# **ERP System Integration Design Based on E-Supplier Self** Service 4.0 for A Sustainable Service and Logistic System

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#### Abstract

The Industrial Revolution 4.0 encourages the implementation of e-procurement in the ERP system as a strategy to facilitate procurement transactions between buyers and suppliers. E-procurement 4.0 is designed to improve data transparency and accuracy. One of the features of the e-procurement application is the self-service e-supplier. This feature connects the post-procurement process between buyers and suppliers. Self-service e-suppliers are expected to be integrated with external systems such as Enterprise Resource Planning (ERP). The object of research in this study is manufacturing companies and information technology companies in Indonesia that have used Oracle JD Edward. These companies are assumed to be internal customers and involve management departments and functions such as finance, procurement, and IT as the main users. This study uses the Quality function deployment (QFD) analysis method for the product development process based on the technical response generated by the QFD analysis. The collection of consumer needs data is grouped using an Affinity Diagram. The relative importance of each need is determined using the Mudge Diagram method. In 3 phases of QFD, this research produces technical responses and design specifications from self-service e-suppliers. Integrating the oracle's JDE and E-Procurement for the feature of self-service e-supplier has been successfully performed, as based on the usability testing at the stage of the user acceptance test (UAT).

## Keywords

E-procurement 4.0, self-service, Oracle JD Edward, QFD, ERP

## **1. Introduction**

The Industrial Revolution 4.0 represents the development of information, technology, and social media networks that affect consumer perceptions of innovation, quality, diversity, and service delivery. It designs a future industry where technology will be integrated into a community (Ferrari et al. 2021). Nick et al. (2021) explained some several sectors in logistics will be affected, especially activities in predicting the machine usage, machine downtime reduction, the ERP System for product management optimization and service scheduling. It also affected to machine repairment and security, as well as information flow between production lines, business management, and supply chain management (Holubčík et al. 2021).

The need for an application in a transparent information system that supports the requirement for information flow with third parties has triggered the trend of developing internet-based ERP support applications such as E-procurement, an application that includes modules or features for E-supplier self-service (Hong et al. 2021). E-procurement is an internet-based application that provides procurement process features including search, sourcing, negotiation, ordering, receiving, and post-procurement review (Bag et al. 2020).

Enterprise Resource Planning is software for automating manufacturing processes from raw materials to finished products and is a development of manufacturing resource planning software (Wallenburg et al. 2019). The ERP system contains some applications that combine the functions of finance, manufacturing, human resources, and other modules that automate the business administration functions. ERP applications that are widely used today are SAP, Oracle, People soft, and JD Edwards (Ramkumar et al. 2019).

## 1.1 Objectives

This study tries to design an e-procurement 4.0 application by considering the trend in demand for a web-based procurement system with an orientation of transparency between the buyer and vendor. Procurement module design using Oracle JD Edwards ERP application. In the purchase process, namely the Purchase order transaction, there is a verification process at the vendor at the time when the goods have been received at the warehouse. This verification process serves as a supporting document for the vendor's billing payments to the company. Practically, in several companies, some verification process is still performed manually by sending the hard copy of invoices and confirmation of goods receipt reports. It is less effective for the verification process and in the tracking of the purchase order process by vendors.

Furthermore, it requires an E-procurement application with a module that supports the verification process and purchase order tracking, to facilitate the flow of information between suppliers and companies. And further, it will be integrated with the company's ERP system. This study employed the Quality Function Deployment (QFD) as a tool in designing the e-supplier system. The process of system design requires analysis of usability testing and gap analysis.

# 2. Literature Review

ERP system refers to the integration and expansion of business operations using technology and information systems with the aim of facilitating the flow of information within and between companies dynamically and quickly thereby increasing the usability of information, eliminating errors, automating routine processes and flexibility of system components (Bag et al. 2020). E-procurement not only provides traditional buying and selling features but also provides infrastructure and features such as payment processing, transaction records, information exchange, and search features for searching the transaction data.

Hong et al. (2021) observed E-procurement has many functional features that concentrate on the procurement process such as e-Tender, e-Marketplace, e-Auction, and reverse auction. E-procurement is an end-to-end solution that integrates all procurement processes (Shahid et al. 2018). E-supplier self-service is a feature that functions as a media for transactions and documentation of website-based procurement needs that can be accessed directly by suppliers or vendors to increase transparency in the business process (Ibrahim and Moertini 2015).

QFD is a planning and development tool that provides various aspects with the goal of meeting customer demands. QFD has a close relationship with the "voice of the customer" (Ocampo et al. 2020). QFD displays detailed design specifications and technical planning based on customer requests (Zhang et al. 2019). This system is often used in conjunction with design development. QFD is a way of realizing customer desires through the right business provisions at every stage, starting from research through product design (Chin et al. 2019) and development to manufacturing, distribution, installation, marketing, sales, and service. This method was originally developed to present certain characteristics in innovative production (Jin et al. 2009).

Usability testing aims to measure efficiency, ease of learning, and the ability to remember how to interact without experiencing difficulties (Jin et al. 2009). Five aspects of usability testing that must be considered in the design of a system are Ease of learning, Efficiency of use, memorability, error frequency, and severity, and Subjective satisfaction (Awasthi et al. 2018). Gap Analysis is usually used in terms of management and is one of the tools used to measure service quality. This approach is commonly used to monitor service quality.

# 3. Methods

In this research, the design and implementation require a detailed prerequisite concerning the business process of procurement. The research used the method of Quality Function Deployment (QFD). This method is used to ascertain that the product developed is certain to meet consumer desires. After the product specifications have been determined, the next step is the design and implementation phase as well as the integration of the e-procurement application of the self-service e-supplier module with JD Edwards' ORACLE. The design and implementation process follow the ERP implementation flow.

## 4. Data Collection

The data collection method used for this research is through direct observation of the relevant divisions using the procurement module to determine the specifications for the e-procurement product requirements of the self-service e-

supplier module. The list of requirements will be used as the Voice of the customer in the QFD process. Furthermore, direct interviews were conducted with each Product development manager. The questionnaire of the voice of customer comparison was grouped using affinity diagrams whereas the respondents were the implementing section of procurement and accounts payable at Oracle JD Edwards involving at least 30 respondents. Measuring the relative importance level of consumer needs were performed through questionnaires using the Mudge Diagram Method. Afterward, the HOQ matrix was made using the percentage of interest in consumer needs which is defined as the importance ratio.

## 5. Results and Discussion

The main objective of designing the feature of self-service e-supplier in the e-procurement 4.0 application is to create features of invoice verification, purchase orders, purchase order receipts between the procurement users, finance, and suppliers, to simplify the operations and to improve the effective performance of procurement process. The results of this design will be verified by the ERP user, to validate, giving contribution, and feedback regarding the design feasibility. The subject of expert judgment as appraisers are employees who are directly involved in the use and design of the e-procurement applications. The activity and flowchart of e-verification process can be seen in Figure 1.



Figure 1. E-Verification Process Flowchart

The collection of consumer needs for developing the feature of the e-supplier self-service was performed to find out complaints and suggestions. The collection method used the interview with the Division of Finance, Procurement, and IT. Based on the interviews with the main respondents and partners, there are 25 requirements from the division and related parties. The list of customer requirements and classifications is formed in the affinity diagram as shown in Table 1.

Consumer needs are grouped by function. The grouping is divided into 7 groups, namely, User interface, User experience, and Invoice verification for suppliers and AP, Real-time data integration with ERP, Supplier Order Relations, Tax Information, and Supplier Self Service. Based on the priority of the relative importance of consumer needs, a House of Quality of the QFD Phase 1. In making the QFD Phase 1, the developer team makes a technical response to answer priority needs for feature development. In advance, the technical response will become the basis for determining the development target for the QFD Phase 1. In making QFD phase 2, the technical response in QFD phase 1 is translated as quality characteristic. Quality characteristic is the specification of the self-service e-supplier feature.

The feature specification or quality characteristic produces a technical response, which is the basis for making the specifications of e-procurement features during development. The detailed technical response and technical targets in QFD phase 2 are based on the results of discussion and preparation of the design specification requirements.

Group	Requirement				
Responsive user interface	Accurate data match on system				
design	Flexible design configuration				
	Minimalist UI design				
	Easy access for users				
	Easy to navigate app content				
	Status on visible system				
	Aesthetic UI design				
	Effective system error handling				
User experience flexibility	Error prevention				
	Easy to use features				
	web-based system				
	Paperless				
	Flexible business process setup adjustments				
	Simple if there is a customized report or dashboard				
Invoicing verification for	Access for suppliers during invoice verification				
supplier and AP	There is approval from the AP finance department at				
	the time of invoice verification				
	There is a payment status				
	Goods receipt information for suppliers				
	Handling invoice match with PO receipt				
Real-time data integration	Real-time data interface with ERP for PO, PO				
with ERP	receipt, and invoice				
Supplier order relationship	There is supplier order information for suppliers				
information	Confirmation of receipt of goods from the warehouse				
tax information	tax invoice information entry				
Self-service supplier	Supplier self-registration				
	Self-registration item supplier				

Table 1. Affinity Chart

The QFD phase 3 aims to determine the parameters of the creation process of the e-procurement feature. The QFD phase 3 is the phase of process design which includes the specification of the process for making technical responses and technical targets. Members of the developer team are the product development teams who are directly involved in making e-procurement products, from the design stage to quality control. The technical response in QFD phase 2 will become the process parameter of the QFD phase 3. The technical response and technical target were arranged based on the process parameters, as can be seen in Figure 2.

The QFD process involves the internal consumers, product development teams, and product owners so that the design specifications and features are functionally and technically in line with research expectations. The steps that must be

taken by the company to meet consumer needs can be seen in the column of the QFD phase 3 technical response. The technical response of QFD phase 3 has 12 components, namely E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, and E12. Calculation of relative importance is performed to observe the level of importance of each technical response. The relative importance of QFD phase 3 can be seen in Figure 3. Then, the development team's decision on the technical response in the development of the self-service e-supplier feature can be seen in Table 2.

			~		$\geq$	$\geq$	$\ge$	$\approx$	$\Rightarrow$	Ş	$\geq$	$\geq$	$\geq$		
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	Direction of Improvement			<b></b>						▲	<b></b>			▼	
m et Importance			mework elements with Vue JS	leatures Home page, export import data, user management, workflow engine, engine, notification engine	er data e-supplier self service and user role assignment, access window, access ss, access per data record	ier invoice verification menu with invoice data from JDE	ce invoice verification menu with invoice data from JDE	ent status check and update features	ation of PO, PO receipt, and invoice data in jde to eprocwith scheduler	vintegration using change data capture and webservice	inquiry status	ite tax invoice number	ier registration menu on supplier portal	supplier product catalog	tance Ratio
usto	Den son Densender		l fra	atch	laste	lddn	nan	aym	tegr	-wa	erify	alidă	lddn	lenu	du
12	Using the JIS Vue UI Framework	+	-	<u>⊽</u>	2 ₫	S	<u> </u>	4	-	~	>	>	S	2	<u>=</u> 2%
11	Making a complete Core feature function	+	$\bigtriangledown$	•	$\bigtriangledown$										1%
10	There is a configurable user management and master data			•	•	0	0								1%
5	Making supplier invoice verification windows form				0	•	-	-	•	•	0				14%
4	Making a form for AP finance after receiving verification							•	•	-	0				14%
2	list of document verification with payment information							•	•	•					14%
3	list of products that have been sent and verification information							•	•	•					19%
1	JDE and eproc integration using spring cloud dataflow	_							•	•					18%
6	Detailed order supplier information	+				•	0	•	•						8%
7	tax entry form at the time of verification	-										•	_	_	7%
8	Supplier Self registration form	+											-	-	1.5%
,	Supplier tien seit registration form	+											<u> </u>	-	270
	Absolute Importance	lecunical larget	tall framework elements with Vue JS	Core features Home page, export import data, user management, workflow engine, S   batch engine, notification engine	Master data e-supplier self service and user role assignment, access window, access & process, access per data record	Supplier invoice verification menu with invoice data from JDE	El Finance invoice verification menu with invoice data from JDE	Payment status check and update features	Bill Integration of PO, PO receipt, and invoice data in jde to eproc with scheduler	2.442 integration using change data capture and webservice	22 Verify inquiry status	Validate tax invoice number	Supplier registration menu on supplier portal	Menu supplier product catalog	100%
	Relative Importance	+	1%	1%	2%	6%	5%	19%	24%	24%	13%	5%	0.1%	0.1%	
	nerverie importance		1/0	1 /0	2/0	0/0	J/0	13/0	24/0	L 44/0	170/0	270			

Figure 2. QFD Phase 3

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Table 2. QFD process conclusion

No	Description	Percentage	Decision	
E1	UI framework elements with Vue JS	1	Low priority	
E2	Core feature home page, export-import data, user management, workflow engine, batch engine, the notification engine	1	Low priority	
E3	Master data e-supplier self-service and user role assignment, access window, access process, access per data record	2	Low priority	
E4	Supplier invoice verification menu with invoice data from JDE	6	High Priority	
E5	Finance invoice verification menu with invoice data from JDE	5	High Priority	
E6	Payment status check and update features	19	High Priority	
E7	integration of PO, PO receipt, and invoice data in JDE to E-Proc with scheduler	24	High Priority	
E8	2-way integration using change data capture and web- service	24	High Priority	
E9	Verify inquiry status	13	High Priority	
E10	Validate tax invoice number	5	High Priority	
E11	Supplier registration menu on the supplier portal	0,1	Low priority	
E12	Supplier product catalogue-menu	0,1	Low priority	

The design results are tested at the User Acceptance Test (UAT) stage. Based on the UAT, there is a gap analysis for usability testing between the expected system requirements with the test results, as shown in Figure 4. UAT scripts are divided into 2 groups of scenarios, namely for user finance and suppliers and for data integration. The UAT scenario group for user finance and suppliers has 49 scenarios. This study shows that there are 48 successful scenarios and there is 1 scenario that has obstacles.



Figure 4. Percentage of (a) Gap usability testing of user finance and suppliers,

#### (b) Gap Usability Testing Data Integration

Based on Figure 4.a, the percentage of gaps in the testing scenario for user finance and suppliers is 2%. Therefore, it can be concluded that the application is adequate to meet the needs of users of finance and suppliers. The data integration scenario group has 18 test scenarios (Figure 4.b). The results show that there are 17 successful scenarios and 1 scenario that has obstacles. Obstacles that occur during the implementation of UAT will be included in the issue log of improving the e-verification feature to prepare for go-live. In addition to UAT, users are also given training to know how to use the application from login to transaction.

The implementation process is carried out after the application development was complete. There are several stages in this process. The stages carried out in the implementation of e-verification are user acceptance test, user training, go-live, and post-implementation support. The user acceptance test is the process of determining whether the application complies with user needs and is feasible to use. This stage involves users from the finance department, procurement, and suppliers to find out the obstacles and issue logs that occurred during the trial. The user acceptance test is performed using a script that contains a process, the process will be executed by the user using the e-verification feature. Measuring the application success rate and integration of e-verification features is carried out by usability testing using gap analysis. The details are summarized in Table 3.

No	Gap	Solution
1	Using the Vue Js UI framework	UI framework elements with Vue JS
2	Making a complete core feature function	Core features Homepage, export-import
		data, user management, workflow engine,
		batch engine, the notification engine
3	The existence of user management, and	Master data e-supplier self-service and
	configurable master data	user role assignment, access window,
		access process, access per data record
4	Making supplier invoice verification window	Supplier invoice verification menu with
	form	invoice data from JDE
5	Making a form for AP finance after receiving	Finance invoice verification menu with
	e-verification	invoice data from JDE
6	Document verification list with payment	Payment status check and update features
	status information, payment schedules, and	
	actual payment date for suppliers	
7	List of products that have been received and	Integration of PO, PO receipt, and invoice
	verification information	data in JDE to e-proc with scheduler
8	JDE and eproc integration using spring cloud	2-way integration using change data
	dataflow	capture and web-service
9	Detailed order supplier information	Verify inquiry status
10	tax entry form at the time of verification	Validate tax invoice number
11	supplier self-registration form	Supplier registration menu on the supplier
	_	portal
12	self-registration item supplier	Menu supplier product catalog

#### Table 3. Gap Analysis and Solution

# 6. Conclusion

Today, from identification of the procurement process at several companies in Indonesia has shown that there is an ineffective process of purchase order in the payment verification section. The main cause is unavailable verification process on the system and there are no features of two-way invoice and payment verification for buyers and suppliers provided by the ERP, the absence of SOPs for the implementation of payment verification, the ineffectiveness of manual work during verification, human error, invoice matching incompatibility. The design uses the method of quality function deployment, adjusts the specification, and improves the method, and facilitates the needs of e-

procurement users. QFD is done through 3 phases. From the three phases, a design specification can be generated based on the technical response from the members of the development team.

Based on the third phase of QFD, the relative importance of feature characteristics of the e-supplier self-service is obtained. Based on the relative importance, it determined the specifications of the self-service e-supplier with low and high priority status to be developed. Design proposals based on QFD results can be developed and implemented, in the e-procurement applications for the invoice verification process. Integrating the oracle's JDE and E-Procurement for the feature of self-service e-supplier has been successfully performed, as based on the usability testing at the stage of the user acceptance test. For further research, as follow is necessary consideration:

- 1. Selling the features of e-supplier self-service through participating in presales activities for external customers.
- 2. Assessment for further usability testing on the final prototype of the self-service e-supplier.
- 3. Analysis of the effect of implementing the self-service e-supplier on procurement performance

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