Creating a Business Process Diagram and
Database Queries to Detect Billing Errors
and Analyze Calling Patterns for
Cell Phone Service

A. Faye Borthick
Georgia State University

Donald R. Jones
Texas Tech University

ABSTRACT: In this case, students develop a business process diagram to understand
the business situation and create database queries to detect billing discrepancies and
manage costs for corporate cell phone service. Using a database query tool or audit
software, students query a database with tables for call details, invoices, invoice de-
tails, plan rates, and users on plan. The queries are representative of those that ac-
countants could develop to analyze transaction-level data to detect errors and develop
insights about business operations. Query-based approaches to analyzing transaction
data can enable businesses to make sense of their operations and ensure that they
and their trading partners comply with their mutual agreements. The case is appropriate
for students with rudimentary database querying proficiency, e.g., at the level devel-
oped by Borthick et al.'s (2001) case on assuring compliance for responses to website
referrals. No auditing expertise is needed. The case is appropriate for database analysis
in accounting systems courses, compliance auditing in auditing courses, and cost anal-
ysis in managerial courses. The database is supplied in the form of a Microsoft Access®
database.

Keywords: auditing with databases; business process modeling; compliance auditing;
cost analysis; database querying; query strategy; queries.

I. INTRODUCTION
Querying to Verify Compliance and Analyze Costs

The existence of databases with transaction data generated about business operations
sets up the expectation that accountants will be able to tap their potential in assuring
compliance and developing insights for improving operations (Borthick 1992; McKinnon
and Bruns 1992; Klamm and Weidenmier 2005). In reality, achieving these hoped-for ben-
efits means querying the data (Speier and Morris 2003). These expectations are reflected
in the increasing demand for analytical and querying skills in audit and analysis situations
enabling productivity improvements through software use (Elliott 2002; McCollum 2002;

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comments.
Fennel 2003; Jackson 2004). This case supports the high-level objective of learning to query databases to solve business problems with the specific objectives of detecting errors to assure compliance and analyzing cost behavior to identify a less expensive alternative. In the process, students have an opportunity to improve their analysis skills as they use query or audit software.

Telecommunications billing, the general domain of the case, has been a persistent source of frustration to managers. The billing is complicated, incorrect billing is common, and telecommunication carriers offer new plans frequently. In this environment, managers wonder if their billing contains errors or if they have optimized their plans from the choices available to them (Alstar 2004; Bannan 2004; May 2004). Consequently, audits of telecommunications billing have become a staple of internal audit groups (Oliven et al. 2003). The volume of auditing of telecommunications billing, coupled with inherent complexity and the perception of potentially large gains, has enabled telecom-expense management firms to flourish (Alstar 2004). The industry-specific terminology and practices are extensive enough to warrant book-length coverage of general approaches to auditing telecommunications billing (Mastel 2003).

The specific context for the case, one manager’s frustration with a monthly bill for wireless telephone service, is enabled through a conversation about the situation, a presentation of contract terms in effect, and a database with tables containing call details, invoices, invoice details, plan rates, and users on plan. Students analyze transaction-level data to detect billing errors by the wireless carrier and to develop insights for reducing wireless telephone costs.

Learning Objectives

The high-level objective for the case is to learn to query databases to solve business problems. The specific learning objectives are for students to learn to (1) prepare a business process diagram, (2) specify potential kinds of errors, (3) query the database to determine the extent to which the errors occurred, (4) identify cost-reducing opportunities, (5) and query the database to determine which alternative would likely be the most advantageous given the usage history. In the first objective, learners construct a business process diagram (BPD) (BPMI 2004; White 2004), which ensures they understand the business processes before working with the database. The second and third objectives simulate a compliance problem, and the fourth and fifth, an optimization problem. These objectives operationalize learning objectives in the information use category (McKinnon and Bruns 1992; Borthick 1996) and illustrate accountants querying a database to provide information for compliance and management purposes (Borthick 1992; Speier and Morris 2003).

Learning Theory: Situation Model Building

The case instantiates the theory of situation model building, according to which constructing one’s own mental situation models constitutes the best preparation for situated action (Zwaan and Radvansky 1998; Barsalou 1999). With respect to this case, the situated action is performance in a novel situation requiring analysis and querying skills. To construct their own situation models, learners make inferences and elaborations as they encounter new information in the situation. From this viewpoint, successful comprehension of a problem is synonymous with constructing a coherent situation model representing it (Johnson-Laird 1983; van Dijk and Kintsch 1983; Gernsbacher 1997; Graesser et al. 1997; Zwaan and Radvansky 1998).

Situations that are easy to understand do not prompt the inferences and elaborations leading to construction of robust situation models (Myers et al. 1987). When a situation is
straightforward, the ease of comprehension comes at the expense of model building. Because easy comprehension does not prompt elaborations or inferences, the subsequent value in having experienced the situation is low (Gernsbacher 1997; Zwaan and Radvansky 1998).

The case was designed to prompt learners to make the substantial inferences and elaborations required to make sense of a business situation. Preparing the business process diagram (BPD) ensures that students make their understanding of the situation explicit, which enables its completeness and correctness to be assessed, which permits them to refine their process skills. Modeling the process ensures that learners think through (1) the sources and purposes of the data files, (2) the decisions and actions vested with different participants, and (3) the timing of participants’ actions in relation to other participants’ actions. Understanding these matters requires insights that come one at a time as learners integrate knowledge from the conversation, the data tables, and other materials into their existing situation models (Gernsbacher 1997; Zwaan and Radvansky 1998). Although experienced business people make these kinds of inferences almost automatically, inexperienced business people, e.g., learners in classroom settings, tend to miss important relationships. The inferences and elaborations are subtle, but they represent the kinds of situation model updating required to make sense of a business situation and develop insights about it. Making the process explicit in a BPD helps learners develop skill in making sense of business situations.

**Prerequisite Skills**

To work the case, students need to have attained rudimentary database querying proficiency defined as the ability to join tables, build expressions, use built-in functions, apply the Group By operator, format and sort results, and name, save, and retrieve queries. A case that develops these skills is Borthick et al.’s (2001) case on assuring compliance for responses to website referrals. Table 1 compares this case and the ones in Borthick et al. (2001) and Borthick and Jones (2005).

Completing this case does not require prior database design training or experience. The case affords students an opportunity to experience the usefulness of data querying without first having invested significant time learning to design databases. We have observed students absorbing database design principles vicariously through the case without explicit study, which prepares them for more intensive study of database theory. The case can also be used to motivate the need to develop database-modeling skills.

**Case Design Rationale**

The database for the case was designed with just enough tables and attributes to represent the situation but without the overwhelming detail customary in wireless billing to organizations. Unlike Borthick et al.’s (2001) web referral case but like Borthick and Jones’ (2005) warranty call center case, the tables in this case have too much data for hand manipulation of records. Consistent with the practice of telecom carriers providing flat files of call and invoice data to customers that request them, the tables with data from the carrier show only a line number (ID field) as the primary key. The absence of semantically based keys sets up a situation in which students need to make explicit their choices of how to link attributes in queries.

In Part 1, learners (1) prepare a business process diagram (BPD), (2) specify potential kinds of errors, (3) query the database to determine the extent to which the errors occurred, (4) identify cost-reducing opportunities, and (5) query the database to determine which alternative would be the most advantageous given usage history. In Part 2, learners respond to multiple-choice questions whose learning objectives appear in Table 2.
TABLE 1
Comparison of Cases: Web Referral, Warranty Call Center, and Wireless Billing

|----------------------------------|-------------------------------------------|-----------------------------------------------------|-----------------------|
| Learning objectives              | 1. Decide what information would be relevant to solving a business problem  
                                    2. Extract the needed information  
                                    3. Put the information in a form conducive to solving the problem  
                                    4. Analyze the information to solve the problem.  
| for business problem solving     |                                           | 1. Identify risks in a business situation  
                                    2. Decide which risks can be investigated with transactional data in an operational database  
                                    3. Query the database to determine the extent to which the risks were realized, and characterize the risks for which the database lacks relevant information.  
|                                  |                                           | 1. Model the business process  
                                    2. Specify potential kinds of errors  
                                    3. Query the database to find errors  
                                    4. Identify cost-reducing opportunities  
                                    5. Query the database to determine the best alternative.  
| Learning objectives              | Recognize the need for and perform the following query operations:  
                                    1. Join tables; select attributes  
                                    2. Build expressions  
                                    3. Use built-in functions  
                                    4. Apply the Group By operator  
                                    5. Format and sort results  
                                    6. Name, save, and retrieve queries  
| for query proficiency            |                                           | Questions about:  
                                    1. The business problem  
                                    2. Query strategy  
                                    3. Querying by keystroke.  
|                                  |                                           | Full-text solution for:  
                                    1. The business problem  
                                    2. Query strategy  
| Learner scaffolding possibilities| Questions about:  
                                    1. The business problem  
                                    2. Query strategy  
                                    3. Querying by keystroke  
|                                  |                                           | Full-text solution for:  
                                    1. The business problem  
                                    2. Query strategy  
|                                  |                                           | Full-text solution for:  
                                    1. Business process diagram  
                                    2. The business problem  
                                    3. Query strategy  
| Prerequisite:                   | None                                      | Ability to recognize the need for and to perform the following query operations:  
                                    1. Join tables; select attributes  
                                    2. Build expressions  
                                    3. Use built-in functions  
                                    4. Apply the Group By operator  
                                    5. Format and sort results  
                                    6. Name, save, and retrieve queries.  
| Query proficiency               |                                           | Questions about:  
                                    1. The business problem  
                                    2. Query strategy  
| Data volume                      | Minimal: Small enough to permit hand verification of results  
                                    | Moderate: Large enough to preclude hand verification of results  
| Objective assessment             | 10 multiple-choice questions              | 20 multiple-choice questions  
                                    | 25 multiple-choice questions; 5 practice questions  

(continued on next page)
TABLE 1 (continued)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Course suitability</td>
<td>Any undergraduate or graduate course with an objective of developing rudimentary query skills in which students: 1. Have no query experience or 2. Need to refresh query proficiency</td>
<td>Any undergraduate or graduate course with an objective of increasing query competence and independence in which students: 1. Have rudimentary query skills</td>
<td>4–12 hours depending on existing skills</td>
</tr>
<tr>
<td>Time</td>
<td>2–6 hours depending on existing skills</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[^a\] Attributes for Borthick et al. (2001) and Borthick and Jones (2005) from Borthick and Jones (2005), Table 1.

TABLE 2
Objective Assessment of Learning Objectives

<table>
<thead>
<tr>
<th>Learning Objective</th>
<th>Question</th>
<th>Problem Strategy</th>
<th>Query Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow business processes</td>
<td>1-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locate relevant information in tables</td>
<td>P3,^a P4, 6, 7, 8, 13</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Plan and sequence individual queries</td>
<td>P5, 9, 10, 12, 14, 18</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Interpret query results</td>
<td>P1, 15, 16, 20, 21</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Debug queries</td>
<td>17, 19</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Constructing queries</td>
<td>P2, 11, 22, 23, 25</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Decide relevancy of database</td>
<td>24</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

\[^a\] “P” in a question number designates a practice question.

Reaction to the Case

From Faculty

Faculty members’ reactions to the case have been uniformly positive, to the point of saying they intended to use the case. One faculty member observed that accountants regularly generate ad hoc reports and that the primary approach is to use relational database queries to extract the data and prepare reports that respond to decision makers’ information needs. Thus, because it affords students an opportunity to develop the skills needed to respond to ad hoc information needs, the case was a welcome addition to the case literature. As another faculty member noted, cases that provide extensive tables for developing querying skill are hard to find. One faculty member specifically commented that the case addresses an unmet need in the curriculum, i.e., developing student expertise in using databases to solve accounting problems.

Another faculty member commented that the comprehensiveness of the case was important because not many cases are available that combine analyzing a business situation, planning a strategy for investigating the situation, and querying a database to make sense of the data. Similarly, a faculty member praised the use of business process modeling as a
means of ensuring that students really did understand the situation before starting to solve
the problem. Another faculty member liked the fact that students have to figure out query
strategies and develop queries to implement them; that is, rather than following someone
else’s directions, students have to think. One instructor observed students being initially
perplexed at having only open-ended questions. After allowing students to struggle for a
class period, the instructor gave some guidance in the form of thought questions, which
enabled even the most confused students to move in productive directions.

Several faculty members thought the multiple-choice questions were especially helpful
because they believed they would be instrumental in prompting students to think deeply
about the situation, guiding them in making sense of the situation, mapping data relation-
ships to the business situation, identifying query objectives, and formulating queries. Faculty
members also commented that the explanations for the multiple-choice questions were
valuable because they revealed the logic for evaluating each choice, which would decrease
instructors’ preparation time.

From Students

Instructors using the case observed that students were fascinated by the authenticity of
the case and were actively engaged in problem solving. One student remarked, “This is
just like my cell phone plan!” Students are intrigued enough by the possibility of billing
errors to be tenacious in looking for them. They have a harder time with the querying for
evaluating competing plans than for detecting billing errors. A likely reason for this is that
the fixed and flexible plans do not require the same attributes, and some thought is required
to reorganize plan terms into a compatible data structure. Students indicated that working
the case developed their confidence in their ability to query databases to solve business
problems.

II. THE CASE

The Business Situation

Grenoir (telecommunications manager): “I’ve had it! I’m just going to accept the cell phone
service bills as the carrier submits them and not worry about billing errors. For all I know,
the carrier may be billing weekend minutes as plan minutes.”

Broell (internal audit director): “What a cop out! How are you going to contain wireless
costs if you don’t even look at them? Fat chance you’d get to hire a telecom audit specialist
like Traq-wireless or TelSoft Solutions.”

Grenoir: “By being creative! Didn’t you say you just hired some new accounting graduates
skilled at database querying” par excellence?”

Broell: “Well, yes, although I don’t know anything about their querying skills yet. Um...I
bet I can tell where this is going.”

Grenoir: “This would be a perfect project for them while they get familiar with our business
processes.”

Broell: “Can’t argue that logic. How much of an audit did you have in mind?”

Grenoir: “Just enough to find billing discrepancies and give me guidance about assigning
plan terms to users when the contracts [Figure 1] roll over at the next two-year anniversary.

1 TRAQ, a provider of management services for wireless-enabled devices, site at http://www.traq.com/. TelSoft
Solutions, a provider of call accounting, billing and telecom cost management services, site at http://
www.telesoft-solutions.com/.
ClearNet Business Plans
ClearNet Plans for Business ensure that your employees stay connected to key business people while working away from the office. They can use their minutes to call anywhere, anytime on ClearNet.

Fixed Plan: Contract 0350214 as of April 1, 2002

<table>
<thead>
<tr>
<th>Anytime minutes:</th>
<th>300</th>
<th>500</th>
<th>700</th>
<th>1100</th>
<th>1400</th>
<th>2000</th>
<th>2500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anytime minutes:</td>
<td>$35</td>
<td>$40</td>
<td>$50</td>
<td>$65</td>
<td>$80</td>
<td>$100</td>
<td>$115</td>
</tr>
<tr>
<td>Night and weekend minutes:</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Additional minutes, each:</td>
<td>$.50</td>
<td>$.45</td>
<td>$.40</td>
<td>$.35</td>
<td>$.30</td>
<td>$.25</td>
<td>$.20</td>
</tr>
</tbody>
</table>

- A minimum two-year contract is required
- A volume discount of 7 percent is available for contracts with 7 or more active users
- Night and Weekend Minutes can be used from Monday through Thursday 9pm to 7am and Friday 9pm to Monday 7am
- Rates are subject to all applicable taxes

Flexible Plan: Contract 0351827 as of April 1, 2004

ClearNet Flexible plan—an entirely new way to buy wireless. Every month your plan automatically adjusts to the minutes you use.

You no longer have to guess which plan is right for you, and you won’t pay costly overage charges or waste a lot of unused minutes. To see how your monthly charge would adjust, check out the chart below.

<table>
<thead>
<tr>
<th>Anytime Minutes:</th>
<th>0-300</th>
<th>301-600</th>
<th>601-900</th>
<th>901-1200</th>
<th>1201 and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your cost:</td>
<td>$35.00</td>
<td>$45.00</td>
<td>$60.00</td>
<td>$80.00</td>
<td>$80.00 plus $0.07 for each minute over 1200 minutes</td>
</tr>
</tbody>
</table>

- A minimum two-year contract is required
- Includes Unlimited Night and Weekend minutes
- Night and Weekend Minutes can be used from Monday through Thursday 9pm to 7am and Friday 9pm to Monday 7am
- Rates are subject to all applicable taxes

From what I read, I’m sure we’re over paying. The reports of erroneous billing just keep coming.”

Broell: “You know, this would be a good warm-up for them because they’ll be querying on the Schlumbeuber project in a week.”

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Grenoir: “Thanks! Send ‘em in. They don’t have a second to spare!”
Broell: “Just so they’ll have a starting point, I’ll give them an article about telecom auditing from The Internal Auditor.\textsuperscript{4} It explains some of the kinds of errors that show up in bills.”
Grenoir: “You are resourceful! I’ll owe you big time for this! Call detail and invoice data come from the carrier as flat files, which I’ll import into Microsoft Access\textsuperscript{®} for them. I should create data definitions [Figure 2] too. What else will they need?”
Broell: “If you want all their energy on analyzing rather than scrounging up data, be sure you include a table showing all the contract plan choices and a table with the calling plans that users are on now and the plans they have been on—a full history.”
Grenoir: “Thanks! I’d have forgotten that. I’ve got the user assignments in Excel\textsuperscript{®}, and I can create a plan rate table from the contracts [Figure 1]. I’m confident I submitted the right user assignments every time we began a new contract, but that doesn’t mean the carrier implemented them.”

**Required**

**Part 1: Analysis**

1. Model the business process by preparing a one-page business process diagram (BPD)\textsuperscript{5} for aspects of the cell phone billing processes that are revealed in the materials provided.
2. Respond to Grenoir’s need for analysis of information by querying the database and completing the report in Figure 3. As you consider the telecommunication manager’s situation, think through the following questions:
   a. To what extent does the billing comply with the rate plans in effect?
   b. Given the existing contract terms and current call usage, are users assigned to the least expensive plan terms?

**Part 2: Practice Objective Questions**

The following questions are for student practice in answering objective questions. Alternatively, these questions could be combined with the objective questions for assessment purposes.

P1. If callDetail.time values were accurate, the presence of minutes occurring after 9 PM on Saturdays in the planMinUsed attribute would be associated with:
   a. Cell phone users abusing their privileges
   b. Potentially understated charges
   c. Potentially overstated charges
   d. Neither understated nor overstated charges

P2. Suppose the callDetail table is available in a query and that its time values are accurate. The query that would reveal night/weekend minutes being billed as plan minutes would be:

\textsuperscript{4} Oliven et al. 2003. Plugging the telecom cash drain. The Internal Auditor (February): 46–51.
\textsuperscript{5} For BPD conventions, see White, S. A. 2004. Introduction to BPMN. Aurora, CO: BPMI. Available at: http://www.bpmi.org/downloads/Introduction_to_BPMN89.pdf.
FIGURE 2
Data Attributes and Sample Data

Panel A: Data Attributes

<table>
<thead>
<tr>
<th>Table/Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>callDetail</strong></td>
<td>Details of calls billed in an invoice</td>
</tr>
<tr>
<td>ID</td>
<td>Unique identifier for a call</td>
</tr>
<tr>
<td>userID</td>
<td>Unique identifier for a cell phone user</td>
</tr>
<tr>
<td>date</td>
<td>Date of call</td>
</tr>
<tr>
<td>time</td>
<td>Time call begun</td>
</tr>
<tr>
<td>planMinUsed</td>
<td>Number of plan minutes used in the call</td>
</tr>
<tr>
<td>nghtWkndMin</td>
<td>Number of night and weekend minutes used in the call</td>
</tr>
<tr>
<td><strong>invoice</strong></td>
<td>Invoices from the wireless carrier</td>
</tr>
<tr>
<td>ID</td>
<td>Unique identifier for a row in the table</td>
</tr>
<tr>
<td>invoiceID</td>
<td>Unique identifier for an invoice</td>
</tr>
<tr>
<td>contractID</td>
<td>Unique identifier for a contract</td>
</tr>
<tr>
<td>invoiceTotal</td>
<td>Total amount billed for this ID and invoiceID</td>
</tr>
<tr>
<td>periodEnd</td>
<td>End of billing period</td>
</tr>
<tr>
<td><strong>invoiceLine</strong></td>
<td>Line item information for each invoice, multiple lines per invoice</td>
</tr>
<tr>
<td>ID</td>
<td>Unique identifier for a row in the table</td>
</tr>
<tr>
<td>invoiceID</td>
<td>Unique identifier for an invoice</td>
</tr>
<tr>
<td>contractID</td>
<td>Unique identifier for a contract</td>
</tr>
<tr>
<td>userID</td>
<td>Unique identifier for a cell phone user</td>
</tr>
<tr>
<td>monthlyAccess</td>
<td>Charge for monthly access to cell phone service for a user</td>
</tr>
<tr>
<td>planMinutesUsed</td>
<td>Total number of plan minutes used in billing period</td>
</tr>
<tr>
<td>minutesOverPlan</td>
<td>Number of minutes used over allocated number</td>
</tr>
<tr>
<td>minuteCharge</td>
<td>Charges due to minutes in excess of allocated minutes</td>
</tr>
<tr>
<td>subtotal</td>
<td>Total of monthlyAccess and minuteCharge</td>
</tr>
<tr>
<td>taxes</td>
<td>Taxes on the sum of monthlyAccess and minuteCharge</td>
</tr>
<tr>
<td>totalCharge</td>
<td>Sum of subtotal and taxes</td>
</tr>
<tr>
<td><strong>planRate</strong></td>
<td>Plan terms by contract</td>
</tr>
<tr>
<td>ID</td>
<td>Unique identifier for a row in the table</td>
</tr>
<tr>
<td>contractID</td>
<td>Unique identifier for a contract</td>
</tr>
<tr>
<td>initializeDate</td>
<td>Date contract begun</td>
</tr>
<tr>
<td>anytimeMinutes</td>
<td>Number of minutes paid for by the monthlyAccess charge</td>
</tr>
<tr>
<td>monthlyAccess</td>
<td>Charge for monthly access to cell phone service for a user</td>
</tr>
<tr>
<td>additionalMinutes</td>
<td>Cost per minute for minutes in excess of number of minutes in anytimeMinutes</td>
</tr>
<tr>
<td><strong>usersOnPlan</strong></td>
<td>Plan designations for users, from Grenoir’s records</td>
</tr>
<tr>
<td>ID</td>
<td>Unique identifier for a row in the table</td>
</tr>
<tr>
<td>contractID</td>
<td>Unique identifier for a contract</td>
</tr>
<tr>
<td>userID</td>
<td>Unique identifier for a cell phone user</td>
</tr>
<tr>
<td>startDate</td>
<td>Date user added to the contract</td>
</tr>
<tr>
<td>type</td>
<td>Type of plan: fixed or flexible</td>
</tr>
<tr>
<td>planMinutes</td>
<td>Number of minutes purchased with monthlyAccess charge</td>
</tr>
</tbody>
</table>

*Primary keys in bold.*
Panel B: Sample Data

Table: callDetail

<table>
<thead>
<tr>
<th>ID</th>
<th>userID</th>
<th>date</th>
<th>time</th>
<th>planMinUsed</th>
<th>nghtWkndMin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>678-541-4573</td>
<td>8/1/2004</td>
<td>1:30:00 PM</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>678-541-4573</td>
<td>8/2/2004</td>
<td>1:12:00 PM</td>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>

Table: invoice

<table>
<thead>
<tr>
<th>ID</th>
<th>invoiceID</th>
<th>contractID</th>
<th>invoiceTotal</th>
<th>periodEnd</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>520178369</td>
<td>350214</td>
<td>$475.49</td>
<td>8/31/2004</td>
</tr>
<tr>
<td>2</td>
<td>520178369</td>
<td>351827</td>
<td>$902.42</td>
<td>8/31/2004</td>
</tr>
</tbody>
</table>

Table: invoiceLine

<table>
<thead>
<tr>
<th>ID</th>
<th>invoiceID</th>
<th>contractID</th>
<th>userID</th>
<th>monthlyAccess</th>
<th>planMinutesUsed</th>
<th>minutesOverPlan</th>
<th>minuteCharge</th>
<th>subtotal</th>
<th>taxes</th>
<th>totalCharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>520178369</td>
<td>351827</td>
<td>678-541-4573</td>
<td>$50.00</td>
<td>1234</td>
<td>534</td>
<td>$213.60</td>
<td>$263.60</td>
<td>$44.81</td>
<td>$308.41</td>
</tr>
<tr>
<td>2</td>
<td>520178369</td>
<td>351827</td>
<td>678-541-4574</td>
<td>$65.00</td>
<td>1122</td>
<td>22</td>
<td>$7.70</td>
<td>$72.70</td>
<td>$12.36</td>
<td>$85.06</td>
</tr>
</tbody>
</table>

Table: planRate

<table>
<thead>
<tr>
<th>ID</th>
<th>contractID</th>
<th>initializeDate</th>
<th>anytimeMinutes</th>
<th>monthlyAccess</th>
<th>additionalMinutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>350214</td>
<td>4/1/2002</td>
<td>2500</td>
<td>$115.00</td>
<td>$0.20</td>
</tr>
<tr>
<td>2</td>
<td>350214</td>
<td>4/1/2002</td>
<td>2000</td>
<td>$100.00</td>
<td>$0.25</td>
</tr>
</tbody>
</table>

Table: usersOnPlan

<table>
<thead>
<tr>
<th>ID</th>
<th>contractID</th>
<th>userID</th>
<th>startDate</th>
<th>type</th>
<th>planMinutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>350214</td>
<td>678-541-4573</td>
<td>4/1/2002</td>
<td>fixed</td>
<td>700</td>
</tr>
<tr>
<td>7</td>
<td>351827</td>
<td>678-644-1397</td>
<td>4/1/2004</td>
<td>flexible</td>
<td></td>
</tr>
</tbody>
</table>
### FIGURE 3
Wireless Billing Report

<table>
<thead>
<tr>
<th>Query Objective</th>
<th>Results from Execution of Queries</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A succinct statement of the purpose of the query</td>
<td>For each query objective, give (1) the name(s) of the query(ies) that executes the query objective and (2) the query results.</td>
<td>Statement of a recommendation to Grenoir based on the query results</td>
</tr>
</tbody>
</table>

**Analysis of Billing Errors**

<table>
<thead>
<tr>
<th>#</th>
<th>Lesson</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>[add/delete rows as needed]</td>
<td></td>
</tr>
</tbody>
</table>

**Analysis of Plan Costs**

<table>
<thead>
<tr>
<th>#</th>
<th>Lesson</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>[add/delete rows as needed]</td>
<td></td>
</tr>
</tbody>
</table>

**Lessons Learned** (e.g., insights and strategies that could be applied in other analysis situations)

<table>
<thead>
<tr>
<th>#</th>
<th>Lesson</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>[add/delete rows as needed]</td>
<td></td>
</tr>
</tbody>
</table>

**Time Log (hours spent on this assignment)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Total Hours</th>
</tr>
</thead>
</table>

---

### a.

<table>
<thead>
<tr>
<th>Field ID</th>
<th>nghtWkndMin</th>
<th>date</th>
<th>time</th>
<th>planMinUsed</th>
<th>day: Weekday ([date])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table:</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
</tr>
<tr>
<td>Sort:</td>
<td></td>
<td>Ascending</td>
<td>Ascending</td>
<td>Ascending</td>
<td>Ascending</td>
</tr>
<tr>
<td>Show:</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Criteria</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>or:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### b.

<table>
<thead>
<tr>
<th>Field ID</th>
<th>nghtWkndMin</th>
<th>date</th>
<th>time</th>
<th>planMinUsed</th>
<th>day: Weekday ([date])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table:</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
</tr>
<tr>
<td>Sort:</td>
<td></td>
<td>Ascending</td>
<td>Ascending</td>
<td>Ascending</td>
<td>Ascending</td>
</tr>
<tr>
<td>Show:</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Criteria</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>or:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
c.

<table>
<thead>
<tr>
<th>Field</th>
<th>ID</th>
<th>nghtWkndMin</th>
<th>date</th>
<th>time</th>
<th>planMinUsed</th>
<th>day: Weekday ([date])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table: callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td></td>
</tr>
<tr>
<td>Sort:</td>
<td>Ascending</td>
<td>Ascending</td>
<td>Ascending</td>
<td>Ascending</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Show:</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Criteria</td>
<td>&gt;#7:00:00 AM# And &lt;#9:00:00 PM#</td>
<td>&gt;1 And &lt;7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>or:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d.

<table>
<thead>
<tr>
<th>Field</th>
<th>ID</th>
<th>nghtWkndMin</th>
<th>date</th>
<th>time</th>
<th>planMinUsed</th>
<th>day: Weekday ([date])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table: callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td>callDetail</td>
<td></td>
</tr>
<tr>
<td>Sort:</td>
<td>Ascending</td>
<td>Ascending</td>
<td>Ascending</td>
<td>Ascending</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Show:</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Criteria</td>
<td>&lt;#7:00:00 AM# Or &gt;#9:00:00 PM#</td>
<td>&gt;1 And &lt;7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>or:</td>
<td></td>
<td>1 Or 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P3. The best approach to determining the tax rate applied to bills would be to:
   a. Ask Grenoir’s staff to retrieve the value from their files
   b. Construct the rate from values in the invoiceLine table
   c. Compute the rate after joining invoice and invoiceLine
   d. Look the value up in the planRate table for each user

P4. A query to determine, for each userID, the least cost fixed contract plan rate requires the following tables:
   a. callDetail, planRate
   b. callDetail, usersOnPlan
   c. callDetail, planRate, usersOnPlan
   d. callDetail, planRate, usersOnPlan, invoiceLine

P5. Consider the following scrambled sequence of tasks:
   1. determine the applicable tax rate for user charges in this billing
   2. identify the kinds of errors that might have occurred in the billing
   3. examine individual user billing to detect errors that might have occurred
   4. verify correct categorizations of plan minutes and night/weekend minutes
   5. compute charges for each user according to the terms in the planRate table
   The best sequence for finding errors in user bills is:
   a. 4, 1, 2, 5, 3
   b. 5, 4, 2, 1, 3
   c. 1, 4, 2, 3, 5
   d. 2, 1, 5, 3, 4

Part 3: Objective Questions
To maximize instructor flexibility, the objective questions appear in the teaching notes. Instructors could use all the questions for assessment of learning at the completion of the
case or select questions for students to work on at different stages of the case to guide them in making sense of the business situation, mapping data relationships to the business situation, identifying query objectives, and formulating queries.

III. IMPLEMENTATION GUIDANCE

Course Use

The case is suitable for undergraduate and graduate accounting systems, auditing, managerial accounting, and other business courses that have a learning objective of increasing students’ ability to use query tools to assure compliance or solve business problems. Because students are likely to be familiar with the case context of wireless telephone service billing, no class coverage of wireless billing should be needed before students begin the case. Students do, however, need rudimentary proficiency in database querying, defined as the ability to join tables, build expressions, use built-in functions, apply the Group By operator, format and sort results, and name, save, and retrieve queries. A case for developing these skills is Borthick et al.’s (2001) web referral case.

In difficulty level, the case is comparable to Borthick and Jones’ (2005) warranty call center case, which requires querying to determine whether a budget overrun exists and, if so, potential causes. This case differs from Borthick and Jones (2005) in that it (1) requires students to model the business process by preparing a business process diagram (BPD) and (2) has a compliance aspect. While these differences distinguish the two cases, we believe that the existence of multiple querying cases of equivalent difficulty is useful to instructors. After several terms with the same case, student sharing of materials across terms can become noticeable. In such situations, instructors can minimize student sharing by using different cases.

The case can be used as an individual or as a team assignment. If students complete the multiple-choice questions in Part 2 individually as an in-class assessment of querying proficiency, the questions in Part 2 can serve as a control on freeloading by team members on the querying in Part 1.

Business Process Modeling Choice

Although the business process diagram can be created in several graphical formats, e.g., flowcharting or data flow diagramming, an approach that works well for this case is the Business Process Modeling Initiative (BPMI) Notation Working Group’s Business Process Modeling Notation (BPMI 2004). BPMN was designed specifically for business process modeling for use by business users, business analysts, technical developers, and business managers. The documentation in White’s (2004) introduction, available at no cost from the BPMI website, is sufficient guidance for preparing the process diagram for this case.

Software Choice

Although the data are supplied in the form of a Microsoft Access® database, audit software such as ACL™ (Audit Command Language) or IDEA™ (Interactive Data Extraction and Analysis) may be used to analyze the data (McCombs and Sharifi 2004). Using a database query tool has the advantage of giving students experience in querying a relational database with relational operators. The learning objectives can, however, be accomplished with any analysis software with the capabilities of importing data and querying the database.
Case Nuances

Even though the requirements distinguish between the compliance and optimization aspects of wireless telephone billing, some students may commingle the two, which makes the querying harder than it needs to be. In such cases, instructors may want to guide students to work on the two aspects separately.

At first glance, it may not be apparent to students how to formulate a query that juxtaposes comparable representations of the fixed and flexible plans, which is needed to perform calculations for comparing alternative plan configurations. If students are unable to solve this problem, it may be helpful to suggest that they focus on one plan at a time and that the fixed plan is probably the easier starting point.

Case Staging

Students can work the case as single or multiple assignments. The single-assignment approach has the advantage of enabling students to experience the case as an integrative whole, in which the completeness of their lists of potential errors to search for and their conceptions of cost minimization affect querying outcomes. A multiple-assignment approach has the advantage of ensuring that student lapses early in the case do not jeopardize subsequent performance. For example, if students get feedback on their lists of potential billing errors, they will miss fewer errors. The feedback could be in the form of discussion in class or on a discussion board. Because students typically make sense of different aspects at different times, they can respond to each other’s questions.

For a multiple-assignment approach, phase one might encompass the objectives (Table 1) of (1) prepare a business process diagram, (2) specify potential kinds of errors, and (4) identify cost-reducing opportunities. Phase two would then include the objectives of (3) query the database to determine the extent to which the errors occurred and (5) query the database to determine which alternative would likely be the most advantageous given the usage history.

Although the calculations required in querying would be represented in the business process diagram, some instructors may want to add an explicit requirement for students to develop a data model such as an entity-relationship (ER) diagram. An ER diagram, prepared according to the conventions in Romney and Steinbart (2006), is included in the teaching notes.

The Teaching Notes for this case include:

1. The text of:
   a. Part 1
      i. A business process diagram
      ii. Analysis of querying with results
      iii. An ER diagram
   b. Part 2 Solutions for practice objective questions with response-level feedback
   c. Part 3 Objective questions and solutions with response-level feedback

2. Links for the following files:
   a. Access mdb file containing the data for student querying: wireless.mdb
   b. Access mdb file containing the data and QBE queries for instructor use that supports the Part 1 analysis of querying: wirelessQueries.mdb
   c. Word file containing the Part 2 practice questions, Part 3 objective questions, solutions, and response-level feedback: wirelessQuestions.doc
   d. HTML files of the case text to enable instructors to stage the case on a website: wireless.htm, wirelessContract.htm, wirelessDataStructure.htm,
wirelessTemplate.htm. Web sites used for this purpose should be password-protected, and the passwords should be given only to students enrolled in courses using the case

IV. SUMMARY

The case, based on the context of wireless telephone billing, affords an opportunity for learners to improve their ability to model business processes and query databases to assure compliance and manage costs. With respect to compliance, learners detect errors in billing for wireless telephone users. With respect to optimization, learners examine historical call detail data to identify plan terms that minimize wireless service cost. The case is workable by learners with rudimentary query skills and includes multiple-choice questions for assessing learners’ query proficiency objectively. The case responds to the need for learning experiences that help students develop skills for analyzing transaction data to solve business problems.

TEACHING NOTES

Teaching Notes are available only to full-member subscribers to the Journal of Information Systems through the American Accounting Association’s electronic publications system at http://www.atypon-link.com/action/showPublisherJournals?codeAAA. Full member subscribers should use their personalized usernames and passwords for entry into the system where the Teaching Notes can be reviewed and printed.

If you are a full member of AAA with a subscription to the Journal of Information Systems and have any trouble accessing this material, please contact the AAA headquarters office at office@aaahq.org or (941) 921–7747.

REFERENCES


