Chapter 2

Requirements Analysis

This chapter describes how, using various fact-finding techniques, information may be gathered about what a new system should do. Two different approaches may be taken to determine requirements. First, the current system may be investigated to learn about the business environment. The good aspects of the current system should be candidates for retention. Naturally, the negative aspects will be identified and modified as requirements of the new system. The second approach is to ignore the current system and concentrate on what the new system should do when implemented. Proponents of this approach suggest that it takes less time and focuses everyone involved on the new system.

REQUIREMENTS DETERMINATION

A requirement may be defined as a feature that must be included in the new system. There are four areas in which requirements should be identified: basic, transaction, decision, and organizationwide.

Basic Requirements

In this area, the very essence of the system is identified. Here it is necessary to understand the process to be followed by the system. The purpose of the business activity should be identified. Also, in order to carry out this activity, it should be determined what steps are performed, where, and by whom. Further, it should be determined what data are used and what information is produced. Anticipated process timing and volumes should be estimated. The identification of any necessary system controls will complete the documentation of the basic system requirements.

Transaction Requirements

In this area, all the components of what constitutes a transaction are documented. The purpose of the transaction should be identified, along with who
and what action initiates a transaction. Frequency, volume, and seasonal variation are other aspects that should be identified. It is also necessary to determine what data are required to process a transaction and if there are any conditions that may affect how a transaction is processed. The determination of what data are stored and what information is generated will complete the identification of transaction requirements.

**Decision Requirements**

This area addresses the issue of how the information generated by the system will be used. Thus it is necessary to analyze the decisions to be made using the information from the system. In order to be able to make effective decisions it is necessary to have suitable transaction-processing procedures in place. Although this is the emphasis placed on the development of the new system, it is wise to also consider the availability of information from other systems, both those internal to the organization and externally provided services such as public databases or Internet.

**Organizationwide Requirements**

It is also important to assess the implications to other departments that interact with the system being investigated.

**FACT-FINDING TECHNIQUES**

Various techniques may be employed here. It is necessary to know whether facts or opinions are being gathered. When investigating information systems, facts are usually gathered. Depending upon the circumstances, either may be valuable. There is also a level of accuracy associated with a fact. Again it is necessary to determine an appropriate level of accuracy.

Initially, access must be gained to the personnel who can provide the necessary facts. Department managers should be contacted first as a courtesy and then to obtain approval to communicate with members of that department. Senior personnel of the department will be able to provide an overview of the system. So more general, policy-oriented facts should be obtained from this higher level. Department operations staff will be able to discuss the area in detail because of their more intimate knowledge of the specific processes.

**Interview**

Conducting interviews can be a very time-consuming process. It may be difficult to arrange interview times because of the work schedules of those who
should be involved. It is also very important to be prepared for the interview. There are a number of steps in the preparation for and conduct of the interview.

1. **Study Background Information:** It will be helpful to review any documents from previous projects as well as current (remember they may be outdated) procedure manuals and job descriptions.

2. **Planning the Interview:** Develop a list of questions, but do not necessarily stick rigidly to the script. Be flexible regarding scheduling. The location of the interview will be important. The workplace may have distractions or the interviewee may feel insecure outside a known environment. The level of questions should be appropriate for the individual; that is, policy-type questions should be directed to more senior management, whereas procedural detail questions should be asked of operations staff.

3. **Preliminary Interview with Department Manager:** This interview is conducted mainly as a matter of courtesy to obtain permission to interview staff in the department. Further valuable background information may be obtained. It is important to verify the terms of reference of the investigation and to discuss any areas of concern as seen by the department manager. The number of personnel within the department to be interviewed and the time requirements should be agreed on.

4. **Interviewing Department Personnel:**
   a. Starting the interview: A good first impression may be made by being prompt and appropriately dressed. Try to relax the interviewee, but do not take up too much time with social chat. Begin the formal part of the interview by explaining the purpose.
   b. Conducting the interview: Keep questions direct and avoid jargon unless it is in standard use by the interviewee. Listen carefully to the answers. Make neither assumptions nor suggestions. Although difficult, it is very important to be patient during quiet periods when the interviewee is thinking about how to respond to a question.

5. **Verify Findings:** Immediately after the interview, transcribe and expand the notes taken during the interview. Provide a copy to the interviewee and ask for verification. All findings should be cross-checked with other sources in order to determine their accuracy. Inaccurate findings will have to be resolved.

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**Questionnaire**

If facts are to be gathered from a large diverse group, employing a questionnaire may be a more appropriate method. The standard questions will lead to results that can be statistically analyzed. Low response rates may be
increased through some form of encouragement, such as a letter from senior management indicating the importance of a response.

Questionnaires are difficult to develop. Care must be taken to ensure that the answers to the questions asked will reveal usable information. It may be helpful to test the questions on a small group of personnel to determine whether the intended analysis can be carried out. Open-response questions may be appropriate for obtaining general ideas, but they will not allow the statistical analysis of closed-response questions.

Observation

This technique provides firsthand information about how activities are carried out. It provides an opportunity to assess the characteristics of a process. The observer can document personnel movement and interruptions, as well as attitudes toward work pressures. It is important to ensure that the act of observation does not affect the process. Further, the observation period should cover both peaks and valleys inherent in the process.

Record Review

Records represent evidence of a business event. The movement of records may be charted. It is important to measure volume of records processed as well as seasonal variation, processes involved with any special cases, and error procedures that exist.

Document Review

Documents describe the business area. They are represented by organization charts, policy manuals, operating procedures, and company instructions. It is important to be aware that the description in the document may not be an accurate representation of the current processes.

The Role of Sampling

Sampling can be used in a more efficient application of all of the above techniques, but should only be used when appropriate. It can help reduce the time and cost to gather facts. It is important to note that easy-to-reach samples may not be representative of the entire population.
It was a lovely July morning but Joseph Wirekai was not happy today. He had just talked with his site manager in Quebec, who told him workers were threatening to walk off the job in an hour if all of them did not receive their pay checks (half a dozen new workers had been taken on last week and their paychecks had not been prepared). And this was not the first time workers had threatened to walk off a project because of payroll problems. In the past year alone there had been two work disruptions and several near disruptions.

Joseph sympathized with these employees. He knew people counted on their paychecks. But he wished they would be a little more tolerant today—he had his hands full with other important things. Payroll was a chronic problem because CCS’s computerized payroll system was archaic. Joseph looked forward to a meeting that afternoon to deal with payroll automation. Now he had further ammunition to get things rolling quickly! Last year management had not listened to him when he said that replacing the payroll system should be a top priority.

Meanwhile, he had to find out why the new workers had not received their paychecks, get the problem corrected, and phone the unions involved. A walkout at the Quebec site would cost his company tens of thousands of dollars per day, and they had a tight schedule to meet.
Background

Canadian Construction Services (CCS) is a wholly owned subsidiary of a large international firm specializing in the design, manufacture, erection, and maintenance of reactors for chemical manufacturers. The company focuses on erection of new facilities and overhaul. Although over half its business comes from Canada, CCS is often involved in projects in Europe, Asia, Central and South America, and elsewhere. CCS erects its own equipment and equipment of competitors, providing a turnkey service for the client. In addition, the company services and repairs all types of equipment to provide proper customer support on their parent's manufactured goods.

Competition comes from two sources. There are only a few firms involved on the design/manufacturing side, and all of them are large. Each has a construction arm. There are a larger number of firms who are solely involved in construction services. In good times, the manufacturing firms concentrate on the largest projects, leaving the least attractive smaller jobs to others. But when times are tough, they go after almost all available work.

Joseph Wirekai has been in the heavy construction industry all his working life, and with CCS for the past 11 years. He is now director of site operations and works out of CCS's head office in Toronto.

The Canadian construction industry is highly unionized and relatively labor-driven. Some unions are more militant than others, but none wants their pay delayed by even a few hours. It is important that checks be issued on time—otherwise an entire job site could be shut down. On some of the larger CCS projects, like the Quebec site, the cost of a labor walkout could be tens of thousands of dollars per day.

Current Payroll System

The current payroll system is a combination of manual and computerized procedures. The computerized part comprises some three dozen programs, written in three languages over two decades. It was developed entirely in-house by programmers who are either no longer with the company or have moved to other positions, and it runs in batch mode on the CCS mainframe located at the head office in Toronto. There is very little documentation available for the system, and none for many of the programs. PL/1, one of the programming languages, is no longer used within the firm and most of CCS's programmers are not familiar with it.

The following procedures are followed in preparing each payroll run:

1. Initial employee payroll data is manually reported at the job site as employees are hired on from local union halls.
2. At the end of each workday, foremen turn in a "push card" (which lists job description, employee number, hours worked, and project number) to the timekeeper.
3. Each morning the timekeeper takes the push cards from the previous day and prepares a "daily time sheet" for each project number. The time sheet lists, by job type, the employee number, trade class, hours worked, and any travel or bonus time. These are totaled and approved by the supervisors and the customer.
4. Every Monday morning the timekeeper prepares a "weekly work report." The report summarizes and totals by day of the week the number of hours of standard time, overtime, and bonus time expended on each project for both tradespeople and supervisors. To the report are added all other job charges,
which are approved by the customer’s on-site rep, then sent to the CCS head office (to be used for customer billing).

5. Every Tuesday the timekeeper manually prepared a paycheck for each site employee. A copy of the check stub is sent to the head office, to be totaled and reconciled with the weekly work reports. Paychecks are handed out on Wednesday morning.

Problems with the Current System

As CCS has grown over the past two decades, the payroll system has not kept pace with company developments and external changes. The current system is quite inflexible and is not fully automated. It now consists of some three dozen programs, written in three different languages (COBOL, RPG, and PL/1). The MIS department at CCS no longer supports PL/1, so programs written in that language are left alone (or, if absolutely necessary, a contract programmer is hired). Over time the code has been patched so many times that it has become a classic example of “spaghetti code.” Any changes require the involvement of a minimum of three people. One manager estimates that maintaining the software costs CCS at least $60,000 a year in addition to operating costs.

The current system, a batch program run on the CCS mainframe, does not allow installation at construction sites. It is centrally run and requires manual records sent from the sites. Thus it does little to meet the needs of site activities. With the recent downturn in the economy, construction services have increased from less than 20 percent to more than 50 percent of CCS’s total business. It is critical for the company to have timely information on the financial status of each contract. But the current system is designed to have daily data feeding into weekly files which in turn feed into monthly files. The monthly files are then used to prepare contract status reports. Ongoing financial information is often not available until 4 to 6 weeks after the relevant time period and, when costs run awry, management is not aware of the problem soon enough.

Another major problem with the program is that many of the fields are too small for current needs. An example of this is the federal income tax field: when the payroll system was initially developed, entries to a maximum of $999.99 were allowed (much more than was needed at the time). Now this field length is inadequate, as it is not unusual for workers to earn up to $4,000 or more per week and owe more than $1,000.00 in federal taxes. Fixing the problem is not a simple matter of increasing the field size, as the maximum record length has now been used. Any increase in field size will require an increase in record size, which will require changes in all programs that read these records as well as changes to the database’s physical structure.

Special procedures have been developed to handle problems such as the inadequate federal income tax field length. The procedures are cumbersome and error prone because they are done manually. For example, in the case of federal income tax, the entire payroll is run. Checks are issued for everyone, but some are incorrect. The incorrect checks are canceled (those with federal tax greater than $999.99), and reissued manually. After this, the database must be updated to reflect the corrections.

Overall the system is very unreliable. Typically there are software problems every week. Programs often do not run through due to field size limitations and various other program faults. It has become the accepted practice to first run the payroll and then fix the payroll.

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CCS uses an older IBM mainframe, with disk drives that IBM will soon no longer support. The maintenance cost of the current system is sufficient to cover the leasing and maintenance costs of a new system. Regardless of what is done with the payroll system, CCS plans to move to a new hardware platform next year.

Everyone recognizes that the payroll system has reached the end of its useful life. However, the MIS department is small and has several other projects underway. It has no slack resources. People would have to be taken off current maintenance and development activities if CCS decided to push through the payroll revision. Besides, just maintaining the system takes up enough of the department's resources already. Last year, it was decided that two other projects would receive priority this year, ahead of payroll. These projects are well underway, but will not be completed until year-end.

**Users of Payroll Data**

The payroll system does a lot more than just provide paychecks to people. Its primary purpose is to ensure that people receive the correct pay and that appropriate deductions are made and forwarded to various groups (government, insurance companies, unions, etc.). But the system also provides data used by other departments at CCS and other computerized applications.

Personnel makes extensive use of the system to ensure that union agreements and provincial labor regulations are followed. Twelve unions are used on most projects, and CCS is active in five provinces (with occasional work in the remaining five). A number of reports are required by certain provincial labor departments, and agreements with trade unions require regular reporting of numbers of tradespeople employed. Union dues are automatically deducted and forwarded to the appropriate union.

Accounting and finance incorporates the payroll information into the monthly profit and loss statement and balance sheet which goes to senior management. As part of financial statement preparation, the work-in-progress accounting module receives payroll information.

Project management is important to CCS, and the current payroll system provides data for it. The current project management system does not provide all the detail that managers want, and consideration is being given to upgrading (either enhancing it, or replacing it). Consideration of changes to the payroll system would have to include the possible future impact on the project management system.

**The Meeting**

Joseph spent the rest of the morning sorting out the current crisis. He grabbed a sandwich and coffee at lunch, then spent an hour preparing for the afternoon meeting. The general manager of CCS, Roy Britton, had called the meeting to develop a plan for improving payroll services.

Several people were already there when Joseph arrived, and he greeted each of them. Susan Bish, MIS director, was seated at the table, along with one of the programmer/analysts (Walt) who spent much of his time on the current payroll system. Because several other departments were involved, they all had people at the meeting. John was there from personnel, Kim from finance and accounting, and Trevor from project management services.

Roy walked in and called the meeting to order.

**Roy:** Thanks for taking time to come today. We're meeting so we can develop some general objectives and an action plan for
improving our computerized payroll system. You all know it's been a problem in the past, and we've put off doing something about it for long enough.

**Joseph:** You can say that again! We just had a problem at the Quebec site, with the workers threatening to walk off the job because some of their paychecks weren't ready this morning. I got things sorted out, but it took me two hours. And it almost cost us big dollars. It's time to stop complaining and start acting. I told you all last year that this should be our top priority.

**Roy:** Joseph, I know your area ends up with more problems than any other because of the payroll system. But all of us are fighting fires more frequently because of it. This afternoon we start doing something to prevent these fires. I've asked Susan to tell us what our options are.

**Susan:** As you all know, our Payroll System was developed for an earlier time. It no longer works well, and it's too difficult for us to maintain. Everyone involved in its initial development is long gone, and there is very little documentation for it. On top of that, the hardware we use for it will be replaced soon, so we have no choice but to change the system. I've prepared a summary of our options. Here's a copy for everyone.

Susan handed out a single page (see Appendix I) to each person, and spent the next 35 minutes talking about the alternatives. There were many questions as she went through the list. Several people thought it would be a good idea to buy packaged software, and Susan indicated the pros and cons of doing this.

**Susan:** I need to point out that our department has everyone committed to various projects at present. Most of our time is spent on maintaining the hundreds of programs in regular use at CCS. We have a few programmers and analysts working on the new cost accounting system and the marketing support system. These were agreed to last year as the priority items. If we suddenly start working on a new payroll system, I'll have to pull people off the other two projects, or hire more people.

While you may think that buying an outside software package would solve our problems, there's more to it than that. First of all, we have to be very careful to ensure that the package meets our current and future needs. And even if the software does, my department needs to be involved in the selection and installation process—that takes time!

**Roy:** Thanks, Susan, for your presentation. We know what the options are, and some of the major advantages and disadvantages of each. Doing nothing is not on the list, and we know action must be taken.

I agree that buying a package looks very attractive. But I also respect Susan's concern about not rushing into this without realizing the possible consequences. Susan, how do you recommend we proceed?

**Joseph:** Just a minute, Roy. We need this done, and we need it done quickly. Buying a package that runs on a micro will solve our problems, and solve them quickly. Why, I'd be willing to look after it, so there wouldn't be any need for overburdening MIS with additional work.

**Susan:** I wish it was that easy, Joe. If packaged software is the best alternative, it will be faster and cheaper than the other options. But, and I emphasize this, we still need to identify all our payroll needs before we can compare them to what the various packages have to offer. It may match force

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may be that we can’t find something that matches our needs completely; we may be forced to change the way we do things.

The analysts in our department are trained to work with users, to help them identify and document all their requirements. We need to have a written list of requirements, so we can carefully compare them to what the various packages have to offer. Otherwise, we could very likely be sold something that would create new problems for us, and particularly for your department.

Joseph: I’m all for changing the way we do things if it’s for the better. Just because we’ve done something in the past doesn’t mean it’s the best way to continue. Our payroll problem is a good example.

But I agree that we don’t want to jump from the frying pan into the fire. I’m just so anxious to get this payroll situation cleaned up so I can get back to my proper job.

Roy: I think it’s clear that we can’t make a decision today. Susan has shown us our options, and buying a ready-made package may well be the best thing to do. However, we need to identify our requirements clearly before proceeding.

Susan, you’ll need help on this. It’s too early to decide what additional resources your department might need, or where they will come from. But we can’t drop the other projects that are underway.

Can we spend some time considering the general requirements of our payroll system? If we can identify the major objectives we want to set for ourselves and this project, we can give further consideration to our options.

The group spent the next hour talking about individual department and company-wide objectives for the payroll system. There were lots of complaints about the current system, but Roy kept things moving.

Appendix II lists the objectives finally agreed upon.

Roy: I think we’ve come up with quite a comprehensive list of things we want to see from the new payroll system. I’ll have the list typed up and sent out with the minutes of this meeting. The last thing we need to do today is develop an action plan—where we go from here, and the major steps in getting us there.

The group focused on immediate actions that could be started this week, and the assignment of responsibility for them. It only took three-quarters of an hour to complete; their results are shown in Exhibit 2-1. Since it was so important for his department, Joseph volunteered to work with the MIS department in preparing a project plan. He was determined to resolve the payroll problems once and for all.

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EXHIBIT 2-1 Action Plan

1. Finalize general objectives
   Confirm agreement with the objectives with each department involved. Complete this week.

2. Select alternative
   Decide whether to develop software in-house or make an outside purchase. Decision to be made in one month.

3. Definition of inputs and outputs required
   For the final project plan, we need to take a close look at what we need in the way of inputs generated on the construction site (time sheets, start/stop notices, etc.), as well as the output or reports that we will require from the system.

4. Final project plan
   This plan should include a detailed schedule as well as the resources required, key documentation points, and project milestones. Joseph and Walt will take responsibility for this.
Roy: We've accomplished a lot this afternoon. Several of you have things to get busy on. We'll meet in a month's time to finalize and make/buy decision. I'll be in touch weekly with everyone involved, and so will Susan. Thanks for coming to the meeting, and for your help.

The Next Step

Joseph went back to his office, reflecting on the meeting, the extra work he had taken on, and how nice it would be to have a payroll system that worked. A proper payroll system was currently the key need for his department. And getting it up and running as quickly as possible would make life easier for him. Without the recurring payroll problems that took up so much of his time, he could concentrate on some projects he had in mind to improve cost control at CCS construction sites. He wished they could just find a software package that would do everything they needed, put it onto a micro, and be finished with it. But was it that simple?

APPENDIX I Alternatives

1. Restructure the current system. This could solve some of the software problems such as “spaghetti code” and inadequate field size. In addition, software maintenance would be simpler. This alternative would not eliminate some of the other deficiencies of the payroll system (such as lack of portability to remote construction sites). The current program is designed for batch processing and would not accommodate real-time on-line processing. In addition, it is not designed to be a multiuser system.

2. Service bureau. CCS uses the Bank of Montreal to handle salaried payroll, and this is very satisfactory. This service (or other similar ones) could handle many of the functions for site payroll, but it is weak in two areas. It cannot handle retroactive pay requirements, or the short turnaround required (e.g., it is not unusual to get a call on a Friday afternoon, and need the system set up and ready to go by Monday morning; a tradesperson hired midweek must be paid the following Wednesday).

3. System used by American branch (American Construction Services). ACS developed their own mainframe-based system which is satisfactory for their needs. The problem with using this system in Canada is that it is not set up to handle Canadian tax requirements, and correcting this would require in-house programming. In addition there would need to be constant updating as tax laws change. There would also be differences in the treatment of the various unions. Finally, with CCS moving to a new computer system in the future, it might require additional modifications for the new operating system and hardware.

4. Reengineer the current system. Develop a new set of custom programs which would meet all of CCS's needs. CCS could contract out the development of a payroll system, or ask their information services unit to develop the application. Currently the MIS Department has an 18-month project backlog.

5. Packaged program. If a suitable package could be found, it might be the fastest option. Depending on how closely the capabilities of the package matched CCS needs, modifications of the package may or may not be required. Alternatively, CCS might change their way of doing things to meet the capabilities of the package.
APPENDIX II General Objectives of CCS Construction Payroll System

1. Reduce payroll production cost
   Any new system should reduce the cost and effort required to maintain the field payroll. CCS is uncompetitive because:
   a. It takes too long to sign tradespeople onto the payroll.
   b. Too many timekeepers are required on a job in order to maintain the current system. Some competitors appear to spend one-tenth the time CCS does maintaining similar-sized payrolls.

2. Improve payroll accuracy
   Correct calculation of all checks, including personal, union, and government remittances automatically.

3. Reduced sign-on time when using system
   The objective would be to have a sign-on time of less than 1 minute per employee. Much of the construction start/stop employee documentation could be maintained on a resident file accessed by the employee’s SIN or similar number.

4. On-line access
   On-line access is required at both the construction site and head office.

5. Dial-up access
   To provide communication between construction sites and head office via telephone.

6. Multiple site capabilities
   On a continuous basis should be able to issue payroll checks from the regional offices in Vancouver, Calgary, Toronto, Montreal, and Halifax.
   For a large construction or maintenance project, CCS would establish a site payroll with the computer system on location. The system should provide for at least 12 sites including the regional offices.

7. Daily pay
   A daily pay capability is required.

8. Interface with WIP
   For accounting purposes, the payroll system must be capable of interfacing with the WIP accounting module.

9. Project management interface
   The payroll system input (e.g., worker time sheets, etc.) must be designed to support an eventual project management system that would provide similar reports to those currently generated.

10. Security
    The system must provide a proper audit trail, part of which is the capability to print a daily workforce report within 30 minutes of shift start.

11. Handle multiple trades
    The system must be able to handle multiple trades in all Canadian provinces. Currently 12 trades are used on a regular basis.

(Continued)
APPENDIX II  General Objectives of CCS Construction Payroll System—(Continued)

12. Head office trade file maintenance

Interpretation of the various agreements for each of the trades with the various locals would be
supported by a combination of head office personnel and payroll departments. This would elimi-
nate the current problem when the local timekeeper on a job has to interpret the proper rates of
pay from the local agreement.

13. User friendly

The system must be easy to use, user friendly, and not unwieldy.

14. Documentation

All software and procedures must be properly documented, and existing documentation removed
from the manuals.

15. Schedule

It is essential that the new system be in place by January 1 of the coming year.

Assignment Questions

1. What are the business and information system issues in this case?

2. What factors and considerations should CCS take into account in deciding upon the best course of actions? Describe these and indicate whether they are of primary or secondary importance. For each alternative CCS is considering, use these to summarize the advantages and disadvantages.

3. What software packages are currently available for the construction industry? Is CCS likely to find one that meets its needs?

4. Based on the facts of the case, critique the management planning and decision-making process at CCS.

5. Given existing technology, would it be cost-effective to provide the connectivity (communication needs) specified in the requirements? Also, what type of computer system might be best suited to handle the new payroll system? What general hardware specifications and network services would you recommend?