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

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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 details, plan rates, and users on plan. The queries are representative of those that accountants 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 developed by Borthick et al.'s (2001) case on assuring compliance for responses to web site referrals. No auditing expertise is needed. The case is appropriate for database analysis in accounting systems courses, compliance auditing in auditing courses, and cost analysis in managerial courses. The database is supplied in the form of a Microsoft Access® database.

Key Words: Auditing with databases; Business process modeling; Compliance auditing; Cost analysis; Database querying; Query strategy; Queries

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I. THE CASE[a]

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[1] or TelSoft Solutions[2]."

Grenoir: "By being creative! Didn't you say you just hired some new accounting graduates skilled at database querying par excellance?"

Broell: "Well, yes, although I don't know anything about their querying skills yet. Um...not sure I like 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 on our wireless contracts (Figure 1). From what I read[3], I'm sure we're over paying."

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

Grenoir: "Thanks! Send 'em in. They don't have a second to spare!"

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[1] TRAQ, a provider of management services for wireless-enabled devices, site at http://www.traq com/

[2] TelSoft Solutions, a provider of telecom cost management services, site at http://www.telesoft-solutions.com/

[3] May, T. A. 2004. Telecom: Opportunity, frustration. *Computerworld* (August 9): 19. Available at http://computerworld.com/managementtopics/outsourcing/isptelecom/story/0,10801,95079,00.html.

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[a] To see the case staged on the web, go to http://www2.gsu.edu/~wwwsys/pro/project/wireless/site/wireless.htm, which includes a link to the database. For access, use name = ac863 and password = Qd0319.

Broell: "Just so they'll have a starting point, I'll give them an article about telecom auditing from *The Internal Auditor*.[4] It's good at characterizing the kinds of errors that show up in bills."

Grenoir: "You are resourceful! I'll owe you big time for this! I'll have the call details and invoice information in Microsoft Access® and data definitions with sample data (Figure 2) ready for them. What else will they need?"

Broell: "Make sure you include a table showing all the contract plans 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'm confident I submitted the right user assignments every time we began a new contract, but that doesn't mean the carrier implemented them."

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[4] Oliven, C., L. Westerfeld, and M. W. Crane. 2003. Plugging the telecom cash drain. *The Internal Auditor* (February): 46-51.

FIGURE 1
Existing Contracts and Terms

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

Per month	$35	$40	$50	$65	$80	$100	$115
Anytime minutes	300	500	700	1100	1400	2000	2500
Night & weekend minutes	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Additional minutes, each	$.50	$.45	$.40	$.35	$.30	$.25	$.20

- A minimum two-year contract is required
- A volume discount of 7% is available for contracts with 7 or more active users
- Night & 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.

Anytime Minutes:	Your cost:	Anytime Minutes:	Your cost:
0-300	$35.00	1201 and above	$80.00 plus $0.07 for each minute over 1200 minutes
301-600	$45.00		
601-900	$60.00		
901-1200	$80.00		

- A minimum two-year contract is required
- Includes Unlimited Night & Weekend minutes
- Night & 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

FIGURE 2
Data Attributes and Sample Data

Panel A: Data Attributes

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

[a] Primary keys in bold

FIGURE 2 (continued)
Data Attributes and Sample Data

Panel B: Sample Data

Table: callDetail

ID	userID	date	time	planMinUsed	nghtWkndMin
1	678-541-4573	8/1/2004	1:30:00 PM		15
2	678-541-4573	8/2/2004	1:12:00 PM	14	

Table: invoice

ID	invoiceID	contractID	invoiceTotal	periodEnd
1	520178369	350214	$475.49	8/31/2004
2	520178369	351827	$902.42	8/31/2004

Table: invoiceLine

ID	invoiceID	contractID	userID	monthlyAccess	planMinutesUsed	minutesOverPlan	minuteCharge	subtotal	taxes	totalCharge
1	520178369	351827	678-541-4573	$50.00	1234	534	$213.60	$263.60	$44.81	$308.41
2	520178369	351827	678-541-4574	$65.00	1122	22	$7.70	$72.70	$12.36	$85.06

Table: planRate

ID	contractID	initializeDate	anytimeMinutes	monthlyAccess	additionalMinutes
1	350214	4/1/2002	2500	$115.00	$0.20
2	350214	4/1/2002	2000	$100.00	$0.25

Table: usersOnPlan

ID	contractID	userID	startDate	type	planMinutes
1	350214	678-541-4573	4/1/2002	fixed	700
.	.	.	.	.	.
7	351827	678-644-1397	4/1/2004	flexible	

Required

Part 1: Analysis

1. Model the business process by preparing a one-page business process diagram (BPD)[1] 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?

[1] 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 3
Wireless Billing Report

	Query objective A succinct statement of the purpose of the query	**Results from execution of queries** For each query objective, give (1) the name(s) of the query(ies) that executes the query objective and (2) the query results.	**Recommendation** Statement of a recommendation to Grenoir based on the query results
Analysis of billing errors			
1			
2			
3	[add/delete rows as needed]		
Analysis of plan costs			
1			
2			
3	[add/delete rows as needed]		

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

#	**Lesson**	**Explanation**
1		
2		
3	[add/delete rows as needed]	

Time log (hours spent on this assignment)

Name	**Total hours**

Part 2: Objective Questions

Required: Select the best response for each question based on the business situation and database. The questions are independent of each other.

1. Bills for wireless service show cell phone minutes used by personnel of the wireless:
    a. carrier in the most recent billing period
    b. customer company without minutes in excess of anytime minutes
    c. carrier in the period following the billing date
    d. customer company in the period following the billing date
    e. customer company in the most recent billing period

2. The wireless carrier's process for preparing bills for customers requires that it:
    a. set the monthly access charge to minimize charges for additional minutes for all plans
    b. compute charges for additional minutes for all plans
    c. bill a monthly access charge that covers minutes used for all plans
    d. distinguish between fixed and variable plans before computing charges
    e. compare the sum of plan minutes used to each level of anytime minutes for all plans

3. In preparing bills for users on flexible rate plans, the wireless carrier computes:
    a. the monthly access charge based on the plan minutes used in the period
    b. the monthly access charge by looking up the charge designated for the user
    c. the monthly access charge and additional minutes charges at predetermined rates
    d. additional minutes charges at the predetermined rate for the user
    e. additional minutes charges for all users at the highest rate

4. In preparing bills for users on fixed rate plans, the wireless carrier computes:
    a. the monthly access charge based on the plan minutes used in the period
    b. the monthly access charge by adjusting it to cover plan minutes used
    c. the monthly access charge and additional minutes charges at predetermined rates
    d. additional minutes charges only for users exceeding the highest anytime minutes level
    e. additional minutes charges for all users at the highest rate

5. Recording call detail at the time of calls takes time and uses hardware, software, and communications facilities. Call volume can be maximized and recording expense minimized by recording which of the following information sets at the time of calls:
    a. user identity, number called, date/time call originated, date/time call terminated
    b. user identity, number called, date/time call originated, date/time call terminated, indicator for plan minutes or night/weekend minutes
    c. user identity, number called, date/time call originated
    d. user identity, number called, date/time call originated, length of call, indicator for plan minutes or night/weekend minutes
    e. user identity, number called, date/time call originated, length of call, indicator for plan minutes

6. A query to determine which user's billed charge has the largest error requires the following tables:
   a. callDetail, invoiceLine, usersOnPlan
   b. callDetail, invoiceLine, invoice, planRate
   c. callDetail, invoice, planRate, usersOnPlan
   d. callDetail, invoiceLine, planRate
   e. callDetail, invoiceLine, usersOnPlan, planRate

7. A query to determine, for each userID, the flexible contract plan rate that would be the least expensive requires the following tables:
   a. callDetail, usersOnPlan, planRate
   b. callDetail, usersOnPlan
   c. callDetail, planRate
   d. callDetail, invoiceLine, planRate
   e. callDetail, invoiceLine, usersOnPlan, planRate

8. If the tax rate were known from other sources, a query to show, by userID, the correct charge for the month requires the following tables:
   a. callDetail, invoiceLine, usersOnPlan, planRate
   b. callDetail, usersOnPlan, planRate
   c. callDetail, invoiceLine, planRate
   d. callDetail, invoiceLine, usersOnPlan
   e. callDetail, invoiceLine, invoice, usersOnPlan, planRate

9. Consider the following scrambled sequence of query operations:
   1. join prior results (from this query set) on userID with planRate
   2. select max(startDate) for each userID
   3. sum monthlyAccess and additional minutes charges
   4. sum planMinutesUsed by userID
   5. calculate charges for additional minutes

   The query sequence most likely to determine the correct charges for users would be the operations in the order of:
   a. 2, 1, 4, 5, 3
   b. 4, 1, 2, 5, 3
   c. 4, 1, 5, 3, 2
   d. 2, 1, 5, 3, 4
   e. 4, 2, 1, 5, 3

10. A way to make the querying more tractable would be to:
    a. combine billing error and optimal plan rate querying because the queries are similar
    b. separate contract optimization and computation of costs of planMinUsed by userID
    c. separate investigating billing errors and looking for more advantageous plan rates
    d. combine computing costs of planMinUsed by userID and selecting better plan rates
    e. separate computation of costs per minute and costs for plan rates by contract

11. Suppose the callDetail table were changed to the following structure:

ID	userID	date	time	minUsed	minType
1	678-541-4573	8/1/2004	1:30:00 PM	15	nghtWkndMin
2	678-541-4573	8/2/2004	1:12:00 PM	14	anytimeMinutes
…	…	…	…	…	…

Compared to querying with the original callDetail table, querying with the restructured table makes:

a. calculating total minutes used harder because minType has to be associated with the corresponding minUsed
b. determining the least expensive plan for each userID easier because minType is already associated with minUsed
c. recalculating charges easier because minType is already associated with the corresponding minUsed
d. recalculating charges harder because minType has to be associated with the corresponding minUsed
e. determining the least expensive plan for each userID harder because plan rates have to be joined on contractID

12. Suppose the query qStartDate appears in design view as:

Field	userID	startDate
Table:	usersOnPlan	usersOnPlan
Total:	Group By	Max
Sort:		
Show:	☑	☑
Criteria:		

To create a query that shows plan type by user for current plans, the best approach is to:

a. create a new query, based on qStartDate, joined on userID, having the design view:

Field	userID	type	planMinutes	startDate	contractID
Table:	usersOnPlan	usersOnPlan	usersOnPlan	usersOnPlan	usersOnPlan
Sort:					
Show:	☑	☑	☑	☑	☑
Criteria					

b. create a new query, based on qStartDate, joined on userID and on startDate to MaxOfstartDate, having the design view:

Field	userID	type	planMinutes	startDate	contractID
Table:	usersOnPlan	usersOnPlan	usersOnPlan	usersOnPlan	usersOnPlan
Sort:					
Show:	☑	☑	☑	☑	☑
Criteria					

c. create a new query, based on qStartDate, joined on userID and from startDate to MaxOfstartDate, having the design view:

Field	userID	anytimeMinutes	monthlyAccess	startDate	contractID
Table:	usersOnPlan	planRate	planRate	usersOnPlan	usersOnPlan
Sort:					
Show:	☑	☑	☑	☑	☑
Criteria					

d. create a new query, based on qStartDate, joined on userID, having the design view:

Field	userID	type	monthlyAccess	startDate	contractID
Table:	usersOnPlan	usersOnPlan	usersOnPlan	usersOnPlan	usersOnPlan
Sort:					
Show:	☑	☑	☑	☑	☑
Criteria					

e. create a new query, based on qStartDate, joined on userID, having the design view:

Field	userID	type	planMinutes	startDate	contractID
Table:	callDetail	usersOnPlan	usersOnPlan	usersOnPlan	usersOnPlan
Sort:					
Show:	☑	☑	☑	☑	☑
Criteria					

13. A query to investigate whether an error in the billed charge for a specific user matched a wrong rate being used would require the following tables:
    a. callDetail, planRate, invoice
    b. callDetail, usersOnPlan, invoiceLine
    c. callDetail, planRate, usersOnPlan
    d. callDetail, planRate, invoiceLine
    e. callDetail, planRate, usersOnPlan, invoiceLine

14. Suppose you suspect some users have been billed at the wrong plan rate. The query set most likely to determine which plan rate might have been used is:
    a. create a query minuteSum containing the sum of planMinUsed by userID, join planRate and usersOnPlan on contractID, compute charges by userID for each rate, compare charges with those billed
    b. create a query currentRates with rates, create a query minuteSum containing the sum of planMinUsed by userID, join currentRates and minuteSum on userID, compute charges by userID for each rate, compare charges with those billed
    c. create a query currentRates with rates, create a query minuteSum containing the sum of planMinUsed by userID, join currentRates and minuteSum with no link, compute charges by userID for each rate, compare charges with those billed
    d. create a query currentRates with rates, create a query minuteSum containing the sum of planMinUsed minus the sum of nghtWkndMin by userID, join currentRates and minuteSum with no link, compute charges by userID for each rate, compare charges with those billed
    e. create a query minuteSum containing the sum of planMinUsed by userID, join planRate and usersOnPlan on contractID and join planRate and minuteSum on userID, compute charges by userID for each rate, compare charges with those billed

15. Suppose a recalculation of the monthly charge by userID with the correct rate plan shows charges that are lower for some userIDs than the billed charges. Some possible explanations for such differences are:
    1. billed minute sums omitting night and weekend minutes
    2. the wrong rate applied for additional minutes
    3. incomplete minute sums generated in billing
    4. users never moved to their current contracts

    The most likely explanation is:
    a. 1 and 2
    b. 1 and 3
    c. 1 and 4
    d. 2 and 3
    e. 2 and 4
    f. 3 and 4

16. Suppose next month's calling patterns are similar to the patterns for the month in the database, but the billed charges are significantly more. This outcome indicates the need to investigate whether:
    a. errors might have occurred in charge calculations
    b. more users should be moved to flexible plan rates
    c. all users should be moved to flexible plan rates
    d. more users should be moved to fixed plan rates
    e. all users should be moved to fixed plan rates

17. Suppose the purpose of the following query, shown in design view, is to find any discrepancies between the billed monthlyAccess charge and the monthlyAccess charge according to the plan rates in effect. Tables planRate and usersOnPlan were joined from anytimeMinutes to planMinutes; tables usersOnPlan and invoiceLine were joined on userID.

Field	userID	monthlyAccess	monthlyAccess	difference: [invoiceLine.monthlyAccess] - [planRate.monthlyAccess]
Table:	usersOnPlan	planRate	invoiceLine	
Total:	Group By	Sum		
Sort:				
Show:	☑	☑	☑	☑
Criteria:				

    The result for this query would:
    a. fail to show differences for users on fixed plans
    b. show all the differences for users on flexible plans
    c. show all the differences for users on all plan types
    d. show some users with a wrong monthlyAccess value
    e. show underbilled amounts as positive dollar amounts

18. Suppose the objective is to find the least-cost fixed plan for each user and that the following queries and results are available:
    Query1: Sum of planMinUsed by user
    Query2: Attributes of plans currently in use
    Query3: Attributes of all plans

The best approach when the contents of callDetail are unknown in advance would be to create a query that:

a. uses Query1 and Query2, selects flexible plans, computes charges, and finds best plans
b. uses Query1 and Query2, excludes plans requiring additional minutes charges, computes charges, and finds best plans
c. uses Query1 and Query3, selects fixed plans, computes charges, and finds best plans
d. uses Query1 and Query3, excludes plans for more than each user's chargeable minutes, computes charges, and finds best plans
e. uses Query1, Query2, and Query3, excludes plans in Query2 that are not in Query3, computes charges, and finds best plans

19. The purpose of the following query, shown in design view where the usersOnPlan and planRate tables are joined (1) on contractID and (2) from planMinutes to anytimeMinutes, is to select the current plan rate by userID:

Field	userID	type	planMinutes	monthlyAccess	additionalMinutes
Table:	usersOnPlan	usersOnPlan	usersOnPlan	planRate	planRate
Sort:					
Show:	☑	☑	☑	☑	☑
Criteria					

With respect to achieving its purpose, the result of this query would have:

a. no rows in the result
b. the right number of rows
c. more rows than are needed
d. fewer rows than are needed
e. the right number of rows but the wrong values

20. Suppose the call patterns in callDetail are typical of current usage but that over time usage trends upward, a little bit each month until most users are in the 1300-2300 minute range per month. Relative to the current situation, this drift would tend to:

a. maintain the advantage of current plan rates and contracts
b. make fixed plan rates for all users more advantageous
c. make flexible plan rates for all users more advantageous
d. make fixed plan rates for high-volume users and flexible plan rates for low-volume users more advantageous
e. make the situation indeterminate due to lack of sufficient data

21. Suppose ClearNet offers a new plan that permits minute pooling, i.e., a large minute pool with a high monthly access cost is assigned to the user (user 1) with the largest minute sum and the minutes not used by user 1 are allocated to other users each month. Each of the other users would incur a small fixed minimum monthly access charge. Additional minutes would incur a small charge. Evaluating whether a pooling plan chosen to avoid additional minutes charges would be advantageous relative to other plans would require querying to:
    a. sum planMinUsed by userID, select the minimum plan minute level greater than the minute sum, compare cost of plan selected with cost of current arrangements
    b. sum planMinUsed by userID, select the minimum plan minute level less than the minute sum, compare cost of plan selected with cost of current arrangement
    c. sum planMinUsed, select the minimum plan minute level greater than the minute sum, compare cost of plan selected with cost of current arrangements
    d. sum planMinUsed, select the maximum plan minute level less than the minute sum, compare cost of plan selected with cost of current arrangements
    e. sum planMinUsed, select the minimum plan minute level less than the minute sum, compare cost of plan selected with cost of current arrangements

22. Suppose the query qStartDate appears in design view as:

Field	userID	startDate
Table:	usersOnPlan	usersOnPlan
Total:	Group By	Max
Sort:		
Show:	☑	☑
Criteria:		

    Making qStartDate, planRate, and usersOnPlan available to a new query with joins only on userID and on startDate to MaxOfstartDate and inserting the attributes userID, anytimeMinutes, monthlyAccess, and additionalMinutes results in a query with the following number of rows:
    a. number of rows of qStartDate plus number of rows of planRate
    b. number of rows of planRate plus number of rows of usersOnPlan
    c. number of rows of usersOnPlan plus number of rows of planRate
    d. number of rows of qStartDate plus number of rows of planRate plus number of rows of usersOnPlan
    e. number of rows of qStartDate times the number of rows of planRate
    f. number of rows of qStartDate times the number of rows of usersOnPlan

23. Consider a query for which the planRate, usersOnPlan, and invoiceLine tables have been made available. In the calculated expression “Sum([invoiceLine].[monthlyAccess])”, the term “[invoiceLine].”:
    a. is necessary
    b. is unnecessary
    c. causes a syntax error
    d. prompts a single join
    e. prompts multiple joins

24. Obtaining information about which of the following outcomes is most likely to be beyond the scope of querying this database?
    a. whether flexible rate plans would be more advantageous than fixed plans

b. whether invoices contain some kinds of updating or data entry errors
c. whether the plan rates for users could be made more advantageous
d. whether existing rate plans are systematic in their minute brackets
e. whether users are inflating minutes used with non-business calls

25. Suppose table fixedRates is available as follows containing information about fixed rate plans:

contractID	anytimeMinutes	monthlyAccess	additionalMinutes

Suppose the query qMinuteSum appears in design view as:

Field	userID	planMinUsed
Table:	callDetail	callDetail
Total:	Group By	Sum
Sort		
Show:	☑	☑
Criteria		

In an analysis to find better plans for users, the purpose of joining fixedRates and qMinuteSum with no link would be to:
a. calculate charges under every different rate
b. match users with the optimal plan based on minutes used
c. compare minute sums with anytimeMinutes by plan
d. match minute sums for every user with every rate
e. find the minimum of the anytimeMinutes larger than the minute sums

II. LEARNING OBJECTIVES

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 benefits 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; Fennel 2003; Jackson 2004). This case gives students practice querying data to assure compliance and analyze cost behavior. 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 narrative of 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 learning objectives for this case 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 that 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 the next 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. The insights come one at a time as learners integrate knowledge from the narrative, the data tables, and other materials into their existing situation models (Gernsbacher 1997; Zwaan and Radvansky 1998). 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.

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 web site 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[1]

Attribute	Web Referral Case Borthick et al. (2001)	Warranty Call Center Case Borthick & Jones (2005)	Wireless Billing Case
Learning objectives for business problem solving	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.	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 for query proficiency	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 Group By 5. Format and sort results 6. Name, save, and retrieve queries	Increase competence and independence in querying databases to solve business problems	
Learner scaffolding possibilities	Questions about: 1. The business problem 2. Query strategy Full-text solution for: 1. The business problem 2. Query strategy 3. Querying by keystroke	Questions about: 1. The business problem 2. Query strategy Full-text solution for: 1. The business problem 2. Query strategy	Questions about: 1. The business problem 2. Query strategy Full-text solution for: 1. Business process diagram 2. The business problem 3. Query strategy
Prerequisite: Query proficiency	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	
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

TABLE 1 continued
Comparison of Cases: Web Referral, Warranty Call Center, and Wireless Billing

Attribute	Web Referral Case Borthick et al. (2001)	Warranty Call Center Case Borthick & Jones (2005)	Wireless Billing Case
Course suitability	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	Any undergraduate or graduate course with an objective of increasing query competence and independence in which students: 1. Have rudimentary query skills	
Time	2-6 hours depending on existing skills	2-6 hours depending on existing skills	

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

TABLE 2
Objective Assessment Learning Objectives

Learning Objective	Question	Query Focus: Problem Strategy	Query Focus: Query Building
Follow business processes	1-5		
Locate relevant information in tables	6, 7, 8, 13		√
Plan and sequence individual queries	9, 10, 12, 14, 18	√	√
Interpret query results	15, 16, 20, 21	√	
Debug queries	17, 19		√
Constructing queries	11, 22, 23, 25		√
Decide relevancy of database	24	√	

Reaction to the Case

From Faculty

Faculty members' reactions to the case have been uniformly enthusiastic. 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. 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.

From Students

Students have been fascinated by the authenticity of the case. One student remarked "This is just like my cell phone plan!" They 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.

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 web site, 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 create comparable representations of the fixed and flexible plans in the database. If students are unable to solve this problem, it may be helpful to suggest that they first design and populate by hand a table that combines attributes from the fixed and flexible plans. Then students can develop queries to create the table.

IV. 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
    b. Part 2 solution for objective questions with question feedback

2. A URL for a zip file containing implementation files for the case:
    a. Access mdb file containing the data for student querying
    b. Access mdb file containing the data and QBE queries for instructor use that supports the part 1 analysis of querying
3. File containing the part 2 multiple choice questions and question feedback: Word doc file
4. HTML files of the case text to enable instructors to stage the case on a web site. Any 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.

V. 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.

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