CSC 340 Assignment 3:
System Study and Design of an All-in-one Database Application
for St-Joseph’s Printing Company

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April 9, 2000
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I. INTRODUCTION

a) Company Information

St. Joseph Corporation is a highly competitive resource for all types of communications needs. The corporation is comprised of ten different divisions, each of whom fulfills a complementary role in the creation, management and distribution of content.

The St. Joseph Printing division is a 300,000 square foot web offset printing plant located in Concord, Ontario. It was the first printer in Canada to offer computer-to-plate technology and one of the few North American printers with the Heidelberg Harris M3000 Sunday offset press, which prints up to 100 million pages per day. St. Joseph specializes in magazine, retail and catalogue production.

b) Current System

Users

The feasibility study will focus on the day-to-day operation of the Finishing department at St. Joseph Printing. The Finishing department is responsible for preparing the printed documents for shipping. This includes cutting, folding and stitching the magazines and catalogues.

The department consists of one manager, three Finishing Supervisors, one Clerk, and 150 Operators. The Manager oversees all of the operations and meetings within department. The supervisors are responsible for creating and modifying reports, which includes the following information: active versus completed printing jobs, printing quantities, reports on jobs and their associated finishing machine, 24-hour reports, which relay information to the Manager on accomplished work in the last 24-hour period, edited job information, report on “over/under” information (over production or under production), and reports on cost of each job. These duties are shared among all of the Finishing supervisors. The Finishing clerk’s duty is collecting data such as print counts from the printing presses and reports this information to the 3 Finishing supervisors. The 150 Operators operate the presses and create quantity reports for the clerks.

Components and Costs

The supervisors currently use many different software components to complete their daily duties. The software used includes Lotus Spreadsheets, Lotus Macros and Covalent Shop system (legacy system).

Lotus spreadsheets have been in use since 1991. The Lotus macros were introduced 4 years later in 1995 incurring costs of approximately $6000 for 3 months development
time. The Covalent system was brought into the department in 1990 with a price tag of about $100,000.

Current machines used are Pentium II systems running Window 95. Approximate cost is $2500 for each of the three machines.

c) Problem Focus

Problems Associated with Current System

Because so many different programs are used, there cannot be easy data exchange between the software. This means that data must be entered multiple times when a report in one program depends on data from another.

Data entry errors occur frequently because each supervisor works on independent computer systems. Each supervisor depends on hard copy printouts of information from each of the other supervisors in order to complete their own tasks.

The manager of the department organizes meetings each morning to discuss current priorities with all of the supervisors. These meetings are also needed to make sure that all of the supervisors are working in synchronization. These meetings are often time-consuming and could be avoided if a new system were in place.

Supervisors are sharing too few duties because of the limitations of the software packages used and current communication procedures. A new system would mean that each supervisor could do more, in less time.

II. FEASIBILITY STUDY

a) Information Collection Procedures

Interviews were held with many people who are involved with current system. The Finishing supervisor provided inside information on current responsibilities of the department and the software used. The Finishing manager provided information about co-ordination among the Finishing supervisors. Information Technology department manager provided software and hardware costs of current system, software programmer from Information Technology department provided information about development of certain software packages currently in use.

b) Alternatives

Alternative 1: All-in-one Database Information System

Description
A computerized database system, which keeps tracks of all job information. All data would be entered into a centralized database, and accessed using a new web-based interface.

**Operational Constraints**

The new system is very easy to learn, and a supervisor’s job could be done quicker and with less error. All members of the department would benefit from a clearer interface.

**Technical Constraints**

Software: C++, Java or Visual Basic, and a database system.

Hardware: a central server, possible a Pentium III system and a network system.

Human resources: A team of two software developers for three months.

**Economical Constraints**

Licensing for MSDN is around $3500, server and network is estimated to be $5,000, and salary for two programmers would amount to $18,000

**Alternative 2: Co-ordination Report System**

**Description**

Keeping Lotus Spreadsheets, Lotus macros, and Covalent Shop systems in current data information system, add one small program to coordinate reports from these three systems.

**Operation Constraints**

Supervisors and manager do not need special training, since the old systems are still in use. Nothing is changed for them. However, the department may need to hire someone to maintain this new system.

**Technical Constraints**

Software: C and Csh script, the MSDN.
Hardware: Pentium II machine

Network: server machines and network cables.

Human resource: three software engineers for three months

**Economical Constraints**

Licensing of MSDN for one year could be $3,570 (only one-month licensing is needed). Hardware requirements would include three Pentium II system and network cable. Costs for each of them are $888 each and $350 respectively. Cost for three software engineers to implement each program is about $27,000.

**Alternative 3: ICQ**

**Description**

Internet application includes a variety of services, such as: automatic mail notice, email, chat, voice message, file transfer, exchange of messages … etc.

**Operational Constraints**

ICQ is very easy to use, supervisors and managers will have no trouble adapt to it.

**Technical Constraints**

Software: Win98, ICQ.

Hardware: Any Pentium machine.

Network: internet access.

**Economical Constraints**

ICQ Software is free of charge, thus the only cost would be the internet access fee which is $20 a month.

c) **Recommendation**

The most emphasis for a decision has been based on reduction of data duplication and reduction of errors. Cost, time, and ease of use are also crucial factors that have to be
taken into consideration. Since third alternative does not improve the data duplication problem and shorten the time-consuming process of the current system, thus it should be eliminated as a possible future information system.

The disadvantages associated with the second alternative are duplication of data and high costs. Since duplication of data is the primary problem that should be solved, Coordination Report System is inefficient in this specific case.

The recommendation is therefore the All-in-one Information System. Since it solved the two main problems of the existing system. Furthermore, increasing work efficiency saves time for the daily operational process. Therefore, this new system is the best choice among the three alternatives.

III. REQUIREMENT ANALYSIS

a) Functional Requirements

Data Collection

The finishing clerk is responsible for going to each of the machines and collection production numbers. These numbers exist on the computer system for each machine. The clerk will write down the numbers on a standardized form.

Data Entry

It is the responsibility of the data entry clerk to enter job information from the machines into the database. There will be a screen for each type of information that needs to be entered. For example, the over/under screen will require a screen with entry fields for docket, customer, actual production, and required counts. This is done through the Data entry screens.

Docket Search

In order for a supervisor to see information about a job, it is necessary to enter a job id into the system. The system will then go to the database and retrieve all information about the job selected such as date of job, customer and customer sales rep. This is done through the Docket Search screens.

Machine Search

The supervisor can get machine information by entering criteria into the database. Criteria could include machine type. For example, list all stitching machines, all cutting machines or even list machine by name. Once the criteria are entered into the system, a list will be returned about a certain machine with associated job information data. This is done through the Machine Search screen.
Enter Machine Make-Ready Hours

It is necessary for the supervisor to enter into the database, the number of make-ready hours that a certain machine will need. The make-ready hours are number of hours spent preparing the machine for work. This value is only known by the supervisor once he has examined all of the job details. This is done through the Machine Configuration screen.

Edit Machine Run-Speed

Sometimes a job needs to be completed ahead of time. Therefore, it is necessary for the supervisor to change the value of the run-speed in the reports to correctly match the actual new speed of the machine. This is done through the Machine Configuration screen.

Edit Run Configuration for a Job

The supervisor will need to change the run configuration of a job as it passes through different stages of completion. For example, the configuration will need to be changed from a stitch/cut configuration to a folder configuration. This is done through the Run Configuration screen.

Edit Actual Quantities Produced for a Job

As the job runs, the values for actual quantities produced will change. Therefore, it is necessary for the supervisor to change this value according to the new quantities entered into the system by the data clerk. This is done through the Over / Under screen.

Edit Carton Date

When a carton (a bundled product) is completed, it is necessary for the supervisor to stamp a data associated with it as to when it was completed. This is done through the Carton Invoice screen.

Edit Carton Type

It is the job of the supervisor to assign a Carton Type to each carton depending on the type of magazines printed. Certain forms of media require different internal IDs to be assigned to them. This is done through the Carton Invoice screen.

Edit Carton Quantity

Once the carton is complete, the supervisor will need to enter the quantity of magazines within that carton. This number is important to the distribution department who will try to fit the maximum number of carton on a truck, depending on the quantity entered by the supervisor. This is done through the Carton Invoice screen.
Edit Completed Flag for Jobs

When a job is totally completed, the supervisor will need to enter this fact into the database. When a job is first started, the “job completed” flag is defaulted to “No”. When the job is done, the supervisor must change this value to “Yes”. This is done through the Edit Daily Bindery screen.

Edit Job Type Information

Each job might have special properties associated with them. For example, the type of job might be a discounted job because the customer might have credit already. Perhaps there is no special property associated with the job, so the job can have a “Normal” type associated with it. Therefore, it is up to the supervisor to associate a type with each job. This is done through the Job Scheduling screen.

Schedule Jobs

New jobs are coming in everyday. It is up to the supervisors to make sure that all new jobs are entered into the database and a schedule is set up. This schedule allows a smooth transition of different jobs on the same machine. This is done through the Job Scheduling screen.

Create Daily Reports for Manager

In order to keep everyone up to date on recent work accomplished, it is necessary for the supervisors to create reports on production in the last 24 hours and a report on all jobs, which are still active. These reports are brought to the manager who will review them and make any necessary decisions, such as the cancellation of a job if need be. This is done by printing out the screens from within the web browser itself.

b) Non-Functional Requirements

Interface Design

There are three interfaces that will be built using Microsoft InterDev, which will be used to connect to the system database: Docket, Schedule and Collection. Navigating among the three interfaces is done using option buttons, as is changing the active user and logout.

A Docket refers to a job. There will be seven main screens: Machine Configuration, Run Configuration, Over/Under, Carton Invoice, Monthly Over/Under, Edit Daily Bindery Runs, Bindery Reports and Job Scheduling. The supervisors can edit Make Ready Hours and Run Speed for a pocket, enter/edit data fields, which includes carton date, carton type, carton quantity and invoice number. Furthermore, they edit required quantity
values for jobs by date, edit a run configuration for a split, actual quantity values by run, display monthly over/under report information and edit job status or job type.

A Clerk is responsible for entering new information about jobs on as they arrive using the Collection screen. It only includes one table that connects to database. Once the information is filed in the table, the clerk will click the save button. The data will automatically be translated into database format and stored in database.

Schedule is used to distribute/arrange jobs among the different supervisors. The manager reviews the report of the work done already and makes decision about the future job schedule. This interface only includes one table that contains information of the jobs that have not been completed or new jobs.

**Interface Requirements**

The interface will contain approximately seven screens. They can be switched among with a single mouse click of the icons.

The jobs contains the same fields as before but will be filled in the new table in the Collection screen. Each job occupies one row in the table. Jobs are listed based on the priority of the jobs.

Each table or form in the Docket screen also has the same content as before but with uniform format for the two supervisors. All of the data in this department is located in the same database.

Each table has fixed fields and a key field, and each form has fixed fields. All fields in the forms and tables can be accessed by drag down or jump ahead.

**Performance Requirements**

Any modifications at clerk’s and supervisors’ terminals propagates immediately to each other’s terminal database and other related terminals in the different offices since we use the existing local area network which satisfies this property. The additional interface will not slow this data flow.

Response to any access to the database is fast in the existing local network. Requests from any of supervisors and clerk only need at most six mouse selections and field options, so any modification can be completed in less than 10 seconds.

**Platform Requirements**
The new system executes on the Windows NT operating system using a Pentium II CPU. The new system does not require more than 128 MB of RAM to operate and 6 GB of local space.

**Fallback Requirements**

If one of terminal crash or an error occurs in a terminal, it will not affect the other terminals because all terminals are connected to the local network.

If a power failure occurs, the network error will not cause the loss of data because the system will have a function to save the updated data after last access database in the temperate disk.

**Backup Requirements**

The system will back up the data daily in tape format.

**Restart Requirements**

Each system takes only 3 seconds to restart in case of any error based on the this time constrains in the new interface.

**Security Requirements**

The Manager has a password to access and modify all data in the database. Clerk has password to only add data in the database. Supervisors have password to modify and edit data in the database.

**Expandability Requirements**

The system can be upgraded easily by adding new machines, database capacity (hard drive space), and RAM.

**Reliability Requirements**

The new system is based on Microsoft Database Software Suite. Therefore, the system is reliable. The mean time between the failure is about two years based on the reputation of the Microsoft Corporation.
Availability Requirements

Of the four terminals, at least one will be available 100% of the working time. Each of them should be available at least 95% of the working time.

Economic Requirements

The initial cost, including hardware, software, network setup, and training will not exceed $50,000.

Lifecycle Requirements

The new system can support the current workload required for more than 10 years without significant changes needed.

Operating Requirements

The required times for training a manager, two supervisors and a clerk on new interface and database should be no more than three days, one week and three days respectively. The new system will have one new database as well as new interfaces. The new system will be easy to master, as it will be similar to the old system.

The workload of manager, supervisors and clerk will be decreased more than 20%, 40% and 20% respectively.

Since there is new standard format of all reports, all staff will only need to transfer information within the local network and access the shared data. There is no need for extraneous paper reports. One supervisor is enough to control the process of the jobs and edit the data.

The new system should also reduce time of the meeting and printing reports by deducting more than 40% workload.

IV. SYSTEM DESIGN

a) General Design

The current system is very inefficient, because different programs are used to store data. Therefore, data can not be exchanged between the software easily. This means that data must be entered multiple times when a report in one program depends on data from
another. As a consequence, time is wasted on the redundant data entry, and the amount of paperwork is high.

These problems induce us to implement an All in one Database System. This is a complete computerized database system, which keeps tracks of all job information. All data would be entered into a centralized database by the clerk. Each of the Finishing supervisors, using a new web-based interface, can access and modify the information. Since all three supervisors access a common database, modifications in the database affect all of them. There is no need for multiple entries anymore.

b) Hardware, Software and Networking Implementation

Hardware

The new system will require 2 new Pentium II 350 MHz computers for the users. Each computer will need at least 64 MB of RAM and a 4GB hard drive. All of the basics will also be needed, such as a monitor, keyboard and mouse for each system.

A new server will also be needed, as there is no existing server available to this department. This server will need to be more powerful as it will be the place where the database will be stored. The server will need to be a 500MHz Pentium III system with 128MB of RAM and 9GB of hard drive space.

A high-speed printer will also be needed to print out the reports. A color printer with a print speed of at least 7 pages per minute will need to be purchased.

Software

The DBMS (database management system) will be Microsoft SQL Server 6.5. The Web Application Server will run on Microsoft Internet Information Server 4.0. The development environment will be Microsoft InterDev 6.0 with Visual J++. The operating system for the developers will be MS Windows NT Server 4.0. The operating system for the users will be MS Windows 98. The user interface will run under Microsoft Internet Explorer 5.0.

Network

As mentioned above, a new server will need to be purchased. Along with this will need to be a network card for each of the systems, so as to connect to the server. Also, network cables will need to be purchased. The network will be straightforward without any complex setup procedures needed.
c) Database Design

The database schema developed requires 4 entities and 3 relationships to be stored. The three relationships are very important, since they each encapsulate the data for one of the interface logs.

Entities

a) Customer:
A customer orders a printing job, and Finishing department is responsible for producing these printings. Therefore, the Finishing needs to acknowledge the customer making the orders. The customer entity has two attributes: Customer_ID, and Customer_name, where Custome_name depends on Customer_ID.

b) Jobs:

The Finishing department needs to keep track of the quantities of the jobs to be processed. Each job is uniquely characterized by the attribute Job_ID. In order to finish the jobs on time, attributes like the date when the order was received and the deadline also need to be kept in the database. Moreover, for magazine printing jobs, the type and quantity of carton must be acknowledged. All the attributes also depend on Job_ID.

c) Bindery Equipment:

For the binding operation of the department, the bindery equipment can be uniquely identified by the primary key, bindery equipment name. The Bindery Equipment also include two non-key attributes, which are:

- Bindery Equipment Type: describes what kind of equipment.
- Description: describes the functions of such equipment.

d) Printing Machines:

Printing Machines are essential for completion of jobs. Its key attribute is the Machine_Name. Moreover, there are three non-key attributes:

- Type: identifies the different type of the printing machine.
- Description: general description on the functions, and things like set up time.
- Speed: shows the speed of the printing machine.

Relations
a) Order:

When a customer requests a service from the company, the customer is ordering printing jobs. Those jobs have to be completed by the Finishing department. This relationship can be identified by two key attributes: the Customer_ID and the Job_ID. There is also a non-key attribute, which is the Quantity of the ordered job.

b) Bind:

When printing is finished, the final copies need to be bound by bindery equipment. To characterize this relationship, Job_ID and Bindery Equipment Name is used as the primary keys. As for non-key attribute, it is the Quantity of the job needed to be binded.

c) Print:

When the Finishing department processes the orders, jobs are printed by the printing machines. The key attributes in this relationship are the Job_ID and the Machine Name. The non-key attribute, Quantity, describes the quantity already completed.

d) Interface Design

There are 3 main interfaces that will need to be built: the Data entry screen for the Clerk, the Search screens for the supervisors, and the Edit Screens also for the supervisors. Navigating between the interface for the clerk and the supervisor will require clicking 1 of 2 icons. However, the clerk will not have access to the supervisor interface for security reasons. (Refer to Appendix for interface displays and explanation of their components).

The data entry interface is used by the clerk once he has finished collecting all of the information from the machines. He will have to enter information for each job running on the machines. This will require him to first select which kind of information he will be entering. For example, he might be entering production numbers information used in the Over/Under screen used by the supervisors. So, the clerk will need to click on the link for Over/Under. Once in this screen, he will be presented with headers describing the table field, followed by empty text boxes. He must fill in all of the necessary information and hit the SAVE button in order to store these changes into the database. The clerk interface is simply a data entry interface without the capabilities of editing existing information.

The search screen interface is used by the supervisor to search for a particular job or machine. These search screens consist of a single text box field which need to be completed in order for job or machine information to be displayed. Once the OK button is clicked, the information screen will pop up displaying the job or machine searched for. Navigating between the search screens can be done via the link on the left-hand frame of the web browser.
The edit screen interface is used by the supervisor to edit data in the database. These screen consist of job and machine information. Certain editable fields will exist as links within the web browser. When these links are clicked, the supervisor is able to edit the information so appropriately reflect any changes made in the department. The new information entered by the supervisor will only be saved into the database once the SAVE button is activated.

e) Program Architecture Design

The objective of this project is to implement a system that accept jobs, print the jobs according their priorities in time and then report the status of process of the jobs. Based on the functional and non-functional requirments, the whole process includes eight subfunctions: Machine Configuration, Run Configuration, Current Under/Over, Monthly Under/Over, Carton Invoice, Edit Daily Bindery, Edit Daily Bindery and 24 Hours Report. The whole process may require mutiple execution of some functions rather than only one round. The some functions can only be executed when their sub-function successfully executes.

Machine Configuration
It list machines that are available. It calls Initialize_Data to create a new form, which can be edit Make Ready Hours and Run Speed for certain pocket by calling function Update_Data or delete the record entirely by calling Delete_Data function. It calls Retrieve_Data to retrieve the status of a certain machine by giving the machine id. By calling Save_Data, the edited data can be saved. It calls Print_Data to print current status of given machines.

Run Configuration
It calls Retrieve_Data to retrieve run configuration by providing a job id. If it exists, then calls Update_Data to change the job’s status. After that, it calls Save_Data to save the status of the job(s). The result can be printed out by calling Print_Data.

Current Under/Over
Current Under/Over calls Retrieve_Data to retrieve values of attributes of given jobs in current time. If it is necessary to change the values, it calls Updat_Data and then save the updated result to database by calling Save_data. Further more, the result can be printed out by calling Print_Data.

Monthly Under/Over
This is similar to the Current Under/Over except that it provides the monthly information. It contains all function calls.
Carton Invoice
Carton Invoice calls **Initialize_Data** to create a new form for entering new values of attributes of a job(s) by calling **Get_Data**. If this is done, it calls **Save_Data**, or changes or delete values by calling **Update_Data** and **Delete_Data**. The result can printed out by calling **Print_Data**

Edit Daily Bindery
It calls **Retrieve_Data** to required values for given jobs by docket. If it is already, then update them by calling **Update_Data**. Then it calls **Save_Data** to save the result to database. It also can printed out by calling **Print_Data**. All information is within 24 hours.

Job Scheduling
It calls **Retrieve_Data** to retrieve those jobs by providing certain criteria. If it is necessary to change the attributes just by calling **Update_Data**, then the result can be saved by calling **Save_Data**. To print out the result, it calls the **Print_Data**.

24 Hours Report
It calls **Retrieve_Data** to retrieve all jobs and their attributes in 24 hours. The report can be printed out by calling **Print_Data**

**Retrieve_Data**, **Delete_Data**, **Get_Data** and **Update_data** call their **Search_Tuple** to search their specified tuple respectively. If the tuple is found, then retrieve the tuple by calling their **Retrieve_Tuple**. Note that all **Search_Tuple** and **Retrieve_Tuple** in those functions can be the same. These Two functions’ parameter can be different. We can use **template** in C++ or **interface** in java. Since these four functions may access more than one tuple so we need a recycle or while loop.

V. CONCLUSION

To sum up, in order to cure the incompatibility problem of the old systems in the Finishing department of St-Joseph’s, three alternatives were proposed. Compared with Co-ordination Report System and ICQ, All-in-one database came out as the best solution based criteria like data duplication, error frequency, time saving, cost of the new system, cost of maintenance, and ease of use. Then functional and non-functional requirements were laid out for the chosen system. Based on these requirements, the design of the new system is carried out. The design is divided into three aspects: interface design, database design, and program design. The complete implementation of the new system would facilitate Supervisors’ and manager’s job, and improve the performance of the Finishing Department.
Appendix A: St. Joseph Printing Mission Statement

Profile

What began, in 1956, as a basement letterpress operation has since evolved into one of North America's most dynamic communications enterprises. The remarkable rise of the St. Joseph Corporation is not just the story of a powerful business vision. We attribute our success to the deeply held core values, which have motivated us from the beginning.

Our values are down to earth and real, consisting of hard work, integrity, and a strong sense of responsibility towards the future. Combine that with innovative thinking, sound business management and strategic planning and you can see why we have grown to become the largest privately owned print and digital communications company in Canada.

We are always looking at the road ahead, evidenced by the fact that we continually reinvest 85% of our profits into building the company. Now, the St. Joseph Corporation has grown to become a fully integrated alliance of ten sister divisions who between them offer a completely unified resource for the Creation, Management and Distribution of Content.

Our idea is simple; we are the one-stop solutions corporation able to take care of all your business communications and marketing needs. Clients benefit from our vast reservoir of knowledge and the value of partnering with the one integrated company who can do it all.

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Appendix B: Interview with Information Technology Manager at St. Joseph Printing

Interviewer:
Could you tell me about a department within St. Joseph Printing that is currently using an information exchange system, which is currently out of date and needs to be replaced with a more technologically advanced solution?

Bruno D'Antonio:
The Finishing department has one of the oldest systems in the entire place. It has been around for over 10 years.

Interviewer:
What is the Finishing department responsible for?

Bruno D'Antonio:
The Finishing department puts on the final touches to any magazine or flyer that we print. This includes cutting, folding, and stitching the magazines for shipment.

Interviewer:
Approximately how many employees are in the Finishing department?

Bruno D'Antonio:
There are 150 machine operators, 1 data collection clerk, 3 Finishing supervisors, and 1 Manager.

Interviewer:
Who is responsible for most of the data manipulation and exchange?

Bruno D'Antonio:
The supervisors handle most of the data editing and run the reports on the current status of Finishing machines.

Interviewer:
What kind of software is currently in use in the Finishing department?

Bruno D'Antonio:
Lotus spreadsheets, Lotus Macros and Covalent Shopsystems, a legacy system.

Interviewer:
How is information exchanged between everyone, currently?

Bruno D'Antonio:
Meetings are held daily between the supervisors and the manager where current reports are exchanged on paper, and future goals are discussed.
Appendix C: Alternatives

Alternative 1: All-in-one Database Information System

Description

This suggested alternative introduces a complete computerized database system, which keeps tracks of all job information. All data would be entered into a centralized database by each of the Finishing supervisors, using a new web-based interface that must be developed to work with existing data warehouses. All existing programs would be replaced with a new integrated database system. When one supervisor needs to make changes to his own relevant data, he may check the database for any changes made by other supervisors.

Operational Constraints

This new system would be very easy to learn because many of the new functions would simply duplicate functions in the old system. Therefore, a simple meeting would be sufficient to familiarize users with this new all-in-one system. To ensure the proper operation for the new system, it would be phased in over a period of a week, working in parallel with the existing system. Once it can be verified that the new system is working properly, the old system would be retired.

Supervisors can do more with less. This new software package would be much more powerful than the system currently in place. Therefore, a supervisor’s job could be done quicker and with less error. All members of the department would benefit from a clearer interface.

Technical Constraints

Software development would require a high level programming language such as C++, Java or Visual Basic. A database system such as SQL Server would be necessary for all database queries.

Hardware requirements would include a central server, possible a Pentium III system and a network system.

A team of two software developers would be able to develop this new system within expected time of three months.

Economical Constraints
The cost related to this project consists of licensing for MSDN which is around $3500, server and network is estimated to be $5,000, and salary for two programmers would amount to $18,000.

The new system would eliminate the need to pass around hard-copy printouts to inform other supervisors of changes made to the system. Furthermore, daily meetings could be reduced in length. It would no longer be necessary to make sure that all of the supervisors are working with the latest data because they would all be accessing a centralized data warehouse, which is updated and modified by all. Also, an all-in-one system would eliminate the need for duplicating data entry into each individual system, therefore, reducing the chance of data entry errors.

**Summary**

Implementation of this system would reduce the possibility for errors, as well as reduce the time it takes to complete a report. The development cost of this new system is far lower than the cost of the original system and will surely pay for itself over a short period of time.

**Alternative 2: Co-ordination Report System**

**Description**

Another alternative is reuse of software: keep Lotus Spreadsheets, Lotus macros, and Covalent Shop systems in current data information system, and add one small program to each software installed in the current three computers. A new computer with a small program will be added in the system in the clerk office to coordinate reports from other three terminals. Then four computers containing the revised system will be connected to existing network in other department of the St. Joseph Corporation. In the new system, each terminal of those three terminals converts the format of current report into standard format and also reverses the process. All of terminals link to each other and automatically update their fields and data corresponding the change in other terminals.

**Operation Constraints**

Since each terminal uses different software for different purposes and produces relatively simple report, the new system will take advantage of reuse of present software. These software has been tested and verified that they are reliable and error free. From this point, the alternative can keep the exiting reliability, save effect and cost of implementation, testing and maintaining new software. It also provides the standard form of reports. On the other hand, the new system keeps the current user interface, the new system keeps the same work environment for the users. The new system also supports new features that will be added to it.
Technical Constraints

The programs added to the new system will implement in C and Csh script. It just needs MSDN package issued by Microsoft to implement the programs. No other special technical is needed. Cost for implement the new system is affordable.

Economical Constraints

Licensing of MSDN for one year could be $3,570 (only one-month licensing is needed). Hardware requirements would include three Pentium II system and network cable. Costs for each of them are $888 each and $350 respectively. Cost for three software engineers to implement each program is about $27,000.

The new system standardizes the reports and has links among the terminals to automatically update the data and reports. So only one supervisor is needed. No hard-copy printouts and meeting is necessary. No duplicate or uncompleted error in different terminals could occur, which happens in current system. The new system keeps the current user-interface, so it saves effects to train the user. Since it also reuses current software, it is reliability and would not bring new error in the new system.

Summary

This alternative reuses exiting software, keeps the reliability, and saves cost brought by the error and labor.

Alternative 3: ICQ

Description

The ICQ software provides another alternative to the problem. This application includes a variety of services, such as: automatic mail notice, email, chat, voice message, file transfer, exchange of messages … etc. For communications among the users, each must have an online access, the ICQ software, and the ICQ number of the person one wants to contact. For Finishing department, if changes or errors occur on one end, clerks, supervisors, and the manager can inform each other by sending email, or by exchange messages, or even chat while online. All reports can be forwarded through the file transfer function of the ICQ.

Operational Constraints
Since ICQ is very easy to use and does not demand any training, the staffs’ effort to adapt would be minimal. While supervisors and the manager are online, any updates or corrections can be made instantly, which lead to reduction in printed reports and errors caused by incompatibility of data. However, sending messages and emails online is insecure, information could be lost during transmission. Moreover, the implementation of the new system did not restructure the current system, thus the inefficiency of employing different software still exits.

**Technical Constraints**

ICQ is a shareware that can be downloaded from www.mirabilis.com free of charge. The software occupies no more than 15 megabytes on hard drive. Moreover, it is compatible with all versions of Windows, Windows NT, and Unix. No other system requirement is necessary.

**Economical Constraints**

For this alternative, no project-related cost would incur since software is free. The operational cost would consists of monthly online access fee, which is 20$ per person per month provided by Sprint Canada. Therefore, for the three supervisors, the total cost would sum up to $720 a year. The primary benefit would be the money saved on printed reports, and the decrease in time spent on daily meetings.

**Summary**

To sum up, the cost of introducing ICQ into the current system is minimal, and the software is very easy to use. However, since it did not change the current structure of the department, saving on time and money is not significant. Furthermore, the insecurity of net transfer and inefficiency of the old system still pose problems.
## Appendix D: Criteria Table

<table>
<thead>
<tr>
<th>Alternatives (relative weight)</th>
<th>Evaluation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data Duplication</td>
</tr>
<tr>
<td>Existing System</td>
<td>High</td>
</tr>
<tr>
<td>1. All-in-one database info system</td>
<td>Low</td>
</tr>
<tr>
<td>2. Coordinati on report system</td>
<td>High</td>
</tr>
<tr>
<td>3. ICQ</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 1: Evaluation table of the three alternatives. Criteria are arranged so that the most important ones are in the left. Ex: “Cost to maintain” is more important than “ease of use”.
Appendix E: Cost/Benefit Analysis

a) First Alternative – All-in-one Database System

Benefits

1. Reduce time spend on meetings:
   - Reduce 1 _ hour a day (usually 2 hours daily)
   - Wages for manager and 3 supervisors (participants in the meeting):
     $20/hour for manager
     $16/hour for supervisor
   - Subtotal
     \[(20 + 16*3) \times (1 \times 269) = $27438 \text{ / year}\]

2. Reduce time spend on fixing errors:
   - _ hour / week spend on fixing errors
   - Subtotal
     \[_ \times 48 \text{ weeks} \times ($16 \text{ / hour for supervisors} \times 3 \text{ supervisors}) = $1152 \text{ / year}\]

3. Eliminate 1 full-time supervisor:
   - $16/hour * 8 hours/day * 269 days = $34432 \text{ / year}

TOTAL BENEFIT: 27438 + 1152 + 34432 = $63022 \text{ / year}

Costs

1. Project-related costs:
   - License for MSDN package
     $2499 U.S \times 1.42 \text{ conversion rate} = $3570
     For reference go to:
     * [http://msdn.microsoft.com/subscriptions/prodinfo/Pricing.asp](http://msdn.microsoft.com/subscriptions/prodinfo/Pricing.asp)

   - 2 programmer for 3 months
     $3000/month \times 3 \text{ months} \times 2 \text{ people} = $18000

   - One Pentium III computer (server) + networks
     $3400 + $1600 = 5000

     For reference check computer paper.
2. Operational Cost
   - Maintenance and upgrade;
     $800 / user /year * 2 supervisors = $1600

TOTAL COST: 3570 + 18000 + 5000 + 1600 = $28170 / year

Payback Analysis

<table>
<thead>
<tr>
<th>Cash Flow</th>
<th>Year 0</th>
<th>Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev. Cost</td>
<td>($26,570)</td>
<td></td>
</tr>
<tr>
<td>Oper. Cost</td>
<td></td>
<td>($1,600)</td>
</tr>
<tr>
<td>Present Value</td>
<td>1</td>
<td>0.91</td>
</tr>
<tr>
<td>Time-adj Costs</td>
<td>($26,570)</td>
<td>($1,456)</td>
</tr>
<tr>
<td>Cumulative Costs</td>
<td>($26,570)</td>
<td>($28,026)</td>
</tr>
<tr>
<td>Benefits</td>
<td>0</td>
<td>$63,022</td>
</tr>
<tr>
<td>T-adj Benefits</td>
<td>0</td>
<td>$57,350.02</td>
</tr>
<tr>
<td>Cumulative Benefits</td>
<td>0</td>
<td>$57,350.02</td>
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<tr>
<td>Net costs + Benefits</td>
<td>($26,570)</td>
<td>$29324.02</td>
</tr>
</tbody>
</table>

- 28170 (total cost) / 63022 (yearly return) = 0.45 =~ 5 1/2 months (0.55 *12 mths)
  * Assume yearly interest rate is 10%. *

b) Second Alternative – Co-ordination Report System

Benefit

1. Reduce time spend on fixing errors:
   - Estimated reduce _ hour / week
   - Subtotal
     _ * 48 weeks * (16*3) (hour wage for 3 supervisors = $1152 / year

2. Reduce meeting time:
   - Reduce 1 _ hr on meeting time
   - Subtotal
     1 _ h * 269 days * (20 + 16*3) (hr wage for manager and supervisor) = $27438

TOTAL BENEFIT: 1152 + 27438 = $28,590

Cost
1. **Project-related cost**
   - Software: MSDN package - $3570
   - Hardware: PIII computer (for programmer) - $1888
     Network - $1,600
   - Human Resource: One programmer - $8000 for two months is needed.
   - Subtotal
     \[
     3570 + 888 + 1600 + 8000 = $15,058
     \]

2. **Operational cost**
   - Maintenance Fee estimated at $400 / year

TOTAL COST: \(15,058 + 400 = 15,458\)

### Payback Analysis

<table>
<thead>
<tr>
<th>Cash Flow</th>
<th>Year 0</th>
<th>Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev. Cost</td>
<td>($15,058)</td>
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<tr>
<td>Oper. Cost</td>
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<td>0.91</td>
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<tr>
<td>Time-adj Costs</td>
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<td>($364)</td>
</tr>
<tr>
<td>Cumulative Costs</td>
<td>($15,058)</td>
<td>($15,422)</td>
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<tr>
<td>Benefits</td>
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<tr>
<td>T-adj Benefits</td>
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<tr>
<td>Cumulative Benefits</td>
<td>0</td>
<td>$26,016.9</td>
</tr>
<tr>
<td>Net costs + Benefits</td>
<td>($15,058)</td>
<td>$10594.9</td>
</tr>
</tbody>
</table>

15458 (total cost) / 28590 (yearly return) = 0.54 \(\sim 6\) months

### C.) Third Alternative - ICQ

**Benefit**

1. Eliminate paper work:
   - Estimated $0.05/person/day
   - Subtotal
     \[
     0.05 * 3\text{ supervisors} * 269\text{ days} = $40.35 / \text{ year}
     \]

2. Save error correction time:
   - Saves _hour/week
   - Subtotal
     \[
     _ * 48\text{ weeks} * ($16 * 3 \text{ supervisors}) = \$1152 / \text{ year}
     \]

TOTAL BENEFIT: 40.35 + 1152 = $1192.35
Costs

1. Project-related costs: None

2. Operational costs:
   - monthly online access fee
   - Subtotal:
     $20 * 4people * 12 month = $960 / year

TOTAL COST: $960

Payback Analysis

<table>
<thead>
<tr>
<th>Cash Flow</th>
<th>Year 0</th>
<th>Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev. Cost</td>
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<td></td>
</tr>
<tr>
<td>Oper. Cost</td>
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<td>($960)</td>
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<td>Present Value</td>
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<td>Time-adj Costs</td>
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<td>($873.6)</td>
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<td>Cumulative Costs</td>
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<td>($873.6)</td>
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<td>Benefits</td>
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</tr>
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<tr>
<td>Cumulative Benefits</td>
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<td>$1,085.04</td>
</tr>
<tr>
<td>Net costs + Benefits</td>
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<td>$211.44</td>
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</table>

- 960 / 1192.35 ~= 0.81 ~= 10 months (0.81 * 12 months)

* Assume interest rate is 10% annually. *

Appendix F: Existing System Data Flow Diagrams
Figure 1: - Context-level diagram for the three Supervisors.
- There are two major entities:
  Clerk who collects the data, and the Manager who oversees the operations.

Figure 2: - Level 0 diagram.
- Three major processes for the Supervisors, they are numbered as 1, 2, 3.

* Note: Sprsht = Lotus Spreadsheet
  Macros = Lotus Macros
Co-shp = Covalent Shop system

Figure 3: - Level 1 diagram for the first process, “enter data”.
- Each Supervisor enters data that they are responsible for into their own computer database generated by different software.
Figure 4: - Level 1 diagram for second process, “Edit Data”
- Each Supervisor review on their data, make necessary changes, then inform other Supervisors. If the changes are relevant, make necessary adjustment.
Figure 5: - Level 1 diagram for the third process, “generate report”.
- Each Supervisor is responsible for different reports.
Appendix G: New System Data Flow Diagrams

Figure 1: - Context Level diagram.
- With the new system, the clerk enters the data instead of the supervisors.
- There is only one database stored on the server.

Figure 2: - Level 0 diagram.
- Each Supervisor now has only two jobs instead of three.
Figure 3: - Level 1 diagram for first process, “Edit data”.
- Data can be changed in the common database, thus no need for meeting.
Figure 4: - Level 1 diagram for second process, “generate report”.
- Only one common database.
Appendix H: Entity-Relationship Diagram
Appendix I: Functional Requirements

Data Collection
3 Collection by data entry clerk
1.1 Entry into database by clerk

Information Search
4 Docket search
2.1 Machine search

Edit Job/ Machine Information
5 Enter machine make-ready hours
3.1 Edit machine run-speed
3.2 Edit run-configuration for a job
3.3 Edit actual quantities
3.4 Edit carton date
3.5 Edit carton type
3.6 Edit carton quantity
3.7 Edit completed flag for jobs
3.8 Edit job type information
3.9 Schedule jobs

Print Reports
4.0 Create daily reports for manager
Appendix J: Non-Functional Requirements

1. Interface requirement
2. Performance requirement
3. Platform requirement
4. Fallback requirement
5. Backup requirement
6. Restart requirement
7. Security requirement
8. Expandability requirement
9. Reliable requirement
10. Available requirement
11. Economic requirement
12. Lifecycle requirement
13. Operating requirement
Appendix K: Entity-Relationship Diagram for Database Design
<table>
<thead>
<tr>
<th>Table</th>
<th>Field</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer</strong></td>
<td>Customer_ID</td>
<td>Int(10)</td>
</tr>
<tr>
<td></td>
<td>Customer Name</td>
<td>Char(20)</td>
</tr>
<tr>
<td></td>
<td>Primary Key</td>
<td>Customer_ID</td>
</tr>
<tr>
<td><strong>Job</strong></td>
<td>Job_ID</td>
<td>Int(10)</td>
</tr>
<tr>
<td></td>
<td>Quantity</td>
<td>Int(7)</td>
</tr>
<tr>
<td></td>
<td>Start Date</td>
<td>Char(8)</td>
</tr>
<tr>
<td></td>
<td>Deadline</td>
<td>Char(8)</td>
</tr>
<tr>
<td></td>
<td>Carton Type</td>
<td>Char(20)</td>
</tr>
<tr>
<td></td>
<td>Carton quantity</td>
<td>Int(7)</td>
</tr>
<tr>
<td></td>
<td>Primary Key</td>
<td>Job_ID</td>
</tr>
<tr>
<td><strong>Printing Machine</strong></td>
<td>Machine Name</td>
<td>Char(20)</td>
</tr>
<tr>
<td></td>
<td>Machine type</td>
<td>Char(20)</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Char(100)</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>Char(10)</td>
</tr>
<tr>
<td></td>
<td>Primary Key</td>
<td>Machine Name</td>
</tr>
<tr>
<td><strong>Bindery Equipment</strong></td>
<td>Equipment name</td>
<td>Char(20)</td>
</tr>
<tr>
<td></td>
<td>Equipment type</td>
<td>Char(20)</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Char(100)</td>
</tr>
<tr>
<td></td>
<td>Primary Key</td>
<td>Equipment name</td>
</tr>
<tr>
<td><strong>Order</strong></td>
<td>Customer_ID</td>
<td>Int(10)</td>
</tr>
<tr>
<td></td>
<td>Job_ID</td>
<td>Int(10)</td>
</tr>
<tr>
<td></td>
<td>Quantity</td>
<td>Int(7)</td>
</tr>
<tr>
<td></td>
<td>Primary Keys</td>
<td>Customer_ID, Job_ID</td>
</tr>
<tr>
<td><strong>Print</strong></td>
<td>Job_ID</td>
<td>Int(10)</td>
</tr>
<tr>
<td></td>
<td>Machine Name</td>
<td>Char(20)</td>
</tr>
<tr>
<td></td>
<td>Quantity Completed</td>
<td>Int(7)</td>
</tr>
<tr>
<td></td>
<td>Primary Keys</td>
<td>Job_ID, Machine Name</td>
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<tr>
<td><strong>Binding</strong></td>
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<td></td>
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<td>Primary Key</td>
<td>Job_ID, Equipment name</td>
</tr>
</tbody>
</table>
Appendix L: Interfaces

Finishing Department

Data Entry for: Carton Invoice

Docket: 
Customer: 
Carton Type: 
Date: 
Quantity: 

SAVE  CANCEL

This screen is used by the data entry clerk. This particular screen would be the one seen by the clerk if he was entering data for the Carton Invoice screen.

The data entry screens for the other areas would look similar except the fields for data entry would differ.
Use this screen to search for a certain job. This screen is used by the supervisors when they need to edit information for a particular job.

This screen is used to search for jobs for the following screens: Run Configuration, Overs/Unders, Carton Invoice, Edit Daily Bindery, and Job Scheduling.

Please enter a Docket number: 21245

OK  CANCEL

Use this screen to search for a machine. This screen is used by the supervisors when they need to edit information for a particular machine.

This screen is used to search for machines for the Machine Configuration screen.

Please enter a Machine ID: Stitcher #1

OK  CANCEL
Machine Configuration

Machine Name | No. of Pockets | Make Ready Hours | Run Speed  
Stitcher #1     | 1                | 5               | 5000 ppm

Use this screen to edit Make Ready Hours and Run Speed for a pocket.

When the screen is first opened, a list of machines are available. Select a machine to edit information. In order to edit an entry, click on the row. This will bring up a new screen, which will allow you to edit Make Ready Hours and Run Speed for a certain pocket or delete the record entirely.

Run Configuration

Docket | Date Ordered | Customer Name     | Run Type    
20955   | 07/06/1999   | Bank of Montreal  | Stitch / Cut

Use this screen to edit a run configuration for a docket (job). Click on the docket number link to change configuration for the entire docket.
Finishing Department

Current Overs / Unders

<table>
<thead>
<tr>
<th>Docket</th>
<th>Description</th>
<th>Required</th>
<th>Produced</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>20955</td>
<td>Stitching</td>
<td>325,000</td>
<td>125,000</td>
<td>200,000</td>
</tr>
</tbody>
</table>

Use this screen to edit actual quantity values by docket. Use this screen to edit required quantity values for jobs by docket. Jobs are returned regardless if they are completed, on hold, or active.

When the screen is first opened, the actual total field is filled with the current total values. Edit any of the fields to store the new information into the database.

Monthly overs / unders simply show reports for the entire month.

Finishing Department

Carton Invoice

<table>
<thead>
<tr>
<th>Docket</th>
<th>Customer</th>
<th>Carton Type</th>
<th>Date</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>21875</td>
<td>Sears</td>
<td>SJP #2</td>
<td>03/22/2000</td>
<td>3000</td>
</tr>
</tbody>
</table>

Use this screen to enter/edit carton date, carton type, and carton quantity.

When the screen is first opened, the carton date field is filled with the current date. Carton Type and Quantity can be edited by clicking on the link. The new information will be saved into the database.
Use this screen to edit information on a certain job based on information entered today, such as the Job Completed field. Perhaps a job will be finished. Therefore, it will be necessary to change the field from “No” to “Yes”.

When the screen is first opened, all jobs meeting the search criteria will be displayed. To change a field, click on the field to choose a new value. This will save the information into the database.

Use this screen to edit job type.

When the screen is first opened, all jobs meeting the search criteria will be displayed. To change a field, click on the field to choose a new value. This will save the information into the database.
## Appendix M: Finishing Printing Job Program Modular Design

### Finishing Printing Jobs

<table>
<thead>
<tr>
<th>Machine Configuration</th>
<th>Initialize Data</th>
<th>Retrieve Data</th>
<th>Update Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delete Data</td>
<td>Save Data</td>
<td>Print Data</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Run Configuration</th>
<th>Retrieve Data</th>
<th>Save Data</th>
<th>Update Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Print Data</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Under/Over</th>
<th>Retrieve Data</th>
<th>Update Data</th>
<th>Print Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
<tr>
<td>Monthly Under/Over</td>
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<td>Update Data</td>
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</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
<td>-------------</td>
<td></td>
</tr>
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<td></td>
<td>Save Data</td>
<td>Print Data</td>
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<tr>
<td>Carton Invoice</td>
<td>Initialize Data</td>
<td>Get Data</td>
<td>Update Data</td>
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<tr>
<td></td>
<td>Delete Data</td>
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<td>Print Data</td>
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<tr>
<td>Edit Daily Bindery</td>
<td>Retrieve Data</td>
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<td>Save Data</td>
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<td>Job Scheduling</td>
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<td></td>
<td>Save Data</td>
<td>Print Data</td>
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</tr>
<tr>
<td>24 Hours Report</td>
<td>Retrieve Data</td>
<td>Print Data</td>
<td></td>
</tr>
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</table>
Appendix N: Finishing Printing Job Program Structure Chart

Long arrow indicates the relation from the top level to the lower level.
Short arrow presents direction of information transmission.
Short arrow with solid cycle at one end show that the low level function return true result.
TEAM REPORT FORM

Description of roles and contributions of each team member:

**Causi Stephen:**
Interview, Introduction, Alternative 1, Functional Requirements, Software, hardware and Networking, Interface Design.

**Zheng ZaiSheng:**
Alternative 2, Non-functional Requirements, Program Structure Design.

**Hui Fei:**
Alternative 3, Database design, Data Flow Diagrams, Entity-Relationship Diagrams, Cost-benefit Analysis, Criteria Table, conclusion.

<table>
<thead>
<tr>
<th>Name</th>
<th>% of team Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causi Stephen</td>
<td>33.3%</td>
</tr>
<tr>
<td>Zheng ZaiSheng</td>
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</tr>
<tr>
<td>Hui Fei</td>
<td>33.3%</td>
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