Application Development and Testing Based on ISO 9126 Framework

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Abstract. Software quality testing is one of the stages in SDLC (systems development life cycle). Software or application testing can’t ensure quality free of bugs or errors, but can provide trust and assurance to the application at some level. Software of freight forwarding, from the development, implementation and testing of this application can achieve some desired objectives by the user that is to help transportation services become more effective and efficient, providing convenience in terms of data and information process. With the use of the application compared with the process of recording manually facilitate the decision makers to be able to monitor transactions and reports in a short time. To design and implement reliable Information Systems (IS) of freight forwarding and avoid bugs or errors, comprehensive testing is required based on the ISO 9126 method, which includes attributes such as aspects of functionality and Maintainability. Testing an application or software is an activity to check if the actual results match the expected results and to ensure that the application is bug-free. IS of freight forwarding services is appropriate and able to become software in the desired by the user consisting of input, process, and output.

1. Introduction
Supply Chain Management (SCM) is increasingly being recognized as the integration of key business processes of organizations. SCM seeks to enhance competitive performance by closely integrating all units within an organization and external stakeholders to be successful [1], [2].

Transportation planning is a human-oriented field with diverse and challenging problems waiting to be solved. Characteristics and performances of transport systems include services, costs, infrastructures, vehicles, and control systems are defined as the basis of quantitative evaluation. Moreover, hard computing models also could not deal effectively with the transport decision-makers’ [3]. For competitive advantages, many organizations have now focused more on their supply chains and hence have thought of ways to improve their SCM. A supply chain stays connected by flows of data, information, finance, and material by the suppliers, producers, retailers, distributors, and customers [4]. The key element in an SCM is a transportation system, which joints the separated activities [5]. Council of Supply Chain Management Professionals (CSCMP) defines logistics (management) as: part of SCM that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related data and information between the point of origin and the point of consumption in order to meet customers' requirements [6].

The major problems faced by those forwarding enterprises are related to software testing. The primary purpose of testing is intended to detect IS of freight forwarding (ISFF) failures so that defects
may be discovered and corrected. Testing can be used as a generic metric as well. The article applies the software testing procedure based on ISO 9126, such as reliability, usability, integrity, security, capability, efficiency, portability, maintainability, compatibility, etc. [7]. Quality testing of application is required before an application to be released or launched. The main purpose of this test is to convince the customer that the system is feasible to use and meet the performance requirements of the customer requirements [8]. Testing is the process of running or executing a program with the primary purpose to find bugs within the application. Proper testing techniques are not only good at detecting errors, however, also enables to uncover all mistakes that have never happened before. Each model has factors that are the main points in software quality assessment, one of which uses the ISO 9126 model. This model is one of the international standard methods used to assess software quality models.

2. Theoretical Foundation

2.1. Freight Forwarding
Freight forwarding is a business that aims to represent the delivery of goods (consigner/shipper/importer) or represent the duty of the consignee/importer required for the implementation of the delivery of export and import goods either by land, sea or air [9], [10]. In logistics systems, transportation is the only source of environmental hazards that need to be anticipated [11]. Scheduling refers to the assignment of start and end times for all manufacturing activities and determines which tool or machine will build the parts by the process plan [12]. The company’s main business involves with providing transportation and logistics, with the aims to provide a reference about the importance of software testing in freight forwarding company.

2.2. Information Systems (IS)
Information System (IS) enables to help managers to solve structured problems [13], [14], [15]. Software and systems engineering is distinct from other forms of engineering to follow and review progress [16]. The use of IS development refers to improving the business activities within and between organizations [17]. All of shipping agency systems and freight forwarding applications within the industry encounter the problems of low efficiency, resource wastes, and inadequate monitoring and management due to the lack of unified planning at the initial stage of development and limited timelines and accuracy data sharing [18].

2.3. ISO 9126 Quality Model
ISO 9126 defines that quality as a set of features and characteristics of a product or service. It provides external quality metrics for measuring software quality characteristics applicable to an executable software product during testing or operating at a later stage of development and after entering the operation process [19].

3. Research Method
The article applies the software development life cycle (SDLC) method to produce high-quality software that meets or exceeds customer expectations, reaches completion within times and cost estimates. The life cycle defines a methodology for improving the quality of software and the overall development process. SDLC comprises the following steps: (1) user requirement, collects some useful information about user needs to know and help design the application to be created. Such information may be in-demand functional requirements, problems, and solutions that can be achieved from application design, and more. The output of this stage can be a business requirement statement; (2) analysis, allows creating a description of the desired design logic of the application. Logical representations can be structured and object-oriented, where the structure means using data flow diagrams; (3) design, explains how we create an overview of the design of the created application. The description can be user interface and the design of the database to be used in the application. The outputs performed by researchers at this stage are the design of the user interface and the design of the database design; (4) coding, the stage where it starts to generate the programming code of pre-defined application development. The output of this stage is the
completed application is made and ready for testing phase; (5) Testing, are done after the application is finished, to make sure the product is good, quality testing must be with comprehensive. Quality has to do with creating comfortable and useful products that meet with user satisfaction. The high-quality software is an essential goal for software developers since it related to software development efforts.

Testing is done with user acceptance testing and coding phase defect, where the output from this stage is UAT and Coding Phase Defect. Testing is performed to identify and identify errors that may occur; (6) Implementation, the stage where ready to provide the application and implement it for use to the user. Based on ISO 9126, the results of the testing are shown in Table 1. The application is built using MS Visual FoxPro.

4. Development and Testing.

4.1 General Process ISFF.

The general process that involves request order delivery of goods, input shipping type, input of customer order list, is described in figure 1 and table 1.

![Figure 1. Order Process.](image)

The Payment process consists of store and delete data payment, store type of payment, determine payment method, save payment type, print payment reports, and store payment data. Shipping process consists of store and edit item, delete an item, print a report warehouse and create invoices for shipping parties. The shipping process activities are summarized as follow: (a) the process starts from the goods out of the warehouse. (b) Then check on the goods to confirm whether the contents of goods (a form of goods) by the data items in the database and do the packing of goods back. (c) Goods are loaded into the truck, if shipping for the inner-city area, then the goods will be delivered directly to the destination. If the shipment is made to an area outside the city / abroad, then the goods are sent to Depot (before port).

4.2 Overview of ISFF.

Overall, the requirement specification is made to know what is required by the client and provide clear direction for the application based on client needs. Features on trucking services, on this order module, include: store and delete customer data, store and delete order data, job order, and invoice, store the service type, save payment type, and print sales report.
4.3 Product Functions
This application serves to assist the performance of back-office trucking services such as entering customer data, order data, delivery type, payment, and data collection.

4.4 User Characteristics
The knowledge that the user needs is only an understanding of the working of this application so that the output is enabled to be produced correctly.

4.5 Stimulus/Response Sequence
The stimulus/response sequence from the perspective product is illustrated as: (1) user input username and password; the system will read data and match it with the database. When it matches, it will display form for input year; (2) the user presses print report button and the system will provide a form to display details of the report to be printed; (3) user inputs the stuffing and presses save button then system automatically store the data.

4.6 Design Testing of ISFF.

| Characteristic | Sub-characteristic | Description |
|----------------|--------------------|-------------|
| Functionality  | Suitability (F1)   | Can the ISFF perform the required functions? |
|                | Accurateness (F2)  | Are the results of ISFF as anticipated? |
|                | Interoperability (F3) | Can the ISFF interact with other systems? |
|                | Security (F4)      | Can the ISFF prevent unauthorized access? |
| Reliability    | Maturity (R1)      | Have the faults in the ISFF and hardware devices been eliminated over time? |
|                | Fault tolerance (R2) | Is the ISFF capable of handling errors? |
|                | Recoverability (R3) | Can the ISFF resume working and recover affected data in case of a failure? |
|                | Reliability compliance (R4) | Does the ISFF adhere to the existing reliability standards? |
| Usability      | Understandability (U1) | Does the ISFF user recognize how to use the system easily? |
|                | Learnability (U2)  | Can the ISFF be learnt easily? |
|                | Operability (U3)   | Can the ISFF work with a minimal effort? |
|                | Attractiveness (U4) | Does the ISFF interface Look good? |
|                | Usability Compliance (U5) | Does the ISFF meet the existing usability standards? |
| Efficiency     | Time behavior (E1) | How quickly does the ISFF respond? |
|                | Resource utilization (E2) | Does the ISFF utilize resources efficiently? |
|                | Efficiency compliance (E3) | Does the ISFF adhere to the existing efficiently standards? |
| Maintainability| Analyzability (M1) | Can faults be easily diagnosed? |
|                | Changeability (M2) | Can the ISFF be easily modified? |
|                | Stability (M3)     | Can the ISFF continue functioning if changes are made? |
|                | Testability (M4)   | Can the ISFF be tested easily? |
| Portability    | Adaptability (P1)  | Can the ISFF be moved to other environments? |
|                | Installability (P2) | Can the ISFF be installed easily? |
|                | Portability compliance (P3) | Does the ISFF comply with portability standards? |
4.7 Functional Requirements
Functional Requirements from Perspective products comprised of: (1) input, edit and delete data plan, stuffing location, job order, invoice and details; (2) print reports based on per sales.

4.8 Performance Requirements
Performance Requirements enables to store data such as customer data, orders, and services in 1-2 seconds so that with fast data storage can support activities on LCL logistics.

4.9 Testing Functionality ISFF, only for Order Module
ISO 9126 defines the quality of software products, models, quality characteristics, and related metrics used to evaluate and define the quality of a software product. Aspects of functionality is divided into four sub-characteristics (ISO 9126), namely: suitability, accuracy, interoperability, security, and standards or compliance. Table 2 shows the entire functionality testing that focuses on the order module.

Table 2. Functionality Testing.

| No | Test case | Pre-condition | Test steps | Expected Result | Actual Result |
|----|-----------|---------------|------------|-----------------|--------------|
| F-01 | Testing the Login function validation using a user not registered in the system | Login page has been displayed after the application is run | 1. Type the letter 'ASD' in the Username textbox 2. Type the number '123' in the Password textbox 3. Click 'Ok' button | Displays a message that the Username or Password entered is incorrect | The message is successfully displayed and App is closed |
| F-02 | Testing the Login function validation using the registered user in the system | Login page has been displayed after the application is run | 1. Type the name 'admin' in the Username textbox 2. Type the password 'ADMIN' in the Password textbox 3. Click 'Ok' button | Displays a message that the Username or Password entered is correct | User successfully logged in |
| F-03 | Testing the Login function validation using a user who has registered in the system without inputting password | Users with the name 'JFA' and 'A' password have been registered in the system | Login page has been displayed after the application is run | 1. Type the name 'JFA' in the Username textbox 2. Empty password input on Password textbox 3. Click the 'Login' button | Displays a message that data must be completed first. Message successfully displayed |

5. Conclusion.
The freight forwarding application enables enterprise system corresponds with entire business process. Tests have been done with following findings: (1) suitability, applications have confirmed with user needs, analysis, design, coding, testing and implementation has been appropriate for the task and purpose of the user; (2) accuracy, the application enables to provide results in accordance with the needs of the user.
accounting system, such as: reporting module meets with expectation and delivers no errors; (3) interoperability, the application has confirmed with interoperability with legacy applications; (4) security, the application enables to prevent unwanted access to the system. It is shown in user data module; (5) standards or compliance, the ability of the software to comply with the standards in accordance with applicable regulations. The author understands that the application must be in accordance with the standards of the company or organization in which the application is implemented and the rules of the other financial statements; (6) the application is in its entirety adequate. However, there is still a lack of this application that can run on other operating systems other than the Windows operating system. Overall, this application is very helpful in logistics activities ranging from delivery orders, payment, receipt of goods, to shipping or delivery of goods.

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