	Test battery in varied conditions to ensure performance, work with suppliers to fix defects.
9	Project budget overruns	Low	High	Conduct detailed cost analysis upfront, track expenditures closely, and adjust as necessary.
10	Weather disruptions during testing	Low	Medium	Develop contingency plans for weather-related delays, schedule tests during periods of favorable weather.

In the Risk Register, risks are categorized based on probability (how likely they are to occur) and impact (how much they would affect the project). Each risk is assigned a response strategy, such as identifying alternative suppliers in case of delivery delays or conducting additional testing in case of software issues. By identifying risks early and planning responses, the project team can effectively mitigate potential disruptions.

7. Human Resources and Team Structure

The success of the Electric Scooter Development Project depends heavily on the effective management of human resources and allocation of the right materials and equipment. Properly organizing resources and ensuring that team members are assigned tasks based on their expertise ensures that the project moves forward smoothly. This section focuses on the Resource Breakdown Structure (RBS) and RACI Matrix, two tools that help clarify roles, responsibilities, and resources needed for successful project execution.

7.1. Resource Breakdown Structure (RBS)

The Resource Breakdown Structure (RBS) categorizes and organizes all the resources required for the project. This includes human resources (team members), material resources (components like batteries and sensors), and cost resources (financial aspects like labor costs and equipment rentals). The RBS helps the project manager ensure that the necessary resources are available at the right time and that there is no disruption in the project flow due to resource shortages.

By breaking down the resources into distinct categories, the RBS provides a clear overview of what is required and ensures that the right personnel and materials are assigned to each task efficiently.

Table 12: Resource Breakdown Structure (RBS) Table

Resource Type	Examples
Human Resources	Project Manager, Engineers, Technicians, Software Developers
Material Resources	Battery, Frame Materials, Gyroscopic Sensors
Cost Resources	Labor Costs, Equipment Rentals, Software Licenses

RBS categorizes resources into human (team members), material (physical components), and cost (financial elements). Proper allocation of these resources ensures smooth project execution without shortages.

7.2. RACI Matrix

The RACI Matrix is a tool used to define and clarify the roles and responsibilities of each project team member. It outlines who is Responsible, Accountable, Consulted, and Informed for each deliverable and task. The RACI Matrix helps ensure that accountability is clear and that everyone understands their role in the project. It prevents overlap and ensures that there is no confusion about who is responsible for what.

- **Responsible**: The individual or group who performs the work.
- **Accountable**: The individual who owns the work and ensures that it is completed successfully.
- **Consulted**: Those who provide advice or input during the task completion.
- **Informed**: Those who need to be kept updated on progress or results.

Table 13: RACI Matrix Table

Deliverable	Project Sponsor	Project Manager	Project Team	SME	Suppliers
Scooter Frame Design	A	R	C	I	-
Balance Control System	C	A	R	I	-
Motor Integration	I	A	C	R	-
Battery & Power System	R	C	A	I	-
Safety Testing	C	R	A	I	-

Roles Explanation:

- **A (Accountable)**: The **Project Manager** is accountable for the completion of each delivery.
- **R (Responsible)**: The **Project Team** executes the tasks to complete the deliverables.
- **C (Consulted)**: The **SME** provides expertise and guidance.
- **I (Informed)**: The **Project Sponsor** is kept informed of the deliverable's progress.

8. Communication Plan

Effective communication is fundamental to the success of any project. The Communication Plan outlines how the project team will communicate internally and with stakeholders, ensuring that everyone remains informed and aligned. The communication plan specifies the communication types, methods, and frequencies for key stakeholders.

Table 14: Communication Plan

Communication Type	Method	Frequency	Audience
Project Status	Meetings, Email	Weekly	Project Team, Sponsor
Risk Review	Meetings	Bi-weekly	Project Team
Budget Review	Reports	Monthly	Project Manager, Sponsor
User Feedback	Surveys, Reports	Monthly	End Users, Project Manager

The Communication Plan ensures that there is a consistent flow of information between the project manager, project team, and stakeholders. Regular updates via meetings, emails, and reports ensure that everyone stays aligned with the project's goals and status. For example, the Project Manager will hold weekly meetings with the Project Team to ensure that tasks are progressing as planned. Monthly reports will be sent to the Project Sponsor to update them on budget status and risk reviews. By clearly defining communication methods and frequencies, the plan minimizes misunderstandings, ensures transparency, and helps resolve issues promptly.

9. Conclusion

The Electric Scooter Development Project is an exciting and ambitious initiative designed to provide a sustainable and eco-friendly transportation solution. The project management plan (PMP) outlined in this document ensures that all aspects of the project, including scope, schedule, budget, and resources, are carefully planned and managed to meet the project's goals. The Risk Breakdown Structure (RBS) and RACI Matrix are key tools that will help mitigate risks and ensure clear accountability within the team. The Gantt Chart, Budget Breakdown, and Communication Plan further ensure that the project stays on track, with clear timelines and regular updates provided to stakeholders. By carefully managing resources, monitoring risks, and keeping all stakeholders informed, the project is set up for success and will contribute to the growth of eco-friendly urban mobility solutions.

References

[1] Project Management Institute, 2017. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*. 6th ed. Newtown Square, PA: Project Management Institute.

[2] Kerzner, H., 2017. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. 11th ed. Hoboken, NJ: Wiley.

[3] Smith, P., 2018. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. 12th ed. Hoboken, NJ: Wiley.

[4] Turner, R., 2014. *Handbook of Project-Based Management*. 5th ed. New York: McGraw-Hill.

[5] Larson, E. W. and Gray, C. F., 2017. *Project Management: The Managerial Process*. 7th ed. New York: McGraw-Hill.

[6] Burke, R., 2013. *Project Management: A Practical Guide to Planning and Managing Projects*. 3rd ed. London: Routledge.

[7] Hillson, D., 2017. *Managing Risk in Projects*. 2nd ed. London: Routledge.

[8] Mulcahy, R., 2018. *PMP Exam Prep: Rita's Course in a Book for Passing the PMP Exam*. 9th ed. London: RMC Publications.

[9] Clements, C. and Gido, J., 2015. *Effective Project Management*. 8th ed. Boston: Cengage Learning.

[10] Schwalbe, K., 2015. *Information Technology Project Management*. 8th ed. Boston: Cengage Learning.

[11] Meredith, J. R. and Mantel, S. J., 2017. *Project Management: A Managerial Approach*. 9th ed. Hoboken, NJ: Wiley.

[12] Verzuh, E., 2015. *The Fast Forward MBA in Project Management*. 5th ed. Hoboken, NJ: Wiley.