

**IMPROVEMENT OF AN INVOICE
VERIFICATION PROCESS:
A SYSTEMATIC APPROACH**

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ABSTRACT

This report describes a consulting project to improve an invoice checking system in an office environment. Simple statistical tools were applied within the context of a structured problem solving process which has six steps, starting with 'Definition of the Problem' and concluding with a 'Follow-Up of the Solution". Tools such as flow charts, scatterplots and histograms are utilized within the structured framework.

1.0 Introduction

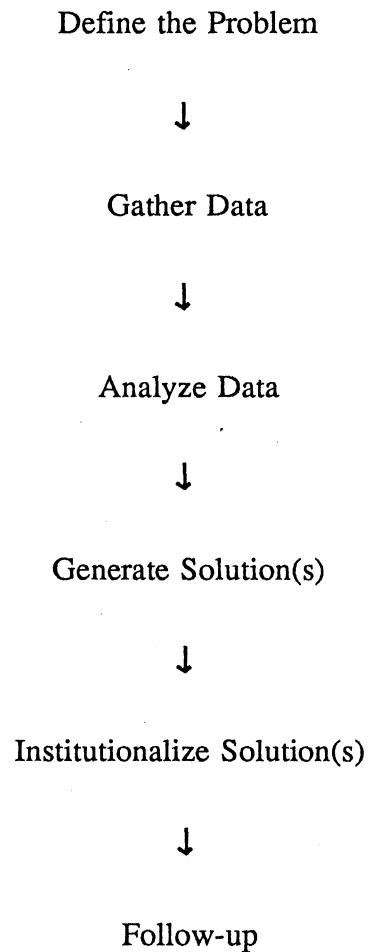
Initially 'Company X' (true name suppressed to keep confidentiality) approached us to develop a sampling scheme to estimate the amount of error in their invoice checking operation so that it can be improved. This report details why a sampling scheme itself was not the solution. The problem is analyzed through the application of simple statistical tools such as flow charts, scatterplots, histograms, and Pareto charts within a six step process.

Each section of this report represents one step in the problem solving process, for example, Section 3.0 is "Define the Problem". The IIQP was not involved with the last two stages of the problem solving process: *Institutionalizing Solutions* and *Follow-Up*. Therefore, these sections of the report include only the consultants' ideas and whether or not these suggestions were implemented is not presently known.

The data have been coded (changed) to observe confidentiality considerations.

2.0 A Structured Problem Solving Process

Many structured problem solving approaches are available, ranging anywhere between four and ten steps. All these approaches are basically different packaging of the same structure. We decided to employ the following process.



3.0 Definition of the Problem

The accounting department at Company X was spending a lot of time verifying the invoices they received from contractors. Before releasing payment to any contractor, the department would check the calculations, rates, and costs on each invoice received. This procedure consumed a large amount of resources.

A flow chart of the accounting group's process is shown in Figure 1. Flow charts are useful tools because they provide a visual representation of a process and in doing so suggest, sometimes immediately, ideas for improvement and streamlining. The flow chart in Figure 1 shows the different groups represented by blocks, for example Accounting, Work Site Supervisors, Contractors etc.. Also, the flow of information from one group to another is shown by the arrows in this flow chart.

The invoicing system includes a number of stages. Every few years, the contractors make an agreement with the company's legal department as to the charging procedure for jobs that the contractors perform. After performing an assignment the company's field personnel observe what was done and note this in check sheets. The contractors then submit invoices to the accounting department. The accounting group then spends a lot of time checking the invoices to see if they are consistent with the contract and with the check sheets. If both are verified, then accounting pays the contractors; if there is a major discrepancy then the invoice is returned.

Flowchart of Invoicing System

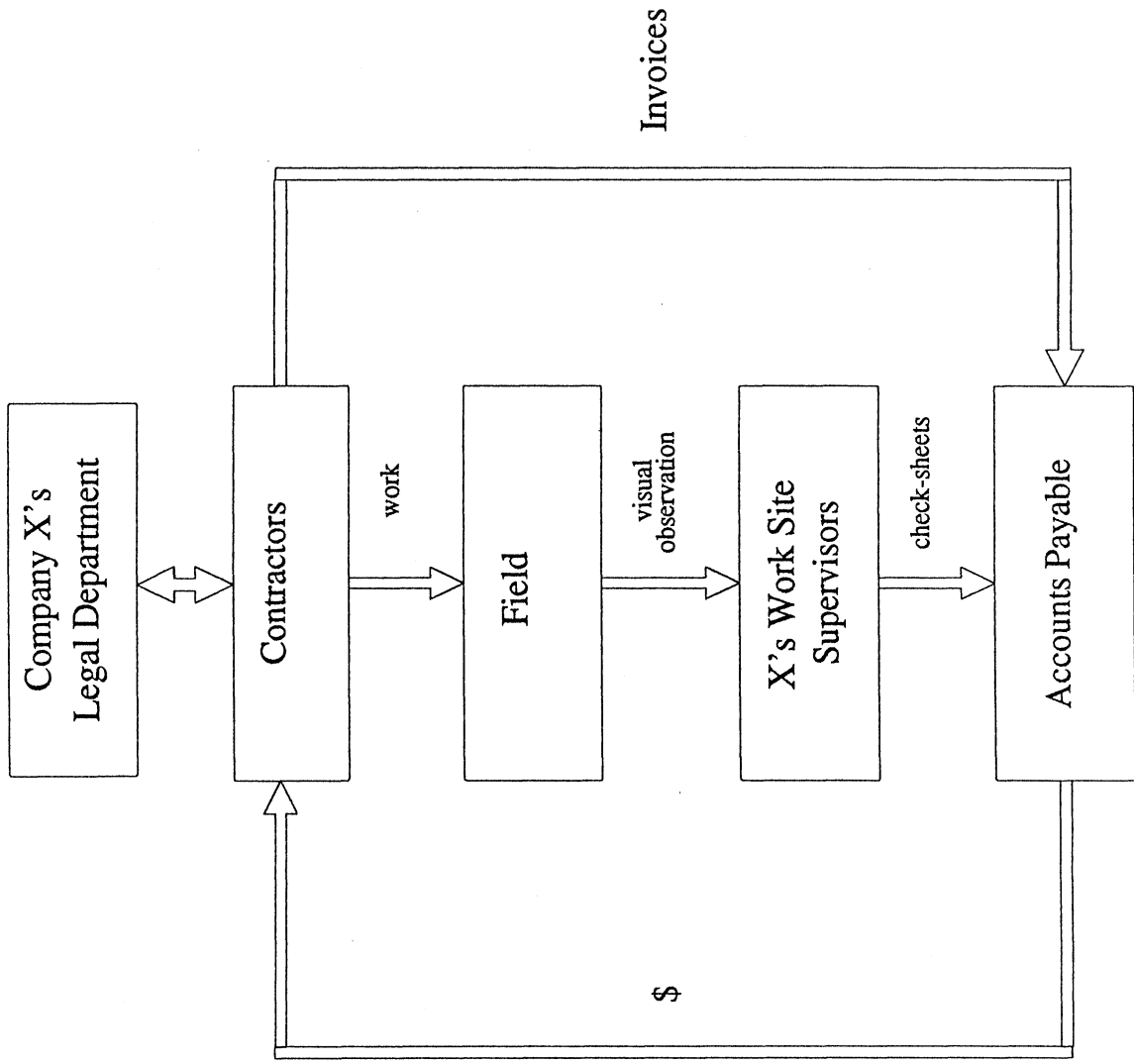


Figure 1.

The accounting team felt that none of the contractors were trying to cheat and over bill; therefore the errors that were found were assumed to be honest mistakes. The department wanted to cut down verification and was hoping that we could come up with a sampling scheme which would enable them to do this. The group initially wanted a statistically sound way to select and check a portion of the invoices, while still maintaining a reasonable estimate of the total error amount.

After some dialogue, we and the accounting group defined the problem as the exorbitant amount of time spent checking invoices.

3.1 Objectives

- Analyze any useful, available data; note key observations, data trends.
- Generate ideas for reducing checking.
- Make recommendations for system improvement.

4.0 Gather Data

We chose to use available data in this study. If we were to collect new data, at least one year's worth of invoices would be necessary and the project would take too long. A member of the accounting group, for two years prior to the IIQP's involvement, had been recording data and had stored these data on a spreadsheet. Of the many invoices that were processed by the department, she checked and recorded a large portion (about 3000) of the total invoices. Her records included the invoice amount, the error amount (if any), the type of error, the contractor and other information. During spring and shut-downs, the invoice volume was high, and not all of the invoices were verified. When the volume of invoices was low, all incoming invoices were verified. We were concerned because the contractor's who did the bulk of their work during shut-downs or in the spring would not be accurately represented in the available data. Despite this fact we decided that this data could be used in the analysis because i) time did not permit the collection of new data, and ii) because the majority of contractors did not perform seasonally.

5.0 Analysis of the Data

5.1 The Process Flow Chart

Before actually delving into the data set provided by Company X, some preliminary observations can be made from the process flow chart, Figure 1. Since the contract agreement is made between Company X's legal staff and the contractors, it is possible (and actually true) that the accounting group's interpretation of the contract differs from the legal department's. Also, sending in invoices and writing out cheques are the primary modes of communication between the contractors and the accounting department.

5.2 Scatterplots In Search of Error Associations

If the error amount or the likelihood of an error can be related to some other distinguishing characteristic, then the incoming invoices can be sorted and checking can be reduced. By only checking invoices that are highly prone to error or to large errors, a substantial portion of the total errors can be found, and a good estimate of the amount of error can be attained. Therefore it is a good idea to determine these distinguishing characteristics.

One simple way to discover linear associations for error is through the use of scatterplots. For such a plot, the amount of error in an invoice is shown on the vertical axis while the source variable (for instance, the total amount of the invoice) is given on the horizontal axis. Although computer's make it easy, they are not required to generate these plots. The data set was large, so a mainframe computer at the university was used and the analysis was run on SAS (Statistical Analysis System). If the two variables are related, the scatterplot will show a trend and the points on the graph will appear to form around a line or a curve.

Originally, we guessed that an invoice's error amount would be associated with the amount charged on the invoice. If this hypothesis were true, we would be able to stratify and then sample based on invoice size. However, a scatterplot of invoice amount versus error amount for each erred invoice (see Figure 2), clearly demonstrates that the two are not associated as we had thought. If we were to stratify the data, some other criteria had to be found. Further scatterplots by other contractor or invoice characteristics, did not

Scatterplot Error Amount vs. Invoice Amount

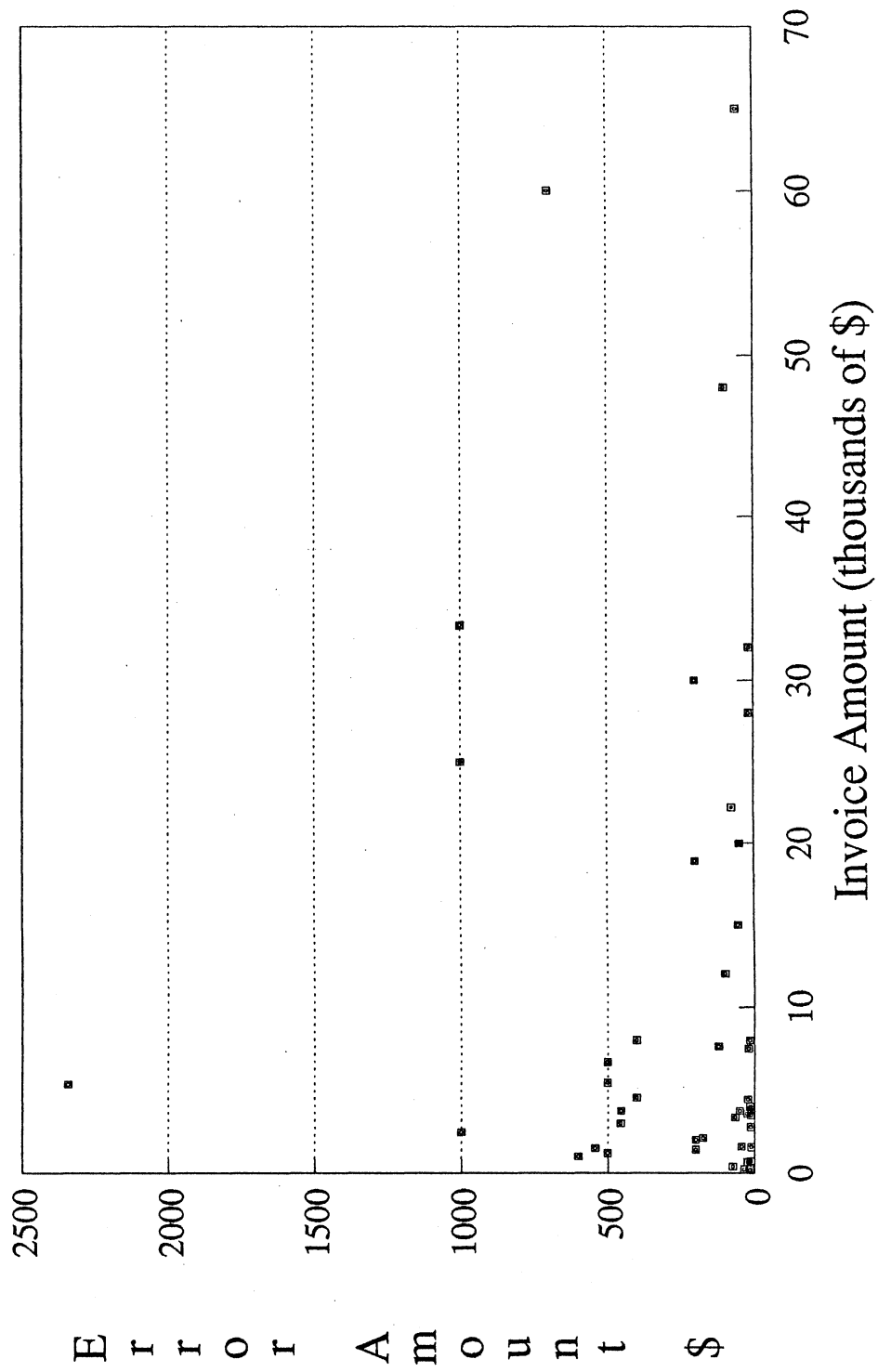


Figure 2.

Pareto Analysis - Type of Invoice Error

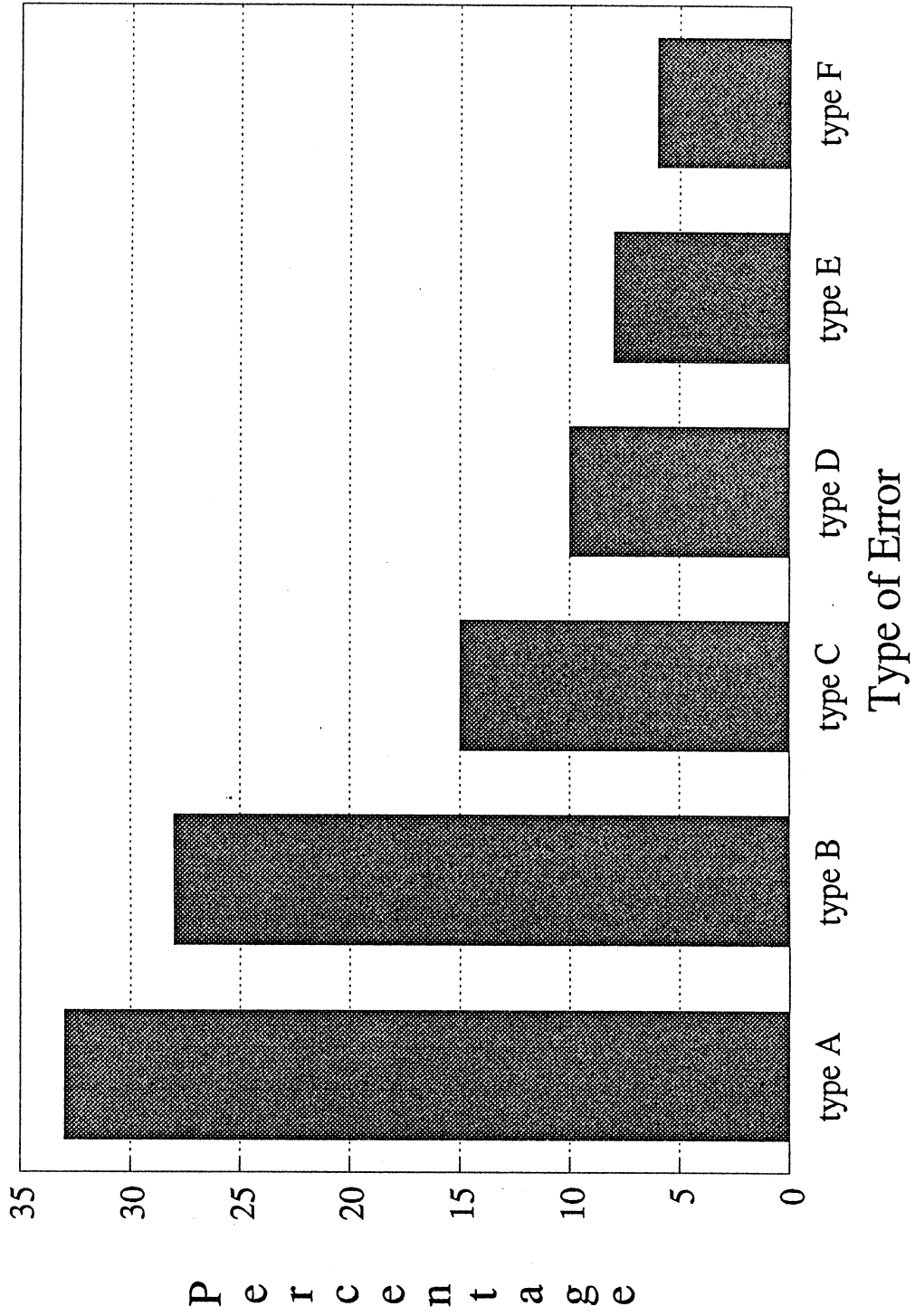


Figure 3.

yield any obvious linear associations. With no obvious way to stratify the data any sampling would be purely random. The range of error estimates for simple random sampling is very large.

5.3 Pareto Analysis of Type of Invoice Errors

A Pareto analysis is simply a bar chart of different causes of an occurrence, plotted in descending order of frequency. A Pareto analysis was performed on the type of error (see Figure 3) and we discovered that two types of invoice errors, A and B, accounted for sixty percent of all invoice errors.

5.4 Other Important Findings

Further analysis yielded two key observations: the number of errors in the entire data set was small, and the total dollar value of all errors was also relatively small.

We wanted to compare contractors to see which ones were more error prone. A histogram of errors per invoice by contractor demonstrated that some contractors had a high errors to number of invoices ratio. When we informed the accounting people they were not surprised. They were aware that most of the errors were due to some misunderstanding of the correct billing procedure and therefore some contractors would err repeatedly.

Also, it should be noted that the population of invoices is not finite or fixed. A certain number could come in on a particular day and a different number on the next day.

6.0 Generating Solutions

6.1 From the Flow Chart

After viewing the flow chart some ideas for improvement became evident. The accounting group is clearly excluded from contract negotiations. The department may find it beneficial to send a representative to the contract negotiations so that all three parties, accounting, legal and contractors, have the same interpretation of the contract. Also, accounting may try to influence the legal department to simplify contracts.

Since Company X has personnel already in direct contact with the contractors, it was suggested to empower field supervisors to assist and educate contractors about billing procedures.

6.2 From the Scatterplot

Because no linear association is evident, and therefore no criteria for stratification is apparent, any sampling scheme would be random.

6.2.1 The Feasibility of Dollar Unit Sampling

Auditors often use a sampling scheme known as Dollar Unit Sampling and the accounting group was familiar with this technique. The scheme requires that i) error amounts are associated with invoice size, and ii) the number of invoices are fixed, and therefore can be sorted in descending order and sampled.

In our problem, we have not associated error amount with invoice amount, and the

invoice population is not fixed but arriving daily. More than a month would be required to collect a significant number of invoices to sort and sample from. Therefore dollar unit sampling is not feasible for our problem.

6.3 From the Pareto Analysis

Following from the Pareto Analysis, the department could focus in on the two major types of errors (A and B) so that the group can concentrate on reducing or eliminating sixty percent of the errors and then go after the other forty. The accounting people can concentrate on particular types of errors by only checking portions of an invoice, for example the pay rates or consumable materials section of an invoice.

6.4 Other Ideas

Random sampling does not yield an acceptable estimate of total error. The consultants generated random samples of a particular size from the historical data (approximately 3000 invoices) and demonstrated that the estimate of total error is out of line and the range of the estimate (95% confidence interval) was too great to be useful. Therefore, complete random sampling was not recommended.

The consultants decided that because complete random sampling is ineffective, invoices with errors are difficult to find, and errors are small relative to total invoice amount and checking costs, it is not cost effective to expend resources in an attempt to catch all of these errors. Thus the goal of the recommended scheme is to reduce errors.

A procedure which samples as many different contractors as possible is suggested. The idea is to find out which contractors misunderstand the billing procedure and work with these contractors to correct the problem. We suggested that Company X start with contractors who were currently having problems. Details on error tracking, and on managing the flow of incoming invoices to smooth the work load, were among the ideas presented to the accounting group. The focus of the recommended scheme was to work with contractors on reducing errors. With the emphasis on working with contractors instead of checking invoices, time could be spent on creating a system for better communication with contractors to make sure that they understand the correct invoicing procedure.

Contract information sheets could be generated by accounting and sent to contractors. In order to insure their use, it may be required that these sheets be sent in with invoices.

7.0 Institutionalizing Solutions

A thorough knowledge of how the accounting system works within the structure of Company X is necessary to provide a complete plan for institutionalizing a new verification program. This kind of knowledge is available to individuals who have worked within an organization for a period of time. Some considerations would include engaging the support of upper management and ensuring that the philosophy of the program is consistent with upper management's overall goals and planning. Enlist the backing of all accounting group members involved in the verification program.

The details of the institutionalization phase are left up to the accounting group.

8.0 Follow-Up

The suggested approach should be checked and adjusted throughout its operation in an attempt to improve and streamline. Weekly meetings should be held to discuss problems in adjusting to the new system. Ideas for tailoring the new program should be solicited and implemented. After the program has settled into place, meetings focused solely on the implementation of the new verification program are not required. Again the accounting group must organize and manage the Follow-Up phase.

9.0 Summary

This report summarizes the steps taken in an office process improvement project. The accounting group wanted a sampling scheme to estimate the amount of error in their invoice verification system. However, it turned out that the real goal was to reduce checking and improve the system. Sampling would not reduce errors. Sampling will only help to estimate the size of the errors, but it may not give any idea of the causes of the errors. Invoices with errors would still go through the system undetected; at present they were checking all invoices possible to prevent this. The suggested scheme involved sampling invoices by contractor to determine which ones have a misunderstanding, and to work with them to correct their misconceptions. Thus, the scheme was intended to eliminate or greatly reduce the possibility of making errors.