FACULTY OF COMPUTING
UTM Johor Bahru

SECD2613-02

SECD2523-03 DATABASE

Semester 01, 2025/2026

Task 1

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Content

1.0 INTRODUCTION

The current cafeteria operations at Universiti Teknologi Malaysia (UTM) face significant challenges that impact both service efficiency and resource management. Long queues during peak hours, frequent order inaccuracies, and preventable food waste have become persistent issues in our dining facilities. These operational inefficiencies not only diminish user satisfaction but also result in unnecessary financial losses and resource mismanagement.

To address these challenges, we propose the implementation of a comprehensive Cafeteria Management System. This innovative solution leverages modern digital technologies to transform traditional dining operations into a streamlined, data-driven service. By introducing automated ordering processes and intelligent inventory tracking, the system will significantly enhance operational efficiency while reducing waste and improving the overall dining experience.

This proposal outlines a practical approach to modernizing our cafeteria operations through technological integration. The proposed system represents a strategic investment in operational excellence, promising measurable improvements in service delivery, cost management, and sustainability. Through careful implementation, we can establish a new standard for efficient and responsive campus dining services that meet the evolving needs of our university community.

2.0 BACKGROUND STUDY

The university cafeteria plays a crucial role in supporting the daily routines of students, staff, and faculty members. However, at Universiti Teknologi Malaysia (UTM), existing cafeteria operations have shown significant shortcomings in adapting to the growing demand for faster, more efficient, and customer-oriented services. Traditional methods of managing orders, menu displays, and inventory tracking are no longer sufficient in meeting the needs of a digitally inclined university community.

Long queues during peak lunch hours, frequent miscommunication between customers and staff, and a lack of real-time menu information have led to frustration among users. For students, who often have limited time between lectures; these inefficiencies result in lost time, missed meals, and a lacking dining experience. Furthermore, order errors and food waste have financial implications for both cafeteria vendors and the university administration.

In addition, the absence of real-time data and analytics makes it difficult to monitor trends such as popular mealtimes, preferred dishes, or inventory levels. This results in poor planning, over-preparation, and underutilization of resources. As a result, both the customer experience and operational productivity suffer.

To address these pressing challenges, the introduction of a digital cafeteria management system is both timely and necessary. By streamlining order processes, enhancing communication, and enabling real-time access to menu and inventory data, the system has the potential to transform the dining experience at UTM. Beyond improving service efficiency and customer satisfaction, it also promises significant operational benefits such as reduced food waste, optimized inventory management, and data-driven planning. With these advantages, the proposed solution is poised to support the university's broader goals of modernization and digital transformation.

3.0 PROBLEM STATEMENT

Problem statement: Systemic limitations of UTM's Traditional Cafeteria System

1. **Chronic service delays**
   - Inefficient transactions: Manual ordering and cash payments create bottlenecks during pick hours, resulting in:
     - Excessive queue time (particularly 12:00-2:00 PM)
     - Frustrated customers abandoning meals

2. **Outdated customer experience**
   - Menu information gap: Static menu displays failed to show:
     - Real-time sold-out dishes leading to customer disappointment
     - Daily specials result in missed sales opportunities
   - Blind visits: Difficult to check the cafeteria's status(closure/crowding) before arrival

3. **Operational weakness**
   - Manual order taking(written) can cause:
     - Miscommunication between staff and customers
     - Incorrect meals are being prepared, resulting in food waste and rework
   - Data deficiency: Lack of automated tracking for:
     - Most and least popular items on the menu
     - Peak demand periods lead to poor staffing and food prep planning

4.0 PROPOSED SOLUTION

Proposed Digital Cafeteria System Solutions:

1. **Smart Ordering Platform**
   - **Online Pre-Orders:**
     - Customers order meals via UTM's existing app or web portal
     - Scheduled pickups to eliminate queues (example: "Ready by 12:15 PM")
   - **Digital Queue Management:**
   - Real-time updates on order status (example: "Preparing the meal")

2. **Dynamic Menu Management**
   - **Live Menu Updates:**
     - Automatically marks sold-out items (synced with inventory)
     - Highlights daily specials and promotions
   - **Dietary Filters:**
     - Tags for halal, vegan, vegetarian
     - Allergy warnings (example: "Contains nuts")

3. **Automated Kitchen Workflow**
   - **Direct-to-Kitchen Orders:**
     - Orders print/prepopulate in the kitchen display system
     - Reduces miscommunication from handwritten notes
   - **Integrated Payment:**
     - Cashless via student ID/QR code (eliminates cashier delays)

4. **Data-Driven Operations**
   - **Sales Analytics Dashboard:**
     - Tracks top-selling items by time/day
     - Identifies underperforming dishes for menu optimization
   - **Feedback System:**
   - Instant ratings after pickup (example: "How was your meal?")

5. **Real Time Cafeteria Status**
   - **Live Occupancy Updates:**
   - Shows crowd levels via colour codes (Green = less than 50% full)
     - Table availability map for dine-in students
   - **Push Notifications:**
     - Alerts for: "Peak hour warning (12:00 PM)", "Chicken Rice sold out", "Flash sale: 2PM to 3PM"

Feasibility Study

To ensure the practicality and viability of the proposed Digital Cafeteria System, a comprehensive feasibility study was conducted across three main areas: **technical**, **operational**, and **economic**. The results support the implementation of this solution at Universiti Teknologi Malaysia (UTM).

4.1 Technical Feasibility

Universiti Teknologi Malaysia has a strong digital infrastructure, including campus-wide Wi-Fi, and most students/staff are equipped with smartphones or laptops. The proposed Digital Cafeteria System will support this infrastructure to allow users to:

- View menus in real-time
- Place orders digitally
- Make online payments

Development can utilize tools (e.g., React or Flutter for frontend, Firebase or MySQL for backend). Cafeteria staff can receive orders via tablets or computers, which are easy to use.

Conclusion: The system is **technically feasible** using available technologies and minimal new hardware.

4.2 Operational Feasibility

From the background study, it is evident that the current system causes inefficiencies, delays, and user dissatisfaction. A digital platform will:

- Reduce queue times significantly
- Improve communication accuracy (no more misheard orders)
- Provide menu visibility in advance
- Help students manage tight schedules between classes

Training for cafeteria staff will be simple and short, focusing on order management via a dashboard or app. Given the digital maturity of students and staff, adoption is expected to be smooth.

Conclusion: **Operationally feasible** with high acceptance from users and low training overhead.

4.3 Economical Feasibility

Economically, the Digital Cafeteria System is viable and presents a strong return on investment. Although the initial implementation cost is higher due to multiple deployment locations, the aggregated benefits in time savings, operational efficiency, and customer satisfaction significantly outweigh the costs. This makes the system highly justifiable and scalable.

Estimated Costs:

- Tablets for Kitchen Use (8 cafeterias x 2 units each): RM8,000
- Training Materials and Sessions: RM2000
- System Development: RM15,000
- Web Hosting & Domain Registration: RM2000/year
- Maintenance and Minor Updates: RM2000/year

Estimated Benefits:

- Time Saved During Peak Hours (across all cafeterias): RM20,000/year
- Reduced Food Waste and Order Errors: RM6,000/year
- Efficient Inventory and Sales Management: RM8,000/year

Assumptions:

- Discount rate: 10%
- Sensitivity factor (cost): 1.1
- Sensitivity factor (benefits): 0.9
- Annual increase in prod. costs: 7%
- Annual increase in benefits: 5%

Estimated cost	
Tablets	RM8K
Training	RM2K
System Dev	RM15K
Web & Domain	RM2K/Y
Maint. & Upd.	RM2K/Y

Estimated benefits	
Time saved	RM20K/Y
Waste and Error	RM6K/Y
Inv & Sales	RM4K/Y

Assumption	
Discount	10%
Sens. (cost)	1.1
Sens. (ben)	0.9
Annual up cost	7%
Annual up ben	5%

PROFITABILITY INDEX
= 112065.96 / 25850.00
= 4.335240232
This shows that it is a good investment because of its index being greater than one. Every RM1 invested, returns RM4.34

Costs	Y0	Y1	Y2	Y3	Y4	Y5
Dev Costs						
Tablets for Kitchen Use	8800.00					
Training Materials and Sessions	550.00					
System Development	16500.00					
Total	25850.00					

Prod Costs	Y1	Y2	Y3	Y4	Y5	
Web Hosting & Domain Registration		2200.00	2354.00	2518.78	2695.09	2883.75
Maintenance and Minor Updates		2200.00	2354.00	2518.78	2695.09	2883.75
Annual Production		4400.00	4708.00	5037.56	5390.19	5767.50
Costs (PV)		4000.00	3890.91	3784.79	3681.57	3581.17
Accu. Costs		29850.00	33740.91	37525.70	41207.27	44788.44

Benefits	Y0	Y1	Y2	Y3	Y4	Y5
Time Saved During Peak Hours		18000.00	18900.00	19845.00	20837.25	21879.11
(PV)		16363.64	15619.83	14909.84	14232.12	13585.21
Reduced Food Waste and Order Errors		5400.00	5670.00	5953.50	6251.18	6563.73
(PV)		4909.09	4685.95	4472.95	4269.64	4075.56
Efficient Inventory and Sales Management		3600.00	3780.00	3969.00	4167.45	4375.82
(PV)		3272.73	3123.97	2981.97	2846.42	2717.04
Total		24545.45	47975.21	70339.97	91688.15	112065.96
Gain or Loss		-1304.55	22125.21	44489.97	65838.15	86215.96

PV(n) Calculation		Y1	Y2	Y3	Y4	Y5
		0.909091	0.826446	0.751315	0.683013	0.6209213

CBA DB03.xlsx

Conclusion: The total estimated cost is approximately RM44,788.44, while the projected benefits across all cafeterias exceed **RM100,000 per year**. This results in a rapid return on investment and strong long-term value. With high scalability and low recurring costs, the system is economically feasible for university-wide deployment.

5.0 OBJECTIVES

Objectives of the Digital Cafeteria System:

1. Streamline Order Processing

- Implement online pre-ordering and digital queue management to reduce customer wait times by at least 50% during peak hours
- Eliminate manual order errors through direct kitchen order transmission

2. Enhance Customer Experience

- Provide real-time menu updates showing available items and dietary options
- Enable cafeteria status monitoring, including crowd levels and table availability via mobile app

3. Optimize Operational Efficiency

- Automate inventory tracking to reduce food waste
- Implement cashless payment integration to minimize transaction errors

4. Improve Decision-Making

- Develop an analytics dashboard to track sales patterns and customer preferences
- Establish a feedback system to collect and analyze customer satisfaction data

5. Support Institutional Goals

- Align with UTM's digital transformation initiatives
- Contribute to sustainability targets by reducing paper use and food waste

6.0 SCOPE OF THE PROJECT

Included Components:

1. Digital Ordering System
Mobile and web-based platform for:
- Pre-ordering meals
- Real-time queue management
- Cashless payment integration

2. Dynamic Menu Management
Live updating of:
- Available and sold-out items
- Dietary information, including halal and vegan options
- Daily specials and promotions

3. Kitchen Operations
- Automated order transmission to the kitchen displays
- Inventory tracking with low-stock alerts

4. Data Analytics
- Sales performance dashboard
- Customer feedback collection system

5. Cafeteria Status Updates
- Real-time monitoring of:
- Occupancy levels
- Table availability
- Push notifications for special announcements

Excluded Components:

1. Meal preparation or food production
2. External food delivery services
3. Staff scheduling or HR management
4. Physical cafeteria renovations
5. Integration with non-UTM systems

6.1 System Boundaries

The provided flow diagram defines the system boundary for the Digital Cafeteria Management System by illustrating which processes are internal (within the system's scope) and how they interact with the external entities (outside the system's scope).
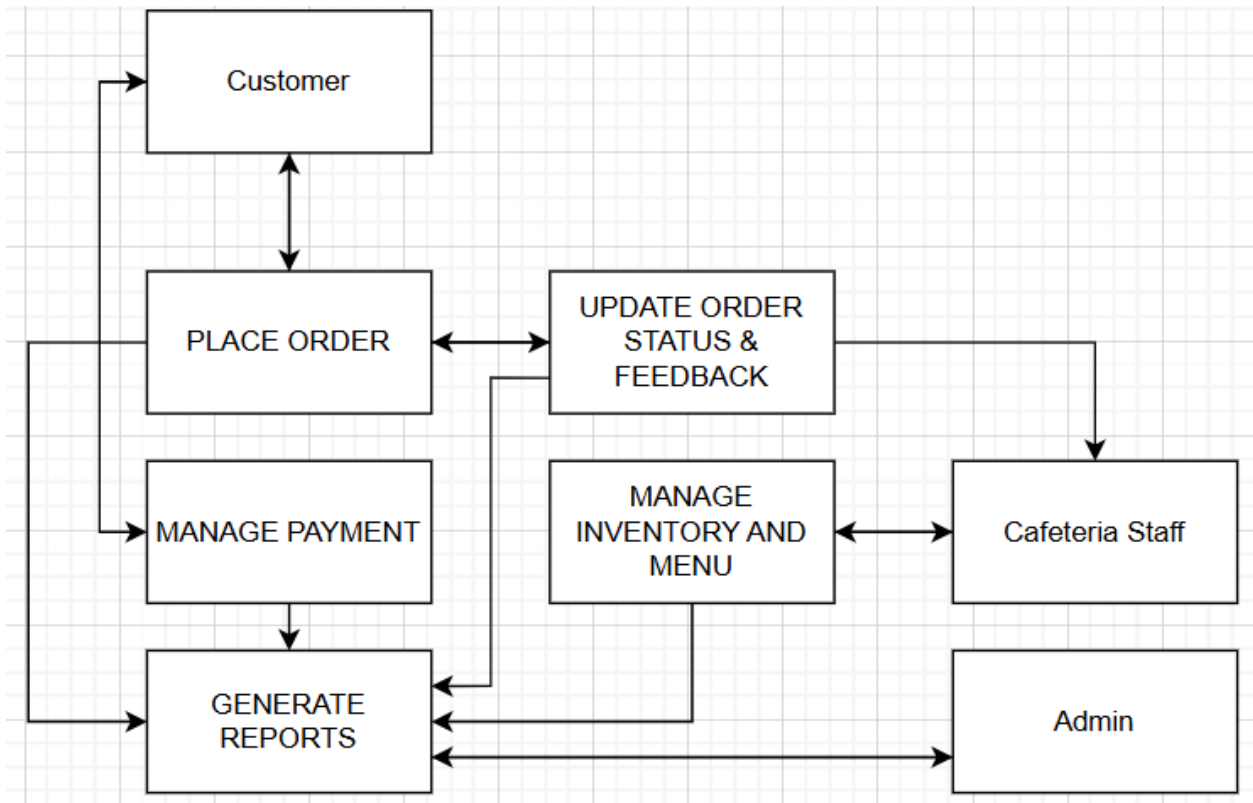
System Boundary for the Digital Cafeteria Management System

6.2 Major User Views

This Major User Views matrix defines the access rights for the core data entities within the system, establishing the system's security boundary and ensuring that each user role only interacts with the data required for their functional duties. Access is categorized as Maintain (Create, Update, Delete), Query (Read specific records), and Report (Analyze aggregated data)

Data	Access Type	Customer	Cafeteria Staff	Admin
ORDERS	Maintain	x		
	Query	x	x	x
	Report		x	x
MENU ITEMS	Maintain			x
	Query	x		x
SALES RECORDS	Maintain		x	
	Query		x	x
	Report			x
INVENTORY	Maintain		x	
	Query		x	x
	Report			x
FEEDBACK	Maintain	x		
	Query	x	x	x

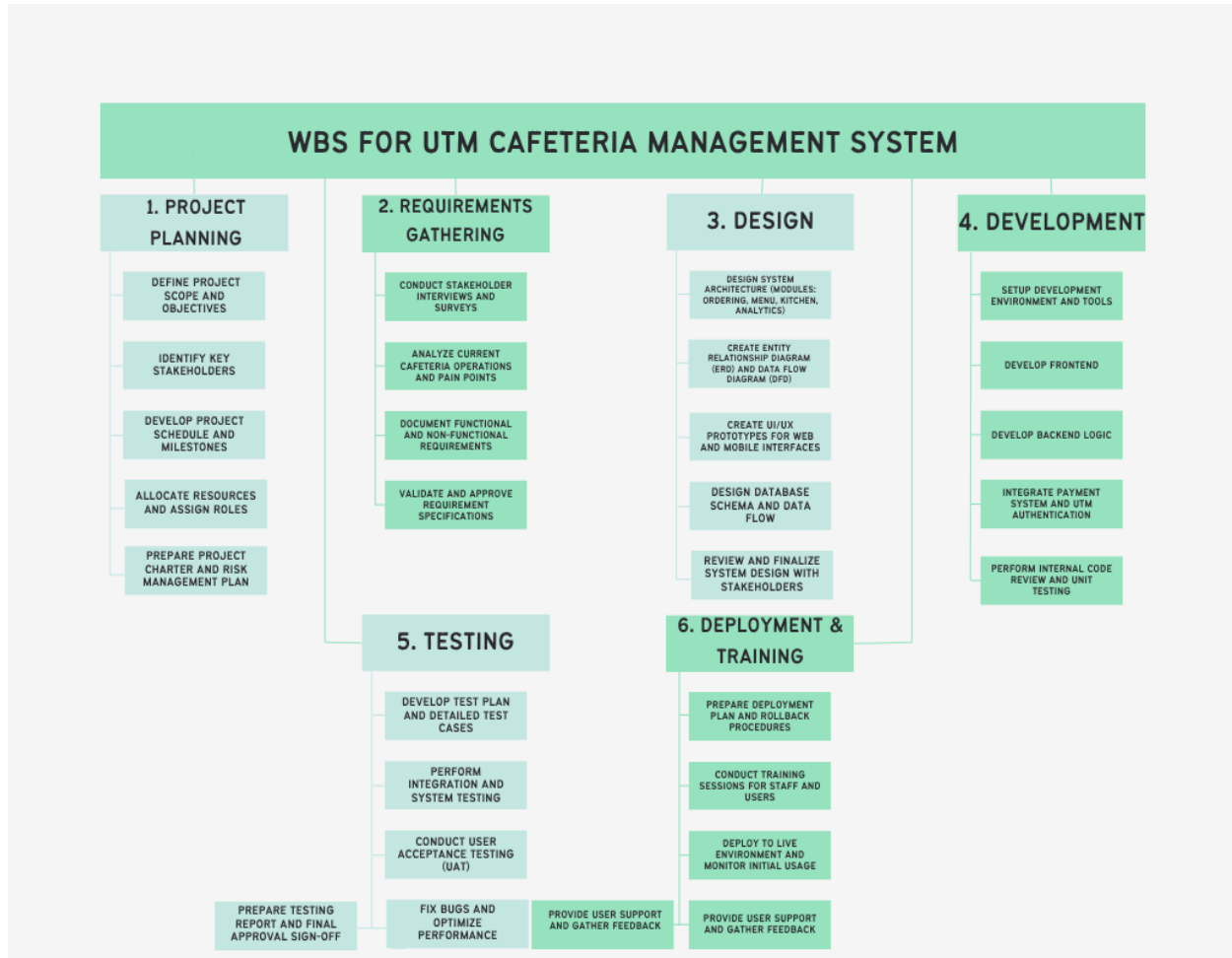**Major User View for the Digital Cafeteria Management System**
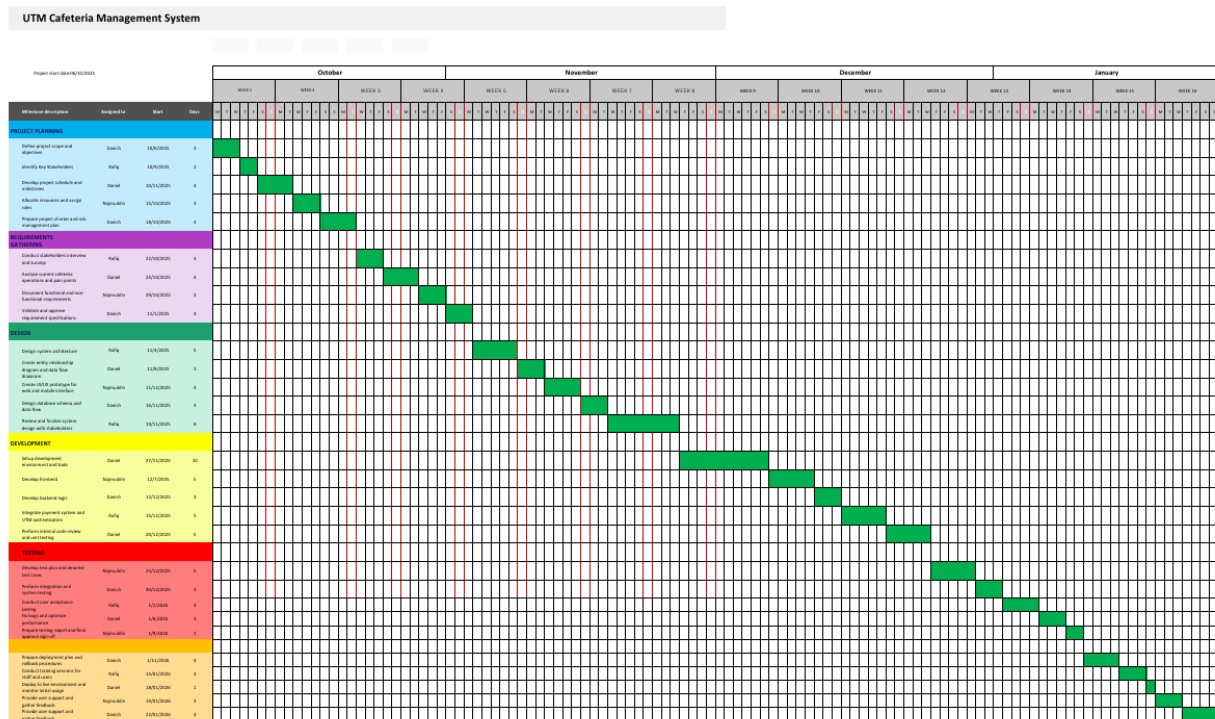
7.0 PROJECT PLANNING

7.1 Human Resources

The successful implementation of the UTM Cafeteria Management System requires effective management of project personnel across all development phases. This section outlines the roles, responsibilities, staffing plan, and coordination strategy.

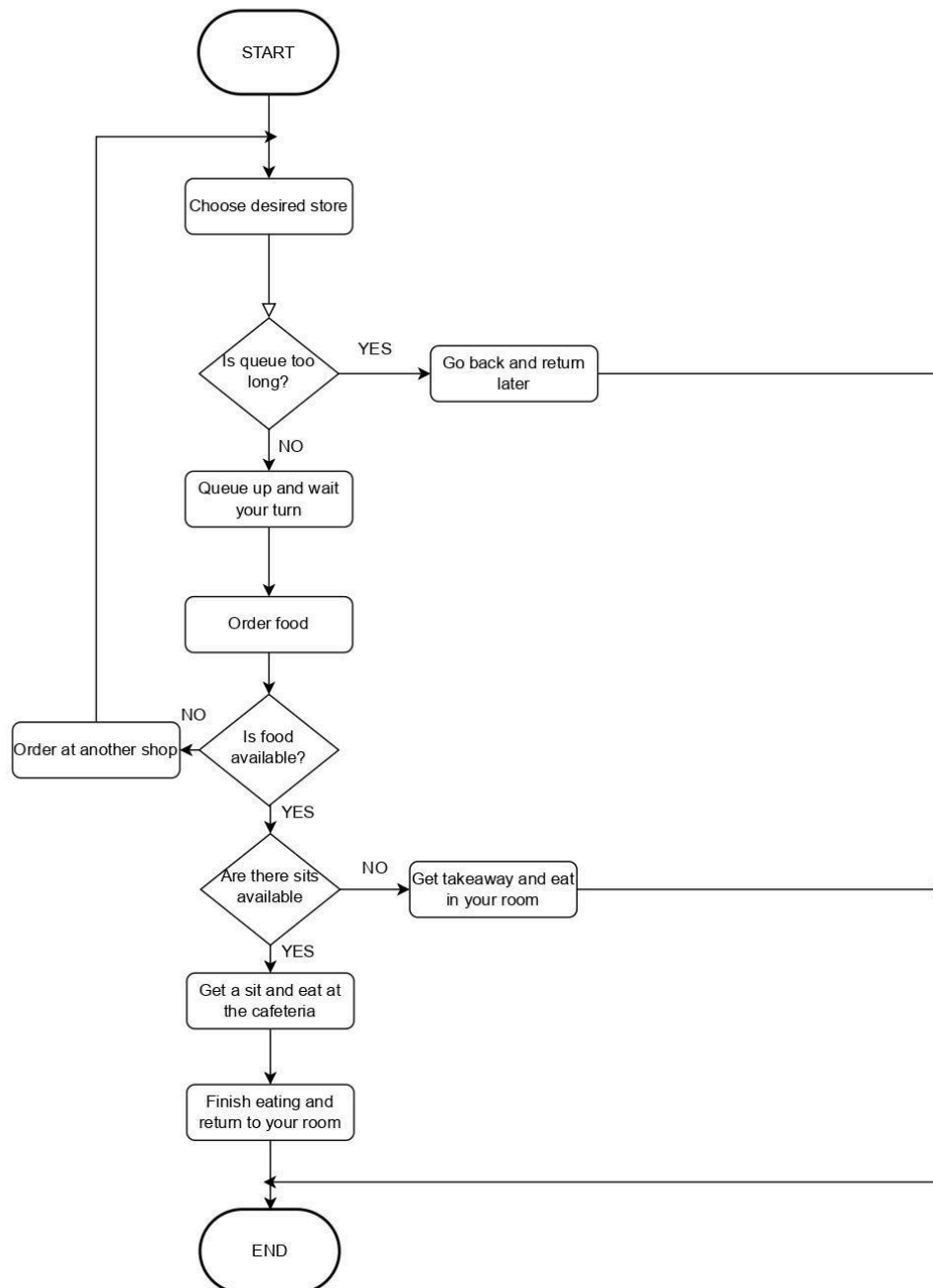| Role	Responsibility
Project Manager	Oversees overall project execution, ensures adherence to scope, schedule, and budget.
System Analyst	Conducts stakeholder interviews, gathers requirements, and analyzes current cafeteria operations.
Software Developers	Develops frontend and backend components, including integration with payment and authentication systems.
UI/UX Designer	Designs intuitive user interfaces for students, staff, and cafeteria operators.
Database Administrator	Designs database schema, manages data flow, and maintains system integrity.
QA/Test Engineer	Develops test plans, performs unit, integration, and system testing, and leads User Acceptance Testing (UAT).
Technical Support Staff	Provides user training, deployment assistance, and post-launch technical support.

7.2 Work Breakdown Structure (WBS)

WBS FOR UTM CAFETERIA MANAGEMENT SYSTEM

1. PROJECT PLANNING
- DEFINE PROJECT SCOPE AND OBJECTIVES
- IDENTIFY KEY STAKEHOLDERS
- DEVELOP PROJECT SCHEDULE AND MILESTONES
- ALLOCATE RESOURCES AND ASSIGN ROLES
- PREPARE PROJECT CHARTER AND RISK MANAGEMENT PLAN

2. REQUIREMENTS GATHERING
- CONDUCT STAKEHOLDER INTERVIEWS AND SURVEYS
- ANALYZE CURRENT CAFETERIA OPERATIONS AND PAIN POINTS
- DOCUMENT FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS
- VALIDATE AND APPROVE REQUIREMENT SPECIFICATIONS

3. DESIGN
- DESIGN SYSTEM ARCHITECTURE (MODULES: ORDERING, MENU, KITCHEN, ANALYTICS)
- CREATE ENTITY RELATIONSHIP DIAGRAM (ERD) AND DATA FLOW DIAGRAM (DFD)
- CREATE UI/UX PROTOTYPES FOR WEB AND MOBILE INTERFACES
- DESIGN DATABASE SCHEMA AND DATA FLOW
- REVIEW AND FINALIZE SYSTEM DESIGN WITH STAKEHOLDERS

4. DEVELOPMENT
- SETUP DEVELOPMENT ENVIRONMENT AND TOOLS
- DEVELOP FRONTEND
- DEVELOP BACKEND LOGIC
- INTEGRATE PAYMENT SYSTEM AND UTM AUTHENTICATION
- PERFORM INTERNAL CODE REVIEW AND UNIT TESTING

5. TESTING
- DEVELOP TEST PLAN AND DETAILED TEST CASES
- PERFORM INTEGRATION AND SYSTEM TESTING
- CONDUCT USER ACCEPTANCE TESTING (UAT)
- FIX BUGS AND OPTIMIZE PERFORMANCE
- PREPARE TESTING REPORT AND FINAL APPROVAL SIGN-OFF
- PROVIDE USER SUPPORT AND GATHER FEEDBACK

6. DEPLOYMENT & TRAINING
- PREPARE DEPLOYMENT PLAN AND ROLLBACK PROCEDURES
- CONDUCT TRAINING SESSIONS FOR STAFF AND USERS
- DEPLOY TO LIVE ENVIRONMENT AND MONITOR INITIAL USAGE
- PROVIDE USER SUPPORT AND GATHER FEEDBACK

7.3 Gantt Chart

UTM Cafeteria Management System

Gann Chart DB.pdf

8.0 REQUIREMENT ANALYSIS

8.1 Current Business Process

a) Customer

Workflow for Customer Entity

The student will first choose their desired store at the cafeteria. If the queue is too long, they will go back and return later, otherwise they will queue up and wait for their turn to order. After placing the order, if the food is unavailable, the student will go to another shop to order. If the food is available, they will check if there are seats. If no seats are available, the student will take the food away and eat in their room. If seats are available, they will dine at the cafeteria. Once finished eating, the student will return to their room, completing the process.
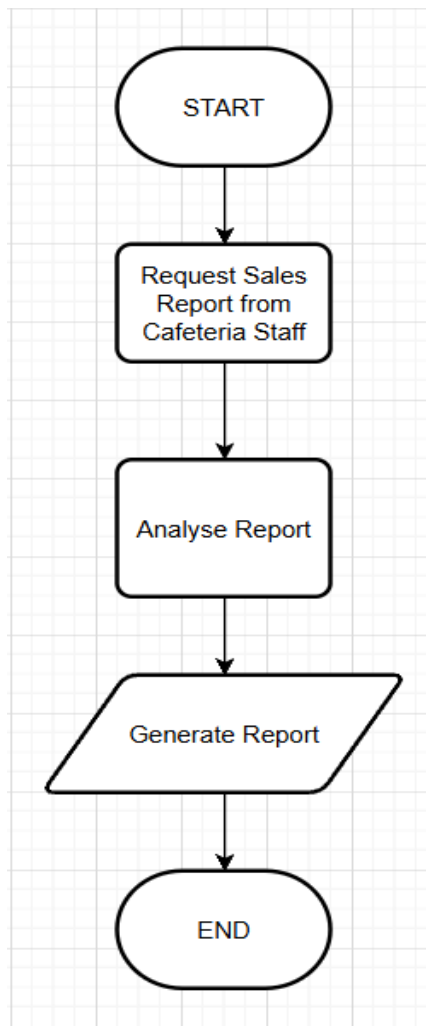
b) Cafeteria Staff
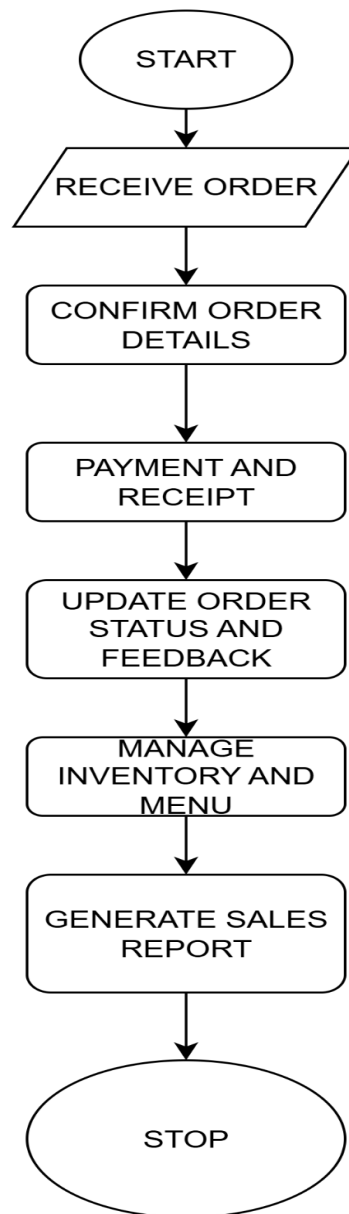
Workflow for Cafeteria Staff Entity

The cafeteria staff will first receive the customer's order and confirm the order details to ensure everything is correct. After confirming, they will process the payment and provide a receipt to the customer. Once the order is completed, the staff will update the order status and record any customer feedback. They will then manage the inventory and update the menu based on available stock. Finally, the staff will generate a sales report to be sent to the admin for review.

c) Administrator

Workflow for Admin Entity

The Admin will receive the sales report from Cafeteria Staff and will then analyse the report. After analyzing, the Admin will then generate a report to be kept as proof.

9.0 TRANSACTION REQUIREMENT (Entry, Update/Delete, Queries)

The Digital Cafeteria Management System (DCMS) will handle multiple data transactions involving customers, cafeteria staff, and administrators. The system's transaction requirements are categorized into data entry, data update/delete, and data queries to ensure smooth operations, accurate record-keeping, and efficient data retrieval.

9.1 Data Entry

Data entry transactions involve adding new records to the system. These records are primarily created by users during interactions with the system.

No.	Transaction Name	Performed By	Description
1	Customer Order Entry	Customer	Customers place a new food order by selecting items from the digital menu and submitting payment.
2	Menu Item Registration	Administrator / Staff	New food or beverage items are entered into the system with details such as name, price, category, and availability status.
3	Feedback Submission	Customer	After receiving an order, the customer can provide feedback or ratings for service and food quality.
4	Inventory Record Entry	Staff	Staff record new stock arrivals, such as raw ingredients and supplies.
5	Staff Account Entry	Administrator	Admin adds new cafeteria staff accounts, defining their roles and login credentials.
6	Sales Record Generation	System (Automatic)	When a payment is completed, a new sales record is automatically created in the database.

9.2 Data Update/Delete

These transactions ensure data accuracy by allowing authorized users to modify or remove outdated information from the system.

No.	Transaction Name	Performed By	Description
1	Update Order Status	Staff	Staff updates each order status (e.g., Pending, Preparing, Ready, Completed).
2	Update Menu Information	Administrator / Staff	Menu prices, availability, or descriptions are updated according to stock changes.
3	Modify Inventory Quantity	Staff	Staff updates inventory quantities after daily stock usage or deliveries.
4	Delete Canceled Orders	Customer / Staff	Canceled orders are removed from the active order list.
5	Update Staff Information	Administrator	Admin edits staff details such as phone number, position, or access rights.
6	Delete Outdated Records	Administrator	Old sales, feedback, or inactive user accounts are deleted to maintain system performance.

9.3 Data Queries

Data query transactions allow users to retrieve and view information stored in the database for decision-making and daily operations.

No.	Transaction Name	Performed By	Description
1	View Menu List	Customer	Displays all available menu items with current stock and prices.
2	Check Order Status	Customer	Allows customers to track their current order progress in real time.
3	View Sales Report	Administrator	Admin generates daily, weekly, or monthly sales reports for performance analysis.
4	Retrieve Feedback Records	Administrator / Staff	Displays all customer feedback and ratings to monitor satisfaction levels.
5	View Inventory Report	Staff / Administrator	Shows current stock levels and automatically highlights low inventory.
6	View Staff Performance	Administrator	Displays staff productivity and total orders processed.
7	Retrieve Transaction History	Customer	Allows customers to view past orders and payment details.

10.0 BENEFITS OF PROPOSED SYSTEM

The proposed Digital Cafeteria Management System for Universiti Teknologi Malaysia (UTM) introduces a transformative approach to campus dining, addressing inefficiencies in service delivery, order management, and resource utilization. By integrating modern digital solutions, this system can enhance convenience, reduce operational costs, and support data-driven decisions, making for a more smarter dining experience.

Key Benefits of the Proposed System

1. **Improved Efficiency & Reduced Wait Times**
   a. Online pre-ordering and real-time queue management drastically cut down wait times, allowing students and staff to pick up meals seamlessly.
   b. Direct-to-kitchen order transmission minimizes errors caused by manual order-taking.

2. **Enhanced User Experience**
   a. Digital menus provide real-time updates on available food items, reducing customer disappointment due to sold-out meals.
   b. Dietary filters improve accessibility for individuals with specific dietary preferences or restrictions.

3. **Optimized Resource Utilization**

   a. Automated inventory tracking enables precise monitoring of food supply, minimizing wastage and unnecessary over-preparation.
   b. Sales analytics and peak-demand tracking help cafeteria operators refine offerings based on customer preferences.

4. **Cashless Transactions for Seamless Payments**
   a. Integration with student ID and QR-based payments eliminates cash handling delays and improves transaction speed.
   b. Reduces reliance on physical cashiers, streamlining financial management.

5. **Data-Driven Insights for Better Planning**
   a. A dashboard offering real-time analytics supports better decision-making regarding menu optimization, peak-hour staffing, and pricing strategies.
   b. Instant feedback collection ensures continuous improvements in service quality.

6. **Real-Time Cafeteria Status & Notifications**
   - Occupancy monitoring allows users to check crowd levels before arriving, improving overall convenience.
   - Push notifications alert customers about peak hours, daily specials, and flash sales, enhancing engagement.

11.0 SUMMARY

The UTM Cafeteria Management System is a necessary strategic investment to modernize campus dining with a core goal to eliminate problems like long service delays, food waste, and inaccurate orders. By implementing features like online pre-ordering and a dynamic menu with real-time updates, the system enhances food visibility and creates a more efficient, user-friendly environment.

The System is highly scalable and has a strong financial justification, showing a high profitability index. It promises long-term operational excellence, aligning directly with UTM's transformation goals. This can help establish a new standard in campus dining, where technology meets convenience, improving the daily experience for the entire university.