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FACULTY OF INFORMATION SYSTEMS**



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COURSE: PROJECT MANAGEMENT FOR INFORMATION SYSTEMS

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**BUSINESS INTELLIGENCE (BI) SYSTEM FOR GOLDEN GATE
RESTAURANT CHAIN – MARKETING AND SALES
MODULES.**

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TABLE OF CONTENT

TABLE OF CONTENT	ii
LIST OF FIGURES.....	viii
LIST OF TABLES.....	xi
COMMITMENT	xiv
ACKNOWLEDGEMENTS	xvi
ABSTRACT	xvii
CHAPTER 1: INITIATION PHASE.....	1
Chapter Overview.....	1
1.1. Introduction to Golden Gate Company.....	1
1.1.1. Vietnam's F&B Industry	1
1.1.2. Golden Gate overview	3
1.1.3. Golden Gate Major Milestones and Innovation	5
1.2. Where is the status of the Golden Company?	7
1.2.1. SWOT analysis	10
1.2.2. Porter's 5 forces analysis of Golden Gate Company	14
1.2.2.1. Competitive Rivalry	14
1.2.2.2. Threat of new entrants	16
1.2.2.3. Bargaining power of suppliers.....	16
1.2.2.4. Bargaining power of buyers	17

1.2.2.5. Threat of substitutes	19
1.2.3. Business requirements/Problems.....	20
1.2.3.1. Golden Gate challenges	20
1.2.3.2. Leveraging Technology to Address Challenges.....	22
1.3. Project Overall Objectives.....	23
1.4. Cost baseline analysis	24
1.4.1. COCOMO analysis.....	24
1.4.1.1. Overview of COCOMO Analysis	24
1.4.1.2. Project's COCOMO analysis	30
1.4.2. Payback and NPV analysis	32
1.4.2.1. Payback.....	32
1.4.2.2. NPV analysis	33
1.4.3. ROI analysis	34
1.4.3.1. Definition of ROI	34
1.4.3.2. Advantages	36
1.4.3.3. Disadvantages.....	36
1.4.3.4. Methodologies for Calculating ROI.....	37
1.4.3.5. Key Metrics for BI ROI Measurement:.....	37

1.4.4. Break-Even analysis	39
1.5. Project Business Case.....	50
1.6. Project Charter	59
1.7. Project scope statement.....	66
1.8. Chosen Project Development Lifecycle	69
1.8.1. Methodology.....	69
1.8.2. Working space	78
CHAPTER 2: PLANNING PHASE.....	80
Chapter Overview.....	80
2.1. Organizational Breakdown Structure (OBS)	80
2.2. List of stakeholders and role analysis.....	82
2.3. RACI matrix	83
2.3.1. Definition.....	83
2.3.2. 4 Core Roles of RACI Defined	84
2.3.3. RACI matrix in this project	85
2.4. Activity list and Work breakdown structure.....	86
2.4.1. Activity List.....	86
2.4.2. Work Breakdown Structure	92
2.5. GANTT chart.....	93
2.5.1. Plan Schedule Management	93

2.5.2. Detailed Scheduling and Resources Allocation	97
2.6. Network diagram (PERT) and critical path	99
2.6.1. Network Diagram	99
2.6.2. Critical Path	109
2.7. Risk management (qualitative risk analysis and quantitative risk analysis)....	112
2.7.1. Risk identification, Risk level, Solution for each risk.....	112
2.7.2. Risk Matrix	118
2.7.3. Decision Tree and EMV Analysis	119
2.8. System Design & Architecture	123
2.8.1. Functional Design.....	123
2.8.1.1. DFD - Data Flow Diagram	123
2.8.1.2. Use case	127
2.8.1.3. BPMN	131
2.8.2. Designing Data Warehouse	139
2.8.2.1. Master Data	139
2.8.2.2. Transaction Data.....	140
2.8.2.3. Fact and Dimension Table	141
2.8.3. Data warehouse model	154

2.8.3.1. The main relationships in the data warehouse model schema	156
2.8.3.2. ETL Process.....	158
2.8.3.3. Data analysis with SSAS	160
CHAPTER 3: MONITORING PROGRESS AND QUALITY CONTROL	163
Chapter Overview.....	163
3.1. Change request form	163
3.2. Project diary.....	169
3.3. Risk log	172
3.4. Earned value analysis.....	177
3.4.1. Related terms and formulas	177
3.4.2. Project Level EVM	181
3.5. Plan Quality management	184
3.5.1. TQM (Total Quality Management)	184
3.5.2. EFQM Model.....	185
3.5.3. Cost-benefit analysis	190
3.5.4. Pareto diagrams	192
CHAPTER 4: LESSON LEARN AND PROJECT EVALUATION.....	194
Chapter overview.....	194
4.1. Project performance analysis	194
4.1.1. Work overview report.....	194

4.1.2. Cost overview report	197
4.1.3. Resource overview report.....	199
4.1.4. Dashboards	201
4.1.4.1 Sales Performance Dashboard.....	201
4.1.4.2. Marketing Effectiveness Dashboard	203
4.1.4.3. Customer Insights Dashboard.....	206
4.1.4.4. Customer Retention & Loyalty Dashboard	208
4.2. Lesson learned.....	210
4.3. Group member evaluation.....	216
4.4. Future development.....	222
REFERENCES	224

LIST OF FIGURES

Figure 1.1. Golden Gate concept.....	2
Figure 1.2. Golden Gate Logo	3
Figure 1.3. Golden Gate Core value	4
Figure 1.4. Typical restaurant chains owned by Golden Gate	5
Figure 1.5. Golden Gate Restaurant Group Milestones	6
Figure 1.6. SWOT Analysis for Golden Gate	10
Figure 1.7. Six phases of COCOMO Model	29
Figure 1.8. Measures of success with Business Intelligence.....	35
Figure 1.9. Hybrid Project Management	72
Figure 1.10. Our working space for the first two phases - Initiation and Planning	78
Figure 1.11. Jira Task Management Board	79
Figure 2.1. Organizational Breakdown Structure of our team	81
Figure 2.2. RACI MATRIX	85
Figure 2.3. Work Breakdown Structure - Top Level	92
Figure 2.4. Work Breakdown Structure - Middle Level	92
Figure 2.5. Work Breakdown Structure - Bottom Level	92
Figure 2.6. Work Breakdown Structure	92
Figure 2.7. Project Schedule Overview for the Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules	93
Figure 2.8. Gantt chart diagram for phases 1	98
Figure 2.9. Gantt chart diagram for phases 2	98

Figure 2.10. Gantt chart diagram for phases 3	98
Figure 2.11. Part of Network Diagram	109
Figure 2.12. Critical path in the final stages of the project	111
Figure 2.13. Critical path in a compact model of the network diagram.....	112
Figure 2.14. Risk Matrix.....	118
Figure 2.15 Decision tree and EMV analysis of scenario 1 - Choosing the Visualization platform	120
Figure 2.16. Decision tree and EMV analysis of scenario 2 - Choosing Data Warehouse platform	121
Figure 2.17. Decision tree and EMV analysis of scenario 3 - Choosing the Cloud Infrastructure	122
Figure 2.18. Data Flow Diagram - Level 0	123
Figure 2.19. Data Flow Diagram - Level 1	125
Figure 2.20. Use case Diagram of Marketing Module	127
Figure 2.21. Use case Diagram of Sales Module	128
Figure 2.22. Use case Diagram of Store Manager.....	130
Figure 2.23. BPMN Diagram: Internal User Login & Authentication Process	131
Figure 2.24. BPMN Marketing Campaign Performance Analysis Workflow	133
Figure 2.25. BPMN Sales Performance Analysis Workflow	137
Figure 2.26. The proposed Data Warehouse model	155
Figure 2.27. Dimension Table's ETL Process.....	159
Figure 2.28. Fact Table's ETL Process	160
Figure 2.29. Data analysis with SSAS.....	161
Figure 3.1. Identification of Project's Earned Value Management (EVM)	182

Figure 3.2. Visualization of earned value analysis.....	182
Figure 3.3. Performance index	183
Figure 3.4. Project Quality Management processes	184
Figure 3.5. EFQM Model for project management.....	187
Figure 3.6. Quality control flowchart	189
Figure 3.7. Cost-benefit analysis of choosing the visualization platform.....	190
Figure 3.8. Cost-benefit analysis of choosing the data warehouse platform.....	191
Figure 3.9. Cost-benefit analysis of choosing the cloud infrastructure.....	192
Figure 3.10. Pareto diagrams.....	193
Figure 4.1. Burndown chart report	194
Figure 4.2. Work overview report (1)	195
Figure 4.3. Work overview report (2)	196
Figure 4.4. Cost overview report (1)	197
Figure 4.5. Cost overview report (2)	198
Figure 4.6. Resource Overview Report	200
Figure 4.7. Resource Status Table	200
Figure 4.8. Sales Performance Dashboard	201
Figure 4.9. Marketing Effectiveness Dashboard	203
Figure 4.10. Customer Insights Dashboard	206
Figure 4.11. Customer Retention & Loyalty Dashboard.....	208

LIST OF TABLES

Table 1.1. Schemas used in the database.....	7
Table 1.2. Comparison Table of Competitive Strategies Between Golden Gate and Redsun	15
Table 1.3. Basic model coefficients	26
Table 1.4. Intermediate model cost drivers	27
Table 1.5. Intermediate model coefficients	28
Table 1.6. Estimated Lines Of Code of the project.....	30
Table 1.7. Determine Scale Factors and Calculate EAF	31
Table 1.8. Fixed Costs related to the project	40
Table 1.9. Variable Costs related to the project	44
Table 1.10. Cost Baseline Analysis of Project	46
Table 1.11. Project Business Case.....	50
Table 1.12. Project Charter.....	59
Table 1.13. Project Business Case.....	66
Table 1.14. Hybrid Approach for the BI System for Golden Gate Restaurant Chain.....	74
Table 2.1. Organizational Breakdown Structure (OBS) of our team	81
Table 2.2. List of Stakeholders and Role Analysis	82
Table 2.3. 4 Core Roles of RACI Defined	84
Table 2.4. Activity List of our project - Summary	86
Table 2.5. Activity List of our project - Detailed	87
Table 2.6. Detailed Activities for each phase in the project.....	94

Table 2.7. Process Flow Network.....	100
Table 2.8. The four possible effects of any risk and assessing the levels of both probability of occurrence	113
Table 2.9. Risk identification, Risk level, Solution for each risk.....	115
Table 2.10. Master Data	139
Table 2.11. Transaction Data.....	140
Table 2.12. DimCustomer	141
Table 2.13. DimOrderItem	142
Table 2.14. DimOrders	143
Table 2.15. DimProducts	145
Table 2.16. DimPayment.....	146
Table 2.17. DimReviews	148
Table 2.18. DimSellers	149
Table 2.19. DimSellers	150
Table 2.20. The description of the tables in the Data Warehouse model.....	155
Table 2.21 The table describes the relationship in the Data Warehouse model.....	156
Table 3.1. Change Request Form (1) – Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules	164
Table 3.2. Change Request Form (2) – Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules	166
Table 3.3. Project Diary – Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules.....	169
Table 3.4. Risk log of the project	174
Table 4.1. Lessons Learned Document	211

Table 4.2. Group member evaluation	217
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COMMITMENT

Subject: Information System Project Management

Dear Assoc. Prof. Dr. Ho Trung Thanh,

Our team is fully committed to developing a Business Intelligence (BI) System for Golden Gate Restaurant Chain, focusing on Marketing and Sales Modules to enhance data-driven decision-making, optimize operations, and improve customer satisfaction. This initiative aims to centralize data, provide actionable insights, and support scalability. This commitment includes several key aspects:

1. Project Scope and Objectives

- Clearly defining the project's scope, including its objectives, functionalities, and features.
- Aligning the project with the academic requirements and learning outcomes specified for our final project.

2. Timelines and Deliverables

- Setting clear timelines with achievable milestones, ensuring the project is completed within the agreed timeframe.
- Provide key features, including interactive dashboards, predictive analytics, and data visualization tools.

3. Resource Allocation

- Allocating the necessary human and technological resources to support the development process effectively.

- Ensuring access to relevant tools, software, and infrastructure essential for the project's execution.

4. Collaboration and Documentation:

- Promoting teamwork and open communication among all team members to foster creativity and efficiency.
- Ensuring regular updates on the project's progress to maintain accountability and transparency.

5. Quality and Continuous Improvement:

- Uphold the highest quality standards in data management, reporting accuracy, and system usability.
- Implement continuous testing, quality assurance, and system performance optimization.

By formalizing this commitment, our team affirms our dedication to delivering a scalable, efficient, and user-friendly BI solution that aligns with Golden Gate's strategic needs. We appreciate your support and guidance in making this project a success.

Thank you for your support and trust in this endeavor.

ACKNOWLEDGEMENTS

In the evolving landscape of data-driven decision-making, the need for an effective Business Intelligence (BI) System has never been more critical. Recognizing this necessity, our team embarked on the development of a BI system for the Golden Gate Restaurant Chain, focusing on Marketing and Sales Modules to centralize data, optimize operations, and enhance customer engagement. This initiative was driven by our commitment to solving challenges related to data fragmentation, operational inefficiencies, and marketing performance evaluation, ensuring a seamless and intelligent decision-making process for the restaurant chain.

We extend our deepest gratitude to Assoc. Prof. Dr. Ho Trung Thanh for his invaluable guidance, expertise, and continuous support throughout this project. His insightful feedback and encouragement have been fundamental in shaping our understanding of business intelligence methodologies, data analytics, and system integration, enabling us to bridge the gap between theory and practical application effectively.

We also appreciate the collaborative efforts of our team members, whose dedication and creativity have contributed significantly to the success of this endeavor. Through meticulous planning, data modeling, and iterative development, we have built a robust and scalable BI solution that empowers data-driven strategies for Golden Gate Restaurants.

This project has not only strengthened our technical skills but also reinforced the importance of teamwork and project management. We are grateful for the knowledge gained and look forward to applying these lessons in our future endeavors.

Once again, we extend our heartfelt thanks to everyone who has supported, guided, and inspired us in making this project a success.

ABSTRACT

In today's competitive F&B industry, data-driven decision-making is essential for businesses to optimize operations, enhance customer engagement, and drive growth. This project presents the Business Intelligence System for the Golden Gate Restaurant Chain, specifically designed to support Marketing and Sales Modules. The system integrates data from multiple sources, including POS systems, CRM, inventory, and financial databases, providing a centralized platform for real-time analytics and data visualization.

The study begins with an in-depth analysis of Golden Gate's current operational challenges, focusing on data fragmentation, marketing inefficiencies, and limitations in customer insights. Using methodologies such as SWOT analysis and Porter's Five Forces, we evaluate the business environment and propose a hybrid project management approach (Waterfall + Agile) to balance structured planning with flexibility. To ensure scalability and efficiency, the BI system employs ETL processes, predictive analytics, and interactive dashboards to enhance decision-making. The system provides valuable insights into customer behavior, sales performance, and marketing campaign effectiveness, enabling data-driven strategies to improve profitability and customer satisfaction.

The project also includes cost analysis, payback period estimation, and ROI evaluation to assess its financial feasibility. Our findings indicate that implementing a BI-driven approach significantly improves data accuracy, operational efficiency, and strategic decision-making for Golden Gate Restaurants. By developing a robust, user-friendly, and scalable BI system, this project contributes to the digital transformation of restaurant management, setting a foundation for future expansion and technological advancements in the industry.

CHAPTER 1: INITIATION PHASE

Chapter Overview

The Initiation Phase serves as the foundation for the Business Intelligence (BI) System project for Golden Gate Restaurants. This phase focuses on evaluating the company's current status, identifying key challenges, and defining business objectives. It includes detailed analyses, such as SWOT, Porter's 5 Forces, and cost evaluations, to ensure the project's feasibility and alignment with strategic goals. Additionally, this phase establishes the project's scope, business case, and key success criteria to guide its future execution.

In **Chapter 1**, the team decided to adopt a Hybrid methodology, combining the strengths of Agile and Waterfall approaches. This allows the project to leverage the flexibility and iterative delivery of Agile for developing the BI system's modules, while maintaining the structured planning and documentation of Waterfall to ensure alignment with the company's strategic vision. This hybrid approach was chosen to balance adaptability with clear milestones, making it well-suited for a complex and strategic initiative like this project.

1.1. Introduction to Golden Gate Company

1.1.1. Vietnam's F&B Industry

Vietnam is emerging as one of the most impressive growth economies in the region, according to forecasts from the International Monetary Fund (IMF). The food and beverage (F&B) sector is considered one of the key drivers of this growth, with the market value projected to exceed VND 655 trillion in 2024, an increase of 10.92% compared to the previous year, according to a report by Kirin Capital, a private equity investment organization specializing in the Vietnamese market.

By 2027, independent F&B outlets are expected to maintain a dominant market share of 93.9%, affirming the sustainability of this business model. However, major F&B chains such as Golden Gate, Goldsun Food... are striving to enhance their appeal to customers. Notable strategies include launching unique product lines, innovating store designs, improving customer experiences, and developing subsidiary brands.



Figure 1.1. Golden Gate concept

(Source: forbes.vn)

A report from Nielsen highlights a steady growth rate of 10% annually in Vietnam's F&B sector, indicating it as an attractive field for both domestic and international investors. Notably, 68% of the industry's revenue came from restaurant services, reflecting a trend

where consumers are willing to spend more on dining experiences, particularly on special occasions.

Between 2023 and 2027, revenue from restaurant chains is expected to grow at a compound annual growth rate (CAGR) of 14.6%, surpassing the 12.52% growth rate of independent F&B outlets. With robust growth and increasing consumer demand, Vietnam's F&B sector remains a highly promising market, offering significant opportunities for businesses and investors in the coming years.

1.1.2. Golden Gate overview

Founded in 2005 by Đào Thé Vinh, Golden Gate Group Joint Stock Company (Golden Gate) is a pioneering Vietnamese enterprise specializing in chain restaurant models. Officially operating since 2008, the company secured a \$2.6 million investment from Mekong Capital, marking its initial steps toward success.



Figure 1.2. Golden Gate Logo
(Source: *Golden Gate Restaurants*)

Golden Gate's mission is "HAPPY TEAM MEMBER – HAPPY CUSTOMER," highlighting that satisfied employees are key to providing excellent service and ensuring happy customers, which creates a continuous cycle of success. Their vision is "BE THE FIRST F&B CHOICE," aiming to become the top choice in the food and beverage industry, known for its quality and customer experience. The company's three core values are Integrity – consistently doing the right thing to build trust, Humanity – focusing on empathy and respect, and High Performance – always aiming for excellent productivity and results.



Figure 1.3. Golden Gate Core value

(Source: *Golden Gate Restaurants*)

Starting with its first brand, Ashima – Natural Mushroom Hotpot, Golden Gate now owns over 40 brands and operates more than 500 restaurants across 42 provinces in Vietnam. Some of Golden Gate's well-known brands include Vuvuzela – Beer Club, SumoBBQ –

Japanese Grill & Hotpot, GoGi House – Korean BBQ, and Kichi Kichi – Conveyor Hotpot. Each brand provides a unique experience, from the flavors of the food to the restaurant design and service style.



Figure 1.4. Typical restaurant chains owned by Golden Gate

(Source: Golden Gate Restaurants)

1.1.3. Golden Gate Major Milestones and Innovation

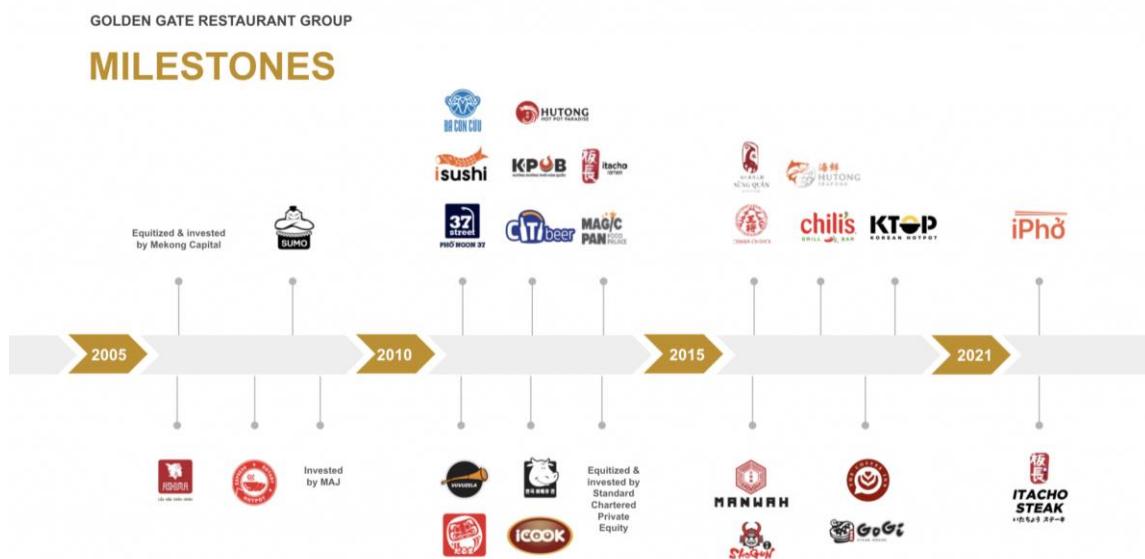


Figure 1.5. Golden Gate Restaurant Group Milestones

(Source: Golden Gate Restaurants)

In February 2009, Golden Gate launched the Kichi Kichi restaurant, which introduced the conveyor belt hotpot concept to Vietnam for the first time. It quickly captured the attention of customers, leading to rapid success. Following the success of Kichi Kichi, in 2010, Sumo BBQ was introduced, quickly becoming a popular spot, especially for the youth.

In 2012, the company introduced multiple Vuvuzela beer restaurants, inspired by the vuvuzela horn from the 2010 World Cup. That same year, Golden Gate also opened other chains like Daruma, 3 Con Cùu, Phô Ngon 37, and iSushi. The company continued to expand with new restaurants, including Gogi House, City Beer Station, and iCook, all of which made a strong impact on customers.

Golden Gate has played a significant role in shaping the food culture in Vietnam. By continuously introducing new restaurant brands each year, it has offered a wide variety of choices for its customers. Those seeking Japanese cuisine can visit Sumo BBQ or iSushi, while those desiring Hong Kong food can head to Crystal Jade Hongkong Kitchen or Hutong. Each Golden Gate restaurant is designed to meet the needs of different customer groups, such as Ashima Hotpot for the high-end market or Kichi Kichi Conveyor Belt Hotpot for young people. Many of Golden Gate's restaurant chains have succeeded by focusing on the right target audience and fulfilling their needs.

Golden Gate Dataset is a comprehensive dataset designed to support data analysis, visualization, and machine learning model training for businesses in the food and beverage (F&B) industry. Inspired by the Brazilian E-Commerce Public Dataset by Olist, this dataset includes detailed information on customer orders, product details, payment methods, delivery performance, customer feedback, and seller performance. The dataset provides a holistic view of online F&B transactions, enabling businesses to uncover insights into

customer behavior, optimize operations, and enhance customer experience. With its structured format and rich content, the Golden Gate dataset is an ideal resource for exploring predictive analytics, classification, and data-driven decision-making in the F&B e-commerce space.

Table 1.1. Schemas used in the database

No.	Schema	Contain related objects	Number of tables
1	Orders	Details about customer orders, including timestamps and status	1
2	Products	Product details such as category and name	1
3	Order Items	Information about the items in each order	1
4	Payments	Payment transaction details	1
5	Reviews	Customer feedback on orders	1
6	Sellers	Data about the sellers on the platform	1
7	Customers	Customer demographic data	1
8	Geolocation	Geographic data for delivery and analysis	1

1.2. Where is the status of the Golden Company?

Golden Gate Company is recognized as one of Vietnam's largest restaurant chains, operating across various dining concepts, including casual dining, hotpot, and BBQ. Its current position in the market reflects a combination of significant achievements and areas for improvement. This evaluation examines the **internal environment, external environment, and key challenges** related to the company's information systems (IS) and operational framework.

- **Internal Environment**

The internal operations of Golden Gate showcase notable strengths in branding and service delivery, but they also highlight inefficiencies that need to be addressed:

- **Operational Efficiency:** The company operates over 400 restaurants nationwide (as of 2024) across multiple brands, such as Gogi House, Manwah, and Hutong. While this scale provides significant market coverage, it also creates logistical challenges. Many restaurant operations, including inventory management and order tracking, are still partially manual or rely on outdated ERP modules. These inefficiencies contribute to higher labor costs and slower service delivery.
- **Information Systems (IS):** Golden Gate's IS includes a mix of legacy systems and newer cloud-based tools for CRM and point-of-sale (POS) tracking. However, these systems **lack full integration**, which creates operational silos across procurement, HR, and financial reporting. For instance, sales forecasting is not seamlessly connected to supply chain operations, leading to frequent overstocking or shortages.
- **Workforce and Talent Development:** The company employs over **15,000 staff**, ranging from service teams to back-office professionals. However, many employees, especially in managerial roles, lack training in using data analytics tools and integrated ERP systems. Employee turnover is relatively high, particularly in customer-facing roles, which affects customer satisfaction and service consistency.
- **Brand Strength and Customer Loyalty:** Golden Gate's diverse dining concepts and innovative menu offerings have garnered a strong customer base. Repeat customers account for over 60% of total sales, particularly through loyalty programs.

- **External Environment**

The external environment presents both growth opportunities and challenges, shaped by industry trends, regulatory changes, and customer expectations:

- **Market Trends:** The Vietnamese dining industry has seen rapid growth in **online food delivery**, with revenue from this segment increasing by **20% annually** from 2020 to 2024. This trend demands investment in user-friendly mobile apps and integration with delivery platforms.
 - **Competitive Landscape:** Golden Gate faces stiff competition from global brands like BBQ Plaza and local chains like RedSun ITI, which offer similar dining experiences. Competitors are increasingly leveraging AI-powered loyalty programs and delivery apps, providing seamless customer engagement.
 - **Economic and Regulatory Factors:** Rising **inflation** and fluctuations in the cost of imported food ingredients have impacted profit margins. The Vietnamese government has introduced stricter regulations on food safety, sustainability, and labor standards, requiring additional investments in compliance measures.
 - **Evolving Customer Preferences:** Millennials and Gen Z now dominate the market, preferring personalized dining experiences and healthier menu options. Companies that fail to adapt risk losing relevance.
- **Key challenges**
- **Technological Gaps:** The company's reliance on legacy systems prevents real-time data sharing between departments. This hinders accurate demand forecasting, efficient supply chain management, and timely decision-making.
 - **Adapting to Digital Transformation:** Competitors like RedSun have fully implemented AI-driven systems for customer data analytics, while Golden Gate lags in adopting these technologies.

- **Scaling Without Compromising Quality:** As the company expands to smaller cities, maintaining consistent service quality and operational standards remains a significant hurdle.

1.2.1. SWOT analysis

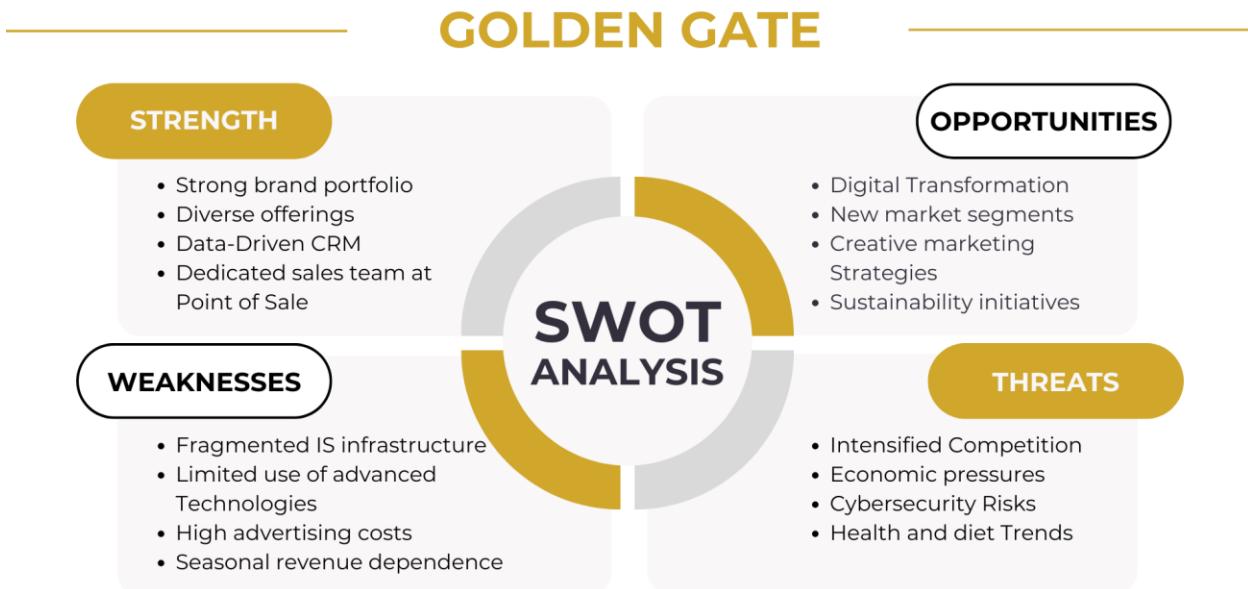


Figure 1.6. SWOT Analysis for Golden Gate

(Sources: Authors' source)

This analysis examines internal strengths and weaknesses alongside external opportunities and threats, with a focus on information systems, Sales & Marketing, and digital readiness.

Strengths:

- **Strong Brand Portfolio:**
 - Well-known brands like Gogi House and Manwah have built a loyal customer base nationwide.

- Customer Trust: Strong brand recognition ensures customers feel confident in choosing the company's services.
- Marketing Advantage: These brands frequently appear in media, amplifying brand awareness and driving traffic.
- **Diverse Offerings and Experiences:**
 - A variety of dining models caters to multiple customer segments, including families, young professionals, and corporate clients.
 - Marketing Leverage: The diverse offerings allow for creative campaigns tailored to specific customer groups.
- **Data-Driven CRM:**
 - A well-established loyalty program collects valuable customer data, enabling insights for personalized campaigns.
 - Marketing Efficiency: CRM data optimizes promotional efforts, improving customer retention rates.
 - Automation in Campaigns: Automated, data-driven tools streamline personalized communications, reducing costs while increasing engagement.
- **Dedicated Sales Team at Point of Sale:**
 - Professional Service: Well-trained staff creates a welcoming customer experience.
 - Upselling & Cross-Selling: Staff expertise increases average order value through effective recommendations.

Weaknesses:

- **Fragmented IS Infrastructure:**
 - Non-integrated systems require manual data consolidation, slowing reporting and decision-making.

- Sales & Marketing Impact: Lack of real-time data limits the effectiveness of marketing campaigns.
- **Limited Adoption of Advanced Technologies:**
 - The company has yet to implement predictive analytics or AI-powered tools, hindering competitive advantage.
 - Marketing Efficiency: Without advanced technologies, budget optimization and product targeting are less effective.
- **High Advertising Costs:**
 - Suboptimal ROI: Heavy reliance on traditional channels like TV and print results in high costs with limited measurability.
 - Lack of Digital Marketing Strategy: Investment in digital platforms (Google Ads, social media) is below competitors' levels.
- **Seasonal Revenue Dependence:**
 - Reliance on Holidays and Events: Revenue spikes during festive periods, while off-peak seasons lack strategies to maintain steady sales.

Opportunities:

- **Digital Transformation:**
 - Cloud-Based ERP Integration: Streamlining operations with cloud-based systems can improve inventory management and reduce costs.
 - MarTech (Marketing Technology): Leveraging tools like HubSpot or Salesforce can enhance customer personalization and multi-channel marketing.
- **New Market Segments:**
 - Smaller Cities: Targeting smaller cities with rising incomes and urbanization offers a growth opportunity.

- Localized Marketing Strategies: Tailored campaigns for each region can attract customers by addressing specific cultural or economic needs.

- **Creative Marketing Strategies:**

- Boosting Digital Marketing: Expanding efforts in Google Ads, YouTube, and Influencer Marketing can increase reach and engagement.
- Content Marketing: Highlighting values like “clean eating” and “transparent sourcing” can attract health-conscious consumers.

- **Sustainability Initiatives:**

- Reducing Single-Use Plastics: Promoting eco-friendly efforts can boost brand image among environmentally-conscious consumers.
- Supporting Local Communities: Using local ingredients not only lowers costs but also enhances community support and goodwill.

Threats:

- **Intensified Competition:**

- Tech-Savvy Rivals: Competitors leveraging AI and automation are enhancing customer experiences, creating a competitive disadvantage.
- Aggressive Promotions: Competitors’ discounts and combos put pressure on pricing strategies.

- **Economic Pressures:**

- Rising Ingredient Costs: Increases in raw material and labor costs erode profitability.
- Decreased Consumer Spending: Economic challenges can lead to reduced discretionary spending on dining out.

- **Cybersecurity Risks:**

- Expanding Digital Operations: Increased reliance on digital systems raises the risk of data breaches.

- Reputation Impact: A significant data breach could erode customer trust and damage brand reputation.
- **Health and Diet Trends:**
 - Competition from Healthy Concepts: The growing popularity of health-focused dining concepts could divert customers unless the company adapts quickly.

By seizing opportunities such as digital transformation and creative marketing strategies, the company can address weaknesses like fragmented IT infrastructure and high advertising costs. To stay competitive, it is essential to invest in technology, mitigate cybersecurity risks, and align with evolving consumer preferences for sustainability and health-conscious choices.

1.2.2. Porter's 5 forces analysis of Golden Gate Company

1.2.2.1. Competitive Rivalry

The food and beverage (F&B) industry in Vietnam is witnessing an increasingly competitive landscape. The number of businesses and establishments continues to grow rapidly. According to a report by VnEconomy, as of the end of June 2024, the country recorded approximately 304,700 F&B establishments, a 3.9% decrease compared to 2023, with at least 30,000 establishments shutting down in the first six months of 2024. Competition has become even fiercer with the participation of major restaurant chains such as Redsun ITI, which owns brands like ThaiExpress, Seoul Garden, King BBQ, Hotpot Story, and Sushi Kei. These brands not only maintain a strong presence in major cities but also continuously expand their influence, raising the competitive intensity in the industry to a new level.

The market is growing rapidly as consumers increasingly favor buffet, grilling, and hotpot dining models, leading to direct competition between brands and Golden Gate chains like Kichi-Kichi and Gogi House.

Amid this context, Golden Gate has managed to maintain its leading position with an extensive network and a diverse portfolio of brands. However, this advantage also comes with significant pressure as it directly faces formidable competitors like Redsun.

Table 1.2. Comparison Table of Competitive Strategies Between Golden Gate and Redsun

	Golden Gate	Redsun
Quality and production process	Focuses on service quality and diverse dining experiences, featuring five main culinary styles: hotpot, grilling, Asian, Western, and coffee shops.	Continuously improves quality and diversifies products to attract customers.
Scale and market share	A network of nearly 400 restaurants, serving 18 million customers annually.	More than 140 restaurants, focused on busy areas and large shopping centers, competing in visibility and customer reach.
Brand loyalty	Builds loyalty through quality service, diverse dining experiences, and a customer loyalty program.	Implements marketing strategies and customer care to retain and expand its loyal customer base.
Competitive Strategy	Expands scale, eliminates underperforming brands, and focuses on profitable ones. Marketing strategies are innovated seasonally, targeting competitors and attracting customers.	Similar to Golden Gate, Redsun innovates marketing strategies, focuses on expanding strong brands, and eliminates underperforming ones.

1.2.2.2. Threat of new entrants

The F&B industry in Vietnam, with relatively low entry barriers, has paved the way for the emergence of numerous new competitors, particularly small restaurants and startups. With minimal initial investment, these businesses can leverage information technology and online business models to enter the market. However, challenges such as managing supply chains, operating on a large scale, and investing in technology to optimize systems remain significant hurdles that new entrants must overcome to effectively compete with major restaurant chains like Golden Gate.

In this context, Golden Gate, with nearly 400 restaurants and 22 brands, has established a strong foundation, creating substantial barriers for new competitors. According to Mr. Dinh Quang Hoan, Deputy General Director of Viet Capital Securities, Golden Gate currently holds a significant advantage in scale, reinforcing its leading position in the industry. In the medium term, no competitor has emerged strong enough to pose a serious challenge to the company's dominance.

However, Golden Gate cannot afford to be complacent, as competitors may choose to focus on niche markets or develop new products and services at more competitive prices. To maintain its advantage in an ever-changing market, Golden Gate must continue to innovate its offerings, enhance customer experience, and incorporate technology into its operations and business activities. These are the key factors that will help the company retain its leadership in the highly competitive F&B industry.

1.2.2.3. Bargaining power of suppliers

Golden Gate, one of the largest restaurant chains in Vietnam, requires specific types of ingredients, including imported beef, fresh seafood, and unique spices, to meet the diverse culinary demands of its system. With a network of over 500 restaurants, Golden Gate holds

a significant advantage in negotiating prices and contract terms compared to smaller individual restaurants. Maintaining stable, large-scale orders has created a reverse dependency from suppliers, thereby reducing their bargaining power.

The food ingredient market in Vietnam is quite diverse, with many competing suppliers, particularly in common product categories such as vegetables, meat, and domestic seafood. However, for premium or imported ingredients such as American beef, wine, or cheese, the number of suppliers is limited, resulting in higher bargaining power for these entities.

A portion of Golden Gate's supply relies heavily on international supply chains, especially for imported products. This dependency makes the company vulnerable to factors such as exchange rate fluctuations, transportation costs, and international trade policies. Additionally, unforeseeable events such as the COVID-19 pandemic or global trade tensions increase the pressure on maintaining stability in the supply chain.

To address these risks, Golden Gate has established long-term relationships with strategic suppliers to ensure a continuous and stable supply. At the same time, sustainable partnerships with local suppliers over the long term help the company mitigate risks and enhance efficiency in its business operations.

1.2.2.4. Bargaining power of buyers

The F&B industry in Vietnam is witnessing strong growth, paving the way for the entry of numerous domestic and international brands. This has significantly expanded customer choices, ranging from buffet restaurants, hotpot, barbecue, and fast food to local eateries. In this competitive landscape, customers are placing higher priority on food quality, service experience, and dining ambiance. They are willing to switch restaurants if their expectations are not met. Therefore, factors such as signature dishes, attractive promotions, and excellent customer service have become critical in retaining consumers.

Online review platforms such as TikTok, Google Reviews, and social media are increasingly playing an important role in shaping consumer purchasing decisions in Vietnam. According to reports, 59% of Vietnamese consumers trust social media to research product information before making a purchase decision. With Vietnam leading the Asia-Pacific region in online shopping rates—67% of consumers using mobile phones and 44% using personal computers for shopping—the significant influence of online platforms is evident. Factors such as interactivity, reliability, brand image, and vibrancy in social media advertising positively impact purchase intentions, while discussions and reviews from online users also strongly influence shopping behavior.

However, negative reviews on these platforms can significantly damage a business's reputation, especially restaurant chains, creating opportunities for customers to shift to competing brands. Customers increasingly tend to compare prices, quality, and reviews directly across multiple brands before deciding, adding more pressure on chains like Golden Gate to continuously improve their products and services to maintain market position.

The mid-range and budget customer segments exhibit high price sensitivity, making promotions and discounts essential tools to attract customers. However, this also puts considerable pressure on business revenue and profits. In contrast, the high-end customer segment is less price-sensitive but demands superior service standards and exceptional experiences.

Post-COVID-19, consumer behavior has changed significantly. Some customers have shifted to delivery services or online ordering instead of dining in, leading to a decline in on-site revenue. At the same time, customers prefer diversity and frequently change dining locations to try new dishes, posing challenges for restaurant chains in maintaining customer loyalty.

Many restaurant chains have implemented loyalty programs, reward points, and promotions to strengthen customer engagement. However, if these programs are not attractive or personalized enough, customers can easily switch to competitors offering better deals.

To sustain and grow in an increasingly competitive market, restaurant chains must constantly innovate, improve service quality, and design promotions that align with customer needs and preferences. Additionally, focusing on listening to feedback and adapting to new consumer trends will help businesses not only maintain their position but also expand their market share in the long term.

1.2.2.5. Threat of substitutes

Golden Gate, one of Vietnam's leading restaurant chains, is facing significant challenges from substitute products in the F&B sector. The rapid growth of online food delivery services has transformed consumer habits, enabling customers to enjoy a wide variety of cuisines at home at lower costs, thereby reducing the need to dine at traditional restaurants. These services not only offer convenience but also provide access to diverse culinary options, leading to decreased in-person dining frequency and negatively impacting restaurant revenues.

Additionally, Vietnam's rich street food culture and the emergence of numerous independent eateries offer customers affordable alternatives, directly competing with large restaurant chains. Furthermore, new dining models such as food trucks, pop-up restaurants, and unique experiential dining are attracting the youth, diverting attention from traditional restaurant chains. These alternatives also diminish customer loyalty, as patrons can easily discover and experiment with new options through online platforms, posing challenges for traditional establishments like Golden Gate in retaining their clientele.

The online food delivery market in Vietnam has experienced substantial growth in recent years. According to Statista, the market size reached approximately \$587 million in 2020 and is projected to continue expanding, potentially reaching \$2.7 billion by 2025.

In terms of market share, GrabFood led the sector in 2022 with 45%, followed closely by ShopeeFood at 41%. This competitive landscape has intensified the challenges for traditional restaurant chains, as consumers increasingly opt for the convenience and variety offered by these platforms.

Moreover, a survey by Q&Me revealed that 83% of Vietnamese respondents use food and beverage delivery services, with 77% utilizing at least one delivery app on their smartphones. The most popular applications are Grab, ShopeeFood, and Baemin. This widespread adoption underscores the shifting consumer preferences towards online food delivery, further impacting traditional dining establishments.

These developments highlight the pressing need for traditional restaurant chains like Golden Gate to adapt their strategies, possibly by integrating delivery services, enhancing in-house dining experiences, or diversifying their offerings to remain competitive in the evolving F&B landscape.

1.2.3. Business requirements/Problems

1.2.3.1. Golden Gate challenges

Golden Gate, one of the leading restaurant chains in Vietnam, owns a diverse portfolio of well-known culinary brands. Golden Gate's success stems not only from the quality of its food and service but also from its efficient management and operations. Currently, the company has over 450 restaurants located throughout Vietnam, which can lead to various emerging issues and pose significant challenges, requiring concrete actions to maintain and develop its brand.

Distributed and Inconsistent Data Management: Golden Gate encompasses multiple restaurant brands (e.g., Kichi Kichi, Gogi House, Ashima) with separate management systems. Each brand may utilize different systems for Point of Sale (POS), Customer Relationship Management (CRM), inventory management, and accounting. Furthermore, data is stored in various formats (CSV, Excel, SQL databases, etc.) and on different platforms. This results in time-consuming, labor-intensive, and error-prone manual data aggregation. Additionally, the company faces challenges in generating comprehensive business reports, comparing brand performance, and analyzing overarching trends.

Difficulty in understanding customers and their behaviors: Efficiently collecting and analyzing customer data (e.g., dining habits, preferences, visit frequency) is a challenge due to:

- Fragmented customer data spread across multiple sources (POS systems, surveys, loyalty programs).
- Difficulty in analyzing customer behavior (e.g., dining habits, favorite dishes, visit times, average spending).
- Limitations in personalizing customer experiences.

Furthermore, the brand must ensure consistent product and service quality across all restaurants and effectively gather customer feedback.

Performance Management and Cost Optimization: Tracking operational performance (Key Performance Indicators - KPIs) for individual restaurants, dishes, or shifts is challenging. Issues in managing materials, controlling costs, and forecasting revenue persist. For instance, inaccurate demand forecasting leads to shortages or surpluses in materials. Manual inventory management is also time-consuming and error-prone.

Evaluating Marketing and Promotion Effectiveness: Measuring the ROI of marketing campaigns and determining the actual effectiveness of promotional programs is challenging. It is difficult to distinguish between sales increases driven by promotions versus natural transactions, while external factors like market trends or competition also play a role.

1.2.3.2. Leveraging Technology to Address Challenges

Amidst growing competition, the adoption of technology, particularly Business Intelligence (BI) systems, is pivotal in optimizing operations and enhancing customer experience. Before deployment, such systems must meet a range of critical requirements to support efficient business operations:

Data Management: The system must have the ability to collect, organize, and put data into one neat, easy-to-use place through robust ETL (Extract, Transform, Load) capabilities to integrate data from dispersed sources into a **centralized** data warehouse, ensuring effective data governance and flexible connectivity.

Customer Analytics: To better understand customers, the system needs to connect with information about existing customers and what they say on social networks, surveys,etc. The system should integrate CRM and interaction channels to segment customers based on their level of intimacy and the value they bring by using RFM (Recency, Frequency, Monetary) analysis, conduct detailed behavior analysis, personalize marketing and experiences, and analyze customer lifecycles.

Performance and Cost Management: It should provide comprehensive performance reports, detailed cost analyses, accurate revenue forecasting, optimized inventory management, and restaurant performance analysis across multiple criteria. By imaging Golden Gate as a big family with many members (brands). Each member has a separate

notebook. The BI system will help collect all those notebooks into a large, neatly arranged book, making it easier for the whole family to see and understand each other. For example, as a dedicated waiter, the BI system will remember the dishes that customers often order, their special occasions, so that next time it can suggest suitable dishes or prepare a small surprise.

Marketing and Quality Management: The system must monitor and evaluate marketing campaign effectiveness, analyze customers by campaign, integrate feedback data from multiple channels, conduct customer sentiment analysis, and generate service and product quality reports.

1.3. Project Overall Objectives

Consolidate and Centralize Data: To integrate disparate data sources across all brands and systems into a unified data warehouse, providing a single source of truth for analysis and reporting. This addresses the challenge of distributed and non-uniform data management.

Gain Deeper Customer Insights: To enhance understanding of customer behavior, preferences, and trends through comprehensive data analysis, enabling personalized marketing, improved customer experience, and increased customer loyalty. This addresses the difficulties in understanding customers. Besides, to monitor and improve service and product quality across all restaurants by effectively collecting and analyzing customer feedback, ensuring consistent brand experience and enhancing customer satisfaction so that the business can maintain consistent quality and improve customer satisfaction.

Optimize Operational Efficiency and Reduce Costs: To improve operational performance by providing detailed insights into KPIs, streamlining inventory management, enhancing demand forecasting, and optimizing resource allocation, ultimately leading to cost

reduction and increased profitability. This addresses the need for operational performance management and cost optimization.

Enhance Marketing Effectiveness and Measure ROI: To accurately measure the effectiveness of marketing campaigns and promotions, enabling data-driven decisions on marketing strategies and resource allocation. This addresses the challenge of evaluating marketing and promotion effectiveness.

Enable Scalability and Flexibility: To implement a BI system that can scale with Golden Gate's growth and adapt to changing business needs and market conditions, ensuring long-term value and adaptability.

1.4. Cost baseline analysis

1.4.1. COCOMO analysis

1.4.1.1. Overview of COCOMO Analysis

COCOMO, which stands for Constructive Cost Model, is a well-known software estimation technique that plays a key role in project management. Introduced by Dr. Barry Boehm, the COCOMO model provides accurate estimates of the resources, time, and costs required for a project. It is based on the principle that different projects have varying levels of complexity and characteristics, which affect the effort and resources needed.

The most important factor influencing a project's time and cost is the Development Mode. There are three modes in the Development Mode, corresponding to three types of projects:

- **Organic Mode:** This mode applies to projects developed in a stable and familiar environment. The product is similar to previously developed products, relatively small in size, and requires minimal innovation.

- **Semi-Detached Mode:** Projects in this mode lie between the characteristics of the Organic and Embedded modes. Teams are of moderate size, and the work involves a mix of experience and innovation. The requirements are less rigid compared to Embedded Mode.
- **Embedded Mode:** Projects in this mode are defined by strict and rigid constraints, as well as specific interface requirements. Such projects often demand significant creativity and innovation.

The COCOMO Model offers several distinct advantages, making it a reliable and widely used software estimation technique. It provides a systematic and structured framework for estimating the effort, time, and costs required for a project. Additionally, its comprehensive consideration of various influencing factors - such as product characteristics, platform, personnel, project attributes, and environmental conditions - gives project managers and engineers a holistic understanding of project dynamics. However, while the COCOMO Model is highly valuable, it has certain limitations. The Basic COCOMO assumes a linear relationship between project size and effort, which may not accurately reflect the nonlinear patterns observed in more complex projects. As a result, the model might be less effective for estimating such projects. Furthermore, COCOMO may not fully account for all potential risks or their impact on project outcomes, which could limit its effectiveness in specific scenarios.

The three development modes in the COCOMO model - are ordered by increasing complexity. More complex modes provide more accurate estimates as they account for a greater number of influencing factors.

(a) Basic COCOMO

Basic COCOMO is best suited for early-stage estimates. It assumes a linear relationship between project size and effort, with program size measured in thousands of source lines of code (KLOC).

$$\text{Effort Applied (E)} = a_b(KLOC)b_b \text{ [person-months]} \quad Eq1$$

$$\text{Development Time (D)} = c_b(\text{Effort Applied})d_b \text{ [months]} \quad Eq2$$

$$\text{People required (P)} = \text{Effort Applied} / \text{Development Time} \text{ [count]} \quad Eq3$$

$$\text{Productivity} = \text{KLOC} / \text{Effort} \quad Eq4$$

Where:

- *Effort Applied*: refers to the total effort needed to develop the software, measured in person-months (PMs)
- *KLOC*: represents the estimated size of the software in thousands of lines of code
- a_b , b_b , c_b , d_b : specific to each type of software, are used in calculations
- *Development Time*: is the estimated duration to complete the software, measured in months

The coefficients a_b , b_b , c_b and d_b are provided in Table 1.3.

Table 1.3. Basic model coefficients

Software project	a_b	b_b	c_b	d_b
Organic	2.4	1.05	2.5	0.3
Semi-Detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

The Basic COCOMO model estimates effort and cost based solely on program size, but it overlooks factors like personnel quality, hardware limitations, experience, and the use of modern tools.

(b) Intermediate COCOMO

As projects become more intricate, Intermediate COCOMO designed for more complex projects, incorporates 15 cost drivers based on various software engineering attributes, making it more accurate. Each driver is rated on a six-point scale from "very low" to "extra high." These ratings determine effort multipliers, and their product yields an Effort Adjustment Factor (EAF) ranging from 0.9 to 1.4.

Table 1.4. Intermediate model cost drivers

Cost Drivers	Rating					
	Very low	Low	Nominal	High	Very high	Extra high
Product attributes						
Required software reliability	0.75	0.88	1.00	1.15	1.40	
Size of application database		0.94	1.00	1.08	1.60	
Complexity of the product	0.70	0.85	1.00	1.15	1.30	1.65
Hardware attributes						
Run-time performance constraints			1.00	1.11	1.30	1.66
Memory constraint			1.00	1.06	1.21	1.56
Volatility of the virtual machine environment		0.87	1.00	1.15	1.30	

Required turnabout time		0.87	1.00	1.07	1.15	
Personnel attributes						
Analyst capability	1.46	1.19	1.00	0.86	0.71	
Applications experience	1.29	1.13	1.00	0.91	0.82	
Software engineer capability	1.42	1.17	1.00	0.86	0.70	
Virtual machine experience	1.21	1.10	1.00	0.90		
Programming language experience	1.14	1.07	1.00	0.95		
Project attributes						
Application of software engineering methods	1.24	1.10	1.00	0.91	0.82	
Use of software tools	1.24	1.10	1.00	0.91	0.83	
Required development schedule	1.23	1.08	1.00	1.04	1.10	

The Intermediate COCOMO formula now takes the form:

$$\text{Effort Applied} = a_i(KLOC)^{b_i} (EAF) \quad \text{Eq5}$$

The Effort Adjustment Factor (EAF) is calculated as described above. The coefficient a_i and the exponent b_i are given in the following table. The development time (D) and also People required (P) similarly to the Basic COCOMO model.

Table 1.5. Intermediate model coefficients

Software project	a_i	b_i

Organic	3.2	1.05
Semi-Detached	3.0	1.12
Embedded	2.8	1.20

(c) Detailed COCOMO

Designed for large and complex projects, Detailed COCOMO offers a more in-depth estimation by considering the impact of cost drivers on each phase of the software process, including analysis and design. It uses phase-specific effort multipliers to determine the effort needed for each phase. In Detailed COCOMO, the software is divided into modules, and the model is applied to each module to estimate and then sum the total effort. The effort is calculated based on program size and cost drivers specific to each software life cycle phase. A Detailed project schedule is dynamic, not fixed.



Figure 1.7. Six phases of COCOMO Model

(Source: geeksforgeeks.org)

1.4.1.2. Project's COCOMO analysis

Step 1: Define Project Size

Table 1.6. Estimated Lines Of Code of the project

Component	Estimated Lines Of Code
<i>Data Warehouse and ETL Scripts</i>	1.000
<ul style="list-style-type: none"> • Database Schema Design • ETL • Stored Procedures and Triggers 	3.000 5.000 2.000
<i>Dashboards and Reports</i>	500
<ul style="list-style-type: none"> • Core Dashboards • Custom Reports • Export Functions 	2.000 2.500 500
<i>Analytics Features</i>	600
<ul style="list-style-type: none"> • Trend Analysis Algorithms • Forecasting Models • KPI Calculations 	2.000 2.000 2.000
<i>Integration with Systems</i>	500
<ul style="list-style-type: none"> • POS System Data Integration • Warehouse System Data Integration • CRM System Data Integration • API Development for External Systems 	1.500 1.000 1.500 1.000

Total	2.600
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The project is estimated to involve about 2.6 KLOC. This estimate may change depending on additional features, requirement changes, or code optimization.

Step 2: Select COCOMO Model

This project will use the **Intermediate COCOMO model**, which is ideal for projects with moderate complexity and requirements.

Step 3: Determine Scale Factors and Calculate the Effort Adjustment Factor (EAF)

Scale factors adjust the estimation based on project-specific characteristics, such as Product, Hardware, Personnel, and Project. The Effort Adjustment Factor (EAF) is calculated using these scale factors.

Table 1.7. Determine Scale Factors and Calculate EAF

Scale factor	Rating	EAF
Required Software Reliability	Nominal	1.00
Volatility of the virtual machine environment	Low	0.87
Application Experience	Very high	0.82
Software engineer capability	High	0.86
Analyst capability	High	0.86
Use of software tools	Nominal	1.00
Effort Adjustment Factor		0.528

Step 4: Estimate Effort

$$\text{Effort Applied (E)} = a_i(KLOC)^{b_i} (EAF) = 3*2.6*0.528 = 4.118 \text{ person-months}$$

$$\text{Development Time (D)} = 2.5*4.118*0.35 = 3.603 \text{ months}$$

$$\text{People required (P)} = \text{Effort Applied} / \text{Development Time} = 4.118 / 3.603 = 1.143 \text{ count}$$

1.4.2. Payback and NPV analysis

1.4.2.1. Payback

The payback method is used to determine how long it will take to recover the initial investment. When net annual cash inflow is even (i.e., same cash flow every period), the payback period of the project can be computed by simply dividing the initial investment by the annual inflow of cash, as shown by the following formula:

$$\text{Payback period} = \frac{\text{Investment required}}{\text{Net annual cash flow}}$$

For example, if a project requires an investment of \$100,000 for development and implementation, and the annual profit generated by the project is \$20,000, the payback period would be calculated as $\$100,000 \div \$20,000 = 5$ years. While this method is straightforward and easy to apply, it does not take into account the time value of money, which is a significant limitation in evaluating the true profitability of a project.

The payback rule focuses on determining the amount of time required for an investor to recoup their initial investment from a project's cash flows. For a firm applying this rule, selecting a specific cutoff date is crucial, as any cash flows occurring beyond this period are ignored. For example, if a firm evaluates Project A with a 2-year cutoff period, and the

project does not generate enough cash flow to recover the initial investment within these 2 years, it would fail under this rule, regardless of potential profitability in subsequent years.

1.4.2.2. *NPV analysis*

Net Present Value (NPV) is a financial metric used to evaluate the profitability of a project or investment by calculating the difference between the present value of cash inflows and outflows over a specific period. It adjusts future cash flows to their present value using a discount rate, which typically reflects the cost of capital or the required rate of return for the project. The goal of NPV is to assess whether a project is financially viable and worth pursuing.

The formula for NPV is:

$$NPV = I + \sum_{t=1}^n \left(\frac{NetCashFlow}{(1+r)^t} \right)$$

Where:

I: total initial investment for the project

NetCashFlow: annual revenue – annual expenses

r: annual discount rate

t: time, measured in years

n: number of years used to calculate the project's net present value

When making decisions based on NPV, a positive NPV indicates that the project is expected to generate more value than it costs, making it a worthwhile investment.

Conversely, an NPV of zero means the project breaks even, neither gaining nor losing value. If the NPV is negative, the project is likely to lose value, suggesting it may not be a good investment.

Additionally, NPV acts as the time value of money when it takes into account the principle that money today is worth more than the same amount in the future due to its earning potential. This is why future cash flows are discounted back to their present value.

In this project, we expect to charge the client \$60,000 per year and the discount rate is 13%. At the same time, the one-time cost is \$187,600, each year the warranty fee is \$5,000 (mainly personnel).

1.4.3. ROI analysis

1.4.3.1. Definition of ROI

ROI (Return on Investment) is an essential financial metric used to measure the profitability of an investment in a project. This indicator helps determine the net profit or loss relative to the initial investment cost, thereby assisting managers and investors in assessing the feasibility and efficiency of a project.

ROI (Return on Investment) in BI (Business Intelligence) is a critical metric for evaluating the effectiveness of data analytics solutions and BI technologies. It enables organizations to determine the value generated by data-driven initiatives compared to the resources (financial and human) invested in their implementation and maintenance.

In practice, according to the **Business Intelligence Market Study** by Dresner Advisory Services, ROI is the third most important success metric when it comes to Business Intelligence tools.

Measures of Success with Business Intelligence

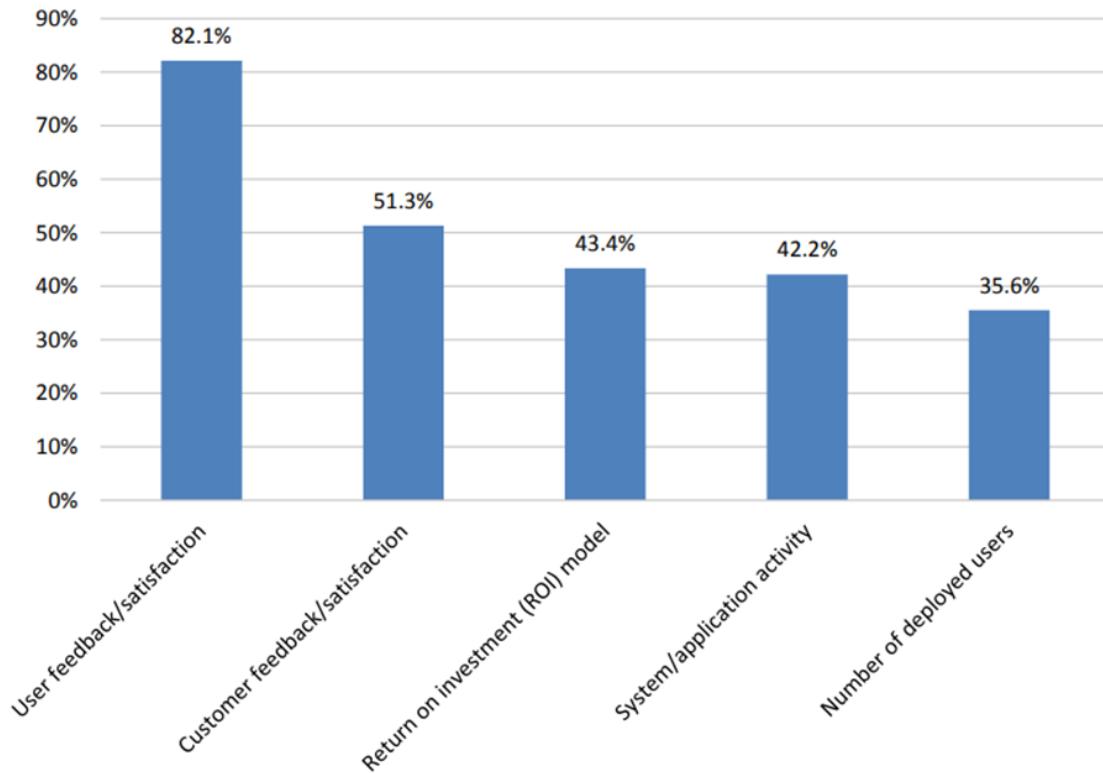


Figure 1.8. Measures of success with Business Intelligence

(Source: zoho.com)

ROI in Projects is divided into 4 types:

- **Expected ROI:** This is an estimate of the profit compared to the investment cost before the project begins. Project managers calculate projected ROI based on research and analysis of similar projects, market conditions, and potential risks. This calculation helps assess feasibility, risk levels, and prioritize projects with higher profitability.
- **Actual ROI:** This measures the actual financial efficiency of a project compared to its initial estimates. It indicates the profitability of the project and helps evaluate the accuracy of the projected ROI. Comparing actual ROI with projected ROI enables project managers to derive valuable lessons for future projects.

- **Positive ROI:** This is the goal of every project manager, as it demonstrates that the project generates revenue exceeding its implementation costs. Achieving positive ROI confirms that the investment has yielded profit, showcasing the success and efficiency of the project.
- **Negative ROI:** This indicates that the project is unprofitable, with costs exceeding the revenue generated. However, such failures can offer valuable lessons. First, negative ROI helps identify inefficiencies, overspending, and underestimated costs, leading to improved processes in the future. Second, a common cause of negative ROI is unforeseen risks or poor risk management, highlighting the need for project managers to focus more on risk assessment and management. Finally, analyzing projects with negative ROI provides invaluable experience, enabling better decisions regarding resource investment in future projects.

1.4.3.2. Advantages

- ROI calculation is straightforward and easy to understand, especially for new investors.
- ROI allows businesses to track and analyze both short-term and long-term projects, enabling them to set specific goals for each time frame.
- Investors can evaluate a company's financial performance through ROI to determine if it is on the right track.
- ROI serves as a standard metric that provides an overview of a company's profitability.

1.4.3.3. Disadvantages

- ROI is more suitable for evaluating short-term projects than long-term ones.
- ROI does not reflect the time value of money, and it is challenging to compare investments due to varying timeframes required to generate profits.

- ROI does not explain why the index value is high or low.
- ROI does not account for opportunity costs or the impact of inflation on investment returns, both of which are critical factors to consider.
- Each business may have different methods of calculating ROI, making investment comparisons potentially inaccurate.
- ROI is not always absolutely accurate; it is necessary to combine it with other financial tools (e.g., NPV, IRR) to assess the efficiency of a business. Relying solely on ROI is insufficient.
- Apart from ROI, there are many other indicators that guide the decision on whether to invest.

1.4.3.4. Methodologies for Calculating ROI

$$ROI = \frac{\text{Total value of investment} - \text{Total cost of investment}}{\text{Total cost of investment}} \times 100\%$$

In BI project:

$$ROI = \frac{\text{Benefits} - \text{Costs}}{\text{Cost}} \times 100\%$$

1.4.3.5. Key Metrics for BI ROI Measurement:

- Improving Data-Driven Decision-Making and Ensuring Data Quality:** Enhancing data-driven decision-making and ensuring data quality are key factors in effectively implementing a BI (Business Intelligence) strategy. BI helps organizations shift from intuition-based to data-driven decision-making, thereby improving accuracy and efficiency in management. To support this process, data must ensure accuracy, completeness, and consistency. This requires leveraging tools and techniques such as data profiling, cleaning, and validation, along with establishing quality standards and closely monitoring

compliance. The combination of high-quality data and data-driven decision-making not only boosts organizational performance but also creates long-term value.

- **User Adoption and Engagement:** A BI solution, no matter how advanced, cannot deliver value if users find it difficult to use or cannot access helpful information. To assess this, businesses need to track login counts, tool usage frequency, the extent of feature utilization, and user feedback. Additionally, surveys and focus group discussions are useful methods for gathering deeper insights. High levels of user adoption and engagement indicate that the BI solution is meeting needs effectively and delivering the desired results.
- **Revenue and Cost Impact:** The success of a BI (Business Intelligence) strategy is evaluated by its impact on organizational performance. This involves identifying key performance indicators (KPIs) directly tied to business objectives. For example, if the goal is to increase sales, you can examine the impact of BI on revenue growth, customer retention rates, or lead conversion rates. Furthermore, establishing baselines and benchmarks for KPIs and monitoring progress over time is an effective approach to assess improvements. Measuring the direct impact of BI on revenue and operational costs provides a clearer view of ROI. For instance, a BI-driven marketing campaign might boost sales by 25%, or BI-enabled supply chain optimization could save 20% on logistics costs. Such results clearly demonstrate the value that BI investment brings.
- **Time-to-Insight:** BI (Business Intelligence) solutions need to deliver insights quickly and accurately to meet organizational demands. The time required to transform raw data into actionable insights plays a critical role in supporting decision-making. Tracking the time taken to generate reports, analyze data, and make decisions is an effective way to measure BI performance. Additionally, setting service level agreements (SLAs) and monitoring compliance helps ensure that the BI system operates in line with requirements.

Reducing this time improves organizational responsiveness and reflects the efficiency of BI investments.

- Cost vs. Benefit Analysis: Return on Investment (ROI) is a critical metric used to assess the effectiveness of business initiatives, including BI (Business Intelligence) solutions. Calculating ROI requires comparing the total investment in BI—covering hardware, software, and personnel costs—with the benefits achieved, such as revenue growth, reduced operational costs, or improved decision-making capabilities. Financial metrics like Net Present Value (NPV) or Internal Rate of Return (IRR) can also be applied to evaluate the financial impact of BI. Supporting this process requires detailed tracking of BI-related expenses, from software licenses and training to personnel, and comparing them with tangible benefits achieved. This analysis not only helps evaluate investment effectiveness but also provides a foundation for optimizing future BI strategies.

1.4.4. Break-Even analysis

Break-even analysis refers to the point at which total costs and total revenue are equal. A break-even point analysis is used to determine the number of units or dollars of revenue needed to cover total costs.

Break-even analysis compares income from sales to the fixed costs of doing business. The five components of break-even analysis are fixed costs, variable costs, revenue, contribution margin, and break-even point (BEP).

Break-Even Analysis is important because:

- **Pricing:** With a clear understanding of their cost structure and a break-even numbers, companies can set prices for their products that cover their fixed and variable costs and provide a reasonable profit margin.

- Decision-Making: When it comes to new products and services, operational expansion, or increased production, businesses can chart their profit to sales volume and use break-even analysis to help them make informed decisions about those activities.
- Cost Reduction: Break-even analysis helps businesses to pinpoint areas where they can reduce costs to increase profitability.
- Performance Metric: Break-even analysis is a financial performance tool that helps businesses ascertain where they stand in achieving their goals.

Table 1.8. Fixed Costs related to the project

FIXED COST RELATED TO PROJECT			
Category	Detail	Description	Estimated Cost (\$)
Software and Licensing	BI Tools (Power BI)	Enterprise licenses for centralized BI reporting across all locations.	0
	ETL Tool Licensing (Visual Studio 2022)	Data pipeline automation for extracting and transforming data from multiple sources.	20.000
	Database License (SQL Server on-premises)	Formatting data	80.000
Evaluate and collect requirements	Surveys & Questionnaires	Distributing forms to staff and management to understand reporting needs and key KPIs for BI implementation.	250

Data Integration/E TL (Data Consolidation & Transformatio n)	Process Documentation	Mapping existing workflows, identifying data sources (POS, ERP, CRM), and defining BI integration points.	300
	Requirement Validation	Reviewing collected data with stakeholders, refining requirements, and ensuring alignment with business objectives.	250
	Competitive Benchmarking	Analyzing BI solutions used by competitors or similar F&B chains to identify best practices and potential improvements.	300
Data Integration/E TL (Data Consolidation & Transformatio n)	Custom Development for ETL Pipelines	Building connectors for integrating POS (Point of Sale) data, customer insights, and operational analytics	7.000
	API & Connector Development	APIs to connect BI dashboards with internal CRM, ERP, and marketing databases.	15.000
	Data Cleaning & Quality Management	Identifying and rectifying inconsistencies in collected data.	2.500
Analyze Data	Descriptive Analytics	Generating summary reports on sales, inventory, and operational performance.	1.500

	Predictive Analytics	Using data models to forecast trends and optimize restaurant operations.	2.000
	Customer Insights Analysis	Analyzing customer behavior and preferences to enhance marketing strategies.	1.500
Visualization	Dashboard Development	Creating interactive BI dashboards for real-time monitoring.	5.000
	Report Customization	Customizing reports for different stakeholders (executives, managers, finance team).	2.500
Salary (Labor)	Project Manager (1 person)		600
	Data Analysts & Engineers (1 person)		400
	QA/QC Specialist (1 person)		400
	Developer (1 person)		500
	Business Analyst (1 person)		500
Consulting Services	BI Consulting Fees (External Experts)	BI consultant, customization support and declarative development.	4.000
User Training	Training Sessions for Employees (120 employees)	In-person or online training to ensure effective use of BI dashboards.	3.000

	Training Materials (Documentation, Videos, Guides)	Costs for content creation and distribution.	1500
Testing	Functional Testing	ensuring all BI dashboards, reports, and integrations work correctly	1.500
	Performance Testing	testing query speed and report generation under load	1.500
	Security & Compliance Testing	ensuring data security and regulatory compliance	1.500
	UAT (User Acceptance Testing)	testing by end-users before final deployment	1.500
Implementation Cost	Internet & Network Expenses	Dedicated broadband connections and leased lines for 20 locations.	1.800
	Electricity & Power Costs	Increased power usage for servers, workstations, and BI dashboards.	2.200
	Office Setup & Operational Costs	Temporary workspace arrangements for BI deployment team.	11.000
Maintenance and Support	System Updates & Patches	Includes ongoing bug fixes, version upgrades, and troubleshooting.	1.000
	Backup & Disaster Recovery	Cloud-based or on-prem backup solutions for BI system data security.	400

Cloud Infrastructure (AWS)	Cloud Storage	Storing transaction data, customer records, and aggregated analytics for 20 locations.	1.000
	BI Servers & Compute Instances	Virtual machines to process BI analytics, run queries, and support data visualization.	4.000
Networking Equipment (Firewalls, Switches, Routers)	Enterprise-Grade Firewalls	Secure data transmission between restaurant locations and cloud servers.	10.000
	Redundant VPN Setup for Secure Remote Access	Secure tunneling for remote data access by executives and analysts.	1.200
Total cost			187600

Table 1.9. Variable Costs related to the project

Variable Costs Related To The Project		
Category	Detail	Estimated Cost (\$)
Contingency Budget	For arising problems, delays or changes, unforeseen expenses.	200
Transportation Costs	Cover travel expenses for team members attending in-person project meetings or restaurant site visits.	500
Internet and Communication	Cover additional expenses for video conferencing tools (e.g., Zoom, Google Meet) and data charges.	200

Materials and Supplies	Include items like pens, notebooks, printed handouts, and snacks for 10 weekly meetings.	200
Total Cost		1,100

The contribution margin represents the difference between the project's revenue and its variable costs. It highlights the portion of revenue that can be used to cover fixed expenses and contribute to overall profitability. The contribution margin is calculated using the following formula:

$$\textbf{Contribution Margin} = \textbf{Revenue} - \textbf{Variable Cost}$$

The next step is to calculate the break-even point, which represents the level of output at which total revenue equals total costs, resulting in no profit or loss. This can be determined using the following formula:

$$\textbf{BEP} = \textbf{Total Fixed Costs} / (\textbf{Price Per Unit} - \textbf{Variable Cost Per Unit})$$

$$\text{Or } \textbf{BEP} = \textbf{Total Fixed Costs} / \textbf{Contribution Margin}.$$

Table 1.10. Cost Baseline Analysis of Project

Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules							
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	TOTALS
Net Economic Benefit	0.00	60,000.00	60,000.00	60,000.00	60,000.00	60,000.00	
Discount rate (13%)	100.00%	88.50%	78.31%	69.31%	61.33%	54.28%	
PV of Benefits	0.00	53,097.35	46,988.80	41,583.01	36,799.12	32,565.60	

NPV of all Benefits	0.00	53,097.35	100,086.15	141,669.16	178,468.28	211,033.88	211,033.88
One-time Costs	(187,600.00)						
Recurring Costs	0.00	(5,000.00)	(5,000.00)	(5,000.00)	(5,000.00)	(5,000.00)	
Discount rate (10%)	100.00%	90.91%	82.64%	75.13%	68.30%	62.09%	
PV of Recurring Costs	0.00	(4,545.45)	(4,132.23)	(3,756.57)	(3,415.07)	(3,104.61)	

NPV of all Costs	(187,600.00)	(192,145.45)	(196,277.69)	(200,034.26)	(203,449.33)	(206,553.93)	(206,553.93)
Overall NPV							4,479.94
Overall ROI							0.02
Break-Even Analysis							

Yearly NPV Cash Flow	(187,600.00)	48,551.89	42,856.57	37,826.44	33,384.06	29,460.99	
Overall NPV Cash Flow	(187,600.00)	(139,048.11)	(96,191.54)	(58,365.10)	(24,981.05)	4,479.94	
Project break-even occurs between Year 4 and Year 5.							
Use first year of positive cash flow to calculate break-even fraction:				2.5430			
Break-even point projected to occur at 4.75 years							

1.5. Project Business Case

Table 1.11. Project Business Case

Project Business Case			
Project Name	Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules.		
Project Description	A Business Intelligence (BI) system for Golden Gate Restaurant Chain designed to centralize data, gain customer insights, optimize operations, enhance marketing effectiveness, and ensure scalability for long-term growth and adaptability.		
Project Sponsor	Assoc. Prof. Ho Trung Thanh, Ph.D		
Program Manager	Assoc. Prof. Ho Trung Thanh, Ph.D		
Project Manager	To Nguyen Tuong Vy		
Organization	Golden Gate Restaurant Chain		
Time scale			
Target Start Date	3rd January, 2025	Target End Date	11st March, 2025
Problems Faced	<p>Inconsistent Data Management: Multiple brands use different systems and data formats (CSV, Excel, SQL), leading to manual, error-prone data aggregation and difficulty in generating comprehensive reports.</p> <p>Fragmented Customer Insights: Customer data is scattered across various systems, limiting the ability to analyze behavior and</p>		

	<p>personalize experiences effectively.</p> <p>Operational and Cost Management: Difficulty tracking KPIs, managing inventory, and forecasting demand, leading to inefficiencies, shortages, or surpluses.</p> <p>Marketing Effectiveness: Measuring the true ROI of campaigns is challenging due to external factors and difficulty isolating promotion-driven sales increases.</p>
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Contribution to Business Strategy

- **Centralized Data Management:** The system consolidates data from multiple sources, including CRM, POS, inventory, and financial systems, into a unified platform. This centralization ensures seamless access to reliable data, empowering leadership to make informed, data-driven decisions.
- **Operational Excellence:** By streamlining operations such as inventory management, demand forecasting, and supply chain optimization, the system reduces inefficiencies. Enhanced operational efficiency lowers labor costs and minimizes errors caused by manual processes, boosting profitability.
- **Enhance Customer Experience:** The system provides insights into customer behavior and preferences, enabling highly targeted marketing campaigns. Personalized offers and loyalty programs tailored to customer needs foster long-term relationships and improve retention rates.
- **Support for Digital Transformation:** Modernizing outdated systems and integrating them with advanced BI tools helps the company embrace the digital age. This transformation positions Golden Gate as a tech-savvy leader, capable of adapting to shifting market dynamics.

Options Considered	<p>Option 1: Maintain Current Systems (Status Quo)</p> <ul style="list-style-type: none"> • Continue using the existing mix of legacy systems and newer tools without integration. • This option would preserve current workflows but fail to address operational silos, data fragmentation, and inefficiencies.
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	<ul style="list-style-type: none"> ● Drawbacks: <ul style="list-style-type: none"> ○ Limited ability to perform real-time analytics. ○ Persisting inefficiencies in inventory and demand management. ○ Inability to compete effectively with technologically advanced rivals. <p>Option 2: Partial Upgrades to Existing Systems</p> <ul style="list-style-type: none"> ● Focus on improving individual components, such as upgrading the CRM or POS systems. ● While this approach offers incremental improvements, it lacks the comprehensive benefits of an integrated system. ● Drawbacks: <ul style="list-style-type: none"> ○ Misses opportunities for synergy across departments. ○ Does not address overarching data integration challenges. <p>Option 3: Build a Centralized BI System (Chosen Option)</p> <ul style="list-style-type: none"> ● Develop and implement a unified BI platform to integrate data across marketing, sales, and operational functions. ● This option enables advanced analytics, automation, and real-time decision-making. ● Advantages: <ul style="list-style-type: none"> ○ Provides a complete, accurate overview of business operations. ○ Improves forecasting, customer targeting, and operational performance. ○ Ensures scalability and adaptability for future growth and digital transformation.
Benefits	<p>Sales Performance Optimization</p> <ul style="list-style-type: none"> ● Improved Sales Reporting Accuracy: By integrating sales

- data from POS systems into the BI platform, the company can reduce reporting errors by **20%**, ensuring more accurate daily and monthly performance tracking.
- **Revenue Growth through Forecasting:** Enhanced sales forecasting with BI tools will increase forecasting accuracy by **15%**, helping restaurants anticipate demand better and reduce lost sales during peak periods, potentially boosting revenue by **1-2%**.

Marketing Campaign Effectiveness

- **Increased Campaign ROI:** BI-driven customer segmentation will enable personalized marketing campaigns, improving the return on investment (ROI) for promotions by 10%.
- **Targeted Upselling:** Insights from the BI system can guide targeted upselling strategies, such as recommending high-margin items based on customer preferences, potentially increasing average transaction value by 5%.

Improved Decision-Making on Sales and Marketing

- **Real-Time Analytics:** Dashboards will provide real-time data on campaign performance and sales trends, reducing decision-making time by **20%**.
- **Quick Adaptation to Market Trends:** With actionable insights, the marketing team can respond to evolving customer preferences (e.g., healthier options or delivery services), reducing the time to adjust strategies by **25%**.

Customer Retention and Loyalty

- **Loyalty Program Optimization:** Better insights into customer behavior will increase active loyalty program participation by **10%**, strengthening the brand's relationship with its existing customer base.

	<ul style="list-style-type: none"> Higher Retention Rates: Personalized marketing through the BI system is expected to improve customer retention rates by 5%. <p>Competitive Advantage:</p> <ul style="list-style-type: none"> Leveraging BI tools helps close the gap with competitors that already use AI and advanced analytics. Enables the company to stay ahead by adapting quickly to emerging trends and customer preferences. <p>Scalability and Adaptability</p> <ul style="list-style-type: none"> A centralized system ensures consistency in service quality and operational standards across locations, even as the business expands. The system's modular design accommodates future updates to meet evolving market demands and regulatory changes.
Time Scales	<p>Project Start Date: January 3, 2025.</p> <p>Project End Date: March 11, 2025.</p>
Costs (For 15 branches)	<p>Fixed Cost Related to Project</p> <p>Software and Licensing</p> <ul style="list-style-type: none"> BI Tools (Power BI) – Enterprise licenses for centralized BI reporting: \$0 ETL Tool Licensing (Visual Studio 2022) – Data pipeline automation: \$20,000 Database License (SQL Server on-premises) – Formatting

	<p>data: \$80,000</p> <p>Evaluate and Collect Requirements</p> <ul style="list-style-type: none"> ● Surveys & Questionnaires – Distributing forms to staff and management: \$250 ● Process Documentation – Mapping workflows, identifying data sources, and defining BI integration: \$300 ● Requirement Validation – Reviewing data with stakeholders and refining requirements: \$250 ● Competitive Benchmarking – Analyzing competitors' BI solutions: \$300 <p>Data Integration/ETL (Data Consolidation & Transformation)</p> <ul style="list-style-type: none"> ● Custom Development for ETL Pipelines – Integrating POS, customer insights, and operational analytics: \$7,000 ● API & Connector Development – Connecting BI dashboards with internal systems (CRM, ERP, etc.): \$15,000 ● Data Cleaning & Quality Management – Rectifying inconsistencies in collected data: \$2,500 <p>Analyze Data</p> <ul style="list-style-type: none"> ● Descriptive Analytics – Summary reports on sales, inventory, and performance: \$1,500 ● Predictive Analytics – Forecasting trends and optimizing operations: \$2,000
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	<ul style="list-style-type: none"> ● Customer Insights Analysis – Analyzing customer behavior and marketing strategies: \$1,500 <p>Visualization</p> <ul style="list-style-type: none"> ● Dashboard Development – Creating interactive BI dashboards: \$5,000 ● Report Customization – Customizing reports for different stakeholders: \$2,500 <p>Salary (Labor)</p> <ul style="list-style-type: none"> ● Project Manager (1 person): \$600 ● Data Analysts & Engineers (1 person): \$400 ● QA/QC Specialist (1 person): \$400 ● Product Developer (1 person): \$500 ● Business Analyst (1 person): \$500 <p>Consulting Services</p> <ul style="list-style-type: none"> ● BI Consulting Fees (External Experts) – BI consultant, customization support, and declarative development: \$4,000 <p>User Training</p> <ul style="list-style-type: none"> ● Training Sessions for Employees (120 employees) – Online or in-person training: \$3,000 ● Training Materials (Documentation, Videos, Guides) – Content creation and distribution: \$1,500
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	<p>Testing</p> <ul style="list-style-type: none"> • Functional Testing – Ensuring correct BI dashboard operations: \$1,500 • Performance Testing – Query speed and load handling: \$1,500 • Security & Compliance Testing – Ensuring data security and compliance: \$1,500 • User Acceptance Testing (UAT) – End-user testing before deployment: \$1,500 <p>Implementation Cost</p> <ul style="list-style-type: none"> • Internet & Network Expenses – Dedicated broadband connections for 20 locations: \$1,800 • Electricity & Power Costs – Increased power usage for BI infrastructure: \$2,200 • Office Setup & Operational Costs – Temporary workspace for the BI deployment team: \$11,000 <p>Maintenance and Support</p> <ul style="list-style-type: none"> • System Updates & Patches – Bug fixes, version upgrades, and troubleshooting: \$1,000 • Backup & Disaster Recovery – Cloud-based or on-prem backup solutions: \$400 <p>Cloud Infrastructure (AWS)</p>
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	<ul style="list-style-type: none"> ● Cloud Storage – Storing transaction data, customer records, and analytics: \$1,000 ● BI Servers & Compute Instances – Running BI analytics and data visualization: \$4,000 <p>Networking Equipment (Firewalls, Switches, Routers)</p> <ul style="list-style-type: none"> ● Enterprise-Grade Firewalls – Securing data transmission: \$10,000 ● Redundant VPN Setup for Secure Remote Access – Secure tunneling for executives and analysts: \$1,200 <p>Total Estimated Cost: \$187,600</p>
Risk	<p>Technical Risks</p> <ul style="list-style-type: none"> ● System Integration Issues: Difficulty in integrating legacy systems with the new BI platform may cause delays or functionality gaps. ● Data Quality Problems: Inconsistent or incomplete data could affect the accuracy of analytics. ● Implementation Failures: Technical errors or system failures during deployment could hinder the system's functionality. <p>Project Management Risks</p> <ul style="list-style-type: none"> ● Scope Creep: Additional requirements or changes during the project may lead to budget and timeline strain. ● Timeline Delays: Dependencies on external vendors or consultants could cause delays in implementation. ● Task Prioritization Challenges: Failure to properly prioritize

	<p>tasks could result in inefficient use of resources and missed deadlines.</p> <ul style="list-style-type: none"> ● Failure to Meet Business Objectives: The BI system may not deliver the expected outcomes, failing to align with business goals. <p>Financial Risks</p> <ul style="list-style-type: none"> ● Budget Overruns: Unexpected costs may exceed the allocated budget. ● ROI Realization Risk: The BI system might take longer than expected to deliver measurable benefits. <p>User Adoption Risks</p> <ul style="list-style-type: none"> ● Resistance to Change: Employees may resist adopting the new system. ● Skill Gaps: Users may lack the necessary skills to use the BI system effectively.
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1.6. Project Charter

Table 1.12. Project Charter

Project Charter			
Project Information			
Project Name	Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules	ID Number	4
Project Description	A Business Intelligence (BI) system for Golden Gate Restaurant Chain designed to centralize data, gain customer insights, optimize operations, enhance marketing effectiveness, and ensure scalability for long-term growth and adaptability.		

Project Sponsor	Assoc. Prof. Ho Trung Thanh, Ph.D		
Program Manager	Assoc. Prof. Ho Trung Thanh, Ph.D		
Project Manager	To Nguyen Tuong Vy		
Organization(s)	Golden Gate		
Target Start Date	3rd January, 2025	Target End Date	11th March, 2025
Business Need/ Project Goal			
<ul style="list-style-type: none"> - Centralize and unify data from all brands into a single data warehouse for streamlined analysis, reporting, and decision-making. - Gain insights into customer behavior and feedback to enhance personalized marketing, service quality, and customer satisfaction. - Optimize operational efficiency by tracking KPIs, improving forecasting, managing inventory, and reducing costs. - Measure marketing effectiveness and ensure the BI system is scalable to support Golden Gate's growth and evolving needs. 			
Project Scope			
In Scope		Out of scope	
<ul style="list-style-type: none"> - Data integration and infrastructure. - System development and reporting. - Marketing and sales analysis. - User training and support. - Security and compliance. 		<ul style="list-style-type: none"> - Third-Party campaign execution. - Customer-Facing platforms. - External consulting and maintenance beyond initial setup. 	

Constraints	<ul style="list-style-type: none"> - Time: 2 months. - Scope: Enabling data integration, real-time reporting, and insights to enhance customer understanding, optimize marketing, and improve operational efficiency while supporting scalable decision-making. - Budget: 1 Project Manager, 1 Business Analyst, 1 QA/QC, 1 Data Analyst, 1 Product Developer - Quality: The focus will be on delivering on time and within budget, with less emphasis on additional features or non-essential improvements.
Key Risks	<ul style="list-style-type: none"> - Limited resources (Time and Budget constraints). - Inconsistent or low-quality data. - Integration with legacy systems. - Misalignment of business requirements. - System usability issues. - Lack of thorough testing.
Assumptions	<ul style="list-style-type: none"> - The required data from restaurant operations, sales, and marketing will be available and accurate. - Necessary software and hardware resources for the BI system will be provided. - The team has the necessary skills in BI, data analytics, and restaurant industry processes. - There will be no major changes to the existing business processes during the project. - Stakeholders will provide timely feedback and approvals as

	needed.
Project Budget	<p>1. Software and Licensing</p> <ul style="list-style-type: none"> • BI Tools (Power BI) – Enterprise licenses for centralized BI reporting: 0 • ETL Tool Licensing (Visual Studio 2022) – Data pipeline automation: 20,000 • Database License (SQL Server on-premises) – Data formatting and storage: 80,000 <p>2. Evaluation and Requirement Gathering</p> <ul style="list-style-type: none"> • Surveys & Questionnaires – Collecting reporting needs and KPIs: 250 • Process Documentation – Mapping workflows, identifying data sources: 300 • Requirement Validation – Reviewing and refining requirements with stakeholders: 250 • Competitive Benchmarking – Analyzing competitors' BI solutions: 300 <p>3. Data Integration and ETL (Extract, Transform, Load)</p> <ul style="list-style-type: none"> • Custom Development for ETL Pipelines – Connecting POS, CRM, ERP data: 7,000 • API & Connector Development – Integrating BI with internal systems: 15,000

	<ul style="list-style-type: none"> • Data Cleaning & Quality Management – Ensuring data consistency and accuracy: 2,500 <p>4. Data Analysis</p> <ul style="list-style-type: none"> • Descriptive Analytics – Generating summary reports on sales and inventory: 1,500 • Predictive Analytics – Forecasting trends and optimizing operations: 2,000 • Customer Insights Analysis – Understanding customer behavior and preferences: 1,500 <p>5. Data Visualization</p> <ul style="list-style-type: none"> • Dashboard Development – Creating interactive BI dashboards: 5,000 • Report Customization – Tailoring reports for executives, managers, and finance teams: 2,500 <p>6. Labor Costs (Salary)</p> <ul style="list-style-type: none"> • Project Manager (1 person): 600 • Data Analysts & Engineers (1 person): 400 • QA/QC Specialist (1 person): 400 • Developer (1 person): 500 • Business Analyst (1 person): 500 <p>7. Consulting Services</p> <ul style="list-style-type: none"> • BI Consulting Fees (External Experts) – Customization and
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	<p>expert support: 4,000</p> <p>8. User Training</p> <ul style="list-style-type: none"> • Training Sessions for Employees (120 employees) – Online or in-person training: 3,000 • Training Materials (Documentation, Videos, Guides) – Content creation costs: 1,500 <p>9. Testing</p> <ul style="list-style-type: none"> • Functional Testing – Ensuring dashboards, reports, and integrations work correctly: 1,500 • Performance Testing – Testing query speed and report load time: 1,500 • Security & Compliance Testing – Ensuring data security and regulatory compliance: 1,500 • User Acceptance Testing (UAT) – Final user testing before deployment: 1,500 <p>10. Implementation Costs</p> <ul style="list-style-type: none"> • Internet & Network Expenses – Dedicated broadband for 20 locations: 1,800 • Electricity & Power Costs – Energy consumption for servers and workstations: 2,200 • Office Setup & Operational Costs – Temporary workspace for BI deployment team: 11,000
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	<p>11. Maintenance and Support</p> <ul style="list-style-type: none"> • System Updates & Patches – Ongoing bug fixes and version upgrades: 1,000 • Backup & Disaster Recovery – Cloud or on-prem backup solutions: 400 <p>12. Cloud Infrastructure (AWS)</p> <ul style="list-style-type: none"> • Cloud Storage – Storing transaction and customer data: 1,000 • BI Servers & Compute Instances – Running BI analytics and processing queries: 4,000 <p>13. Networking Equipment</p> <ul style="list-style-type: none"> • Enterprise-Grade Firewalls – Securing data transmission across locations: 10,000 • Redundant VPN Setup for Secure Remote Access – Secure access for executives and analysts: 1,200 <p>Total Cost: \$187,600</p>
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Project Team		Key Project Milestones	
Name	Role	1	Finalize the official project plan, defining the scope, objectives, and timeline.
To Nguyen Tuong Vy	Project Manager	2	Gather and analyze business requirements, and identify key performance indicators

			(KPIs) for marketing and sales.
Nguyen Que Anh	Business Analyst	3	Develop the architecture and design of the BI system, ensuring it aligns with business needs.
Ngo Thanh Van	QA/QC	4	Allocate resources and assign tasks to development and testing teams.
Nguyen Huynh Kim Suong	Product Developer	5	Provide a demo version of the BI system to stakeholders after initial development.
Tran Thi Thuy Loi	Data Analyst	6	Conduct thorough system testing, ensuring functionality and data accuracy.
		7	Deliver the final, fully-tested product after addressing any issues from testing.
		8	Handover the product to the customer for review and collect feedback.
		9	Obtain customer approval and formally close the project.

1.7. Project scope statement

Table 1.13. Project Business Case

Project Idea: Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules – Scope Statement

Project Sponsor: Assoc. Prof. Ho Trung Thanh, Ph. D

Project Manager: To Nguyen Tuong Vy

Target Kick-Off Date: 3rd January, 2025

Target Completion Date: 11th March, 2025

Project Goal:

- Implement business intelligence to streamline operations by centralizing data from POS, warehouse, and CRM systems for clear analysis.
- Use SQL Server, Visual Studio, and MDX to manage and analyze databases, supporting sales and marketing.
- Enable data-driven decisions with real-time insights using tools like Power BI, Tableau, and Excel for reports and forecasts.
- Enhance business performance across **15 restaurant branches** by optimizing operational processes and improving customer satisfaction through trend and behavior analysis.
- Displaying KPIs such as revenue, profit margins, customer count, and expenses...

Scope Description: BI system will integrate data from various sources, including POS, warehouse management, and CRM systems, into a unified platform, ensuring real-time accuracy and consistency. By providing actionable insights, improve the operational efficiency of 15 branches, boost restaurant performance, and improve customer satisfaction.

Deliverables:

- Official Project Plan: Goals and Scope
- Centralized Data Platform
- Interactive Dashboards
- Customizable Reports
- Trend Analysis and Forecasting

- Marketing Analysis
- Restaurant Performance Metrics

Challenges / Constraints:

- Resource Limitations (Time and Budget): Break the project into phases to prioritize critical functionalities and ensure timely delivery.
- Complex Data Integration and Standardization: Work closely with technical teams from each system and all 15 branches to ensure compatibility and resolve integration issues promptly.
- Data Security and Privacy Risks: Implement clear data access control, encryption, and security protocols in line with industry standards.
- Inadequate User Adoption and Training: Collect user feedback on system usability and make necessary adjustments to improve the user experience.
- Inadequate Testing and Quality Assurance: Conduct multiple testing cycles across 15 branches to ensure system stability, performance, and error reduction before deployment.

Acceptance criteria:

- The delivered BI system must meet all defined objectives and support operations.
- All deliverables must be fully functional, thoroughly tested, and meet quality standards.
- The system must address the needs and expectations of key stakeholders.
- The project must be completed within the agreed timeframe and budget constraints.

Approver: Golden Gate's Executive Sponsor, typically a senior executive or representative from the management team overseeing the BI initiative across 15 branches.

Assumptions:

- All team members have the skills and knowledge needed to use tools like SQL Server, Visual Studio... to complete their tasks effectively.
- Data from POS, warehouse, and CRM systems across all 15 branches will be available and suitable for analysis and integration into the central data warehouse.
- All necessary hardware and software will be accessible and sufficient to meet project needs.
- Stakeholders will actively take part in gathering requirements, reviewing progress, and testing the system during User Acceptance Testing (UAT).
- The project scope and requirements will stay consistent after the initial planning and requirement-gathering stages.
- The allocated budget will be enough to support all project activities.

1.8. Chosen Project Development Lifecycle

1.8.1. Methodology

The **hybrid methodology** is designed to manage projects by blending the best practices of **Waterfall** and **Agile**. It offers a clearly defined, sequential structure for project phases while incorporating iterative cycles to adapt to changing requirements. This approach is particularly beneficial when some project components are well-defined and require a rigorous plan, whereas others may evolve based on stakeholder feedback and emerging needs.

Key Components of Hybrid Methodology:

1. Waterfall Foundation:

- **Structured Phases:** The core of the hybrid model is built on Waterfall principles, ensuring that the project is divided into clearly defined phases (such as requirements analysis, design, implementation, testing, deployment, and maintenance). Each phase is completed fully before moving to the next, which helps maintain order and predictability.
- **Risk Management and Control:** With a detailed upfront plan, potential risks are identified early and managed through scheduled milestones and checkpoints. This structured approach minimizes surprises and provides clear documentation of progress and deliverables.

2. Agile Iterative Elements:

- **Iterative Development Cycles:** While Waterfall provides a clear roadmap, Agile elements allow for short, iterative cycles (often called sprints or iterations) within each phase. These cycles enable the team to refine features incrementally, integrating stakeholder feedback regularly to ensure the product evolves according to real-world requirements.
- **Enhanced Communication and Collaboration:** Agile emphasizes constant communication among team members and with the customer. Regular meetings, daily stand-ups, and iterative reviews ensure that everyone is aligned and any necessary adjustments can be made swiftly.

3. Iterative Development within a Waterfall Framework:

- **Layered Development Approach:** In the hybrid model, even though the overall project follows a Waterfall sequence, each major phase can include mini-iterations. For example, the design phase might involve developing and refining prototypes through several iterations before finalizing the design.

- **Controlled Adaptability:** Rather than strictly adhering to the original plan, the hybrid approach allows teams to incorporate changes during each iterative cycle. Each proposed change is carefully analyzed for its impact, cost, and urgency before being integrated, ensuring that the project remains both structured and flexible.

4. **Continuous Testing:**

- **Ongoing Quality Assurance:** Unlike traditional Waterfall where testing is typically left until the end, the hybrid model integrates testing throughout the project lifecycle. By performing testing in each iteration, issues are detected early, reducing the risk of accumulating defects that could derail later phases.
- **Incremental Problem Resolution:** Continuous testing not only ensures quality but also provides frequent opportunities to address bugs and performance issues. This iterative validation helps maintain the overall health of the project and keeps the final deliverable on track.

5. **Change Management:**

- **Systematic Change Analysis:** While Waterfall is generally resistant to changes once the project has begun, the hybrid methodology incorporates a structured change management process. Each request for change is thoroughly evaluated to determine its impact on the schedule, resources, and overall project goals.
- **Prioritization and Controlled Integration:** Changes are prioritized based on their urgency and strategic importance. This ensures that critical changes are implemented without disrupting the project's fundamental structure, striking a balance between maintaining a clear project path and adapting to new insights.

6. **Customer Collaboration:**

- **Ongoing Stakeholder Engagement:** Regular interactions with customers and stakeholders are a hallmark of the Agile component. Scheduled review meetings, demos, and progress reports keep everyone informed and involved, ensuring that the final product aligns closely with customer expectations.

- **Responsive Feedback Loop:** Continuous customer feedback allows the team to adjust the product dynamically. This collaborative process not only improves the quality of the deliverable but also fosters a sense of ownership and satisfaction among stakeholders.

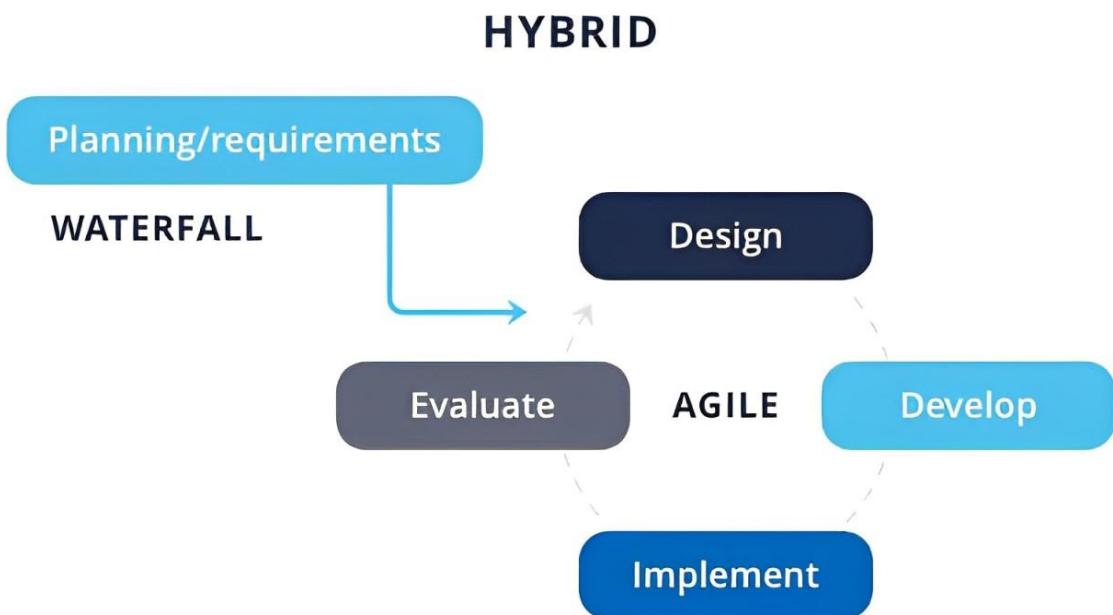


Figure 1.9. Hybrid Project Management

(Sources: Nifty PM. (2025). *Hybrid project management: A complete guide for 2025.*

Nifty.)

Benefits of Hybrid Methodology:

- **Predictability with Flexibility:** The integration of a structured Waterfall framework with Agile's iterative cycles ensures that the project has a clear roadmap while remaining adaptable to changes. This dual approach is particularly useful when dealing with both stable and evolving project requirements.
- **Early Issue Detection:** Continuous testing and iterative reviews facilitate the early detection of issues, significantly reducing the risk of major problems emerging late in the project lifecycle.
- **Enhanced Stakeholder Satisfaction:** Regular customer collaboration and transparent progress tracking result in a product that better meets the evolving needs of the client, thereby increasing overall satisfaction.
- **Efficient Resource Allocation:** The structured change management process allows for prioritizing tasks based on their importance and impact. This ensures that resources are utilized effectively and that critical components receive the attention they deserve.

Table 1.14. Hybrid Approach for the BI System for Golden Gate Restaurant Chain

Hybrid Approach for the BI System for Golden Gate Restaurant Chain					
<i>Our project follows a Hybrid Model, combining the strengths of Waterfall and Agile methodologies. This ensures structured planning and requirement gathering while allowing for iterative development and flexibility in data modeling, integration, and module development.</i>					
Number	Phase	Methodology	Detail	Sprints-bases breakdown	Output
1	Initiation and Planning	Waterfall	This phase requires structured planning, budget estimation, and team formation.		Project Charter, Business Case, Scope, Budget Estimate, Team Structure, Cost Baseline Analysis.
2	Requirement Analysis	Waterfall	- Collect business requirements, define KPIs, and analyze existing workflows. - Stakeholders must approve final requirements before moving forward.		Requirement Documentation, KPI List, Business Process Maps.

3	Data Preparation and Modeling	Agile	<p>Use iterative cycles to clean, structure, and validate data models.</p>	<ul style="list-style-type: none"> - Sprint 1: Data cleaning (handling missing values, duplicates, standardization). - Sprint 2: Build initial data models (schemas, relationships). - Sprint 3: Validate, refine, and confirm models with stakeholders. 	Data Model Documentation, Schema Design, Fact & Dimension Tables.
4	Data Integration	Agile	<ul style="list-style-type: none"> - Apply Continuous Integration/Continuous Deployment (CI/CD) for ETL processes. - Phased integration testing ensures smooth data flow. 	<ul style="list-style-type: none"> - Sprint 1: Source system mapping, ETL setup. - Sprint 2: Test data integration with a small dataset. - Sprint 3: Full-scale integration. 	ETL Pipelines, Automated Data Refresh Setup.
5	Development of Sales & Marketing Modules	Agile	<p>Daily Meetings ensure continuous progress.</p>	<ul style="list-style-type: none"> - Sprint 1: Basic dashboards for KPIs visualization. - Sprint 2: Sales performance and trend analysis tools. - Sprint 3: Marketing campaign tracking, customer 	Interactive Dashboards, Marketing & Sales Insights.

				segmentation. - Sprint 4: Stakeholder feedback integration.	
6	Testing and Quality Assurance	Agile	This ensures the system meets functional, performance, and data accuracy standards.	- Sprint 1: Unit testing for individual components. - Sprint 2: System Integration Testing. - Sprint 3: User Acceptance Testing (UAT) with business teams.	Test Reports, Bug Fixing Logs, UAT Approval.
7	Deployment and Training	Waterfall	Develop training materials, user manuals, and support documentation.		Deployment Plan, Training Materials, User Guides.
8	Post Implementation Review	Waterfall	- Gather feedback from business units. - Create a maintenance and continuous improvement plan.		Project Review Report, Maintenance Strategy.

9	BI Solution Report Completion	Waterfall	Finalize documentation and prepare the official project report and presentation.		Final Report, Presentation Slides.
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1.8.2. Working space

Our team uses Jira to manage tasks, streamline workflows, and ensure efficient project execution. With its comprehensive features, we can plan activities, monitor progress in real-time, maintain quality standards, and evaluate team performance.

Additionally, Jira supports effective collaboration by organizing team meetings and centralizing project-related communication, making it an essential tool for project management.

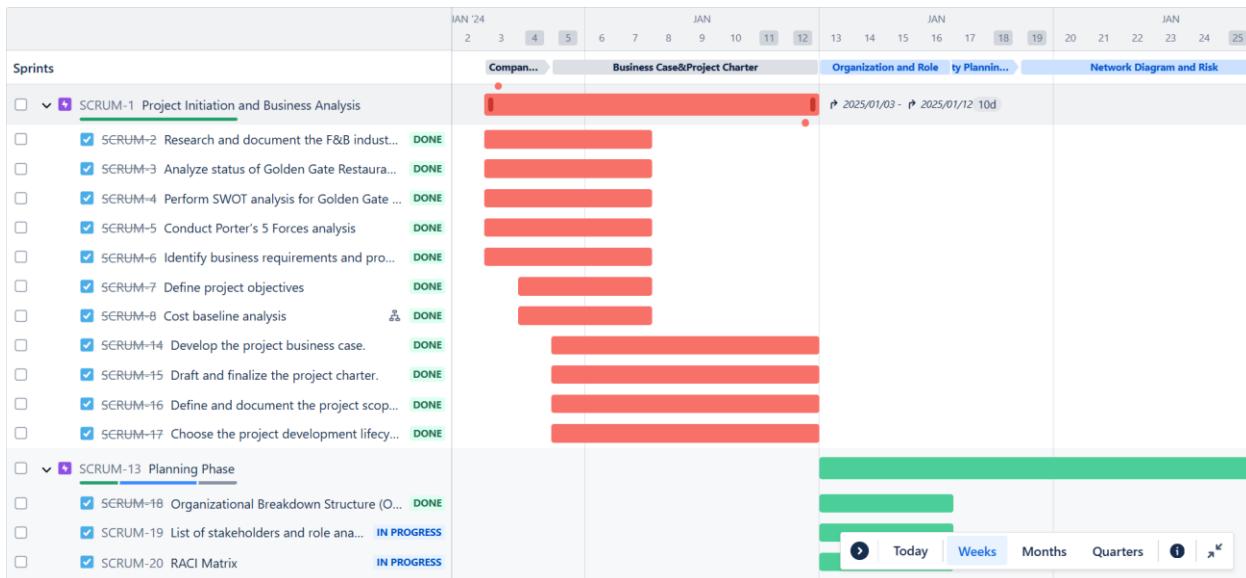


Figure 1.10. Our working space for the first two phases - Initiation and Planning

(Sources: Authors' source)

BI System for Golden Ga...
Software project

Projects / BI System for Golden Gate Restaurant Chain – Marketing and Sales Modules.
All sprints

PLANNING

- Summary
- Timeline
- Backlog
- Board**
- Forms
- Goals
- + Add view

DEVELOPMENT

- Code

Project pages

Project settings

TO DO 2

- Network diagram (PERT) and critical path
PLANNING PHASE
 SCRUM-24
- Risk Management
PLANNING PHASE
 SCRUM-25

+ Create issue

IN PROGRESS 4

- List of stakeholders and role analysis
PLANNING PHASE
 SCRUM-19
- RACI Matrix
PLANNING PHASE
 SCRUM-20
- Work Breakdown Structure
PLANNING PHASE
 SCRUM-22
- Organizational Breakdown Structure (OBS)
PLANNING PHASE
 SCRUM-18

DONE 2

- Activity List
PLANNING PHASE
 SCRUM-21
- Organizational Breakdown Structure (OBS)
PLANNING PHASE
 SCRUM-18

GROUP BY None

Complete sprint ...

Figure 1.11. Jira Task Management Board

(Sources: Authors' source)

The board is structured into columns: **To Do, In Progress, and Done**, enabling clear visualization of task statuses. This setup follows an Agile workflow with sprints, ensuring streamlined task management, team collaboration, and timely delivery of project goals.

CHAPTER 2: PLANNING PHASE

Chapter Overview

This chapter establishes a structured roadmap for successful project execution. This phase defines the Organizational Breakdown Structure, assigning roles and responsibilities to key team members, including the Project Manager, Business Analyst, QA/QC, Product Developer and Data Analyst & Engineer. Stakeholder analysis clarifies the involvement of Marketing, Sales, IT, and Clients, ensuring alignment with business objectives. A RACI Matrix is developed to prevent role overlap and enhance accountability. The Work Breakdown Structure and Gantt Chart outline the 73-day project timeline, detailing each phase from initiation to closure. PERT and Critical Path Analysis optimize scheduling by identifying task dependencies and critical milestones. Comprehensive risk management is conducted through a Risk Matrix, EMV Analysis, and Decision Tree Analysis, mitigating potential challenges and guiding key technology decisions, such as data warehouse and cloud infrastructure selection. This phase ensures a well-structured, risk-aware, and strategically aligned foundation for the BI system implementation.

2.1. Organizational Breakdown Structure (OBS)

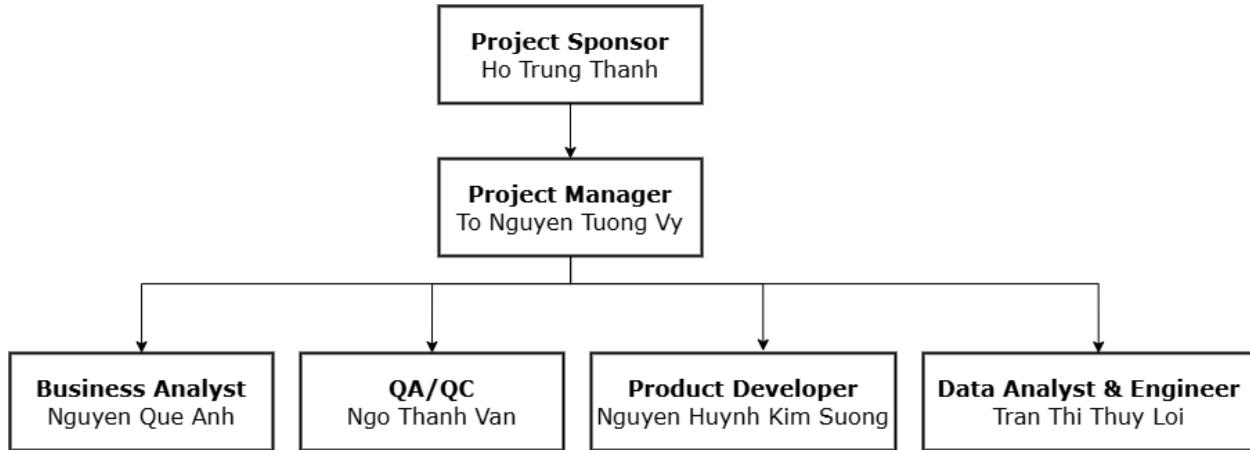


Figure 2.1. Organizational Breakdown Structure of our team

(Sources: Authors' source)

Our team has 6 positions including a project sponsor, a project manager, a business analyst, a data analyst and engineer, a product developer, and a QA/QC.

Table 2.1. Organizational Breakdown Structure (OBS) of our team

Role	Member	Responsibility
Project Sponsor	Mr. Ho Trung Thanh	<ul style="list-style-type: none"> - Provides high-level guidance and support to ensure the project aligns with strategic business goals. - Secures funding and resources for the project.
Project Manager	Tuong Vy	<ul style="list-style-type: none"> - Oversees the entire project lifecycle, including planning, execution, and monitoring. - Manages the project timeline, budget, and deliverables. - Coordinates communication between the team, stakeholders, and sponsor.
Business Analyst	Que Anh	<ul style="list-style-type: none"> - Collaborates with stakeholders to gather business requirements. - Translates business needs into functional specifications for the Marketing and Sales Modules.

		<ul style="list-style-type: none"> - Provides input to developers and ensures the system meets business goals. - Identify KPIs and metrics.
QA/QC	Thanh Van	<ul style="list-style-type: none"> - Designs and executes test plans and cases to ensure system quality. - Conducts functional, performance, and user acceptance testing (UAT). - Identifies, tracks, and resolves defects or issues throughout the development process.
Product Developer	Kim Suong	<ul style="list-style-type: none"> - Develops and integrates the BI system according to requirements. - Designs and implements dashboards, ensuring seamless data visualization. - Ensures system functionality and data security. - Provides system maintenance and upgrades as needed.
Data Analyst and Engineer	Thuy Loi	<ul style="list-style-type: none"> - Collects, cleans, and standardizes data from various sources (POS, CRM, ERP, etc.). - Develops data models for Marketing & Sales analysis. - Creates reports and dashboards to provide actionable insights. - Optimizes data processing and ensures data accuracy.

2.2. List of stakeholders and role analysis

Table 2.2. List of Stakeholders and Role Analysis

Stakeholder	Role
Marketing Team	Defines data requirements for customer segmentation, campaign tracking, and ROI analysis. Uses the BI system to optimize marketing strategies and drive growth.

Sales Team	Leverages BI dashboards to track sales performance, identify customer trends, and adjust strategies to improve revenue and operational efficiency.
IT Department	Ensures system development, security, and scalability. Provides technical support and integrates the BI system with existing infrastructure.
Project Sponsor	Acts as a senior leader, shaping the strategic vision of the project, ensuring core objectives are met, and providing support to overcome challenges during implementation.
Project Manager	Responsible for managing the overall activities of the project, overseeing progress, allocating resources, and coordinating collaboration among teams to achieve the set goals.
Team Members	Perform specific tasks during each phase of the project, ensuring quality and timely delivery. Provide suggestions for improvement based on their professional expertise.
Clients	Serve as end-users, offering feedback and input on system requirements. Play a critical role in identifying suitable features and participating in performance evaluations post-deployment.

2.3. RACI matrix

2.3.1. *Definition*

A RACI matrix is a tool in project management designed to clarify team roles and responsibilities across tasks.

Each role is categorized as Responsible, Accountable, Consulted, or Informed, ensuring that everyone understands their role in a project's success. By assigning these roles, project managers prevent confusion and overlapping duties while increasing accountability.

The RACI framework is especially beneficial for complex projects where clear role distribution is essential for smooth workflows and improved communication.

2.3.2. 4 Core Roles of RACI Defined

Table 2.3. 4 Core Roles of RACI Defined

Role	Description	Example
R - Responsible	<p>The individual(s) with responsibility for the task or deliverable is responsible for developing and completing the project deliverables themselves.</p> <p>The responsible parties are typically hands-on team members who make direct contributions toward the completion of the project. The responsible team is composed of the project's doers, who work hands-on to ensure that each deliverable is completed.</p>	<ul style="list-style-type: none"> - Project managers - Business analysts - Developers - Graphic designers - Copywriters
A- Accountable	<p>Accountable parties ensure accountability to project deadlines, and ultimately, accountability to project completion.</p> <p>This group frequently also falls under the informed category.</p>	<ul style="list-style-type: none"> - Product owners - Signature authorities - Business owners - Sponsors - Key stakeholders
C- Consulted	<p>Consulted individuals' opinions are crucial, and their feedback needs to be considered at every step of the game.</p> <p>These individuals provide guidance that is often a prerequisite to other project tasks, for</p>	<ul style="list-style-type: none"> - Legal experts - Information security and cybersecurity experts - Compliance consultants

	<p>example, providing legal guidance on a project throughout the process. If you are working on new product development or expansion, this could essentially be the entire organization.</p>	
I-Informed	<p>Informed persons are those that need to stay in the loop of communication throughout the project.</p> <p>These individuals do not have to be consulted or be a part of the decision-making, but they should be made aware of all project updates.</p> <p>This group often also falls under the accountable group.</p>	<ul style="list-style-type: none"> - Project committee members - External stakeholders - Business owners

2.3.3. RACI matrix in this project

Deliverables or Tasks	Roles		Project Management			Production Department			
	PMO	Production Department	Product Developer - Nguyen Huynh Kim Suong	QA/QC - Nguo Thanh Van	Business Analyst - Nguyen Que Anh	Project Manager - To Nguyen Tuong Vy	Sponsor - Ho Trung Thanh		
Project Management									
Appoint PM and support project	A			I	I				
Project Planning and Kick-Off	C	A/R	C		C				
Weekly Status Report	I	A/R	I	C	I				
Phase 1: Business requirement collection									
Market Research		A	C						
Analysis report about customer (SWOT, Current	I	A			I				
Phase 2: Implementation									
Distribute resources based on each sprint or phase			I		C	I			
Build additional capacity / upgrades	I	A/R			I				
Evaluate product functionality at every stage	I			C					
Process report/meeting	I	A/R	I		I	I			
Phase 3: Testing									
Comprehensive testing on the system is completed		A		C	I				
Testing report	I	A				I			

R Responsible
A Accountable
C Consulted
I Informed

Figure 2.2. RACI MATRIX

(Source: Authors' source)

2.4. Activity list and Work breakdown structure

2.4.1. Activity List

Table 2.4. Activity List of our project - Summary

ID	Activity list
0	Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules
1	Initiation and Planning
2	Requirement Analysis
3	Data Preparation and Modeling
4	Data Integration
5	Development of Sales Module
6	Development of Marketing Module
7	Testing and Quality Assurance
8	Deployment and Training
9	Post Implementation Review
10	BI Solution Report Completion
11	BI PROJECT CLOSURE AND COMPLETE

Table 2.5. Activity List of our project - Detailed

ID	Activity list
0	Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules
1	Initiation and Planning
1.1	Introduction to Golden Gate Company
1.1.1	Vietnam's F&B Industry
1.1.2	Golden Gate overview
1.1.3	Golden Gate Major Milestones and Innovation
1.2	Research the current status of the Golden Company
1.2.1	SWOT Analysis
1.2.2	Porter's 5 forces analysis of Golden Gate Company
1.2.3	Business Requirements/Problems
1.3	Define Project Scope and Objectives
1.4	Cost baseline analysis and budget estimate
1.4.1	COCOMO analysis
1.4.2	Payback and NPV analysis
1.4.3	ROI analysis
1.4.4	Break-Even analysis
1.5	Define Project Business Case

1.6	Define Project Charter and Assemble Project Team
1.7	Define Project Development Lifecycle
1.8.	Initiation and Planning Complete
2	Requirement Analysis
2.1	Conduct detailed stakeholder interviews and surveys
2.2	Analyze existing business processes to understand current workflows
2.3	Identify key performance indicators (KPIs) needed for success
2.4	Draft user stories and detailed use cases
2.5	Review all identified requirements with stakeholders
2.6	Revise and finalize the requirements documentation
2.7	Secure stakeholder sign-off on the approved requirements
2.8	Requirement Analysis Complete
3	Data Preparation and Modeling
3.1	Collect and review existing datasets from all relevant departments (Sales & Marketing)
3.2	Perform data cleaning
3.2.1	Identify and handle missing values
3.2.2	Remove duplicate records
3.2.3	Standardize data format
3.3	Transform raw data into structured formats suitable for modeling

3.4	Develop initial data models
3.4.1	Create data schemas and relationships
3.4.2	Define primary and foreign keys
3.4.3	Bus Matrix
3.4.4	Master Data
3.4.5	Transactional Data
3.4.6	Fact and Dimension Tables
3.4.7	Relationships
3.5	Validate the data models against the approved requirements
3.6	Iterate on data models, incorporating stakeholder feedback
3.7	Document the final data model design for reference
3.8	Data Preparation and Modeling Complete
4	Data Integration
4.1	Analyze source systems to determine data extraction points
4.2	Design ETL (Extract, Transform, Load) workflows
4.2.1	Map source data fields to target data fields
4.2.2	Define transformation rules and data cleansing steps
4.3	Set up the data integration environment
4.4	Conduct test runs of the ETL process with sample data
4.5	Verify that integrated data meets accuracy and consistency standards

4.6	Implement automated processes for regular data refreshes
4.7	Document the entire integration process for future reference
4.8	Data Integration complete
5	Development of Sales Module
5.1	Create sales performance dashboards
5.2	Develop tools for sales trend analysis
5.3	Implement regional and product-specific sales reporting
5.4	Integrate POS (Point of Sale) data into reporting
5.5	Development of Sales Module Complete
6	Development of Marketing Module
6.1	Build campaign performance dashboards
6.2	Implement customer segmentation analysis tools
6.3	Develop social media and email marketing metrics tracking
6.4	Integrate customer feedback analysis
6.5	Development of Marketing Module Complete
7	Testing and Quality Assurance
7.1	Perform unit testing on individual components
7.2	Conduct system integration testing
7.3	Validate data accuracy and consistency
7.4	Execute user acceptance testing (UAT)

7.5	Testing and Quality Assurance Complete
8	Deployment and Training
8.1	Deploy BI system to production environment
8.2	Provide training sessions for marketing and sales teams
8.3	Develop user manuals and reference guides
8.4	Offer ongoing support during the transition period
9	Post Implementation Review
9.1	Document all outcomes and lessons learned from the review
9.2	Distribute to team members
9.3	Create software maintenance team
9.4	Address any issues identified during the post-implementation phase
9.5	Post implementations review complete
10	BI Solution Report Completion
10.1	Collect and organize all project documents
10.2	Perform content validation and quality checks
10.3	Format the report
10.4	Add visual documents
10.5	Make presentation
11	BI PROJECT CLOSURE AND COMPLETE

2.4.2. Work Breakdown Structure

Work Breakdown Structure (WBS) is the tool that utilizes this technique and is one of the most important project management documents. It single handedly integrates scope, cost and schedule baselines ensuring that project plans are in alignment.



Figure 2.3. Work Breakdown Structure - Top Level

(Sources: Authors' source)



Figure 2.4. Work Breakdown Structure - Middle Level

(Sources: Authors' source)

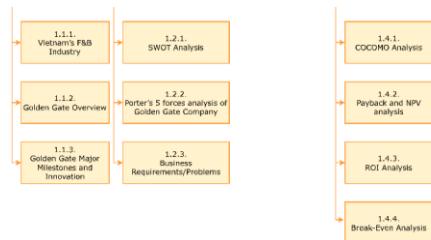


Figure 2.5. Work Breakdown Structure - Bottom Level

(Sources: Authors' source)

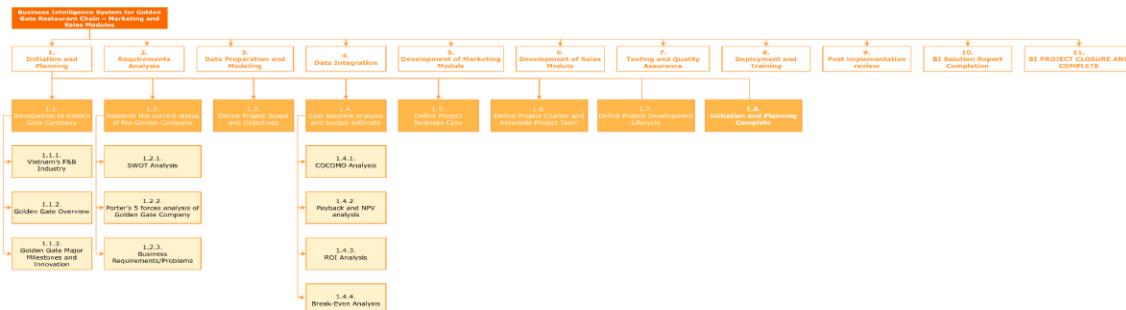


Figure 2.6. Work Breakdown Structure

(Sources: Authors' source)

2.5. GANTT chart

2.5.1. Plan Schedule Management

		Task Mode	Task Name	Duration	Start	Finish	Predec	% Complete
1	✓	➡	Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules.	48 days	Fri 1/3/25	Tue 3/11/25		100%
2	✓	➡	▷ Initiation and Planning	10 days	Fri 1/3/25	Thu 1/16/25		100%
21	✓	➡	▷ Requirement Analysis	7 days	Fri 1/17/25	Mon 1/27/25	2	100%
30	✓	➡	▷ Data Preparation and Modeling	7 days	Mon 1/20/25	Tue 1/28/25	21	100%
49	✓	➡	▷ Data Integration	7 days	Tue 1/28/25	Wed 2/5/25	30	100%
60	✓	➡	▷ Development of Sales Module	5 days	Thu 2/6/25	Wed 2/12/25	49	100%
66	✓	➡	▷ Development of Marketing Module	5 days	Thu 2/13/25	Wed 2/19/25	60	100%
72	✓	➡	▷ Testing and Quality Assurance	5 days	Thu 2/20/25	Wed 2/26/25	66	100%
78	✓	➡	▷ Deployment and Training	5 days	Thu 2/27/25	Wed 3/5/25	72	100%
83	✓	➡	▷ Post Implementation Review	2 days	Thu 3/6/25	Fri 3/7/25	78	100%
89	✓	➡	▷ BI Solution Report Completion	2 days	Mon 3/10/25	Tue 3/11/25	83	100%
95	✓	➡	BI PROJECT CLOSURE AND COMPLETE	1 day	Mon 3/10/25	Mon 3/10/25		100%

Figure 2.7. Project Schedule Overview for the Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules

(Sources: Authors' source)

The project is scheduled to begin on **Friday, January 3, 2025**, and conclude on **Tuesday, March 11, 2025**, spanning a total duration of **48** working days. It is divided into several key phases, starting with Initiation and Planning (10 days), followed by Requirement Analysis (7 days) and Data Preparation and Modeling (7 days). These foundational phases are crucial for defining the scope, gathering requirements, and preparing the data infrastructure before system development begins.

After the initial setup, the project moves into the Data Integration phase (7 days), ensuring all relevant datasets are structured and integrated properly. This is followed by the development of two core modules: the **Sales Module** (5 days) and the **Marketing Module** (5 days), which run sequentially. The project then enters the Testing and Quality Assurance

phase (5 days), where the system undergoes rigorous evaluation to ensure performance, accuracy, and user acceptance.

The final stages of the project focus on Deployment and Training (5 days), allowing for smooth implementation and user onboarding. A Post Implementation Review (2 days) is conducted to evaluate project outcomes and address any issues. The BI Solution Report Completion phase (2 days) ensures that all documentation is finalized before officially closing the project with the BI Project Closure and Completion phase (1 day).

Table 2.6. Detailed Activities for each phase in the project

Phase	Activities	Start Date	Finish Date	Duration (days)
Initiation and Planning	This phase sets the foundation for the BI project by researching Golden Gate's business landscape, defining objectives, and establishing the project scope. Key activities include industry analysis, identifying business challenges, cost estimation, and forming the project team. The project charter and development lifecycle are also finalized to ensure a clear roadmap.	03/01/2025	16/01/2025	10
Requirement Analysis	This phase focuses on gathering and defining business and technical requirements through stakeholder interviews,	17/01/2025	27/01/2025	7

	process analysis, and KPI identification. It ensures that all project requirements are well-documented, reviewed, and approved to align with business needs before moving forward.			
Data Preparation and Modeling	In this phase, raw data is collected, cleaned, and transformed into structured formats for analysis. Data models, including schemas, relationships, and key metrics, are developed and validated to ensure accuracy and consistency with business requirements.	20/01/2025	28/01/2025	7
Data Integration	This phase involves extracting data from various sources, transforming it for consistency, and loading it into the BI system. ETL processes are designed and tested to ensure seamless data flow, accuracy, and automation for continuous updates.	28/01/2025	05/02/2025	7
Development of Sales Module	The Sales Module is built to provide insights into sales performance, trends, and regional or product-specific analysis. Dashboards and	06/02/2025	12/02/2025	5

	reports are developed to help decision-makers track and optimize sales strategies.			
Development of Marketing Module	This phase focuses on building BI tools for marketing analytics, including campaign performance tracking, customer segmentation, and feedback analysis. The module enables data-driven marketing decisions and performance optimization.	13/02/2025	19/02/2025	5
Testing and Quality Assurance	Before deployment, rigorous testing is conducted, including unit testing, system integration testing, and user acceptance testing (UAT). This ensures the system meets functional, performance, and data accuracy standards.	20/02/2025	26/02/2025	5
Deployment and Training	The BI system is deployed to the production environment, and training sessions are conducted for end-users. User manuals and guides are provided to ensure smooth adoption, and initial support is offered during the transition phase.	27/02/2025	05/03/2025	5
Post	This phase evaluates the	06/03/2025	07/03/2025	2

Implementation Review	project's success, gathers lessons learned, and identifies areas for improvement. A maintenance team is established to address any post-deployment issues and ensure system sustainability.			
BI Solution Report Completion	A final report documenting the entire project, key findings, and outcomes is compiled. The report includes visual data representations, insights, and recommendations, serving as a reference for future BI initiatives.	10/03/2025	11/03/2025	
BI PROJECT CLOSURE AND COMPLETE				

2.5.2. Detailed Scheduling and Resources Allocation

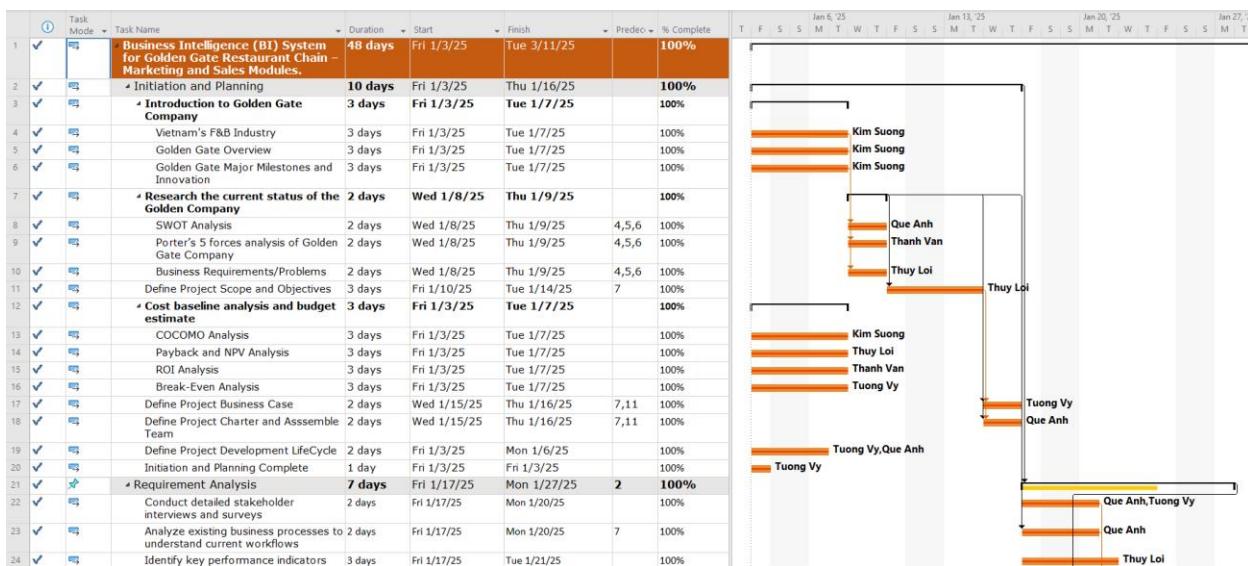


Figure 2.8. Gantt chart diagram for phases 1

(Sources: Authors' sources)

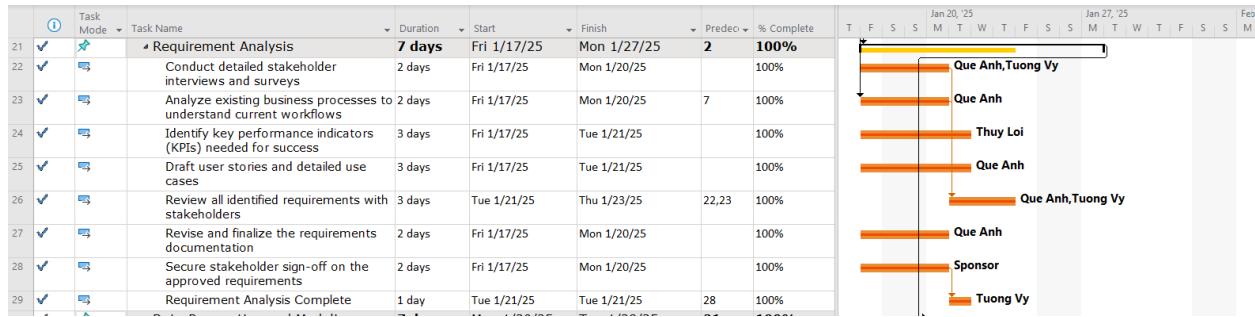


Figure 2.9. Gantt chart diagram for phases 2

(Sources: Authors' sources)

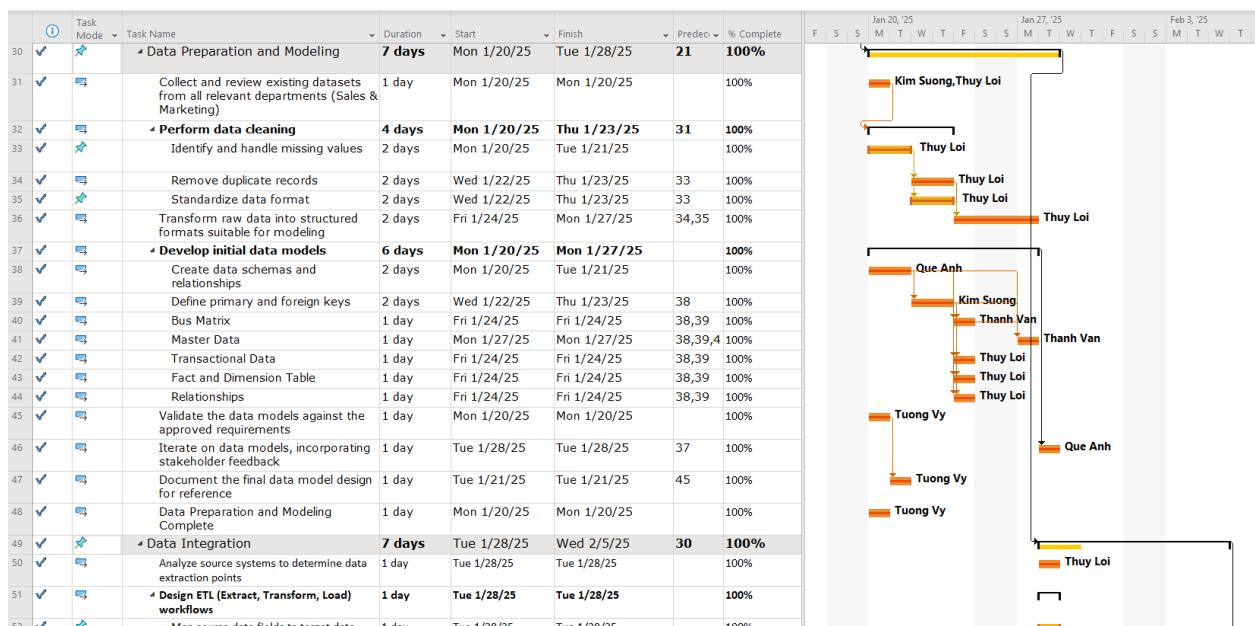


Figure 2.10. Gantt chart diagram for phases 3

(Sources: Authors' sources)

2.6. Network diagram (PERT) and critical path

2.6.1. Network Diagram

To improve project management efficiency, the team has adopted the PERT (Program Evaluation and Review Technique) method, a technique that helps identify and plan project activities scientifically. PERT is commonly used to estimate the time required to complete a project and determine the sequence in which critical tasks should be carried out.

In this method, tasks are represented as a network or PERT chart, which illustrates the dependencies between tasks and the estimated completion time. PERT allows the team to analyze and plan in detail the essential tasks and activities involved in the project execution process.

The method involves creating a network diagram that clearly shows the dependencies between tasks and their execution sequence. By applying PERT, the team can determine the minimum time required to complete the project, while also identifying critical tasks that have a significant impact on the overall project timeline.

Accurately estimating the time required for activities is crucial in building the project schedule. When the duration of activities involves uncertainty, using three time estimates—optimistic, most likely, and pessimistic—helps project managers consider unpredictable factors, thus identifying the critical path and optimizing the schedule.

The PERT formula for calculating the expected time (ET) is:

$$ET = \frac{O + 4M + P}{6}$$

Where:

- **Optimistic time (O):** Represents the shortest time in which the activity can be completed if all conditions are favorable. This is the ideal scenario and rarely occurs. On the probability distribution chart, this value is located at the lower bound.
- **Most probable time (M):** This is the time that has the highest likelihood of occurring when all conditions proceed as expected. It is also the value with the highest probability, corresponding to the peak of the probability distribution chart.
- **Pessimistic time (P):** This is the longest time required to complete the activity under the worst possible conditions, such as unforeseen issues or resource shortages. This value is located at the upper bound of the probability distribution chart.

Table 2.7. Process Flow Network

ID	Activity list	TE	O	M	P
0	Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules	-	-	-	-
1	Initiation and Planning	-	-	-	-
1.1	Introduction to Golden Gate Company	3.83	3.0	4.0	4.0
1.1.1	Vietnam's F&B Industry	1.33	2.0	1.0	2.0
1.1.2	Golden Gate overview	1.58	0.5	2.0	1.0

1.1.3	Golden Gate Major Milestones and Innovation	0.92	0.5	1.0	1.0
1.2	Research the current status of the Golden Company	1.42	1.0	1.5	1.5
1.2.1	SWOT Analysis	2.17	2.0	2.0	1.0
1.2.2	Porter's 5 forces analysis of Golden Gate Company	2.83	3.0	2.5	4.0
1.2.3	Business Requirements/Problems	1.92	0.5	2.0	1.0
1.3	Define Project Scope and Objectives	1.92	1.5	2.0	2.0
1.4	Cost baseline analysis and budget estimate	3.92	3.0	4.0	4.5
1.4.1	COCOMO analysis	2.17	1.0	2.5	2.0
1.4.2	Payback and NPV analysis	1.25	1.5	1.0	2.0
1.4.3	ROI analysis	2.0	1.5	2.0	2.5
1.4.4	Break-Even analysis	1.83	1.0	2.0	2.0
1.5	Define Project Business Case	1.83	1.5	2.0	1.5

1.6	Define Project Charter and Assemble Project Team	3.12	3.0	3.0	4.0
1.7	Define Project Development Lifecycle	2.0	1.5	2.0	2.5
1.8.	Initiation and Planning Complete	3.17	2.0	3.0	5.0
2	Requirement Analysis	-	-	-	-
2.1	Conduct detailed stakeholder interviews and surveys	2.92	2.0	3.0	3.5
2.2	Analyze existing business processes to understand current workflows	1.33	1.5	2.0	2.5
2.3	Identify key performance indicators (KPIs) needed for success	1.42	1.5	2.0	3.0
2.4	Draft user stories and detailed use cases	1.50	2.0	2.0	3.0
2.5	Review all identified requirements with stakeholders	1.08	1.5	1.5	2.0
2.6	Revise and finalize the requirements documentation	1.0	1.0	1.5	2.0
2.7	Secure stakeholder sign-off on the approved requirements	1	1.0	1.0	1.0

2.8	Requirement Analysis Complete	0.58	0.5	1.0	1.0
3	Data Preparation and Modeling	-	-	-	-
3.1	Collect and review existing datasets from all relevant departments (Sales & Marketing)	1.83	2.0	3.0	3.0
3.2	Perform data cleaning	1.58	2.0	2.5	2.5
3.2.1	Identify and handle missing values	2.83	2.0	3.0	3.0
3.2.2	Remove duplicate records	2.17	1.0	2.0	4.0
3.2.3	Standardize data format	2.17	2.0	2.0	3.0
3.3	Transform raw data into structured formats suitable for modeling	4.83	3.0	5.0	6.0
3.4	Develop initial data models	3.67	2.0	4.0	4.0
3.4.1	Create data schemas and relationships	3.17	2.0	3.0	5.0
3.4.2	Define primary and foreign keys	5.0	3.0	5.0	7.0
3.4.3	Bus Matrix	4.67	3.0	5.0	5.0
3.4.4	Master Data	3.83	2.0	4.0	5.0

3.4.5	Transactional Data	3.17	3.0	3.0	4.0
3.4.6	Fact and Dimension Tables	2.83	2.0	3.0	3.0
3.4.7	Relationships	2.33	3.0	2.0	3.0
3.5	Validate the data models against the approved requirements	2.17	2.0	2.0	3.0
3.6	Iterate on data models, incorporating stakeholder feedback	4.17	3.0	4.0	6.0
3.7	Document the final data model design for reference	3.83	3.0	4.0	4.0
3.8	Data Preparation and Modeling Complete	2.83	2.0	3.0	3.0
4	Data Integration	-	-	-	-
4.1	Analyze source systems to determine data extraction points	4.0	3.0	4.0	5.0
4.2	Design ETL (Extract, Transform, Load) workflows	5.12	4.0	5.0	7.0
4.2.1	Map source data fields to target data fields	3.42	2.5	3.5	4

4.2.2	Define transformation rules and data cleansing steps	3.92	3.0	4.0	4.5
4.3	Set up the data integration environment	4.25	3.5	4.5	4.0
4.4	Conduct test runs of the ETL process with sample data	4.25	3.0	4.5	4.5
4.5	Verify that integrated data meets accuracy and consistency standards	4.0	3.0	4.0	5.0
4.6	Implement automated processes for regular data refreshes	3.67	3.0	3.5	5.0
4.7	Document the entire integration process for future reference	3.42	2.5	3.5	4.0
4.8	Data Integration complete	2.83	2.0	3.0	3.0
5	Development of Sales Module		-	-	-
5.1	Create sales performance dashboards	3.67	3.0	3.5	5.0
5.2	Develop tools for sales trend analysis	4.33	3.0	4.5	5.0
5.3	Implement regional and product-specific sales reporting	4.0	3.0	4.0	5.0

5.4	Integrate POS (Point of Sale) data into reporting	4.9	3.0	4.0	5.0
5.5	Development of Sales Module Complete	3.58	3.5	3.5	4.0
6	Development of Marketing Module	-	-	-	-
6.1	Build campaign performance dashboards	4.83	4.0	5.0	5.0
6.2	Implement customer segmentation analysis tools	4.08	3.0	4.0	5.5
6.3	Develop social media and email marketing metrics tracking	4.0	3.0	4.0	5.0
6.4	Integrate customer feedback analysis	4.08	3.0	4.0	5.5
6.5	Development of Marketing Module Complete	2.5	2.0	2.5	3.0
7	Testing and Quality Assurance	-	-	-	-
7.1	Perform unit testing on individual components	4.33	3.5	4.5	4.5
7.2	Conduct system integration testing	4.67	4.0	4.5	6.0
7.3	Validate data accuracy and consistency	4.25	3.0	4.5	4.5

7.4	Execute user acceptance testing (UAT)	4.42	4.0	4.5	4.5
7.5	Testing and Quality Assurance Complete	2.92	2.0	3.0	3.5
8	Deployment and Training	-	-	-	-
8.1	Deploy BI system to production environment	5.17	4.0	5.0	7.0
8.2	Provide training sessions for marketing and sales teams	3.83	3.0	4.0	4.0
8.3	Develop user manuals and reference guides	4.67	3.0	5.0	5.0
8.4	Offer ongoing support during the transition period	4.75	3.0	5.0	5.5
9	Post Implementation Review	-	-	-	-
9.1	Document all outcomes and lessons learned from the review	3.92	3.0	4.0	4.5
9.2	Distribute to team members	3.58	2.5	3.5	5.0
9.3	Create software maintenance team	4.58	3.5	4.5	6.0
9.4	Address any issues identified during the post-implementation phase	4.08	3.0	4.0	5.5

9.5	Post implementations review complete	2.42	2.0	2.5	2.5
10	BI Solution Report Completion	-	-	-	-
10.1	Collect and organize all project documents	4.42	4.0	4.5	4.5
10.2	Perform content validation and quality checks	4.33	3.0	4.5	5.0
10.3	Format the report	3.67	3.0	3.5	5.0
10.4	Add visual documents	2.67	3.0	2.5	3.0
10.5	Make presentation	1.0	1.0	1.0	1.0
11	BI PROJECT CLOSURE AND COMPLETE	0.33	1.0	0.0	1.0

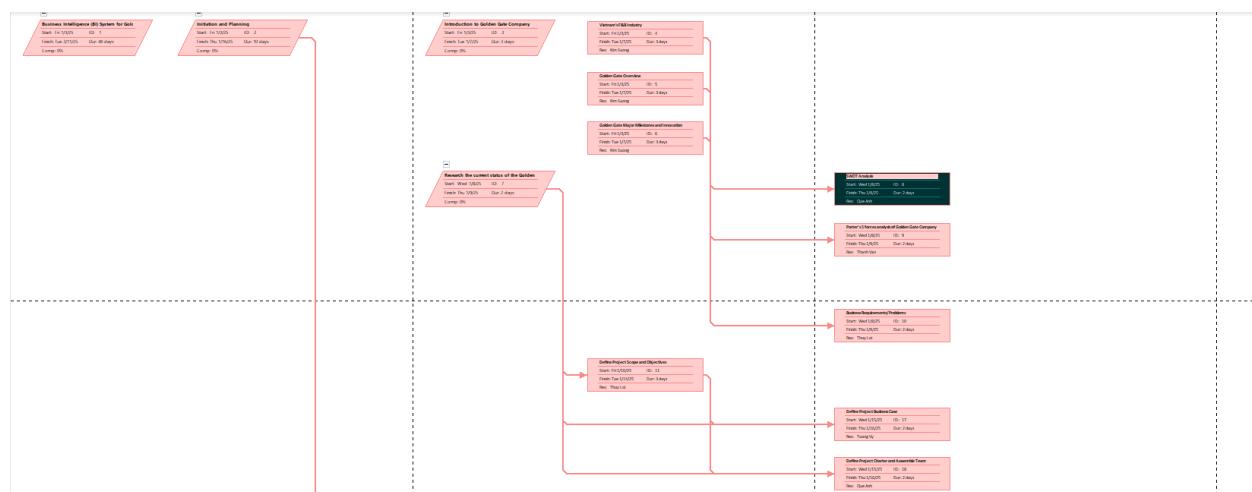


Figure 2.11. Part of Network Diagram

(Sources: Authors' source)

2.6.2. Critical Path

The critical path in the development of the Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules represents the sequence of tasks that determine the shortest duration required to complete the project. It outlines the longest path in the project schedule, identifying tasks that must be completed on time to prevent overall delays in project delivery.

The critical path method (CPM) involves identifying all necessary tasks, determining their sequence, and calculating the longest time required for completion. It provides a clear timeline and helps prioritize critical over non-critical tasks, ensuring efficient scheduling and project completion.

The critical path for this BI system project includes several essential tasks: Requirement Analysis & Business Needs Assessment to identify key marketing and sales data needs from stakeholders, Data Source Identification & Integration to map and integrate various data sources such as POS systems, CRM, and ERP, and Data Warehouse Design & Development to structure and optimize a data warehouse that supports business intelligence functions.

Following this, the ETL (Extract, Transform, Load) Implementation ensures that data is extracted, transformed into usable formats, and loaded into the BI system. The BI Dashboard & Report Development phase focuses on designing and implementing analytical dashboards for marketing and sales insights. To maintain data accuracy, system reliability, and report effectiveness, Testing & Validation is conducted before proceeding to User Training & Documentation, where employees are trained to use the system

efficiently. The final phase, System Deployment & Monitoring, ensures the BI system is deployed in production and monitored for performance.

The CPM method offers multiple benefits, including clear project visualization using flowcharts or Gantt charts, identification of critical tasks to mitigate risks, improved resource management, and enhanced team collaboration. By outlining the longest sequence of tasks, project managers can anticipate bottlenecks and allocate resources efficiently to ensure the timely completion of the project.

Moreover, it facilitates risk identification and proactive mitigation, reducing potential project delays and associated costs. The method also improves communication within teams by clearly outlining roles, responsibilities, and dependencies, thereby increasing overall efficiency and project success.

To calculate the critical path, project managers must identify all tasks, determine the task sequence, estimate task duration, draw a network diagram, identify the critical path, calculate float (slack time), and monitor the critical path. Actively managing and monitoring the critical path allows the project team to optimize execution and minimize risks of delays.

Understanding and leveraging the critical path feature in Microsoft Project enables informed decision-making and proactive risk mitigation, ensuring successful delivery of the BI System for Marketing and Sales Modules within the planned time frame.

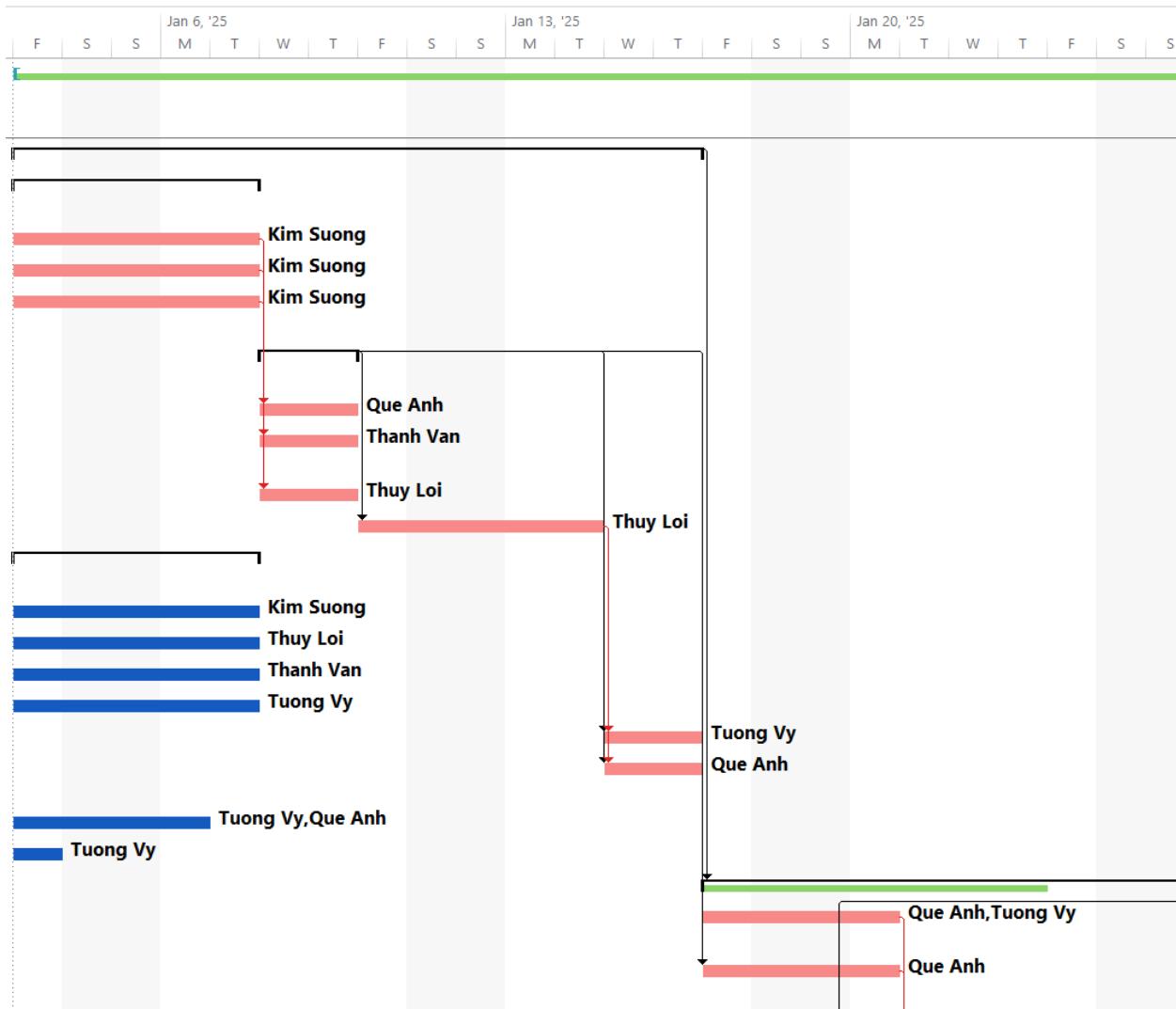


Figure 2.12. Critical path in the final stages of the project

(Sources: Authors' source)

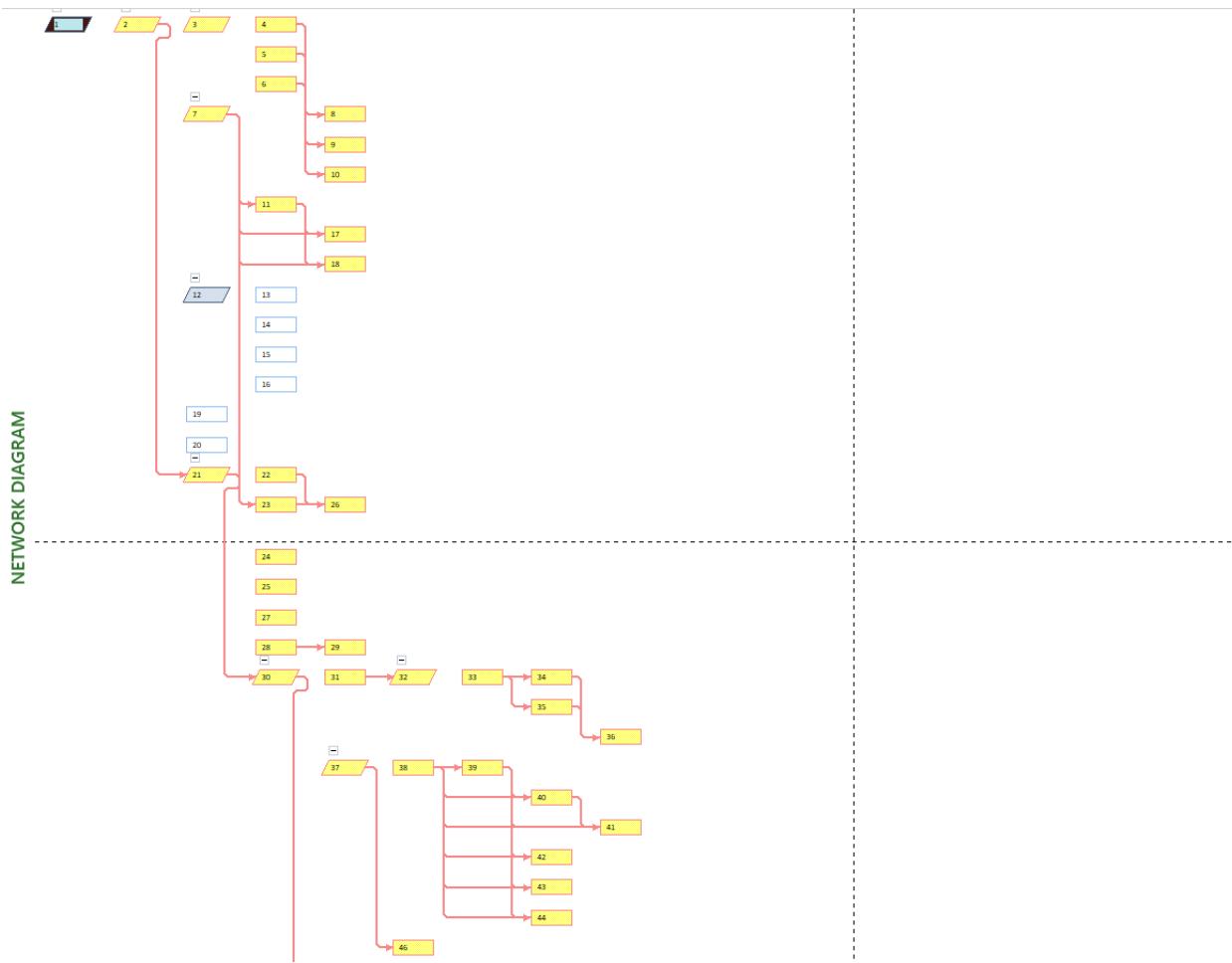


Figure 2.13. Critical path in a compact model of the network diagram

(Sources: Authors' source)

2.7. Risk management (qualitative risk analysis and quantitative risk analysis)

2.7.1. Risk identification, Risk level, Solution for each risk

Risk identification is identifying potential business risks and analyzing them to learn about their effects on the business. Risk identification is important at all stages of your business's lifespan because it helps identify your biggest challenges and helps create a clearer picture of the business's overall health. Identifying risks early during the project planning phase can help the team navigate the challenges more effectively by planning.

Risk assessment provides an estimate of the severity of a risk. Without this assessment, a project manager can fail to give sufficient attention to significant risks. Qualitative assessment of risks can always be performed, and will usually take far less time and resources than quantitative analysis. The severity of any risk can be defined in terms of two quantities: impact, the effect that a risk will have on the project if it occurs; and likelihood, the extent to which the risk effects are likely to occur.

To give this scale meaning, consider the four effects that any risk can have: *cost*, project costs can increase; *schedule*, project deliverables can be late; *functionality*, the level of performance or capability provided by the project deliverables can be reduced; *quality*, the level of excellence of the deliverables can be reduced; and *probability of occurrence*, how likely it is for a risk to occur.

Table 2.8. The four possible effects of any risk and assessing the levels of both probability of occurrence

	1 Very Low	2 Low	3 Medium	4 High	5 Very High
Cost	Insignificant cost increase	<5% cost increase	5-10% cost increase	10-20% cost increase	>20% cost increase
Schedule	Insignificant schedule slippage	Overall project slippage <5%	Overall project slippage 5-10%	Overall project slippage 10-20%	Overall project slippage >20%
Functionalit y	Functionalit y decrease	Minor areas of	Major areas of	Functionalit y reduction	Project end item is

	barely noticeable	functionality are affected	functionality are affected	unacceptable to the client	effectively useless
Quality	Quality degradation barely noticeable	Only very demanding applications are affected	Quality reduction requires client approval	Quality reduction unacceptable to the client	Project end item is effectively unusable
Probability of occurrence	Extremely unlikely to happen	Less likely to happen than not.	Just as likely to happen as not.	More likely to happen than not.	Almost certain to happen

The next step of risk management includes analyzing risks. The purpose of risk analysis is to assign levels to risks. A risk level can be calculated as follows:

$$\textbf*Risk level} = \textbf*Impact} \times \textbf*Probability}***$$

- *Probability*: The chance of something happening (typically a threat exploiting a weakness), while the consequence is the outcome of such exploitation.
- *Impact*: The severity of the risk to the rights and freedoms of the data subject.

Table 2.9. Risk identification, Risk level, Solution for each risk

Risk Category	Risk Code	Hazard identification	Description	Risk assessment			Safety risk control
				Probability	Impact	Risk level	
Technical Risks	R01	System Integration Issues	Difficulty in integrating legacy systems with the new BI platform may cause delays or functionality gaps	High	High	16	Implement middleware solutions to bridge system gaps and ensure detailed documentation of existing systems.
	R02	Data Quality Problems	Inconsistent or incomplete data could affect the accuracy of analytics	Medium	High	12	Perform data profiling and cleansing before migration and train staff on maintaining high data quality standards.
	R03	Implementation Failures	Technical errors or system failures during deployment could hinder the system's functionality	Medium	Very High	15	Conduct extensive system testing, create rollback plans, and provide technical support during deployment.

Project Management Risks	R04	Scope Creep	Additional requirements or changes during the project may lead to budget and timeline strain	Very Low	Very High	5	Establish strict change management policies and client approvals for new requirements.
	R05	Timeline Delays	Dependencies on external vendors or consultants could cause delays in implementation	High	Very High	20	Identify critical dependencies and create contingency plans for delays.
	R06	Task Prioritization Challenges	Failure to properly prioritize tasks could result in inefficient use of resources and missed deadlines	Medium	High	12	Implement project management methodologies and use task tracking tools to optimize prioritization.
	R07	Failure to Meet Business Objectives	The BI system may not deliver the expected outcomes, failing to align with business goals	Medium	Very High	16	Ensure continuous alignment with business stakeholders, set clear KPIs, and conduct periodic evaluations of system performance.

Financial Risks	R08	Budget Overruns	Unexpected costs may exceed the allocated budget	Very Low	Very High	5	Monitor budgets closely and build a contingency fund into the project budget.
	R09	ROI Realization Risk	The BI system might take longer than expected to deliver measurable benefits	Medium	Medium	9	Establish clear KPIs for ROI measurement and regularly review system performance post-implementation
User Adoption Risks	R10	Resistance to Change	Employees may resist adopting the new system	Medium	High	12	Involve key stakeholders in the decision-making process and provide ongoing support and training programs.
	R11	Skill Gaps	Users may lack the necessary skills to use the BI system effectively	Medium	Medium	9	Provide training programs and create user-friendly guides or resources.

2.7.2. Risk Matrix

In the process of assessing probability and impact, a probability-impact risk rating matrix serves as a visual tool to illustrate project risks by mapping the likelihood of their occurrence against the potential consequences they may have on project outcomes. This matrix helps in categorizing risks based on their impact and probability, aiding in more effective risk management and decision-making.

		Impact				
		Very Low	Low	Medium	High	Very High
Probability	Very high					
	High				R01	R05
	Medium			R09,R11	R02,R06, R10	R03,R07
	Low					
	Very Low					R04,R08

Figure 2.14. Risk Matrix

(Source: Authors' source)

The risk matrix is designed to highlight the significance of various risks, helping to determine their priority for mitigation. In the matrix shown below, risks that fall within the blue zone should be given special attention and addressed proactively, as they have a high likelihood of occurring and could significantly impact the project. The project team should develop appropriate strategies to manage and resolve these risks if they arise.

2.7.3. Decision Tree and EMV Analysis

Expected Monetary Value (EMV) is a quantitative risk analysis technique that helps assess the potential value of different project options by considering the probability of various possible outcomes and their associated financial impacts. This method provides a structured approach to evaluating risks and opportunities by assigning probabilities to different scenarios and calculating their weighted average value. By doing so, EMV allows project managers and decision-makers to make more informed choices regarding risk mitigation and investment strategies.

Similarly, decision tree analysis is a visual representation technique used to systematically analyze potential courses of action. It breaks down complex decisions into a tree-like structure, where each branch represents a possible decision or outcome, along with its associated costs, benefits, and risks. By mapping out these different possibilities, decision tree analysis helps in identifying the most favorable path based on logical evaluation and comparative assessment.

When used together, EMV and decision tree analysis complement each other in decision-making processes. EMV quantifies risk by assigning financial values to uncertain outcomes, while decision tree analysis provides a clear and structured framework for evaluating different decision paths. The combination of these two techniques enhances the decision-making process by identifying the most advantageous course of action, minimizing potential risks, optimizing resource allocation, and ultimately improving work efficiency. By leveraging both methods, organizations can make well-informed, data-driven decisions that save time and contribute to better project outcomes.

There are 5 steps to analyze the decision tree and EMV, including:

1. Determine the Probability (P) of an Outcome.

2. Determine the Monetary Impact (I) of the Outcome.
3. Multiply probability by impact to calculate EMV.

Here are several scenarios that require making suitable decisions during the execution of a project:

Scenario 1: Choosing the Visualization platform

- Option 1: PowerBI
- Option 2: Tableau
- Option 3: Looker

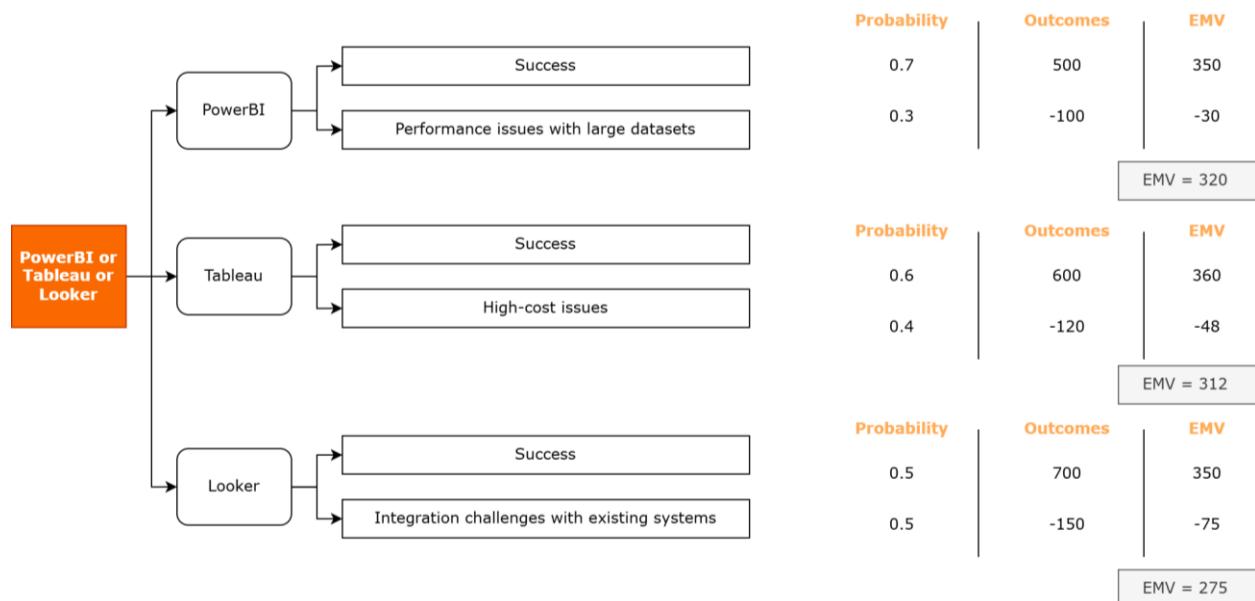


Figure 2.15 Decision tree and EMV analysis of scenario 1 - Choosing the Visualization platform

(Sources: Authors' source)

The image presents a **Decision Tree and Expected Monetary Value (EMV) analysis** to determine the best visualization platform for the Golden Gate Restaurant Chain BI System.

Three options are evaluated: Power BI, Tableau, and Looker, each with different probabilities of success and failure.

Power BI has the highest EMV (\$320) and the highest success probability (70%), making it the most balanced and risk-efficient choice.

Scenario 2: Choosing Data Warehouse platform

- Option 1: Amazon Redshift (Cloud-based)
- Option 2: Microsoft SQL Server (On-premise)
- Option 3: Google BigQuery (Cloud-based)

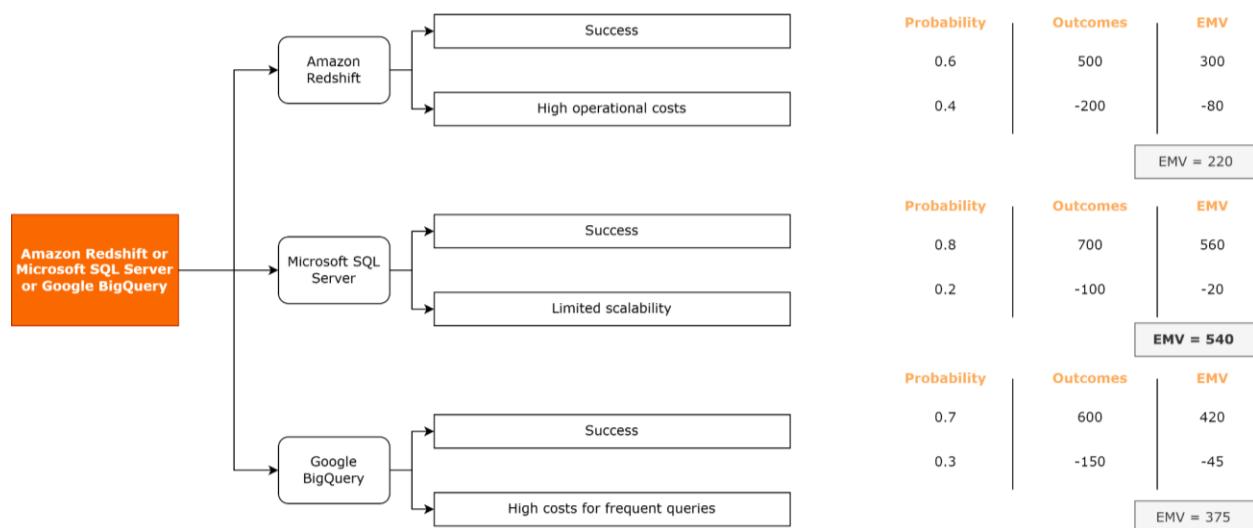


Figure 2.16. Decision tree and EMV analysis of scenario 2 - Choosing Data Warehouse platform

(Sources: Authors' source)

The image presents a **Decision Tree and Expected Monetary Value (EMV) analysis** to determine the best database platform for the Golden Gate Restaurant Chain BI System. Three options are evaluated: Amazon Redshift, Microsoft SQL Server, and Google BigQuery, each with different probabilities of success and failure.

Microsoft SQL Server has the highest EMV (\$540) and the highest success probability (80%), making it the most balanced and risk-efficient choice.

Scenario 3: Choosing the Cloud Infrastructure

- Option 1: AWS (Amazon Web Services)
- Option 2: Google Cloud (GCP)
- Option 3: Microsoft Azure

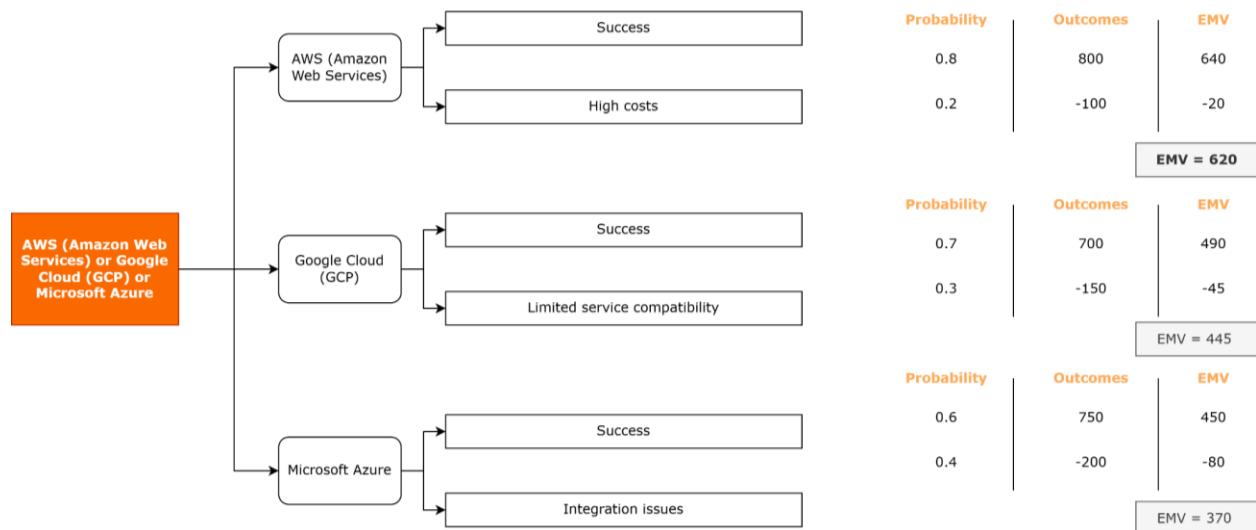


Figure 2.17. Decision tree and EMV analysis of scenario 3 - Choosing the Cloud Infrastructure

(Sources: Authors' source)

The image presents a **Decision Tree and EMV analysis for choosing the cloud infrastructure** for the BI system. Three options are evaluated: AWS (Amazon Web Services), Google Cloud Platform (GCP), and Microsoft Azure.

AWS has the highest EMV (\$620) and the highest success probability (80%), making it the most reliable and profitable option.

2.8. System Design & Architecture

2.8.1. Functional Design

2.8.1.1. DFD - Data Flow Diagram

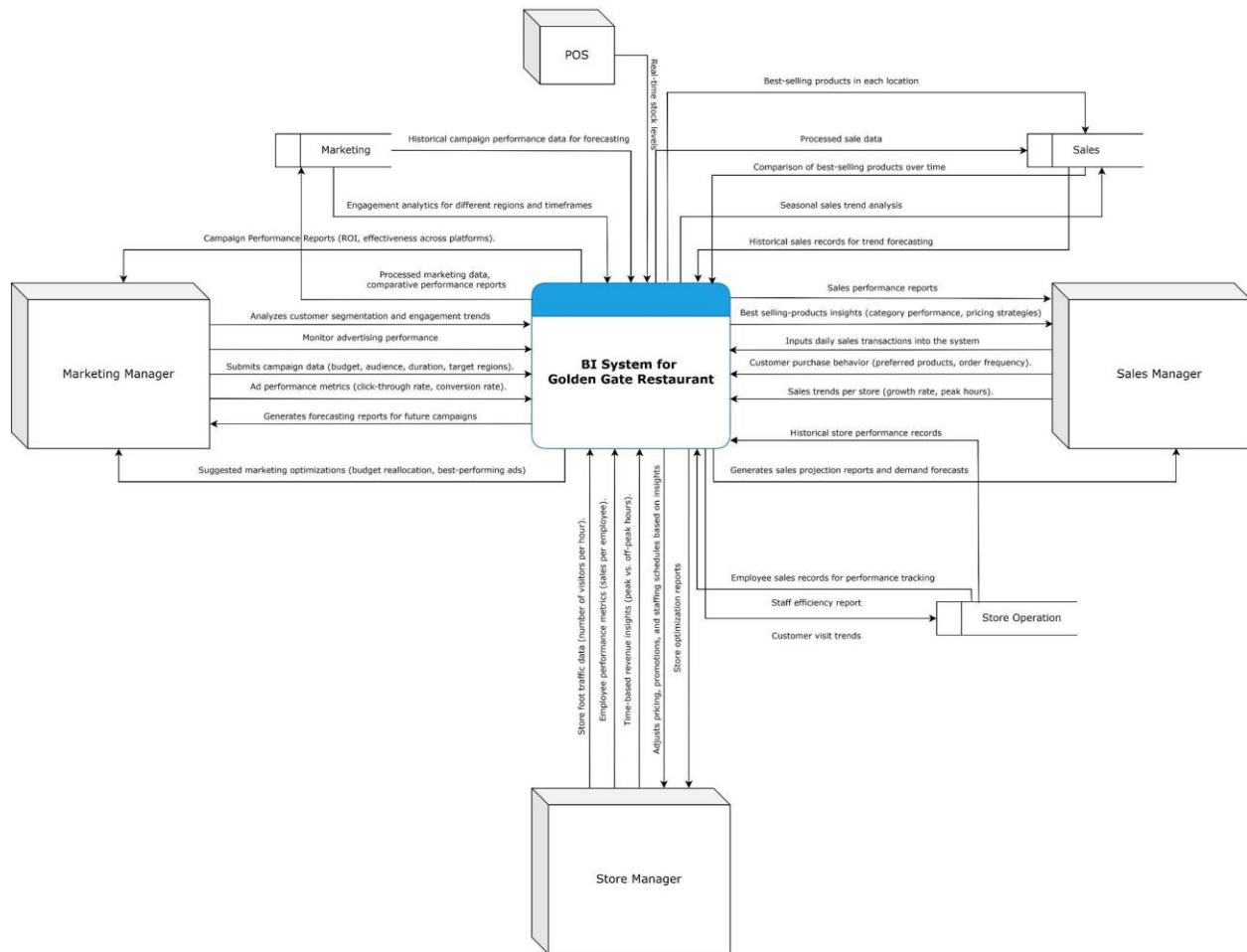


Figure 2.18. Data Flow Diagram - Level 0

(Sources: Authors' source)

The Data Flow Diagram (DFD) Level 0 for the Business Intelligence (BI) System of Golden Gate Restaurant illustrates how different entities interact with the system to

optimize marketing, sales, and store operations. The Marketing Manager provides historical campaign performance data, engagement analytics, and advertising metrics, which the BI system processes to generate forecasting reports and suggest marketing optimizations. The Sales Manager inputs daily sales transactions and customer purchase behavior, enabling the BI system to analyze sales trends, compare best-selling products over time, and generate demand forecasts. Meanwhile, the Store Manager submits operational performance data, including staff efficiency and customer visit trends, which the BI system processes to adjust shift schedules and improve store operations.

Additionally, the POS system continuously feeds sales transaction data into the BI system, allowing for real-time sales tracking, historical trend analysis, and best-selling product insights. The BI system serves as a central hub that collects, processes, and analyzes data to support data-driven decision-making across departments. By providing actionable reports, forecasting insights, and operational recommendations, the system enhances marketing effectiveness, sales performance, and store management, ensuring a more efficient and profitable business strategy.

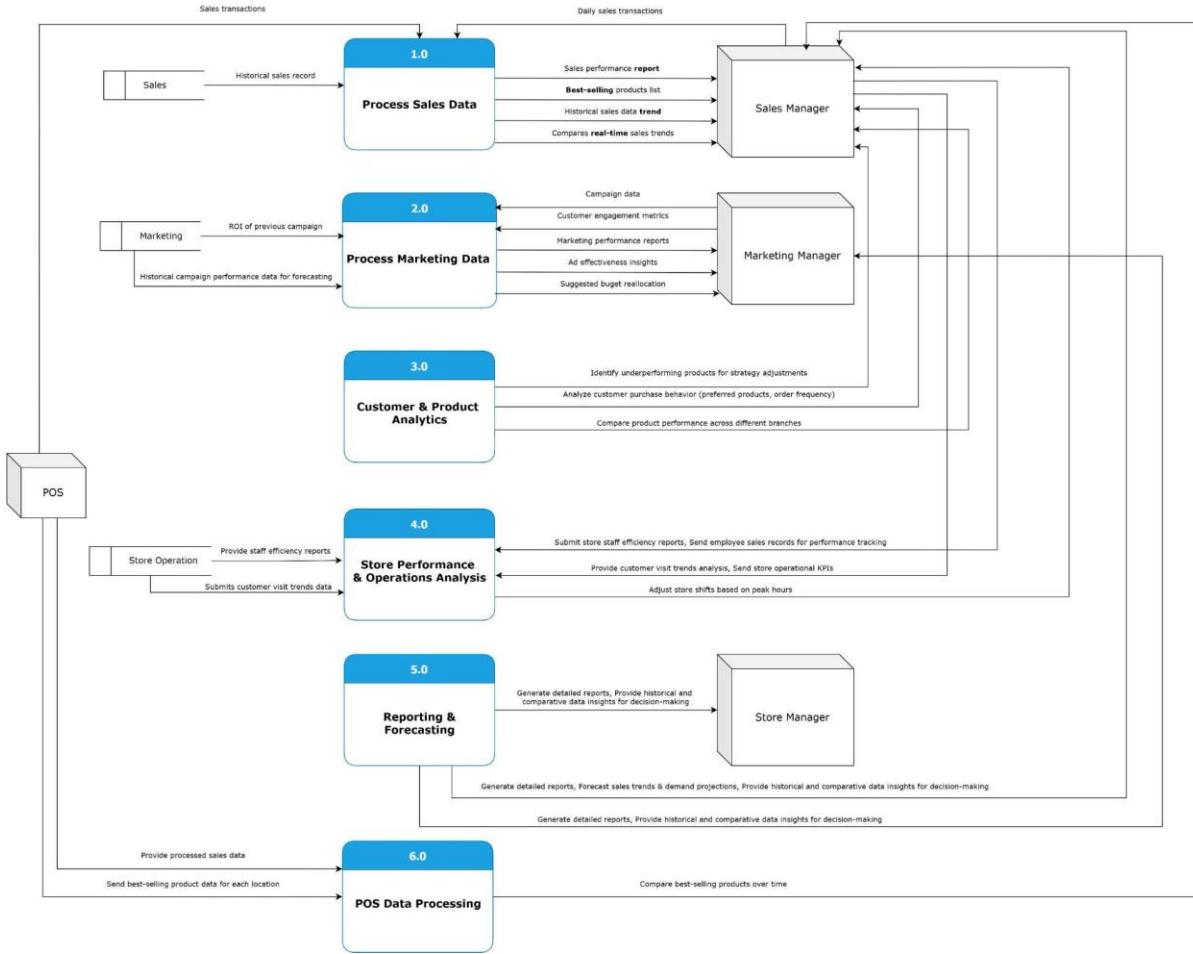


Figure 2.19. Data Flow Diagram - Level 1

(Sources: Authors' source)

The Data Flow Diagram (DFD) Level 1 for the Business Intelligence (BI) System of Golden Gate Restaurant provides a more detailed breakdown of the system's processes, expanding on the high-level interactions from DFD Level 0. It consists of six key processes: Processing Sales Data, Processing Marketing Data, Customer & Product Analytics, Store Performance & Operations Analysis, Reporting & Forecasting, and POS Data Processing. These processes handle data flow from Sales, Marketing, Store Operations, POS, and deliver insights to Sales Managers, Marketing Managers, and Store Managers to support data-driven decision-making.

The Process Sales Data module collects daily sales transactions and historical records from the Sales entity, generating sales performance reports, best-selling product lists, and trend analysis for the Sales Manager. Similarly, Process Marketing Data handles campaign data, engagement metrics, and historical performance records, providing marketing insights and budget reallocation suggestions to the Marketing Manager. The Customer & Product Analytics module identifies underperforming products, analyzes purchase behavior, and compares product performance across locations. Store Performance & Operations Analysis evaluates staff efficiency, customer visits, and store KPIs, allowing store managers to optimize shift schedules. Reporting & Forecasting consolidates data from all processes, generating reports, sales forecasts, and comparative analytics for decision-making. Lastly, POS Data Processing integrates sales transaction data and identifies best-selling products for trend comparison. This DFD Level 1 effectively visualizes how the BI system transforms raw data into actionable insights, enhancing marketing, sales, and operational strategies.

2.8.1.2. Use case

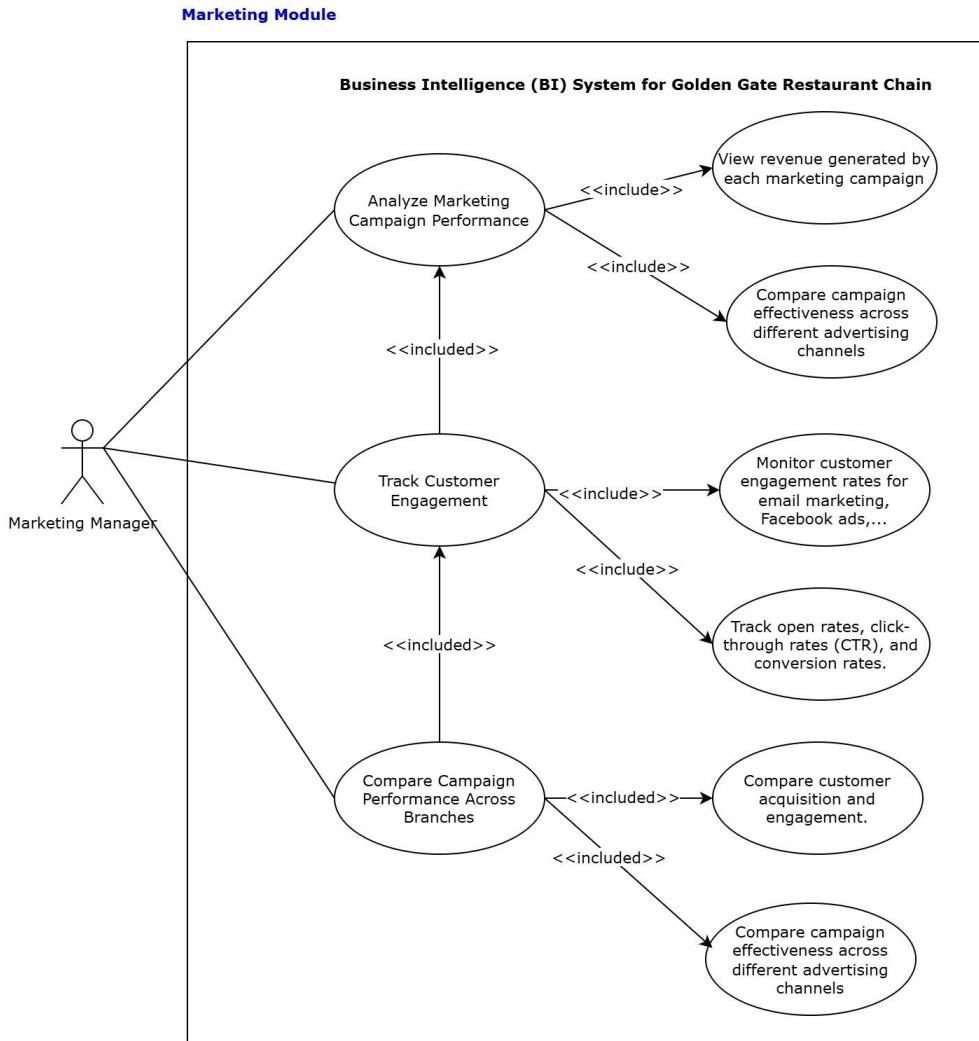


Figure 2.20. Use case Diagram of Marketing Module

(Sources: Authors' source)

The Marketing Module enables the Marketing Manager to evaluate and optimize marketing campaign performance by tracking key revenue metrics and customer engagement data. The system allows the manager to analyze marketing campaign performance by providing

insights into revenue generated by each campaign and comparing advertising effectiveness across platforms such as Facebook, Google Ads, and Email Marketing. Additionally, it includes customer engagement tracking, where the system monitors interaction metrics like open rates, click-through rates (CTR), and conversion rates to assess campaign effectiveness. Another key functionality is the ability to compare campaign performance across branches, which helps evaluate customer acquisition and engagement trends across different locations. By leveraging these insights, the Marketing Manager can make data-driven decisions, refine advertising strategies, and allocate marketing budgets more efficiently to maximize campaign impact.

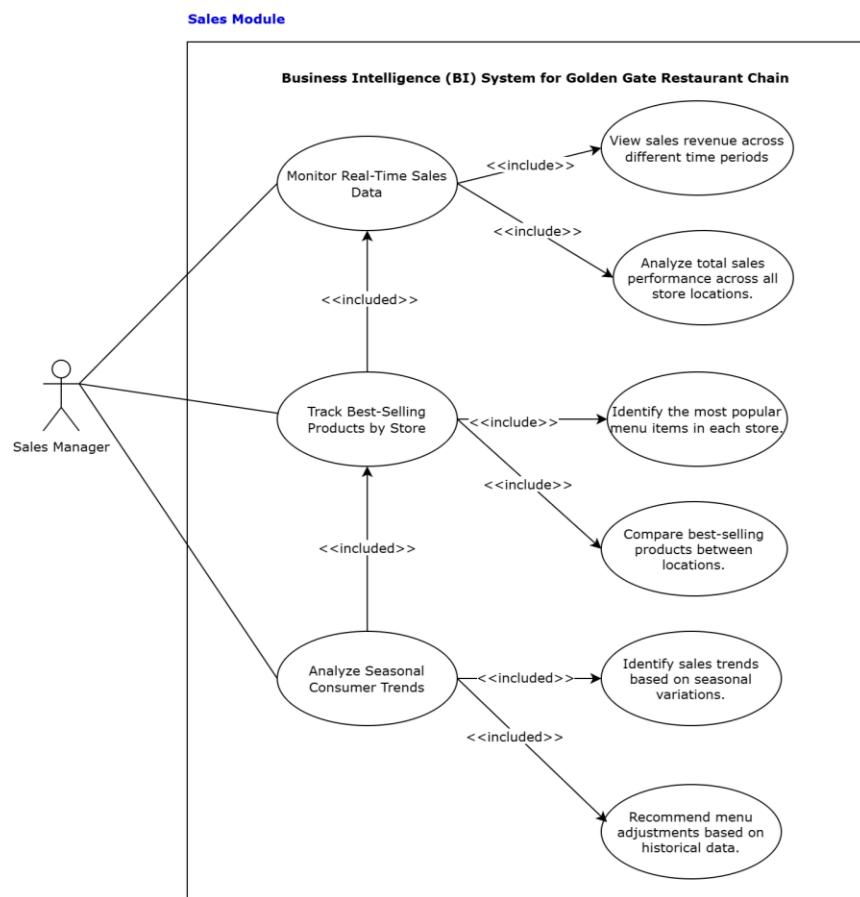


Figure 2.21. Use case Diagram of Sales Module

(Sources: Authors' source)

The Sales Module assists the Sales Manager in monitoring sales performance, identifying top-selling products, and analyzing seasonal consumer trends across different restaurant branches. The system provides real-time sales monitoring, allowing the manager to track sales revenue across different time periods and analyze total sales performance across all store locations. Included within this functionality is the ability to track best-selling products by store, which identifies the most popular menu items and enables comparison of sales trends between different locations to adapt business strategies accordingly. Additionally, the system helps analyze seasonal consumer trends by identifying sales fluctuations based on different times of the year and providing menu adjustment recommendations based on historical data. By utilizing these insights, the Sales Manager can optimize inventory, enhance product offerings, and develop sales strategies tailored to seasonal demand, ultimately improving overall revenue and business efficiency.

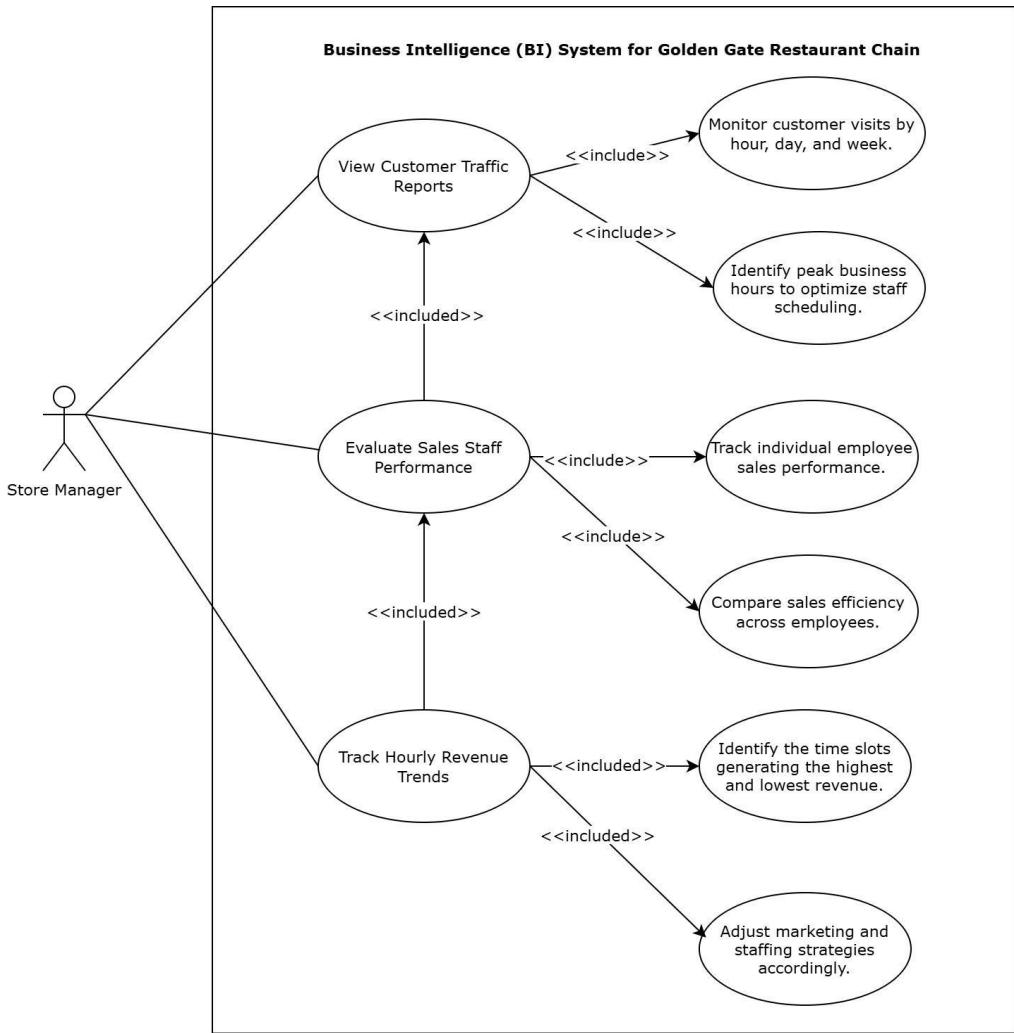


Figure 2.22. Use case Diagram of Store Manager

(Sources: Authors' source)

The Use Case Diagram outlines the key functionalities available to the Store Manager in the Business Intelligence (BI) System for Golden Gate Restaurant Chain, focusing on customer traffic analysis, employee performance evaluation, and revenue tracking. The system allows the Store Manager to view customer traffic reports, monitoring customer visits by hour, day, and week while identifying peak business hours to optimize staff scheduling. Additionally, it facilitates evaluating sales staff performance by tracking individual employee sales contributions and comparing sales efficiency among staff

members, enabling data-driven workforce management. Another crucial function is tracking hourly revenue trends, which helps identify the highest and lowest revenue-generating time slots and allows managers to adjust marketing and staffing strategies accordingly. The include relationships highlight the interdependence of these functions, ensuring a structured approach to store optimization. Overall, the BI system empowers the Store Manager to enhance operational efficiency, improve employee productivity, and maximize profitability through real-time data insights.

2.8.1.3. BPMN

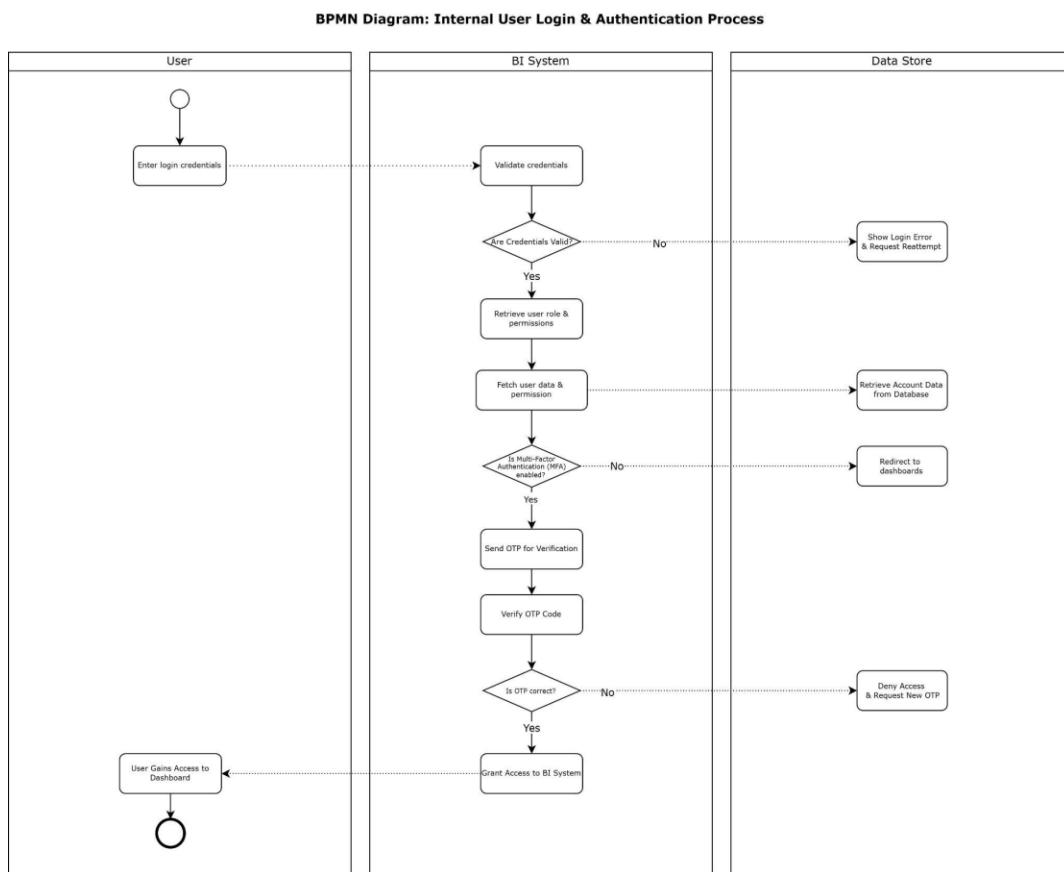


Figure 2.23. BPMN Diagram: Internal User Login & Authentication Process
(Sources: Authors' source)

The Internal User Login & Authentication Process ensures secure access control within the BI System for Golden Gate Restaurant Chain. The process begins when an internal user (Marketing Manager, Sales Manager, or Store Manager) enters their login credentials. The BI System validates these credentials, retrieves user roles & permissions, and determines if Multi-Factor Authentication (MFA) is required.

If MFA is enabled, the system sends an OTP for verification before granting access. If the login attempt is from an internal company network, MFA is bypassed, and the user is redirected directly to their dashboard. If the credentials are invalid, the system displays a login error and requests a reattempt. If OTP verification fails, access is denied, and a new OTP is required.

This authentication workflow ensures secure login handling, protects sensitive business data, and enforces role-based access control (RBAC). It also improves user experience by optimizing security based on network location and role-based permissions.

Table. High-level requirements of User Authentication & Access Control

ID	Feature	Request Name	Description	Priority
REQ-001	User Login & Authentication	Enter Credential Log in	As an internal user, I want to securely log in with credential validation and optional MFA, so that I can access the BI System safely.	Must have

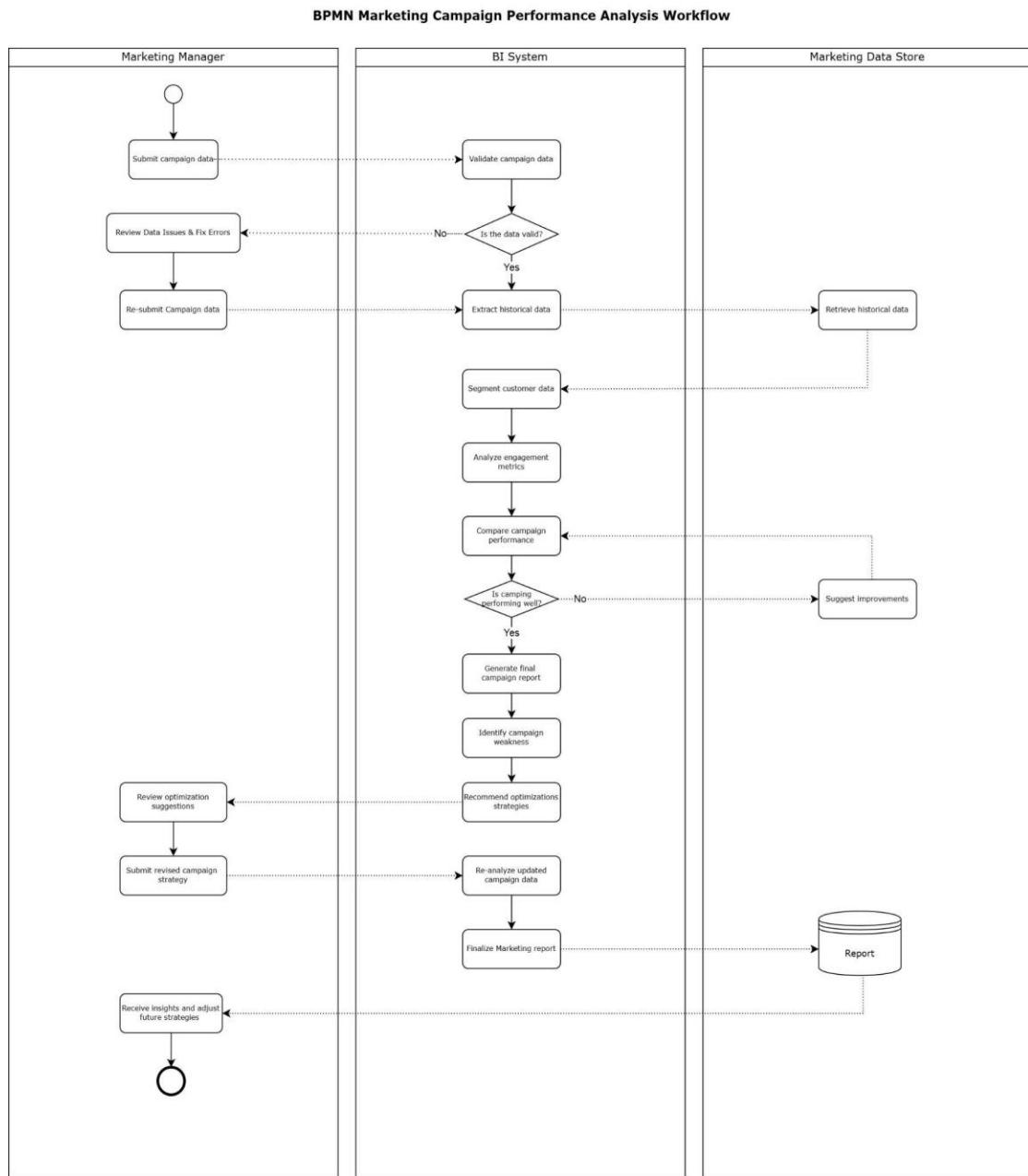


Figure 2.24. BPMN Marketing Campaign Performance Analysis Workflow

(Sources: Authors' source)

The Marketing Campaign Performance Analysis Workflow ensures accurate evaluation of campaign effectiveness, customer engagement, and optimization strategies within the BI System. The process begins when the Marketing Manager submits campaign data, which is validated by the BI System. If errors are detected, the system requests corrections before proceeding with analysis.

The BI System extracts historical campaign data, segments customer groups, and analyzes engagement metrics to compare campaign performance across different channels. If the campaign performs well, a final report is generated. If underperformance is detected, the system identifies weaknesses and recommends adjustments. The Marketing Manager reviews and submits a revised strategy, which is then re-analyzed before finalizing the report.

This workflow enhances data-driven decision-making by enabling marketing teams to refine strategies based on real-time insights and historical trends, ultimately improving campaign performance and audience targeting.

Table. High-level requirements of Marketing Campaign Analysis

ID	Feature	Request Name	Description	Priority
REQ-002	Marketing Campaign Performance Analysis	Campaign Data Validation	As a marketing manager, I want the system to validate and analyze campaign data, so that I can evaluate campaign effectiveness and	Must have

			optimize advertising strategies.	
REQ-003	Marketing Campaign Performance Analysis	Analyze engagement metrics	<p>As a marketing manager, I want to measure customer engagement metrics and ad performance, so that I can enhance marketing efficiency and increase customer satisfaction.</p>	Must Have
REQ-004	Marketing Campaign Performance Analysis	Segment customer data	<p>As a marketing manager, I want to segment customer data based on demographics, behavior, and purchase history, so that I can personalize marketing efforts and improve targeting.</p>	Nice to have
REQ-005	Marketing Campaign	Finalize Marketing report	<p>As a marketing manager, I want to generate and export detailed reports on</p>	Must Have

	Performance Analysis		sales, marketing, and inventory performance, so that I can monitor business operations and make strategic improvements.	
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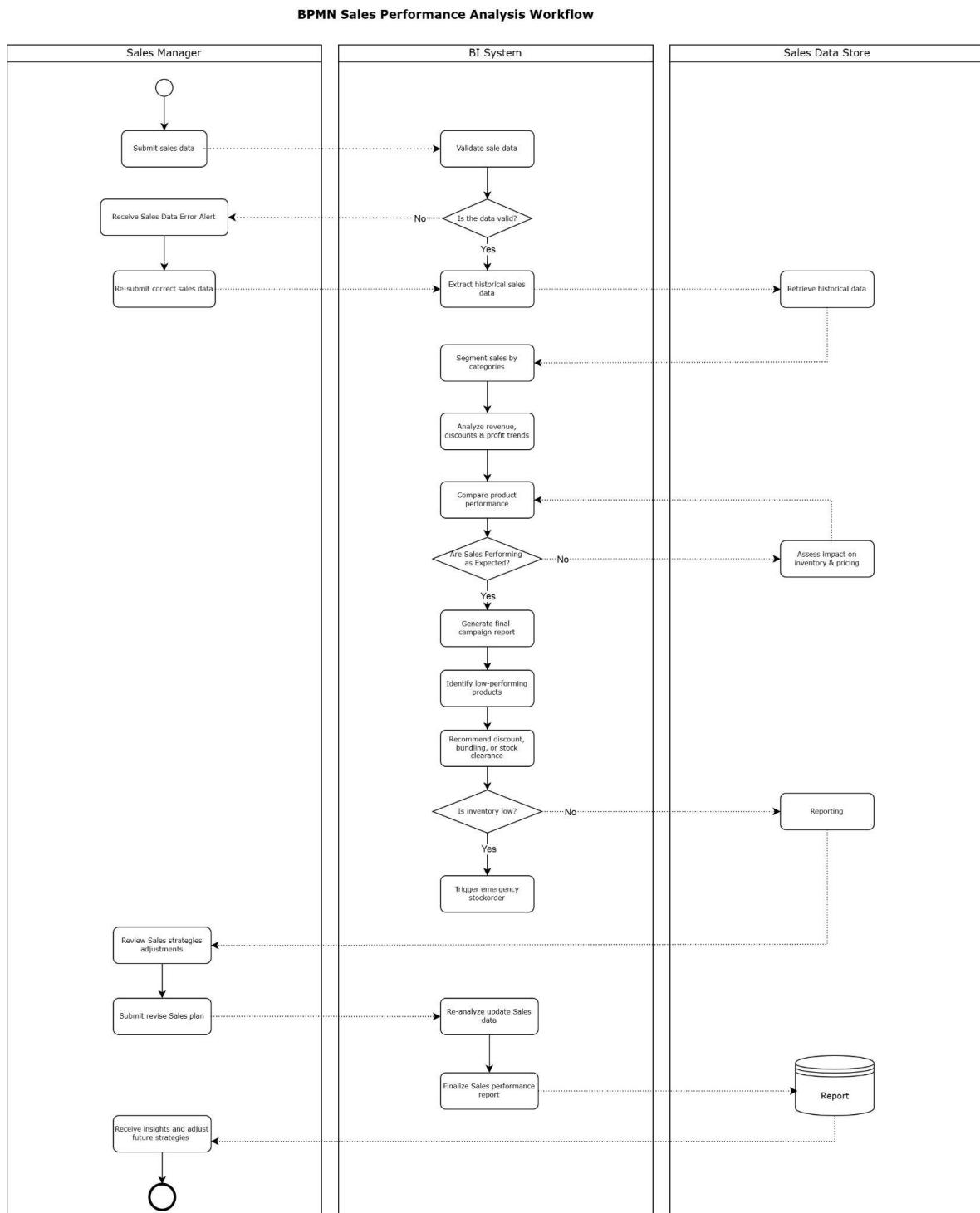


Figure 2.25. BPMN Sales Performance Analysis Workflow

(Sources: Authors' source)

The Sales Performance Analysis Workflow ensures accurate sales tracking, product performance evaluation, and inventory optimization within the BI System. The process begins when the Sales Manager submits sales data, which is validated by the BI System. If errors are detected, the system triggers a correction request before proceeding with data extraction and analysis.

The BI System segments sales data, analyzes revenue, discounts, and profit trends, and determines if sales are performing as expected. If underperformance is detected, the system identifies low-selling products and recommends pricing adjustments or stock clearance strategies. Additionally, if inventory levels are critically low, an emergency stock reorder is triggered. The finalized sales performance report is then stored for future reference, allowing the Sales Manager to review insights and adjust strategies accordingly.

This workflow enhances data-driven decision-making, ensures product availability, and optimizes revenue generation through automated reporting and intelligent inventory management.

Table. High-level requirements of Sales Performance Analysis

ID	Feature	Request Name	Description	Priority
REQ-006	Sales Performance Analysis	Validate sales data	As a sales manager, I want the system to process and validate sales data accurately, so that I can ensure reliable insights for	Must have

			optimizing sales performance.	
REQ-007	Sales Performance Analysis	Analyze revenue, discounts & profit trends	As a business analyst, I want to track sales trends, best-selling products, and revenue impact, so that I can support data-driven decision-making and optimize restaurant operations.	Must Have

2.8.2. Designing Data Warehouse

2.8.2.1. Master Data

Master Data refers to a type of data that is highly static, meaning it rarely changes and typically holds long-term value. Because Master Data is utilized by many departments within a company, it is closely tied to all business processes of the organization. Master Data is one of the criteria used in the process of data analysis and evaluation. It serves as the key and core of the organization.

Table 2.10. Master Data

Objective	Description
dbo.olist_customers_dataset	Contains customer information such as unique IDs, zip codes, cities, and states.

dbo.olist_products_dataset	Stores product details like category, weight, freight, and description length.
dbo.olist_sellers_dataset	Includes seller details such as seller ID, location, and zip code prefix.

2.8.2.2. *Transaction Data*

Transaction Data refers to dynamic data used by specific departments and related to the transactions of a business. Its relevance is confined within a certain timeframe. For the mentioned statistics, Transaction Data provides the factual basis behind the criteria of Master Data. Additionally, Transaction Data is dependent on Master Data; without Master Data, there can be no Transaction Data. Therefore, Transaction Data is often renewed and replaced.

Table 2.11. Transaction Data

Objective	Description
dbo.olist_orders_dataset	Core order dataset, including order status, timestamps, and delivery details, etc.
dbo.olist_order_items_dataset	Stores items per order (product, seller, price, shipping details).
dbo.olist_order_payments_dataset	Transactional payment details (amount, type, installments).
dbo.olist_order_reviews_dataset	Customer reviews, ratings, and comments for each

	order.
--	--------

2.8.2.3. Fact and Dimension Table

2.8.2.3.1. Dimension tables

Dim Customer: Information about Customer

Table 2.12. DimCustomer

Data Warehouse		Data Source		Data type	Allow Null	Rules
Table	Column name	Table	Column name			
DimCustomer	CustomerKey			int		Auto increment
	CustomerID	dbo.olist_customers_dataset	customer_id	nvarchar(50)		From source
	CustomerUniqueID	dbo.olist_customers_dataset	customer_unique_id	nvarchar(50)		From source
	CustomerZipCodePrefix	dbo.olist_customers_dataset	customer_zip_code_prefix	int		From source
	CustomerCity	dbo.olist_customers_dataset	customer_city	nvarchar(50)		From source
	CustomerState	dbo.olist_customers_dataset	customer_state	nvarchar		From

		mers_dataset	te	(50)		source
	StartDate			datetime	x	FromDate
	EndDate			datetime	x	ToDate
	IsCurrent			bit	x	Indicates active record

Dim Order Item: Information about Order Item

Table 2.13. DimOrderItem

Data Warehouse		Data Source		Data type	Allow Null	Rules
Table	Column name	Table	Column name			
DimOrderItem	OrderItemKey			int		Auto increment
	OrderID	dbo.olist_order_items_dataset	order_id	nvarchar(50)		From source
	OrderItemID	dbo.olist_order_items_dataset	order_item_id	tinyint		From source
	ProductID	dbo.olist_order_items_dataset	product_id	nvarchar(50)		From source

SellerID	dbo.olist_order_items_dataset	seller_id	nvarchar (50)	x	From source
ShippingLimit Date	dbo.olist_order_items_dataset	shipping_limit_date	datetime 2(7)	x	From source
Price	dbo.olist_order_items_dataset	price	float	x	From source
FreightValue	dbo.olist_order_items_dataset	freight_value	float		From source
StartDate			datetime	x	FromDate
EndDate			datetime		ToDate
IsCurrent			bit		Indicates active record

Dim Order: Information about Order

Table 2.14. DimOrders

Data Warehouse	Data Source	Data	Allow	Rules

Table	Column name	Table	Column name	type	Null	
DimOrders	OrderKey			int		Auto increment
	OrderID	dbo.olist_order s_dataset	order_id	nvarchar (50)		From source
	CustomerID	dbo.olist_order s_dataset	customer_id	nvarchar (50)		From source
	OrderStatus	dbo.olist_order s_dataset	order_status	nvarchar (50)		From source
	OrderPurchase Timestamp	dbo.olist_order s_dataset	order_purcha s_etimestamp	datetime 2(7)		From source
	OrderApproved At	dbo.olist_order s_dataset	order_approv ed_at	datetime 2(7)		From source
	OrderDelivered CarrierDate	dbo.olist_order s_dataset	order_deliver ed_carrier_da te	datetime 2(7)		From source
	OrderDelivered CustomerDate	dbo.olist_order s_dataset	order_deliver ed_customer _date	datetime 2(7)		From source
	OrderEstimated DeliveryDate	dbo.olist_order s_dataset	order_estimat ed_delivery_	datetime 2(7)		From source

			date			
	StartDate			datetime	x	From source
	EndDate			datetime	x	FromDate
	IsCurrent			bit	x	ToDate

Dim Product: Information about Products

Table 2.15. DimProducts

Data Warehouse		Data Source		Data type	Allow Null	Rules
Table	Column name	Table	Column name			
DimProducts	ProductKey			int		Auto increment
	ProductID	dbo.olist_products_dataset	product_id	nvarchar(50)		From source
	ProductCategoryName	dbo.olist_products_dataset	product_category_name	nvarchar(50)		From source
	ProductNameLength	dbo.olist_products_dataset	product_name_length	tinyint		From source
	ProductDescriptionLength	dbo.olist_products_dataset	product_description_length	smallint		From source

			h			
ProductPhotos Qty	dbo.olist_products_dataset	product_photos_qty	tinyint		From source	
ProductWeightG	dbo.olist_products_dataset	product_weightg	nvarchar(50)		From source	
ProductLengthCM	dbo.olist_products_dataset	product_length_cm	tinyint		From source	
ProductHeightCMM	dbo.olist_products_dataset	product_height_cm	tinyint		From source	
ProductWidthCMM	dbo.olist_products_dataset	product_width_cm	tinyint		From source	
StartDate			datetime	x	FromDate	
EndDate			datetime	x	ToDate	
	IsCurrent		bit	x	Indicates active record	

Dim Payment: Information about Payment

Table 2.16. DimPayment

Data Warehouse		Data Source		Data type	Allow Null	Rules
Table	Column name	Table	Column			

			name			
DimPayment	PaymentKey			int		Auto increment
	OrderID	dbo.olist_order_payments_dataset	order_id	nvarchar(50)		From source
	PaymentSequential	dbo.olist_order_payments_dataset	payment_sequential	tinyint		From source
	PaymentType	dbo.olist_order_payments_dataset	payment_type	nvarchar(50)		From source
	PaymentInstallments	dbo.olist_order_payments_dataset	payment_installments	tinyint		From source
	PaymentValue	dbo.olist_order_payments_dataset	payment_value	float		From source
	StartDate			datetime	x	FromDate
	EndDate			datetime	x	ToDate
	IsCurrent			bit	x	Indicates active

						record
--	--	--	--	--	--	--------

Dim Reviews: Information about Reviews

Table 2.17. DimReviews

Data Warehouse		Data Source		Data type	Allow Null	Rules
Table	Column name	Table	Column name			
DimReviews	ReviewKey			int		Auto increment
	ReviewID	Warehouse.StockItems	review_id	nvarchar(50)		From source
	OrderID	Warehouse.StockItems	order_id	nvarchar(50)		From source
	ReviewScore	Warehouse.StockItems	review_score	tinyint		From source
	ReviewCommentTitle	Warehouse.StockItems	review_comment_title	nvarchar(50)		From source
	ReviewCommentMessage	Warehouse.StockItems	review_comment_message	nvarchar(250)		From source
	ReviewCreationDate	Warehouse.StockItems	review_creation_date	datetime		From source
	ReviewAnswer	Warehouse.StockItems	review_answer	datetime		From

	Timestamp	ockItems	_timestamp	2(7)		source
	StartDate			datetime	x	FromDate
	EndDate			datetime	x	ToDate
	IsCurrent			bit	x	Indicates active record

Dim Sellers: Information about Sellers

Table 2.18. DimSellers

Data Warehouse		Data Source		Data type	Allow Null	Rules
Table	Column name	Table	Column name			
DimSellers	SellerKey			int		Auto increment
	SellerID	dbo.olist_seller s_dataset	seller_id	nvarchar (50)		From source
	SellerZipCodePrefix	dbo.olist_seller s_dataset	seller_zip_code_prefix	int		From source
	SellerCity	dbo.olist_seller s_dataset	seller_city	nvarchar (50)		From source
	SellerState	dbo.olist_seller	seller_state	nvarchar		From

	s_dataset		(50)		source
StartDate			datetime	x	FromDate
EndDate			datetime	x	ToDate
IsCurrent			bit	x	Indicates active record

2.8.2.3.1. Fact table

Fact Sales: Information about Sales Order

Table 2.19. DimSellers

Data Warehouse		Data Source		Data type	Allow Null	Rules
Table	Column name	Table	Column name			
FactSales	OrderKey			int		Auto increment, Primary Key
	OrderID	dbo.olist_order	order_id	nvarchar (50)		From source
	OrderStatus	dbo.olist_order	order_stat	nvarchar (50)		From source
	OrderItemKey		order_item	int		Foreign Key

			_id			→ DimOrderIt em
Price	dbo.olist_order_items_dataset	price	float			From source (olist_order_items_dataset)
FreightValue	dbo.olist_order_items_dataset	freight_value	float			From source (olist_order_items_dataset)
ShippingLimit Date	dbo.olist_order_items_dataset	shipping_limit_date	datetime 2(7)			From source (olist_order_items_dataset)
PaymentValue	dbo.olist_payments_dataset	payment_value	float			From source (olist_order_payments_dataset)
PaymentType	dbo.olist_payments_dataset	payment_type	nvarchar (50)			From source (olist_order_payments_dataset)

	CustomerKey		Customer Key	int		Foreign Key → DimCustomer
	PaymentKey		PaymentKey	int		Foreign Key → DimPayments
	CustomerState	dbo.olist_customer_dataset	customer_state	nvarchar(50)		From source (olist_customers_dataset)
	ProductKey		product_id	int		Foreign Key → DimProducts
	ProductCategoryName	dbo.olist_products_dataset	product_category_name	nvarchar(50)		From source (olist_products_dataset)
	ProductDescriptionLength	dbo.olist_products_dataset	product_description_length	smallint		From source (olist_products_dataset)
	ProductWeight	dbo.olist_products_dataset	product_w	nvarchar		From source

	G	cts_dataset	eightg	(50)		(olist_products_dataset)
	SellerState	dbo.olist_sellers_dataset	seller_state	nvarchar(50)		From source (olist_sellers_dataset)
	SellerKey		SellerKey	int		Foreign Key → DimSellers
	ReviewKey	dbo.olist_reviews_dataset	ReviewKey	int		Foreign Key → DimReviews
	ReviewScore	dbo.olist_reviews_dataset	review_score	tinyint		From source (olist_order_reviews_data set)
	ReviewCommentMessage	dbo.olist_reviews_dataset	review_comment_message	nvarchar(250)		From source (olist_order_reviews_data set)
	ReviewCreationDate	dbo.olist_reviews_dataset	review_creation_date	datetime2(7)		From source (olist_order_reviews_data set)

	StartDate			datetime	x	FromDate
	EndDate			datetime	x	ToDate
	IsCurrent			bit	x	Indicates active record

2.8.3. Data warehouse model

The Star Schema model is the Data Warehouse model used here, incorporating DimCustomer, DimOrderItem, DimOrders, DimPayments, DimProducts, DimReviews, and DimSellers tables for both the FactSales table.

The Star Schema model, a widely adopted data modeling approach in Business Intelligence (BI), is utilized to efficiently manage e-commerce transaction data. This model primarily supports two key functions: Sales Transactions (captured in FactSales) and Customer & Product Analytics (managed through corresponding dimension tables).

The FactSales table is designed to store transactional data related to customer orders. It contains key metrics such as order status, pricing, freight cost, payment details, and customer reviews. These facts are linked to dimension tables, including DimCustomer, DimOrderItem, DimOrders, DimPayments, DimProducts, DimReviews, and DimSellers, which provide contextual attributes for in-depth analysis.

Each dimension table helps categorize transactional data. For instance, DimCustomer stores customer information, DimProducts captures product details, while DimPayments records payment methods and values.

The Star Schema model facilitates the development of comprehensive reports and analytics, enabling businesses to gain valuable insights into customer behavior, sales performance, and operational efficiency. This data-driven approach supports strategic decision-making and enhances overall business intelligence capabilities.

The proposed DW model is described in the figure below (Figure 2.26)

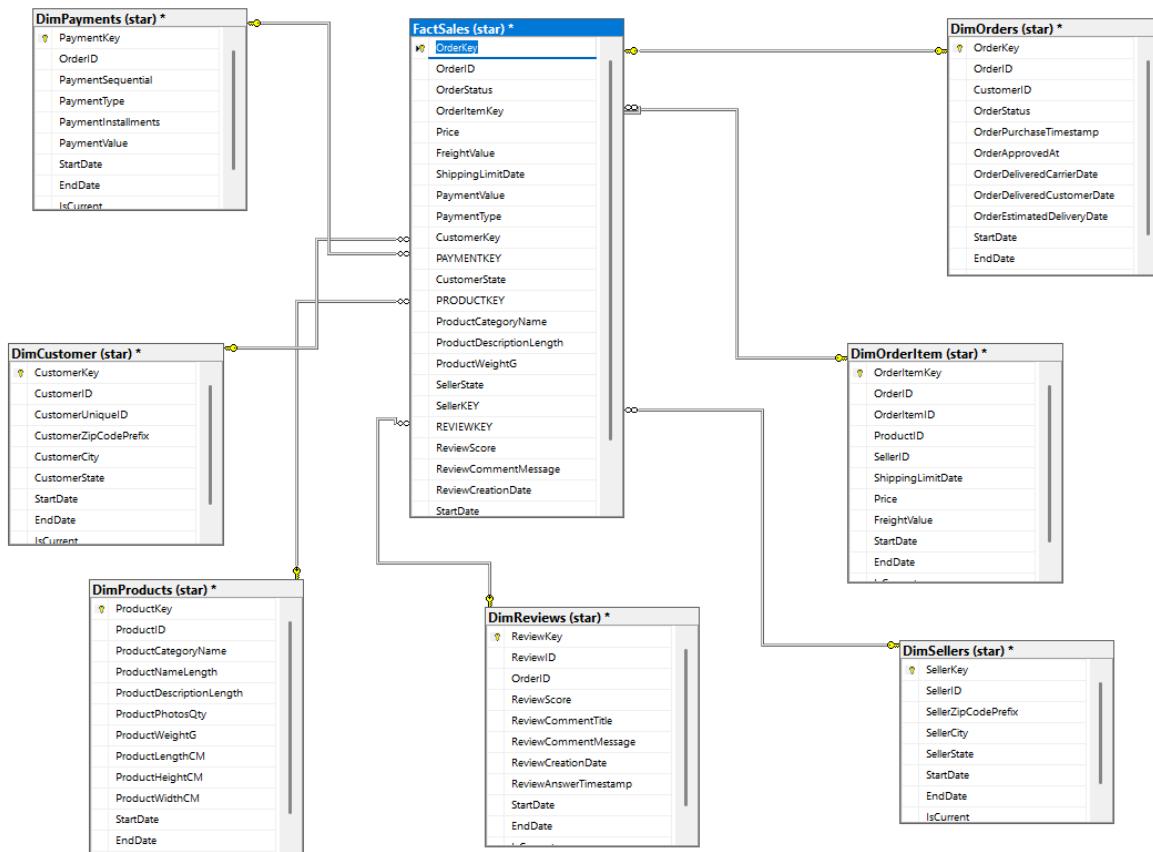


Figure 2.26. The proposed Data Warehouse model
(Source: Authors' source)

Table 2.20. The description of the tables in the Data Warehouse model

Objective	Description

DimCustomer	Information about Customers (e.g., customer location, unique ID, and state).
DimOrderItem	Information about Order Items (e.g., product, seller, price, shipping details).
DimOrders	Information about Orders (e.g., order status, timestamps, delivery details).
DimPayments	Information about Payments (e.g., payment method, value, and installments).
DimProducts	Information about Products (e.g., category, weight, dimensions, and description).
DimReviews	Information about Customer Reviews (e.g., ratings, comments, timestamps).
DimSellers	Information about Sellers (e.g., seller location and zip code).
FactSales	Detailed information about Sales Transactions (e.g., order status, price, freight cost, payment value, and customer reviews).

2.8.3.1. The main relationships in the data warehouse model schema

Table 2.21 The table describes the relationship in the Data Warehouse model

No	Relationship	Relationship Type	Description

1	DimCustomer - FactSales	1 - n	One customer may have one or many transactions in FactSales, each transaction in FactSales belongs to only one customer.
2	DimOrderItem - FactSales	1 - n	One order item may have one or many records in FactSales, each record in FactSales belongs to only one order item.
3	DimOrders - FactSales	1 - n	One order may have one or many transactions in FactSales, each transaction in FactSales belongs to only one order.
4	DimPayments - FactSales	1 - n	One payment method may have one or many transactions in FactSales, each transaction in FactSales belongs to only one payment method.
5	DimProducts - FactSales	1 - n	One product may have one or many records in FactSales, each record in FactSales belongs to only one product.

6	DimReviews - FactSales	1 - n	One review may be associated with one or many transactions in FactSales, each transaction in FactSales belongs to only one review.
7	DimSellers - FactSales	1 - n	One seller may have one or many sales records in FactSales, each sales record in FactSales belongs to only one seller.

2.8.3.2. *ETL Process*

After defining the data warehouse model, the next step is to use the SSIS (SQL Server Integration Services) tool to convert the data from the original source to the Data Warehouse.

2.8.3.2.1. *Dimension Table's ETL Process*

Utilize Slowly Changing Dimension Type 2 (SCD2) for integrating data into Dimension tables to effectively track and manage historical changes in Dimension properties. By preserving the complete history of values, we can analyze data trends and make informed business decisions based on the historical context of the data.

The following will illustrate the data integration for the Dimension table:

- *Step 1:* Define a data source for the Dimensions table, primarily using the Wide World Importers sample database.

- *Step 2:* Convert the source data attributes into columns for the Dimensions table, ensuring that data types, lengths, and formats are consistent between the source and the target.
- *Step 3:* Set up a Dimension table in the target database or data warehouse with the appropriate columns and data types. Add extra columns to the Dimension table for tracking historical changes, such as “FromDate”, “ToDate”, and the surrogate key for the previous version of the record.
- *Step 4:* Load the transformed data into the Dimensions table, ensuring to handle SCD2 changes properly.
- *Step 5:* Verify that the data in the Dimensions table is accurate, complete, and consistent with the source data.

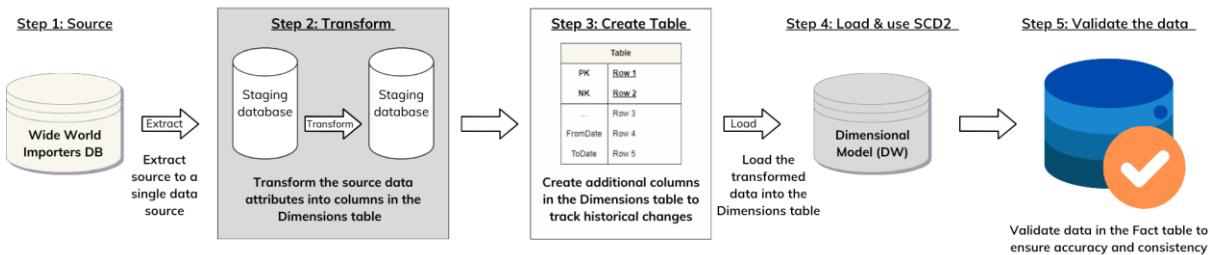


Figure 2.27. Dimension Table's ETL Process

(Source: Authors' source)

2.8.2.2.2. Fact Table's ETL Process

The process for integrating data into the Fact table involves identifying the source data, transforming it to meet the required format, and updating existing records in the Fact table condition. This ensures the data's accuracy and performance are maintained over time.

The following will illustrate the data integration for the Fact table:

- *Step 1:* Identify the data source for the Fact table, which is drawn from the Wide World Importers sample database, and outline the Dimension tables.
- *Step 2:* Merge join data from source data into a single data source by performing a merge join. Prior to this, ensure that the data is sorted uniformly across the two input sources. Transform the source data attributes to align with the columns of the Fact table, ensuring that data types, lengths, and formats are consistent between the source and the destination.
- *Step 3:* Set up a Fact table in the target database or data warehouse, ensuring it includes the necessary columns and data types. Add an additional column, ModifiedDate, RunAs, to track changes in the data.
- *Step 4:* Load the converted data into the Fact table. This may involve updating existing records in the Dimensions table based on previously defined business rules.
- *Step 5:* Verify the data in the Fact table to confirm its accuracy and consistency with the original source data.

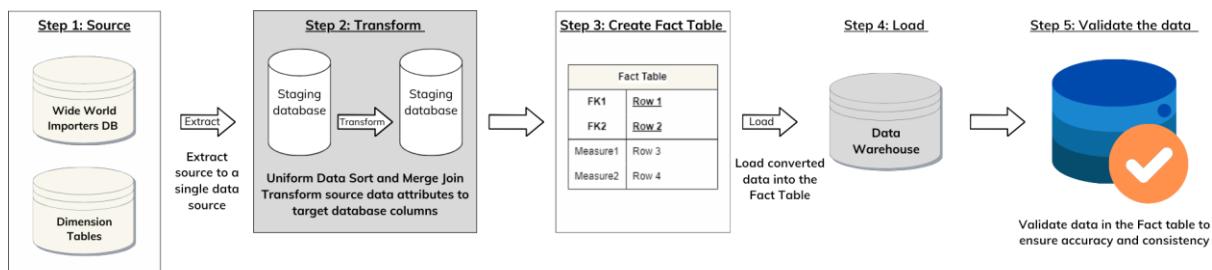


Figure 2.28. Fact Table's ETL Process

(Source: Authors' source)

2.8.3.3. Data analysis with SSAS

To analyze data from Data Warehouse, the project uses SSAS (SQL Server Analysis Service) tool, which is an online analytical processing (OLAP) tool and data mining in Microsoft SQL Server.

The 5 steps to install and analyze data using SSAS technology will be described briefly below:

- *Step 1:* Create a SSAS project (choosing Analysis Service Multidimensional Project).
- *Step 2:* Create Data Source is the data source for building data cube, here is the previously built SQL data warehouse Sale DW.
- *Step 3:* Create a Data Source View, add the tables one by one dimension and facts table contained in the datastore. After successful creation, we will see the same diagram as in Data Warehouse.
- *Step 4:* Create a cube.
- *Step 5:* Linking columns in the Dimension Table.

Next, the project's data dump is depicted in the diagram below:

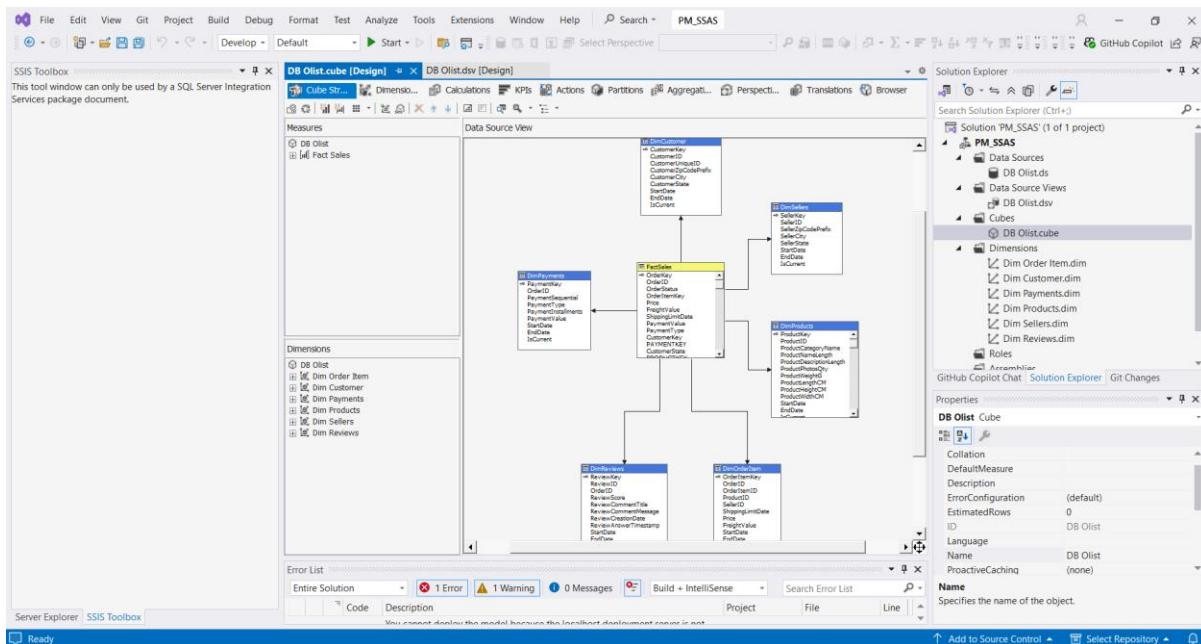


Figure 2.29. Data analysis with SSAS

(Source: Authors' Source)

CHAPTER 3: MONITORING PROGRESS AND QUALITY CONTROL

Chapter Overview

This chapter delves into essential project documentation and management tools that play a crucial role in ensuring project success. It begins with the Change Request Form, highlighting its function in formalizing modifications to project scope while emphasizing strict compliance with change management protocols. Next, it examines the Project Diary, showcasing its role in fostering transparency and enhancing communication among team members. The discussion then shifts to the Risk Log, which focuses on proactive risk management and ongoing monitoring to mitigate potential issues. Additionally, the chapter explores EVA metrics, including BAC, BCWS, BCWP, and ACWP, to evaluate project performance. It also covers key indicators such as CV, SV, CPI, and SPI, shedding light on their significance in project management. Lastly, the chapter addresses Plan Quality Management and TQM, emphasizing the necessity of strong quality assurance processes in achieving project objectives. This comprehensive overview offers valuable insights into the practical application of these tools in driving project success.

3.1. Change request form

Change Request Form is a formal document used in project management to propose modifications, adjustments, or additions to a project's scope, timeline, resources, or other key aspects. It typically outlines the details of the requested change, including its purpose, potential impact on the project, proposed solutions, and required approvals. This form serves as an essential tool for documenting and tracking changes throughout the project lifecycle, ensuring transparency, accountability, and effective change management. Below is an example of a Change Request Form used in our project.

Table 3.1. Change Request Form (1) – Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules

Transition from manual data extraction to API-Based Real-Time Integration	
Date:	16/02/2025
Change No:	01
Description:	<p>Modification in data integration strategy for the BI system. Initially, data from different sources (POS, CRM, inventory) was planned to be extracted and loaded using manual data entry and batch processing. This change request proposes a shift to real-time API-based data integration, ensuring faster updates, increased accuracy, and better system efficiency.</p>
Reason:	<ol style="list-style-type: none"> Optimized data accuracy & efficiency: Manual data extraction may result in delays and inconsistencies, whereas real-time API integration synchronizes data instantly, reducing errors. Cost efficiency & Long-term scalability: <ul style="list-style-type: none"> While initial setup requires API development, it reduces long-term operational workload compared to maintaining batch processing. The system will be easier to scale as more data sources and modules are added in future phases. Better integration with existing IT infrastructure: <ul style="list-style-type: none"> Golden Gate is already using cloud-based CRM and POS systems, making API integration a natural extension for smoother operations.

	<ul style="list-style-type: none"> - Ensures faster reporting for sales and marketing teams, enabling better decision-making.
Scope Impact:	No changes to scope – The BI system was designed to collect data from various sources; this change only modifies the data collection method (from manual/batch processing to API-based integration).
Timelines Impact:	Minor impact on the development phase (+1 week) for API configuration and testing. However, this is within the project's contingency buffer, meaning the overall go-live date remains unchanged.
Budget Impact:	<ol style="list-style-type: none"> 1. No additional costs - The switch to API integration will be implemented using existing BI tools and infrastructure, avoiding new software expenses. 2. Cost-saving advantage: Reduces the need for long-term manual data processing and maintenance, making the system more efficient in the long run.
Other Impact:	<ol style="list-style-type: none"> 1. Enhanced real-time analytics: Faster and more accurate reporting for sales and marketing teams. 2. Lower manual workload: Less reliance on manual data imports, freeing up team resources for strategic analysis. 3. Improved security & compliance: API-based integration provides better data control and reduces the risk of human errors.

Change Requested By:	Nguyen Huynh Kim Suong – Product Developer
Approver:	Assoc. Prof. Ho Trung Thanh, Ph.D – Project Sponsor Approval Date: 18/02/2025

Table 3.2. Change Request Form (2) – Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules

<i>Upgrade to a Cloud-Based Data Warehouse for Enhanced BI Performance</i>	
Date:	05/03/2025
Change No:	02
Description:	This change request proposes migrating the Business Intelligence (BI) system from on-premise servers to a Cloud-Based Data Warehouse (Cloud DWH) to improve data processing speed, expand storage capacity, and enhance query performance. This upgrade aims to enable faster big data processing and support more advanced analytics.
Reason:	<ol style="list-style-type: none"> 1. Higher performance & scalability: The current BI system faces limitations in processing power as data volume increases. Cloud DWH provides automatic scaling to meet business demands. 2. Faster query execution & reporting: The current system takes a long time to execute complex queries. Cloud DWH significantly reduces query response time.

	3. Better integration with modern BI tools: Many advanced analytics tools work more efficiently with cloud infrastructure, optimizing data analysis and reporting capabilities.
Scope Impact:	Significant scope change – Migrating to Cloud DWH not only alters data storage methods but also requires updates to data processing workflows and integration with existing BI tools.
Timelines Impact:	Estimated 2-3 additional months for setup, data migration, testing, and system optimization.
Budget Impact:	<p>Current On-Premise BI System Cost:</p> <ul style="list-style-type: none"> • Fixed Setup Costs: \$187,600 • Annual Operational Cost: \$32,000 (including maintenance, power, internet, and software updates) <p>Cloud-Based Data Warehouse (AWS) Cost Estimate:</p> <ul style="list-style-type: none"> • Setup Costs: \$50,000 (initial migration, cloud infrastructure setup, security configuration) • Monthly Cost: \$8,000 - \$12,000 (compute instances, storage, BI analytics tools, data transfer fees) • Annual Cost Estimate: \$96,000 - \$144,000 <p>Key Budget Impacts:</p> <ol style="list-style-type: none"> 1. Higher recurring costs – Cloud DWH increases operational expenses significantly, with estimated annual

	<p>costs ranging from \$96,000 - \$144,000, compared to the current on-premise system's \$32,000/year.</p> <ol style="list-style-type: none"> 2. Data migration expenses – The transition requires specialized technical resources, increasing consulting and labor costs. 3. Not feasible within the current budget – The additional \$64,000 - \$112,000 per year for cloud operations exceeds the allocated budget, potentially affecting other critical initiatives.
Other Impact:	<ol style="list-style-type: none"> 1. Improved system performance - If implemented, the BI system would run faster and handle large-scale data analysis more efficiently. 2. Increased operational costs - Cloud infrastructure requires ongoing monthly fees, adding financial pressure in the long term. 3. Security and compliance risks - Migrating data to the cloud requires additional security measures to ensure compliance with data protection regulations.
Change Requested By:	Tran Thi Thuy Loi – Data Analyst and Engineer
Approver:	Assoc. Prof. Ho Trung Thanh, Ph.D – Project Sponsor Approval Date: 07/03/2025

After careful evaluation, the proposed migration to a **Cloud-Based Data Warehouse (Cloud DWH)** has been deemed not feasible due to its significant cost impact and budget constraints. While the upgrade offers clear benefits in terms of performance, scalability, and efficiency, the high initial investment and ongoing operational expenses exceed the allocated budget for this project phase.

Additionally, the longer implementation timeline (2-3 months) could delay other critical project milestones. The transition also introduces potential security and compliance risks, requiring additional safeguards and audits, further increasing costs.

Given these financial and operational challenges, the project team has decided **not to approve** this change request at this time. Alternative solutions, such as optimizing the current on-premise infrastructure or gradual cloud adoption, may be considered in future project phases when budget conditions allow.

3.2. Project diary

The **Project Diary** serves as a comprehensive record of all daily activities, decisions, and progress related to a project. It should be written in a clear and detailed manner, ensuring that it accurately reflects the project's status on any given calendar day. This diary acts as a valuable reference for stakeholders, team members, or anyone reviewing the project in the future, even years later. By maintaining a well-documented and structured diary, project continuity is enhanced, facilitating accountability, transparency, and informed decision-making throughout the project's lifecycle.

Table 3.3. Project Diary – Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules

No	Action	Owner	Due Date
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1	Conduct project kickoff meetings with stakeholders, define scope, objectives, and expected outcomes. Finalize the project team and assign responsibilities.	Project Manager	03/01/2025
2	Perform business landscape research on Golden Gate's market, analyze competitors, and document key challenges in the restaurant industry.	Business Analyst	05/01/2025
3	Estimate project costs, identify resource requirements, and finalize the project budget. Develop and approve the project charter. Send the Initiation Phase report progress to the Project Sponsor.	Project Manager	16/01/2025
4	Conduct stakeholder interviews to gather business requirements, identify key performance metrics, and document technical needs for BI implementation.	Business Analyst	16/01/2025
5	Document and finalize business and technical requirements. Review and obtain approvals from stakeholders before moving forward. Send the report progress to the Project Sponsor.	Business Analyst	19/01/2025
6	Collect raw sales and marketing data, perform data cleaning, and prepare structured datasets for modeling.	Data Analyst & Engineer	20/01/2025

7	Develop logical data models, define schema relationships, and ensure alignment with business needs. Validate data accuracy and consistency.	Data Analyst & Engineer	27/01/2025
8	Implement and test ETL (Extract, Transform, Load) processes to automate data integration and ensure seamless data flow from multiple sources.	Data Analyst & Engineer	30/01/2025
9	Develop the Sales Module, including dashboards for sales trends, product performance, and regional sales analysis. Conduct initial testing. Send the report progress to the Project Sponsor.	Product Developer	11/02/2025
10	Transition from manual data extraction to API-Based Real-Time Integration.	Product Developer	16/02/2025
11	Develop the Marketing Module, including customer segmentation analysis, campaign performance tracking, and predictive analytics. Send the report progress to the Project Sponsor.	Product Developer	17/02/2025
12	Conduct unit testing and system integration testing to validate data accuracy, BI tool performance, and dashboard functionality.	QA/QC	17/02/2025
13	Approval change from Project	Project Sponsor	18/02/2025

	Sponsor		
14	Organize User Acceptance Testing (UAT) with marketing and sales teams to gather feedback, ensure usability, and address potential system gaps.	QA/QC & Business Analyst	21/02/2025
15	Deploy the BI system to the production environment and ensure all necessary configurations are in place.	Project Manager	25/02/2025
16	Conduct user training sessions on dashboard usage, report generation, and system functionalities. Provide documentation and guidelines.	Business Analyst	27/02/2025
17	Perform a post-implementation review, collect feedback from stakeholders, and identify areas for future improvement.	Entire Project Team	28/02/2025
18	Finalize and submit the BI solution report, including key insights, data visualizations, lessons learned and recommendations for future BI development.	Entire Project Team	03/03/2025

3.3. Risk log

A risk log is an essential document that helps identify and manage potential risks that could impact a project's progress and outcome. Although it is commonly used during project execution, it should be created as early as the planning phase. Identifying risks early allows the project team to prepare appropriate responses and minimize negative impacts.

The risk log is the first step in risk management and plays a crucial role in any risk management framework. With a well-maintained risk log, the entire project team can proactively monitor and address risks, ensuring smooth execution and successful project completion. It helps the project team to:

- List potential risks
- Assess their impact and prioritize them
- Develop risk mitigation strategies
- Assign ownership of each risk

Table 3.4. Risk log of the project

No.	Risk	Description	Severity	Probability of Occurrence	Controls or Mitigation Strategy	Owner
1	Changing customer requirements	Delays due to constant changes in requirements.	2	4	1. Require the customer to clearly define the requirements up front with an SRS (Software Requirement Specification) document. 2. Limit the number of free changes, then charge for additional changes.	Que Anh
2	BI system mismatch	BI reports and insights may not align with business needs, affecting decision-making.	5	3	1. Conduct thorough research before implementation to ensure BI meets actual needs. 2. Continuously gather feedback from departments to adjust the system accordingly. 3. Run pilot tests before full deployment.	Que Anh
3	Extra requirement costs	Unexpected costs may cause budget overruns, delaying implementation.	2	4	1. Define the project scope from the start and sign a tight contract. 2. Budget for contingencies (~10-20% of total budget).	Tuong Vy
4	Data format inconsistency	Inaccurate data input may result in unreliable BI reports.	4	4	1. Standardize data input and processing workflows across different systems. 2. Use ETL tools for automated data	Thuy Loi

					conversion. 3. Establish common data standards across integrated systems.	
5	Human data errors	Data errors may lead to incorrect analysis and decision-making.	3	4	1. Use Data Validation Checks to alert you when data is formatted incorrectly. 2. Automate data entry with API integration.	Thanh Van
6	Poor task prioritization	Mismanagement of tasks may slow down the project timeline.	4	3	1. Use project management frameworks like Kanban or Scrum to prioritize tasks. 2. Develop a task prioritization matrix based on impact and urgency. 3. Regularly review progress and adjust priorities as needed.	Tuong Vy
7	Deployment technical errors	System malfunctions may hinder operational efficiency.	5	3	1. Run tests on a staging environment before deploying to the real world. 2. Create a rollback plan to have a backup plan in case of errors.	Kim Suong
8	Limited resources	Lack of resources may prolong project delivery.	5	3	1. Plan detailed resource allocation and distribute workload efficiently. 2. Leverage automation tools to reduce labor demands. 3. Propose a contingency budget to handle financial constraints.	Tuong Vy

9	Employee resistance	Employee hesitation in using the system may slow down adoption.	3	4	<p>1. Explain the benefits of the BI system by demonstrating performance & efficiency.</p> <p>2. Organize training & support sessions to help employees get familiar with the new system.</p>	Que Anh
10	Inadequate training	Untrained staff may struggle with system functionality, reducing efficiency.	5	2	<p>1. Develop comprehensive training materials and conduct regular training sessions.</p> <p>2. Provide online learning modules or 24/7 support for easy access.</p> <p>3. Assess employees' learning progress and adjust training programs accordingly.</p>	Thanh Van

3.4. Earned value analysis

Effective project management requires continuous monitoring of progress to ensure that budget and schedule expectations are met. One of the most widely used techniques for tracking project performance is **Earned Value Analysis (EVA)**. EVA integrates key project management components—scope, time, and cost—to assess whether a project is on track. By comparing planned budgets with actual expenditures and completed work, project managers can identify deviations early and take corrective actions to improve efficiency. This section provides an overview of the key terms and formulas associated with EVA to enhance understanding and application in real-world project management.

3.4.1. *Related terms and formulas*

Earned Value Analysis (EVA) is a very powerful cost-control method that helps project teams assess whether a project is likely to meet its budget and timeline objectives. By analyzing planned expenditures against actual costs and work completed, EVA provides a comprehensive view of project performance. Given a predefined cost baseline, the project team can track progress by inputting actual figures and comparing them with the original plan.

To implement EVA effectively, the project is typically divided into specific time periods based on activities or summary components from the **Work Breakdown Structure (WBS)**. For each activity, key financial metrics are calculated, including:

Planned value (PV): Also known as the Budgeted Cost of Work Scheduled (BCWS), Planned Value represents the budgeted amount for the work that was scheduled to be completed by a specific time. Because it is derived from the project's approved budget, this figure is predetermined and serves as a baseline against which actual progress is measured.

Earned value (EV): Known alternatively as the Budgeted Cost of Work Performed (BCWP), Earned Value is the monetary value of the work that has actually been completed at a given point in time. It is computed by multiplying the Planned Value by the percentage of work completed:

$$EV = PV \times \text{Percentage of Work Completed}$$

Actual cost (AC): Referred to as the Actual Cost of Work Performed (ACWP), this value reflects the actual expenditures incurred for the work completed during a specific period. Unlike PV and EV, Actual Cost is not calculated but recorded from financial documents such as invoices and receipts. This figure is essential for comparing what was planned versus what was truly spent.

Cost variance (CV): is the difference between the earned value (EV) and the actual cost (AC), It is calculated using the formula:

$$CV = EV - AC$$

Cost variance is thus a monetary indicator of whether the project has cost more than it should have up to a particular point in time. If EV is greater than the AC, this means the organization has “earned” more value on the project than it has actually cost, and thus the project is currently coming in under budget. If EV is less than AC, the project is costing more than it should.

Schedule variance (SV): is the difference between the scheduled completion of the activity and the actual completion. Schedule Variance provides insight into the timing of project work by comparing the Earned Value with the Planned Value:

$$SV = EV - PV$$

Schedule variance is thus a monetary indicator of whether the project is on time. A positive SV indicates that more work has been completed than planned at that point in time, suggesting the project is ahead of schedule. A negative SV, on the other hand, signals delays in project progress.

Cost performance index (CPI): is the ratio of EV to AC , evaluating the cost efficiency of the project:

$$CPI = \frac{EV}{AC} \times 100$$

Similar to cost variance, CPI looks at EV and AC—but this time as a ratio—to calculate how efficiently the project is being accomplished from a cost standpoint. A CPI of 100% implies that the project is perfectly aligned with its budget. A value below 100% reveals that the project is overspending, while a CPI above 100% indicates cost efficiency, meaning that less money is being spent than planned for the work performed.

Schedule performance index (SPI): Similarly, the Schedule Performance Index assesses the efficiency with which the project adheres to its timeline:

$$SPI = \frac{EV}{PV} \times 100$$

Much like schedule variance, the Schedule Performance Index (SPI) uses the ratio of EV to PV to assess how efficiently the project adheres to its timeline. An SPI of 100% indicates that the project is progressing exactly as planned. If the SPI is below 100% (for example, 80%), it suggests that the project or activity is 20% behind schedule. Conversely, an SPI above 100% signifies that the project is ahead of schedule.

Earned Value Analysis (EVA) goes beyond merely tracking present performance—it also serves as a powerful tool for trend analysis and forecasting. By evaluating historical performance data, managers can gauge whether corrective measures are urgently needed to realign schedules and budgets. In this way, EVA offers insights not only into the current state of the project but also into potential future outcomes if current trends persist.

One of the key forecasting components of EVA involves estimating the final project costs through two critical metrics: **Estimate at Completion (EAC)** and **Estimate to Complete (ETC)**. EAC provides an overall forecast of what the project will ultimately cost, assuming that future work will mirror the performance observed so far. Conversely, ETC calculates the additional funds required to finish the remaining work. Together, these estimates enable managers to understand the financial trajectory of the project, especially when no adjustments are made to the existing performance trends.

To determine the EAC, the **Budget at Completion (BAC)**—which is the total budget allocated for the project—is essential. The calculation is straightforward: divide the BAC by the current Cost Performance Index (CPI), expressed by the formula

$$EAC = \frac{BAC}{CPI}$$

For instance, if a project has a BAC of US\$100,000 and a CPI of 0.80, the EAC would be US\$125,000, signaling that the project is expected to exceed its initial budget. This method, while common, might be adjusted with alternative formulas based on specific project circumstances.

Once the EAC is calculated, determining the ETC is equally simple—subtract the Actual Cost (AC) incurred to date from the EAC. This gives a clear picture of the funds needed to

complete the project. Additionally, by comparing the BAC with the EAC, managers can calculate the **Variance at Completion (VAC)** using the formula

$$VAC=BAC-EAC$$

This figure indicates whether the project is likely to finish under or over budget, providing an early warning sign for potential financial shortfalls or surpluses.

By leveraging these forecasting techniques, project managers can make informed decisions on whether to implement corrective actions. The insights gained from EAC, ETC, and VAC allow for a proactive approach to managing project finances, ensuring that deviations are addressed promptly to keep the project aligned with its original objectives.

3.4.2. Project Level EVM

The team determines the cost estimates for each key activity by leveraging their expertise and insights from past projects, using major deliverables as a reference. The total Budget at Completion (BAC) is obtained by aggregating these individual cost estimates. In Chapter 1's Break-Even analysis, both fixed and variable costs are assessed, amounting to a total of \$187,600. Consequently, the BAC is also set at \$187,600. To maintain effective cost control, Earned Value Management (EVM) will be reviewed on a weekly basis over the course of nine weeks.

Project Overall Budget	2025									Plan	% Completed	EV
Category	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9			
Software and Licensing	\$ 100,000									\$ 100,000	100%	\$ 100,000
Consulting Services	\$ 2,000	\$ 2,000								\$ 4,000	100%	\$ 4,000
Cloud Infrastructure (AWS)	\$ 5,000									\$ 5,000	100%	\$ 5,000
Networking Equipment (Firewalls, Switches, Routers)	\$ 11,200									\$ 11,200	100%	\$ 11,200
Evaluate and collect requirements			\$ 1,100							\$ 1,100	100%	\$ 1,100
Analyze Data				\$ 2,500	\$ 2,500					\$ 5,000	100%	\$ 5,000
Data Integration/ETL (Data Consolidation & Transformation)					\$ 12,250	\$ 12,250				\$ 24,500	100%	\$ 24,500
Visualization						\$ 2,500	\$ 2,500			\$ 7,500	100%	\$ 7,500
Implementation						\$ 5,000	\$ 5,000			\$ 15,000	100%	\$ 15,000
Testing							\$ 6,000			\$ 6,000	100%	\$ 6,000
User Training								\$ 2,250	\$ 2,250	\$ 4,500	100%	\$ 4,500
Maintenance and Support									\$ 1,400	\$ 1,400	100%	\$ 1,400
Salary (Labor)	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 300	\$ 2,400	100%	\$ 2,400
Weekly PV	\$ 118,500	\$ 2,300	\$ 1,400	\$ 2,800	\$ 15,050	\$ 20,050	\$ 7,800	\$ 16,050	\$ 3,650	\$ 187,600	100%	\$ 187,600
PV or cumulative plan	\$ 118,500	\$ 120,800	\$ 122,200	\$ 125,000	\$ 140,050	\$ 160,100	\$ 167,900	\$ 183,950	\$ 187,600			
Weekly AC	\$ 120,950	\$ 1,400	\$ 5,300	\$ 24,725	\$ 3,925	\$ 4,000	\$ 6,075	\$ 5,975	\$ 15,250			
AC or cumulative actual	\$ 120,950	\$ 122,350	\$ 127,650	\$ 152,375	\$ 156,300	\$ 160,300	\$ 166,375	\$ 172,350	\$ 187,600			
Weekly EV	\$ 118,500	\$ 2,300	\$ 1,400	\$ 2,800	\$ 15,050	\$ 20,050	\$ 7,800	\$ 16,050	\$ 3,650			
EV or cumulative actual	\$ 118,500	\$ 120,800	\$ 122,200	\$ 125,000	\$ 140,050	\$ 160,100	\$ 167,900	\$ 183,950	\$ 187,600			
CV = EV - AC	\$ (2,450)	\$ (1,550)	\$ (5,450)	\$ (27,375)	\$ (16,250)	\$ (200)	\$ 1,525	\$ 11,600	\$ -			
SV = EV - PV	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -			
CPI = EV/AC	97.97%	98.73%	95.73%	82.03%	89.60%	99.88%	100.92%	106.73%	100%			
SVI = EV/PV	100%	100%	100%	100%	100%	100%	100%	100%	100%			

Figure 3.1. Identification of Project's Earned Value Management (EVM)

(Source: Authors' source)

The project will first identify the total budget for key components within the cost structure in order to determine and analyze the earned value. Next, it will assess performance work to determine the completion rate. Following this, essential metrics such as PV, AC, EV, CPI, and SVI will be calculated to facilitate effective earned value management.

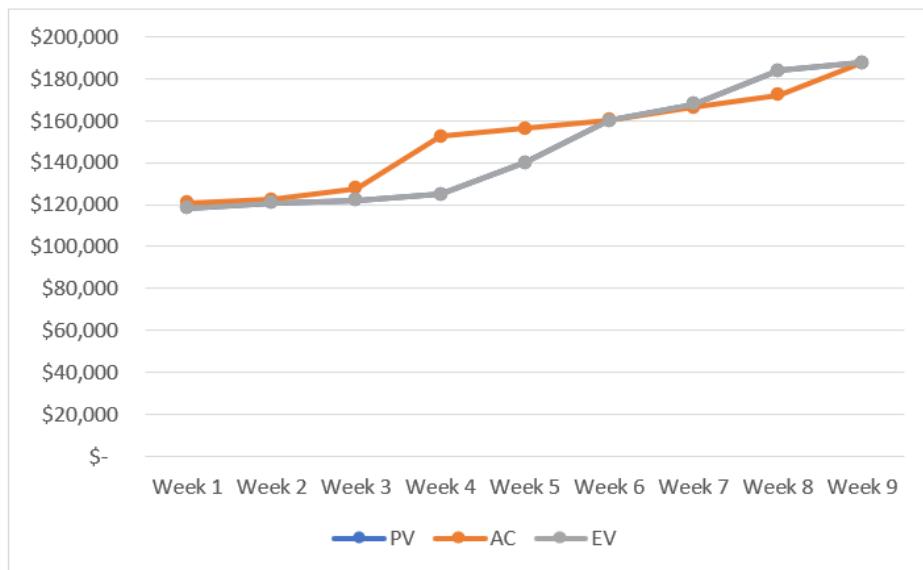


Figure 3.2. Visualization of earned value analysis

(Source: Authors' source)

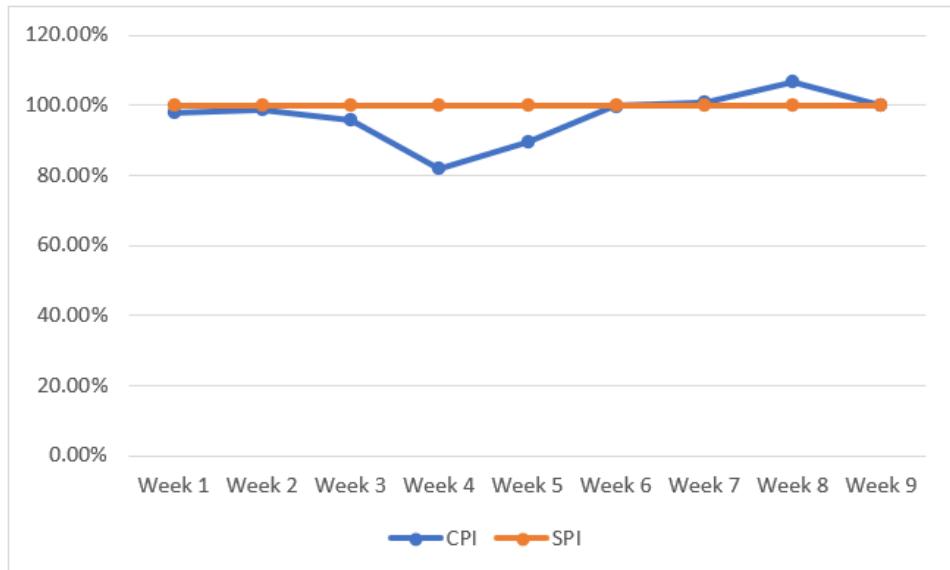


Figure 3.3. Performance index

(Source: Authors' source)

The analysis results indicate that the project initially faced cost overruns, as Actual Cost (AC) exceeded Planned Value (PV) in the early weeks, reflecting higher-than-expected expenses. However, cost management measures helped stabilize AC, aligning it more closely with PV and Earned Value (EV) over time. Although EV remained slightly below PV, indicating minor schedule delays, the variance was not significant. Meanwhile, the Cost Performance Index (CPI) fluctuated, dropping around Week 4 before gradually improving and surpassing 100% near Week 8, suggesting an initial phase of inefficiency that was later corrected. In contrast, the Schedule Performance Index (SPI) remained consistently at 100%, showing that the project adhered to its planned timeline. Despite early cost inefficiencies, the project maintained stable progress, ensuring nearly full completion. These insights underscore the importance of accurate cost estimation, proactive budget adjustments, and continuous performance monitoring to balance financial efficiency and timely execution.

3.5. Plan Quality management

3.5.1. *TQM (Total Quality Management)*

Total Quality Management (TQM) is a systematic approach to quality management. It is a comprehensive management method aimed at improving the quality of products and services within an organization. TQM emphasizes continuous improvement by encouraging the involvement of all employees, from management to operational staff. This approach focuses on ensuring the highest quality from product development, production, to distribution. To achieve this, TQM applies various tools and techniques such as quality control, employee training, process management, and gathering customer feedback for continuous improvement.

Additionally, TQM describes the culture, organization, and mindset of the business aimed at delivering products and services that meet customer needs. Implementing TQM requires quality in every aspect of business operations, ensuring that processes are performed correctly from the start, to minimize errors and waste. TQM is not just a management system but also a philosophy that requires the commitment of the entire organization to continuous improvement to enhance quality and efficiency. Project management follows processes including: Plan Quality Management, Manage Quality, and Control Quality.

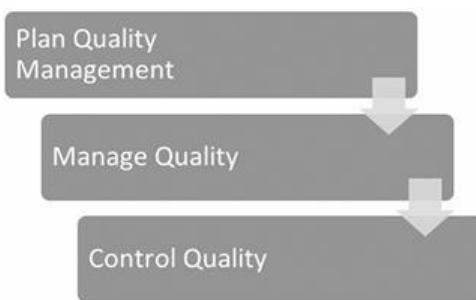


Figure 3.4. Project Quality Management processes

(Source: *Information Systems Project Management*)

- **Planning Quality Management**

Planning Quality Management (Plan Quality Management) is the process of identifying relevant quality standards and developing a plan to ensure the project meets those standards. Quality planning is often done simultaneously with other planning activities in a project, as factors like scheduling and resource allocation also have quality aspects.

3.5.2. *EFQM Model*

EFQM (European Foundation for Quality Management) model is a comprehensive quality management model developed by the European Foundation for Quality Management. This model provides a framework for organizations to self-assess and improve their processes, products, services, and overall performance. EFQM focuses on achieving excellence through continuous improvement and meeting stakeholder needs.

The model includes two main elements: criteria and the RADAR assessment model.

The criteria in the EFQM model are divided into two main groups: Enablers and Results. The Enablers group consists of key factors that help the organization achieve excellent results. These include leadership, strategy, people, processes, systems, and innovation. Leadership plays a critical role in guiding the organization and building a quality culture. Strategy is clearly defined and aligned with the organization's long-term goals. People are a crucial asset, and a positive working environment needs to be created and nurtured. Processes and systems supporting the organization's activities must be optimized for maximum efficiency, and innovation is essential for sustaining growth.

The Results group encompasses the outcomes the organization achieves by applying the Enablers. These results are divided into categories: customer results, people results, societal results, and financial results. Customer results measure customer satisfaction and the ability to meet their needs. People results assess employee satisfaction and productivity

within the organization. Societal results focus on the organization's impact on the community and the environment, while financial results reflect the financial effectiveness, such as profitability and the sustainable development of the organization.

Additionally, the RADAR model is a tool to help organizations assess the level of achievement of the criteria. It includes four main components: Results, Approach, Deployment, and Assessment and Refinement. Results refer to the goals the organization aims to achieve. Approach refers to the methods and strategies used to achieve these goals. Deployment is the implementation of these strategies in practice, and Assessment and Refinement is the process of checking, monitoring, and improving processes to optimize performance.

The EFQM model provides a comprehensive framework that helps organizations continuously assess and improve from leadership to financial outcomes, aiming to achieve excellence in all areas of operation.

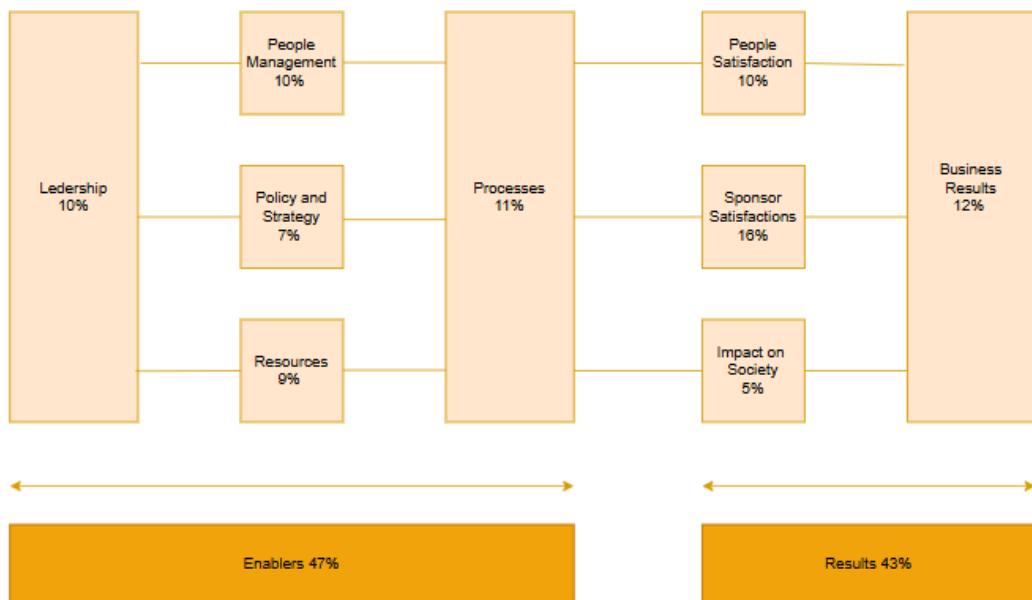


Figure 3.5. EFQM Model for project management

(Source: Authors' source)

- **Manage Quality**

The Manage Quality process includes all activities and efforts necessary to ensure that the project meets the quality standards defined in the quality management plan. This is a continuous process focused on controlling and improving processes within the project, to ensure that the final outcome aligns with stakeholder expectations. The process uses information from the Control Quality process to enhance process efficiency and product design, thereby ensuring overall project quality.

Activities in this process include quality audits, process analysis, and applying Design for X (DfX) to optimize processes and improve product design. Inputs to the Manage Quality process include the quality management plan, quality metrics, quality control measures, and lessons learned from previous projects. The outputs of this process include quality reports, testing documents, and change requests, which may affect elements such as project scope, cost, and schedule.

- **Control Quality**

The Control Quality process monitors the results to ensure that the project's quality standards are met. This process is closely linked with the Plan Quality Management and Manage Quality processes, using the outputs from these processes as inputs, while also providing outputs for the Manage Quality process. The main tools used in this process include inspections, product testing, statistical sampling, and surveys to gather feedback on quality from customers and stakeholders. The primary outputs are the deliverables that meet quality standards, along with quality control measurements, which provide valuable information for process improvement and maintaining project quality. Control Quality also

evaluates and monitors changes during project implementation, ensuring that project progress and quality are not compromised.

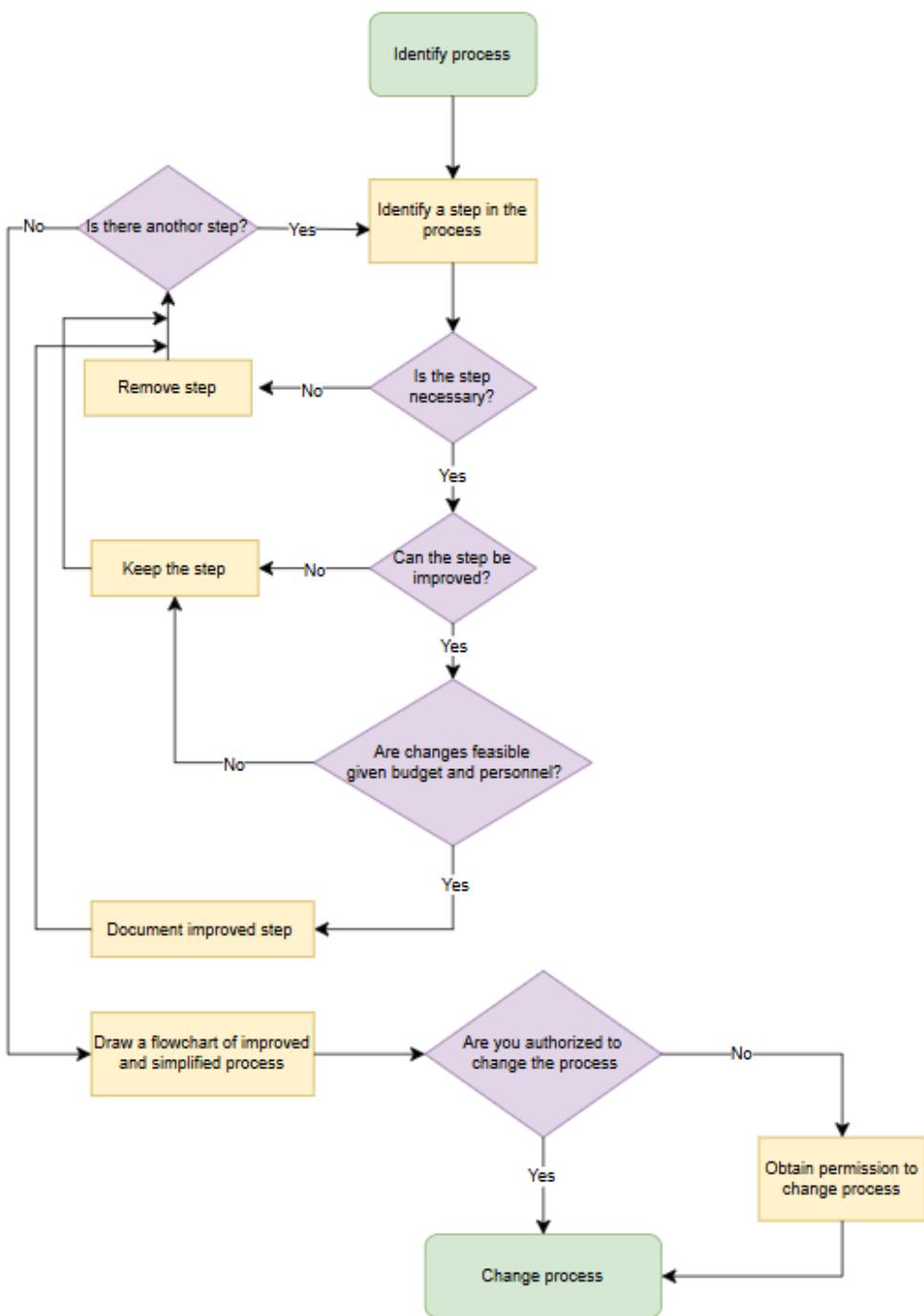


Figure 3.6. Quality control flowchart

(Source: *Information Systems Project Management*)

3.5.3. Cost-benefit analysis

Cost-benefit analysis (CBA) is an evaluation method used to compare the costs and benefits of a project, decision, or alternative approach to determine the best option. The purpose of CBA is to aid decision-making based on financial and economic factors, where the benefits derived from a decision or project are compared with the costs incurred to implement it. By performing a CBA, organizations can assess whether the benefits outweigh the costs, ensuring the optimal use of resources and enabling informed decisions that maximize the potential for success and efficiency.

The formula for calculating EMV (Expected Monetary Value) is an important method in decision analysis, helping to calculate the expected average value based on the probability of occurrence and the financial outcome of each possible scenario. The purpose of EMV is to evaluate the overall financial benefit of a decision in uncertain situations, helping to make the optimal choice.

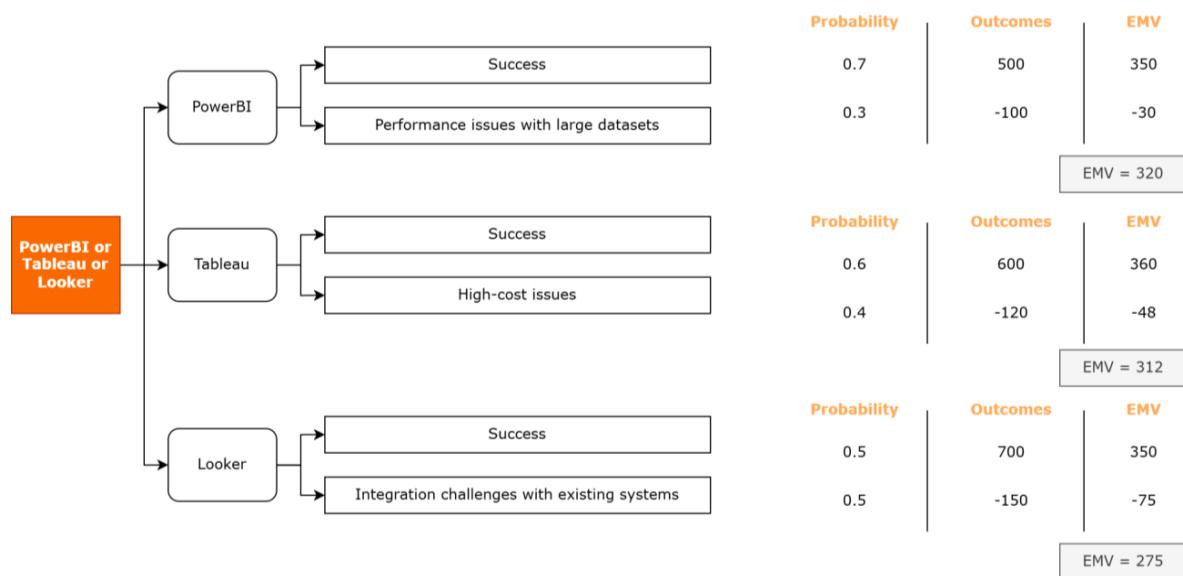


Figure 3.7. Cost-benefit analysis of choosing the visualization platform

(Source: Authors' source)

Power BI has the highest EMV at \$320 and the highest probability of success at 70%. This makes it the best choice because it offers the best balance between potential profit and risk. With its high chance of success and relatively low risk, Power BI is the most efficient and safe option for making decisions.

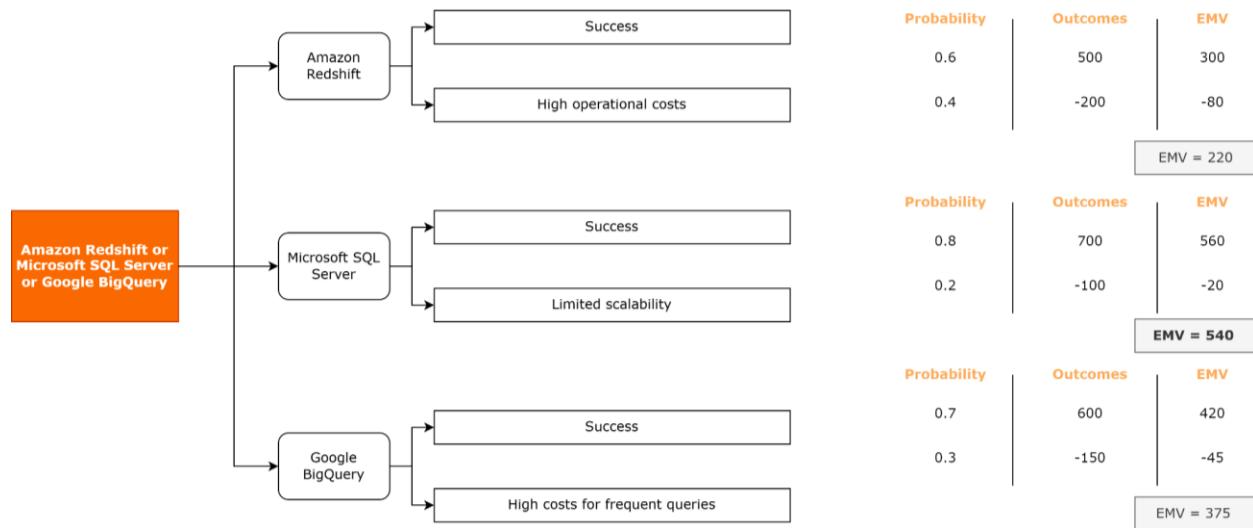


Figure 3.8. Cost-benefit analysis of choosing the data warehouse platform

(Source: Authors' source)

Microsoft SQL Server has the highest EMV at \$540 and the highest success probability at 80%. This shows that it is the best choice because it not only offers the highest expected financial value but also has an excellent success rate. With a combination of high profit potential and low risk, Microsoft SQL Server is the most balanced and risk-efficient option, ensuring long-term and sustainable success for the project.

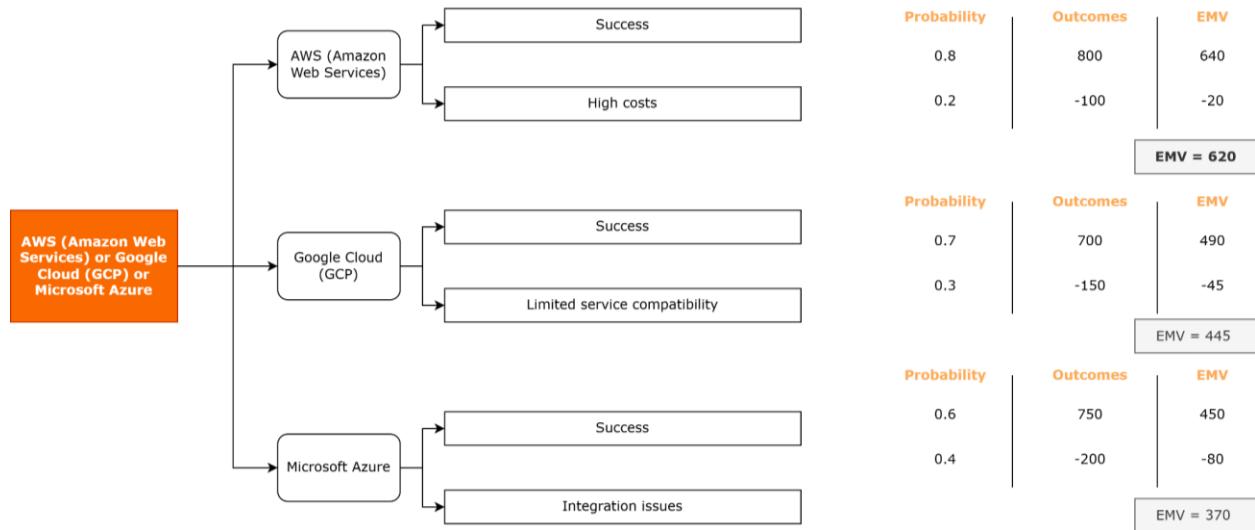


Figure 3.9. Cost-benefit analysis of choosing the cloud infrastructure

(Source: Authors' source)

AWS has the highest EMV at \$620 and the highest success probability at 80%, making it the most reliable and profitable option. With its outstanding expected financial value and high success rate, AWS not only offers the potential for significant profit but also reduces risks. This combination of high profit and reliability makes AWS the preferred choice for long-term projects, providing security and high returns on investment.

3.5.4. Pareto diagrams

A Pareto chart, also known as a frequency chart, is a powerful visual tool used to analyze and prioritize data based on importance. This chart combines columns and a curve, where the columns represent the values of factors in descending order, making it easy to identify the dominant factors. The curve reflects the cumulative percentage of these factors.

The purpose of a Pareto chart is to identify the most important issues that need to be addressed. According to the 80/20 principle, the chart shows that about 80% of the impact on results usually comes from 20% of the causes. To help users easily identify the most critical factors, the chart often includes an 80% cutoff line, indicating the issues that require

the most attention. This allows business managers to create more effective strategies and action plans, focusing on the factors that have the greatest impact.

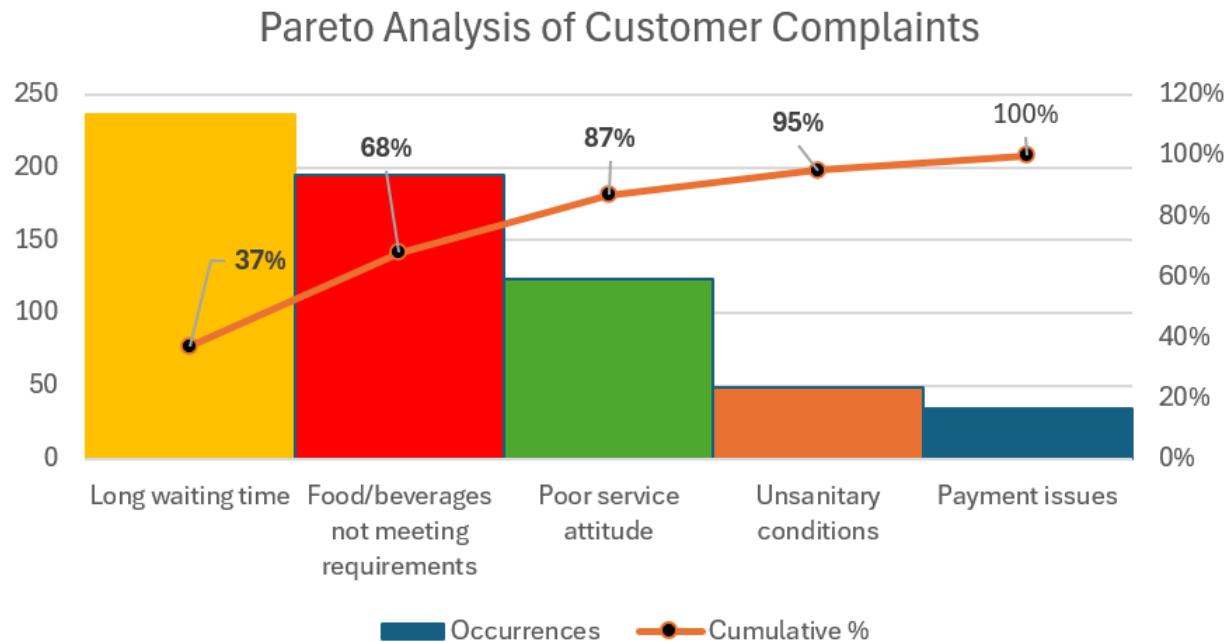


Figure 3.10. Pareto diagrams

(Source: Authors' source)

The Pareto chart analyzing customer complaints shows that the main cause of dissatisfaction is long waiting time (237 occurrences, accounting for 37%), followed by food/beverages not meeting requirements (195 occurrences, bringing the cumulative percentage to 68%). When combined with poor service attitude (123 occurrences, 87%), these three issues make up the majority of complaints, aligning with the Pareto principle (80/20), meaning that addressing them could significantly enhance the customer experience. Meanwhile, issues such as unsanitary conditions (49 occurrences, 95%) and payment issues (34 occurrences, 100%) occur less frequently and are not top priorities. To reduce complaints, businesses should optimize service processes to minimize waiting times, implement stricter food quality control, and improve staff attitudes.

CHAPTER 4: LESSON LEARN AND PROJECT EVALUATION

Chapter overview

Chapter 4 provides a comprehensive evaluation of the project's performance, draws key lessons learned, and reviews the contributions of team members. The Project Performance Analysis section offers an overview through detailed reports on work progress, cost management, resource allocation, sales results, and marketing activities, helping to assess effectiveness and identify factors affecting the final outcome. The Lessons Learned section summarizes strengths and limitations, providing recommendations to improve quality and efficiency in future projects. The Team Member Evaluation section analyzes roles, responsibilities, and individual contributions while suggesting solutions to enhance teamwork and optimize collaboration processes. The Future Development section outlines improvement strategies, applies optimal methods, and proposes solutions to enhance operational quality in upcoming projects.

4.1. Project performance analysis

4.1.1. Work overview report



Figure 4.1. Burndown chart report

(Source: Authors' source)

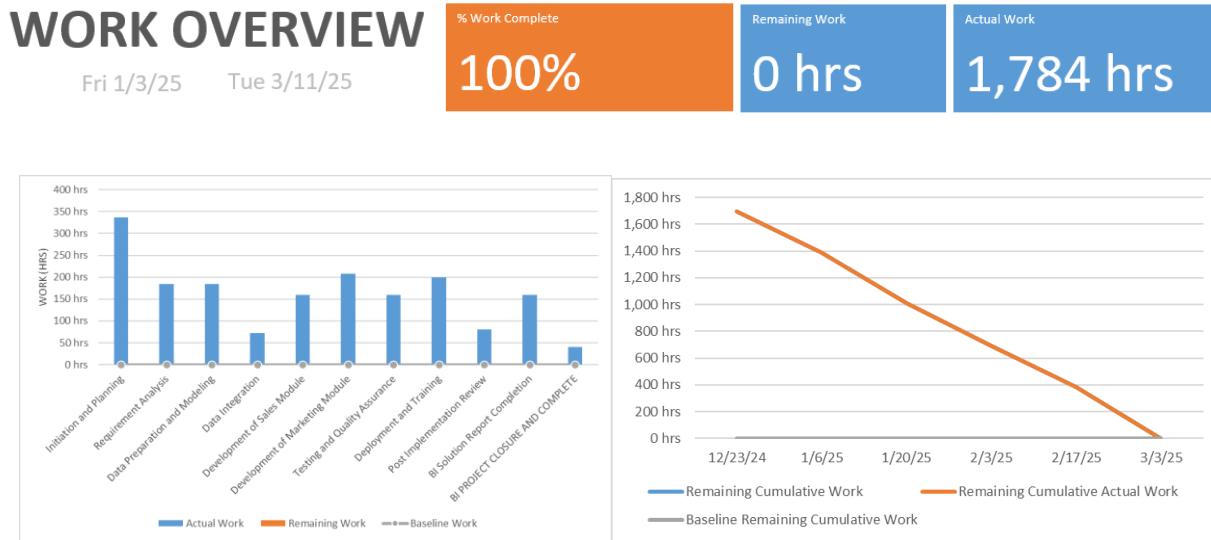


Figure 4.2. Work overview report (1)

(Source: Authors' source)

The **Work Overview Report** provides a comprehensive summary of the progress and completion of the "Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules." The project has been 100% completed with a total of 1,784 work hours logged.

The **Work Overview Chart** illustrates the actual work completed across different project phases. The most time-consuming stages were "Initiation and Planning," "Deployment and Training," and "Development of the Marketing Module," each requiring approximately 250-350 work hours. Since no remaining work is shown, the project has been successfully completed.

The **Burndown Chart** tracks the reduction of remaining work hours over time, from 12/23/24 to 3/3/25. The trend lines indicate that work progressed steadily and closely

followed the planned schedule. There were no significant delays, demonstrating that the project was well-managed and executed on time.

The Work Stats bar graph offers valuable insights into various aspects of the project:

- Actual Work: represents the completed tasks for each week.
- Remaining Work: indicates the workload that still needs to be completed.
- Baseline Work: refers to the originally planned workload.

By analyzing these metrics, it becomes easier to monitor progress and detect any deviations from the initial plan.



Figure 4.3. Work overview report (2)

(Source: Authors' source)

In conclusion, this dashboard offers a holistic overview of work-related data, covering completion rates, total hours worked, resource distribution, and availability. It acts as a crucial tool for informed decision-making, efficient resource management, and performance assessment.

4.1.2. Cost overview report

COST OVERVIEW

FRI 1/3/25 - TUE 3/11/25

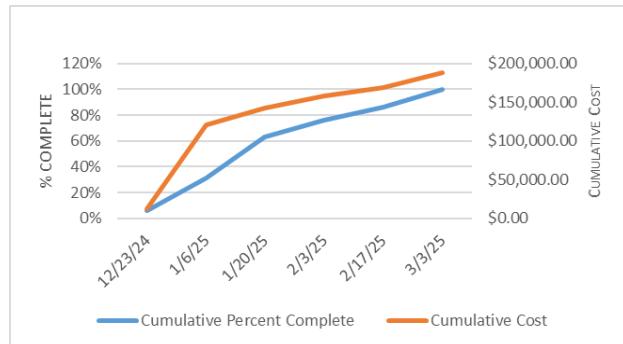


Figure 4.4. Cost overview report (1)

(Source: Authors' source)

The Business Intelligence (BI) system project for the Golden Gate restaurant chain, especially for the Marketing and Sales modules, was completed with positive results. The total cost of the project was \$187,600.00, and there were no additional costs, which shows the effective management of the budget and financial control throughout the project. The project was completed on time and did not exceed the planned budget. The cost and progress charts show excellent control over the project's timeline and expenses. Specifically, the orange line in the chart represents cumulative costs, which steadily increased, while the blue line, representing the percentage of project completion, also increased in sync, from December 2024 to March 2025. This shows that both costs and progress were well-managed, ensuring that the project was finished on time and within the budget.

The project reached 100% completion, meaning the BI system was fully implemented, helping the Golden Gate restaurant chain to have a powerful tool for data analysis and

decision-making in marketing and sales activities. By completing the system on schedule, the project helped optimize business processes, provided insights into consumer trends, and improved marketing strategies and revenue growth. The BI system also offered strong analysis tools, making it easier for managers to make smart and timely decisions. The project's successful completion without exceeding costs and deadlines is a clear example of effective project management, especially for a complex project like implementing a BI system for a large restaurant chain like Golden Gate.



Figure 4.5. Cost overview report (2)

(Source: Authors' source)

The Business Intelligence (BI) system project for the Golden Gate restaurant chain, particularly for the Marketing and Sales modules, was well-managed in terms of cost and financial planning. The cost for the Initiation and Planning phase was \$120,950, which is slightly higher than the initial budget of \$118,500, with a variance of \$2,450. This small increase might have been due to unforeseen factors or necessary adjustments to ensure proper preparation for the following stages.

For the subsequent phases, such as the Development of the Sales Module (actual cost: \$3,925, budgeted: \$15,050, savings of \$11,125), the Development of the Marketing

Module (actual cost: \$4,000, budgeted: \$20,050, savings of \$16,050), and Data Integration (actual cost: \$24,725, budgeted: \$2,800, variance of \$21,925), the costs were largely in line with the planned budget. However, Data Integration showed a significant cost overrun, with actual costs much higher than the estimated amount. On the other hand, other phases were more cost-efficient, such as the Testing and Quality Assurance phase (actual cost: \$6,075, budgeted: \$7,800, savings of \$1,725).

The Deployment and Training phase (actual cost: \$5,975, budgeted: \$16,050, savings of \$10,075) and the BI Solution Report Completion (no actual cost due to completion) were completed without significant cost overruns, reflecting good cost control during the implementation process.

In total, the project was completed within the planned budget of \$187,600, with the actual costs also being \$187,600. This shows that, despite some variances in specific phases, the project was well-managed and completed on time, providing the Golden Gate restaurant chain with an effective and cost-efficient BI system for improving its marketing and sales strategies.

4.1.3. Resource overview report

RESOURCE OVERVIEW

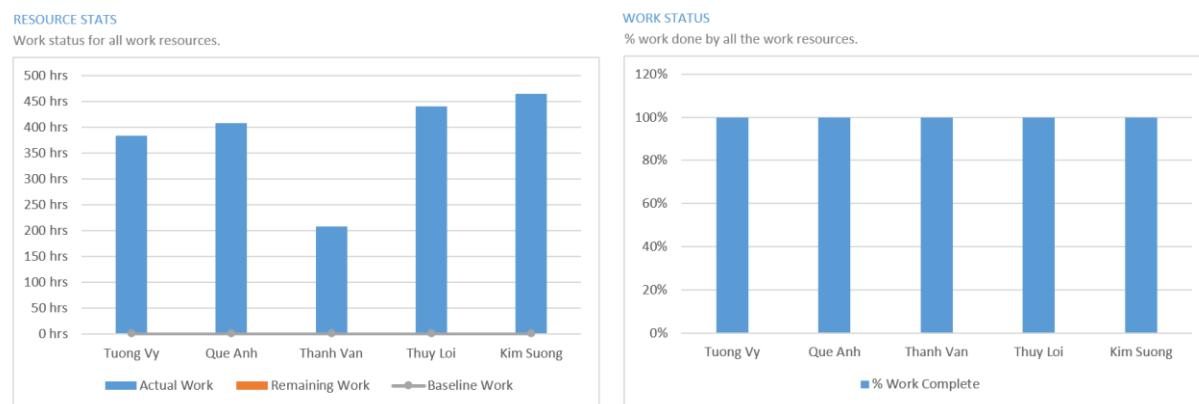


Figure 4.6. Resource Overview Report

(Source: Authors' source)

The **Resource Overview** chart provides an overall view of the work status of project resources, showing that all members have completed 100% of their assigned tasks. However, there is a significant discrepancy in actual work hours among members, particularly Thanh Van, who has significantly fewer total work hours compared to Thuy Loi and Kim Suong. This may indicate that the workload has not been evenly distributed or that the complexity of tasks varies. Additionally, **Baseline Work** remains almost unchanged from the initial plan, indicating that the project has been executed according to the planned schedule. To optimize resource allocation in future phases, the project team may need to review task distribution to ensure fairness and maximize efficiency for all members.

RESOURCE STATUS

Remaining work for all work resources.

Name	Start	Finish	Remaining Work
Tuong Vy	Fri 1/3/25	Tue 3/11/25	0 hrs
Que Anh	Fri 1/3/25	Tue 3/11/25	0 hrs
Thanh Van	Fri 1/3/25	Tue 3/11/25	0 hrs
Thuy Loi	Fri 1/3/25	Tue 3/11/25	0 hrs
Kim Suong	Fri 1/3/25	Tue 3/11/25	0 hrs

Figure 4.7. Resource Status Table

(Source: Authors' source)

The "**RESOURCE STATUS**" table provides an overview of the remaining work for project resources. It includes five individuals—Tuong Vy, Que Anh, Thanh Van, Thuy Loi, and Kim Suong—who all started working on January 3, 2025, and completed their tasks on March 11, 2025.

The "Remaining Work" column shows 0 hours for all team members, indicating that the assigned tasks have been fully completed.

4.1.4. Dashboards

4.1.4.1 Sales Performance Dashboard

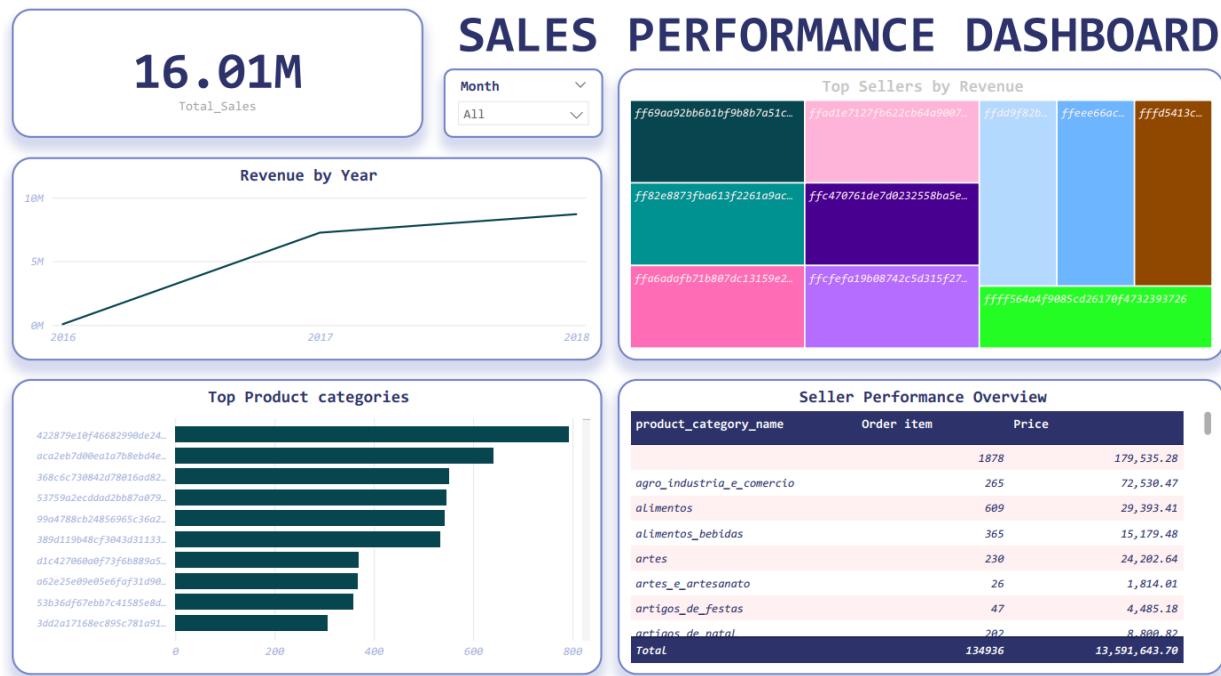


Figure 4.8. Sales Performance Dashboard

(Source: Authors' source)

The total revenue recorded on the dashboard is 16.01M, representing the overall sales performance. However, the total revenue from sellers is only 13.59M, showing a discrepancy of 2.42M. This suggests that some revenue sources may not have been accounted for in the seller breakdown, requiring further investigation.

Regarding seller performance, the highest revenue-generating category is agro_industria_e_comercio, contributing 179,535.28 from 1,878 orders. The alimentos category follows with 72,530.47 from 265 orders, while alimentos_bebidas generated 29,393.41 from 609 orders. Other categories recorded significantly lower revenues, ranging from 1,814.01 to 24,202.64. The total number of orders processed across all categories is 134,936, with an average revenue per order of approximately 100.79 (13.59M / 134,936).

Analyzing product category performance, agro_industria_e_comercio leads in order volume, but the average revenue per order is only 95.6. Meanwhile, alimentos_bebidas has a lower average revenue per order (48.3) but a higher number of transactions (609 orders). The artigos_de_festas category generates 95.43 per order, yet it has only 47 orders, indicating a high-value but less popular product category.

From this data, several insights emerge. Firstly, product category performance is inconsistent, with some categories having high order volumes but lower average revenue per order, while others generate higher revenue but with fewer orders. Secondly, the total revenue discrepancy of 2.42M needs to be verified to ensure data accuracy. Lastly, the average revenue per order is relatively low at 100.79, suggesting potential opportunities to increase revenue through upselling, bundling strategies, or price adjustments.

Further analysis could focus on tracking trends in product categories over time, such as by month or quarter, to better understand sales fluctuations and optimize business strategies.

4.1.4.2. Marketing Effectiveness Dashboard

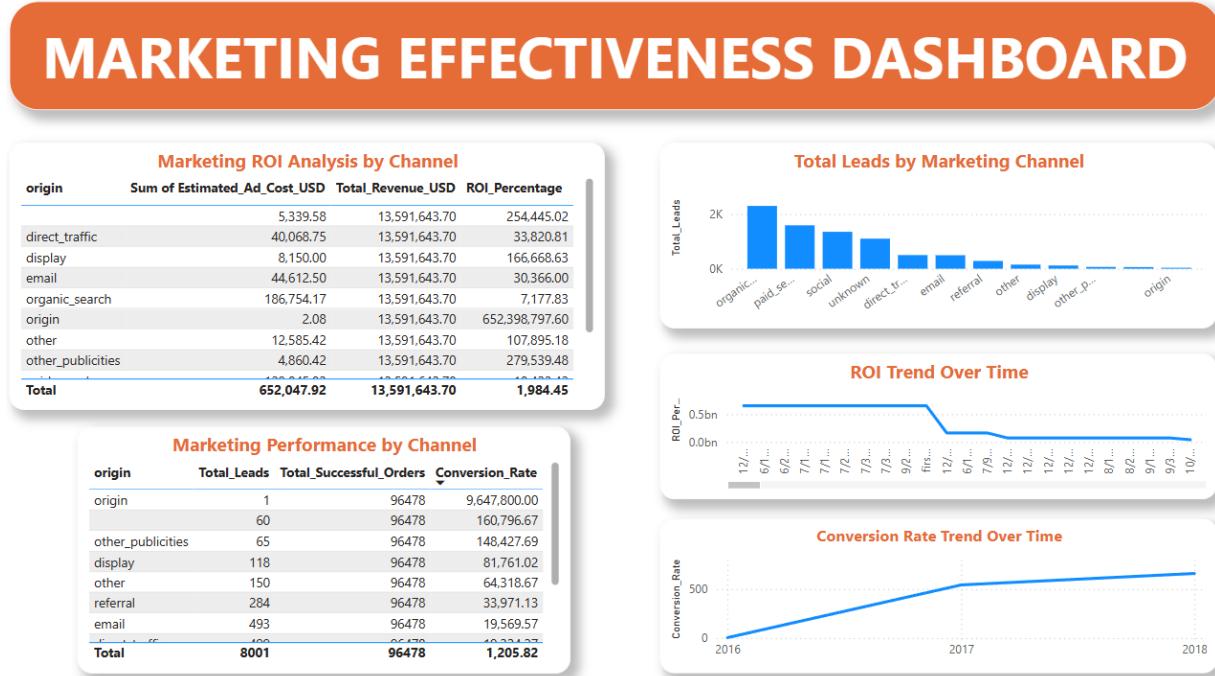


Figure 4.9. Marketing Effectiveness Dashboard

(Source: Authors' source)

The "Marketing Effectiveness Dashboard" provides an overview of marketing performance through three main charts: Total Leads by Marketing Channel, ROI Trend Over Time, and Conversion Rate Trend Over Time. These indicators help assess the success of each channel and develop appropriate optimization strategies.

First, the bar chart "Total Leads by Marketing Channel" shows a clear difference in the number of potential customers across marketing channels. Organic Search generates the highest number of leads, followed by Paid Search and Social Media. In contrast, Origin has the lowest number of leads, indicating its low effectiveness and the need for further evaluation. The large gap between channels highlights different levels of success in

attracting customers, requiring businesses to optimize strong channels and adjust strategies for less effective ones.

However, the number of potential customers is just one aspect of marketing effectiveness. It is also essential to consider Return on Investment (ROI). The line chart "ROI Trend Over Time" displays ROI trends over time and reveals some significant fluctuations. Specifically, there was a sharp decline in December 2016 and June 2017, possibly due to higher advertising costs or lower revenue. Despite this, ROI showed signs of recovery at the end of the period, indicating positive adjustments in marketing strategies. To ensure sustainable ROI growth, businesses need to analyze the reasons for these drops, optimize investment budgets, and allocate funds more effectively to high-performing channels.

Additionally, marketing effectiveness is not only measured by ROI but also by the Conversion Rate. The line chart "Conversion Rate Trend Over Time" shows a steady increase in conversion rates, with a notable surge in 2017. This may result from changes in marketing strategies, improved user experience, or better advertising content. To maintain this growth, businesses should focus on key factors such as content quality, user experience (UX/UI), and call-to-action (CTA). Understanding the reasons behind this surge will help apply successful strategies to future campaigns and increase conversion rates in the long term.

Overall, these three charts offer a comprehensive view of marketing performance, helping businesses evaluate the success of campaigns over time. Key fluctuations, such as the ROI drop at certain times or the spike in conversion rates in 2017, need further analysis. Understanding these changes will allow businesses to optimize marketing strategies, improve investment efficiency, and enhance overall business performance.

To achieve these goals, businesses should focus on optimizing customer acquisition channels, especially those with high effectiveness, such as Organic Search, Paid Search,

and Social Media. At the same time, strategies for lower-performing channels like Origin, Display, and Other_p... should be adjusted to improve customer attraction. A/B testing can help determine the best approach to increase lead generation.

Moreover, to address the ROI decline in December 2016 and June 2017, businesses should carefully manage budgets, prioritize investments in high-ROI channels, and use historical data to predict trends. This will help reduce negative fluctuations and ensure marketing campaigns remain stable.

To sustain and optimize the Conversion Rate, businesses need to analyze the reasons behind the surge in 2017 and continue applying successful strategies. Improving user experience (UX/UI), optimizing call-to-action (CTA), offering attractive promotions, and personalizing marketing content will help increase conversion rates. Additionally, continuous data monitoring will ensure timely campaign adjustments, maintaining stable performance.

Finally, businesses should use in-depth data analysis to understand customer behavior, personalize marketing content, and leverage remarketing to re-engage potential customers. By combining these strategies, businesses can improve ROI, increase the number of potential customers, and maintain a stable conversion rate, ultimately optimizing long-term marketing effectiveness.

4.1.4.3. Customer Insights Dashboard

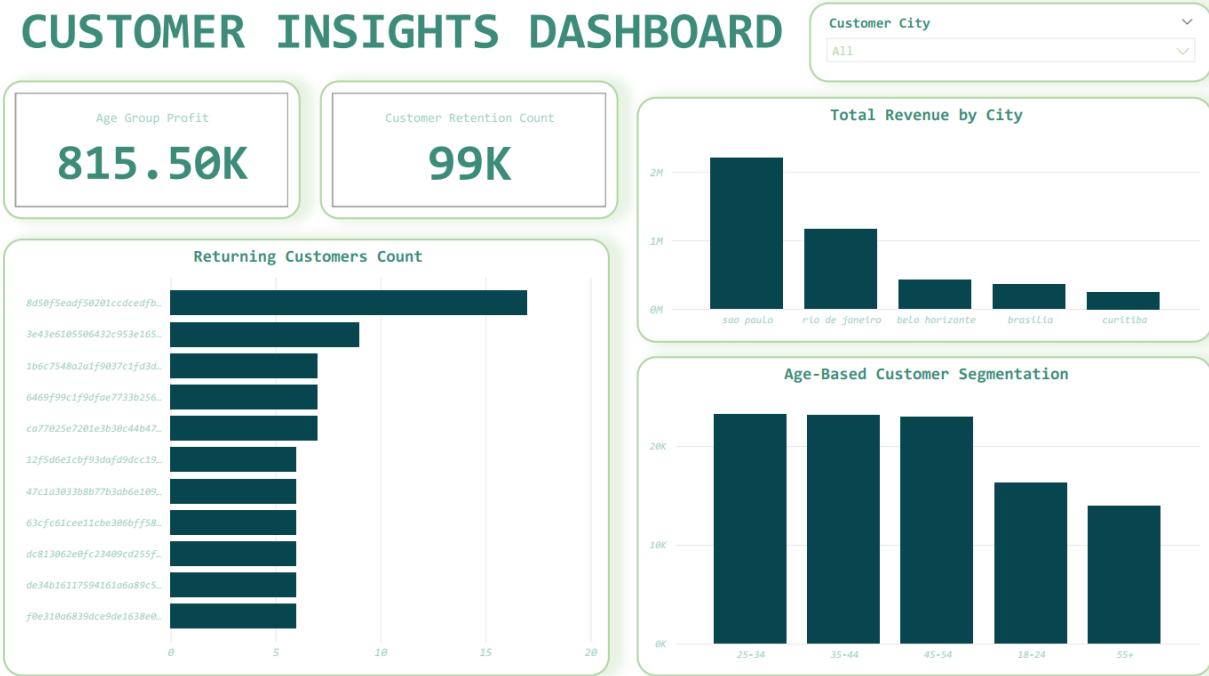


Figure 4.10. Customer Insights Dashboard

(Source: Authors' source)

The Customer Insights Dashboard provides an overview of customer behavior through key metrics such as age group profitability, customer retention, total revenue by city, returning customer count, and age-based customer segmentation.

The age group profit is recorded at 815.50K, reflecting the contribution of different customer segments to overall profitability. This metric helps identify which age groups generate the most revenue. Additionally, the customer retention count stands at 99K, indicating a substantial number of returning customers. This is a crucial metric for assessing customer loyalty and satisfaction.

In terms of geographical analysis, São Paulo leads with over 2M in revenue, followed by Rio de Janeiro, which generates over 1M. Other cities like Belo Horizonte, Brasília, and Curitiba show significantly lower revenue, suggesting that marketing and sales strategies in these regions may need to be reevaluated to drive growth.

The returning customer count highlights a group of highly frequent buyers, with the top returning customer significantly outpacing others. Analyzing these customers helps businesses identify their most loyal shoppers and implement tailored loyalty programs or exclusive offers to retain them.

From an age-based segmentation perspective, the 25-34, 35-44, and 45-54 age groups have the highest customer counts, making them the most valuable segments for targeted marketing efforts. Meanwhile, the 18-24 age group has fewer returning customers, which may indicate lower loyalty or spending habits. Similarly, the 55+ segment has a lower presence, possibly due to different shopping behaviors or lower engagement with e-commerce platforms.

Several key insights can be drawn from this data. Customers aged 25-54 are the most significant contributors to revenue, meaning businesses should prioritize engagement strategies for this segment. São Paulo and Rio de Janeiro are the highest-value cities, while other regions require more focus to expand the customer base. Additionally, the high returning customer rate suggests effective customer retention strategies, though further optimization—such as loyalty programs—could increase Customer Lifetime Value (CLV).

Overall, the Customer Insights Dashboard provides valuable data-driven insights that can help businesses optimize their strategies, from identifying high-value customer groups to refining geographical targeting and improving customer retention efforts.

4.1.4.4. Customer Retention & Loyalty Dashboard

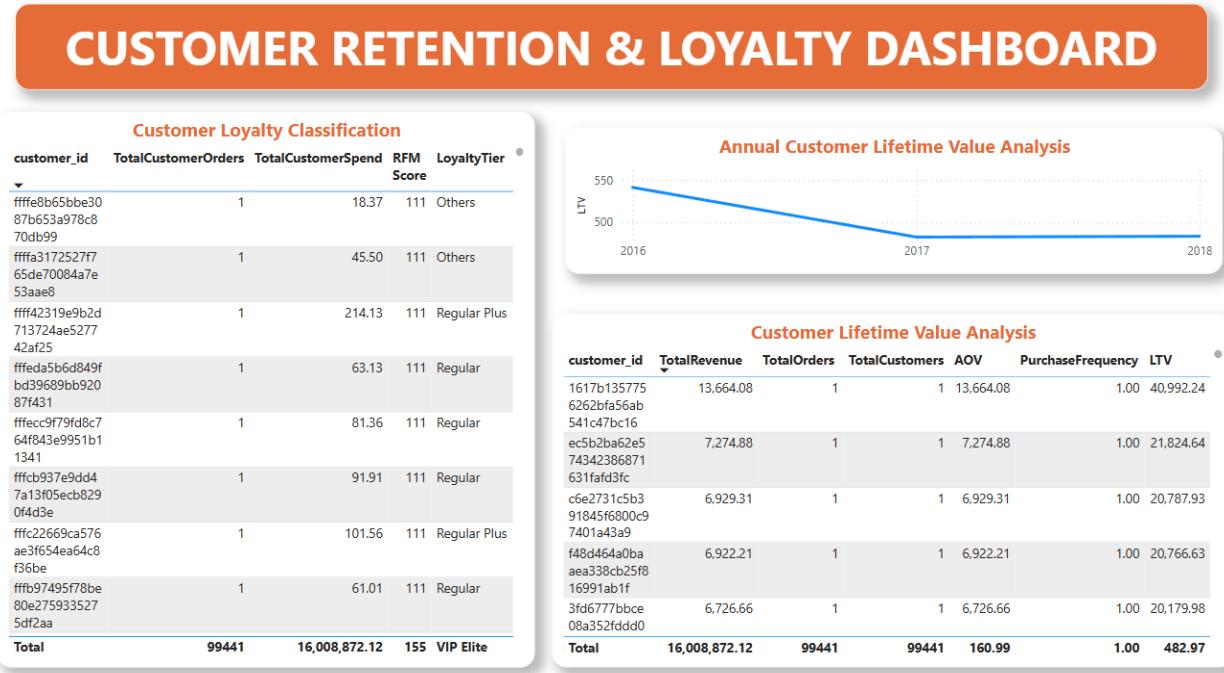


Figure 4.11. Customer Retention & Loyalty Dashboard

(Source: Authors' source)

This dashboard provides a comprehensive view of customer loyalty and customer lifetime value (LTV), helping businesses assess customer engagement and optimize customer care strategies. The data includes customer loyalty classification, annual customer lifetime value analysis, and detailed customer lifetime value analysis, allowing businesses to identify consumption trends and the contribution of each customer.

The Customer Loyalty Classification analysis shows that most customers have only one order and are classified as "Others" or "Regular", indicating a low level of engagement with the business. However, there is a special case where one customer is classified as "VIP Elite", with 99,441 orders and a total spending of 16,008,872.12. This could be a very high-value customer.

Additionally, the Annual Customer Lifetime Value Analysis chart shows that LTV has gradually decreased from 550 in 2016 to 500 in 2017 and remained at this level in 2018. This decline may reflect changes in consumer behavior, pricing policies, or the effectiveness of customer loyalty programs. Without improvements, this trend could affect the long-term profitability of the business.

The Customer Lifetime Value Analysis table provides detailed information on total revenue, total orders, number of customers, average order value (AOV), purchase frequency, and LTV per customer. Some customers have very high LTV, such as customer ID "16176135775" with LTV reaching 40,992.24, showing significant differences in customer value. However, the average LTV is only 482.97, which is lower than in 2016. This indicates a decline in customer lifetime value, meaning the business needs a more effective strategy to retain customers.

Overall, the data from the dashboard shows that customer engagement is still low, as seen in the low average number of orders, the decreasing LTV over time, and the lack of variation in purchase frequency among customers. To address this issue, businesses should focus on optimizing customer loyalty programs, including creating attractive membership levels, offering special benefits to loyal customers, and launching reward programs to encourage repeat purchases. Additionally, enhancing the user experience, improving website design, streamlining the purchasing process, and personalizing marketing content will help attract customers to return.

Furthermore, businesses should review RFM scores and purchase frequency data to ensure these indicators accurately reflect differences among customers, allowing for more targeted strategies. To encourage customers to spend more, businesses can implement discount policies based on purchase frequency, offer product bundles, or provide special promotions for frequent shoppers. Finally, analyzing the reasons for the decline in LTV over time,

evaluating changes in shopping behavior, pricing policies, and the effectiveness of marketing strategies will help businesses make necessary adjustments to retain customers more effectively.

By applying these strategies, businesses can increase customer lifetime value, improve engagement, and optimize long-term business performance.

4.2. Lesson learned

During the implementation of the Business Intelligence System for Golden Gate Restaurant Chain – Marketing and Sales Modules project, the project team compiled key lessons learned to enhance future projects. Both successes (*WIN*) and challenges (*ISSUE*) were recorded in detail. These include building the fact table, managing scattered data, and handling changes in client needs. The impact of each issue was reviewed, and solutions were suggested, such as making data systems more consistent, and improving change management. These lessons will help make future BI projects more effective.

Table 4.1. Lessons Learned Document

Today's Date:	1/3/2025
Project Name:	Business Intelligence (BI) System for Golden Gate Restaurant Chain – Marketing and Sales Modules.
Project Manager:	To Nguyen Tuong Vy

WIN / ISSUE	Categorize	Describe What Happened	What Was the Impact?	How Does This Change Future Projects?	Action Items
WIN	Design	Creating the Fact table is a critical and complex task. The team struggled with building it due to a lack of experience and reference materials.	The team faced delays building the Fact table but gained experience, improved data modeling, and enhanced problem-solving for future tasks.	Future projects will benefit from better training and documentation to ensure the team has the necessary expertise. Standardized guidelines and best practices can be developed to streamline the process and avoid similar challenges.	<ol style="list-style-type: none"> 1. Create a knowledge base with best practices for Fact table design. 2. Train the team on Fact table design and data modeling. 3. Assign mentors to support junior members.
ISSUE	Requirement Gathering	Golden Gate's fragmented data	The fragmented data system causes	Standardize POS, CRM, and inventory systems	1. Standardize POS, CRM, and inventory

		management system causes inefficiencies, as different brands use different POS, CRM, and inventory systems, making data consolidation difficult.	inefficiencies, reporting delays, and analysis inconsistencies, making decision-making harder and hindering operational performance due to the lack of a unified view across brands.	across all brands for better efficiency. Prioritize early integration planning to avoid inconsistencies.	systems across all brands. 2. Implement a centralized data management strategy to streamline integration. 3. Establish cross-brand data governance policies to ensure consistency.
WIN	Deploy	During implementation, the team discovered several data errors and inconsistencies across different software versions.	Finding data errors early helped avoid reporting and decision issues. The team fixed mistakes, improved data quality, and made the system more reliable.	Adopt proactive data validation early. Use automated checks to detect issues before they affect operations.	1. Use automated data validation before and during implementation. 2. Set up a dedicated data quality assurance process. 3. Perform regular system audits to detect and fix inconsistencies early.
WIN	User Acceptance Testing	Employees struggled to adapt to the new BI system due to unfamiliarity with data analytics	User resistance and lack of familiarity with analytics tools slowed down adoption, reducing	Future projects need a structured change management process to document scope changes and plan budget	1. Establish a clear change request process with cost analysis. 2. Allocate contingency budgets for unexpected

		tools and resistance to change. Many found the interface complex and had difficulty extracting insights.	the initial effectiveness of the BI system. Training programs were needed to improve user competency.	adjustments. Clear client communication on cost impacts is also essential.	changes. 3. Communicate proactively with clients to manage expectations.
WIN	User Acceptance Testing	Changes in client requirements during the project implementation may result in an increased budget.	Changes in client requirements increased the budget, enabling better features, functionality, and business alignment. This flexibility led to a more tailored and effective solution.	Using advanced analytics and attribution models can improve ROI measurement. Controlled testing and AI insights help remove external factors for better campaign evaluation.	1. Use advanced analytics to track marketing ROI accurately. 2. Create a standardized framework to measure campaign effectiveness. 3. Apply A/B testing to isolate promotion-driven revenue changes.
ISSUE	Testing	Difficulty in evaluating the ROI of marketing campaigns due to external factors, making it hard to assess promotion-driven revenue increases.	Difficulty in measuring ROI made it harder to optimize marketing spend and assess campaigns. Lack of clear insights weakened data-driven decisions,	Standardizing software versions across all team members will be a priority in future projects. A centralized software update policy should be enforced to avoid compatibility issues and ensure	1. Standardize software versions across the team. 2. Use centralized version control for consistency. 3. Train regularly on software updates.

			risking poor budget use and missed revenue growth.	smooth collaboration.	
ISSUE	Coding and Unit Testing	There were inconsistencies in the versions of SQL Server, Power BI, and Visual Studio used by different team members.	Software version mismatches caused delays, errors, and collaboration issues, requiring extra time for standardization.	Future projects will enforce strict data governance with uniform security policies. Regular audits and compliance checks will reduce integration risks.	<ol style="list-style-type: none"> 1. Establish strict data security policies across all brands. 2. Conduct regular security audits and compliance checks. 3. Provide cybersecurity training to all relevant stakeholders.
ISSUE	Design	Data security issues arose due to inconsistent governance across brands, leading to potential risks during integration.	Inconsistent governance increased data breach risks, compliance issues, and integration failures, requiring stronger security and standardized policies.	A more thorough assessment of legacy systems should be conducted before implementation. Future projects should allocate more time for integration planning and consider middleware solutions earlier to reduce delays.	<ol style="list-style-type: none"> 1. Assess legacy systems before integration. 2. Preemptively implement middleware to bridge gaps. 3. Allow extra time for integration challenges.
WIN	Deploy	The team encountered	Despite early challenges, the team	A stronger change management policy will	<ol style="list-style-type: none"> 1. Implement change management with

		<p>difficulties integrating legacy systems with the new BI platform. These issues caused delays and required additional middleware solutions to bridge system gaps.</p>	<p>implemented middleware to connect systems, ensuring smooth integration between old and new platforms. This improved data flow, system compatibility, and future scalability.</p>	<p>be enforced to track and evaluate scope changes. Future projects will include contingency budgets and predefined approval processes to manage financial impacts effectively.</p>	<p>financial impact analysis.</p> <ol style="list-style-type: none"> Define clear scope control and approval guidelines. Maintain a flexible contingency budget for adjustments.
WIN	Project Management	<p>Budget overruns occurred due to new requirements and weak change management, leading to extra costs and resource reallocation.</p>	<p>Despite budget overruns, fund reallocation met changing needs, highlighting the need for better change management and financial planning.</p>	<p>Future projects should use A/B testing and multi-touch attribution to isolate promotion effects. Data teams must work closely with marketing to improve evaluation methods.</p>	<ol style="list-style-type: none"> Implement multi-touch attribution models for accurate ROI tracking. Introduce AI-driven analytics to analyze the impact of external factors. Enhance collaboration between marketing and data teams to refine evaluation methods.

4.3. Group member evaluation

The group member evaluation is based on five criteria, rated on a scale from 1 to 5, where **1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, and 5 = Always**. The criteria include Contribution & Work Quality, measuring task completion, work accuracy, and innovation; Responsibility & Accountability, assessing reliability, ownership, and deadline adherence; Teamwork & Collaboration, evaluating communication, cooperation, and conflict resolution; Engagement & Proactiveness, considering initiative, participation, and adaptability; and Adherence to Project Goals & Ethics, ensuring commitment, professionalism, and integrity.

Table 4.2. Group member evaluation

No.	Criteria	Tuong Vy	Que Anh	Thuy Loi	Kim Suong	Thanh Van
1	<p>Contribution & Work Quality</p> <ul style="list-style-type: none"> • Task Completion: Evaluate whether the member consistently completes assigned tasks within the given deadlines. • Quality of Work: Assess the accuracy, clarity, and effectiveness of the completed work. High-quality contributions should meet project requirements and standards. • Innovation & Problem-Solving: Determine if the member contributes creative ideas, finds efficient solutions, or improves project 	5	5	5	5	5

	processes.					
2	<p>Responsibility & Accountability</p> <ul style="list-style-type: none"> • Reliability: Measure the consistency of the member's performance and whether they fulfill commitments without constant supervision. • Ownership: Assess whether the member takes responsibility for their tasks, acknowledges mistakes, and actively works toward solutions. • Meeting Deadlines: Evaluate if the member delivers work on time and meets project milestones without delays. 	5	5	5	5	5

3	<p>Teamwork & Collaboration</p> <ul style="list-style-type: none"> • Communication: Examine how effectively the member shares information, responds to messages, and participates in discussions. Clear and professional communication is key. • Cooperation: Evaluate their willingness to collaborate, support teammates, and contribute to team success beyond individual tasks. • Conflict Resolution: Assess the ability to handle disagreements constructively and maintain a positive working environment. 	5	5	5	5	5
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4	<p>Engagement & Proactiveness</p> <ul style="list-style-type: none"> Initiative: Determine if the member takes action without waiting for instructions, suggests improvements, or takes the lead when needed. Participation: Evaluate the level of involvement in meetings, brainstorming sessions, and decision-making processes. Adaptability: Assess how well the member adjusts to project changes, unexpected challenges, or new requirements. 	5	5	5	5	5
5	<p>Adherence to Project Goals & Ethics</p> <ul style="list-style-type: none"> Commitment to Project Objectives: Check 	5	5	5	5	5

	<p>whether the member aligns their efforts with the overall project goals and delivers work that contributes to success.</p> <ul style="list-style-type: none"> ● Work Ethics: Evaluate professionalism, dedication, and adherence to ethical standards, such as honesty and respect for others. ● Integrity: Assess whether the member maintains transparency, avoids cutting corners, and upholds the team's trust. 					
	Total Score (/25)	25	25	25	25	25

4.4. Future development

In the coming time, the Business Intelligence (BI) system of Golden Gate Restaurant Chain will continue to be upgraded to better support marketing and sales operations. Expanding data sources, improving real-time analytics, and enhancing reporting capabilities will help the company maximize the potential of its data, optimize business strategies, and make more accurate decisions.

First, the system will focus on expanding and integrating data. Data will not only come from sales transactions but also from various sources such as customer information, online behavior, social media feedback, and market trends. Additionally, the system will connect with third-party delivery platforms, loyalty programs, and CRM systems to provide a more comprehensive view of customer purchasing behavior. This will enable the company to better understand real customer needs and develop more effective marketing strategies.

In addition, the BI system will be upgraded to support real-time data analytics. This means the company can instantly track key metrics such as order volumes, customer interest levels, and the performance of promotional campaigns. The system will also feature automated alerts for major fluctuations, allowing the marketing and sales teams to respond promptly. Furthermore, with the support of Artificial Intelligence (AI) and Machine Learning (ML), the system can predict future consumer trends, offering recommendations for more effective sales strategies.

Enhancing marketing and sales analytics is also a top priority. The system will classify customers based on shopping behavior, preferences, and visit frequency to optimize personalized marketing campaigns. At the same time, businesses will be able to track the effectiveness of each promotional campaign, measure conversion rates, and calculate

return on investment (ROI). Beyond that, AI-driven cross-selling and upselling strategies will be implemented to increase revenue from existing customers.

Additionally, the reporting and data visualization system will be improved to become more intuitive and accessible. Managers will be able to monitor business performance through an interactive dashboard that displays real-time key metrics. The system will also allow customized reports, enabling different departments to extract relevant data for faster decision-making. Moreover, with AI-driven insights, the system can automatically detect hidden trends or anomalies, providing recommendations to help businesses seize opportunities and mitigate risks.

Finally, scalability and cloud-based infrastructure will ensure that the BI system operates efficiently and remains flexible. By migrating to a cloud-based BI system, restaurant branches will have seamless access to data, ensuring synchronization and accuracy across locations. The system will also receive enhanced security measures to protect customer data and comply with industry regulations. Additionally, the implementation of self-service BI will empower employees to generate reports and analyze data independently, reducing reliance on IT teams and increasing decision-making agility.

With these improvements, the Business Intelligence (BI) system of Golden Gate Restaurant Chain will continue to evolve, enabling the company to leverage data effectively, optimize marketing and sales strategies, and enhance business performance in an increasingly competitive market.

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