

DATQUAL: a prototype e-learning application to support quality management practices in service industries

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ABSTRACT *One overriding factor required for success in any quality improvement endeavour is a decentralization of decision-making responsibility to a well-trained problem-solving labour force (i.e. employee participation in decision making). Unfortunately, many workers, especially service workers involved in operational processes, lack the knowledge, skills and experience required to use data effectively to make decisions required for quality improvement. Training is available only in blocks and does not provide the type of continuous support required for operational workers to understand how to collect and use data to make good decisions. The Internet and company Intranets are being exploited to provide a platform to deliver education and training to workers on an as-needed basis. E-learning has the potential to be a revolutionary way to empower a workforce with the skills and knowledge it needs to turn change to an advantage and can be thought of as 'just in time learning'. To be effective, however, learning content and delivery is of critical importance. In this paper we describe a prototype e-learning system to assist service operational workers involved in decision making in a TQM environment. Our prototype system, DATQUAL, not only guides operational workers in the use of quality improvement tools but also provides users with a mental model of the quality improvement process. DATQUAL achieves this through the use of procedural cueing in which users, typically novices in data collection and analysis, are guided toward a decision through a series of focused questions that help them develop an understanding of the questions they should ask to uncover quality problems and identify improvement opportunities. With current advances in telecommunications, especially the use of company Intranets as e-learning delivery mechanisms, this type of system provides both the necessary content and interactivity required to promote sound TQM practices and the 'just-in-time' learning critical for TQM success.*

Introduction

There is an overwhelming consensus that the need for process improvement is at the heart of all quality initiatives (Slater, 1991). And at the heart of all process improvement is an emphasis on the use of data to make decisions associated with quality improvement.

Easton (1993), a Senior Examiner for the Malcolm Baldrige National Quality Award,

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has observed that there is little real management-by-fact among senior management and, in many cases, improvement efforts by operational workers are based on informal brainstorming and not on management-by-fact and systematic analysis. He attributes this to the failure of quality improvement teams to use effectively a well-developed problem-solving process supported by analysis tools. He observed that many companies examined for the Baldrige award seldom used the quality tools, avoided collecting data, and have relatively few direct operational and customer measures that can be stratified for effective root-cause determination.

In contrast, the authors observed many companies who collected copious amounts of data that were of little or no use in uncovering or understanding problems related to quality. Data were often collected in a random and haphazard manner, with little or no thought in advance of what data were important or the context in which the data could help with quality improvement. No systematic, designed plan for data collection and analysis had been established.

In this paper we address the concerns cited by Easton and others (Cole *et al.*, 1993; Dimitriadis, 2001; Saraph *et al.*, 1989) regarding the need for quality improvement teams to effectively use a well-developed problem-solving process supported by analysis tools. We do this by describing the development of an e-learning TQM application called DATQUAL. The system, which was developed after extensive field research with service organizations involved in continuous quality improvement, provides an opportunity for service workers to learn how to identify quality improvement opportunities in a systematic, interactive fashion. Unlike many computer support systems used in industrial settings (see, for example, Crawford & Eyada, 1989; Dagi & Stacey, 1990; Fard & Sabuncuoglu, 1990; Moore, 1995; Ntuen *et al.*, 1990), DATQUAL helps users develop a mental model of the ties among organizational objectives, quality imperatives, processes, and data in addition to providing advice on the use of quality improvement tools. The system can be used as part of any service organization's e-learning strategy by bringing just-in-time learning to its workers through the company Intranet. In addition, 'lessons learned' can be shared across the enterprise through electronic focus groups and compiled into best practices that are distributed through a knowledge management repository.

Before describing the system, we will briefly discuss the characteristics of e-learning. Then we present the knowledge acquisition phase of our study including two field studies conducted at sites in both Hawaii and New Zealand. A synthesis of the quality literature, personal observations, and our field studies resulted in a Conceptual Model of the process of identifying quality improvement opportunities. The Conceptual Model serves as a basis for the Logical Model that represents the knowledge-base of DATQUAL. We present both models, describe their role in developing DATQUAL, and discuss the system implementation issues within the context of an e-learning environment. We conclude with a scenario illustrating a consultation with the system.

E-learning

John Chambers of Cisco Systems said, 'The two great equalizers in life are the Internet and Education'. E-learning, the exchange of knowledge through online media, is an effort to combine the two as a means of empowering a workforce with the skills and knowledge it needs to remain current with rapid changes in the marketplace and to learn skills that will help organizations remain competitive. To be effective, e-learning should not be just the passive delivery of learning one way. Online learning can take full advantage of the multimedia aspects of the web and it encourages peer interaction through electronic focus groups, bulletin

boards, chat rooms, etc. In addition, e-learning personalizes the learning experience and allows for greater flexibility by allowing employees to use learning modules around their schedules and at their own pace while maintaining a consistency of material with their fellow workers. This is of utmost importance in a TQM environment in which continuous learning is an integral part of the philosophy of continuous quality improvement. For e-learning to be successful, in addition to the requisite technological infrastructure, the appropriate presentation style and content for a target learning community is critical. Considerations for presentation style (Wild *et al.*, 2002) include the following. E-learning should be interactive, provide the means for repetition and practice, and offer a selection of presentation styles. In addition, the content should be relevant and practical. The Internet and company Intranets provide the means to distribute such a system to target employee communities. Connectivity with enterprise-wide mechanisms for employees to share insights and lessons learned extends the benefits of such a system by allowing best practices to be formulated, stored, and distributed as part of the larger knowledge management structure.

We conducted field studies in service industries to understand some of the issues deemed important before developing an application system that could be used in an e-learning environment to support quality improvement among service workers. The following sections describe the system development process.

Knowledge acquisition

To develop a model of data needs for service quality improvement we undertook two field studies in the banking industry. The banking industry has often been targeted as a model industry for studying the determinants of service quality (Roth & Jackson, 1995). One study was conducted at a bank in Hawaii and one at a bank in New Zealand; ten sites in both banks were involved. The studies consisted of interviews with employees from all levels of the banks from CEOs to entry-level operators, examination of appropriate documents including strategic and operational plans, direct observation of quality teams, and group meetings that served as informal focus groups. From these multiple sources of information a database was compiled which consisted of field notes, audio tapes, transcribed interviews, and documents.

To construct our Conceptual Model we searched for *chunks of meaning* within the database. This was achieved by comparing incidents, reported practices, and interviewee comments both during and after data collection. Significant ideas or comments were recorded and grouped by topics or themes. From the combination of this procedure, insights from the quality management literature, and personal reflection, relationships emerged and a Conceptual Model of data needs for quality improvement materialized. To obtain face validity of the Conceptual Model, ongoing validation and modification became part of the iterative model development process. The final model was further validated through a structured walk through with key participants from both banks, as suggested by Lincoln & Guba (1985), as well as by a wide array of service industries. The model is presented in two phases. Phase 1 involves the process of identifying quality improvement opportunities. The prototype system presented in this paper supports Phase 1. Phase 2 focuses on the activities following the identification of quality improvement opportunities and is presented later as a future enhancement to DATQUAL.

Phase 1. Identifying quality improvement opportunities

Figure 1 represents the descriptive model for identifying quality improvement opportunities that emerged as a result of the field studies. This part of the model was validated first through

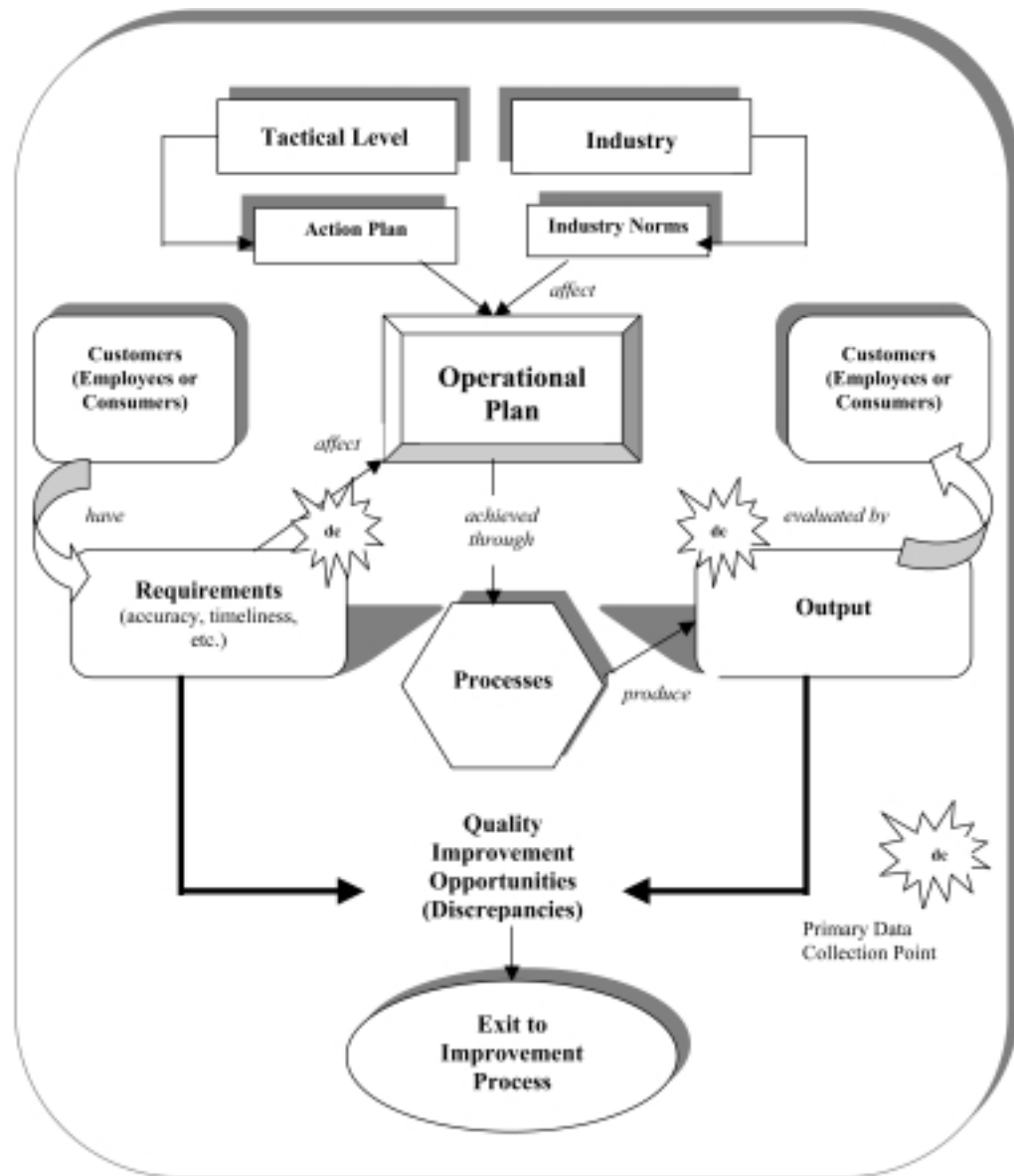


Figure 1. Conceptual model, phase 1 identifying quality improvement opportunities.

structured interviews with field study participants and then, to ensure generalizability to other service industries, a survey was distributed and completed by a variety of service firms, which included car dealerships, hotels, the military, and medical facilities, to name a few. The Conceptual Model in Fig. 1 reflects the feedback received during the validation process and includes details of the specific data needs of operational workers. For example, at the operational level, field study participants spoke of ‘customers’ rather than ‘stakeholders’. In most cases, they were referring to external customers but internal ‘customers’, such as other employees or workers involved in upstream or downstream internal processes, were also important.

Data from our field study showed that customer needs, tactical level plans, and industry norms were important inputs to operational planning and functioning. As the model indicates, the processes that produce the output 'experienced' by customers reflect this operational plan. The model underscores the fact that quality improvement opportunities arise when data suggest there are discrepancies between the performance expected by customers and the actual performance of operational processes as measured by process output. This Conceptual Model served as a guide to the creation of the Logical Model and knowledge-base of DATQUAL.

DATQUAL: an expert support system

Our problem domain called for support in a complex series of decisions required over an extended time period. Consequently, an Expert Support System (ESS) appeared to be the most logical choice among the alternative computer-based support systems investigated. Expert Support Systems help users by structuring a complex problem-solving task (Silverman, 1987). An Expert Support System is neither a conventional Decision Support Systems (DSS) nor an Expert System (ES), but combines concepts from both to provide intelligent support in decision making.

Expert Support Systems utilize Expert System knowledge representations, tools, and techniques but differ in functionality in that they require the user to do more of the work, as does a DSS. The ESS structures a task and provides some of the knowledge required to perform it. The user also contributes knowledge, usually in response to stimuli presented by the system, and the user makes the decision.

The prototype developed in this research uses procedural cueing to guide teams through a data-driven quality improvement process. Procedural cueing is a technique in which the user is guided toward a decision by being directed through a series of steps and sub-steps. Procedural cueing reminds the user of all steps involved, suggests steps overlooked, provides step advice when requested, and cues the user on the latest and most recent techniques.

This questioning is analogous to selecting a step in DATQUAL. Users are initially provided with the major steps in identifying quality improvement opportunities. When they do not know how to complete a particular step, they select that step and the step is decomposed into a series of smaller steps. Information or advice is provided at every step and sub-step.

We see several benefits from the use of our system. DATQUAL simplifies a very complex process by providing a logical sequencing of steps. For novices, this acts as a performance aid and provides training. DATQUAL acts as a performance aid by informing users of questions that must be asked and answered at each step of the process. On-the-job, context-based electronic training is supplied in each DATQUAL consultation. The order in which steps are presented, and the fact that selected steps and sub-steps remain visible on the screen, helps users to form a mental model of the quality improvement process. Thus, users can internalize the knowledge embedded in the system and become more effective members of quality improvement teams. For experts, DATQUAL helps ensure that no important steps are omitted. DATQUAL also provides a language by which quality improvement can be understood and through which actions can be communicated. Most importantly, DATQUAL enforces the notion that quality improvement is a data-driven process.

Figure 2 provides a representation of the architecture of DATQUAL with the six modules that comprise DATQUAL's knowledge-base. The user accesses the system through a company Intranet and is provided with interactivity, the means for repetition and practice, and a variety of presentation styles (text, graphs, examples, etc) that are considered important for successful

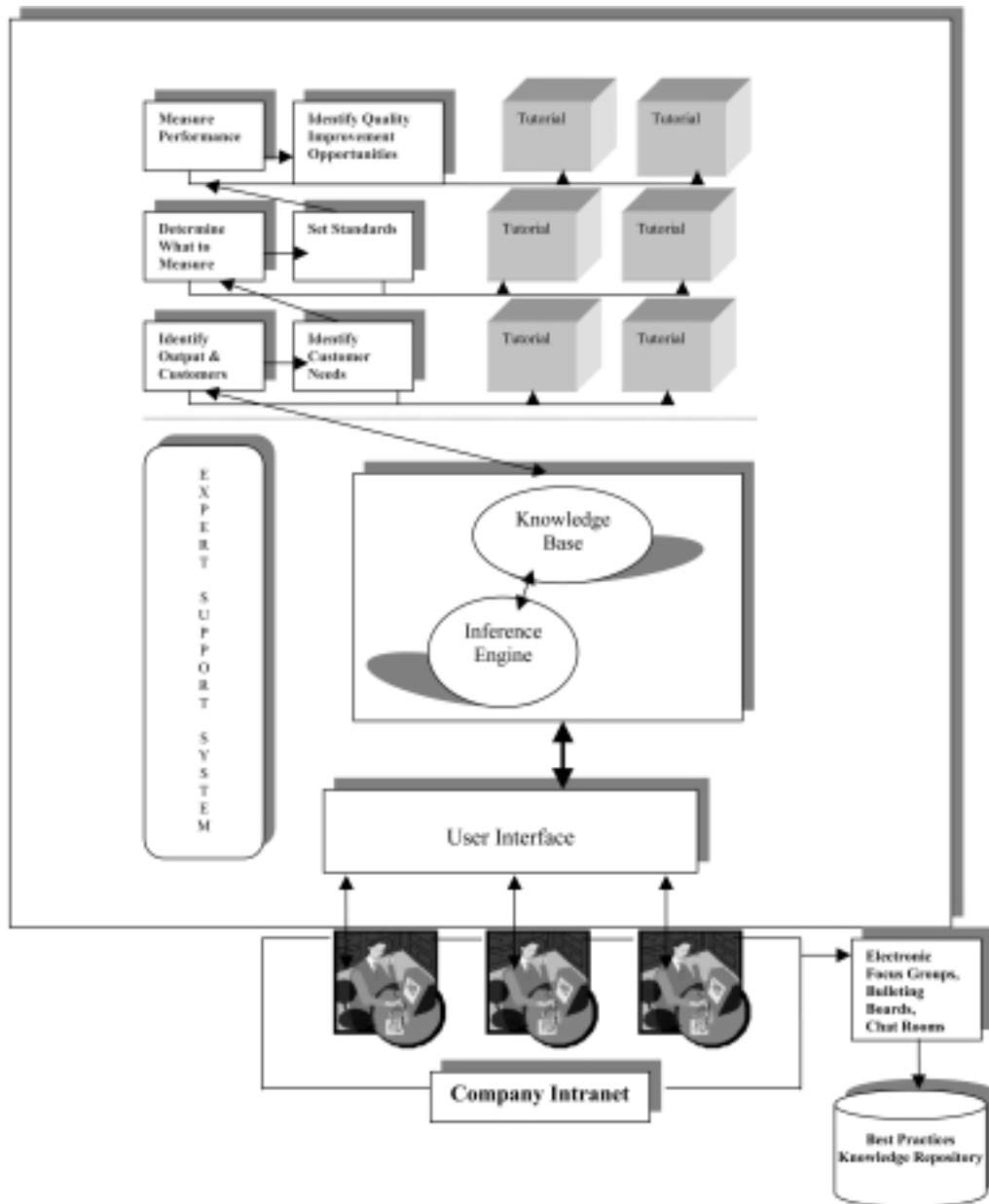


Figure 2. Architecture of DATQUAL expert support system.

e-learning. The inference engine triggers the appropriate knowledge-base components in response to user input. In addition, insights gained through system use can be shared across the enterprise through a variety of team support products accessible through a firm's Intranet. Examples shown in the figure include electronic focus groups, bulletin boards, and chat rooms. Ultimately, the lessons learned can be compiled and stored in a knowledge management repository of 'best practices' to be distributed throughout the enterprise.

The Conceptual Model previously presented in Fig. 1 described a macro model of data needs for service quality improvement. Implementation required a Logical Model that details the steps and sub-steps required to structure the problem domain.

A logical model for DATQUAL

Figure 3 represents the Logical Model of DATQUAL and shows the major activities derived from the descriptive Conceptual Model (Fig. 1). The six major steps of the Logical Model are shown in the vertical column at the left. To the right are the sub-steps or options offered

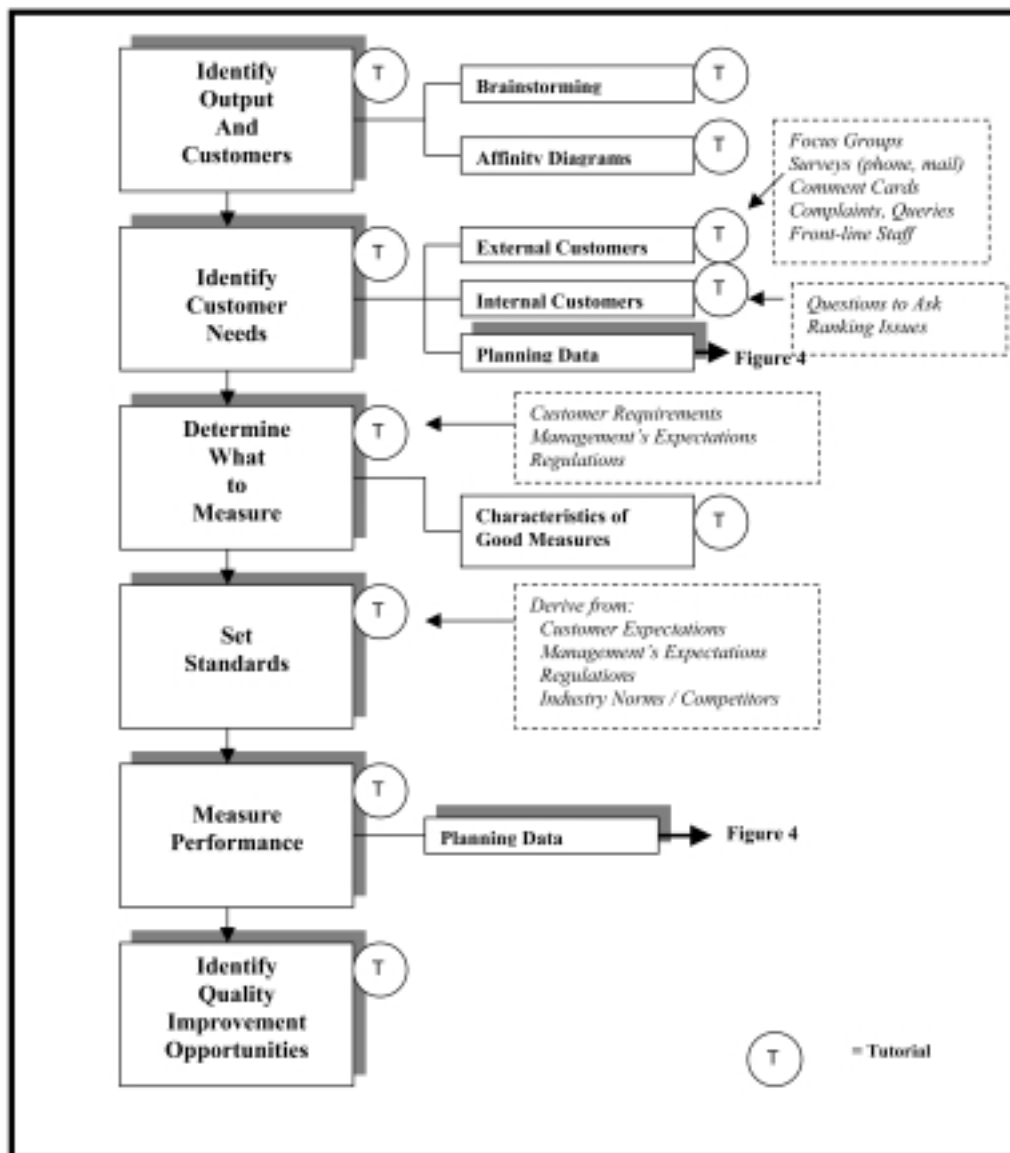


Figure 3. Logical model of DATQUAL's knowledge base.

in each step. A solid box represents a step or option a user can select, a circled 'T' indicates the availability of a tutorial, and a broken line box shows topics covered within a tutorial. For example, in Step 2, *Identify Customer Needs*, a user can select external customers, internal customers, or planning data collection. Each of these has a tutorial attached (circled 'T'). The contents of the broken line box attached to the internal customers' box show that major topics in this tutorial are: (1) questions to ask and (2) ranking issues. We will now discuss each major step in the model.

Step 1. Identify Output and Customers

The first step in our Conceptual Model was identification of current and potential output. Once output is defined, the next step is identifying users of that output, i.e. customers. These two steps of the Conceptual Model were combined in the Logical Model.

Essentially in this step, teams are asked to determine:

1. What do you produce?
2. For whom do you produce it?

The identification of all outputs is not as simple as might be expected. Many service operational level quality improvement teams in the organizations we studied omitted this step. Our logical model suggests teams may wish to use brainstorming and affinity diagrams to help identify and classify the outputs of the unit or sub-process. Brainstorming is an effective way for teams to generate a list of ideas quickly, in this case unit outputs, and affinity diagrams can then be used to classify or group these outputs. The tutorials describe the techniques, including their uses and advantages as well as sample implementations. Once output is specified, customers of that output are more readily identified by the team.

Step 2. Identify customer needs

Following identification of output and customers, the Conceptual Model called for teams to determine customer needs. This becomes the second step of the Logical Model. Our field experts agreed operational workers must consider the needs of both external and internal customers (consumers or employees). However, this was often not done or was done poorly in the firms participating in the field studies. In this step of the Logical Model, teams are advised to answer two basic questions.

1. What service attributes do customers consider important?
2. What level of performance do they expect relative to these attributes?

From interviews we learned that identification of needs of external customers often involved the use of focus groups, surveys (phone and mail), comment cards, complaint and query analysis, and listening to the insights of front-line staff. The tutorial on external customers describes these procedures and suggests advantages and hints for each. We constructed the details of our tutorial from a review of selected classic texts in the area (Churchill, 1987; Harrington, 1991; Ishikawa, 1982; ISO, 1992). The techniques in this step can be difficult and teams are advised to seek help from their quality support group as and when needed.

To identify the needs of internal customers, operational level teams are advised to meet regularly with their internal 'customers' (i.e. fellow employees). We suggest teams ask these customers:

1. What does our 'team' deliver to you?

2. What are its important attributes (timeliness, completeness, etc)?
3. How important is the attribute to you (1–10 scale)?

This line of questioning was derived from Internet communications with practising consultants. Question 1 confirms a team’s description of output and its customers (Step 1) and questions 2 and 3 determine the relevant attributes and their importance.

Identification of customer needs is a major data collection point. Consequently, from this step of the Logical Model we provide access to a support module on planning data collection which, because of its complexity and importance, is presented in Fig. 4 and is discussed later.

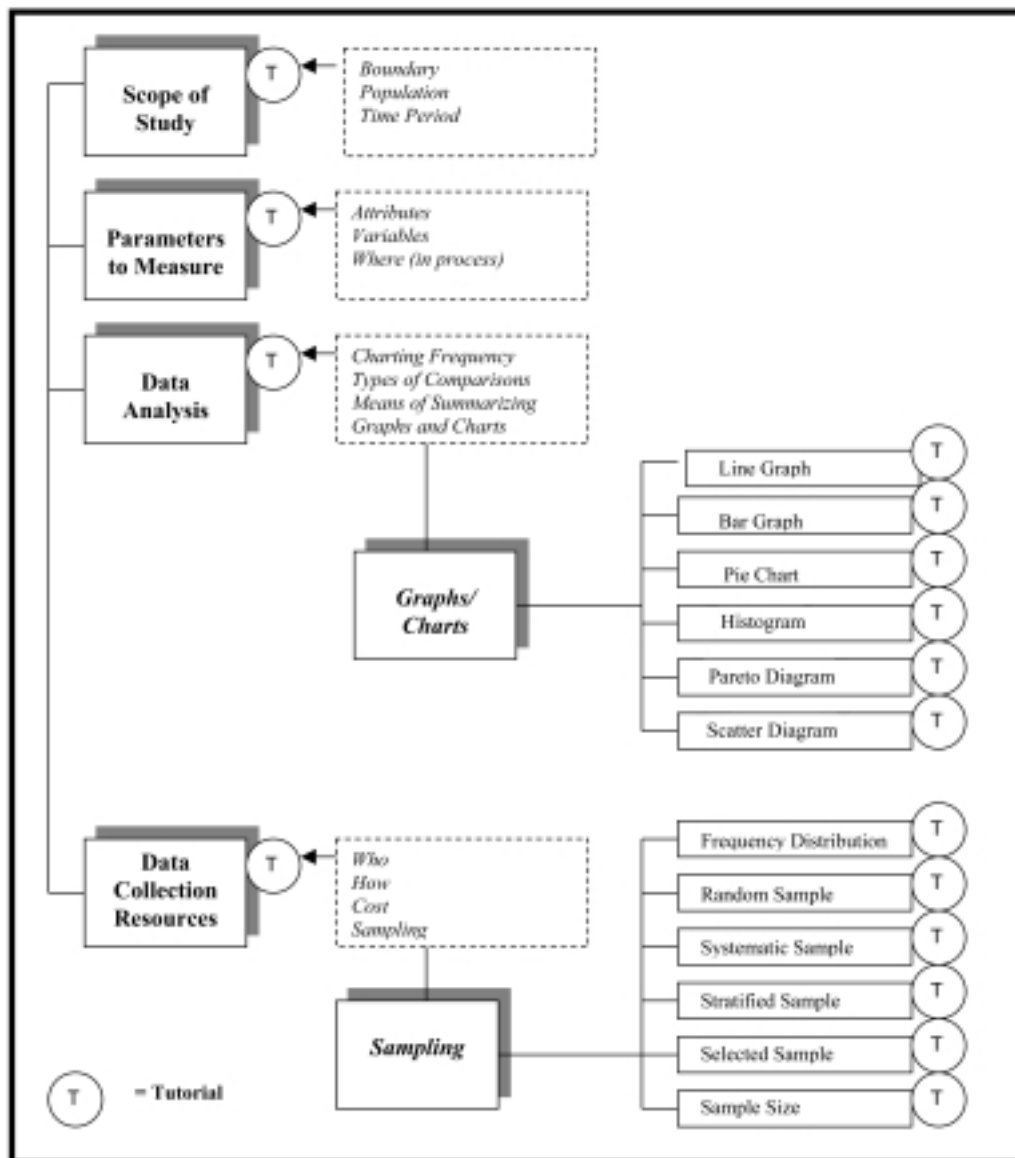


Figure 4. Logical model—planning for data collection.

Step 3. Determine what to measure

In this step, teams select measures. From interviews with field experts we learned that in selecting measures teams need to consider customer requirements, managerial requirements and industry regulations. Ideally these would be embodied in the unit's operational plan although this was not always done in practice or the influences were not evident. In our Logical Model, customer expectations are identified in the previous step (Step 2). Managerial expectations are set out in tactical plans, business plans, and service briefs, and regulations are set out in various publications. Many writers in the literature on quality restrict consideration to the requirements of customers, but our field participants agreed that the needs of management and compliance with regulations were also important.

In addition to providing information on the determinants of measures, advice is given on the characteristics of good measures with examples of how to operationalize generic measures. For example, 'promptness' may be important to customers and thus needs to be defined in a way in which it can be both measured and tracked, such as target values for wait times, product delivery times, conflict resolution times, etc. These characteristics were synthesized from the literature on quality management (see, for example, Case & Bigelow, 1992, Tenner & Detoro, 1992).

Step 4. Set standards

The setting of goals or standards for measures is the next important step following the decision of what to measure. Not surprisingly, data for setting standards come from the same sources that determine what to measure: customer expectations, management expectations, and regulations. In addition, some data can be obtained from industry norms. In the Logical Model we show these four sources of standard setting as topics in the tutorial at this step.

Step 5. Measure performance

Once measures and standards have been identified and imposed, actual process output is measured. Teams are directed to the major sub-step on planning data collection, as shown in Fig. 4 and discussed later.

Step 6. Identify quality improvement opportunities

The final step in the process 'to identify quality improvement opportunities' is the listing of quality improvement opportunities resulting from the discrepancies found between customer requirements and process outputs. Most of the work is completed at this step. DATQUAL simply reminds users of the steps they have completed and asks them to list all areas in which the measures of actual performance (Step 5) do not meet standards (Step 4). Since the standards in Step 4 are strongly influenced by customer expectations this amounts to identifying the areas in which the unit's performance is not meeting or exceeding customer expectations.

Data preparation

As might be expected, planning data collection is a major activity in any data-driven approach to problem solving. In DATQUAL, the two steps that most require expertise in data collection are Step 2, Identifying customer needs, and Step 5, Measuring performance. The logical

model for DATQUAL shows that from these steps a user can access a sub-step or module on planning data collection. Because this sub-step is quite detailed it is shown separately in Fig. 4.

The structure of the data collection sub-step is based on a data definition process used in Boeing's Fabrication Division and reported by Munoz & Nielsen (1991). Boeing's data definition process was developed for monitoring output and process performance. Since DATQUAL supports the quality improvement process at the operational level, the Boeing data definition process was considered relevant to our task domain. The detail we provide within this sub-step is our synthesis of a variety of sources including best practices in the field organizations, recommendations of ISO 9000, and recognized experts in the literature (Churchill, 1987; Harrington, 1991; Ishikawa, 1982).

The data definition process focuses on four aspects of data collection: scope of the study, parameters to measure, data analysis requirements, and data collection resources. These are shown in the left vertical column of Fig. 4. DATQUAL provides support on each of these aspects of data collection and on graphing and sampling, as described next.

Scope of the study

In this sub-step, the team defines the limits of the study by defining the physical or process boundaries, the population of interest, and the time limit for the study. These are common considerations in setting boundaries for any experimental study. In the Scope of Study support module, we briefly define each term and give several examples to clarify each concept. For example, DATQUAL users are told to set boundaries for their study by selecting beginning (input specification) and ending points (output specification) within the process of interest. One of the examples given is the setting of boundaries for a study of a loan approval process: 'The personal loan approval process begins with the arrival of the application forms at the loan center (input) and ends with the transfer of files to Housing Loans Division (output).' The concepts of populations and setting time periods are similarly explained through easy to understand examples.

Parameters to measure

In this sub-step, teams select the attributes and variables to be measured and stipulate where in the process they will be measured. In the banks we visited we found quality improvement teams collected 'attribute' data almost exclusively, thereby excluding some of the rich information that can be obtained from 'variables' data. In the Parameters to Measure support module, we define attribute and variables data and give several examples of each. For example, DATQUAL users are told that attribute data consist of counts of items generally in situations where the answer is of the form yes/no or accept-reject. The difference between counting defective items (how many forms contain errors) and counting defects (how many errors are there on each form) is explained. Examples of attribute data ('was the phone answered in time', 'was the temperature within limits for this period' and 'what percentage of forms contained errors') were deliberately constructed to contrast with the examples presented later for variables data ('time taken to answer the phone', 'temperature in the room' and 'cost of correcting forms').

In this sub-step, advice is also given on where in the process to collect data. This module offers the common wisdom of measuring 'as close as possible to the activity of interest,' but also presents specific recommendations extracted from the broad literature on manufacturing

quality; for example, fail-points, critical activities, irrecoverable activities, cover-up activities, bottlenecks, costly activities, and process changeover points.

Data analysis

In this sub-step, teams determine their data analysis needs with respect to charting frequency, types of comparisons to be made, means of summarizing data, and types of graphs and charts to use. These are important decisions because they will impact other decisions about the types of data to collect and the manner in which to collect them. In the Data Analysis support module, we provide several examples of comparisons that could be made. Examples include comparisons over time (trend analysis), comparisons before and after interventions, comparisons by time periods such as time of day, comparisons by type (customer, query, transaction, form), comparisons by staff group, and comparisons by location. When explaining ways to summarize data we include discussion of standard statistical measures, such as the mean, median, range, variance, and standard deviation as well as measures such as percentages, cumulative frequencies, and statistical process control limits.

In this support module, we recommend graphing or charting as a way to show relationships, patterns, or trends visually, so that data can be more readily understood and interpreted. In the DATQUAL support module on graphing we discuss the general characteristics of good graphs, such as titles, labelled axes, use of legends, notes on charts, etc. We also present individual support modules on charts commonly used in quality improvement, including line graphs, bar graphs, pie charts, histograms, Pareto charts, and scatter diagrams. In DATQUAL, the tutorial for each chart or graph gives a brief description of the chart, including the situations in which it is useful, notes on how to construct the graph including a final list of check points, and a note on how to interpret the chart.

Data collection resources

In this sub-step, teams define the resource requirements of their study in terms of people, equipment, money and time. DATQUAL gives advice on determining who should collect data and how the data should be collected to assist ease and accuracy of data collection and subsequent analysis. In this step, the issue of sampling is addressed. DATQUAL users can opt to read mini-tutorials on frequency distributions or review any one of several sampling techniques commonly used in surveys including random samples, systematic samples, stratified samples, and selected samples. Detailed support on sampling is beyond the scope of the current computer implementation but is an area worthy of further research and development.

The Logical Model presented in Figs 3 and 4 captures the basic knowledge-base and modular structure of the DATQUAL computer implementation. The next section describes that implementation.

DATQUAL implementation environment

The system chosen to meet the requirements of DATQUAL was LEVEL5 OBJECT 3.0 supplied by Information Builders, Inc. LEVEL5 OBJECT is a high-level development environment providing object-oriented programming, logic capabilities, and database access. Development in this environment is aided by the provision of graphical display builders, editors, and debugging tools. Compiled, run-only applications are available to run under Microsoft Windows.

DATQUAL operates somewhat like a hypertext implementation. Indeed, hyper-regions

underlying onscreen text provide the means of connecting and activating displays in DATQUAL. An important difference is that in our application we leave the previous steps and sub-steps displayed on the side of the screen (see Figs 5–8). Hypertext applications can cause novice users to become lost in a maze of screens. We wanted our users to retain a ‘sense of place’ within a consultation session. By leaving step selections visible on the side of the screen we gave users a record of the step history, a sense of place within the application, and the ability to go back to previous steps or sub-steps easily. More importantly, a concurrent display of step and sub-step breakdowns assists users in creating a mental model of the data-driven quality improvement process. This was one of our intended system objectives.

The current version of DATQUAL was developed primarily for proof of concept and assessment of the validity of the knowledge-base that directs the user’s learning process.

The prototype had been installed on PCs in the offices of the field study participants for demonstration and testing purposes. The responses have been very favourable. The feedback confirms the system captures the essence of the quality improvement process and provides a systematic problem-solving process to guide service workers in identifying quality improvement opportunities. After further development through Phase 2, the system will be ready to be placed on the company Intranet so workers will have the opportunity to use it as part of their e-learning initiative.

A sample scenario

In all service industries, operational-level workers often have direct customer contact. Customer satisfaction with both the product and the level of service provided has a direct impact on the success of the firm. The challenge of providing customer satisfaction is made more difficult by the high turnover of front-line employees because of promotion or attrition. Thus, the provision of an online, flexible application to assist operational workers in understanding how to identify quality improvement opportunities could greatly benefit just about any type of service organization. We will present an abbreviated scenario from one of the banks in our field studies to demonstrate the use of DATQUAL. However, the type of customer contact service described is applicable to any service industry concerned with improving customer service.

The bank tellers at Bank H are initially trained to handle typical bank transactions. In addition, they are responsible for understanding the processes involved in the provision of customer service and improving those processes. They are required to provide reports using data to describe process performance relative to guidelines outlined in the operational plan and share insights from their quality improvement efforts.

The tellers have been given cursory training in accessing DATQUAL through the bank’s Intranet and are expected to use the system on both an as-needed basis and when convenient for training purposes. In addition, they are encouraged to share their lessons learned through electronic focus groups, bulletin boards, and chat rooms.

A new teller at Bank H has been told that, because customers do not like to wait very long in line, one important operational target for customer service is to process customers quickly. The teller recognizes, however, that even though the lines are kept short, customers seem rushed and dissatisfied with this level of service. She doesn’t know if her hunch is correct but believes this is one area of customer service that may need improvement. When using DATQUAL for the first time a few initial screens will appear to welcome her and explain how to navigate through the system.

Because she is new to the system, the teller decides to go through all the modules to gain a better understanding of the process she needs to internalize in order to recognize

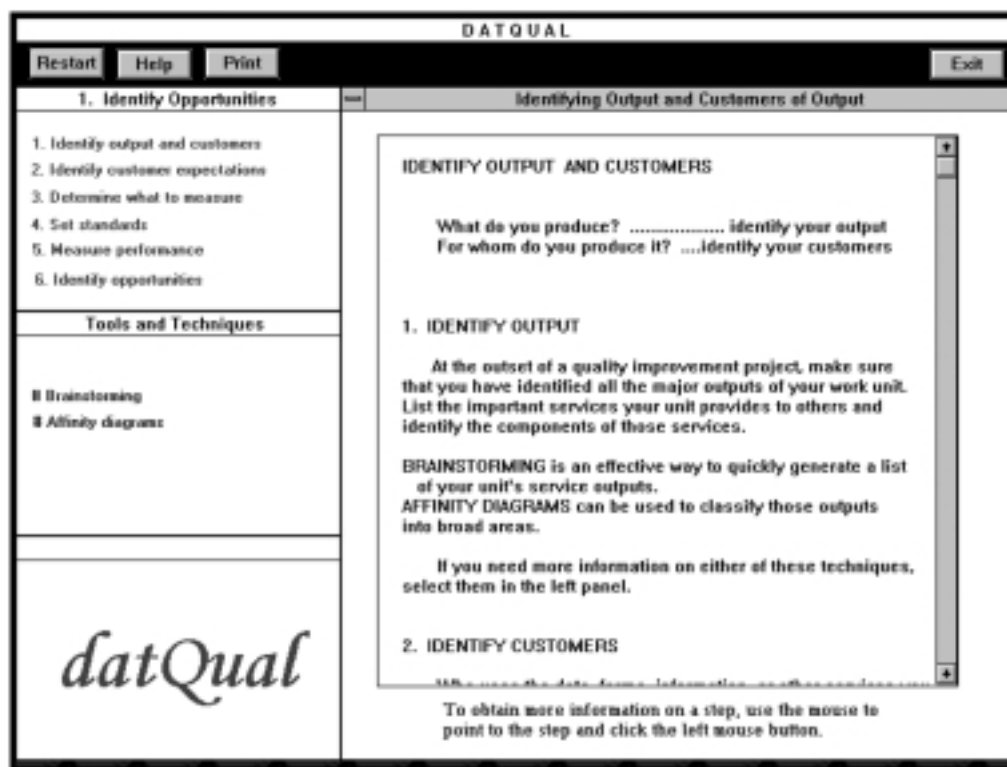


Figure 5. Identifying output and customers.

quality improvement opportunities. Figure 5 depicts part of the screen that will guide her through the process of identifying output and customers along with the tools needed to do so (brainstorming and affinity diagrams). For now she decides to skip to the next step since she is mainly concerned with finding out how she can test her hunch that maintaining short wait lines is not enough to satisfy customers.

The next screen (Fig. 6) helps her understand how to collect data to identify what customers expect from the teller service. She selects option (a) 'Asking external customers' from Determining Needs and is presented with the tutorial in Fig. 7. She learns about the benefits and requirements of focus group interviews, surveys and comment cards and decides to take the system's suggestion to discuss what to do next with her supervisor.

Her supervisor thinks she is on to something and suggests she learn more about comment cards from DATQUAL and then design a comment card to exchange with her customers to gain feedback on their level of satisfaction with the teller service. Surprisingly, nearly all of her customers over the next couple of weeks completed the cards because the questions were direct and short and required very little time and effort.

After some time using DATQUAL to learn about the process of collecting data from actual customers and comparing their service expectations to the actual service provided by the bank, her hunch was confirmed. The majority of customers were pleased they do not have to wait in long lines, however, they thought the tellers did not take sufficient time to answer their questions and, because they seem rushed, were not very pleasant or helpful.

The entire teller team realized that minimizing wait times, although important, was not

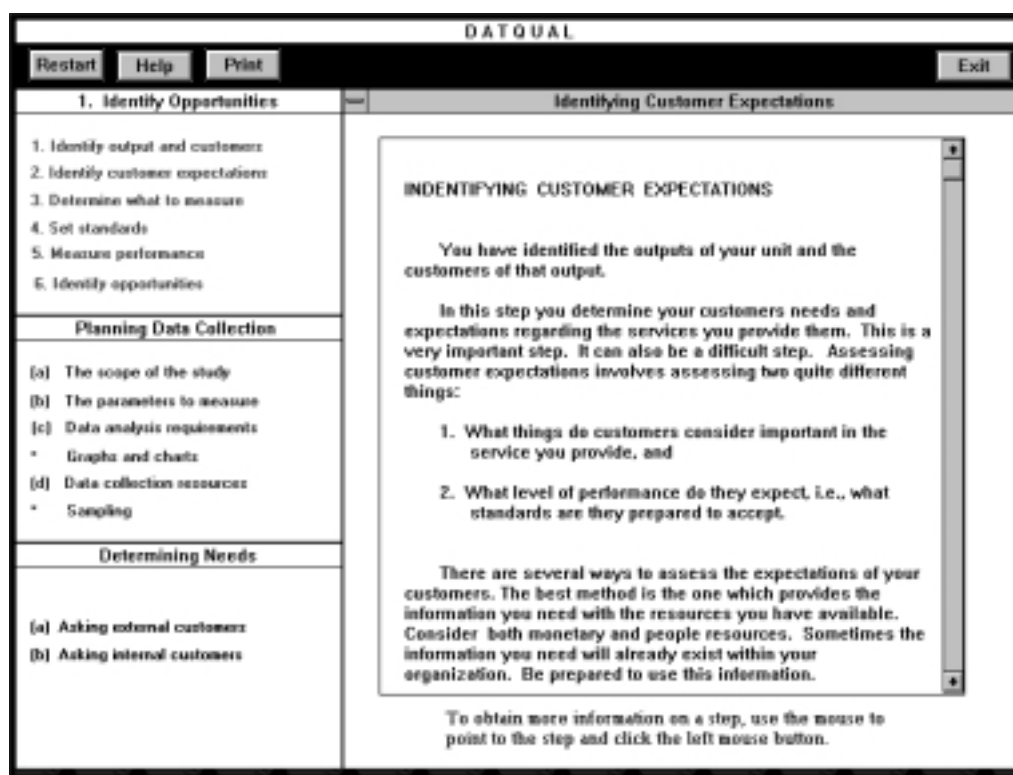


Figure 6. Identifying customer expectations.

the sole determinant of customer satisfaction with teller service. They communicated their discovery to the operational managers and to other divisions and branches through the bank's Intranet bulletin board. Tellers at other divisions used DATQUAL to learn how to collect and graph data about service times. First they used DATQUAL to learn how to construct good graphs and charts. The process improvement team decided a histogram would be a good starting point to view the distribution of service times at various branches of the bank. They queried DATQUAL to learn how to construct a histogram. Figure 8 depicts a partial DATQUAL screen for this activity.

After applying several of the tools learned using DATQUAL, a team jointly revised the teller process to be more flexible so the tellers could both minimize wait times *and* take the time necessary to answer customer questions to provide an exceptional level of service. The process improvement team learned how to do a follow-up study using DATQUAL, from which the follow-up data indicated that not only were customers more satisfied with their service, but the tellers enjoyed interacting with customers in a friendly and non-rushed manner.

By having access to DATQUAL through the bank's Intranet, the new teller was able to begin to understand the questions she needed to ask and how to use the necessary tools to systematically identify quality improvement opportunities. Every situation poses a unique challenge, however, and each time she uses DATQUAL she learns something new and gradually begins to internalize the quality improvement process.

Even though this example may appear to be common sense, as the bank realized,

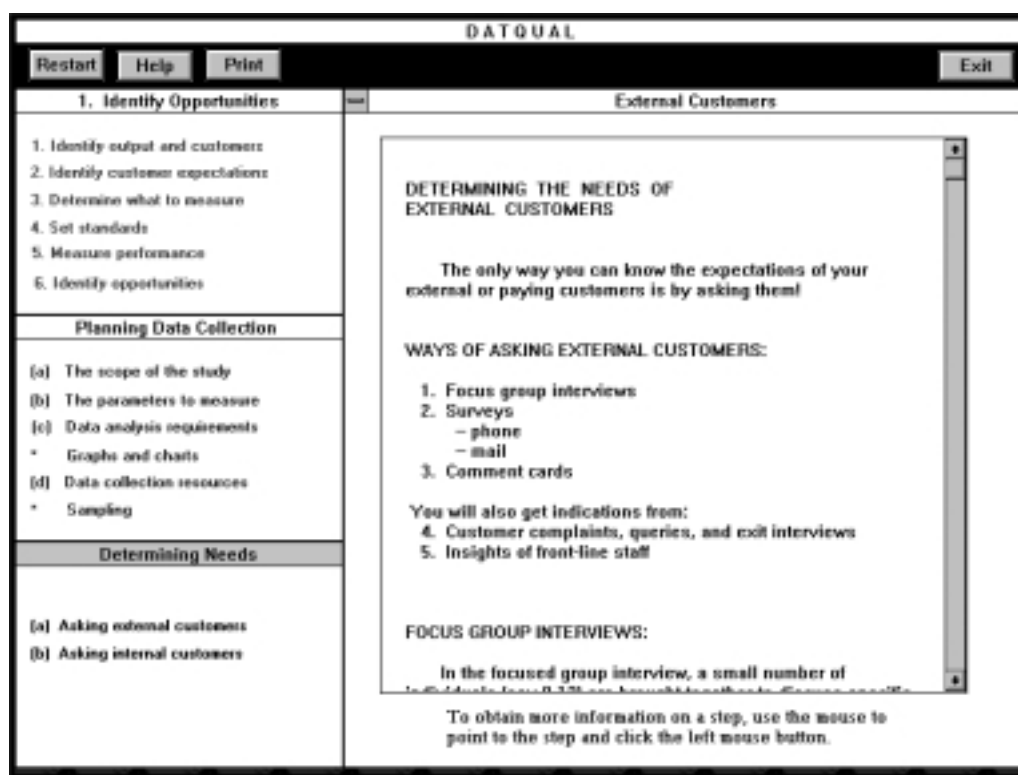


Figure 7. Determining the needs of external customers.

common sense is not always common practice. The lesson learned was an important one for all service industries and the subsequent process improvements illustrate an example of 'best practices' that can be stored in the bank's knowledge management repository and distributed throughout the enterprise.

DATQUAL: future developments

The potential task domain for an e-learning application in service quality improvement is very broad. We defined one aspect with an application to provide a systematic problem solving process for service workers. Future developments will extend the domain to include the steps required once opportunities have been identified. These were determined during the field studies and referenced as Phase 2 of our Conceptual Model. Figure 9 outlines this phase of the Conceptual Model, which will be used to develop the necessary Logical Model and extensions to the knowledge-base of DATQUAL. As Fig. 9 illustrates, this phase in quality improvement involves identifying the causes of process problems, making changes to processes, monitoring the changed processes, and measuring output to ensure improvements have in fact been realized.

A system such as DATQUAL, which is accessible through a firm's Intranet, has the added ability to collect feedback from the firm's users to update and improve the application on a continuous basis. In addition, the networked use of such a system will standardize

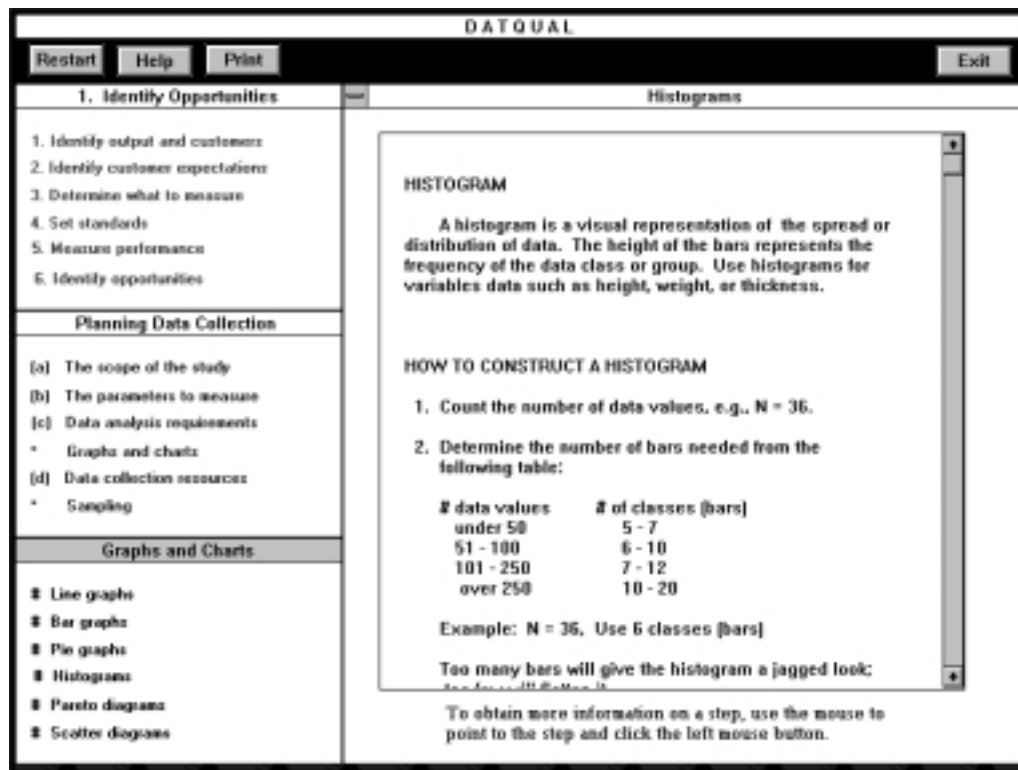


Figure 8. Constructing histograms.

learning content across an enterprise and encourage peer interaction through electronic links to the system.

Summary

E-learning is an important component of e-commerce. For e-learning to be successful the content must be tied to the strategic knowledge requirements of a firm and the presentation must engage the users by being interactive, providing opportunities for both repetition and practice. There is a need for organizations to develop applications that permit participants to acquire knowledge, pass it from one person to another, apply it to organizational problems/opportunities, and store that knowledge for future use. We have demonstrated an application critical to the success of any quality improvement system: an application that encourages the learning of a systematic, data-driven, problem-solving process and the tools required for collecting and using data effectively for continuous quality improvement in service industries. Our prototype system, DATQUAL, evolved as a result of a systematic development process involving field studies with banks and model validation from a variety of service industries, such as hotels, car dealerships, medical facilities, and the military. Delivering DATQUAL through a firm's Intranet guarantees a level of uniformity of content and process knowledge and encourages cooperation across the enterprise. DATQUAL illustrates one type of e-learning application that is capable of providing just-in-time learning for service workers involved in continuous quality improvement.

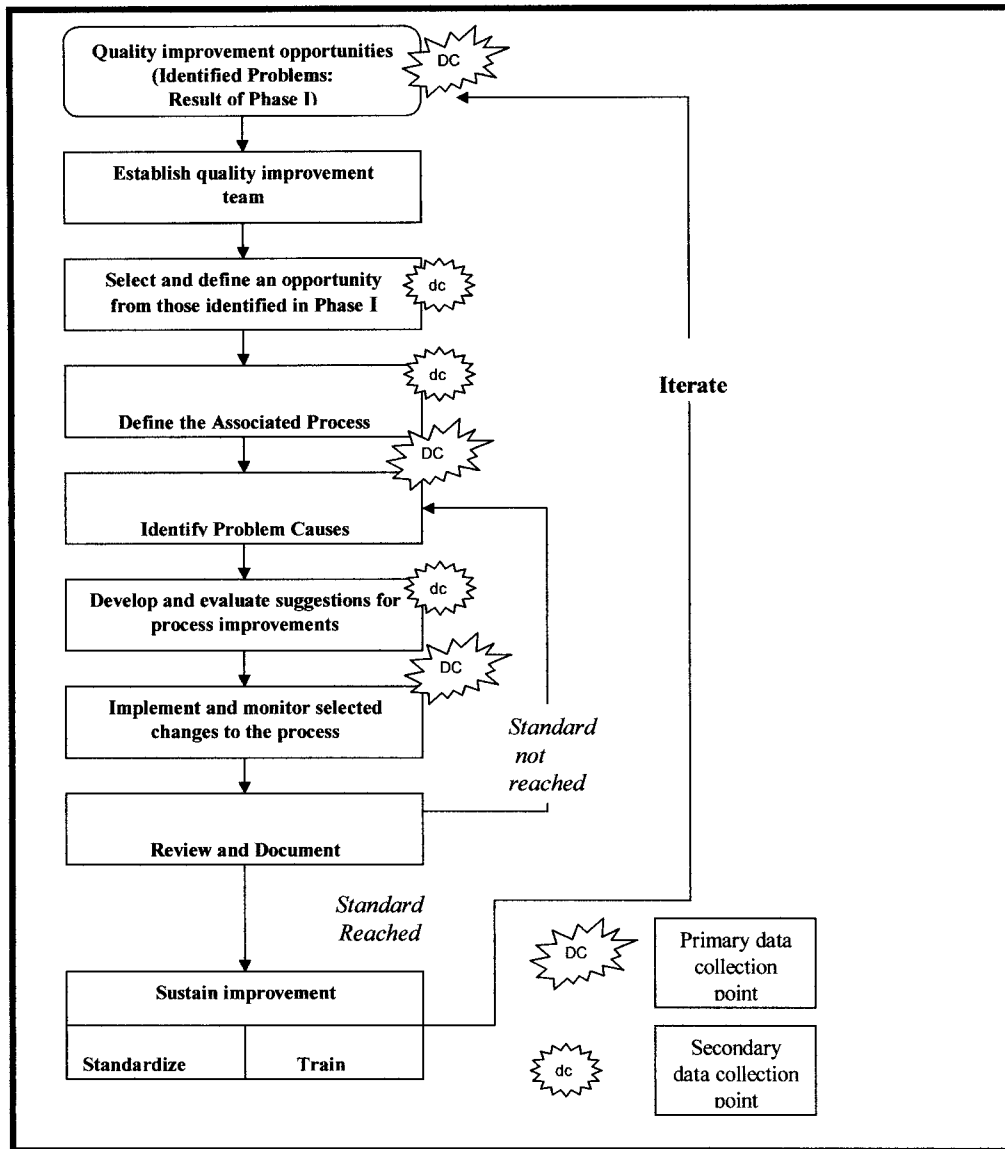


Figure 9. Conceptual model, phase 2 activities following the identification of quality improvement opportunities.

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