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An Enterprise Resource Planning System Solution for Small-Mid Size Enterprises: An Information System Development Case Study

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ABSTRACT

The paper aims to present a solution of managing an enterprise information system or enterprise resource planning (ERP) in small-mid size enterprises (SMEs). The research was focused on developing an integrated enterprise information system for resolving faced problems in managing SMEs' business. The methods were investigating business requirements regarding information system, system analysis, system design which included processes, data, and interface model, implementation of system design using selected programming language, and system testing which included unit and integrated testing. The research produced a tested model of the enterprise information system and a working enterprise resource planning information system software named Qinova ERP. The system is implemented in a real environment, a hazardous waste transporter company in Indonesia, and the system has been tackling their business information system management problems. The system is ready to be employed to the different companies in the same industry with minor revision and to the other industries with some customizations to adapt their business requirements.

Keyword : information system, enterprise system, business information system, ERP, enterprise system, hazardous waste management business, hazardous waste transporter

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1. INTRODUCTION

Enterprise resource planning (ERP) system is a software tool employed for managing business functions from operational, tactical, strategic management towards the emergence of information system management(Hassan et al., 2016). ERP is also defined as business management software which allows an organization to use an integrated system to manage its main business processes(Dweib et al., 2014). The system manipulates data to provide information to their stakeholders who are external information users such as customers, vendors, or public and internal users such as end user clerks or operators, managers, executives, or shareholders.

Using ERP software a company can improve the performance of its business processes. ERP software is expensive and complicated. However, a company using the software becomes more effective and efficient in delivering products and services to its customers(Ellen F. Monk & Wagner, 2013). It serves the company in purchasing raw materials or services from the company's suppliers. Therefore, by using an ERP software a company improves their supply chains. An integrated business solution using ERP also increases business efficiency, drives report preparation to the management, and increases efficiency of decision making processes(Knežević et al., 2015).

SMEs are business entities which intend to adopt an ERP system to their business in order to seize the advantages of ERP implementation. They desire to resolve their problem concerning their data processing on their main business processes. On the other hand, ERP system acquisition requires substantial resources and investments. The majority of businesses around the globe can be considered to be SMEs. Thus, SMEs are seen to be typical companies that are the cornerstone of most economies. Compared with large enterprises, an SME-context contains several characteristics, and scarcity of resources is among the top of them(Haddara & Elragal, 2013). Investment and cost for ERP implementation in SMEs is a big issue globally as well as in Indonesia.

Hazardous waste management is an industry that is inhabited by SMEs. This study aimed to develop an ERP software for one of a hazardous waste transporter company in Indonesia. The

company was founded in 2017 and heretofore all of its main business processes had been handled manually using Microsoft Excel spreadsheet. This became issues for managing its customers and vendor data, handling invoicing and bank payments both to their customers and for their vendors. In turn, delivering financial reports to the management and its investors was not timely.

In responding the needs, the company has been collaborated with Sekolah Tinggi Teknologi Muhammadiyah Cileungsi (Muhammadiyah Cileungsi School of Technology), a higher education institution in Indonesia, to realize the necessity and resolve its issues by a comprehensive and integrated ERP solution and inexpensive cost.

2. RESEARCH METHOD

We employed the waterfall model as a system development methodology because we develop a software product which was quite large, the requirements are specified clearly documented, and deliverables of each phase are recorded well(Gechman, 2019)(Kakar, 2012)(Whitten & Bentley, 2007).

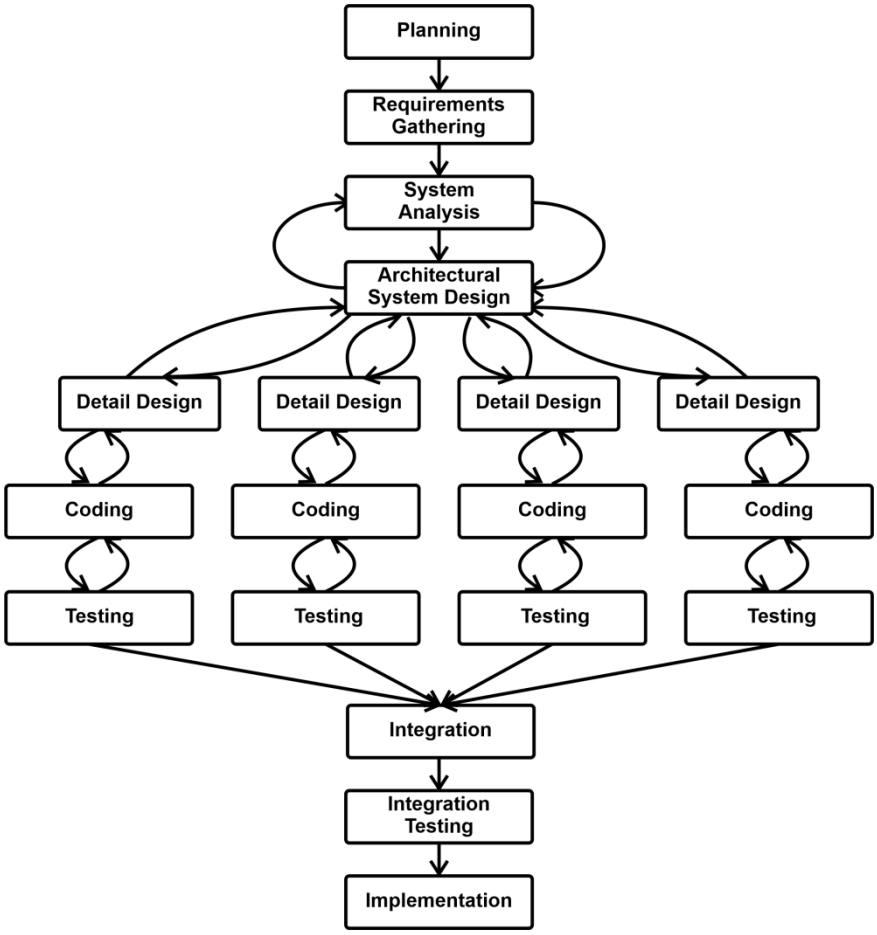

Fig 1. Research Methodology

The development processes are started with planning then requirements gathering, system analysis, and architectural design. We modified and enhanced the next phases – detail design, coding (construction), and testing - by dividing into parallel tasks and each task returns to the previous task for feedback for any refinement. After testing for each division the next development process is the integration phase and continuing with integration testing and implementation. The detail phases are depicted at Figure 1. Parallel tasks are conducted in detail design, coding, and testing. Each task may loop back to the previous one for requesting any corrections or improvements.

3. RESULTS AND DISCUSSION

A. System Requirements

Gathering of requirements was conducted by literature study, interviewing of executives, managers, and accountants of a waste management company which intends to adopt this ERP system, and conducting focus group discussion (FGD) with several accountants. The results of this stage sum up that the system must integrate all business processes within the company. All financial related transactions integrate to accounting records and general ledger. Sales process generates product/service delivery, customer invoices, account receivables, and sales/marketing expenses. Then, account receivables produce bank payment receipts. While the procurement process yields receiving goods/services process, vendor bills, and account payables. Accordingly, account payables make bank payments to suppliers.

Thus, whole processes are integrated into one single system which one process affects or is affected by the other process. A process stops other processes if it is not completed or not done well. The system controls each process with other processes. Additionally, in the accounting perspective the system must serve recording of expenses, petty cash, and fixed assets particularly depreciation expenses. The business processes which must exist in the system are depicted in details at figure 2.
Regarding stored data in the system, the business requires that data must be valid, accurate, accountable, and consistent. To ensure data accuracy, entered data by a business function needs to be validated by an accountable responsible for the other business function. For instance a sales transaction which is entered by a sales assistant or sales clerk is valid after validation or authorization by a sales supervisor, invoices data which input by an invoice officer is valid and records as an accounting transaction when the data authorized by an accounting officer.

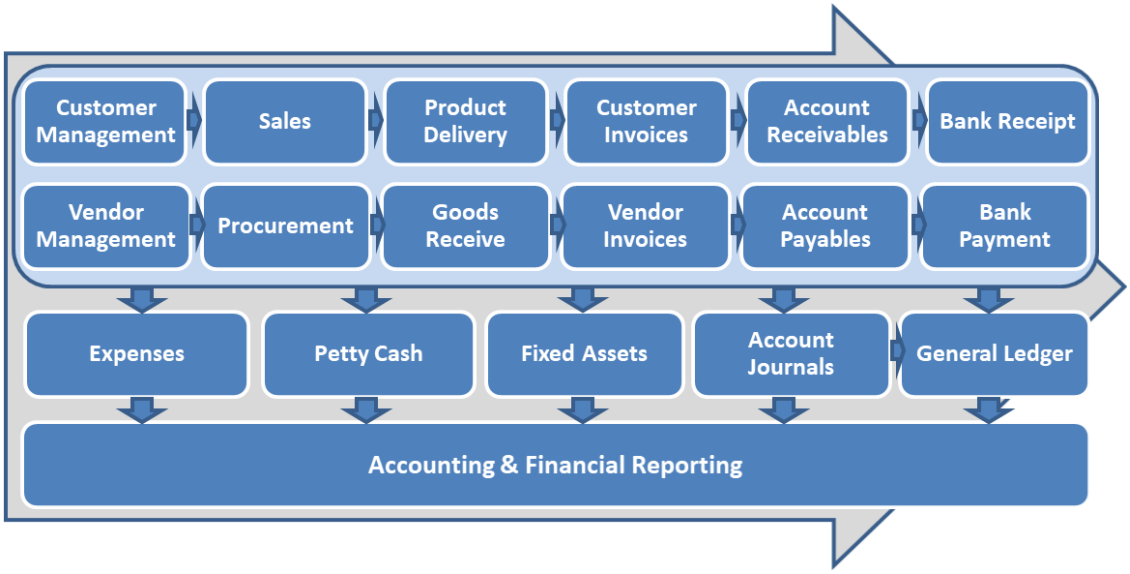

Fig 2. Business Requirements

After defining business requirements we specify software requirements. The requirements are divided into system features, functional requirements, and nonfunctional requirements (Suzanne Robertson & James Robertson, 2008)(Andi Saputra et al., 2020). The following below are functional requirements of the system:

1. The system provides a function to manage customer data (SRS001),
2. The system is able to support product delivery and acknowledge the delivery as sales (SRS002),
3. The system is able to generate customer invoices based on product delivery and record the invoices as sales/revenue and account receivables journal in accounting (SRS003),
4. The system provides a function for receiving bank payment from customers based on invoices and records the payment as adding bank receives (bank account) and reducing account receivables journal in accounting (SRS004),
5. The system provides a function in managing vendor data (SRS005),
6. The system is able to support procurements as well as good receives and acknowledge the good receive as purchasing (SRS006),
7. The system is able to produce vendor invoices based on good receives and record the invoices as cost of good sales and account payables journal in accounting (SRS007),

8. The system provides a function for bank payment to vendor based on vendor invoices and records the payment as reducing bank accounts and reducing account payables journal in accounting (SRS008),
9. The system is support all business transactions from point 1 until 8 to be able to generate or require expenses as well as petty cash and both of them are recorded as account journal (SRS009),
10. The system has automatic calculation for fixed assets depreciations and generates depreciation expense account journal (SRS010),
11. The system has a function to record other common or memorial journals (SRS011), and
12. The system has a function to generate general ledger to issue financial statements such as balance sheet, profit or loss, and statement of changes in equity (SRS012).

In order to realize the functional requirement to come true as a software product, we need to specify nonfunctional requirements of the software as below.

1. The system authenticates to registered users (SRS013),
2. The system classified users into user roles and each user role has authorized system functions to be accessible (SRS014),
3. Each entered data in a functional requirement firstly is recognized as draft data. Then the data flows to the user's superior or other business function to request an approval. Once the data are approved they are recognized as valid-authorized data (SRS015),
4. The system assures data quality: valid, accurate, timely, reliable, complete, consistent, and available (SRS016),
5. The system provides reminder for users who demand to follow up action particularly for approval process (SRS017),
6. The system contains attachment of any evident for each entered transaction (SRS018),
7. The system fits and accessible via web browsers and mobile devices (SRS019), and
8. The system is available on the cloud (SRS020).

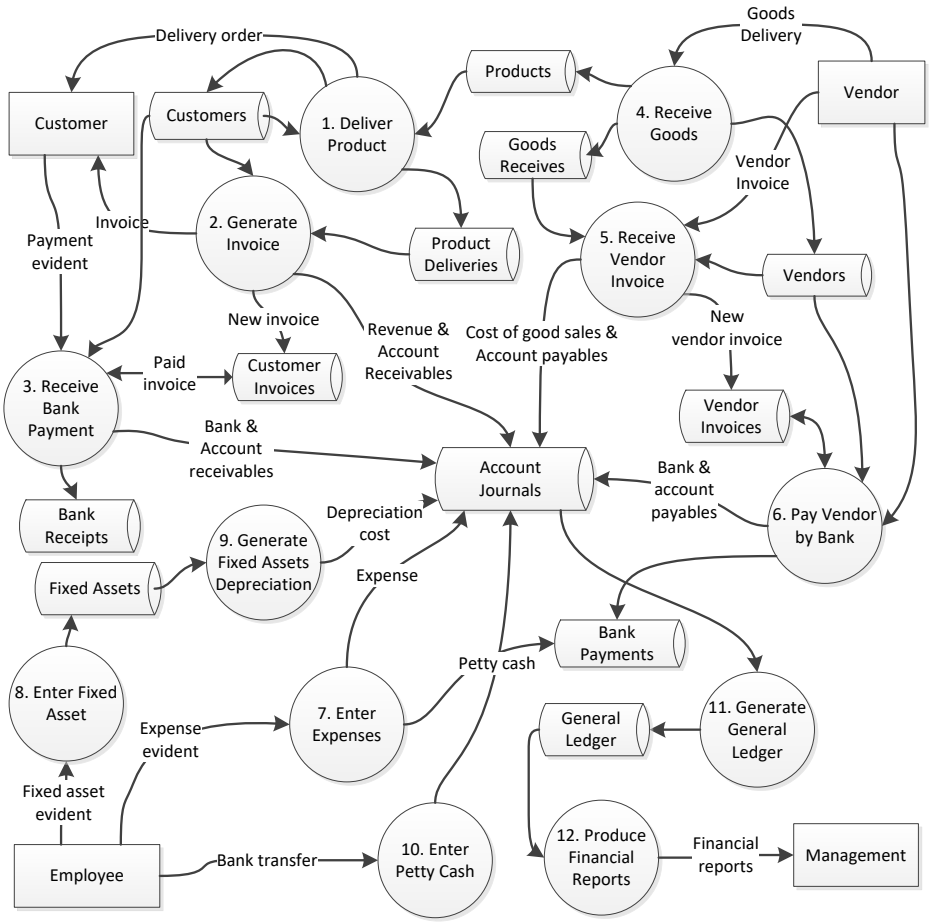

Fig 3. Data Flow Diagram

B. System Design

The design of the system comprises process, data, and interface(Whitten & Bentley, 2007). The process design is depicted using a data flow diagram (DFD) as at Figure 3. The diagram shows 4 (four) external entities, 12 (twelve) processes, and 12 (twelve) data sources. The DFD comprises all defined functionalities at functional requirements.

To implement the requirements regarding approval for each drafted data. Figure 4 shows an example of the implementation of how a bank payment proceeds in the system. User role AP & Bank Payment enters all required information of a bank payment then asks approval to the Accounting user role. Once a user of Accounting User role approves the request approval then the data is recognized as valid data and recorded to a bank payment journal otherwise the data will be back to the requester for a revision.

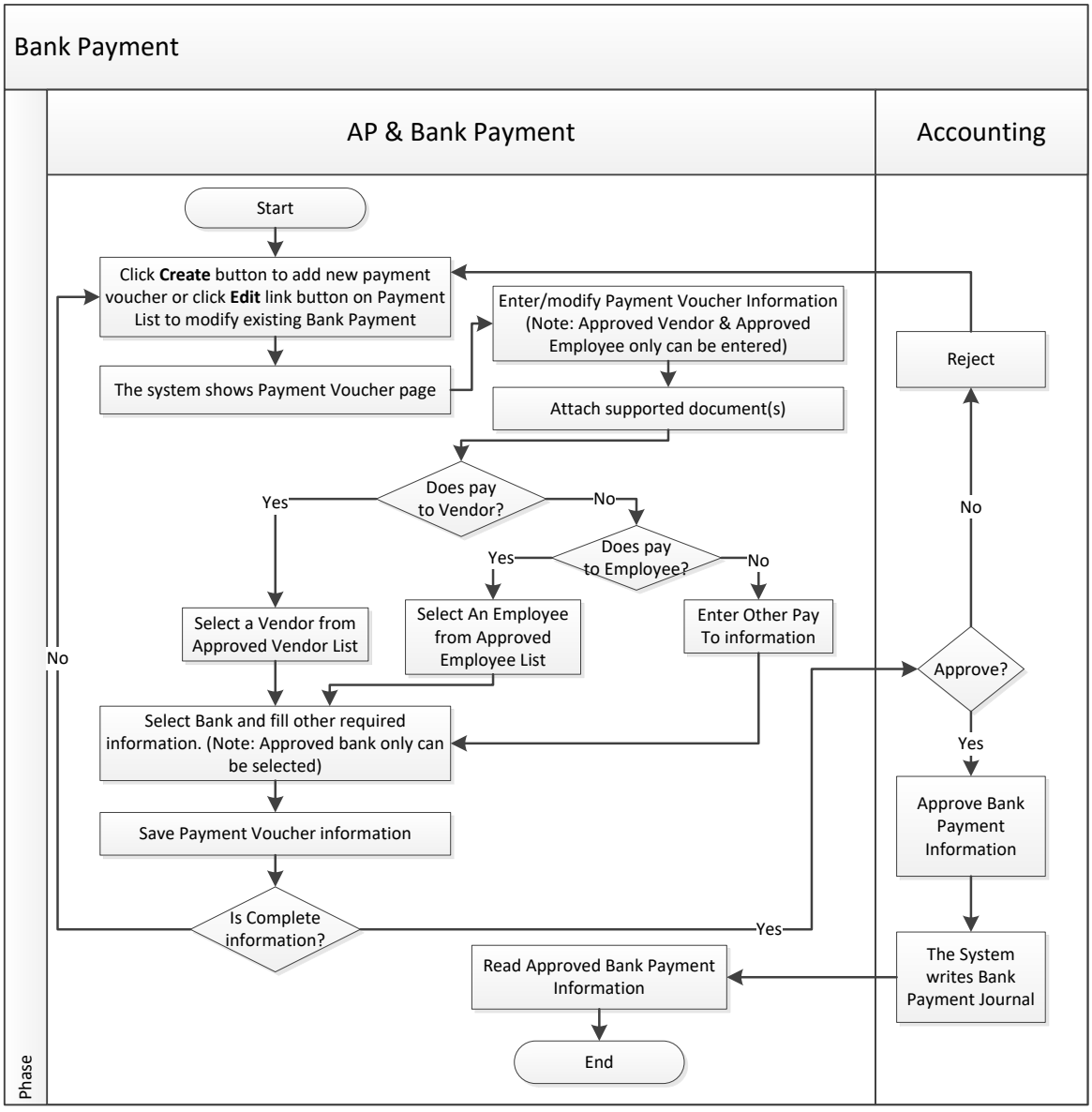

Fig 4. Approval Process

The diagram shows interconnection between processes occurs through data stores. The following is mapping between shared data source and processes as at Table 1. By using shared data sources we assure data consistency in that the system uses the same data for different processes. For instance, the process of generating customer invoice reads Product Deliveries data store as the same data source retrieved by the product delivery process. Consequently, the invoice consistently refers to

product delivery and the invoice cannot be generated before product delivery occurs. This method ascertains that a process depends on completeness and accuracy of data in the previous process. The method also confirms that a process controls other processes as in the business requirements. The DFD also exhibits that all financial related processes have journal transactions in Account Journals data source.

Table 1. Processed and Data Sources Matrix

Data Source / Process	Products	Customers	Product Deliveries	Customer Invoices	Bank Receipts	Goods Receives	Vendors	Vendor Invoices	Bank Payments	Fixed Assets	Account Journals	General Ledger
1. Deliver Product	CR	CRU	C									
2. Generate Invoice		R	R	C							C	
3. Receive Bank Payment		R		RU	C						C	
4. Receive Goods	CR					C	CRU					
5. Receive Vendor Invoice						R	R	C			C	
6. Pay Vendor by Bank							R	RU	C		C	
7. Enter Expenses									C		C	
8. Enter Fixed Asset										C		
9. Generate Fixed Assets Depreciation										R	C	
10. Enter Petty Cash									C		C	
11. Generate General Ledger											R	C
12. Produce Financial Reports												R

Based on data stores in the DFD we design the database using ERD (entity relationship diagram) as at Figure 5. In the paper we present the ERD in conceptual level (Date, 2004)(Ashari Imamuddin, 2007). The database consists 12 (twelve) entities which are adopted from data sources at the DFD.

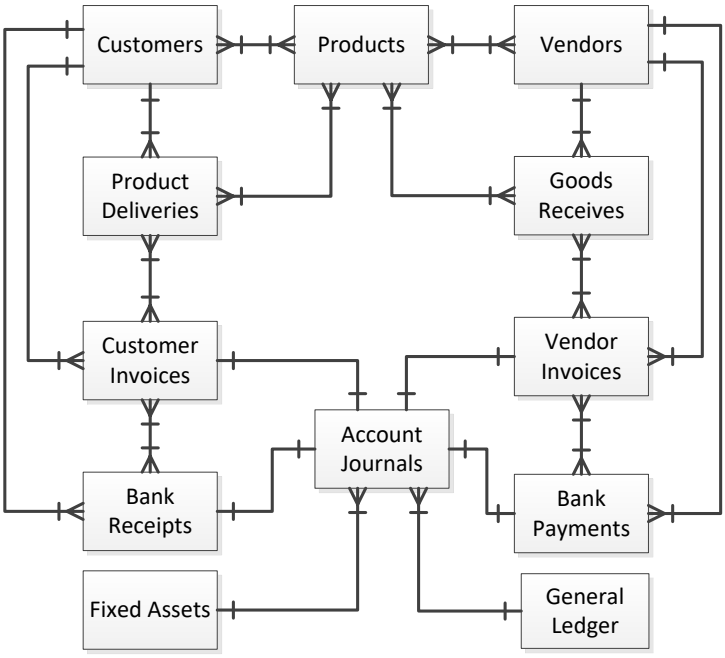

Fig 5. Conceptual ERD

After designing processes by DFD as process model and designing database using ER model, we completed the model with user interface design including menu structures and input/output design. According to the process model, firstly we designed the menu structure of the system as at Figure 6.

Qinova ERP Menus

Customer
- Customer Profile
- Customer Reference & Pricing
- Products
- Delivery
- Invoices
- Bank Receipts

Vendor
- Vendor Profile
- Vendor Reference & Pricing
- Raw materials
- Good Receive
- Invoices
- Bank Payments

Accounts
- Chart of Accounts
- Fixed Assets
- Account Journals
- General Ledger
- Financial Reports

Company
- Setup

System Administration
- Users
- User Roles

Fig 6. Menu Structure

After designing all components of the system including processes, database, and user interface, we move forward to implement the design into coding/construction using ASP.Net with Visual Basic language and database using MySQL. Figure 7 is the login page of the real-constructed system and Figure 8 is an example of coding results of customer invoice.

Fig 7. Login Page

C. System Testing and Implementation

After the coding process was complete we continued to test the system (A Imamuddin et al., 2020). System testing here was divided into two phases. Firstly, testing is unit testing or component testing. It was conducted on each module which code in parallel tasks. After the unit testing confirmed that all modules were adequate to the requirements then all modules integrated into one single system then testing was conducted for the integrated system to confirm that the system was stable and in fine performance after the integration. Results of the tests processes confirmed that the system was adequate to the software requirements and fit to the business requirements. The test results also stated that the system was ready to be used.

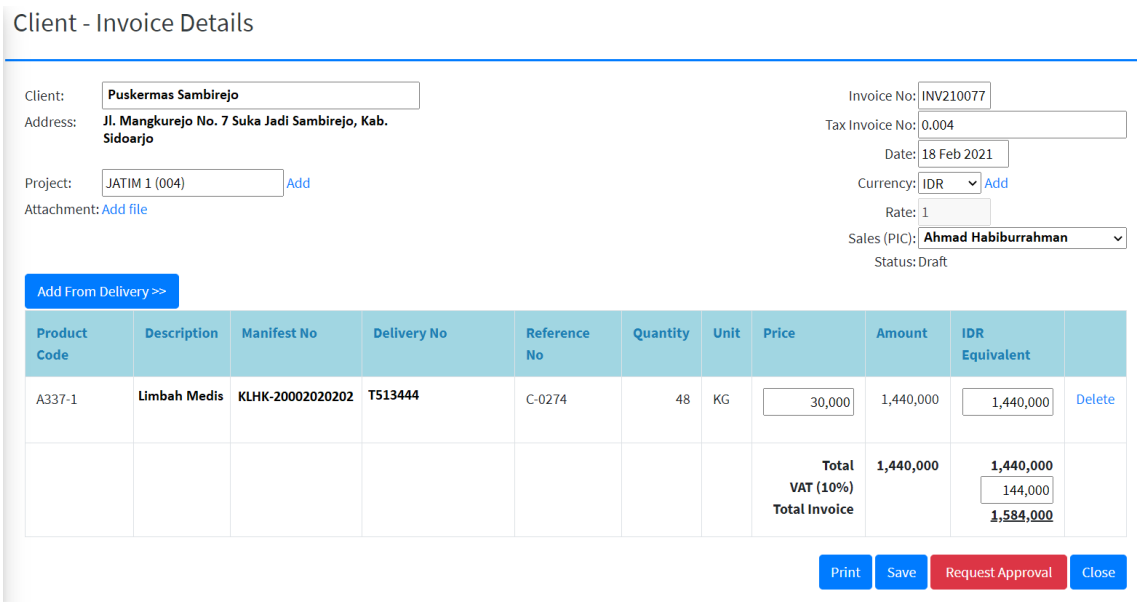

Fig 8. Invoice Page

4. CONCLUSION

This was a development research and resulted design of enterprise resource planning for SMEs. The design was implemented using ASP.Net with Visual Basic language and MySQL database platform and the result is a working web information system application which fits for accessing by web browsers or mobile devices. The application was tested and confirmed that the application is ready to be employed.

The system has been implemented and gone live at a waste transporter company in Indonesia since August 2021. There were minor bugs to be fixed during the operation period. We conclude that the system is ready to be implemented by other companies in the same industry with little modification and more customization for other industries.

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