**CHAPTER 19**

**SPECIAL TOPICS IN REA MODELING**

**SUGGESTED ANSWERS TO DISCUSSION QUESTIONS**

**19.1** **Often it takes several sales calls to obtain the first order from a new customer. Why then does Figure 19-1 depict the relationship between the Call on Customer and Take Customer Order events as being 1:1?**

When a sales person visits a customer it is represented by the event Call on Customer. Although single sales call may be followed by many orders from a customer over time, it is easier and more effective to evaluate sales force productivity by linking each sales call only to orders placed at the time of the sales call, that is, only those sales calls that linked to an order are successful. Hence, the maximum cardinality between the Call on Customer and the Take Order event is 1. However, a sales call does not always result in a sales order. Thus, the minimum cardinality from the Call on Customer event to the Take Order event is 0. Some orders, however, do not follow directly from a sales call. Therefore, the minimum cardinality from the Take Order event to the Call on Customer event is also 0.

**19.2** **How could an automobile dealer model the use of loaner cars, which it gives to customers for free whenever they drop off a vehicle for maintenance that will take longer than one day to complete?**

The loaner car arrangement could be handled the same as rental car arrangement, except that cash receipts will not be involved. The resource is the loaner car, the events are the loan (or free rental) of the car and its subsequent return, and the agents would be the customer whose car is in the service department and the employee who makes the loan arrangement.

**19.3** **In what situations would you expect to model a relationship between an agent and a resource?**

Relationships between agents and resources can be modeled for two reasons. Relationships between resources and suppliers provide information about preferred and alternate suppliers. Relationships between resources and employees can represent custody responsibilities. This would most likely be limited to high-cost and high-value resources.

**19.4** **Why is depreciation not represented as an event in the REA data model?**

Depreciation is not modeled as an event in the REA diagram because it is an accounting concept that arbitrarily allocates the cost of an acquired resource to different fiscal periods. Periodic depreciation is simply a calculation based on a formula (depreciation method) and a set of assumptions (estimated useful life, salvage value, etc.). Information about the formula and assumptions is stored in the resource entity for use in calculating periodic depreciation charges, but the calculation process itself is not an event, just as the processes of calculating the total amount of a particular sales transaction or the amount of an employee’s paycheck are not modeled as events.

**19.5** **How would you model the acquisition of a digital asset, such as the purchase of software online (the software is downloaded and then installed on the purchaser’s computer)?**

There is very little difference in modeling an event where a physical resource is sold as opposed to a digital resource. The digital asset must still be ordered, received, recorded, and paid for. The primary difference is that with digital assets, all of these functions occur almost simultaneously. Nonetheless, all aspects of acquiring digital assets must still be addressed just like a physical asset. Therefore, if the digital asset was purchased for resale, its acquisition would be recorded as a Receive Inventory event and another row in the inventory table would be created to represent this new product. If the software was purchased for use in the business, its acquisition would be recorded as a Receive Software event and another row in a Software resource table would be created.

**19.6** **How are the similarities and differences between the purchase of services, such as telephone service, and the purchase of raw materials reflected in an REA data model?**

In terms of the REA model, the two types of transactions are handled much the same. In both cases, the acquisition (receive) event would be linked to a Disburse Cash event and to a resource. One difference, however, is that as shown in Figure 19-4, each service acquisition event is linked to only 1 service, because most service suppliers are specialists. For example, electric utilities provide electricity, but not other utilities. In contrast, each Receive Raw Materials event can be linked to many different raw materials, because most suppliers sell a variety of items. A bigger difference concerns the actual process. Acquired services often cannot be counted, so it is important to verify that a service (e.g., painting, cleaning, etc.) was indeed performed appropriately.

**19.7** **How would you modify the expenditure cycle REA diagram in Figure 19-4 to include the return of defective products to suppliers for credit?**

Since the supplier, inventory, and employee entities already exist on the diagram, return of defective good to the supplier would only need one additional event entity on the diagram. An event labeled something like “Return Defective Goods” would be added. It would be linked to both the supplier and employee agent entities to facilitate performance tracking for accountability purposes. It would be linked to the Inventory resource, because it would decrease the quantity on hand. Each “Return Defective Goods” event would be linked to a minimum of 1 and a maximum of many inventory items; each inventory item would be linked to 0 or many “Return” events. The “Return Defective Goods” event would be linked to the “Receive Inventory” event. Each “Receive Inventory” event would be linked to 0 or 1 “Return Defective Goods” events. The minimum is zero because the inventory has to be received prior to its return; the maximum is 1 because a given receipt event will be linked to at most one return event for defective merchandise. Each “Return” event would be linked to a minimum and maximum of 1 “Receive” events because something would have to be purchased before it could be returned, and if defective, the item would only be returned one time.

**SUGGESTED ANSWERS TO PROBLEMS**

**19.1 We-Fix-Computers, Inc. provides spare parts and service for a wide variety of computers. Customers may purchase parts to take home for do-it-yourself repairs, or they may bring their systems in for repair, in which case they pay for both the parts and the labor associated with the type of service required. Some services do not include any new parts, just a labor charge for that service. Individual customers must pay for all parts purchases in full at the time of sale. Individual customers must pay 50% down when they bring their computers in for servicing and pay the balance at pickup. Corporate customers, however, are billed monthly for all sales (parts or service). Although We-Fix-Computers, Inc. has several different banking accounts, all sales are deposited intact into its main checking account.**

**We-Fix-Computers, Inc. purchases its inventory of parts from more than a dozen different vendors. Orders are usually delivered the next day; sometimes, however, suppliers ship only partial orders. We-Fix-Computers pays for some of its purchases COD, but usually pays by the 10th of the month for all purchases made the prior month. None of its suppliers allows it to make installment payments.**

**Required**

**Draw an integrated REA diagram for We-Fix-Computers’ revenue and expenditure cycles.**



**19.2 The Mesa Veterinary Hospital is run by Dr. Brigitte Roosevelt. She has two employees in the office and has asked you to develop a database to help better track her data. Dr. Roosevelt currently uses her personal computer only for word processing, but she is interested in also using it to maintain pet histories and accounting information. She is excited about the transition and is counting on you to help her through the process. She describes her daily activities as follows:**

***When new customers come to Mesa Veterinary Hospital, the “owners” of the pets are required to complete an introductory form. This form includes the following:***

**• *Owner name***

**• *Address***

**• *Day phone***

**• *Night phone***

***They are also required to provide the following information about each pet, as some people own many pets:***

**• *Pet name***

**• *Breed***

**• *Color***

**• *Birth date***

***Dr. Roosevelt would like to enter this information once and then have the system retrieve it for all subsequent visits.***

***When customers call to make appointments, one of the office clerks asks what kind of services they require (e.g., is it a routine exam, a surgery, etc.). Dr. Roosevelt sees only one pet during each appointment. If she is going to see one owner’s two pets, then two separate appointments are necessary (but scheduled back-to-back). For each appointment, Dr. Roosevelt records the pet’s weight, notes the reason for the appointment, and records her diagnosis. Depending on the diagnosis, the doctor will possibly prescribe any number of medications to cure the pet.***

***Owners are charged $25 for each appointment and must pay additionally for any medications prescribed for their pets. Dr. Roosevelt requires all pets to be brought back for another examination prior to refilling any prescriptions. Customers must pay for services and medication in full at the conclusion of their visits.***

**You also learn that Dr. Roosevelt orders drugs and medications from several different suppliers. She places orders weekly, on Fridays. Suppliers usually make one shipment to fill each order, but sometimes have to make additional shipments if they are currently out of stock of one or more items. In such cases, they always ship the back-ordered item as soon as they receive it from the manufacturer; they never combine such back orders with subsequent orders by Dr. Roosevelt.**

**Suppliers bill Dr. Roosevelt monthly and expect payment in full by the 15th of the following month. A few suppliers do permit Dr. Roosevelt to make installment payments. The prices charged by suppliers for a given product may change several times during the year, so it is important to accurately store the cost of each item each time it is purchased.**

**Dr. Roosevelt concludes the interview by requesting that in addition to the facts mentioned,**

**she wants the system to store the following attributes:**

**• Number of pets owned by each customer**

**• Total charge for the appointment**

**• Prescription price**

**• Drug name**

**• Length of appointment**

**• Diagnosis**

**• Date of appointment**

**• Service requested**

**REQUIRED**

**a. Given this brief overview, draw an integrated REA diagram for the Mesa Veterinary Hospital and include cardinalities.**



**b. As directed by your instructor, either draw the tables necessary to implement the integrated REA diagram you developed for the Mesa Veterinary Hospital or build the tables in a relational DBMS to which you have access. Be sure to include all attributes from the narrative plus the additional ones explicitly listed by Dr. Roosevelt at the conclusion of the interview. Create additional attributes only if necessary.**

|  |  |  |
| --- | --- | --- |
| **Table** | **Primary Key** | **Other Attributes (*foreign keys in italics)*** |
| Services | Service number | Name, standard cost, list price, standard time to perform |
| Drugs | Drug number | Drug name, standard cost, list price, beginning quantity-on-hand |
| Cash | GLAccount number | Bank name, type of account, beginning balance |
| Make Appointment | Appointment number | Date, Reason for visit, *employee number, customer number, pet number* |
| Perform Exam | Exam number | Date, *Pet number*, time started, time completed, scheduled time, diagnosis, total charge, *receipt\_number*, weight, *appointment number* |
| Receive Cash | Receipt number | Date, amount, *customer number, employee number, GLAccount number* |
| Pets | Pet number | Pet name, breed, color, birth date, *customer number* |
| Customers | Customer number | Customer name, address, day phone, night phone, number of pets owned |
| Employees | Employee number | Name, date hired, salary |
| Appointment-Services | Appointment numberService number |  |
| Appointment-Exam | Appointment numberExam number |  |
| Drugs-Exams | Drug numberExam number | Dosage, actual cost, actual price |
| Vendor | Vendor number | Name, address, account balance |
| Order Drugs | Purchase order number | *Vendor number, employee number*, date, amount |
| Receive Drugs | Receiving report number | *Vendor number, employee number, purchase order number,* date, vendor invoice |
| Disburse Cash | Check number | *Vendor number, employee number, GL Account number,* amount, description, date |
| Order Drugs-Drugs | Purchase order number, Drug number | Quantity, unit cost |
| Receive Drugs-Drugs | Receiving report number, Drug number | Quantity received, condition |
| Receive Drugs-Disburse Cash  | Receiving report, Check Number | Amount applied to invoice |

**19.3** **Your university hires you to implement a database system for the library network. You have interviewed several librarians, and the following summarizes these discussions:**

**• The library’s main goal is to provide students and professors with access to books and other publications. The library, therefore, maintains an extensive collection of materials that are available to anyone with a valid university identification card.**

**• The standard procedure for lending materials is that the student or faculty member comes to one of the three campus libraries and locates the book or journal on the shelves.**

**• Each book is assigned three unique numbers. First, the book is assigned a number by the publisher, called the International Standard Book Number (ISBN). This number allows the publishers to track each title and the number changes with each new edition. The second number is the Dewey decimal number, which is assigned to the title and written on the outside spine of the book. This number is used to organize the library shelves and is thus helpful to the students and faculty. It is therefore critical that this number be available to users on the online inquiry screens. The last number is a university book ID number. A different number is assigned to every book that is received so the library can track all copies of each book. This number is different from the other two numbers such that if the library has three copies of one book, each will have a unique university book ID number.**

**• When students or faculty check out books, the system must be able to track the specific copy that is being borrowed. Each book has a magnetic strip inserted in its spine, which is used as a security measure. If someone tries to take a book without checking it out, an alarm sounds.**

**• In general, students and faculty have equal clout in the library. Both are able to check**

**out most books and to check out several books at one time. No one is allowed to remove periodicals from any library. The length of time that the book may be borrowed varies, however, depending on who checks it out. Students are allowed to check out a book for several weeks; faculty may borrow books for several months.**

**• When patrons check out books, they take their materials to the circulation desk. At that time, the librarian scans in each item’s university book ID number and the borrower’s ID number. The system records a separate loan event for each book being checked out, assigning each a separate loan number. At this time, each book’s due date is calculated and marked on a slip located inside each book’s front cover. Simultaneously, the magnetic strip is deactivated so the book may be removed from the library.**

**• After borrowers check out a book, they are expected to return it by its due date. In reality, everyone is allowed 30 days after the due date recorded on the checkout slip before the book is officially overdue. At that point, the book must be returned, and the borrower is assessed a $10 fine. If the book is permanently lost, then the borrower is fined $75 for the book’s replacement. All fines must be paid in cash, in full. Students are not allowed to enroll for subsequent semesters until all library fines are paid; they also do not receive a diploma until all library fines are paid. Faculty must pay all outstanding fines by June 30 of each year.**

**• When a book is returned, the return must be entered into the system, and a unique return number is used to log the transaction. At that time, the loan record is updated to show that the book has been returned.**

**The following attributes have been identified as critical for the new system:**

* **University book ID**
* **Book publisher**
* **Due date**
* **Loan number**
* **Checkout date**
* **Borrower phone number**
* **Cash account number**
* **Librarian name**
* **Book status (on the shelf or checked out)**
* **Type of borrower (faculty or student)**
* **Librarian college degree**
* **Actual return date**
* **Borrower ID**
* **Borrower name**
* **Book title**
* **Fine receipt number**
* **Amount received**
* **Library name**
* **Amount of fine**
* **Default library where book is shelved**
* **Borrower’s fine balance owed**
* **ISBN number**
* **Book return number**
* **Dewey decimal number**
* **Borrower address**
* **Book copyright date**
* **Borrower e-mail address**
* **Library borrowed from**
* **Librarian number**
* **Account balance**
* **Total number of books in a specific library**
* **Loan status (still outstanding, or returned)**
* **Author name**

**REQUIRED**

1. **Draw an REA diagram for the library system. Remember to include cardinalities.**

a. REA diagram solution.



 Explanation of cardinalities:

1. One key to the problem is understanding that the Loan Book event represents the checking out of a single book. As stated in the problem, if a borrower checks out 5 books, the system adds five rows to the Loan Book table. This does not affect the borrower’s checkout experience at all.
2. Another important fact is realizing that books have multiple authors.
3. One final important fact involves recognizing the distinction between physical books and book titles. If the library has five copies of the same book title, it wants to track the status of each individual physical copy. But, a great deal of information about publisher, copyright, etc. is not affected by how many copies the library owns. Therefore, it is more efficient to create a separate entity called book title, to store this constant information.
4. The cardinality from Receive Fines to Loan Book is (1,N) because a loan has to occur prior to a fine being paid, but one cash receipt may pay for fines associated with a number of different loans. The cardinality from Loan Book to Receive Fines is (0,N) because many loans never result in fines, but some loans result in multiple fines ($10 late fee, $75 replacement fee).
5. **As directed by your instructor, either create the tables on paper that would be required to implement your REA diagram or actually build those tables in a relational DBMS to which you have access. Only use the attributes listed, unless others are absolutely necessary.**

Problem 19-3, part b. Table solution

|  |  |  |
| --- | --- | --- |
| **Table** | **Primary Key** | **Other Attributes (*foreign keys in italics)*** |
| Library | Library name \* | Number of books |
| Books | University Book ID | Book status, *ISBN#, default library shelved at* |
| Book Title | ISBN# | Publisher, copyright date, Dewey Decimal number |
| Author | Author number | Name |
| Book Title-Author | Author numberISBN# |  |
| Loan Book | Loan number | Due date, *University Book ID*, *Borrower ID*, loan status, *library borrowed from*, *librarian #*, date checked out |
| Book Return | Book return number | *University Book ID*, *Loan number*, *library name*, return date, *borrower ID*, *librarian #* |
| Cash | Cash account number | Beginning account balance |
| Receive Fine | Fine receipt# | Amount received, *cash account#, library name, librarian #, borrower ID*  |
| Employee | Librarian# | Name, College degree, YTD loans processed |
| Borrower | Borrower ID | Name, address, email, SSN, fine balance owed, phone number |
| Fine-Loan | Fine receipt#Loan number | Amount of fine |

\* Library name can be the primary key because it is created by the library system and, therefore, guaranteed to be unique for each library**.**

**19.4 The XYZ Company sells tools and parts to automotive repair shops. Shops call in orders; all orders received by noon are delivered the same day. Between 12:00 and 1:00, the system prints out schedules. From 1:00 to 5:00, drivers make deliveries according to the printed schedules. Typically, each driver makes between 25 and 30 deliveries each day. Each delivery is signed for by a repair shop manager; the portable laptop then uses wireless communications to transmit information about the delivery back to the XYZ Company and the information is recorded as another row in the sales event table. The XYZ Company uses its own trucks to make local deliveries to its customers. It wants to track information about the use of those trucks: which employee drove which truck, to which customers did a particular truck make deliveries, which deliveries are made on which days, what was the starting and stopping mileage each day?**

**REQUIRED**

**a. Draw a partial REA diagram of the XYZ Company’s revenue cycle to model these**

**events: Taking Customer Orders, Deliveries, and the Use of Vehicles. Be sure to**

**include cardinalities.**



**b. Create a set of tables (either on paper or in a relational DBMS to which you have**

**access) to implement the REA model you developed for the XYZ Company.**

|  |  |  |
| --- | --- | --- |
| **Table Name** | **Primary Key** | **Other Fields(*foreign keys in italics*, others in normal font)** |
| Take Order | Order Number | *Customer Number, Employee Number,* Amount |
| Delivery | Delivery Number | *Order Number, Vehicle Use Number, Truck Number, Employee Number, Customer Number* |
| Use of Vehicles | Vehicle Use Number | *Employee Number, Truck Number,* Depart Time, Return Time |
| Inventory | Item Number | Description, Quantity, List Price, Unit Cost, Beginning Quantity On Hand, Reorder Quantity, Reorder Point  |
| Truck | Truck Number | Type, Description |
| Employee  | Employee Number | Name, Address, Position, Pay Rate |
| Customer | Customer Number | Name, Address, Phone, Beginning Account Balance, Credit Limit |
| Take Order-Inventory | Order Number, Item Number | Quantity |
| Delivery-Inventory | Delivery Number, Item Number | Quantity |

**19.5 Assume that Stained Glass Artistry, a new shop that specializes in making stained glass artwork, has hired you to design an integrated database that will provide the owners with the accounting information they need to effectively manage the business. Stained Glass Artistry makes a wide variety of stained glass windows for sale in its store.**

**A unique job order is assigned to each production run, which includes creating multiple copies of the same basic design. When raw materials are issued to employees, the issuance is documented on a prenumbered raw material issue form. The different kinds of glass needed for the product, and other materials such as copper foil or lead, are issued at one time, so that employees can efficiently produce the design.**

**Creating a piece of stained glass art involves several different steps, including cutting, foiling, and soldering. The owners want to track how much time each employee spends each day performing each of those various tasks.**

**The owners have developed raw material and direct labor standards for each design they offer. They want their AIS to track actual costs and standard costs so that they can generate reports that provide price and quantity variance information.**

**The owners also have provided you with the following list of facts that they want**

**stored in the database. (*Note:* You must create appropriate primary keys for each table;**

**this is the list of other attributes.) Attributes in Standard Glass Artistry AIS:**

* **Date hired**
* **Time started task**
* **Time completed task**
* **Style of glass (name or description)**
* **Quantity on hand**
* **Color of glass**
* **Quantity to be produced**
* **Actual cost of design**
* **Design name**
* **Standard quantity of glass use in design**
* **Quantity issued**
* **Standard hours to make design**
* **Standard cost of design**
* **Date design produced**
* **Date of birth**
* **Wage rate**
* **Employee name**
* **Standard cost of glass**

**REQUIRED**

**a. Draw an integrated REA diagram for Stained Glass Artistry. Include both minimum**

**and maximum cardinalities.**



Explanation of cardinalities:

1. Each row in the Bill of Materials table represents the standards for using one specific raw material to produce one specific finished good design. Therefore, every row in the Bill of Materials table is linked to one and only one row in the finished goods table. A finished good, however, may consist of numerous raw materials and, therefore, be linked to many rows in the Bill of Materials table.
2. Each row in the Labor Standards table represents the standards for making a particular design. Thus, each such standard is linked to one, and only one, finished good. A finished good, however, may involve several different labor activities and, therefore, be linked to multiple rows in the labor standards table.
3. Jobs consist of making one or more copies of a specific design. Therefore, each Work in Process is linked to one and only one finished good. Each finished good, however, may be produced many different times and, therefore, can be linked to multiple rows in the Work in Process table.
4. All raw materials are issued at one time; thus, the relationship between Raw Materials Inventory and Issue Raw Materials is M:N.
5. Sometimes there may be a need to obtain additional raw materials, due to breakage. Therefore, each Work in Process job may be linked to multiple Issue Raw Materials events. Each event, however, is linked to one, and only one, specific job.
6. Each specific job operation is linked to one, and only one, Work in Process, but any given Work in Process job can be linked to many different labor operations.
7. The Employee Services entity is an abstract entity that represents the time acquired from various classes of employees. It will be discussed in chapter 14. For now, just explain that each row represents all the time the company acquires from a specific class of employees (artisans, clerks, management, etc.)

**b. Create the set of relational tables required to implement your REA diagram for Stained**

**Glass Artistry in a relational database.**

|  |  |  |
| --- | --- | --- |
| **Table Name** | **Primary Key(s)** | **Other Attributes (*foreign keys in italics*, others in normal font)** |
| Raw Materials | Raw Material number | Style of glass, beginning quantity on hand, color of glass, standard cost of glass |
| Employee | Employee number | Name, date hired, wage rate, date of birth |
| Employee Services | Category number |  |
| Bill of Materials | B.O.M. number | *Raw materials number, design number,* Standard quantity of glass to use in this design |
| Issue Raw Materials | Raw Materials Issue number | *W.I.P. number, issuing employee number, receiving employee number* |
| Work in Process | W.I.P. number | *Design number,* Quantity to be produced, date design produced, actual cost of design |
| Perform Job Operation | Job Operation number | *Employee number, category number, labor standard number, W.I.P. number,* Time started task, time completed task |
| Finished Goods Inventory | Design number | Design name, beginning quantity on hand, standard cost of design |
| Labor Standards | Labor Standard number | *Design number,* Standard hours to make design |
| Raw Materials – Issue Raw Materials | Raw Material numberRaw Materials Issue number | Quantity issued |
| Bill of Materials – Issue Raw Materials | B.O.M. numberRaw Materials Issue number |  |

**19.6 Bernie’s Pet Store sells pet food, toys, and supplies. Bernie, the owner, is the only person who places orders with suppliers. He is also the only person who writes checks. Suppliers ship each order individually; if they are out of an item, they back order it and ship it separately as soon as it arrives. Bernie pays each supplier monthly for all purchases made the previous month. Suppliers do not allow him to make installment payments.**

**Bernie has eight employees, each of whom can check in materials received from suppliers and sell merchandise to customers. Bernie pays his employees weekly from a separate checking account used only for payroll purposes.**

**All sales are made in-store and are paid for immediately by cash, check, or credit card.**

**When employees are not working the cash register or checking in merchandise, they restock shelves and clean up the premises. Bernie does not want to track each *individual* restock or clean-up event, but does want to know how much time each employee spends each day doing those tasks. He also wants to track how much time each employee spends each day receiving inventory and how much time they spend working at the cash register.**

**He wants to be able to write queries that would show time spent by job task (restocking, cleaning, receiving, or sales) for each employee. It is not practical, however, to try to measure the time spent on individual tasks (e.g., Bernie does not want employees to track the time they start and finished unloading a shipment from supplier X, then repeat for supplier Y; similarly, he does not want to track how long it takes to ring up each individual customer at the cash register). All he wants is to know how much time each day (e.g., 3.75 hours) each employee spent performing each different type of job.**

**REQUIRED**

**Draw an integrated REA diagram for Bernie’s Pet Shop. Be sure to include both payroll processing and the ability to track how employees use their time.**



Explanation of cardinalities in Bernie’s pet store:

1. Checks may be written to either suppliers or to employees. One table can be used for both types of checks. The primary key of that table would be a concatenated key consisting of two attributes: check number and account number. (The latter attribute distinguishes operating checks from payroll checks). Since a check may go to either a vendor or an employee, the minimum cardinalities from the disburse cash event to those agents are zero.
2. Bernie pays employees weekly. Each day an employee works a new row is created in the Get Employee Time table. Each row thus represents a daily time card. Therefore, each paycheck is linked to many rows in the Get Employee Time event.
3. The Employee Time resource represents the time acquired from various classes of employees. Since any one employee only falls into one category (i.e., full-time, part-time, management), each daily time card (row in the Get Employee Time table) can be linked to one, and only one, row in the Employee Time resource.
4. The Use Employee time event is used to track how employees spend their time. A row would be created for each block of time an employee spent performing a particular type of task. An attribute in this table would be a text field describing what an employee did during that block of time. For example, if the employee restocked shelves from 8:00 am to 11:00 am, there would be one row in the Use Employee Time table for that block of time, with the description being “restock shelves.” Similarly, if an employee worked the cash register from 1:00 pm to 5:00 pm, there would be one entry in the Use Employee Time table with the description being “worked cash register.” Some tasks, like working the cash register, can be linked to specific events that Bernie wants to track, such as cash receipts and receiving inventory. During a block of time, an employee is likely to participate in many such events. For example, during the block of time from 1:00 to 5:00, an employee working the cash register is likely to participate in many receive cash events. Thus the cardinality each Use Employee Time event can be linked to a minimum of 0 and a maximum of many Receive Cash events. Any specific cash receipt, however, is linked to one and only one employee’s use of time. Therefore, each Receive Cash event can be linked to 1, and only 1, Use Employee Time event.
5. The Employee Time resource is shown in dashed lines because it is not likely to be implemented in a table.

**19.7 At Big Time University (BTU) students are allowed to purchase two basketball tickets for each home game. Each ticket contains the date of the game, and the seat information, such as section, row, and individual seat number. Students pay for each game individually; that is, student sporting event passes are not used at BTU. BTU deposits the proceeds from each game into its bank.**

**REQUIRED**

**a. Prepare an REA diagram with cardinalities for the revenue cycle for BTU’s basketball games. State any assumptions you may have to make concerning BTU’s business policies and practices.**



**b. Implement your model in a set of relational tables. Be sure to specify primary keys, foreign keys, and identify at least one other attribute that should be included in each table.**

|  |  |  |
| --- | --- | --- |
| **Table Name** | **Primary Key(s)** | **Other Attributes (*foreign keys in italics*, others in normal font)** |
| Ticket Sales | Invoice Number |  *Student Number, Employee Number,* Date, Total Amount |
| Receive Cash | Remittance Number | *Invoice Number, Employee Number, Student Number, GLAccount Number,* Date, Total Amount |
| Ticket | Ticket Number | *Invoice Number*, Event, Date, Section, Row, Seat  |
| Student | Student Number | Name, Address, Phone  |
| Ticket Window Clerk | Employee Number | Name, Address, Phone, Position |
| Cash | GLAccount Number | Name, Beginning Balance |

**19.8 Small contractors often rent special equipment for specific jobs. They need to track the equipment that is rented, when it is returned, and payments made to the rental company.**

**REQUIRED**

1. **Draw a partial REA diagram for the acquisition, payment, and return of rental equipment. Be sure to include cardinalities and state any assumptions you made when specifying those cardinalities.**



This solution is based on the following assumptions:

1. Each Rent event is independent of every other Rent event. For example, each time the contractor rents equipment, they must sign a rental agreement or contract for all the equipment they rent at that particular time.
2. Each Return Rented Items event is tied to one and only one Rent event. In other words, all equipment rented according to a previously signed rental agreement is returned at the same time.
3. The contractor pays for the rental at the time of Rent event.
4. The contactor maintains a listing of all types of equipment that they rent. This listing allows the contractor to rent multiple items of the same type. For example, the contractor may rent 5 jackhammers and 5 air compressors in a single Rent event. Thus, many rental item types may appear on a single Rent event.

Note: An alternative solution would be to model the rental and return of each individual piece of equipment separately. This would be appropriate if assumption 2 is relaxed and the contractor is permitted to return each individual item at different times. This alternative solution would be modeled similar to Figure 19-3.You may want to explore the effects of these two alternative solutions on both the processing of events and the subsequent generation of queries and reports.

**b. Create a set of tables (either on paper or in a relational DBMS to which you have**

**access) to implement the REA model you developed.**

|  |  |  |
| --- | --- | --- |
| Table Name | Primary Key | Other attributes (*foreign keys*) |
| Rented Equipment | Equipment number | Description,  |
| Cash | GL Account Number | Name, beginning balance |
| Return Rented Items | Return number | Date, time, *vendor number, employee number, rental number* |
| Rent Equipment | Rental number | Date, time, *vendor number, employee number* |
| Disburse Cash | Check number | Date, amount, *GL Account number, Employee number, Vendor number* |
| Employee | Employee number | Name, date hired, pay rate |
| Vendor | Vendor number | Name, address, beginning balance |
| Rented Equipment – Rent Equipment | Equipment number, rental number | quantity |
| Rented Equipment – Return Rented Items | Equipment number, return number | quantity |

**SUGGESTED ANSWERS TO THE CASES**

**Case 19.1** **This case involves creating a database from an integrated REA diagram and then using the REA diagram to guide the writing of queries to prepare financial statements.**

**Required**

**a. Create the tables necessary to implement Figure 19-9 in a relational database. Be sure to include primary keys and other relevant attributes in each table.**

|  |  |  |
| --- | --- | --- |
| **Table Name** | **Primary Key(s)** | **Other Attributes (*foreign keys in italics*, others in normal font)** |
| Customer | Customer number | Name, address, phone, beginning account balance, credit limit |
| Employee | Employee number | Name, date hired, wage rate, date of birth, position |
| Take Customer Order | Sales Order Number | *Customer number, employee number*, date, total amount |
| Sales | Invoice Number | *Customer number*, *employee number*, *sales order number, Item Number,* date |
| Receive Cash | Remittance Number | *Customer number, employee number, GLAccount number,Invoice Number* date, amount |
| Finished Goods Inventory | Item Number | Name, Description, beginning quantity on hand, standard cost, list price |
| Work in Process | W.I.P. Number | *Item Number,* Quantity to be produced, date design produced  |
| Use Equipment | Machine Operation Number | *Equipment ID number, W.I.P. number, Machine Operation List number,* Time Started, Time Finished, Date |
| Equipment Operations List | Machine Operation List Number | *Item number*, standard time |
| Job Operations List | Job Operations List Number | Standard time, *Item number* |
| Use Employee Time | Job Ticket Number | Description, Time started, Time Finished, Date, *Employee Number, WIP Number, Job Operations List Number* |
| Bill of Materials | Bill of Materials Number | *Raw materials number, item number,* Standard quantity used in this design |
| Raw Materials | Raw Material Number | Description, beginning quantity on hand, standard cost  |
| Issue Raw Materials | Raw Materials Issue Number | *W.I.P. number, issuing employee number, receiving employee number, Raw Material Number* |
| Suppliers | Supplier Number | Name, Address, Phone, Beginning balance |
| Equipment | Equipment ID Number | Description, Cost, Depreciation Method, Useful Life, Salvage Value, Year Acquired, *Purchase Order number, Receiving report number* |
| Acquire Services | Service Acquisition number | Description, Cost, *Check number, supplier number, employee number, GL Account number* |
| General and Administrative Services | GLAccount Number | Description, length of contract, budget |
| Cash | GLAccount Number | Description, beginning balance |
| Time Worked | TimeCard Number | *Employee Number, Supervisor Number,* Time in, Time Out, Date, *Check number* |
| Order Raw Materials and Equipment | Purchase Order Number | Date, *employee number, supplier number, equipment ID number* |
| Receive Raw Materials and Equipment | Receiving Report Number | Date, *supplier number, equipment ID number* |
| Disburse Cash | Check Number | *GLAccount Number*, Date, Amount, Purpose, *Employee (payee) Number, Supplier Number, Cashier number, Stock issuance number, Loan number, Transfer Agent Number*  |
| Issue Stock | Issuance Number | Date, *Transfer Agent Number*, *Employee (Treasurer) number, GLAccount number,* Number of Shares, par value |
| Issue Debt | Loan Number | Amount, Date, Interest rate, term, *Transfer Agent number, employee (Treasurer) number, GLAccount number* |
| Transfer Agent | Transfer Agent Number | Name, Address, Phone |
| Customer Order – Finished Goods | Order Number, Item Number | Quantity ordered, unit sales price |
| Sale – Receive Cash | Invoice Number, Receipt Number | Amount applied |
| Order Raw Materials and Equipment – Raw Materials | Purchase Order Number, Raw Materials Number | Quantity ordered, unit cost |
| Receive Raw Materials and Equipment – Raw Materials | Receipt Number, Raw Materials Number | Quantity received, condition |
| Receive Raw Materials and Equipment – Cash Disbursements | Receiving Report Number, Check number | Amount applied to invoice |
| Order Raw Materials and Equipment – Receive Raw Materials and Equipment | Purchase Order number, Receiving Report number |  |
| Issue Raw Materials – Raw Materials | Raw materials number, Issue Raw Materials Number | Quantity issued |
| Sales - Finished Goods Inventory | Invoice Number, Item Number | Quantity sold |
| Employees – Receive Raw Materials and Equipment | Employee number, Receiving Report Number |  |

1. **Write the query, or set of queries, necessary to generate as many elements of financial statements as possible. For example, write the query or set of queries that would be used to calculate the amount of cash on hand, the total of accounts receivable, the total value of raw materials, inventory on hand, etc.**

The actual syntax will depend on the software used. The following logic describes the queries that can be used to provide most of the information needed to construct a simple income statement and balance sheet:

1. To derive total sales you need to query three tables: Take Customer Order, Take Customer Order – Finished Goods Inventory, and Sales. First, find the set of customer order numbers that have been realized as sales (i.e., all customer order numbers that appear in the Sales table). Then, for that set of customer orders, query the M:N relationship table between Take Customer Orders and Finished Goods Inventory and sum the product of quantity ordered times unit sales price.
2. To derive total actual Cost of Goods Sold requires assumptions about inventory costing method (LIFO, FIFO, etc.). However, it is straightforward to calculate the standard cost of goods sold as follows: query the Finished Goods Inventory, the M:N relationship table between Finished Goods and Take Customer Order, Customer Orders, and Sales. First, find the set of customer order numbers that have been realized as sales (i.e., all customer order numbers that appear in the Sales table). Then, for that set of customer orders, query the M:N relationship table between Take Customer Orders and Finished Goods Inventory and the Finished Goods Inventory tables and sum the product of quantity ordered times standard cost per unit.
3. Only three expenses can be calculated from the model: wages, general administrative expenses, and depreciation.
	1. To calculate wages expense: Sum hours worked (from the Time Worked entity) and group by employee number. Then multiply the total hours worked for each employee by that employee’s payrate (found in the Employees table).
	2. To calculate general administrative expenses, sum the cost column in the Acquire Services table.
	3. The Equipment table contains all the information needed to calculate depreciation (acquisition cost, useful life, depreciation method, salvage value, and year acquired).
4. To calculate cash balance first retrieve the sum of the beginning balance attribute from the Cash table. Second, sum the amount column in the Receive Cash, Issue Stock, and Issue Debt tables and add those three numbers to the beginning balance. Then sum the amount in the Disburse Cash table and subtract that from your previous total.
5. To calculate accounts receivable begin by computing the sum of the beginning balance attribute from the customers table. Next, add to that the total amount of sales (see step 1). Then, subtract the sum of the amount column in the Receive Cash table.
6. It is straightforward to calculate the standard cost of ending inventory using the standard unit price. Calculating the actual cost of ending inventory is complex, requiring retrieval of information from many tables and assumptions about the costing method (FIFO, LIFO, Weighted Average).
7. The equipment table has the cost of all equipment. Cumulative depreciation can be calculated from the information in the table and that amount subtracted from cost to yield book value.
8. Accounts payable can be calculated as follows.
	1. Begin by retrieving the sum of the beginning balance attribute from the suppliers table.
	2. Then calculate the total of all purchases.
		1. For equipment, this involves summing the cost attribute for all rows in the equipment table linked to a Receive Raw Materials and Equipment event this fiscal period.
		2. For raw materials, this involves several steps. Begin by finding the set of raw materials orders that are linked to receive events this period. Then query the Order Raw Materials and Equipment – Raw Materials M:N table and sum the product of quantity ordered times unit cost.
		3. For services, this equals the sum of the cost column in the Acquire Services table for all rows in which the check number is null.
	3. Then calculate payments to suppliers by summing the amount attribute in the Disburse Cash table for all rows that are linked to suppliers.
	4. Accounts payable = step a + step b – step c
9. Long term debt can be calculated by summing the amount column in the Issue Debt table.
10. The total par value of common stock can be calculated by summing the product of par value times number of shares.