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## **THE WORKFLOW KERNEL DEVELOPMENT AND BENEFIT ANALYSIS FOR ELECTRONIC MANUFACTURING INDUSTRY**

William Hsueh and Min-Jen Tsai, National Chiao Tung University, Taiwan, [mjtsai@cc.nctu.edu.tw](mailto:mjtsai@cc.nctu.edu.tw)

### **ABSTRACT**

Since the advantage of low production cost is not existing any more for companies based in Taiwan due to the global manufacturing approach, how to reduce the production costs effectively is a critical issue for most of the manufactures. In the mean time, the communication of research and design, human resource management, customer support service, and daily operations across the international boundary also become important in order to achieve the goal of making the accurate daily support, create good quality products and providing products more quickly for customers. At the same time, companies usually grow up by merging other companies to quickly catch up the speed of innovation and production. How to integrate information & culture quickly between each other also needs to be studied. The purpose of this research is to make a suitable workflow development that can fit company culture requirement and handles daily demands and lead into manufactory & sub-company rapidly for Taiwanese electronic industry. The developed workflow fits the needs of WfMC which specify the requirements of process definition tools, workflow client applications, invoked applications, other WFMS enactment service and administration & monitoring tools. By using the workflow control, the case company efficiently reduces the inventory level, production cost up to 10% within one year testing period.

*Keywords:* Workflow, Competitive Strategy.

### **INTRODUCTION**

Workflow Management System (abbreviated as WfMS [1-7]) is a complete set of process management system, which has been defined in WfMS by applying the logical definition of daily workflow to allow computer to promptly and precisely implement logical definition of workflow, as well as automatically dispatch the preset workflow route, or manually designate the workflow route to assist people in the daily workflow by taking advantage of computer's powerful automation capability. The evolution of workflow management is composed of the regulations or procedures of business process automation, while workflow is composed of document, information and work task, which would pass from one to another participant.

The key benefits of workflow can be categorized as following:

- a. Improving Efficiency - automated business workflow can eliminate many unnecessary procedures
- b. Better Flow Control - improved management in the process of business workflow to make the standardization for work methods and provide improvement for inspection and audit
- c. Enhancing Customer Service – customers' response can be projected within the consistent leading flow
- d. Flexibility – in accordance with the change in business workflow, software can also be changed flexibly according to the workflow
- e. Improving Business Workflow - focusing on the business workflow to make the process to be more streamlined and simplified

As early as 1995, "A CASE COMPANY" has already stepped into the filed of CR-ROM, and recruited the excellent R&D team from Industrial Technology Research Institute (ITRI). Currently, it has more than 330 engineers with master's degree or Ph.D. degree who are responsible for tasks of the anti-seismic design, circuit design, programming and functional adjustment that made A CASE COMPANY's CD-ROM to reach the world-class standard. In 1997, its China plant has been established, since then A CASE COMPANY has not only been started its OEM business for major global PC players, but also entered the domestic market in China; therefore, A CASE COMPANY has boosted its reputation in the CD-ROM industry, and it has also built the image and praise of being the Top 1 brand in China.

When implementing Workflow to company, Paperless is the first thought for employees, which is able to cut down the costs of regular administrative process, such as the overtime, approval of the leave, etc. For long term business planning, the Information Management department of this company should think about what is the solution of making the maximum competitiveness for this company after implementing the process automaton. By adopting the 80/20 Principle (known as Pareto Principle) to discover the 20% most important process that influenced company's process; among which, pre-electronicalized prior process will be the most effective method of creating value.

It is not difficult to sort out the most important 20% process and have them to be electronicalized, the hard part is how to smoothly promote such idea and action to related personnel in this company. In addition, it would rather be regarded it as an implementation of enterprise transformation than a promotion of process automation. The purpose of this study is to propose a solution for the issue of how promptly integrate with employees who scattered all over the world and the problem in certainly implementing the workflow and order for this company.

### **METHODOLOGY**

As to reach the purpose, this study has adopted the onsite operation of each workflow in this company and the interview

with its employees who are currently using the workflow to discover the most optimal tool of workflow for this company by aiming at its company culture.

The methodology and content of this study has included the following:

- a. Research on the state of each workflow inside the company.
- b. Evaluate the importance to company (degree of company's competitiveness) in accordance with each workflow
- c. Discover the process of core competitiveness and make proper adjustment and rationalization, and then make it able to apply in the future automation process to achieve the purpose of enterprise transformation.
- d. Evaluate the comparison between functions for the workflow softwares that sold in the existing market, and make discussion on related types (patterns) of workflow.
- e. Evaluate the workflow software sold in the existing market that conformed to the company's demand, and the feasibility of self-R&D for the workflow software.
- f. Evaluate the overall improved efficiency after implementing the workflow software.

This study has adopted the workflow automation that implemented in A CASE COMPANY as the main research item, and researched on the improvement in company's competitiveness after the implementation.

The research process of this study is divided into the following steps:

a. Drafting Research Plan:

Collecting related process (Workflow) data and conducting analysis and organization on the collected data and literature, and then determining the research direction and making the correlative plan.

b. Related Literature Review of Workflow to Manufacturing Industry

Aiming the literature review of general manufacturing industry that they are R&D and taking orders in Taiwan, producing and shipping in China after implementing the workflow in their companies.

c. Analyze the related issues on the CD-ROM manufacturers that they are R&D and taking orders in Taiwan, producing and shipping in China, through conducting the onsite inspection and interview to understand their workflow and problems.

d. Construct or Implement Workflow System

Since the pattern that A CASE COMPANY is R&D and taking orders in Taiwan, producing and shipping in China to understand the issue and study related literature, as well as make comparison with the existing workflow to conduct the evaluation of feasibility and construct an optimal set of workflow system for A CASE COMPANY workflow system.

e. Follow-up Performance Evaluation of Empirical Research

Implement the actual process of enterprise to the workflow system in this study, and then conduct the empirical study after implementing the follow-up performance evaluation.

f. Conclude the Conclusion and Suggestion that Came Out from this Experiment

## LITERATURE REVIEW

In 1993, as for the workflow management systems that were provided by each major manufacturer at that time, their functions were irregular and all of them were unique systems. Thus, a non-profit organization (NPO) named as Workflow Management Coalition (WfMC) has been established internationally, and it has proposed the Workflow Reference Model in 1995 which has been accepted and approved by Object Management Group (OMG) on November 1998. Therefore, it became the standard referential criteria of workflow management facility in CORBA [2]. WfMS has defined the term of "workflow" as: "Automation of Handling Process for Computerizing All or Partial Business". It is emphasized on the process automation of operation, among which, document, information and work items, etc. should be follow the programmed process and regulation to transfer among participants (including personnel, unit organization, information system) to jointly complete the work.

WfMC has defined the term of "workflow management system" as: "A system that is able to completely define, manage and execute the workflow, and it is able to deduce the executing sequence of software according to the workflow logic which represented by computer."

In recent years, due to the transformation of A CASE COMPANY from a simple company that is R&D and taking orders in Taiwan to become producing and shipping in China, such adjustment of operation strategy caused significant difference between workflow and organizations, and this is the so-called "change management," among the process of change management, the implementation of workflow management system is one of the important steps.

In the analysis of construction requirement for A CASE COMPANY's Workflow, Easy Maintenance is one of the main targets due to all employees of A CASE COMPANY are scattered in various locations, such as Hsinchu, Taipei, Guangzhou China, US, Holland, Hungary, etc., if it adopted the 2-tier framework, it may encounter the problem in different Client versions which will cause higher maintenance cost; and the most important issue is that the IT personnel is insufficient at beginning for A CASE COMPANY.

In order to solve the issue of insufficient IT manpower, and make it to operate within the existing notes 2-tier environment, the only way is to develop the Workflow Web, and the Client can be maintained by using the least manpower; in addition, current notes 2-tier environment can be applied to develop the Workflow Application to achieve the goal of money saving.

Plan out the workflow kernel that conformed to the need of A CASE COMPANY, in addition to follow the workflow pattern that possessed the internal credibility, it should be conducted the comparison with the function of well-known workflow tools; therefore, it can be then made A CASE COMPANY's workflow kernel to be more completed. Although A CASE COMPANY is seldom conducted the manpower development, it still can be reached the desired functions by using customized methods. The accessibility of developing environment is only issue that A CASE COMPANY is unable to make comparison with

international major players; however, it only used the manpower of 2-3 persons to complete all workflow that conform to A CASE COMPANY, and it is the workflow tool that is unable to be matched by some international major players' workflow tools.

The 3 following points are the characteristics of Workflow Kernel for A CASE COMPANY:

1. The minimum maintenance cost:
  1. Modulized signing and reviewing workflow which is able to use repeatedly.
  2. IT development program, signing and reviewing personnel of workflow responsible unit.
  3. Self-development, it is no need to pay maintenance cost to supplier.
2. The same workflow that used in RONIC COMPANY group:

To reach the integration with the environment of using interface in order to reduce the employee education training cost, and the integration with workflow between different systems.
3. Implementing action of each order and indication:

No more time, geographic and environmental restriction, though a series of actions, such as sign/review, discussion, response and issuance for the sign/review system of Workflow Kernel to achieve the Information Transparency and Order Consistency. In addition, adopted the most rapid and correct working commend to reach the entire process's smoothness of R&D, production and marketing in order to increase the company's competitiveness

The Workflow Kernel is the electronic sign-off for the internal system of A CASE COMPANY, which is a multifunctional system on the basis of connecting Web and Lotus Notes mails and integrated with workflow sign-off, mails, document management, authority security control into an entire system that self-developed by A CASE COMPANY. The Workflow Kernel is able to satisfy the internal basic need for OA system, such as ask for leave, overtime, etc, and the document sign-off workflow systems, such as EN, ECN, etc. that used for advanced RD in A CASE COMPANY.

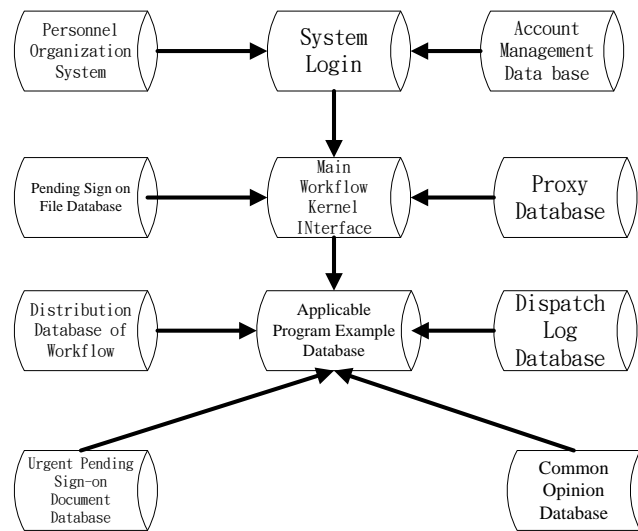
#### Relationship between Workflow Kernel and Each Applicable Program of A CASE COMPANY

The main function module of workflow kernel for A CASE COMPANY: system logon, account management database, main workflow kernel interface, distribution database of personnel organization system, distribution database of workflow, dispatch log database, proxy database, sign on file database, urgent pending sign-on document database, common opinion database, applicable program example database, etc.

Data among these modules are mutually related to each other, which connected to form the entire Workflow Kernel of A CASE COMPANY, and it can not be lacked any one of them. In addition, there's an example database which defaulted the program of basic workflow functions, and used to customize the applicable program of any workflow for A CASE COMPANY.

The function introduction of each module: (as shown in Figure 1)

1. System Login: Portal Site of A CASE COMPANY.
2. Account Management Database: individual basic information and account password management.
3. Main Interface of Workflow Kernel: Personal portal site after logon
4. Personnel and Organizational System Distribution Database: Official department, organization and personnel of A CASE COMPANY which provided for the using of WorkFlow Kernel, and employee inquiry.
5. Workflow Distribution Database: the designed access location of each workflow, which can be used repeatedly
6. Dispatch Log Database: provided dispatch record of document control center that used to be the reference to inquire the issuers, time and versions of technology document.
7. Proxy Database: when employees asked for leave or on the business trip, they can designate the proxy. The function of proxy is that they can sign the document according their own authorization, and they also can wait the person who asked for leave and went on the business trip back to sign the document. As for the person who asked for leave and went on the business trip, they also need to designate the proxy, and they can sing-off the document via Internet.
8. Pending Sign On Database: store the pending sign-on document or match sign-on document for each applicable program, after the sign-off personnel logon, the remained pending sign-on document or file will come out automatically.
9. Urgent Pending Sign-on Document database: when it exceeded the set time of pending sign-on document for the signing personnel, this database will send a message to such personnel to urgently sign on the paper or document.
10. Common Opinion Database: when signing on the document, the sign-on personnel is able to use this database to embed the common personal opinion into the sign on document or file in case of the additional signing remarks.
11. Applicable Program Example Database: The development of workflow applicable program for A CASE COMPANY is able to use this applicable program example database to develop various types of applicable program to reduce the lead time of development.



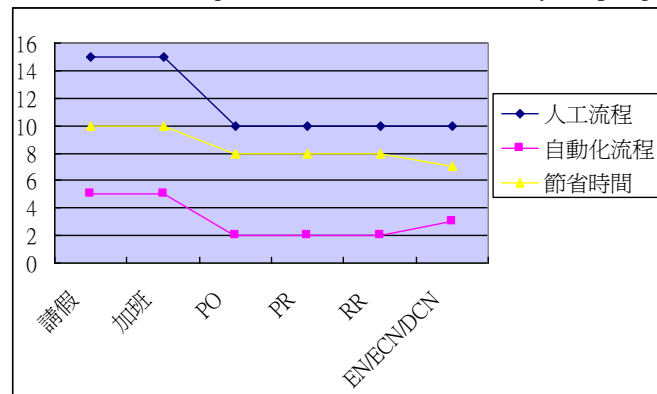
**Figure 1 Function Description of Each Module**

### EMPERICAL FINDINGS AND DISCUSSION

Since 2005, after the Workflow Kernel of A CASE COMPANY has been completed, it then has continually completed various applicable programs; in addition, they were successfully used to the applicable programs that developed in accordance with the Workflow Kernel of A CASE COMPANY. Meanwhile, these programs were not restricted within the geographic regions, and can be transmitted to each business point of A CASE COMPANY all over the world via Internet to achieve the benefit of Workflow Kernel for A CASE COMPANY.

By using the interview with users and the advantage and disadvantage analysis of each workflow Kernel of A CASE COMPANY, we get the following findings: I. Comparison between the time consumed by inquiring the information of manual and automatic sign-off: it will be obtained from the result in Figure 2.

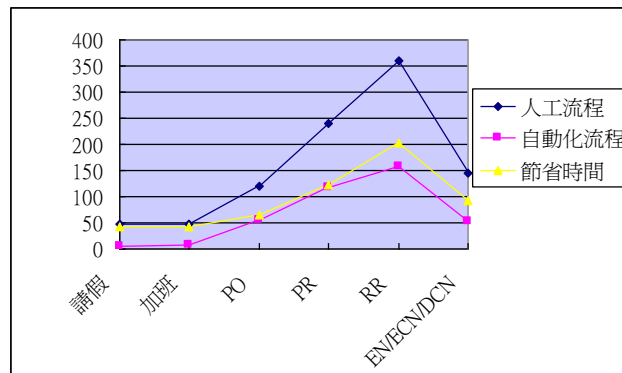
1. Information source of consumed time by the manual workflow inquiry is the averaged value of interviewing with company's employees, which the data is obtained by adopting the round-off method.
2. Information source of consumed time by the automatic workflow inquiry is the averaged value of interviewing with company's employees and actual onsite testing, which the data is obtained by adopting the round-off method.



**Figure 2. Comparison between the Time Consumed by Inquiring the Information of Manual and Automatic Sign-off**

II. Comparison between the Time Consumed by Manual and Automatic Sign-off: it is obtained from the result that listed in the following Figure 3

1. Information source of consumed time by the manual workflow inquiry is the averaged value of interviewing with company's employees, which the data is obtained by adopting the round-off method.
2. Information source of consumed time by the automatic workflow inquiry is the averaged value that obtained from the systematic calculation of the sign-off time, which the data is obtained by round off to the second decimal point.

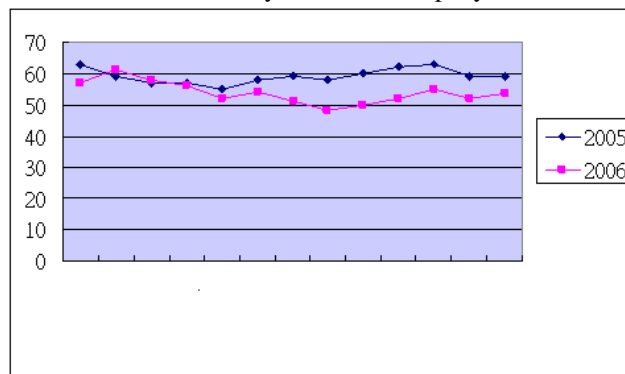


**Figure 3. Comparison between the Time Consumed by Manual and Automatic Sign-off**

### III. Relationship of Implementing EN/ECN/ECR to the Days of Inventory (DOI) between 2005 and 2006

It has improved about  $(59.1-53.8)/53.8 \approx 10\%$ , which converted to the inventory turnover of NT\$1.1 billion  $\times 10\% =$  NT\$1100 million. As shown in Figure 4.

The data source is the public information that released by A CASE Company.



**Figure 4. Relationship of Implementing EN/ECN/ECR to the Days of Inventory (DOI) between 2005 and 2006**

## CONCLUSION

This study has adopted the Reference Model as the basis to design a framework of Workflow Kernel System that conformed to the need of A CASE COMPANY and the standard interfaces that were proposed by WfMC [1][2].

As for the relationship between business patterns of A CASE COMPANY, it always merged the companies that possessed same characteristics as it did, thus the mergence must caused the problem in integration between systems inside A CASE COMPANY; in addition, the integration with Workflow is also a difficulty in A CASE COMPANY. On the other hand, after completing the integration of workflow between enterprises, what is the impact on benefit and culture will be brought that can be an extended discussion from this study.

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