



## Research Article

## Design of Web Application Program for Reducing Processing Time of Raw Material Incoming in an Appliance Industry

Athakorn Kengpol\*

Advanced Industrial Engineering Management Systems Research Center, Department of Industrial Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand

Sopida Tuamsee

Department of Information and Production Technology Management, College of Industrial Technology, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand

Tattima Chanmanee

Department of Industrial Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand

Kalle Elfvingren

LUT School of Engineering Science, LUT University, Lappeenranta, Finland

\* Corresponding author. E-mail: athakorn@kmutnb.ac.th DOI: 10.14416/j.asep.2020.04.001

Received: 19 November 2019; Revised: 13 February 2020; Accepted: 2 March 2020; Published online: 15 April 2020

© 2020 King Mongkut's University of Technology North Bangkok. All Rights Reserved.

### Abstract

In the study of the case company's refrigerator production process, it found that the 'Incoming Section' takes a long time. The employees are unable to fill in the 'Parts Incoming Report' in the inspection area and there is no purchase orders in storage area, resulting that documents are filled out retrospectively by the employees. The information recorded is inaccurate and fail to be used to analyze the problems, lost time filling documents, causing the huge workloads compared to the daily input, an average of 98.4 items per day. The filling documents in vain during January–May 2017 totally amounted to 106,600 Baht. For this reason, this research aims to improve the incoming inspection performance by applying the information systems to design web applications for data storage on incoming inspection. A database system is designed by using the Visual Studio 2010 to manage web applications. The My SQL database is used via phpAdmin to manage data. It found that the user can fill out the information in the inspection area immediately. The comparison of filling-out times spent between the paper-based process and the web-based process by the conventional work method is an average of 1 min 53 s individually compared to the new working system; an average of 36.58 s individually. Filling-out time is reduced by up to 1 min 16 s. The number of 108 errors is found on filling before the update can be reduced to only 3 items. The result is representing a decline in a loss of 77,659.08 Baht for five months.

**Keywords:** Database management system, Reducing processing time, Microsoft visual studio, Consumer electronics industry

Please cite this article as: A. Kengpol, S. Tuamsee, T. Chanmanee, and K. Elfvingren, "Design of web application program for reducing processing time of raw material incoming in an appliance industry," *Applied Science and Engineering Progress*, vol. 13, no. 4, pp. 370–376, Oct.–Dec. 2020.

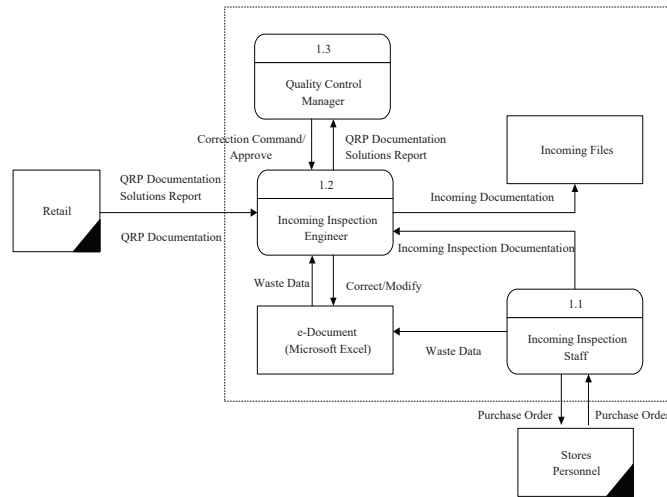
## 1 Introduction

At present, Thailand's electrical appliances production rates have been growing. The electrical appliance manufacturers have been driven by the competition in terms of price and quality to meet customer needs. The product quality, reliability, and good service are key factors that make the business to achieve competitive advantages and success. In this study, a case company is one of the electrical appliance manufacturers which its main product includes the refrigerator. The company has adopted the Information Systems to help manage the organization; namely, information system has been rendered to facilitate the development and management on employee performance and organizational behaviour to achieve goals such as the improved control of the organization; including Computer-Aided System and to check whether or not the assigned personnel can achieve their functions, as well as training process before starting work which the departmental supervisors need the different information when functioning.

In the field survey of the case company's refrigerator production process, it found that in the process, the 'Incoming Section' takes a long time, the raw materials quality inspection process before moving into the production process consists of two parts; 'incoming inspection' and 'input recording'. It found that the employees are unable to fill in the 'Parts Incoming Report' in the inspection area and there is no purchase orders storage area, resulting that documents are filled out retrospectively by the employees. The information recorded is not 100% accurate and fail to be used to analyze the problems, lost time filling documents, unclear division of duties, causing the huge workloads compared to the daily input, an average of 98.4 items per day. The filling documents in vain during January–May 2017 totally amounted to 106,600 Baht. For this reason, the researcher is aware that the introduction of information systems is necessitated to improve the incoming inspection performance by applying the information systems to design web applications for data storage on incoming inspection. This can reduce the waste of time filling in documents and filling in information on incoming inspection in the area.

In 2006, Olypiada [1] proposed a way to develop a Dedicated Software computer program to help detect and identify the underlying causes of abnormalities

on the induction motors and provided the decision-making system in which the users can use the database consisting of 5 components, namely equipment information, information about faults, information about the causes, information about the fault diagnosis for the AC motors, using the Dedicated Software computer program. The results found that computer program can be applied with the technicians to detect problems before they ruin the equipment. It helps increase work efficiency, and identify the problems quickly and accurately. Afterward, Pipat [2] proposed the development of billing information management system to facilitate the users on making payment through the exhibition booths, roadshow, including money transfers, accepting checks between firms in the format of the application, using the Microsoft Visual Studio 2010 Visual Basic.Net Crystal Report and Microsoft SQL Server 2008 to manage the system database. The results of the satisfaction appraisal by five experts were  $\bar{x} = 4.13$ , S.D. = 0.66, and by general users were  $\bar{x} = 4.01$ , S.D. = 0.82. The design and development of billing information management systems showed the fair level of the user satisfaction and it can be applied effectively. In 2012, Anucha [3] design and develop a database management system on suppliers to reduce time in searching and data storage on the suppliers. The Microsoft Access 2007 is a tool to develop data and it is actually tried on, finding that with the Microsoft Access 2007 can reduce searching time by up to 99%, higher than expected of 85%, as well as facilitate database management and data transmission to the different departments. As Paponphat [4] develops an application for mobile service reporting to reduce time and to summarize the mobile service reporting, finding that it took a lot of time of manipulating the telephone with the Visual Studio 2010 C sharp language program to design, develop, and manage Excel files. The results showed that it could reduce time by 98.45% and reduced cost from 4,999.995 Baht to only 73.80 Baht per month. Chatnarin [5] examined the sales opportunity loss and a long time of queuing, and conceived an idea to develop the computer programs used to store data and analyze the data that are transmitted into the database management system with document recording. The results showed that it can increase the volumes of goods delivery and can use data storage and details, and improved the delivery performance by up to



**Figure 1:** Data flow diagram on current work systems at the ‘Incoming Materials Inspection’.

100% compared to the same period in 2011. Then, Kittichai [6] develops a database to reduce searching time and introduces the computer programs to help manage documents, specifications and engineering designs systematically, reduce the time it may take to search for documents and ease business transactions quickly. In present study, the researcher has adopted the Management Information System (MIS) and applied Visual Basic program to help database management. It can reduce the searching time for documents from 8.4 min to 0.287 min per item, representing 96.58%, saving up to 18,984 Baht per year and reduce the damages resulting from erroneous calculation up to 149,260 Baht per year. In 2015, Pornthip [7] introduced a solution with the Visual Studio 2010 application to design and develop database program. The data searching time was 2.55 min per copy, reduced from the previously 36 min per copy, representing 92.92%. The file searching time was 3.32 min per item, reduced from the previously 40 min per item, representing 91.62% and no lost data was found, thereby reducing a loss of 400,000 Baht per year. Later, Theerapong [8] examined the warehouse management systems which it previously took an average of 31.91 min to search data and an average of 8.31 min to analyze data. The lost time of searching and analysis accounted 108,901.18 Baht per 6 months or about 217,807.36 Baht per year. With the Microsoft Visual Studio 2010 and MySQL for database management, finding that it can reduce a searching time by 76.80% and reduce an

analyzing time by 77.37%, resulting in the reduced cost of 167,706.22 Baht per year.

The relevant researches demonstrated that database design and development for database storage can increase operational efficiency and it also prevents the document information from loss, convenient to use, and can retrieve data quickly.

## 2 Research Method

### 2.1 Examination of current work systems

The current work systems examined indicate the absence of a storage database system while the employees are unable to fill out documents in the unit of work examined. Additionally, employees shall have to fill out the information in multiple systems, thereby resulting in that gathering documents and filling out can be achieved on certain days by the employees. At timing, filling out of 20 items individually takes an average of 37.58 min.

#### 2.1.1 Data Flow Diagram (DFD)

Data Flow Diagram (DFD) on current work systems at the ‘Incoming Materials Inspection’ demonstrates the complicated work procedures without a management information system. Besides, database management in the form of files and folders cannot be retrieved immediately as shown in Figure 1.

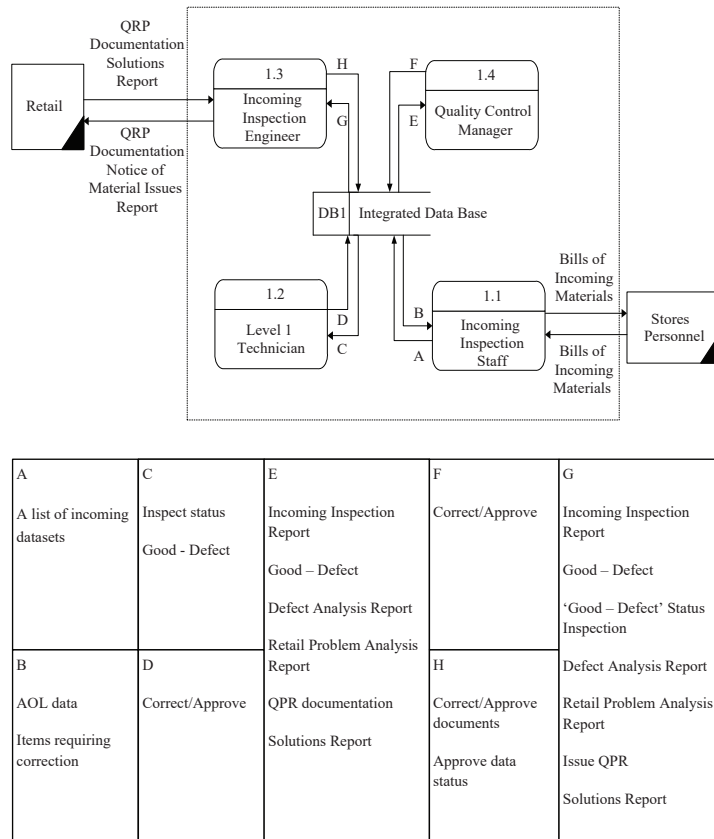


Figure 2: Data flow diagram on re-design of work system at the ‘Incoming Materials Inspection’.

## 2.2 Solutions

Re-design of work system – analysis of problems where the incoming materials inspection is currently encountered demonstrates that the underlying cause of problems is derived from an absence of database management system, thereby resulting in the lateness of filling out documents by the employees and the filled-out information is not 100% accurate. For this reason, it inspires a concept of web application design that can be applied to the incoming materials inspection and is beneficial to the inter-linkage of information to improve the workflow to be more efficient through re-designing of work system, as shown in Figure 2.

## 2.3 Design and development of database management systems

Based on problems arising with the work process at

the incoming materials Inspection, the corresponding database management system is designed and outlined through web applications. The sequences of works are presented in Figure 3.

## 3 Results

### 3.1 Developed database program

A database system is designed by using the Visual Studio 2010 to manage web applications. The My SQL database is used via phpAdmin to manage data. In this way, the user can fill out the information in the inspection area immediately as well as the launching of inspection reports in Excel, PDF format while the supervisor can check the accuracy of the data and can analyze workpieces and stores encountering quality problems as well.

To log-in to access the web application, the users

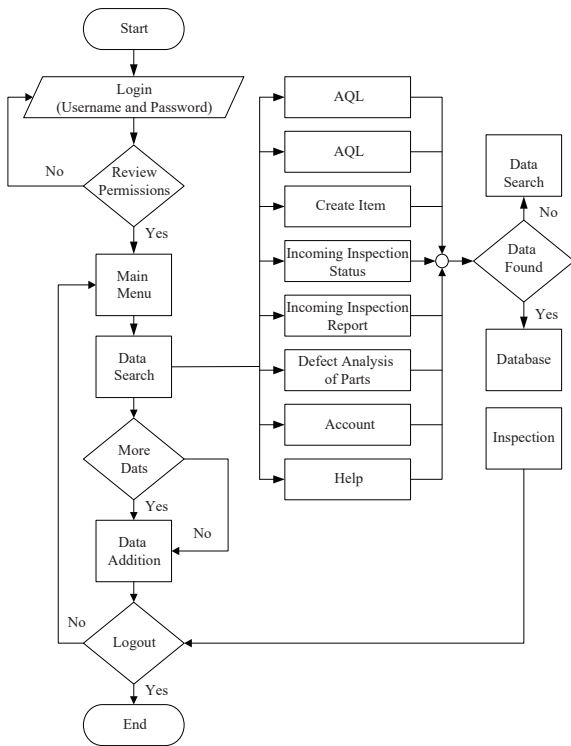


Figure 3: Algorithm and procedure.



Figure 4: Register page.

must key username and password for user authentication to log to access the web application as shown in Figure 4.

Then, access to the ‘Main Menu’; comprising ‘Search’, ‘Add Data’, ‘Update Status’, ‘Report,’ ‘Analysis of Raw Materials’, ‘Stores’, and ‘Help’ tab as shown in Figure 5.



Figure 5: Main page.

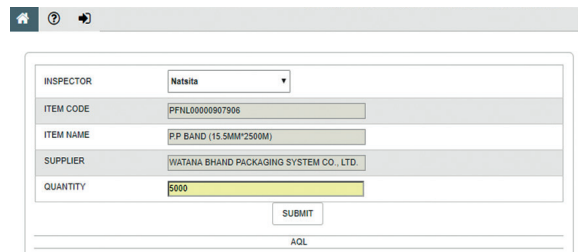


Figure 6: Add data page.

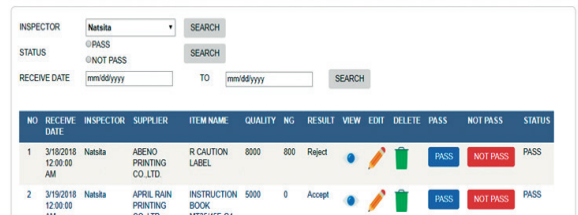


Figure 7: Update status page.

At ‘Add Data’ tab, the users are required to add information regarding a quantity of incoming raw materials per 1 item, number of incoming materials, number of wastes, receiving date, and description. Then, the user can select to ‘accept’ or ‘refuse’ as shown in Figure 6.

Once filling out completely, the filled-out information shall be inspected by the supervisor on the Update Status page and then approve or notify users to edit information as shown in Figure 7.

At the ‘Material Inspection Report’ page, the reports in PDF and Excel format can be retrieved, making checking of all incoming materials easily and to reduce a document storage area as shown in Figure 8.

NO	ITEM CODE	ITEM NAME	SUPPLIER	QUANTITY	NG	DESCRIPTION	First Qty1	Second Qty2	Result
1	RFNL00000415	INSTRUCTION BOOK D1 SERIES	APRIL RAIN PRINTING CO. LTD.	50	0	OK	5	0	1
3	RFNL0000061300	SCREW WITH WASHER M6x12	BUAYAT INDUSTRY 1998 CO. LTD.	100	0	-	13	0	2
6	PF8800000416	THEMATOR (655 074 2000) MTS, 45G	THAI SHIBAUURA DENSHI CO. LTD.	100	0	-	13	0	2
7	RFNL000120000	HEAT INSULATION A	ASIAN INOAC CO. LTD.	1,000	0	-	50	2	5
2	PFNL000005913	INSTRUCTION BOOK MTS/ASF-G4 (APRIL RAIN PRINTING CO. LTD.)	APRIL RAIN PRINTING CO. LTD.	5,000	0	-	125	5	9
8	PFNL0000061512	LITTEL FUSE (15A)	JIBUNH ENGINEERING LTD. PART.	5,000	200	Defect	125	5	9
1	RFNL0000061300	R CAUTION LABEL	ABENO PRINTING CO. LTD.	800	800	Defect	125	5	9
4	PFNL0000051515	INSTRUCTION BOOK (MRO D24) ACAPRIL RAIN PRINTING CO. LTD.	APRIL RAIN PRINTING CO. LTD.	8,000	200	Wrong Series	125	5	9
5	PFNL0000051515	INSTRUCTION BOOK (MRO D24) ACAPRIL RAIN PRINTING CO. LTD.	APRIL RAIN PRINTING CO. LTD.	8,000	200	Wrong Series	125	5	9

Figure 8: Report page in PDF format.

NO	ITEM CODE	ITEM NAME	SUPPLIER	QUANTITY	NG	DESCRIPTION	RECEIVE_QTY	RESULT
1	RFNL00000415	R CAUTION LABEL	ABENO PRINTING CO. LTD.	800	0	Defect	3/28/2018 0:00	Reject
2	RFNL000005913	INSTRUCTION BOOK MTS/ASF-G4 (DIGITAL)	APRIL RAIN PRINTING CO. LTD.	5000	0	-	3/28/2018 0:00	Accept
3	RFNL0000061300	SCREW WITH WASHER M6x12	BUAYAT INDUSTRY 1998 CO. LTD.	100	0	-	3/28/2018 0:00	Accept
4	RFNL0000061512	INSTRUCTION BOOK (MRO D24) ADD AGENCY ADDRESS	APRIL RAIN PRINTING CO. LTD.	8000	8000	Wrong Series	3/28/2018 0:00	Reject
5	RFNL0000061300	INSTRUCTION BOOK (MRO D24) ADD AGENCY ADDRESS	APRIL RAIN PRINTING CO. LTD.	8000	8000	Wrong Series	3/28/2018 0:00	Reject
6	PF8800000416	THEMATOR (655 074 2000) MTS, 45G	THAI SHIBAUURA DENSHI CO. LTD.	100	0	-	3/28/2018 0:00	Accept
7	RFNL000120000	HEAT INSULATION A	ASIAN INOAC CO. LTD.	1000	0	-	3/28/2018 0:00	Accept
8	PFNL0000061512	LITTEL FUSE (15A)	JIBUNH ENGINEERING LTD. PART.	5000	5000	Defect	3/28/2018 0:00	Reject
9	RFNL00000415	INSTRUCTION BOOK D1 SERIES	APRIL RAIN PRINTING CO. LTD.	50	0	OK	3/28/2018 0:00	Accept

Figure 9: Report page in Excel format.

At 'Report' page in Excel format is to facilitate data search and data analysis and release of documents as shown in Figure 9.

### 3.2 Comparison of a conventional system and a newly developed system

Based on testing results of on web application implementation, the employees fill out information on incoming raw materials in the area examined and filling-out timing is rendered. In this study, the number of filling-out timing includes 95% confidence interval. The Maytag's data table [9] is used to determine the optimal number of filling-out timing.

The comparison of filling-out times spent between the paper-based process and the web-based process by the conventional work method is an average of 1 min 53 s individually compared to the new working system; an average of 36.58 s individually. Filling-out time is reduced by up to 1 min 16 s. The developed web application includes a filling field. The tracing of the filled-out data can be accessed by the original database. Consequently, filling out is conducted more carefully by the employees. It can

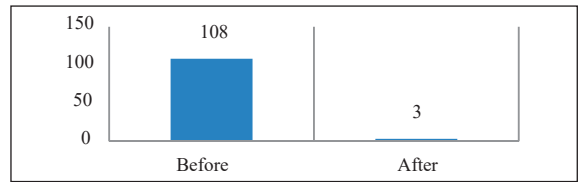


Figure 10: The comparison of filling-out errors.

improve how employees perform in the inspection area immediately, and employees can perform works more conveniently, quickly, and more efficiently.

### 3.3 Comparison of data entry accuracy

In this study, data collection is conducted from January to May 2017. The number of 108 errors is found on filling before the update, compared to the post-update errors during February–April 2018 when the web application is introduced to filling-out, it can be reduced to only 3 items as shown in Figure 10.

## 4 Conclusions

Web application design is carried out using the Visual Studio 2010 to design and to manage the database via phpAdmin web browser for the incoming materials inspection in the case company. The practical testing is proven that hypothesis is met, the result is 60% higher than the hypothesis postulated, representing a decline in a loss of 77,659.08 Baht for five months. The advantage of this research is that the manpower aspect comparing between the proposed method and conventional work method has been improved significantly.

### 4.1 Suggestions

It's important that the users follow the work instruction appropriately and must be trained by the corresponding quality control department only to achieve the performance smoothly and it can be possibly extended in the future.

### 4.2 Guidelines for future database development

In the future, information on waste for the production line can supplementary to integrate all data into the same database [10], and database improvement with

more effective security systems is also needed.

### Acknowledgments

This research is sponsored by the electrical appliance company at Incoming Material Inspection. Gratefully, thank the manager, supervisor, as well as employees for assistance regarding data, work instructions, and cooperation for performance improvement.

### References

- [1] A. Olypiada, "Induction motor' faults detection and diagnosis by using dedicated software," *Journal of Material Processing Technology*, vol. 181, pp. 313–317, 2006.
- [2] W. Pipat, "Payment file management system," M.S. thesis, Faculty of Information Technology, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand, 2010 (in Thai).
- [3] S. Anucha, "Design and development for control database system of supplier: A case study of auto parts manufacturing company," M.S. thesis, Department of Industrial Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand, 2012 (in Thai).
- [4] T. Paponphat, "Development of a program for making telephone service system reports. Case study: Electricity generating authority of Thailand," M.S. thesis, Department of Industrial Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Thailand, 2012 (in Thai).
- [5] T. Chatnarin, "The development a computer programing for delivery planning of pressure control industrial product: A case study in industrial product trading company," M.S. thesis, Department of Industrial Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand, 2012 (in Thai).
- [6] B. Kittichai, "Development of a database management program to reduce search engine time: A case studies of sheet compression, machine manufacturing companies," M.S. thesis, Department of Industrial Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand, 2013 (in Thai).
- [7] T. Pornthip, "Management system development database for product development parts of product design agency case study the company produces and assembles the wiring harness," M.S. thesis, Department of Industrial Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand, 2015 (in Thai).
- [8] S. Theerapong, "Computer program designed to decrease data-Searching time in a warehouse department: A case study of electrical equipment company," M.S. thesis, Department of Industrial Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand, 2016 (in Thai).
- [9] W. Ratchawan, *Industrial Work Study*. Bangkok, Thailand: Top Publishing Co. Ltd., 2009.
- [10] C. Supaartagorn, "A framework for web-based data visualization using google charts based on MVC pattern," *KMUTNB International Journal of Applied Science and Technology*, vol. 9, no. 4, pp. 235–241, 2016.