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A WEB-BASED ELECTRONIC DATA INTERCHANGE AS SUPPLIER AND ASSEMBLY INTERFACE

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Abstract
In the assembly industry, almost all components are outsourced or transferred to other parties, in order to meet the need for supply. This is referred as outsourcing of production. The outsourcing of assembly product components is based on a relationship model between the contractor and the industry. However, there is no relationship or communication pattern between the contractor or supplier and the assembler. Hence, in order to accelerate line production and overcome problems with assembly components, the communication path is shortened by providing a direct communication channel between the assembler and the supplier or contractor, in order to communicate any problems that arise during the assembly process by internal communication within the industry. The purpose of this study is the design and development of a web-based software application electronic data interchange (EDI) that can be used as a tool for communication between the assembler and supplier. The EDI application provides formal communication between the assembly industry and the contractor providing the components or parts needed in the assembly process. The main purpose of using EDI technology is to help the assembler to communicate the relevant documents to suppliers quickly, accurately and efficiently. The documents to be communicated are in the form of reports or claims, and are related to non-conformities, errors and component difficulties arising during the assembly process. This research novelty is providing direct communication between assembly and supplier by using EDI application that can give contribution in manufacturing area so it can accelerate the line production in assembly.

Keywords
Assembly, communication, electronic data interchange, production outsourcing, supplier.

Introduction

The development of the global economy and related technological advancements have had certain impacts on business competition, which has become fierce on all fronts. This increase in global business competition can determine the strength of an industry in terms of its efficiency in competition and maintaining its survival. The cost efficiency of the various aspects of corporate financial expenditure offers one way to increase competitiveness, and one possible approach involves outsourcing strategies. This approach has been in great demand by companies in developing countries over the last 20 years as a potential way of achieving competitive advantage [1]. If a company has limited production resources and is unable to produce all its own product components, outsourcing is an option for meeting this need [2].

The outsourcing of development originated from a need for cost efficiency and a focus on the main competencies of a company [3]. In 2000, about six out of every 10 products were filled by outside suppliers [4]. Other research has shown that around 70% of American manufacturing industries outsource at

least one of the company's functional activities [5], meaning that outsourcing is one of the key trends of current industrial business [6]. This situation may force a company to carry out extensive outsourcing in its core production activities, so that it is no longer involved in production [7]. This is also referred to as outsourcing of production. Outsourcing of production has become a vital strategy for generating profit in several industries, including the assembly industry, in which several components are combined into a single unit of product that functions appropriately.

In the assembly industry, most component products are obtained from an external company in order to fulfill the availability needs of a particular assembly component. Outsourcing production in the assembly industry adopts the research model [8], involving the relationship or communication model between contractors (external companies that accept outsourcing production contracts and work on the manufacture of assembly product components) and industry, the relationship between the industry and a particular assembly department and its processes (testing and packaging), and finally the relationship between the assembly department and resales. The relationship or communication that occurs between the contractor and the industry takes place via trading of components or parts of the product required by the industry, based on outsourcing agreements or contracts between the two parties. Components or parts are obtained from the contractor, and then forwarded to the assembly department to be assembled, until the components form a single unit of product. In this model, there is no relationship or formal direct communication pattern between the contractor and assembly department or assembler that relates to problems arising during the assembly process involving the outsourcing of components. Problems associated with the assembly process include a lack of understanding of the components supplied by the contractor, ordering of unsuitable components, difficulties in assembly and errors arising during the component assembly process. These have an impact on the time consumed in processing and assembling the components. Other adverse effects include the breakage of components, which increases costs. In manufacturing systems, assembly is an important aspect that is connected with cost and time factors. The cost of the assembly system can reach between 20% to 60% of the total cost of manufacturing industry activities [9], and manufacturing assembly systems can consume more than 50% of the production time [10]. Hence, assembly activities need to be done precisely and quickly, in order to achieve efficiency and effectiveness in terms of both time and cost.

To achieve successful outsourcing production, an approach is needed in the form of a more flexible communication pattern that can minimize the existing risks, for example limited control over product components shared between the contractor and the assembler. Communication with suppliers is defined [11] as the sharing of information in a useful and timely way between companies and suppliers. Communication with suppliers is considered to influence the optimal benefits obtained by both parties in their dealings, due to its ability to reduce conflict. Based on the importance of the role of communication between assembler and suppliers, a web-based electronic data interchange (EDI) application is proposed as a medium for communicating business documents (such as reports and claims related to assembly components) to suppliers. This is also the novelty of this research, by providing the direct communication between assembly and supplier to communicate problems during assembly process through electronic data interchange application so it can be used as solution in manufacturing area to accelerate production line.

The main purpose of this paper is to examine the production outsourcing model that still no direct communication between assembly and supplier in order to communicate problems during assembly process. And it cause the assembly process consume more time. This research also provide a direction for future research of EDI application in the manufacture area. The remainder of this paper is organized as follows. In the next section is literature review. Section 3 outlines the research method used in developing EDI application. Section 4 describe the result and discussion. Finally the conclusion is given in Sec. 5.

Literature review

Outsourcing involves an agreement between the manufacturer and the supplier to provide goods or services based on a contract [12, 13]. The term 'outsourcing' has undergone a shift in meaning. If previously outsourcing practices occur in many areas and non-core activities such as security services, information technology and others, then outsourcing will be widely applied to core areas; for example, a production area is known as outsourcing production. The outsourcing of production activities to outside suppliers has a significant impact on how companies develop, produce, and deliver products to consumers [14]. There are many companies that now outsource production, especially since these activities have become valuable assets and require a technological pro-

cess that involves very rapid innovation. One model of production outsourcing is illustrated in the figure below.

In the production outsourcing model shown Fig. 1, the company orders components to be produced by a contractor, which are then used to fulfill the need for assembled product components. The components purchased from outside parties are forwarded to the assembler to be put together with other components. In this implementation, there are several problems that relate to the components. Difficulties may arise in the form of component mismatches, outspec dimensions, broken components, residual material in components, problems with assembly operations, and errors due to broken components. These problems have an impact on time consumption, and the process becomes less efficient. This problem is communicated by the assembler to the supplier through an internal system (procurement section), a pattern of communication that is relatively inefficient. In order to make the production line faster in terms of overcoming problems with assembly components, the communication path is shortened by providing a direct communication channel between the assembler and the supplier or contractor, allowing them communicate about problems that occur during the assembly process by knowing the internal industry with the support of EDI applications.

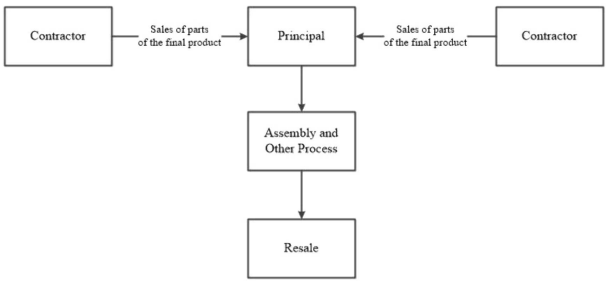

Fig. 1. Production outsourcing model [8].

Outsourcing production requires a pattern of communication and a good relationship with an outside partner, the supplier. EDI technology is needed to improve communication and coordination with foreign business partners, so that the relevant parties can communicate quickly and accurately. The implementation of EDIs in the supply chain has changed the way in which businesses operate [15]. In order to compete in the global market, companies must have a competitive supply chain, which requires the ability to communicate quickly and accurately with their business partners. EDI is one method by which organizations throughout the world have successfully improved communication [16, 17].

EDI technology has influenced both internal and external company management and business practices, with effects in various areas such as the creation of economic value and strategic competitive advantages [18], and EDI systems have played an important role in achieving competitive success [19,20]. Several studies have shown that the use of EDI can help companies to build cooperative relationships and share important information [21,22]. EDI adds value to communication relationships by increasing the efficiency of transaction processing, facilitating related systems (manufacturing and marketing), and improving coordination and communication systems [23]. EDI also develops additional connections that can strengthen a company's structural relationships [18]. As a form of electronic communication, EDI can facilitate the coordination of activities and goals both between and within organizations [24], and represents an effort to manage interdependence in a company, creating closer and better relationships both within and between organizations [25].

Research method

Website architecture and design

The first step in the creation of a website is to perform research in order to obtain an understanding of the client's needs through examination and brainstorming, and to learn more about the subject that is to be presented on the site. There is also a need to gather as much information as possible, to help in developing an outline for the site and its design, when meeting with the client. This includes asking about the target audience, goals, creative direction and other variables that may affect what can be offered to the client. Figure 2 below gives a method of research and Fig. 3 give the overview of this process.

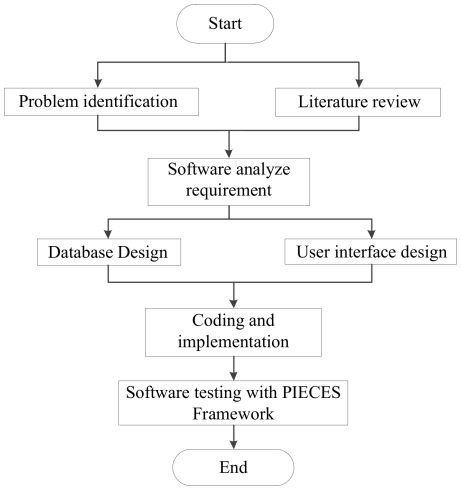

Fig. 2. Research method.

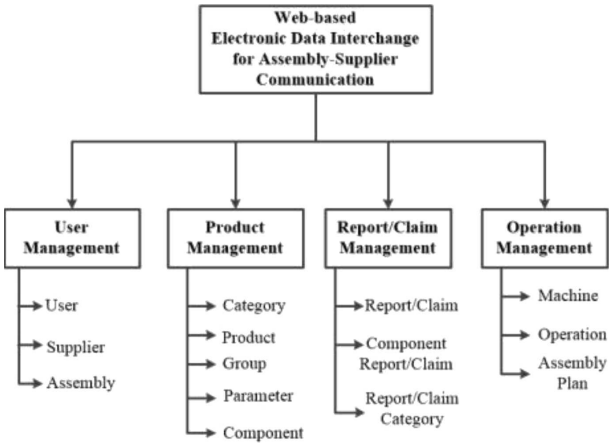

Fig. 3. Website architecture of EDI web-based .

Web-based EDI data flow diagram

The primary source of data is the assembly stage, where information about the component reports or claims is stored into the system. There are three users in this process: the assembler, the supplier and the production team. The assembly team can manage a report/claim, and can view supplier feedback and the status of a report/claim. The supplier receives the component report/claim from the assembly team and sends feedback on the report/claim. The production team can only view a report/claim on a component.

Results and discussion

Evaluation

The conceptual design and development of the EDI was implemented in the form of a prototype. The next important step is testing of the software applications that have been used. This testing is the final stage in the cycle of system design, which requires a verification test to be conducted with the aim of determining whether or not the translation of the conceptual model into an EDI application has been achieved correctly. Verification testing is done by comparing the design with pseudocode, and comparing this pseudocode with

System testing using the PIECES method. PIECES method is a research instrument where data collection is done by giving questionnaires to respondents. The questionnaire in the form of indicators in the PIECES framework has been adapted to the usefulness of the research. With this framework, new things can be produced which can be considered in the development of the system. PIECES method consisting of Performance, Information/data, Control/security, Efficiency, Service.

Validity test

Validity test is conducted to determine the ability of PIECES questionnaire as a research instrument in measuring EDI applications as interface media in a direct communication pattern between assembly parts and parts of suppliers in a production outsourcing process. In SmartPLS, the indicator is declared valid if it has a loading factor above 0.5 and has an AVE value above 0.5. So it can be concluded that the measurement of the questionnaire fulfills the validity criteria. The results of the validity test on 20 items of questionnaire questions conducted on 100 respondents are as follows (Table 1).

Table 1
Validity testing result.

	P	I	E	C	E	S
Throughput	0.883					
Respon Time	0.965					
Audability	0.903					
Communication commonly	0.960					
Completeness	0.895					
Consistency	0.945					
Fault tolerance	0.929					
Accuracy		0.882				
Relevance		0.728				
Information presentation		0.846				
Data Flexibility		0.605				
Reusability			0.953			
Resources			0.954			
Integrity				0.866		
Security				0.905		
Usability					0.993	
Maintanability					0.994	
Accuracy						0.960
Reliability						0.869
Simpleness						0.760

P –performances, I – information, E – economics, C – control, E – efficiency, S – service

Testing validity for reflective indicators uses correlation between item scores and construct scores. The table above shows that the loading factor gives a value above the recommended value of 0.5. Means the indicators used in this study are valid or have met convergent validity.

The chart and table in Fig. 4 give AVE values above 0.5 for all parameters contained in the PIECES model. It means that, the PIECES questionnaires is valid to measure the EDI software application as assembly and supplier interface to communicate several problems due assembly process. This applica-

tion suitable with six aspect of PIECES from respondent view.

Table 2
AVE testing result.

	Average Variance Extracted (AVE)	Validity
Performance	0.858	Valid
Information	0.598	Valid
Economic	0.909	Valid
Control	0.785	Valid
Efficiency	0.987	Valid
Service	0.751	Valid

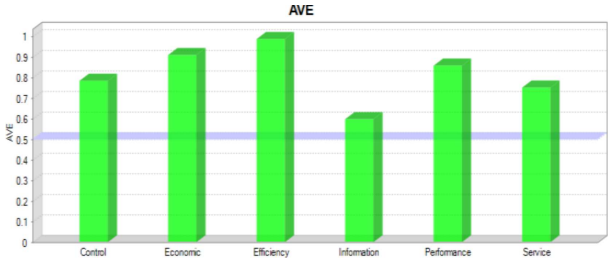

Fig. 4. Comparation of AVE.

Reliability test

Reliability testing is done by looking at the composite reliability value of the indicators on each parameter. The composite reliability results will show a satisfactory value if above 0.7. Following are the composite reliability values at the output.

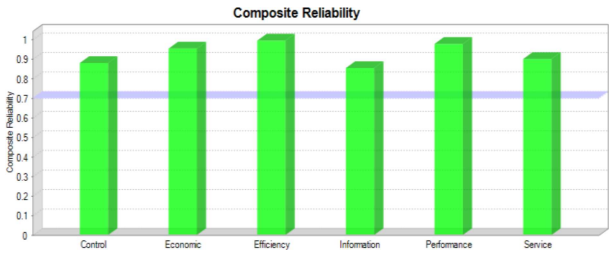

Fig. 5. Comparation of composite reliability value graphic.

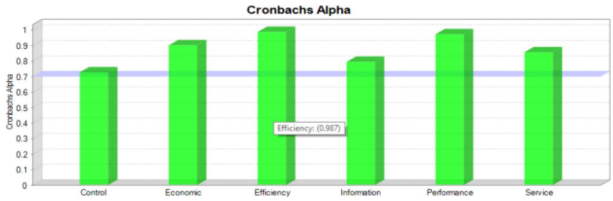

Fig. 6. Comparation of cronbachs alpha value graphic.

In Figs 5 and 6, present the comparation of composite reliability and cronbachs alpha value graphics that show the PIECES questionnaires was valid and reliable to evaluate the web-based EDI. Composite reliability is a measure of internal consistency in scale items. In SmartPLS we can use composite reliability to measure reability and also Cronbach Alpha.

This EDI web-based system has been implemented in 100 user from assembly industry in Indonesia. The user fill PIECES questionnaires and from the questionnaires we can conclude that based on PIECES framework, this system has been meet the user requirement for EDI as supplier and assembly media communication 80.45% (Table 3). 80.45% means that this EDI application meet the requirement of user of EDI.

Table 3
A web-based EDI testing result.

Indicator	User [%]	Average for each parameter [%]	Average for all parameter [%]
Performance			
Throughput	84.4		
Respon Time	83.8		
Audability	84.8	84.34	80.45
Kelaziman Komunikasi	84		
Completeness	84.8		
Concistency	84.6		
Fault Tolerance	84		
Information			
Accuracy	73.6		
Relevan	77.2	77.8	
Information display	84.4		
Data flexibility	76		
Economy			
Reusability	84.6	84.1	
Resources	83.6		
Control			
Integrity	79.4	79.4	
Security	79.4		
Efficiency			
Usability	78	78	
Maintanability	78		
Service			
Accuracy	81	79.07	
Reliability	77.4		
Simpleness	78.8		

Conclusions

The outsourcing of production in the assembly industry involves a model of the relationship between both the contractor and the industry, and between the industry and the assembly department. This of-

ten has a negative impact on the time consumption, costs and quality of outsourcing. Problems often arise in the component assembly process of a final product, with the most common taking the form of component mismatches, outspec dimensions, damaged components, residual material in components, difficulties in assembly operations, and errors due to component damage. These issues have an impact on time consumption, making the process less efficient, and the pattern of communication used is also less efficient in terms of the use of time. The production line therefore needs to overcome problems with the assembly of components more quickly, and the communication pattern can be shortened by providing a direct communication channel between the assembler and the supplier or contractor in order to communicate any problems that occur during the assembly process by knowing the internal industry.

To facilitate this relationship of direct communication, an interface is needed that can support communication links between the related objects. An EDI software application is therefore established as a communication channel between the assembler and the supplier or contractor, to communicate problems with components when the assembly process is carried out. The EDI software implemented here allows the assembler and the supplier or contractor to communicate reports and claims involving the components obtained from the supplier, and has a mechanism that can simplify the relationship and communication between the two parties.

Furthermore, there is still need more research in the future to integrate this system with another information system, such as decision support system and enterprise resource planning.

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