Application of Product Data Management at MIMOS Bhd

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Abstract

Bill of Material (BOM) is an important technique document of the product structure that lists all the materials needed to produce an end product. The existing system available at MIMOS Bhd is capable of processing online forms for handling various ID requests, data submission and Engineering Change Notice (ECN) requests. However the challenge is to manage the multiple changes to the BOM while remaining consistent and accurate using the existing process. Many problems arose from duplications of parts' ID and parts' descriptions hence a need for a centralized and organized solution. An online system that can monitor BOM's updates correctly and that can solve centralize storage issues is proposed. Product data management (PDM) is adopted to manage product data and process-related information in a single centralized system. This will provide solutions for online data management, process enablement and change management, hence eliminating existing errors related to product data.

Keywords: Product Data Management (PDM), Bill of Material (BOM), Engineering Change Notice (ECN)

1. Introduction

BOM (Bill of Material) is an important technique document of the product structure that is part of the production data management system [1]. It holds valuable characteristic information of each component. For example, the drawing number of component, the request of assembly, the criterion of technology, the demand of customer, the standard of quality, the data of supplier, the standard of tolerance, the data of the purchasing price, the quotation of supplier, the replacement of part, the structural validity and the cross-reference for marked document.

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The existing system available at MIMOS Bhd is capable of handling online forms for various ID requests, data submission and Engineering Change Notice (ECN) requests. However the challenge is to manage the multiple changes to the BOM while remaining consistent and accurate using the existing process. Many problems arose from duplications of parts' ID and parts' descriptions hence the need for a centralized and organized solution is imminent.

The motivation of this project is to create an online system to monitor BOM's updates and to centralize the storage of BOMs. This way, the duplication problems can be overcome. It is difficult to find an existing tool that can fully provide automatic solutions for managing the document lifecycle, especially during reviews and approval process, hence the needs to develop our own system for that. In this project we have developed an online system to monitor all BOMs updates and at the same time to centralize the storage.

Product data management (PDM**)** makes use of software to handle overwhelming product definition data stored using many formats in various locations [2]. It can manage product data and process-related information in a single, centralized system. This information includes computer-aided design (CAD) data, models, parts information, manufacturing instructions, requirements, notes and documents. The ideal PDM system is accessible by multiple applications and multiple teams across an organization, and supports business-specific needs. Choosing the right PDM software can provide a company in any industry with a solid foundation that can be easily expanded into a full product lifecycle management (PLM) platform. At its core, a PDM system provides solutions for secure data management, process enablement, and configuration management [3]. PDM originates from engineering design activities using CAD to create BOM (part lists). To date, many companies are adopting Product Data Management (PDM) to help improve work productivity by managing product data and documents. However, they still lack the capability to share the artifact design and documents efficiently, thus affecting the revision control and engineering change in the workflow process.

This paper will start with the literature review of the existing system. The second section will elaborate on the development of MiPDM, followed by the discussion in the third section. We will end this paper with an evaluation section and present our conclusions.

2. Literature Review

We will first discuss the existing system at MIMOS Bhd. Then we will define Bill of Material, Product Lifecycle Management and Product Data Management, before performing the gap analysis on existing tools to create the online system.

CSC/PAL (Central Specification Control/Process Asset Library) Portal is a semi-manual system available at Mimos Bhd. This portal was developed using SharePoint and has been running since 2006. In 2010 it was enhanced with online forms

capability. However, this system is not user friendly when it comes to handling various requests of ID, data submission, data request and Engineering Change Notice (ECN) request [3]. It is also incapable to auto generate email to update the requesting party on any activity related to the request.

Based on the following figure, the process starts when a user logs into the CSC portal and selects any transaction such as data request. After filling up the required information on the online form, the form will be sent to the CSC admin via e-mail. Then, CSC admin will check the email received from SharePoint and processes the request according to the standard practice defined in the portal's procedure and guidelines manually. Therefore there are times that a specific request cannot be entertained immediately if the CSC admin is not available at that instance.

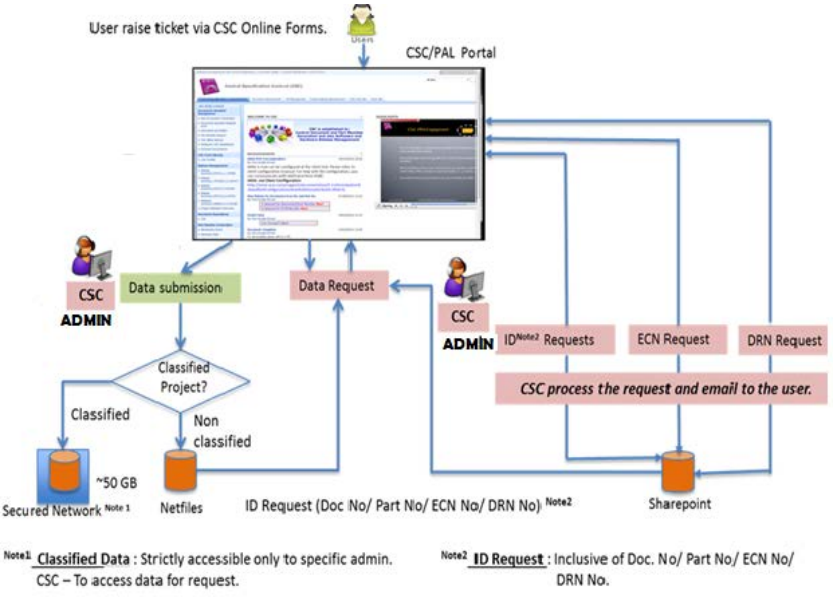

Figure 1: CSC/PAL Portal process

A. *Bill of Material (BOM)*

BOM consists of an ordered list of the parts, sub-assemblies, assemblies, and raw materials that are needed to realize a product. It is created and maintained within the project structure management function where the type, number, quantity, and relationships of parts and assemblies are defined [1].

Before there is enough product information for a formal BOM to be generated, product designers can capture conceptual product definitions as product structures. Product structures may contain requirements, drawings, rough sketches and other documents in a hierarchical representation that reflects a logical breakdown of the

product into components. The product structure typically comes before final specifications are developed and formal part numbers are defined.

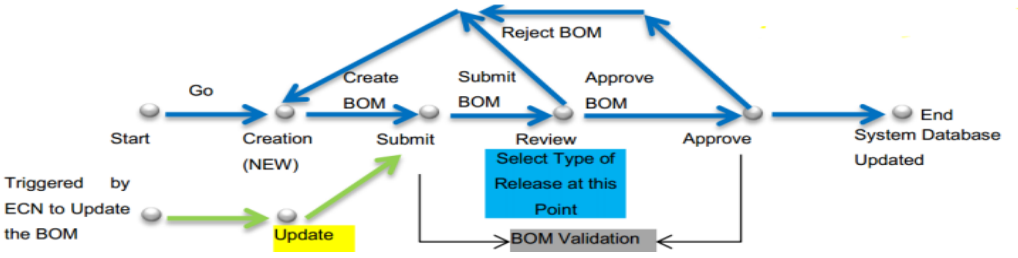

Figure 2: BOM configuration workflow

Figure 2 shows the flow of the BOM configuration workflow states. It starts with the creation of a new BOM followed by the main standard template. BOM consists of an ordered list of the parts, sub- assemblies, assemblies and raw material that define a product. It was created and maintained within the Project Structure Management function. BOM also defines the types, numbers, quantity and relationships of parts and assemblies.

i. Creation (New) - The configuration workflow starts from the creation a new BOM which include the Product Kit, Finished Good, Master Assembly and Sub Assembly. The creation and configuration of the Mechanical BOM is done precisely by selecting the data from the database and converting the existing BOM in MsExcel format into the BOM format.

ii. Update - The trigger point to update the approved BOM is through the ECN. By updating means that the BOM Change History and the graphical BOM comparison report are created.

iii. Submit and Review State - In the 'Submit' phase, user / BOM creator selects the type of release of the BOM. The 3 types of BOM releases during the user's check-in the BOM into the system at Submit for Review state are:
- Type of Release 1: Engineering Built / Prototype Built
- Type of Release 2: Pilot Run
- Type of Release 3: Mass Production.

iv. BOM Validation - For the validation state, the function is to indicate or to flag any missing designator in the BOM, to validate and to report the quantity of items listed in the BOM, to compare multiple BOMs and to produce a BOM comparison report and to list down the ECNs created for the particular BOM

v. System Database Updated - Once the BOM is approved, the revision of the BOM is updated (i.e. A1, A2, A3 to An). The approved BOM (officially released) is then stored into the database according to the different Product Lifecycle Stages (Engineering & Prototype Built / Pilot Run / Mass Pro). A notification is sent to the BOM creator, reviewer and approver after the BOM is successfully stored into the database. (i.e The BOM ID:_____ is available in the database for reference).

The lifecycle of the BOM ends only after BOM has been approved.

B. Product Lifecycle Management (PLM)

[4] defines PLM as a set of business approaches that supports the collaborative creation, management, dissemination and use of product definition information, while [5] described PLM as an integrated approach that, with information technology aid, realized and integrated cooperative and collaborative information product management during all the life cycle. [6] says that a PLM method must fulfill and make accessible for all information produced during all phases of the product life cycle for all stakeholders of the organization.

According to [7][8], delivering the right product to market is only half the battle today's product makers are facing. Best-in-class companies employ lean manufacturing and design for manufacturing initiatives to optimize the product lifecycle's downstream processes. Therefore, the authors concluded that, PLM is about managing the lifecycle of the product from engineering design until hardware manufacturing. It is useful to the organization to decrease complexity and engineering challenges to develop a new product for the competitive world market.

C. Product Data Management (PDM)

One of the core elements of the PLM is Product Data Management (PDM). PDM is going to be used to solve the problem in MiPDM. Product Data Management (PDM) began in the 1980s and rapidly developed in the 1990s. It takes software technologies as the basics and it takes the product as the core. Through it, the data, process and resources relative to the product are managed in a unified manner. And it can regulate the product lifecycle management; ensures the coherence and traceability of the product data and gives correct information to the proper person by correct modes. It has been an important platform for modem enterprise information construction [9][10] [11].

According to [12], the main usage of PDM is to organize the data, to keep and to control all the data related to the manufacturing product during product design in life

cycle management. [13] agrees that the aim for the PDM is to resolve the problem of the product data management. It is suitable for people from any division, department to be involved in the design, development process and work flow of the product throughout this life cycle product. In the enhanced world of the web-technology, it is important to maintain information connection across the globe.

With the help of web-technology, it is possible to establish information connectivity across a world of diversity. Hence, the complex and dynamic environment can be handled using PDM.

The benefit of using the PDM system as mention by [14][15] are:

i. Interdisciplinary collaboration.
ii. Reduced product development cycle time.
iii. Improved project management
iv. Improved life cycle design
v. Supply chain collaboration.

Needless to say that, the PDM is the choice that looks the best to solve the problem of product data management in MIMOS. If we can see the benefit using PDM is reducing product development cycle time that means we can manage the lifecycle of the product properly.

D. Analysis of Existing Product Lifecycle Management (PLM) Tools.

Many tools are available to support PLM. Among them are ARAS Innovator, Windchill Intralink and Manufacturing Execution System (MES). Descriptions of each of these tools are presented in the following sub-sections:

1) *ARAS Product Lifecycle Management*

ARAS Product Lifecycle Management is a product of ARAS Corp. This tool is used to bring solutions to manage BOM, CAD File Management, Configuration Management, Document Management and Product Management [16]. ARAS PLM can fulfill all MiPDM's requirements.

2) *Windchill PLM*

The tool is for Industry Standard Solution to manage concurrent design teams & the Pro-Engineer/ Creo Tools. Windchill Intralink is used by the Mechanical Department to handle the CAD Data Management. Windchill Product Lifecycle Management (PLM) is offered by PTC Company and it helps manufacturers to

manage their products going through all the phases of the product lifecycle as the central repository for all the product-related information [17]. It has the capabilities to help manufacturers manage their products through all phases of the product lifecycle and bring products to market faster, improves quality and performance and reduces risk.

3) *Manufacturing Execution System (MES)*

MES control system is built to manage and to monitor the work-in-process in a factory. The only usage of MES is to keep track of all engineering information in real time and to receive minute update data from robots, machines monitors and workers [18]. MES is used by the wafer fabrication team as a manufacturing facility to support and to control system in order to manage and to monitor work-in-process on the factory floor. It has the feature MiPDM wants, which is the ability to manage the document and product data.

E. Comparison of ARAS Innovator, Windchill Intralink and MES

In order to select the most suitable tool, a comparison among three different tools based on the requirements of MiPDM was conducted. Customization can be done after the deployment of the tool. The configuration Management of BOM is based on the

BOM contents, BOM validation, management of BOM & Product Structure and Viewing BOM. All three tools have the features required for the BOM configuration management. However only ARAS PLM has the capability to integrate the BOM Data Management which includes the management of Mechanical BOM-ProENGINEER, Management of Electrical BOM (PCB Design, Electronic and Electricals), Linking MIMOS Software/ Firmware BOM-Software development tools and Management Product related document and files. MES is not capable to do the Management of Mechanical products. Even though Windchill PLM has this feature, the product is not readily available at MIMOS and had to be purchased.

As the aim of this project is to ensure all the MIMOSians can use MiPDM, the management had to make a decision to choose a tool that is of reasonable price when purchasing for full license. ARAS PLM met MIMOS requirements besides its reasonable cost & potential in-house customization capability. It can also control all the relevant tools in MIMOS. Furthermore ARAS PLM was suggested because of the customization capability, so that the tool can be customized to follow the user requirements.

3. The MiPDM Development

E. Introduction to MiPDM System

MiPDM stand for MIMOS Product Data Management. MiPDM is a system that manages all MIMOS documents, project/product related data and the processes to the management of the document and data. MiPDM is customized using PLM specific application, consisting of six modules as shown in Table 1.

Table 1: MiPDM modules

No	Modules	Descriptions
1	Module A	System Requirements and Database Requirements
2	Module B	Item Management &Classification (Inclusive of the Identification Number Generation for Document, Part & Product).
3	Module C	Document Management System.
4	Module D	Product Data Management.
5	Module E	BOM Configuration & Management.
6	Module F	Change Configuration & Management.

MiPDM is used to serve user according to the following functional activities depicted below.

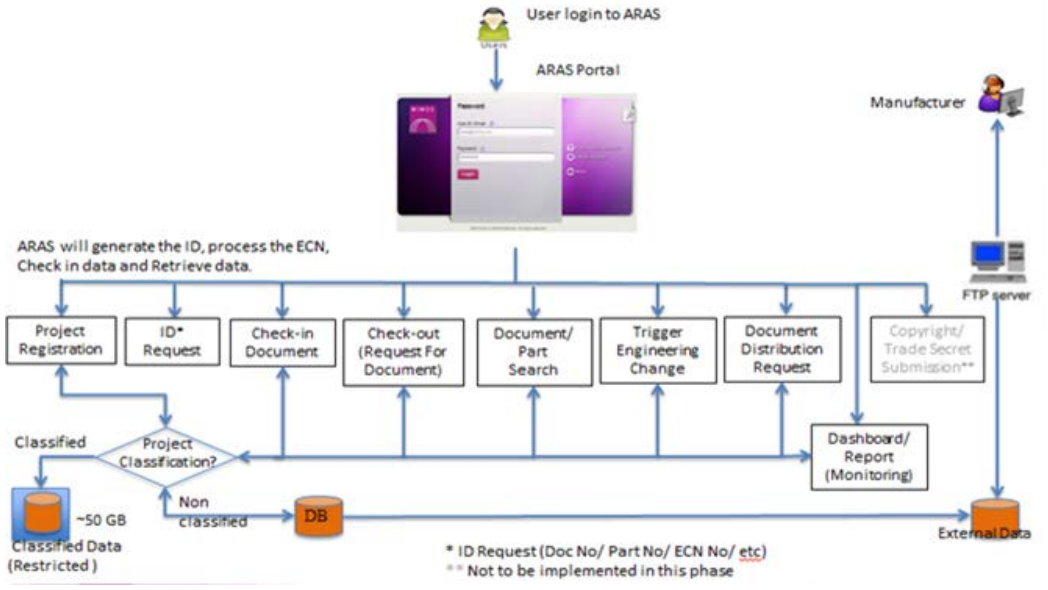

Figure 3: MiPDM System Overview

Figure 3 shows the workflow of the processes involved in the ARAS MiPDM system once the user has logged in. After the user login the system provides 6 options in the process menu as shown in Table 2.

Table 2: MiPDM Activities

Activities	Descriptions
Project Registration	Used for PMO to register project detail into the system. Registered project team members will automatically logged to their project folder.
ID Requests	Used for user to register Document ID, Product ID, Part ID, ECN related ID, etc. ID requests is related to check-in document.
Check-in	Used for user to check-in (submit) document into the system.
Check-out	Used for user to check out (request) or download document from the system.
Document/Part Search	Used for user to search for ID, document, part
Trigger Engineering	Used for user to manage engineering change. Authorized user can trigger Engineering Change Order, Engineering

The system will manage all the product lifecycle inclusive of review and approval processes. For the manufacturers, the system will provide all the information they need from the external database through the FTP server.

F. ARAS MiPDM System Architecture

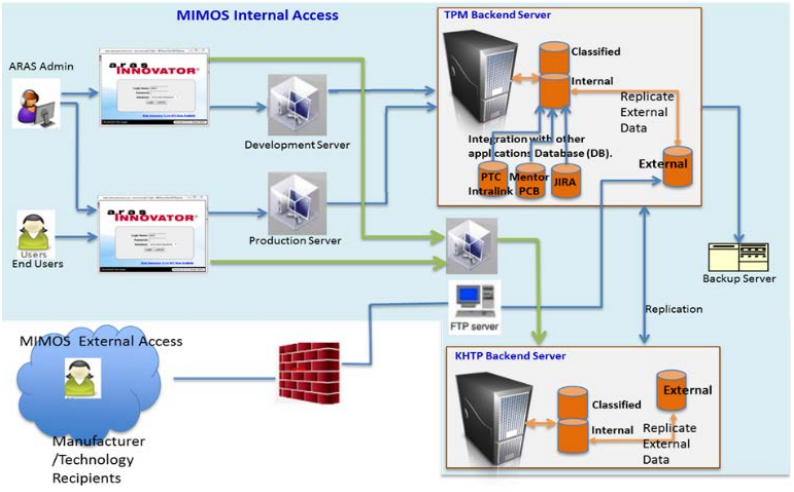

Figure 4: MiPDM Architecture

The system in Figure 4 is represented as an integrated system which comprised of several components to make the ARAS MiPDM system work. Production server is for

ARAS administrator and user while the development server is specifically for development purposes. The database for ARAS MiPDM is kept at the Technology Park Malaysia (TPM) Backend Server (Internal). For external user, such as manufacturer or technology recipient (TR) the access is through FTP server and they can only view specific data from an external database. The external database replicates external user related data from an internal database.

TPM Backend Server keeps both classified and non-classified internal data. Kulim Hi-tech Technology Park (KHTP) Backend Server provides backup facility to the TPM Backend Server.

G. Project Methodology

MiPDM project methodology is derived from the project objective. The step by step is shown in the following Figure 5:

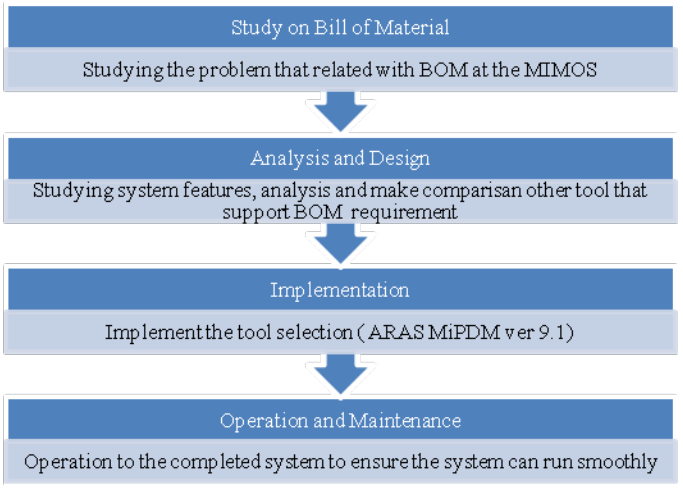

Figure 5: MiPDM project methodology

i. Study on Bill of Material
The first step from hierarchy is to investigate and to study all the BOM related problems encountered previously. The previous system in MIMOS was using the manual system. The problem arose when it came to review and to approve when some changes were done on the BOM. Another problem was that every single change was not updated. Last but not the least was the problem of misplaced documents when submitted for review and for approval.

ii. Analysis and Design

The second stage of the hierarchy is analysis and design. It consists of the study about the system features that meet the requirements as stated in the MIMOS requirement book. Some analysis and comparison about other tool that support BOM requirement like Windchill, ARAS and MES.

iii. Implementation
The next stage of hierarchy is the implementation. This stage consists of the process to implement the tool selection after comparison has been made to select the tools that meet BOM's requirements. A system with improved features that can handle all these issues are proposed. The newly developed system with enhancement using ARAS PLM was later implemented and tested.

iv. Operation and Maintenance
The last stage is operation and maintenance after the delivery of the system to end-user.

4. Evaluation

The evaluation of the MiPDM project based on the measurement criteria as listed below:-

i. BOM Management (Includes)
- ✓ Design BOM
- ✓ Manufactured BOM/ Production BOM (for Technology Recipients)
- ✓ Manage Access to Effective BOM for Production / Manufacturing
- ✓ Managing Product Configuration

ii. Configuration Management / BOM (Includes)
- ✓ BOM Content
- ✓ BOM definition
- ✓ BOM Validation
- ✓ Managing BOMs & Product Structures
- ✓ Viewing BOMs & Product Structures.

iii. Integrated BOM Data Management (Includes)
- ✓ Management of Mechanical BOM- ProENGINEER
- ✓ Management of Electrical BOM (PCB Design, Electronics and Electrical) – Mentors Graphics.
- ✓ Linking MIMOS Software/ Firmware BOM- Software development tools
- ✓ Management Product related Document and Files.

The evaluation of the MiPDM project is focused on the conversion from manually created BOM to the automatic one. The figure below demonstrates the normal flow of the BOM.

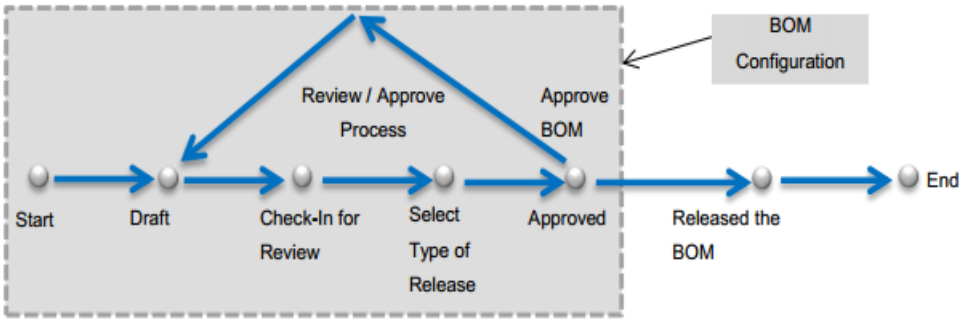

Figure 6: Workflow of BOM

The manual work flow of BOM started with the submission of all drafts of BOM to the Center Specification Control (CSC) staff. These staff will check all the requirements fulfilled and then submit them to the person in charge to review and to approve them. So in the manual work flow there is a possibility of misplaced document and the BOM will not be updated accordingly.

The automated workflow only relies on user's login to MiPDM and the submission of all the documents through the system. From here, the MiPDM will send them to the person in charge to review and to approve the documents.

The goal of this work is to enhance the efficiency in managing the BOM and to handle all the process systematically in MiPDM. This system is aimed to solve the existing problems of BOM at MIMOS.

With this system, the engineering group can benefit from the automated creation of BOM. They will have the ability to retrieve all the data and documents needed efficiently and at the same time they can effectively review and improve the approval process. To ensure the system functions better in the future, its performance can be enhanced by carrying a more detailed study to ensure the system is free from defects and system failure, which might affect the system data. It is hoped that ARAS MiPDM which was initially developed for CSC staff will benefit all MIMOS employees in implementing an effective and efficient product data management system.

5. Conclusions

ARAS MiPDM is hoped to bring a paradigm shift to the product and document management system at MIMOS, for it to be more systematic. This system will help in solving the issues with product data and documents. The main objective of the system is to automate the current manual process and to prevent common mistakes from reoccurring. Information system can be processed quickly and the security of the data and information are also assured. In a nutshell, this system helps the employees with their daily task to be more efficient and effective. This system can be improved further by enhancing the user interface and to expand the system to support documents or policies from the Human Resource Department in order to increase the effectiveness and efficiency of the current system.

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