

**UNIT 3:** *Systems Analysis*

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IT 303: SYSTEMS ANALYSIS AND DESIGN **130**

LESSON 2:

Modeling System Requirements

OBJECTIVES:

#### At the end of the lesson, the students will be able to:

* Explain the purpose of the data flow diagram;
* Understand the meaning of the elements used in data flow

diagrams;

* Follow the proper way of creating data flow diagrams;
* Construct simple data flow diagrams and context diagram; and
* Capture business data and process requirements and create a

logical model for the new system by using the data flow

diagrams.

##### Duration: 10 hours

**UNIT 3:** *Systems Analysis*

Modeling Requirements Using Data Flow Diagrams

The data flow diagram is one of the most commonly used systems-modeling tools, particularly for operational systems. The functions or processes of the system are of paramount importance and more complex than the data that the system manipulates. It is used to graphically represent the flow of data in an information system. It describes the various processes involved to transport data from the input to the data storage and generation of reports.

A set of DFD’s provides a logical model that shows what the system does, not how it does (Shelley and Rosenblatt, 2016). It defines the boundary of the area under investigation. It shows what processes are within that boundary and what are the areas, people, etc. external to the scope of the system. It is a graphical system model that shows all of the main requirements for an information system in one diagram: *inputs, outputs, processes*, and *data storage*.

DFD can be used to show:

* + An existing system and how well it performs
  + An existing system from the logical viewpoint explains what is going on without reference to how it works and when it works, or who does what.
  + A required system in logical terms
  + A critical system in physical terms, demonstrating manual separation from computerized processes and the various forms of automation.

### Elements of DFD

DFD includes a set of symbols, naming conventions, and syntax rules. There are two styles of symbols that are commonly used. One was developed by Chris Gane and Trish Sarson and the other by Tom DeMarco and Ed Yourdon (Dennis, Wixom and Roth, 2013).

*Note: This module used Gane and Sarson symbols. Gane and Sarson's notations used uppercase labels, though it is not uncommon to see mixed case labels used in data flow diagrams. However, you must remember to be consistent with your labeling (Gould, 2016).*

1. **Process**. DFD's first component is termed a process. Popular synonyms are a transformation, a function, or a bubble. It's an operation typically carried out in a system for a particular purpose or function. It contains the business logic, called business rules, that transforms the data and yields the results needed. Process represents work being performed within the system and should be named using one of the following formats:
   1. Assign the name of the whole system when naming a high-level process.
   2. Use a name such as Inventory Reporting Subsystem when naming major subsystem.
   3. Use a *verb-adjective-noun* format for detailed processes.
      * The *verb* describes the activity type, such as COMPUTE, VERIFY, PREPARE, PRINT, ADD, CALCULATE, and SEARCH.
      * The *noun* indicates what the significant outcome the process is, such as REPORT or RECORD.
      * The *adjective* illustrates which specific output, such as BACK- ORDERED INVENTORY, is produced.

Examples of complete process names are **COMPUTE SALES TAX**, **VERIFY CUSTOMER ACCOUNT STATUS**, **PREPARE SHIPPING INVOICE**, **VERIFY CUSTOMER ORDER**, and **CALCULATE AGENT COMMISSION**.

***Note:*** a process must also be given a unique identifying or reference number that indicates its level within the diagram. In the naming process that pertains to a system (subsystem), you do not need to follow the format applied to a detailed process (e.g., billing or billing system) (see Table 3.3)

**Table 3.3 Process**

|  |  |  |
| --- | --- | --- |
| **DFD ELEMENT** | **GANE AND SARSON SYMBOL** | **DEMARCO AND YOURDON SYMBOL** |
| Each *process* has   * a unique identifying number * a name (verb + adjective, if needed) * Use exact, meaningful names * at least one output data flow and at least one input data flow |  |  |

1. **Data flow**. It is an arrow on a DFD, reflecting data movement between systems, data stores, and external entities. It's a single piece of data or logical information. Examples of data flow names are **GRADE, INCOME, INVOICE, QUANTITY AVAILABLE,** and **ORDER RECEIPT.**

**Table 3.4 Data Flow**

|  |  |  |
| --- | --- | --- |
| **DFD ELEMENT** | **GANE AND SARSON SYMBOL** | **DEMARCO AND YOURDON SYMBOL** |
| *Data flow* has   * has a name (a singular noun) * one or more connections to a process |  |  |

1. **Data Store**. It is a place where the data are kept by one or more processes awaiting future access. A depository is called with a noun for data allowing data to be added and retrieved. Data store represents a database file or part that stores

information about a data entity. It's a location inside the device where data is processed and retrieved.

* The data flow from the data store shows that data is being retrieved from the data store.



* Data flow going into a data store indicates that information is added to the data store.



**Table 3.5 Data Store**

|  |  |  |
| --- | --- | --- |
| **DFD ELEMENT** | **GANE AND SARSON SYMBOL** | **DEMARCO AND YOURDON SYMBOL** |
| Every *data store* has   * a number * a name (a noun) * one or more input data flows * one or more output data flows |  |  |

1. **External Entity**. It is often referred to as a data source or endpoint, or terminators because they are data origin or end destinations. It is a person, organization, particular type of a department, or another information system that provides data input or accepts data outputs or a system external to the system but interacts with it. It lies beyond the boundaries of the investigation's current area.

The critical thing to remember about an external entity is that it is external to the system, but may or may not be part of the organization. People who use the data or information from the system to do other processes or the one who decides what data or information goes into the system are defined as external entities.

##### Examples: CUSTOMER, MANAGER, STAFF, SUPERVISOR, and TEACHER

**Table 3.6 External Entity**

|  |  |  |
| --- | --- | --- |
| **DFD ELEMENT** | **GANE AND SARSON SYMBOL** | **DEMARCO AND YOURDON SYMBOL** |
| Every external entity   * has a name (a noun) |  |  |

Rules in Creating Data Flow Diagram

When creating Data Flow Diagrams, there are specific rules that need to follow.

1. All data flows must flow to or from a process. All data must flow either coming from or going to a process. External entities, as well as data stores, cannot flow directly to each other. Remember that data cannot move between external entities or data stores without being processed first. All processes must be connected to either another process or a data store.

**Table 3.7 Do’s and Don’ts**

|  |  |
| --- | --- |
| **Don’ts** | **Do’s** |
|  |  |
|  |  |

1. Data flow should not split into two or more different data flows.
2. A Process must have at least one input flow and one output flow.

In a data flow diagram, when a process has input flow but no output flow, it is called a *black hole*. When a process has output flows, but no input flows, it is called a *miracle*. On the other hand, a process with at least one input and one output, but the input is insufficient to generate the output is called a *grey hole*. Remember that a process must have at least one input flow and one output flow.

A Process must have at least one input flow and one output flow.

Black Hole Miracle

ID Number

Grade

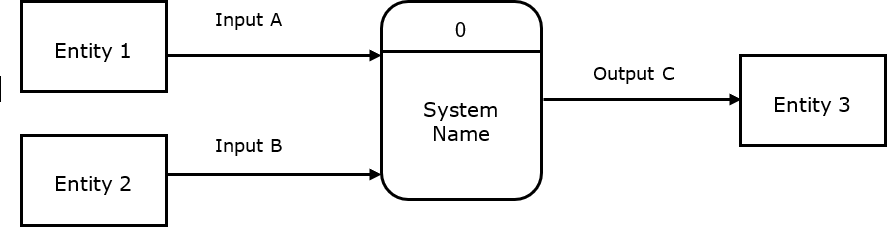
Grey Hole

1. Don't include more than nine processes on a DFD. If more than nine processes are involved in the system, group some of the processes that work together into the subsystem and place them in a level 2 diagram.

### Context Diagram

The Context Diagram is the high-level view of the information system. As the name indicates, the context diagram shows the entire or whole system in context with its environment. The purpose of the context diagram is to define and clarify the boundaries of an application system. It usually shows the flows of data or information between the information system and external entities. The entire application system is shown as a single process.

A context diagram is also called a Level 0 data flow diagram.



**Figure 3.2 Context Diagram**

### Levelled Data Flow Diagram

Data flow diagrams can be exploded or expanded into lower levels by separating processes into sub-process.

The Level 1 DFD shows the main processes, external entities, and data stores for investigation. A Level 2 DFD is usually produced for each process shown at level 1, though it is not always the case to break every process down to the next level.

On lower levels DFD, the processes are numbered using the following convention.

* 1. If the Level 1 DFD had a process in which the unique identifier is numbered one and consisted of 3 sub-processes, these sub-processes would be shown on a Level 2 DFD numbered 1.1, 1.2, and 1.3.
  2. If the second Level 1 DFD had process in which the unique identifier is numbered two and had two sub-process, these would be labeled as 2.1 and 2.2 on a Level 2 DFD.

It is important to note that the data flows shown on the lower level DFD match those shown on the context diagram. This is called "balancing."

##### The Data Flow Diagram of a Sample Accounting Information System

An excellent example of **an Accounting Information System (AIS)** is the one used by distribution companies – businesses that deliver to their customer's goods or services. We call the system the **distribution system**. As you research this method, it will help you think of a manufacturer, wholesaler, or retailer as a product-oriented company. But the distribution system can also be used in such hospitals and support organizations, and such government departments like the military. Both organizations, in one way or another, are in the distribution industry. Also, you might not find a company that processes its data precisely the same way as mentioned here. Our model is a general one which suits most companies in a general way.



Sales order

Commitment

Purchase order

Rejected sales

Invoice

Statement

DISTRIBUTION SYSTEM

Shipment

Supplier Invoice Supplier statement

SUPPLIER

Payments to supplier

Payments by customer

Income Statement

Balance Sheet

Budget report

Other reports

Stock Notice

CUSTOMER

MANAGEMENT

MATERIALS STOCKROOM

**Figure 3.3 A Context Diagram of the Distribution System**

The whole system is depicted in the center by the upright rectangle, which describes the entire operation. Horizontal rectangles reflect the environmental elements or entities connected to the system by arrows called data flows.

The distribution system's environmental elements include customers, suppliers, materials stockroom, and management. In DFD terminology, the term environment refers to the recorded method. Accordingly, some features, such as management and the materials stockroom, exist within the firm.

The data flows that link the company to its customers are very close to the company's flows to its suppliers. This is because the firm is the supplier's customer. The orders that the firms get from their customers are typically called *Sales Orders*, while the orders that the business places are called *Purchase Orders*. In some instances, the firm may first receive verbal *commitments* from its supplier before preparing the purchase orders.

Frequently, the firm will have to give notifications of *Rejected sales order* to its customers-maybe their credit rating is low. While suppliers also provide the firm notices of a rejected purchase order, we have omitted the flow for simplicity. Both the company and its suppliers use Invoices to advise customers how much money they owe, and *statements* to recover bills that are not paid. Finally, both the firm and its customers have to make their *payments* for their purchases.

The data flow from the distribution system to management consist of the standard accounting reports.

All but two of the data flows shown in the figure consist of conceptual resources; the two exceptions are the one from the suppliers to the system, which is labeled Shipments, and the one from the system to the stock room, labeled stock. The data may represent both conceptual and physical resources; data or information may be included in the conceptual resources.

**The Major Subsystems of The Distribution System**

The context diagram is perfect to describe the device boundary-the environmental elements and interfaces. Yet we need to understand more about the implemented operations. We can do this by defining the three major subsystems mentioned in Figure 3.4. This is considered a level 1 in DFD terminology. When used in a hierarchy, a sequence of DFDs is called levelled DFDs.

Figure 3.4 defines the subsystems by the numbered upright rectangles. The first subsystem is about filling customer orders, the second about ordering replenishment stock from suppliers, and the third about keeping the general ledger of the firm. You may note that the figure includes all four environmental elements or entities from the context diagram. The same applies to the data flows which link the distribution system to those elements. This condition creates balanced DFDs, which means that the same system relations appear on all the levels of the systems they are involved in.

Sales order



SUPPLIER

CUSTOMER

MANAGEMENT

MATERIAL

STOCKROOM

Rejected sales order notice

Invoice Statement

Payments by customer

Receivables ledger data Inventory ledger data

Received item

1

Fill Customer Orders

Purchasing

data

Commitment

3

Maintain General

ledger

Payables ledger data Other reports

Budget report

2

Order Replenish- ment Stock

Purchase order

Shipments notice Supplier Invoice Supplier statement

Balance sheet

Income

Payments to supplier

Stock notice

**Figure 3.4 A Level 1 diagram of the Distribution System**

##### Systems that Fill Customer Orders

Figure 3.5 shows the four central systems that are involved in filling customer orders – order entry, inventory, billing, and accounts receivable. Figure 3.5 is an explosion of **Process 1** in Level 1. It is called a **level 2**. The Level number refers to the corresponding process number on the next higher level DFD.

You will notice the relation of some of the arrows to small circles with numbers in them. The circles are connectors that set flows to other DFDs. The numbers identify the system numbers of the other DFDs. For example, the data flow labeled *Receivables ledger data* is connected to **Process 3**, which is the process that maintains the general ledger.

We will learn more about the four order-filling systems later. For now, you need only understand that the ***order entry system*** enters customer orders into the system, the ***inventory system*** maintains the inventory records, the ***billing system*** prepares the customer invoices, and the ***accounts receivable system*** collects the money from the customers.

CUSTOMER

Sales order

Rejected sales order notice

Payments by customer

Statement

1.1

Order Entry

Accepted order

Completed order

Filled item

1.2

Inventory

Invoice

Billed order

1.3

1.4

Accounts Receivable

Billing

Receivables ledger data

Inventory

Ledger

Purchasing

**2**

Received item

**3 2**

**3**

**Figure 3.5 Level 2 diagram of the Systems that Fill Customer Orders**

##### Systems that Order Replenishment Stock

Similarly, we describe the subsystems that deal with the suppliers ordering replenishment stock. This detail is shown in figure 3.6, and it is called a **level 2 diagram** because it explodes **Process 2** of the Level 1 diagram. The ***purchasing system*** issues purchase orders to suppliers for the needed stock, the ***receiving system*** receives the stock, and the ***accounts payable system*** makes payment.



**1**

Purchasing data

2.1

Purchasing

Commitment

Purchase Order

Filled purchase order

Issued purchased order data

Shipment

SUPPLIER

2.2

Receiving

Received item

**1**

Stock

Received purchase

Incurred obligation

Payables ledger

data

2.3

Accounts payable

Supplier invoice Supplier statement

Payments to supplier

**3**

MATERIALS STOCKROOM

**Figure 3.6 Level 2 diagram of the Systems that Order Replenishment Stock**

##### Systems That Perform General Ledger Processes

Figure 3.7 shows the detail for the last three processes in Level 1 – *Maintain general ledger*. The ***general ledger system*** is the accounting system that combines data from other accounting systems to present a composite financial picture of the firm's operations. The file that contains the combined accounting data is the ***general ledger***.

Two subsystems are involved. The first, called the ***general ledger update subsystem***, posts the records that describe the various actions and the transactions to the general ledger. The ***report preparation subsystem*** uses the contents of the general ledger to prepare the manager's reports.

The general ledger system will not be recorded in any greater detail than seen here. Figure 3.7 is necessary to comprehend the system.

Unlike previous DFDs, Figure 3.7 includes a **data store** – the DFD term for a file or table in a database. The data store is illustrated by an open-ended rectangle with a number on the left side and labeled with the name, such as *general ledger*. We did not include data stores in the higher-level DFDs because we wanted to keep those diagrams as uncluttered as possible. As we drop down to the next level of detail, we will encounter more data stores.

Now that we have a clear description of the distribution system, we will explain the subsystems used to fill customer orders and order replenishment stock.

Management report data

Receivables ledger data

**1**

**1**

**2**

Inventory ledger data

Payables ledger data

3.1

Update General Ledger

General ledger record

Updated general ledger record

D1



3.2

Prepare Management report

Other reports Budget report

Balance sheet

Income Statement

MANAGEMENT

General ledger

**Figure 3.7 Level 2 diagram of the Systems that Perform General Ledger Processes**

##### FILL CUSTOMER ORDERS

We will use the numbers from the DFDs to explain and subsystem to make it easier to relate the narrative to the diagrams. We're all going to say the system is computer-based.

##### ORDER ENTRY

Figure 3.8 documents the order entry system. It is a **child diagram** of level 2 diagram of the systems that fill customer orders – it documents in greater detail the processing in step 1.1 of the level 2 diagram (figure 3.5).

* + 1. **EDIT ORDER DATA**. Sales order forms are used by firms to document the details required to process a customer order. When the customer receives the purchase order, it will be checked for missing or incorrect information. Where appropriate, the order entry clerk corrects errors – for example, searching for a customer number. But if a correction can't be made, as in the case of reconciling a difference between item number and name, the clerk prepares a *Rejected sales order notice* that is sent to resubmit the corrected order. The clerk also files the sales order in a file named *Sales Order Edit Rejects*. The rejected orders will be held in that file,

called a *suspense file*, until the customer resubmit new orders or placed in a history file. We will not include that activity in our system.

The third output from process1.1.1 consists of the *Edited orders* that passed the edit. These orders are the input to the next step.

* + 1. **COMPUTE CREDIT CHECK**. The purpose of this step is to determine whether the firm wants to do business with the customer. This is accomplished with a credit check.

One approach to performing a credit check considers the effect of the order amount on the customer's reports receivable amount. The **accounts receivable** is money due to the firm for previous sales. The receivable amount is maintained in the Accounts Receivable file. Still, we also include that data in a particular file called a *Customer credit file* used to conduct the credit check. Also, in the Customer Credit file are the customer credit limits. A **credit limit** is the total amount of receivables that the firm is willing to accept from a customer.

The data flow labeled *Credit data* includes both the receivable amount and the credit limit. The order amount is added to the receivable amount, and the sum is compared to the credit limit. When the credit limit is exceeded, the order is rejected. Orders that do not pass the credit check are filed in the *Sales Order Credit Rejects file*, and *Rejected sales order notices* are sent to the customers.

The third output from the credit check is the Edited and checked orders, which are input to the next step.



Sales order

Edit reject

Sales order edit rejects

Rejected sales order notice

Rejected

sales order

1.1.1

Edit Order data

Edited order

Customer Credit file

Credit

data

1.1.2

Compute

Accepted order

**1**

1.1.3 Edited & checked order

Log In

Credit check

orders

Order data

Credit reject

Sales order

1.1.4

**1**

Completed order

Mark filled orders

Date filled

Order log

D5

D4

D3

D2

CUSTOMER

**Figure 3.8. Level 3 diagram of the Order Entry System**

* + 1. **LOG IN ORDERS.** When an order is accepted, a brief identifying description is entered in an Order Log, and an *Accepted orders* record is written and is input to the inventory system. The **Order Log** is used to follow up on orders to make sure that they are filled. The order log contains such data elements as customer name, customer order number, customer order data, and order received date. Orders in the file are called **open orders**. That means they are unfilled.
    2. **MARK FILLED ORDERS**. The first three steps of the order entry system from a connected chain. Data link them flows, with no intervening data store. Step 1.1.4 is separate because it is performed later – when the billing system signals that orders have been filled. The *Completed orders* data flow is created by the billing system to serve as the signal. In step 1.1.4, the order log records for the filled orders are marked by *entering the date filled* to indicate that they are no longer open.

The informative value of that file is improved by documenting the date filled out in the order log. To evaluate open orders, the computer will search the fields filled into the date. It may also compare the dates the orders were finished with the dates they were issued to decide how long it takes for orders to be filled in. This information is valuable for managers.

##### INVENTORY

When a decision has been taken to accept the orders, there must be a decision about whether they can be filled in. Figure 3.9 shows the four main processes of the inventory system. Two processes (1.2.1 and 1.2.2) accomplish the order filling. The other processes (1.2.3 and 1.2.4) have additional responsibilities.

* + 1. **CHECK THE BALANCE ON HAND**. The first step is to check the balance on hand for each ordered item. The *Item record* for the ordered item is retrieved from the Inventory file. The balance-on-hand field from the record is compared with the order quantity from the accepted orders record to see if adequate stock exists to fill the order. For those orders that cannot be filled, Backorder records are entered in the Backorder file. A **backorder** means, "We cannot fill the order now, but we will later replenish our inventory."

This is the point where all of the data elements relating to the inventory item are obtained. The inventory record includes such elements as item descriptions and warehouse locations that will be used later. It will not be necessary to reaccess the inventory file by retrieving the data here and carrying it along with the transaction data. Accessing records is usually the most time-consuming part of any design and is minimized as much as possible.

When the order can be filled, an *Item available* data flow provides the next process's linkage.

* + 1. **CHECK THE REORDER POINT.** In the case of filled orders, the next step is to determine whether the new, lowered balance on hand caused the reorder point to be reached. Each item record contains a reorder point field. The **reorder point** is the inventory quantity that triggers a stock replenishment activity. When the balance on hand drops to the reorder point, it is time to reorder. The reorder point is set high enough to receive the new supply before all of the stock is entirely exhausted – a

**stockout**. At least that is the plan. When the reorder point has been reached, reorder data is recorded as *Purchasing data* to be used by the purchasing system.

The order-filling process is completed by writing the *Updated item records* back to the inventory file. Each of these updated records contains the new balance on hand.

The *Filled items* data flow provides the linkage to the next order-filling system

– billing.

**1**

Inventory

1.2.3

Received

Accepted order

1.2.1

Backorder record

Check balance on hand.

Item record

Add received items

**2**

Items available

D7

D6

Backorder file

Inventory file

Updated item

1.2.2 record

Filled item

Check reorder point

Purchasing data

Inventory

record

1.2.4

Prepare general ledger

**1**

Inventory

**2**

Ledger data

**3**

**Figure 3.9. Level 3 diagram of the Inventory System**

* + 1. **ADD RECEIVED ITEMS*.*** The above processes reduce inventory balances when orders are filled. Another process increases balances when replenishment stock is received from suppliers. Step 1.2.3 uses the *Received items* data flow from the receiving system and updates the balance-on-hand fields of the inventory file's received items.
    2. **PREPARE GENERAL LEDGER DATA.** Inventory data is an essential input to the general ledger system. The value of the inventory is included as an asset on the balance sheet. This step extracts data from the Inventory file that the general ledger system needs and passes it along to that system in the form of the *Inventory ledger* data flow.

##### BILLING

An invoice, or bill, is the official notice that the firm sends to its customers to advise them of the amount of money owed. The system that prepares the invoices is the **billing system**. Figure 3.10 illustrates the two main billing processes.

As a consumer, you receive invoices that you probably do not identify as such. Each time you use your credit card, the slip that you sign is an invoice. It describes a single credit transaction and establishes your obligation to pay at a later date.

**1**

Filled item

1.3.1

Obtain customer data

Customer data

D8

Customer file

Invoice

data

1.3.2

Invoice

Prepare customer invoice

Billed order

**1**

Completed order

**1**

CUSTOMER

**Figure 3.10. Level 3 diagram of the Billing System**

* + 1. **OBTAIN CUSTOMER DATA.** First, the inventory data for the filled items are supplemented with customer data from the Customer file. The customer data includes such elements as name, and address, shipping instructions, and salesperson number. These elements will be printed on the invoices and other such documents as management reports. The output *Invoice data* from this step contains both the inventory and customer data.
    2. **PREPARE CUSTOMER INVOICES.** Preparation of the invoices requires that each **line item**, or item listed in the body of the form, be **extended** by multiplying the quantity's price times. Other arithmetic includes accumulating a total amount for all of the items and perhaps computing a sales tax.

After the *Invoices* are printed, they are mailed to the customers, and the *Billed orders* data is passed along to the accounts receivable system. The *Billed orders* data do not include detail about each line item. Instead, this information summarizes the

billing transaction by identifying the invoice number, invoice date, customer name and address, customer order number, salesperson number, and invoice amount.

Now that the order has been filled, it is necessary to notify the order entry system so that the filled status can be reflected in the order log. This notification is accomplished with the *Completed orders* data flow.

##### ACCOUNTS RECEIVABLE

Figure 3.11 shows four processes performed by the accounts receivable system. This system is unique in that each process is conducted separately from the others. This situation exists because each process has a trigger.

* + 1. **ADD NEW RECEIVABLES.** Records are added to the Accounts Receivable file immediately the next billing. The *Billed orders* trigger occurs daily.
    2. **DELETE PAID RECEIVABLES.** Likewise, records are removed from the Accounts Receivable file reflect *Payments by customers*.
    3. **PREPARE CUSTOMER STATEMENTS.** On a monthly basis, the Accounts Receivable file is used to prepare *Statements*. A **statement** is a reminder that money is owed on one or more invoices. It is common practice to give the customer thirty days to pay their invoice. The receivable is considered **current** until thirty days have passed since the billing date. Then, the receivable becomes **past due**.

A statement contains a single line for each **outstanding invoice** – an invoice that has not been paid. The statement you receive each month from a credit card company lists all of your outstanding invoices (unpaid purchases).

* + 1. **PROVIDE GENERAL LEDGER DATA.** Also, monthly, the receivables system provides Receivables ledger data to the general ledger system that appears on the balance sheet as an asset.

At this point, we have handled all of the activities related to customer orders. Next, it is necessary to respond to the inventory system's reorder point signals and procure replenishment stock.



Billed order

**1**

Receivables

1.4.1

Add new receivables

New Receivable

1.4.4

Provide general ledger

Receivables

Statements record ledger data

D9

Accounts Receivable file

**3**

1.4.3

Prepare customer statement

Statement

CUSTOMER

Receivables records to delete

1.4.2

Delete paid receivable

Paid receivables

Payments by

customer

D10

Paid receivables file

**Figure 3.11. Level 3 diagram of the Accounts Receivable System**

##### ORDER REPLENISHMENT STOCKS

The three systems that work together to order, receive, and pay for replenishment stocks are purchasing, receiving, and accounts payable.

##### PURCHASING

The purchasing department consists of several buyers responsible for selecting suppliers to provide replenishment stock and negotiating such arrangements as price and delivery date.

The inventory system triggers the purchasing system in step 1.2.2, figure 3.9, when the reorder point is reached. A record is added to the *Purchasing data flow,* which serves as input to the purchasing system. Figure 3.12 shows the four subsystems of the purchasing system.

* + 1. **SELECT SUPPLIERS.** The buyer decides which supplier should be considered to provide the replenishment stock, using data from the Supplier file and possibly other sources. The Supplier file maintains data that describes the supplier's past transactions with the firm in terms of material quality, prices, and ability to meet promised delivery dates.

**1**

Purchasing data

2.1.1

Select Prospective

Supplier

Past performance data

D11

Inventory and supplier data

Supplier file

2.1.2

Obtain verbal commitment

Commitment

**2**

Issued purchase 2.1.3

Order data

Prepare

Incurred obligation

Purchase order

**2**

purchase orders

Purchase Order record

SUPPLIER

D12

Outstanding

Purchase records to closeout

D13

Purchase order

Removed purchase

order record

2.1.4

Closeout purchase orders

Filled purchase order

**2**

* + 1. **OBTAIN VERBAL COMMITMENTS**. When the buyer determines which suppliers are the best prospects, they are contacted by telephone or perhaps by a data communication network to reach the agreement.

**Figure 3.12. Level 3 diagram of the Purchasing System**

* + 1. **PREPARE PURCHASE ORDERS.** The buyer then uses his or her terminal to initiate the preparation of the purchase order.

Another input is the *Purchase order records* that are added to the Outstanding Purchase Order file. The file provides a degree of control over purchase orders becoming lost in the mail or shipments not being made as promised. When the file is stored on a magnetic medium, the computer can scan each record daily and advise the appropriate buyers of each **outstanding purchase order** – one that should have been filled but has not. The buyers can follow up with the suppliers to determine the reasons, an example of management by exceptions.

The order two outputs from Step 2.1.3 are notifications to other systems that a purchase has been made. The I*ssued purchase order data* flow alerts the receiving system that a shipment is due. The *Incurred obligations* data flow notifies the accounts payable system that an invoice is expected from the supplier. We will see shortly how these two notifications are used.

* + 1. **CLOSEOUT PURCHASE ORDERS.** It is necessary to remove records from the Outstanding Purchase Order file when the orders are filled. This signal comes from

the receiving system in the form of the *Filled purchase orders data* flow. The *Removed purchase order* records are filed in the Purchase Order History file.

Of all the subsystems in the distribution system, purchasing has been the most difficult to computerize. The main reason is that the human element is so important. All of the activities revolve around the negotiations of the buyer with the suppliers.

This situation seems to be changing. Innovative communications technologies such as ISDN, EDI, and videotext are being applied in the purchasing area to improve the information flow between the firm and its supplier. Besides, knowledge-based systems are being programmed to make some portions of the buyer’s decisions.

##### RECEIVING

The receiving system has the responsibility of updating the firm's conceptual system to reflect receipt of replenishment stock from suppliers.

* + 1. **PROCESS RECEIPTS**. You recall that the purchasing system alerted the receiving system to a future receipt with the *Issued purchase order data* flow. See Figure 3.13 those records are kept in the Purchase Items file until the receiving process is triggered. The trigger comes when a truck delivers the *Shipments* to the receiving dock. The shipping cartons are opened by receiving personnel, who visually inspect the contents for breakage, count the items, and remove the packing slips. A **packing slip**, often a copy of the supplier’s invoice, is enclosed in each carton as a record of the contents. The receiving clerk processes the receipt using a terminal located in the receiving area to retrieve the *Purchase item* data from the Purchased Items file. The clerk compares data elements on the packing slip using the displayed data – the firm's purchase order number, the items number, and the quantities – to corresponding entries on the screen display.

The purpose of these inspections is to ensure that the supplier shipped the ordered merchandise and the merchandise was received. When everything checks out, the stock is routed to the materials stockroom, and *Receipt information* is assembled.

* + 1. **NOTIFY OTHER SYSTEMS**. The *Receipts information* consists of all the data used by other systems. A *Received items* data flow is directed to the Inventory system to report on the item numbers and quantities used to update the Inventory file. A *Filled purchase orders* data flow is directed to the purchasing system for use in closing out the outstanding purchase orders. The next section will see how the *Received purchase* data flow is used by the accounts payable system.

Communication-oriented systems do an excellent job of transmitting the three receipts notices with little or no delay. In manual systems, it can take days for the notifications to reach everyone.

|  |  |
| --- | --- |
| SUPPLIERS | |
|  | Shipment |

**Figure 3.13. Level 3 diagram of the Receiving System**

**2**

Issued purchase order data

Purchased item data

Purchased items file

Stock

2.2.1

Process

receipts

Receipt Information

Received item

2.2.2

Notify other systems

**1**

Filled purchase orders

**2**

Received purchase

**2**

D14

MATERIALS

STOCKROOM

##### ACCOUNTS PAYABLE

The accounts payable system is responsible for paying the supplier for the purchases. Before payment is made, the firm wants to make sure that the money is owed. This certainty is established when three conditions exist:

1. There is proof that the *stock was ordered*. This proof is provided by a record in the Accounts payable file.
2. There is proof that the *stock was received*. This proof is provided by the Received Purchases file that contains the notification of the receipts by the receiving system.
3. An *invoice has been received* from the supplier, as reflected in the Invoice and Statement file.

Figure 3.14 shows the process of the accounts payable system.

* + 1. **SET UP SUPPLIER PAYABLE RECORDS.** Records are added to the Accounts Payable file when the *Incurred obligations* data flow is received from the purchasing system. Considerable time then might elapse before the items are received.

|  |  |  |
| --- | --- | --- |
| D1 | Received purchases file | |
| Receipt data | |  |

**Figure 3.14. Level 3 diagram of the Accounts Payable System**

Payables record

**2**

New payables data

Incurred obligation

2.3.1

Set up supplier payables

2.3.4

Provide general ledger

Payables ledger

**2**

Received

purchase

Accounts Payable file

**2**

Payables records to delete

Paid payables record

Paid payables

file

2.3.3

Payment data

Delete paid payables

Invoice & Statement file

Paid supplier data

2.3.2

Make supplier payments

Invoice data

Payments to supplier Supplier statement

Supplier invoice

D1

D1

D15

SUPPLIERS

* + 1. **MAKE SUPPLIER PAYMENTS.** S*upplier invoices* and *Supplier statements* are entered in the Invoice and Statement file, where they are held until payment is made. Payments are made when all three of the conditions, as mentioned earlier, have been met. *Payment data* from the Accounts Payable file and *invoice* data from the Invoice and Statement file are used in making the *payments to suppliers.*
    2. **DELETE PAID PAYABLES**. When a supplier payment is made, the corresponding record is removed from the Accounts Payable file and added to the Paid Payables file.
    3. **PROVIDE GENERAL LEDGER DATA**. The accounts payable system provides data to the general ledger system. Payables are shown as liabilities on the balance sheet.

This brings our journey across the distribution system to an end. Although it might have seemed complicated, our system is straightforward compared to the ones other businesses use. We skipped quite a few exceptions routines – tasks that only

happen periodically but have to be accounted for when developing an operating system. We did not provide, for example, the processes of withdrawing rejected sales orders from their suspense files of follow-up on backorders. But even though the system has been streamlined, it gives a clear understanding of what data processing entails using a computer-based system.