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Optimizing Business Management with Electronic Customer Relationship Management Systems: A Case Study of Biotek Abadi

Ong Pei Yee[1], Rosmamalmi Mat Nawi[2]*, Ng Jie Kai[3]

[1,2] *Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia, Parit Raja, Batu Pahat, 86400, MALAYSIA*
[3] *Biotek Abadi Sdn. Bhd., Shah Alam, Selangor, 40170, MALAYSIA*

*Corresponding Author: rosmamalmi@uthm.edu.my
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Abstract

The paper explores the implementation and impact of an electronic customer relationship management (e-CRM) system at Biotek Abadi. It focuses on how this system can optimize business management processes, enhance customer relationships, and improve overall organizational efficiency. Biotek Abadi Sdn. Bhd., a scientific supplier in Malaysia, lacks a dedicated CRM system and currently relies on Microsoft Excel for sales and customer management. The Biotek Abadi Customer Relationship Management System (eBACRM) was introduced to minimize the time spent by users and provide an efficient platform for managing customer data. The implementation of the eBACRM system combines the prototyping model with the Analytic Hierarchy Process (AHP) modeling. This approach involves iterativbuse refinements based on user feedback, ensuring the final product meets user needs effectively. Additionally, AHP modeling aids in prioritization and decision-making, enhancing the implementation process. Upon implementation, the eBACRM system aims to streamline the CRM process with a user-friendly interface.

1. Introduction

In today's business environment, the field of customer relationship management (CRM) is extremely important. Due to the fiercer competition and constantly shifting customer needs, businesses must build solid relationships with their clients and maximize interactions at every touchpoint. Effective communication and collaboration within an organization are made possible by a well-designed CRM System, which acts as a central platform to manage customer data, forecast sales possibilities, and explore marketing opportunities. The system is typically used by the company's sales team to ensure an efficient and organized approach to customer interactions.

Biotek Abadi Sdn. Bhd. (BASB) is a Malaysia scientific supplier that represents prominent brands for locals and overseas. The head office of BASB is in Shah Alam, and the other two offices are in Penang and Johor. On a daily basis, BASB needs to interact with different customers from every corner of the world. However, BASB does not have any existing CRM system.

The business situation of BASB is examined to find a solution for the problem of developing a system effectively. This activity includes breaking out the development process into more modest activities or stages where the actual task might be done in a smoother way. Due to the absence of a centralized CRM system, they face several significant issues. One of the main issues is that BASB struggles to control their sales pipelines without a

standardized CRM system. They heavily rely on Microsoft Excel for data management such as total sales amount. It is a manual and error-prone process to generate reports and analyze sales data. Indeed, the lack of data-driven can significantly hinder BASB from adapting sales strategies and marketing opportunities effectively.

Without a CRM system, BASB struggles with visibility and accurate forecasting, which are essential for planning growth and executing effective marketing campaigns. This shortfall might cause BASB to miss potential customers or emerging markets, leading to investments in low-demand assets or misdirected marketing efforts. Additionally, using Microsoft Excel for data management can lead to errors, outdated records, and cumbersome documentation, resulting in missed follow-ups and difficulties in maintaining customer relationships.

One of the implications is the negative customer perception. The company will be viewed negatively by customers for being unreliable and unresponsive to their needs. BASB could be perceived as unreliable and unresponsive, harming its reputation and customer retention. Another implication is customer churn and revenue loss. Unsatisfied customers are more inclined to seek another company that can promptly fulfill their orders. The company may lose profit and market share because of this turnover.

The development of the Biotek Abadi Customer Relationship Management (eBACRM) system will be visually appealing and straightforward. The system aims to minimize the time users spend, particularly sales agents, searching for customer information or familiarizing themselves with the system. The objectives of the eBACRM system are to design a web-based CRM System using a structured approach, develop it to enhance customer management processes, and evaluate its functionality and usability, ultimately benefiting users by providing an efficient, user-friendly tool for managing customer data and improving sales and marketing efforts. Consequently, the eBACRM system will prioritize simplicity and user-friendliness, ensuring that users can efficiently manage their tasks and navigate the system with minimal effort.

This project will mainly help BASB to organize and categorize customers in a more effective way as the database system plays an important role in business. This facilitates the use of specific marketing strategies to target particular customer segments. As a result, this will improve the quality and consistency of information compared to the traditional workflow and data management system. By offering a centralized platform for storing and managing client data, the CRM system will enable firms to create and maintain strong customer relationships. With the help of this technology, businesses will be able to better understand their customers' demands and create individualized experiences, which will boost client happiness and loyalty. Last but not least, BASB can obtain a competitive advantage in the market by providing better customer experiences and more successfully focusing on particular customer segments. A CRM System makes it easier for the business to stay one step ahead of rivals by improving customer service.

In short, this paper is organized into five parts. Section 2 will explore related work, including research on the existing CRM systems with a comparison of the characteristics between four existing related systems and the eBACRM system. Section 3 will detail the methodology used to develop the eBACRM system, along with the system development activities for this project. Section 4 will present the system analysis and design, featuring structural diagrams. Finally, Section 5 will summarize the paper's discussion and provide suggestions for future work.

2. Related Work

In this section, the foundational concepts and existing solutions relevant to CRM, AHP modeling, and web-based systems are discussed. Additionally, four current CRM systems are compared with the eBACRM system based on their features, highlighting the unique advantages of each.

2.1 Customer Relationship Management

Customer Relationship Management (CRM) is defined in a variety of ways. Although CRM can mean many different things, but all of them have to do with meeting the expectations of the customer. CRM is a comprehensive strategy for locating, attracting, and keeping customers. CRM helps businesses maximize the value of each customer connection and promote better corporate performance by helping them to manage and organize client interactions across many channels, departments, lines of business, and locations [1]. In order to improve relationships, raise customer retention, and eventually drive business growth, it entails using information and technology, as well as procedures to understand client preferences and behaviors. There are four types of CRM including strategic, operational, analytical and collaborative.

CRM that prioritizes the needs of the client is known as strategic CRM. Businesses can more effectively focus their marketing efforts by using strategic CRM to segment customers based on a variety of criteria, including preferences, purchasing behavior, and demographics. In order to create a better value option for the customer, it gathers, sorts, and utilizes data about customers and market trends.

Besides, the core of operational CRM is the automation of procedures related to customers, such as marketing, sales, and customer services [1]. It is intended to enhance standard business processes and safely retain information about all interactions with customers and potential customers. Within the field of CRM, analytical CRM focuses on obtaining and analyzing customer data in order to obtain a deeper understanding of consumer

behavior. This type of CRM collects and evaluates various customer information, such as sales, financial, and marketing data, making it essential for efficient CRM. CRM that emphasizes encouraging cross-departmental cooperation by optimizing team member communication and cooperation is known as collaborative CRM. It facilitates information sharing and collaboration across marketing, sales, service, and other divisions to provide a more efficient customer experience, raise operational effectiveness, and increase profitability.

In short, combining these CRM kinds offers a comprehensive method for managing and maximizing customer connections.

2.2 Analytic Hierarchy Process

The Analytic Hierarchy Process, or AHP for short, is a decision-making technique that simplifies logic for complicated situations with several goals. Thomas L. Saaty created it in the 1970s, and since then, it has been improved [2]. AHP consists of the following basic steps:

a. Define the goals or main objectives to solve an issue.
b. List all the potential answers or alternatives.
c. Quantify the criteria and build the matrix of judgments.

By quantifying the criteria and other choices involved in a decision and connecting them to the main objective, AHP offers a logical framework for making necessary decisions. It is a paradigm and process for choosing actions for intricate systems that are challenging to measure fully [3]. The AHP modeling can be used to analyze each decision's results separately. Both simple and sophisticated mathematical computations may be required for the AHP procedure. Long-term decisions and the need for a lot of resources are two typical scenarios in which this methodology can be applied.

2.3 Web-based System

Software that operates on the web is known as a web-based management system. It allows users to administer different parts of a company or organization. Furthermore, web-based management systems can also be customized to meet unique company requirements, providing unparalleled flexibility across several devices without requiring individual installation.

Currently, most of the existing CRM systems are web-based, as the system offers many advantages, such as reduced development time and costs, simple installation and upkeep, great customizability, and scalability.

2.4 Study of the Existing Related Systems

This section will study five existing related systems to the CRM system. The five existing related systems are act!, Zoho, Salesforce, Insightly and Microsoft Dynamics 365.

act! is designed specifically for small and medium-sized organizations. Users may track interactions, manage relationships, and plan out their sales and marketing campaigns with its assistance. act! offers a fantastic function in-app calendar function. This function helps the user to mark the time so that appointments and communications are in sync at all times.

Zoho CRM was created to assist companies in managing their marketing, support, and sales initiatives. Zoho provides a highly customizable environment for users to suit their specific needs. Users can customize the home page according to the role of the user.

Salesforce assists companies in managing marketing, sales, and customer support, among other areas. It has several customizable features, including tools for customer service, marketing automation, sales monitoring, and intelligent analytics. Its opportunity function gives teams the ability to anticipate possible sales from a deal, track the status of active deals in the pipeline, and keep an eye on the bandwidth between sales representatives to execute specific deals.

Insightly is intended for small to medium-sized enterprises. It facilitates lead tracking, contact management, and project management efficiency. With Insightly's project management, marketing, and sales services, teams can efficiently automate and arrange their operations. It is well-known for its ease of use, adaptable interface, and business tool integrations, including file sharing, email, and calendaring.

Table 1 shows the comparison between the existing system and the eBACRM system. The eBACRM system stands out from other existing systems due to its comprehensive features and accessibility. Unlike alternatives like Act!, Zoho, Salesforce, and Insightly, eBACRM offers all essential functionalities, such as login and logout, registration, user and customer management, product management, sales order management, marketing opportunity management, and reporting, in a single platform. Additionally, it is the only system among the compared options that is free to access, making it highly cost-effective for organizations. This combination of extensive features and affordability makes eBACRM an exceptional choice for businesses seeking to streamline their customer relationship management processes.

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Table 1 *Comparison between Existing System and eBACRM System*

No.	Features	act!	Zoho	Salesforce	Insightly	eBACRM
1	Login and Logout	√	√	√	√	√
2	Registration	√	√	√	√	√
3	User Management	√	√	√	√	√
4	Customer Management	√	√	×	×	√
5	Product Management	×	√	×	×	√
6	Sales Order Management	×	√	×	×	√
7	Marketing Opportunity Management	×	×	√	√	√
8	Report	√	√	√	√	√
9	Freeware	×	×	×	×	√

3. Methodology

This section explains the use of the prototyping model in this project and the activities that were carried out in each phase. The prototyping model is a software development methodology that involves building, testing, and iteratively refining a prototype until a workable and functional version is reached [4]. When clients are unsure about the precise project requirements in advance, this strategy is employed. Under this model, an end-product prototype is first created, tested, and iterated based on customer feedback until a final, workable prototype is obtained. Fig. 1 shows the prototyping model phases.

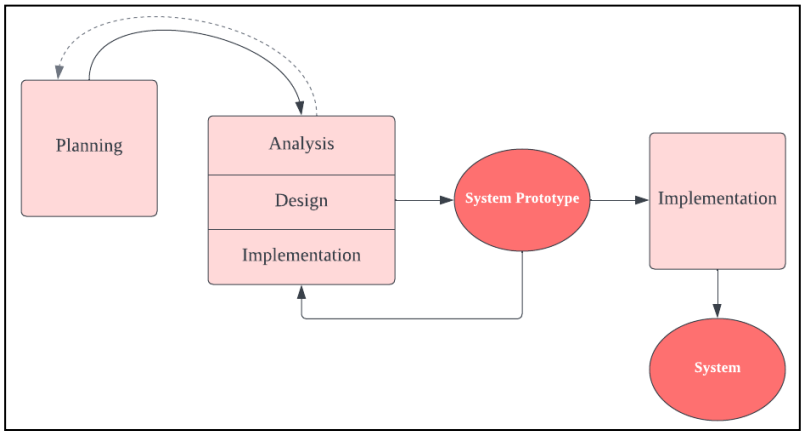

Fig. 1 *Prototyping Model*

The decision to opt for the prototyping model is driven by the fact that BASB lacks a detailed understanding of CRM and, consequently, doesn't have a clear vision of the system they want. The prototyping model is useful in such situations as it enables gradual development and refinement of a prototype while also allowing for ongoing feedback and collaboration between the development team and BASB. This iterative process helps BASB to clarify its requirements and preferences for the CRM system.

The initiation of the systems planning phase typically starts with a systems request, which is a written request to the IT department outlining issues or desired modifications to an information system or business process [5]. Within this phase, the problems with the current system are highlighted. The project's objectives, scope, and significance of the system are defined, taking into consideration the requirements of stakeholders to address problems and meet their needs. In order to obtain the necessary resources and information, planning activities involve conducting interviews and observations.

The second phase of the prototype model is the analysis phase. The aim of the systems analysis phase is to construct a coherent representation of the new system in the form of a logical model. In this section, the information obtained from the interview sessions is deeply analyzed and summarized in table form. The information obtained from the interview session is assessed and transformed into the eBACRM system functions.

Besides, a literature review was conducted to study the existing systems, comprehensively analyse their structure and functionalities. The process is instrumental in order to identify both strengthens and limitations of

the eBACRM system. Furthermore, the process of requirement specification is undertaken to ascertain both functional and non-functional requirements. During the requirement specification phase, the focus is on determining the essential features that the new system should possess in terms of both functional and non-functional aspects. The functional requirements are shown in Table 2.

Table 2 *Functional Requirements*

No.	Modules	Functionalities
1	Login and Logout	The system should allow the users to log into the system using username and password. Then, the system should verify the user's input. Only the valid users will be redirected to the system's dashboards based on user role, or else the system should display an error message.
2	User Management	The system should store and display the user list. Besides, the system should allow the administrator to add, edit and delete a user account.
3	Sales Agent Management	The system should store and display the sales agent list. Besides, the system should allow the administrator to add, edit and delete a sales agent.
4	Supplier Management	The system should store and display the supplier list and allow the administrator and sales agent to add, edit and delete a supplier.
3	Customer Management	The system should store and display the customer list. Besides, the system should allow the sales agent to add, edit and delete a customer.
4	Product Management	The system should store and display the product category and product list. Besides, the system should allow the administrator and sales agent to add, edit and delete a product category and product.
5	Sales Order	The system should store and display the sales order list, and it should allow the sales agent to add, view, print, and download a sales order.
6	Marketing Opportunity Management	The system should store and display the marketing opportunity list. Besides, the system should allow the sales agent to add, edit and delete a marketing opportunity. Then, the system should display the information in the customer development plan list whenever there is a record of marketing opportunity. The system should allow the sales agent to create a customer development plan by adding the action to be taken and the plan's effect. Then, the system should determine the customer development plan status.
7	Report	The system should generate sales reports and lead report.

Next, the third phase is the design phase. The system architecture is discussed and constructed at this stage. Flowcharts are created to have a better view of the overall system design. Besides, Data Flow Diagram (DFD) and Entity Relationship Diagram (ERD) are generated at this stage. These diagrams play a crucial role in helping to visualize and articulate the flow of data within the system and the relationships between different entities in the database.

During the implementation phase, the development of the eBACRM system progresses by referring to the diagrams created in the design phase. The system prototype undergoes thorough testing to ensure its functionality aligns with user requirements. Once this phase is complete, the system is deemed ready for operational use, having successfully met user needs. Additionally, AHP modeling is employed in this phase to enhance the customer development plan. AHP helps prioritize different aspects of the plan based on their importance, contributing to its refinement. The eBACRM system is built using HTML, CSS, PHP, and Javascript, with XAMPP serving as the web server for its implementation.

The testing phase is the last step for the prototyping model. The eBACRM system is tested right after the implementation phase. It is essential to test the system to ensure its functionality and overall performance. The system will repeat the testing step if any errors or defects are found until no errors or bugs are found. Later on, the end users will test the system to determine if the system satisfies the users' requirements. The result of the user testing will be recorded in a table form.

3.1 System Development Workflow

There are a total of five phases from the prototype model. As shown in Table 3, each phase has its own assignment and output that needs to be produced during the entire project development. Besides that, the output had been completed within the specific days that have been given.

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Table 3 *eBACRM System Development Workflow*

Phase	Task	Output
Planning	i. Proposed the project ii. Identify the existing problems, objectives and scope iii. Determine the project schedule, activities and output iv. Conduct interview session with stakeholders	i. Project proposal ii. Gantt Chart
Analysis	i. Analyse information obtained from interview ii. Review the existing systems iii. Analyse functional and non-functional requirements iv. Analyse hardware and software requirements	i. User and system requirements ii. Software and hardware requirements iii. Interview transcript
Design	i. Create flowcharts ii. Design user interfaces iii. Design Database	i. Flowchart ii. Data Flow Diagram iii. Entity Relationship Diagram iv. Database v. User Interfaces
Implementation	i. Develop the eBACRM System	i. System with complete functions ii. Program code
Testing	i. Test the system functionality	i. Test case results ii. Complete System

4. Result and Discussion

This section provides a comprehensive overview of the eBACRM System, covering its analysis, design, implementation, and testing phases.

4.1 System Analysis and Design

Fig. 2 shows the Context Diagram for the eBACRM system. Based on Fig. 2, the three external entities are the sales agent, the administrator, and the director. In the eBACRM system, the sales agent, administrator and director must fill in their username and password to log into the system.

The administrator can manage user accounts and sales agents, while both sales agents and administrators can handle suppliers, product categories, and products. Sales agents can manage customers, create sales orders and marketing opportunities, with the system storing all data. Additionally, the sales agents can develop customer strategies and track plan status. Lastly, sales agents and directors can request and view reports through the system.

Fig. 2 *Context Diagram for eBACRM System*

Fig. 3 shows the DFD Level 0 for the eBACRM System. There are three entities, which are sales agent, administrator, and director. Eleven processes are involved in DFD Level 0, which are login, manage user, manage sales agent, manage supplier, manage product category, manage product, manage customer, manage sales order, create marketing opportunity, construct customer development plan, and generate reports. Besides, there are ten data stores and each of the processes includes one data store except for the process of generating reports.

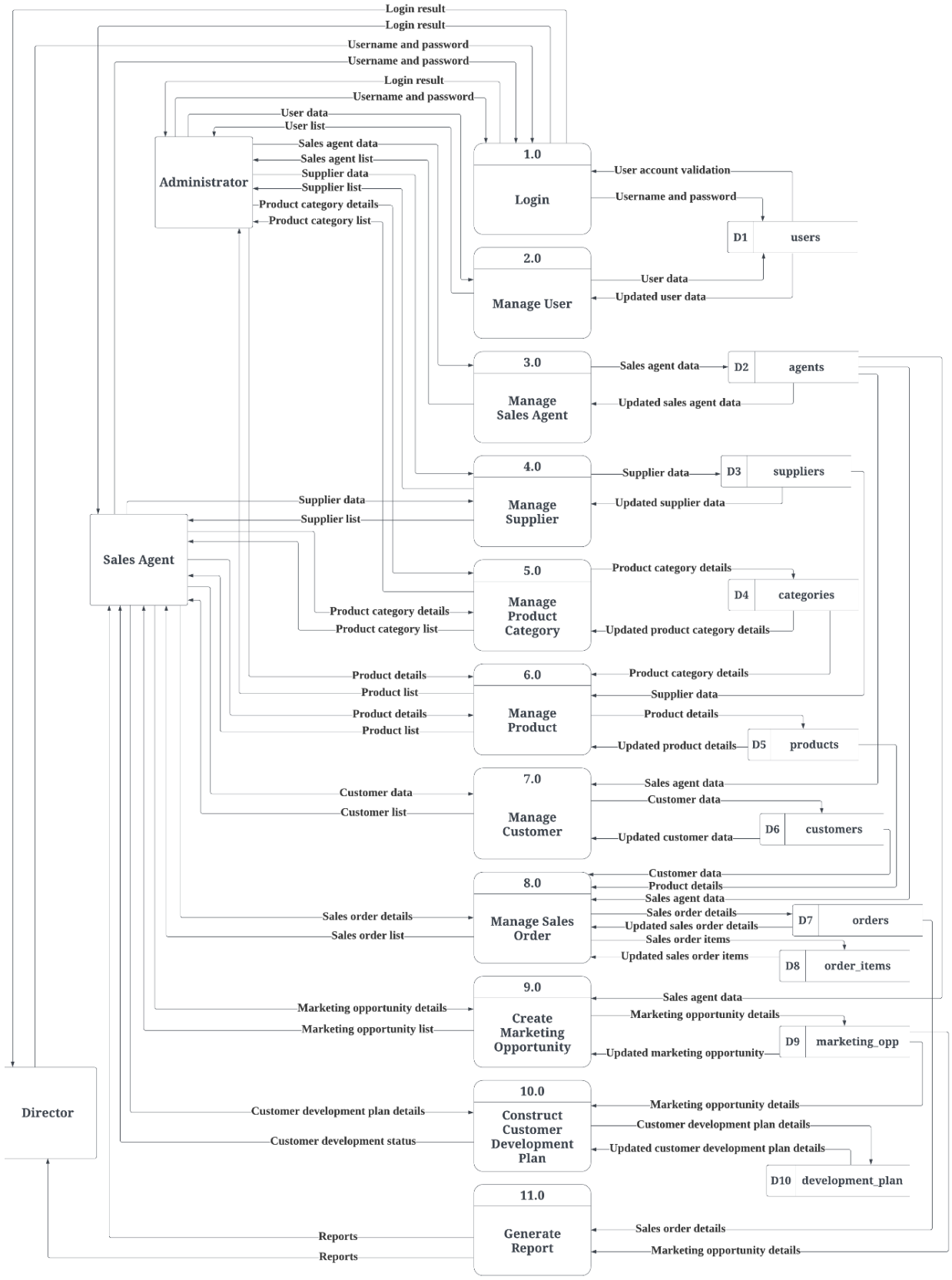


Fig. 3 *DFD Level 0 for eBACRM System*

The ERD serves as a visual representation of the eBACRM system's data model, illustrating entity organization, attributes, and relationships within the database. It comprises ten tables, including `users`, `agents`, `suppliers`, `categories`, `products`, `customers`, `orders`, `order_items`, `marketing_opp`, and `development_plan`. Primary keys (PK) uniquely identify records, while foreign keys (FK) establish relationships between tables. The `users` table stores user information, while the `agents` table manages sales agents. Suppliers are recorded in the `suppliers` table, and product categories in `categories`. Product details are stored in `products`, with customer information in `customers`. Orders and associated items are managed in `orders` and `order_items`. Marketing opportunities are tracked in `marketing_opp`, and customer development plans in `development_plan`. Each table's attributes and relationships are delineated, providing a comprehensive understanding of the system's database structure. Fig. 4 shows the ERD for the eBACRM System.

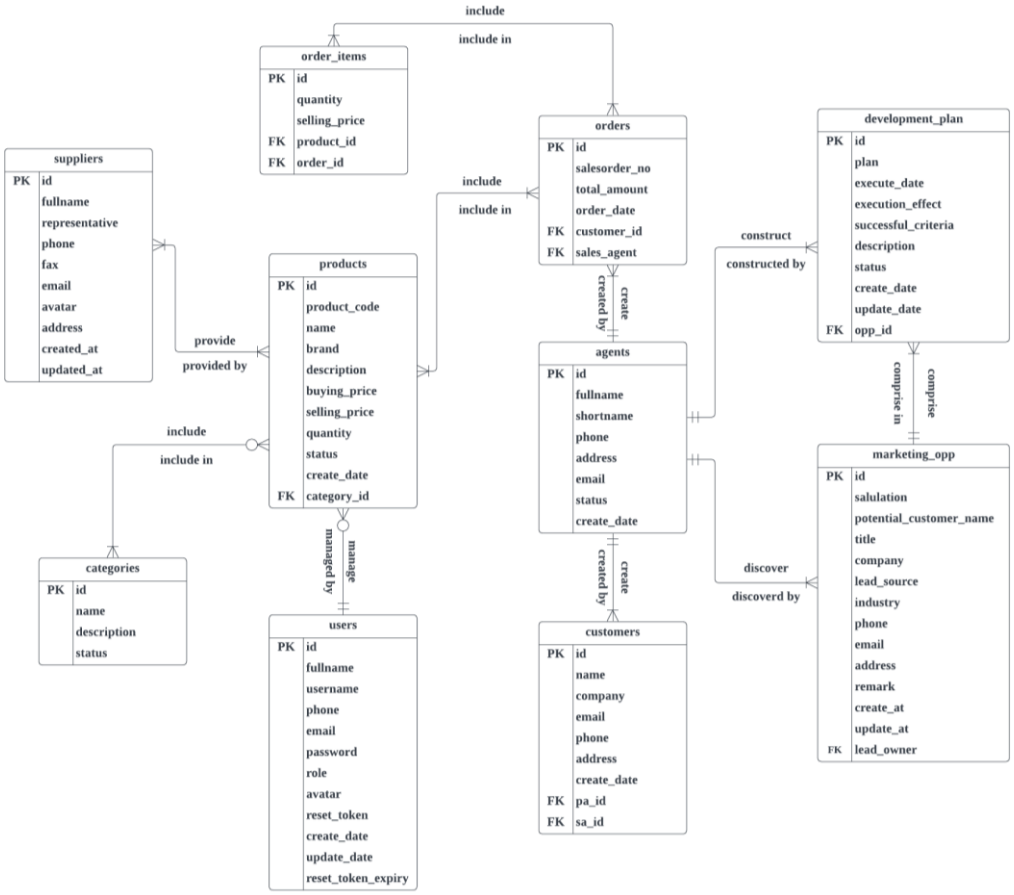


Fig. 4 *ERD for eBACRM System*

4.2 Interface Design

In this section, the interface design of the eBACRM system will be presented clearly. Fig. 5 shows the login interface for the eBACRM system. This is compulsory for every user to go through in order to access the system. If both username and password are correct, the system will redirect the user to the dashboard of the system, or else it will display an error message.

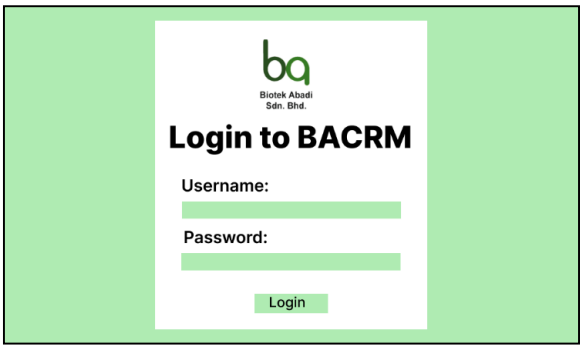
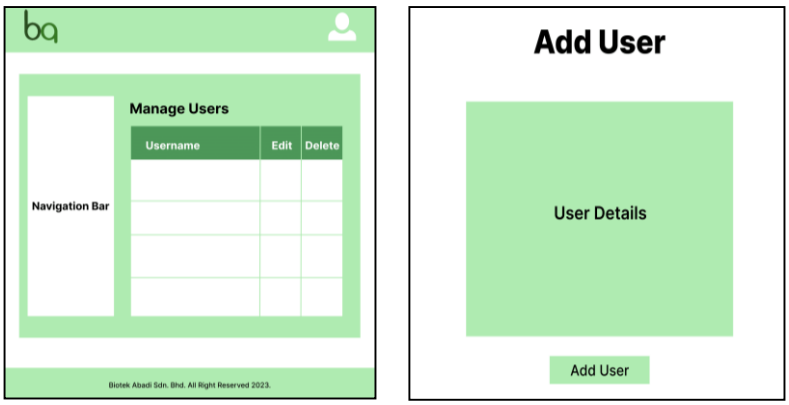


Fig. 5 *Login Interface for eBACRM System*

Fig. 6 shows the User Interface, where Fig. 6(a) is the Manage Users Interface while Fig. 6(b) is the Add User Interface. The Manage User Interface will show all the user details. The administrator can edit or delete the user account in this interface. Besides, the administrator can add a new user by entering the user details in the Add User Interface. The remaining interfaces are similar to the user interface.



(a) **(b)**

Fig. 6 *Users Interface (a) Manage Users; (b) Add Users*

4.3 Implementation

The implementation of the modules inside the eBACRM system will be discussed in this section.

4.3.1 Login Module

Fig. 7 shows the login interface for the eBACRM System. It provides a secure way for users to access their accounts using a username and password. Those without an account are advised to contact the administrator for registration.

Fig. 7 *Login Interface*

Incorrect credentials will trigger an error message. A "Forgot Password?" link helps users reset their passwords if needed. When a user clicks on the link, the system prompts them to enter the email associated with their username in order to receive a reset password email notification. Once the user clicks the reset password link in the email, they will be redirected to update their password. The user can use the new password to log into the system. Fig. 8 shows the reset password interface.

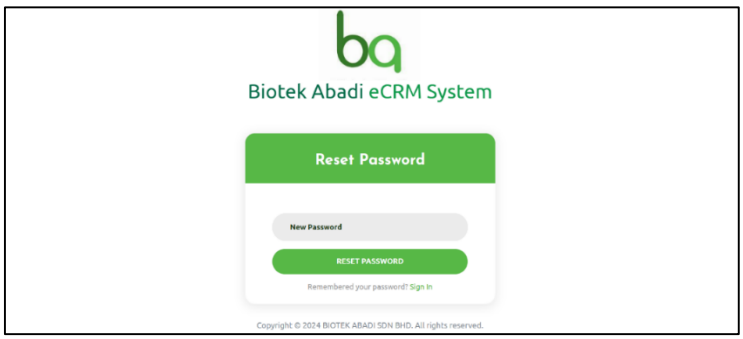


Fig. 8 *Reset Password Interface*

Successful logins redirect users to dashboards specific to their roles. There are three roles in total, which are administrator, sales agent and director**.** Fig. 9 shows the login algorithm.

Algorithms

Start

1. Check if the user has an existing account.

```
If user have an account
     Then proceed to the login process
Else
     click 'Forgot Password' button to prompt the user to provide their
     email and reset password
```

2. Validation check of user inputs for login

```
if(isset($_POST['login'])) {
    $username = validate($_POST['username']);
    $password = $_POST['password'];

    $query = "SELECT * FROM users WHERE username=? LIMIT 1";
    $stmt = mysqli_prepare($conn, $query);
    mysqli_stmt_bind_param($stmt, 's', $username);
    mysqli_stmt_execute($stmt);
    $result = mysqli_stmt_get_result($stmt);

    }
```

3. Check if the user is available in the database.

```
if ($result && mysqli_num_rows($result) == 1) {
        $user = mysqli_fetch_assoc($result);
        if (password_verify($password, $user['password'])) {
            // Password is correct, start a new session and save user data
            session_start();
            $_SESSION['user_id'] = $user['id'];
            $_SESSION['fullname'] = $user['fullname'];
            $_SESSION['username'] = $user['username'];
            $_SESSION['role'] = $user['role'];
            $_SESSION['avatar'] = $user['avatar'];
```

4. Redirect the user to the dashboard based on the user role.

```
switch ($user['role']) {
       case 'Administrator':
            redirect('admin/index-admin.php', 'Login Successful!');
            break;
       case 'Sales Agent':
            redirect('admin/index-agent.php', 'Login Successful!');
            break;
       case 'Director':
            redirect('admin/index-director.php', 'Login Successful!');
            break;
       default:
            redirect('login.php', 'Invalid role!');
            break;
```

End

Fig. 9 *Algorithm of Login*

4.3.2 User Management Module

Fig. 10 shows the add user page. Only the administrators have the authority to create new users within the system. The administrator can add a new user by clicking the "Add User" button on the user list page and entering the user details. The default password is set for every new user.

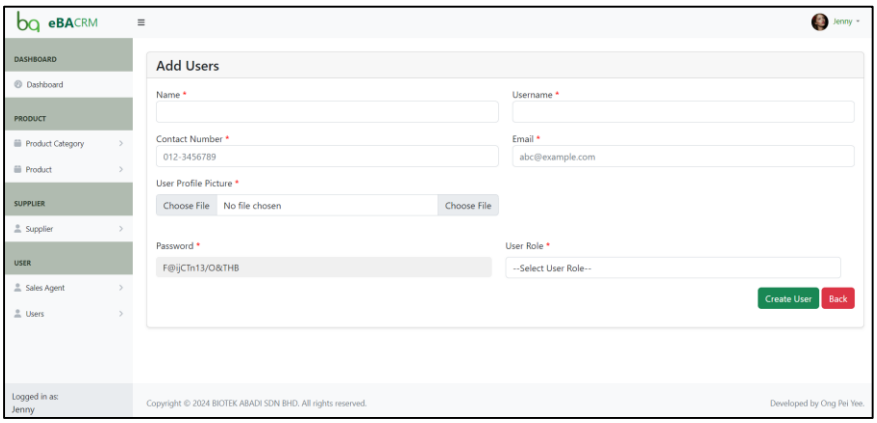


Fig. 10 *Add User Interface*

If a username already exists in the system, the administrator will receive an error message indicating that the chosen username is already in use. Upon successful creation of a user, the administrator is redirected to view the

newly created account. From this page, the administrator can send an email notification to the user regarding the account creation. However, the email notification can only be sent once. Fig. 11 shows the algorithm of the user registration.

Algorithms

Start

1. Check for existing accounts.

```
If the user already exists
      Then prompt error message of 'Username already exists!'
Else
      Enter name, username, contact number, email, password, user role, and
      image then click the 'Create User' button
```

2. Validation check of user inputs for registration

```
if (isset($_POST['saveAdmin'])) {
    $fullname = validate($_POST['fullname']);
    $username = validate($_POST['username']);
    $phone = validate($_POST['phone']);
    $email = validate($_POST['email']);
    $role = validate($_POST['role']);
    $password = password_hash($_POST['password'], PASSWORD_DEFAULT);
```

3. Create new user in the database.

```
$data = [
      'fullname' => $fullname,
      'username' => $username,
      'phone' => $phone,
      'email' => $email,
      'role' => $role,
      'avatar' => $new_avatar_name,
      'password' => $password
      ];
      $result = insert('users', $data);
```

End

Fig. 11 *Algorithm of User Registration*

The administrator can modify all user details within the system except for the username and password. This restriction ensures that sensitive credentials remain secure. After successfully updating a user's details, a message indicating "User Updated Successfully" is displayed.

The administrator can delete a specific user by clicking the "Delete" button on the user list page. This action permanently removes the user from the system, including all associated data and credentials. Before the deletion is finalized, the administrator is prompted to confirm the action to prevent accidental deletions.

4.3.3 Sales Agent Management Module

The administrators have access to manage sales agents within the system. The administrator can click on the "Add Sales Agent" button on the sales agent page to create a new sales agent. The administrator will receive an error message if the sales agent already exists in the system. Upon successful creation of a sales agent, the administrator will receive a success message and be redirected to the sales agent list. Fig. 12 shows the success message.

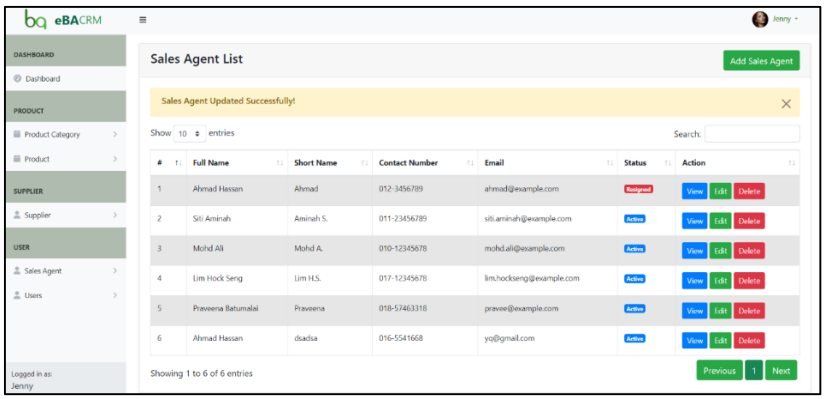


Fig. 12 *Sales Agent Updated Successfully Message*

The administrator can view the sales agent's details. Besides, the administrator can modify all sales agent details within the system. Once a sales agent's employment status is marked as "resigned", they are no longer eligible to be assigned as the owner of a sales order or lead. Fig.13 illustrates the algorithm for updating a sales agent.

Algorithms

Start

1. Check for an existing sales agent

```
if (isset($_POST['updateAgent'])) {
    $agent_id = validate($_POST['agent_id']);
    $existingAgent = getAgentByNameAndEmail($fullname, $email);
    if ($existingAgent && $existingAgent['id'] != $agent_id) {
        redirect('agents-edit.php?id=' . $agent_id, 'Sales Agent already
exists!');
```

2. Validation check of user inputs for updating sales agent

```
$fullname = validate($_POST['fullname']);
$shortname = validate($_POST['shortname']);
$phone = validate($_POST['phone']);
$email = validate($_POST['email']);
$address = validate($_POST['address']);
$status = isset($_POST['status']) == true ? 1 : 0;
```

3. Update sales agent in the database.

```
$result = update('agents', $agent_id, $data);

        if ($result) {
            redirect('agents.php', 'Sales Agent Updated Successfully!');
        } else {
            redirect('agents-edit.php?id=' . $agent_id, 'Something Went
Wrong!');
        }
```

End

Fig. 13 *Algorithm of Update Sales Agent*

The administrator can delete a specific sales agent by clicking the "Delete" button on the sales agent list page. Before the deletion is finalized, the administrator is prompted to confirm the action to prevent accidental deletions.

4.3.4 Supplier Management Module

This section showcases the Manage Supplier module. The administrator and sales agent have the authority to manage suppliers within the system. The users can create a new supplier by entering the new supplier's details after clicking the "Add Supplier" button.

If the supplier already exists in the system, the user will receive an error message. This prevents the creation of duplicate suppliers, ensuring that each supplier has a unique identifier within the system. Upon successful creation of a supplier, the user is redirected to the supplier list. The user can view the supplier details by clicking the "View" button. Fig. 14 shows the supplier details.

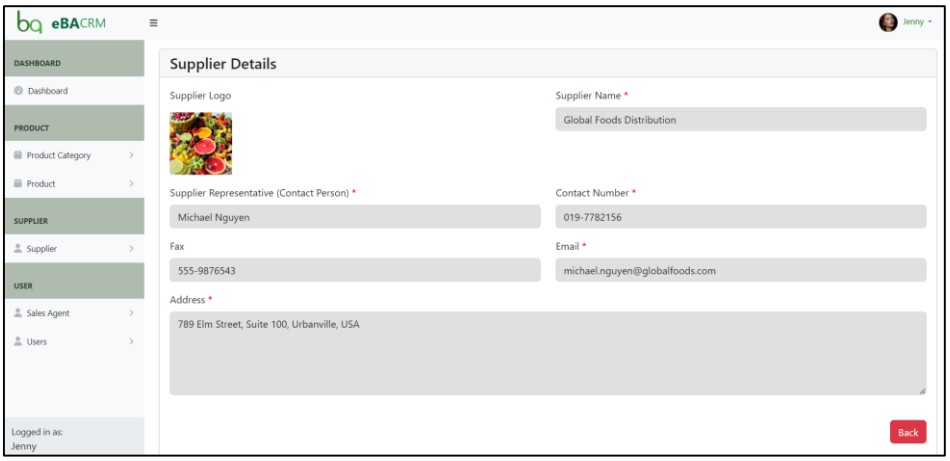


Fig. 14 *Supplier Details*

The user can modify all supplier details within the system. After successfully updating a supplier's details, a message indicating "Supplier Updated Successfully" is displayed. Besides, the user can delete a specific supplier by clicking the "Delete" button on the supplier list page.

4.3.5 Product Management Module

This section showcases the Product Management module. This module consists of two parts, which are the product category and product. The administrator and sales agent can manage product categories within the system. Both of them can add new categories by providing details, with error messages for existing categories.

After successful creation, the administrator and sales agent are directed to the category list, where they can view, update, or delete specific categories. Deletion requires confirmation to prevent accidental removal.

Next, the administrator and sales agent can manage products within the system. The administrator and sales agent must enter the new product's details in order to create a product. If the product already exists in the system, the user will receive an error message. Upon successful creation of a product, the administrator and sales agent are redirected to the product list. They can view the product details and update a specific product. Moreover, the administrator and sales agent can delete a specific product by clicking the "Delete" button on the product list page. Before the deletion is finalized, the user is prompted to confirm the action to prevent accidental deletions. Fig. 15 shows the deletion of the product, while Fig. 16 shows the algorithm of product deletion.

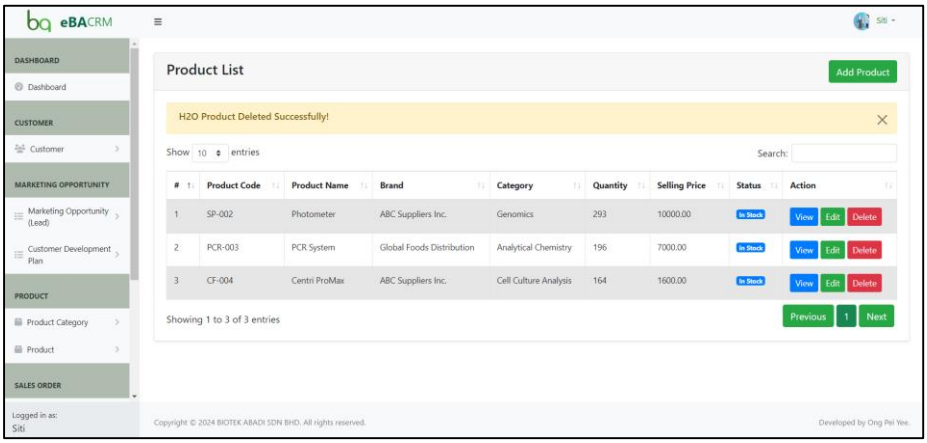


Fig. 15 *Product Deleted Successfully*

Algorithms

Start

1. Check for the product id in database

```
$paraResultId = checkParamId('id');
```

2. Validation check of user inputs for deleting product

```
if(is_numeric($paraResultId)){
    $productId = validate($paraResultId);
    $product = getById('products', $productId);
```

3. Delete the product from the database.

```
if($product['status'] == 200){
   $response = delete('products', $productId);
   if($response){
       redirect('products.php', "{$product['data']['name']} Product Deleted
       Successfully!");
```

End

Fig. 16 *Algorithm of Product Deletion*

4.3.6 Sales Order Management Module

The sales agent can manage the sales orders within the system. Meanwhile, the sales agent can search for specific sales orders according to order date and sales agent on this page. Fig. 17 shows the sales order list.

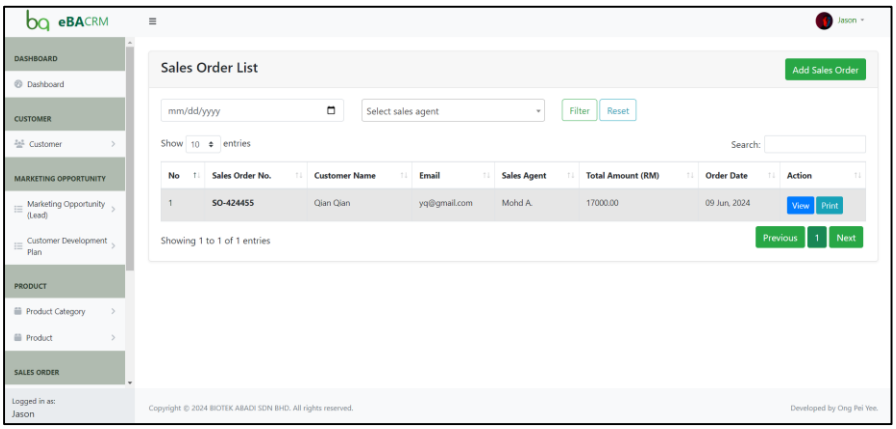


Fig. 17 *Sales Order List*

The sales agent can create a new sales order by selecting the product from the product list and specifying the quantity. Next, the sales agent needs to choose the appropriate sales agent from a dropdown menu and enter the customer's email address to complete the order. Fig.18 shows the add sales order interface.

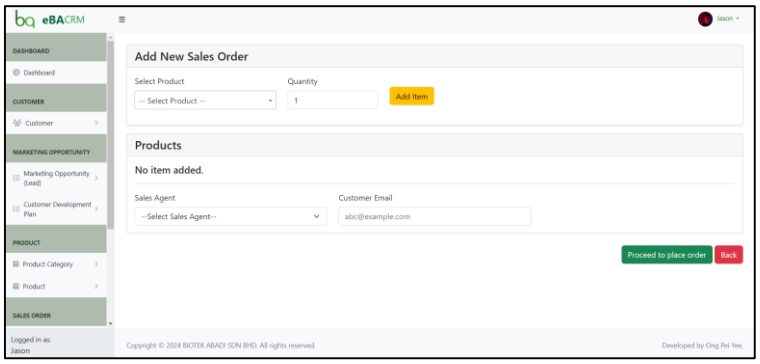


Fig. 18 *Add Sales Order*

If the quantity entered exceeds the available stock, an error message will be displayed, indicating insufficient stock. Once the sales agent adds an item, a success message confirming the addition will be displayed. An error message will be displayed if the sales agent attempts to proceed to place the order without selecting a sales agent for the sales order. Besides, if the sales agent enters an invalid email address that does not follow the correct format, an error message will be displayed. An error message will be displayed if the customer's email is not found. The sales agent can add new customer details directly in the prompt modal.

After inputting all order details, the sales agent can proceed to finalize the order by clicking the "Proceed to Place Order" button. An order summary is displayed to the sales agent. The sales agent is required to review all the details of the sales order before proceeding. The sales agent has the option to press the "Back to create order" button for any modification. Fig. 19 shows the order summary page.

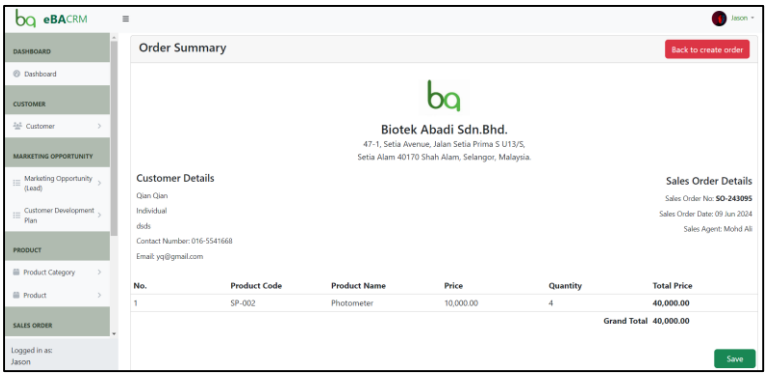


Fig. 19 *Order Summary*

After saving the sales order, the sales agent can easily access it for further actions. They have the option to view the details within the system, print a hard copy if needed, or download the file for offline use or sharing. This flexibility enables efficient management of sales orders according to the sales agent's preferences. Fig. 20 shows the algorithm of sales order creation.

Algorithms

Start

1. Validation check of user inputs for product id and quantity

```
if (isset($_POST['addItem'])) {
    $productId = validate($_POST['product_id']);
    $quantity = validate($_POST['quantity']);
```

2. Check the product stock availability

```
If the product added is more than the available product stock
   Then
   redirect('orders-create.php', 'Only ' . $productData['quantity'] . '
quantity available for ' . $productData['name'] . '!');
Else
   ($_SESSION['productItems'] as $key => $prodSessionItem) {
     If ($prodSessionItem['product_id'] == $productData['id']) {
       $newQuantity = $prodSessionItem['quantity'] + $quantity;
       if ($newQuantity > $productData['quantity']) {
          redirect('orders-create.php', 'Requested quantity exceeds
available quantity for ' . $productData['name'] . '!');
       }

       $productItem['quantity'] = $newQuantity;
       $_SESSION['productItems'][$key] = $productItem;
```

Fig. 20 *Algorithm of Sales Order Creation*

3. Validation check of user inputs for sales agent id and customer email

```
if (isset($_POST['proceedToPlaceBtn'])) {
  $email = validate($_POST['cemail']);
  $sales_agent = validate($_POST['sales_agent']);      'status' => $status,
  ];
$result = insert('products', $data);
```

4. Check the customer data

```
$checkCustomer = mysqli_query($conn, "SELECT * FROM customers WHERE email=
'$email' LIMIT 1");
If customer is not in the database
   Then
   $_SESSION['cemail'] = $email;
   jsonResponse(404, 'warning', 'Customer Not Found');
Else
jsonResponse(200, 'success', 'Customer Found');
```

5. Calculate the total amount

```
$sessionProducts = $_SESSION['productItems'];
$totalAmount = 0;
foreach($sessionProducts as $amtItem) {
   $totalAmount += $amtItem['selling_price'] * $amtItem['quantity'];
```

6. Save the sales order

```
$data = [
  'customer_id' => $customerData['id'],
  'salesorder_no' => $salesorder_no,
  'total_amount' => $totalAmount,
  'sales_agent' => $sales_agent,
  'order_date' => date('Y-m-d'),
  ];
  $result = insert('orders', $data);
```

End

Fig. 20 *Algorithm of Sales Order Creation (cont.)*

4.3.7 Marketing Opportunity Management Module

The marketing opportunity is also known as the lead in this case. There are two parts in this module which are the marketing opportunity and customer development plan. The sales agent can manage products within the system. The sales agent can create a new marketing opportunity by entering the new marketing opportunity details. Fig. 21 shows the add lead interface.

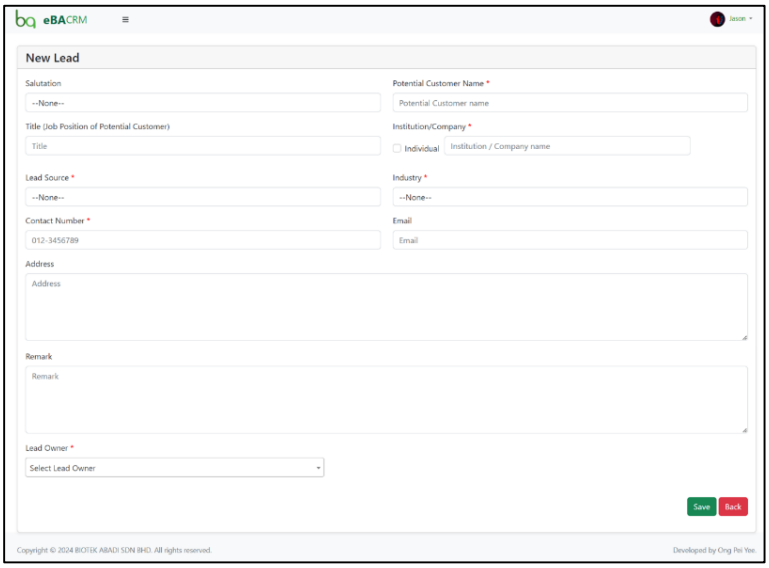


Fig. 21 *Add Lead*

If the lead already exists in the system, the sales agent will receive an error message to prevent the creation of duplicate leads. Fig. 22 shows the marketing opportunity module algorithm, outlining the steps for creating a marketing opportunity within the system.

Algorithms

Start

1. Validation check of user inputs for lead creation

```
if (isset($_POST['saveLead'])) {
 $salutation = validate($_POST['salutation']);
 $potential_customer_name = validate($_POST['potential_customer_name']);
 $title = validate($_POST['title']);
 $company = $_POST['individualCheckbox'] === 'off' ?
validate($_POST['company']) : 'Individual';
 $lead_source = validate($_POST['lead_source']);
 $lead_owner = validate($_POST['lead_owner']);
 $industry = validate($_POST['industry']);
 $phone = validate($_POST['phone']);
 $email = validate($_POST['email']);
 $address = validate($_POST['address']);
 $remark = validate($_POST['remark']);
```

2. Check existing lead

```
$existingLead =   getLeadByNameAndCompany($potential_customer_name,
$company);;
   if ($existingLead) {
       redirect('opportunities-create.php', 'Lead already exists!');
```

```
3.    Create new lead in the database.
      $data = [
            'salutation' => $salutation,
            'potential_customer_name' => $potential_customer_name,
            'title' => $title,
            'company' => $company,
            'lead_source' => $lead_source,
            'lead_owner' => $lead_owner,
            'industry' => $industry,
            'phone' => $phone,
            'email' => $email,
            'address' => $address,
            'remark' => $remark
            ];
      $result = insert('marketing_opp', $data);
End
```

Fig. 22 *Algorithm of Marketing Opportunity Creation (cont.)*

Besides, the sales agent is able to update a lead by clicking the "Update" button. Moreover, the sales agent can delete a specific lead. Before the deletion is finalized, the sales agent is prompted to confirm the action to prevent accidental deletions.

The customer development plan module will extract data from the marketing opportunity module. The sales agent can only add plans for potential customers within the marketing opportunity module. Fig. 23 shows the customer development plan list.

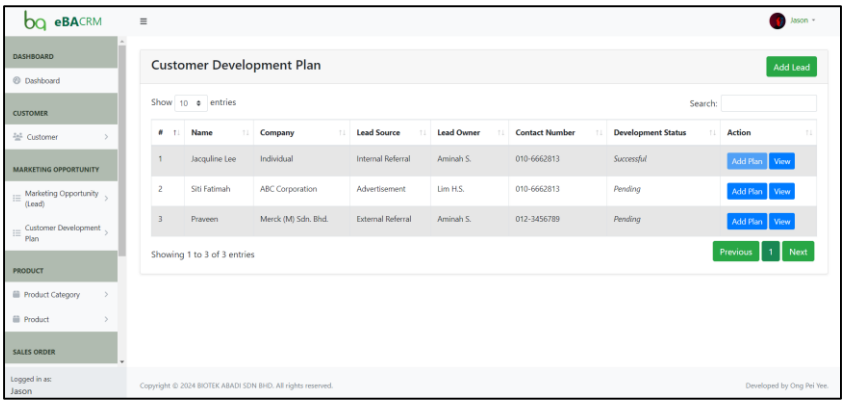


Fig. 23 *Customer Development Plan List*

The sales agent can create a new plan for the specific potential customer. However, if the development plan status for the potential customer is marked as successful or unsuccessful, the sales agent will no longer have the ability to add a plan for them. Fig. 24 shows the add plan page. The sales agent is required to enter the customer development plan, select the date to execute the plan and the execution effect, and also the description regarding the details of the plan.

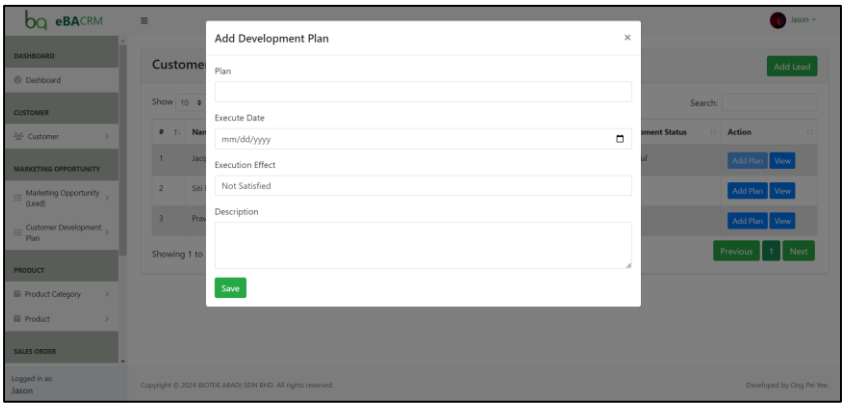


Fig. 24 *Add Customer Development Plan*

If the sales agent selected the execution effect as "Satisfied", the sales agent is required to further select the successful criteria. Subsequently, the system will compute the final customer development plan status based on the execution effect. The AHP model is employed for this purpose, ensuring a comprehensive evaluation process. Fig. 25 shows the customer development plan creation algorithm.

Algorithms

Start

1. Validation check of user inputs for plan creation

```
if ($_SERVER["REQUEST_METHOD"] == "POST") {
    $opp_id = $_POST['opp_id'];
    $plan = $_POST['plan'];
    $execute_date = $_POST['execute_date'];
    $execution_effect = $_POST['execution_effect'];
    $description = $_POST['description'];
```

2. Save the plan in the database

```
$stmt = $conn->prepare("INSERT INTO development_plan (opp_id, plan,
execute_date, execution_effect, successful_criteria, description, status)
```

3. Calculate the successful criteria

```
$status = calculateStatus($opp_id);
$successful_criteria = '';
if (isset($_POST['criteria1']) && $_POST['criteria1'] === 'yes') {
   $successful_criteria .= 'Customer interested with our company. ';
}
if (isset($_POST['criteria2']) && $_POST['criteria2'] === 'yes') {
  $successful_criteria .= 'Customer interested with specific product. ';
}
if (isset($_POST['criteria3']) && $_POST['criteria3'] === 'yes') {
  $successful_criteria .= 'Customer request for quotation. ';
}
```

End

Fig. 25 *Algorithm of Customer Development Plan Creation*

In order to classify the potential customer as successfully developed, three criteria of success must be met. The three success criteria include 'Customer interested with our company. ', 'Customer interested with specific product. ' and 'Customer request for quotation. '. Nevertheless, when the execution's effectiveness falls below satisfactory levels on five occasions, the potential customer will be classified as development unsuccessful. Fig. 26 shows the details of the unsuccessful customer development plan.

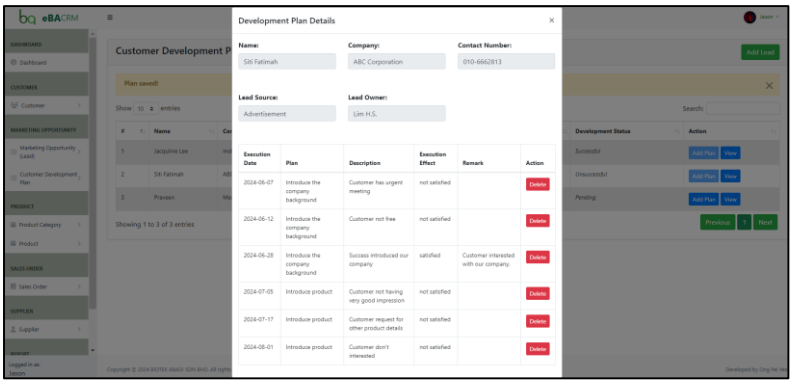


Fig. 26 *Unsuccessful Customer Development Plan Details*

The sales agent is able to delete a specific plan detail. The system will automatically reassess the final status of the customer development plan in response to any modifications. Fig. 27 shows the algorithm of customer development plan deletion.

Algorithms

Start

1. Check for the plan id in database

```
$paraResultId = checkParamId('id');
```

2. Validation check of user inputs for deleting a plan

```
if ($_SERVER['REQUEST_METHOD'] == 'POST') {
    $plan_id = $_POST['plan_id'];
```

3. Delete the plan from the database.

```
$query = "DELETE FROM development_plan WHERE id = ?";
    $stmt = $conn->prepare($query);
    $stmt->bind_param('i', $plan_id);
    if ($stmt->execute()) {
        echo json_encode(['status' => 'success', 'message' => 'Plan deleted
successfully.']);
    } else {
        echo json_encode(['status' => 'error', 'message' => 'Failed to
delete plan.']);
    }
    $stmt->close();
} else {
      echo json_encode(['status' => 'error', 'message' => 'Invalid
      request.']);
```

End

Fig. 27 *Algorithm of Customer Development Plan Deletion*

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4.3.8 Report Module

The director and sales agent can view reports within the system. There are three main reports available which are the total sales report, the sales agent's total sales report, and the lead report. Each report can be printed or downloaded. Fig. 28 shows the total sale report.

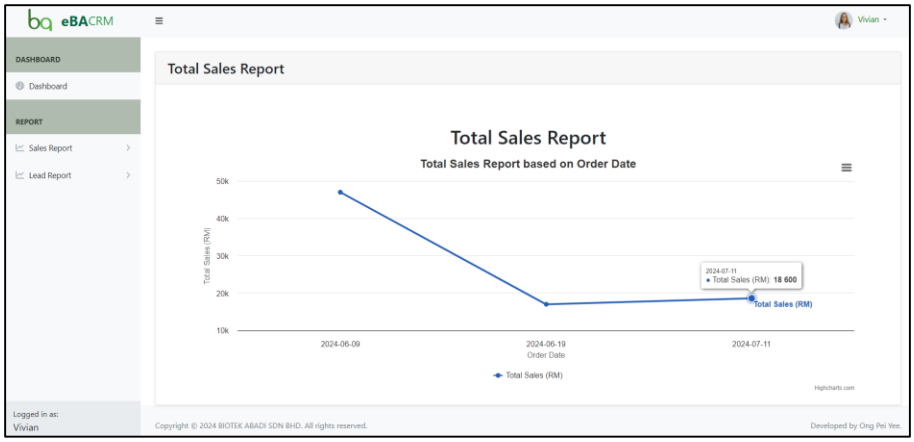

Fig. 28 *Total Sales Report*

Fig.29 presents the lead report, focusing on quantifying the quantity of marketing opportunities discovered by each sales agent. This report tracks and assesses individual sales agents' effectiveness in identifying potential marketing prospects.

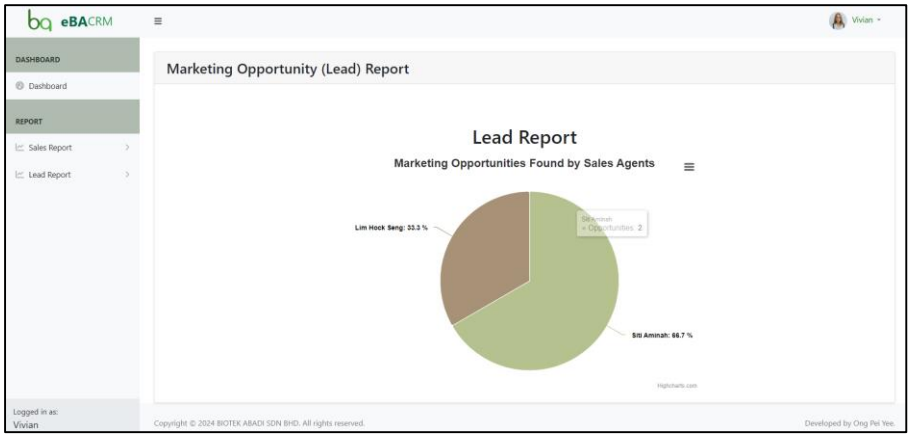

Fig. 29 *Lead Report*

4.4 System Testing

Implementing a testing phase for each module is aimed at improving the overall quality and reliability of the web application development process. This phase involves thorough testing of each module to detect and address any possible issues or flaws prior to deployment.

A total of 89 test cases were conducted across all modules of the system. Each module successfully passed its respective test cases, demonstrating the system's full functionality and reliability. This extensive testing process verifies the system's readiness for deployment and operational use. Table 5 shows the summary table of test case results.

Table 5 *Summary Table of Test Case Results*

No.	Modules	Total Test Cases	Total Pass	Total Fail
1	Login	5	5	-
2	User Management	9	9	-
3	Sales Agent Management	8	8	-
4	Supplier Management	8	8	-
5	Product Category Management	8	8	-

Table 5 *Summary Table of Test Case Results (cont.)*

No.	Modules	Total Test Cases	Total Pass	Total Fail
6	Product Management	8	8	-
7	Customer Management	8	8	-
8	Sales Order Management	9	9	-
9	Marketing Opportunity Management	8	8	-
10	Customer Development Plan Management	10	10	-
11	Report	8	8	-

5. Conclusion and Recommendation

In summary, the development and integration of the eBACRM System marks a significant advancement for BASB. The project's primary objective was to tackle BASB's issues with managing customer interactions and sales operations effectively by developing the eBACRM system. This system aims to streamline processes, improve customer management, and support data-driven decision-making. By providing real-time access to comprehensive customer data and sales analytics, BASB can make informed decisions, identify sales opportunities, and tailor marketing strategies more effectively. The system's user-friendly interface and intuitive features ensure easy adoption by sales agents and administrators, reducing training time and boosting productivity. Additionally, eBACRM enhances sales activity visibility by tracking sales pipelines, monitoring performance metrics, and generating detailed reports, thereby aiding strategic planning and business growth.

However, the system also has certain drawbacks. A notable drawback is the inability to modify or cancel sales orders. Another disadvantage is the rigid role-based access, which prevents customization of access permissions for different user roles, limiting the system's adaptability to changing user responsibilities. Additionally, concerns about data security and privacy regarding the storage of sensitive customer information and ongoing maintenance costs pose further challenges for BASB.

To address these limitations, several recommendations are proposed for future improvements. Adding features that allow for the cancellation or editing of sales orders would enhance flexibility. Introducing customizable role-based access permissions would offer greater adaptability to evolving organizational needs.

Upon successful implementation, eBACRM is poised to transform BASB's CRM processes by reducing time spent on tasks such as information retrieval and providing a centralized hub for managing customer data. The expected benefits include heightened productivity, streamlined workflows, and improved analytical capabilities, facilitating more informed decision-making. The eBACRM system reflects a commitment to innovation and efficiency within the dynamic landscape of business technology.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Ong Pei Yee, Rosmamalmi Mat Nawi;* ***data collection:*** *Ong Pei Yee, Rosmamalmi Mat Nawi, Ng Jie Kai;* ***analysis and interpretation of results:*** *Ong Pei Yee, Rosmamalmi Mat Nawi;* ***draft manuscript preparation:*** *Ong Pei Yee, Rosmamalmi Mat Nawi. All authors reviewed the results and approved the final version of the manuscript.*

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