Tutorial: What is a Data Base? (Abstracts* taken from an original paper presented during the SIGBDP, SIGFIDET Tutorial Sessions, ACM 72)

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1. Definitions

Solely for the purposes of ... this tutorial, these four terms are defined: ENTERPRISE, ENTERPRISE INFORMATION, DATA BASE SYSTEM, DATA BASE PROBLEM, DATA BASE.

ENTERPRISE: a well defined environment for which an information system exists -- probably, this environment is under a single administrative control (the significance of "what is the enterprise" will be discussed) ....

ENTERPRISE INFORMATION: that collection of facts ... used to operate the enterprise -- the point will be discussed that enterprise information is more than what is generally considered to be the data base.

DATA BASE SYSTEM: a computer system to which ... certain functions related to enterprise information have been assigned.

DATA BASE PROBLEM: the degree to which certain information functions are being suggested for transfer to a computer system and how such functions would be distributed among the elements of the computer system (such as the application programmer, the data base administrator, the language processors, or data management.)

DATA BASE: that portion of enterprise information under the custody and control of the data base system.

2. Purpose

Understanding

A computer system can be, and has been, used to relieve people of the effort required for custody, creation, and use of information.

An understanding of the environment from which the concepts of data

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* - Abstracting was done by editor of FDT, April, 1973 -- most, of course, remains as presented at the Tutorial Session. Editor may have erred somewhere slightly while converting from a visual-presentation paper to format more suitable to our needs. If so, fault is mine, not Harry's.

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bases have emerged will help to judge, first, the extent to which computer systems today are capable of assuming certain information functions, and, second, the extent to which more technology must be developed to have the ability to assume more information functions.

Appreciating

... state of the art, and opportunities for further development:

No claim is ... made that the technology exists today ... which can provide for the full function of information processing by a computer system, and no claim is being made that, if it did exist, everybody would want it.

This half of (this two-part) ... tutorial will address the "understanding" area, and the second half of the stated purpose (... "appreciating" ...) will be left to John Lyon ... and to you ....

Opportunity through technology

* Stored Programmed Computer
* Direct Access Storage Devices
* Demountable Media for Direct Access Devices
* Telecommunications
* Terminal Devices

Figure 1

3. Figure 1's purpose is to illustrate areas of technology related to the computer and which have encouraged the use of computers to relieve people ... of certain functions associated with information processing.

The sequence of these items implies neither a sequence of importance nor of availability.

First ... is the computer itself ... significance of this type of computer is ... that because it is a stored program computer it is general purpose. It is in no way oriented towards any particular application, industry, or type of work -- it can be used for any form of (information) manipulation you choose.

Second ... is ... the family of devices such as disks, drums, large core storage ..., which can replace magnetic tape as a ... storage medium and can eliminate the requirement for sequential processing of information..

Significance of additional items (in the Figure) should be obvious ... each provides either new or improved function ...., which leads us to the next Figure.

A moving target

* Functional Capability
* Performance of Function
* Cost of Function

Figure 2

4. The Figure above is associated with the examples of new technology, and makes the point that in general, at a moment in time, functional capability is limited, but through (the passing of) ... time, additional function becomes available. However, often the performance level of new functions are limited, and the cost ... is high.

Often the second phase of new function is an increase in performance, such as capacity, speed, or reliability, and the third phase is reduction in cost of function.

The message here is: don't freeze information systems -- design to a moment-in-time technology. Take advantage of the changing economics, and don't let the fundamental information problem get mixed up with ... compromises to limited functional capability.

Enterprise/ Information

* A System
* A Model
* Matter of Degree
* Life Blood
* A Resource
* Discipline

Figure 3

5. The illustration which follows this (Figure 4) considers the relation which exists between the enterprise and the enterprise information. (Such information may be said to be "internal" or "external ...) External information is of two kinds.

The first kind of "external information" is (that) ... which causes the enterprise to react to an external influence. An example would be that of a customer placing an order for products from the enterprise.

The second kind "external information" is information ... required by the enterprise to be able to operate, but it is also information for which it is dependent upon someone outside of its control to provide. For example, customer billing must include certain forms of taxes, but what tax to impose -- and at what rate-- are some things the enterprise cannot decide itself but must gain from various branches of government.

There is a host of information needed to operate the enterprise which is only available externally.

(As with "external" types, there are two types of "internal" enterprise information.)

The first type has as its source recorded events. An example might be that of a manager who initiates action to increase the salary of one of his employees.

The second type creates enterprise information internal to the enterprise within the information system. An example could be preparation of the weekly payroll.

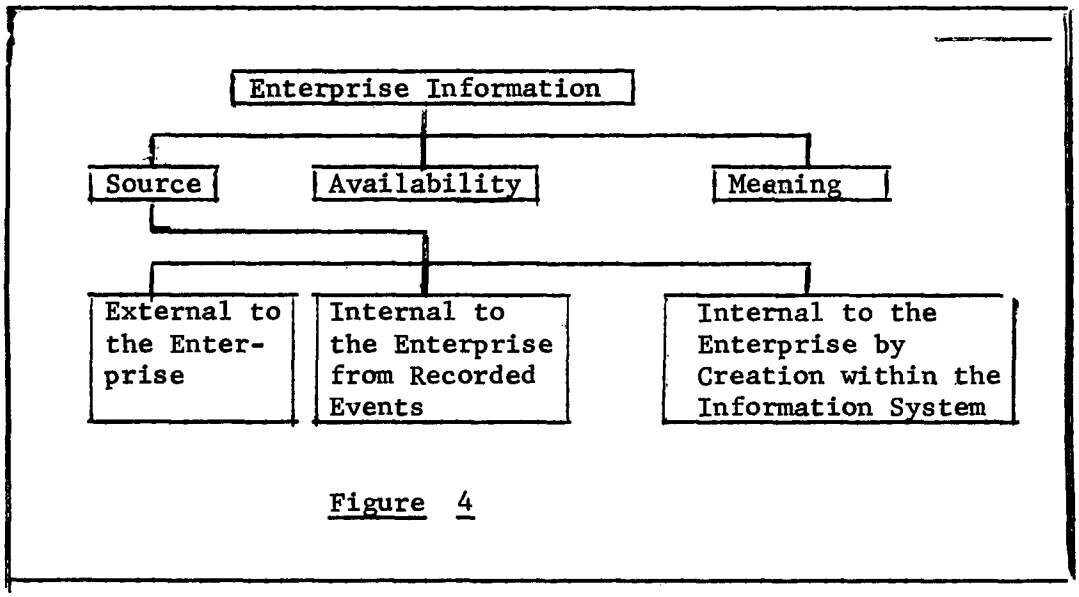

Figure 4

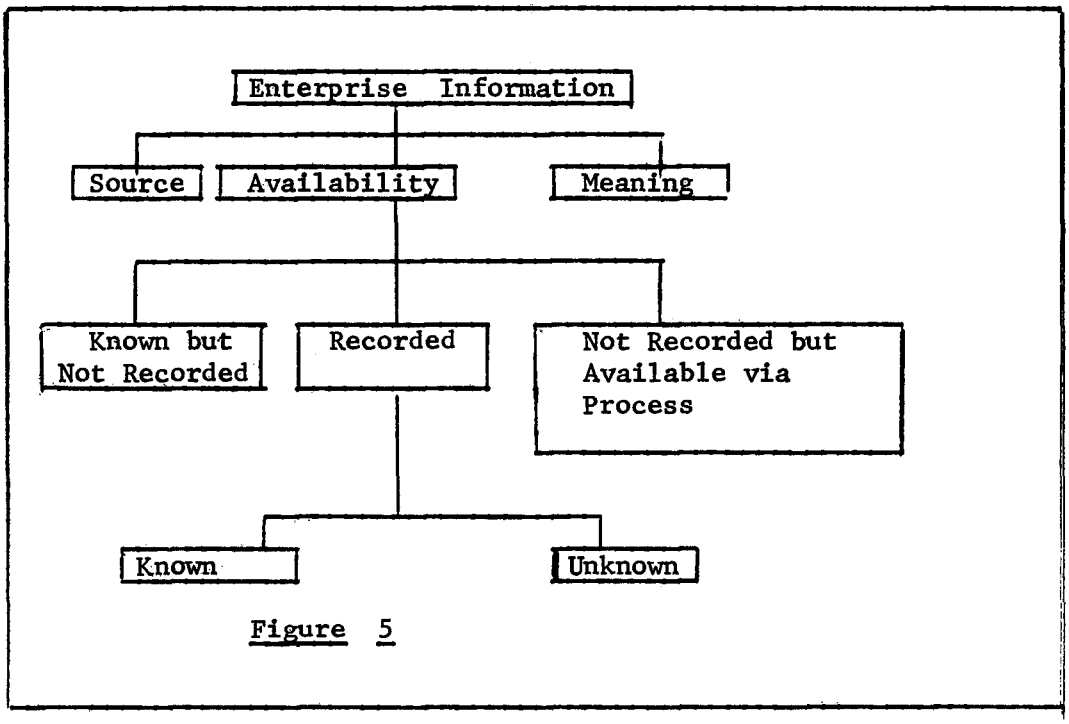

Figure 5

6. Figure 5 ... illustrates the availability of the information used to operate the enterprise ... of particular importance is the class on the left, "known but not recorded."

This is the information which people "know" because of their experience and training and, incidentally, is one of the major problems encountered in an attempt to formalize a going system. People are often reluctant to lose their status of (being) ... indispensable because no once else has even understood how they performed their work.

This does not imply that two people who "know" a piece of information know it the same way. This leads to many interesting problems.

I ... never heard of anyone who ... tried to identify all of the information it takes to operate a business and (to) ... focus attention upon the area of unrecorded information. I would .. guess that it would be a significant portion of the total information.

Recorded information is fine as long as its existence is known and some thought has been given to the value of having it and keeping it. On the other hand, it would be sad if information were really needed (and) ... nobody remembered that it was recorded in the system.

Another point ... should be made .... (T)hat is, that normal use alone should not determine the retention value of information ... (since) ... there can be a class of information which someday may have legal value. The ... problem of this is the fact that it is almost impossible to anticipate what information may have future legal value.

The last type of available information is that which while not recorded in the system is available by process from other recorded information. For example, (consider the question) ... "what is the trend of usage for a particular supply item, adjusted for substitutions?" What is significant in considering this type is that users must be aware that ... processes which create this kind of information are available.

There ... should have been a fourth class of available information (drawn into the foregoing figure).... This is information which is actually available (although) ... its existence and significance are not recognized.

7. Now we will consider the meaning of the information it takes to operate the enterprise. The following Figure establishes four general categories which will be discussed individually ... (hereafter.)

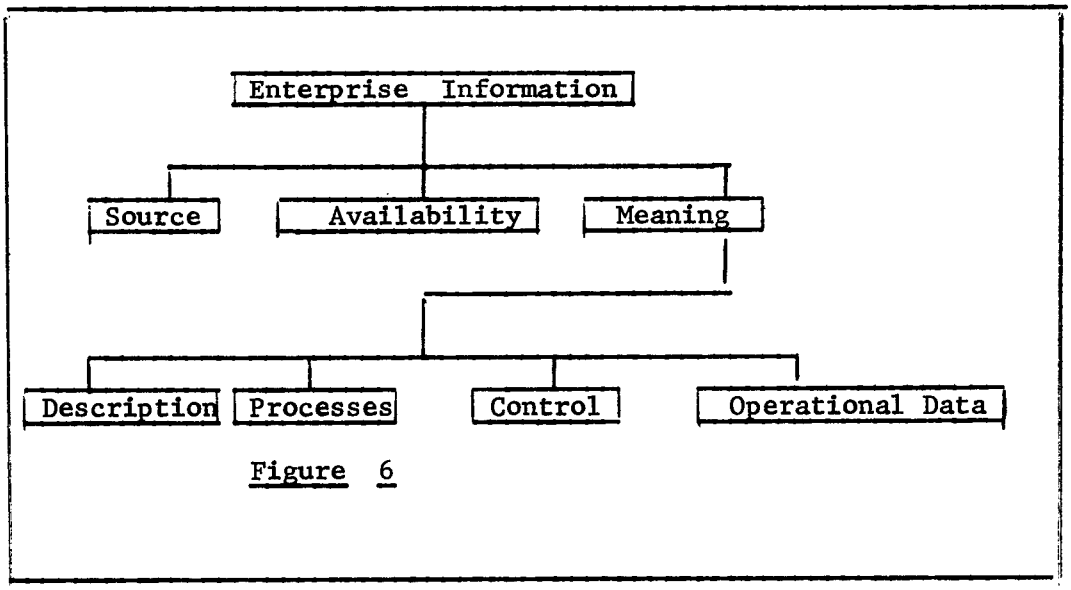

Figure 6

8. "Description Information" is probably the class of information which contributes the most to the previously discussed "known but not recorded" information.

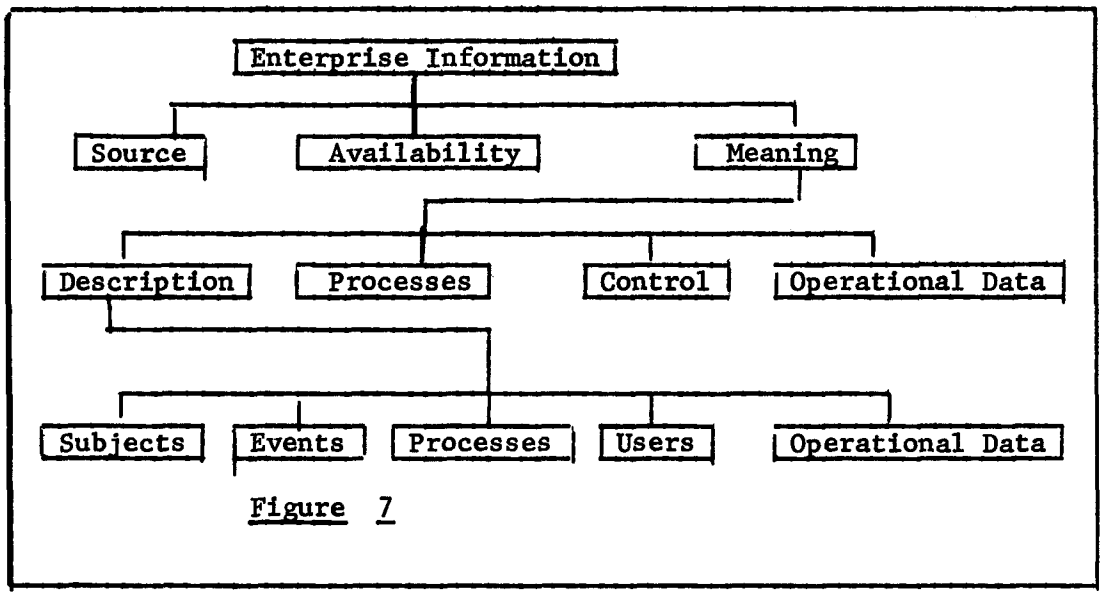

Figure 7

(See Figure above) ...

"Subjects" refers to the things about which the enterprise is concerned in its operation, such as customers, products, employees and equipment. Examples of "subjects" ... could be ther precise meaning of "employee" in the system. While a person remains in the tax report for the full calendar year, he is probably dropped from the next organizational directory after termination of employment.

(Moving from left to right, in the Figure, notice that) ... the second item is "events" ..., those actions which cause the enterprise to react and about which information is recorded and information created.

Description of events could include information such as who has authority to originate ... (some specific enterprise) ... action, who must approve the action, what information is associated with the action, and what are the process nodes of the information system through which the event information flows.

Description of "processes" refers to what information processes take place within the system but not how they perform the process.

Description of "users" would include the authorities, responsibilities, and priorities assigned to users with respect to the information system.

Description of "operational data" is the description of the attributes of the subjects. For example, what information is available from the system regarding individual employees and for each piece of information would be a description of its source, reliability, frequency of change as well as a precise definition of its meaning ... (e.g.,) ... just what does "salary/performance ratio" mean?

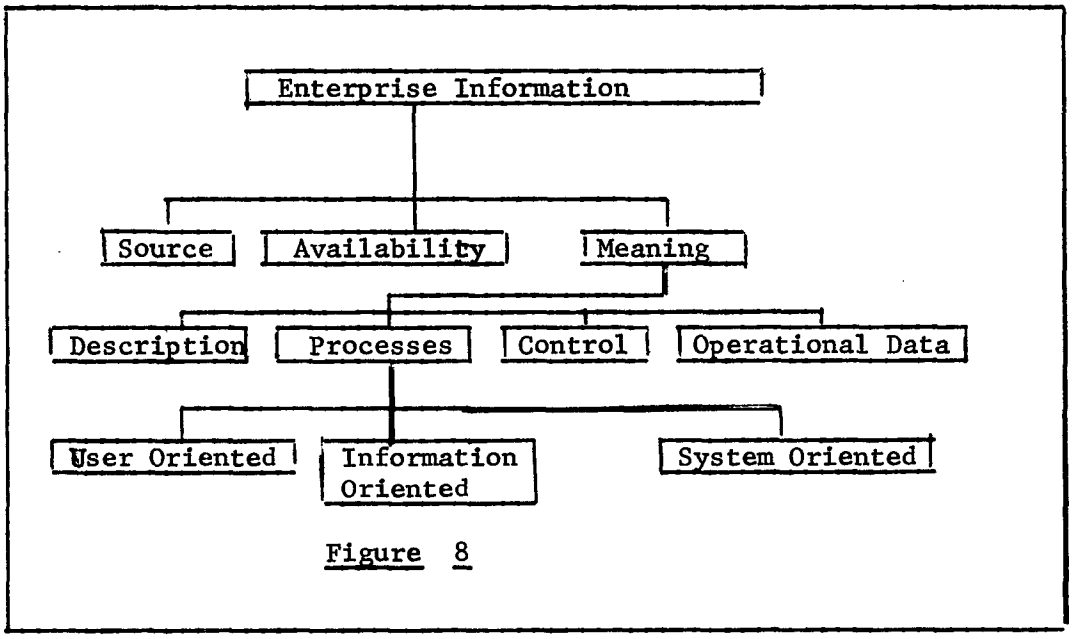

Figure 8

9. Regarding "processes," we are talking about description of actual process mechanisms and how they perform the functions of information processing.

"Processes" appear to be oriented towards three purposes:

"User-oriented" ... processes provide users with information --- for example, the mechanism which prepares monthly cost statements for cost centers is operating in a user-oriented mode.

An example of an "information-oriented" process would be the mechanism that maintains the integrity of the information by preventing misuse of information

An example of a "system-oriented" mechanism would be the overall control of the information system by application of priorities of classes of

work within schedules of work.

Unfortunately, very often the processes of a system get these three classes ... so mixed up they are hard to separate.

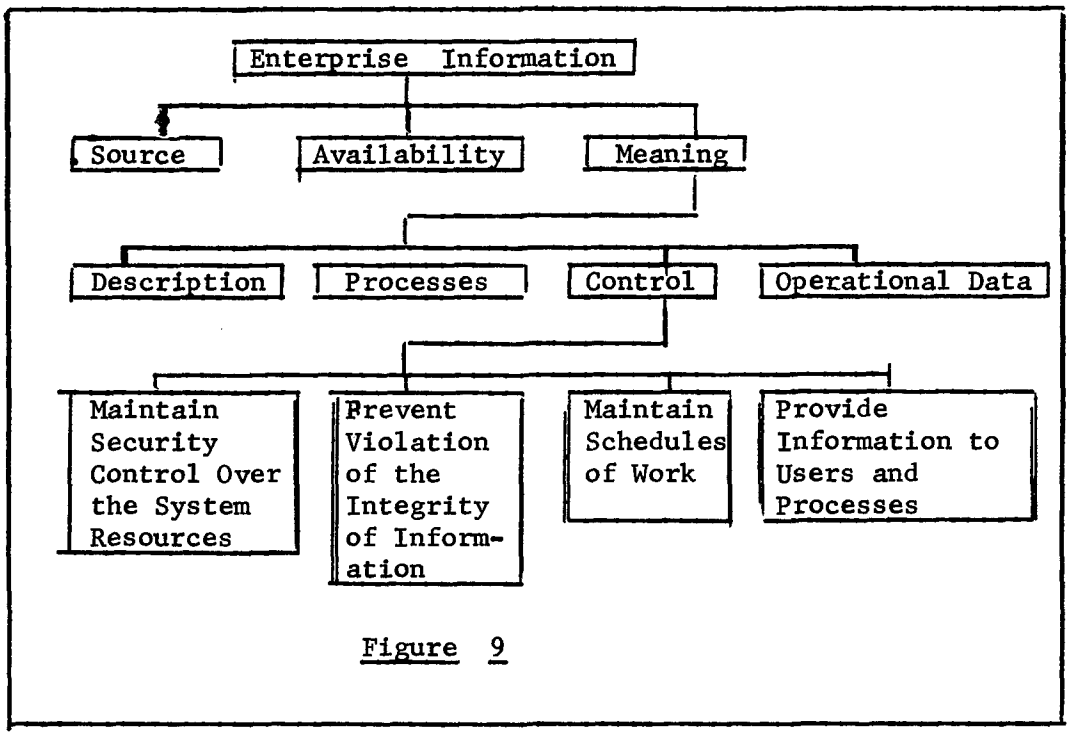

Figure 9

10. In Figure 9 (above) ... we have "control" information which is the information required for the previously-discussed "processes" to accomplish their function.

The first collection of such information is associated with the authority users and elements of the system must have before they can be allowed to ... use ... resources of the system.

The second collection ... is associated with protection of the integrity of information in the system from users or from the system itself. Regarding collections of information, this would include conventional accounting controls ..., a part of any well controlled system, ... which will detect the loss or error in groups of information values. Another form could be the information in the system which would prevent illogical processes such as extracting the square root of someone's social security number.

The third collection ... is associated with schedules of the work of the system and priorities, e.g., "it's Friday night and the weekly payroll has top priority."

Another example would be ... the label on a file drawer which states "A thru M," providing the file clerk with information with which to find the "Abbott" folder in a collection of filing cabinets. It is such a collection of "control information," together with (its) ... processes, which makes possible application of the concept of integrated data processing.

11. Before discussing so-called "operational data," which is information about the "subjects" of interest to the enterprise, here is a list of subjects which might have this interest:

Capital Equipment; Chart of Accounts; Customers; Employees; Inventory Items; Occupations; Organizations; Products; Salary Grades; Supply Warehouses; and Supplies.

To illustrate the fact that "operational data" is information about "subjects," consider the following (list as an example) ... of a few pieces of information which probably would be known to a system about individual employees.

Information About Subjects

Employees:
Name
Employee Number
Social Security Number
Date of Hire
Occupation
    Title
    Effective Date
Salary
    Hourly Rate
    Effective Date
Organization
    Name
    Effective Date

Figure 10

You will note in the example of this Figure that for occupation, salary, and organization, an effective date is shown, which implies a history of values,and (that) if this history of values and of effective dates were traced back through time, the first effective date of each would probably be the same as "date of hire."

12. Figure 11, which follows ... illustrates ... that operational data is either (a) ... current value, historical (value) ..., or (one or more) ... of the events which created historical values leading up to current values.

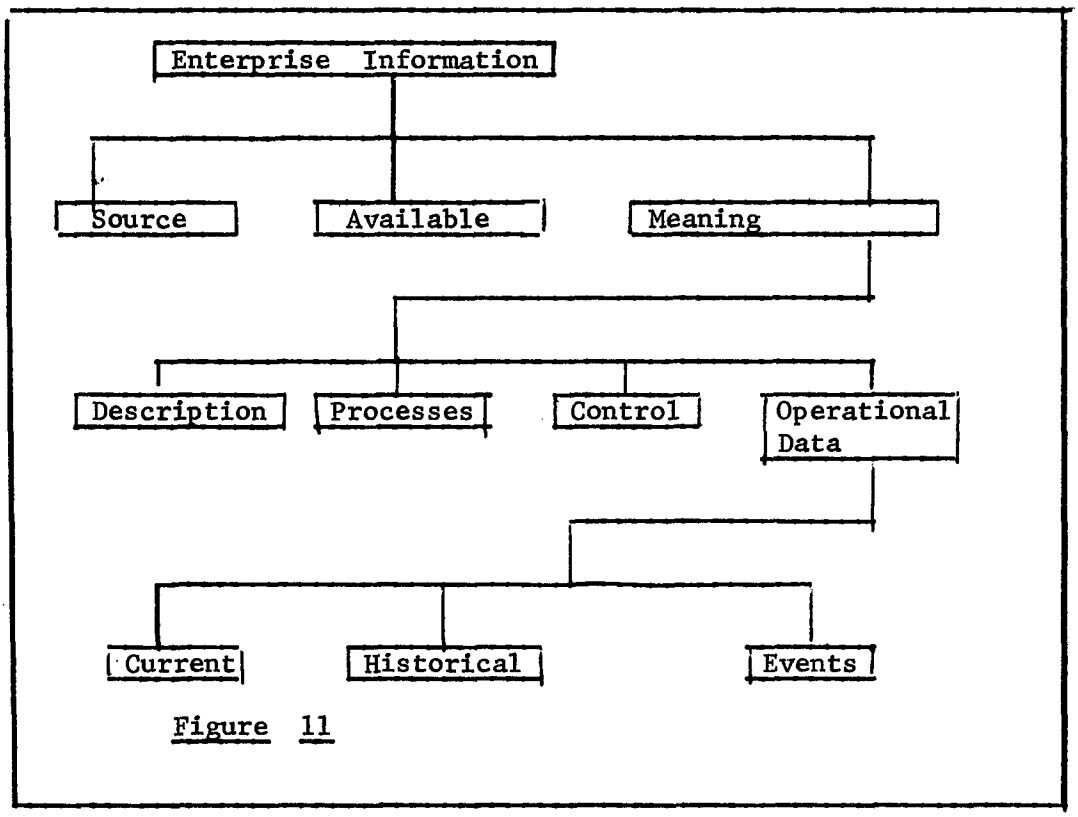

Figure 11

For example, the quarterly budget for travel for a particular organization is "overrun" during the second month of the quarter, and the events associated with travel that week identify the particular employee who took an unanticipated (and) expensive trip.

It is important to note that many information systems place primary emphasis upon ... current ... information. While there certainly are many cases in which the current values are important (for example, "Can I get a set on the one o'clock flight to Chicago?"), management is usually concerned with "why" rather than "what."

"Events" are probably the most significant kind of information for management ... analysis. (One has) ... to go back to the equivalent of the ledger system to be able to trace the reasons why current status is what it is.

13. There are two basic causes for information flow:

A. Information Itself;
B. Organization.

... Within an information system, there is a flow of information through that system which appears to have two separate causes -- one of them is the nature of the information itself, and the other is that organization of the enterprise causes flow.

It (is) ... important to understand the distinction between these because organization is often blamed for causing all of the information problems. This point will be discussed.

There are a number of different reasons why information itself causes flow of information within the system, and one of them is the relationships which exist among the subjects about which there is information.

Figure 12, which follows, will illustrate ... very simple relationships which might ... exist within an enterprise.

Employees	Salary Grade
Name	Number
Occupation	Range
Organization	Minimum
	Maximum
	Occupations
Occupation	**Organizations**
Title	Title
Salary Grade	Employees
Employees	

Figure 12 - Relations Among Subjects

14. In the example of Figure 12, each "employee" has a name and an occupation, and is a member of an "organization." ... For each "occupation," ... note that it has a title, a salary grade, and that there are "employees" assigned to it.

For each "salary grade" there is an identification number, a salary range, and to each salary grade are assigned certain "occupations."

Finally, each "organization" has a title, and to it are assigned certain specific "employees."

These relationships between subjects must be known to the information system if the integrity of ... relationships is to be maintained, and if these relationships are known to the information system, the protection of the integrity of the relationships will cause a flow of information within the system.

I have intentionally chosen ... simple relationships. ... There are more complex ones, but trying to explain them would ...(only) strengthen the case for the point I am trying to make.

One-way Relationship Between Two Different Subjects

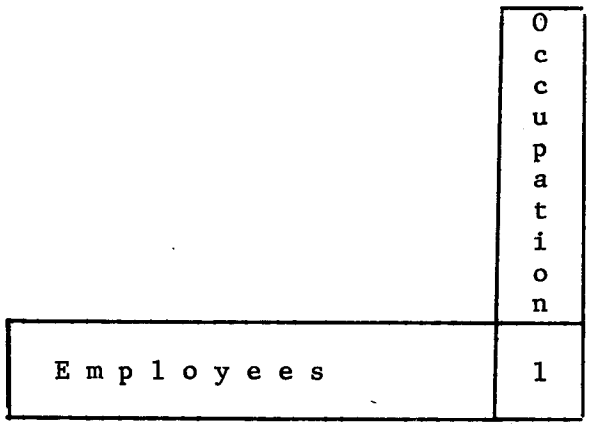

Figure 13 ("There is one occupation associated with each employee")

15. Figure 13 ... is one way of illustrating relationships ... which (is) effective.... In the example, the relationship is between occupations and employees, and ... is expressed as "there is one occupation associated with each employee." (This is only an example ... I know there are situations where an employee can be employed under a number of different occupations, even during the same day.)

In many cases, ... there will be a history of such relationships through

time, but what we are discussing here is only the "now state."

One-way Relationship Between Two Different Subjects

	Employees
Occupation	N

Figure 14 ("There are N employees associated with each occupation")

16. (What is seen in Figure 14) ... is the reverse of the prior ... (Figure) and is the one-way relationship of employees to occupations. It would be expressed as "there are N employees associated with each occupation."

Two-way Relationship Between Two Different Subjects

	Employees	Occupations
Employees	x	1
Occupation	N	x

Figure 15 ("There is one occupation associated with each employee and N employees associated with each occupation")

17. The relationships in Figures 13 and 14 are both "one-way," ... and can be (combined) ... as an expressin of a two-way relationship between the two subjects, "employees" and "occupations," ... giving Figure 15.

The example would be expressed as "there is one occupation associated with each employee and N employees associated with each occupation."

Perhaps now is the time to establish reasons for my statement that "relationships between subjects cause a flow of information through the system."

Let's say that for some reason, the employment department has established that the present occupational title, "engineering assistant," will be changed to "junior engineer." This will require that the title of the occupation must be assigned a new value, but it will also require that every employee (who is) ... currently an "engineering assistant" must be assigned the new title, "junior engineer."

Two-way Relationship Between
Two Different Subjects

	Occupation	Salary Grade
Occupation	X	1
Salary Grade	N	X

Figure 16 ("There is one salary grade associated with each occupation and N occupations associated with each salary grade")

18. The two-way relationship ...(of Figure 15) ... was between employees and occupations. (In the example of Figure 16, above) ... we have another two-way relationship ... between occupations and salary grades.

* * *

Two-way Relationship Between
Two Different Subjects

	Employees	Organizations
Employees	X	1
Organizations	N	X

Figure 17 ("There is one organization associated with each employee and N employees associated with each organization")

19. Figure 17 shows ... a third two-way relationship, this one ... between employees and organizations.

* * *

20. The next step is to merge together from three previous Figures illustrating two-way relationships (to) ... create a four-way relationship matrix.

Four-way Relationship Between
Four Different Subjects

Figure 18

	Employees	Occupations	Salary Grade	Organization
Employees	X	1		1
Occupations	N	X	1	
Salary Grade		N	X	
Organization	N			X

This illustration (Figure 18) tellus us that there is no direct relationship in this example system between

* Employees and salary grades,
* Occupations and organizations, and
* Salary grades and organizations.

(However, there are such relationships -- they exist through other relationships.)

21. The following Figure illustrates ... that two subjects which are not directly related may, in fact, have a relationship because they each have a relationship with a third subject.

Indirect Relationships via One Level of Indirection

	Employees	Occupations	Salary Grades	Organizations
Employees	X		1	
Occupation		X		N
Salary Grade	N		X	
Organization		N		X

Figure 19 ("A two-way relationship exists between employees and salary grades via the occupations of employees and a two-way relationship exists between occupations and organizations via the employees of the organizations")

In this Figure, there are two such relationships, between

* Employees and salary grades, and between
* Occupations and organizations.

* * *

You will notice I have used the term "one level of indirection;" ... while I'm not pleased with the word, "indirection," ... I can't think of a better one.

We still have one missing relationship, and that is between salary grades and organizations.

22. The following Figure illustrates the relationship which exists between salary grades and organizations.

Indirect Relationships via Two Levels of Indirection

	Employees	Occupations	Salary Grades	Organizations
Employees	X			
Occupations		X		
Salary Grades			X	N
Organizations			N	X

Figure 20 ("There is a two-way relationship which exists between salary grades and organizations through, first, the employees of the organization, and, second, through the occupations of the employees")

* * *

All of the relationships which we have looked at can be summarized into a ... different form to illustrate whether the relationship is direct or indirect (and if indirect,) ... through how many levels of indirection.

(In Figure 21, which follows, assume that the abbreviation "Ind-1" implies an Indirect Relationship "one level deep," that "Ind-2" also implies an Indirect Relationship "two levels deep," and "Dir" implies a Direct Relationship.)

Direct and Indirect Relationships

	Employees	Occupations	Salary Grades	Organizations
Employees		Dir	Ind-1	Dir
Occupations	Dir		Dir	Ind-1
Salary Grades	Ind-1	Dir		Ind-2
Organizations	Dir	Ind-1	Ind-2	

Figure 21

23. It is interesting ... that if the integrity of all direct relationships is maintained, then the integrity of indirect relationships will also be maintained, provided, of course, that the paths or relationships are known to the information system.

When you realize that, within an enterprise at the total business level there will be tens of subjects, there may be cases where no type of relationship exists between certain subjects, and some that do exist have little or no significance. However, they (exist), and "you can take them or leave them."

... In our example of two levels of indirection between salary grades and organizations, we can invent a situation which is not too improbable, in which office facilities -- e.g., size of office, furniture type, number of windows, carpeting -- are a function of salary grade of an employee.

* * *

We mentioned previously that maintaining the integrity of relationships between subjects causes flow of information through the information system. Another cause is ... that through these relationships, information about one subject also applies to the related subject(s).

For example, the likelihood of a particular employee's attending a conference is directly related to the status of the travel budget of the organization of which the employee is a member. Thus, the budget of the

organization is also an attribute of the employee.

(While discussing ...) relationships between subjects of the enterprise, I might mention a type of conditional relationship worth of consideration.

For example, the relationship between employees and suppliers might be conditional in that only employees with the occupation of "buyer" have a direct relationship with suppliers. These conditional relationships make the problem of information integrity ... more complicated.

There is another kind of relationship within the information of an enterprise information system which causes flow of information within the system, and that is a relationship (existing) ... between the values of certain pieces of information ....

Relationship Between Pieces of Information About a Specific Employee			
1	-	Regular Earnings	$100.00
2	-	Premium Earnings	20.00
3	-	Gross Earnings	120.00
4	-	Withholding Tax	12.00
5	-	Misc. Deductions	5.00
6	-	Net Pay	103.00

Figure 22

24. In Figure 22, above, is given ... an example of a relationship between information about an employee's weekly earnings. ... note that gross earnings is the sum of regular and premium earnings. Withholding tax is ten percent of gross earnings, and net pay is gross earnings, less withholding tax and miscellaneous deductions.

Obviously, if premium earnings are ... in error (and if they should be,) for example, ten, rather than twenty, dollars, gross earnings, withholding tax, as well as net pay, are subject to correction at the same time as premium earnings. The system must understand and take car of this kind of relationship.

Earlier, when were discussing the characteristics of enterprise information, we talked about "events" as actions which caused the enterprise to react, and about which information is created and recorded within the information system. Figure 23, following, ... gives examples of what could be "events" within an enterprise -- ... you will notice that some of them ... originate outside the enterprise, some originate inside it.

Events

* Receive an Order for Products	* Receive Payment from an Invoice
* Order Supplies	* Transfer an Employee
* Receive Shipment of Ordered Supplies	* Prepare the Weekly Payroll
* Issue Stock from Warehouse	* Buy a Piece of Capital Equipment
* Hire an Employee	* Change an Employee's Occupation

Figure 23

25. The significance of "Events" is that, as the enterprise reacts to them, there is a flow of information through a network of process nodes of the information system.

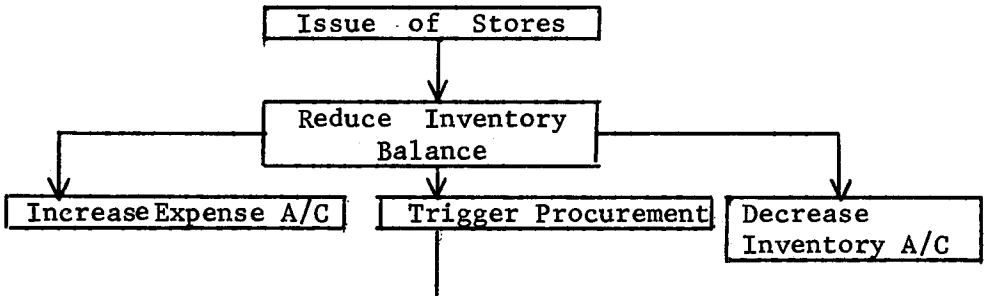

Figure 24: Information Flow Through Process Nodes for a Stores Issue

Figure 24, above, shows ... an example of ... process flow ... for a stores issue "event." In this particular case, after the issue of stores the first process node is the reduction of inventory balance, and at this

point, the quantity on hand is reduced, the average unit value is determined, the inventory account determined, and the resulting balance on hand is tested against the order point.

After these processes, there can be three parallel processes:

A. The one "on the left" (in Figure 24) will increase the expense account by an amount equal to the average unit value times the quantity issued;

B. On the right, the inventory account will be reduced by the same value as used for the expense account;

C. In the center, procurement will be triggered if the resulting balance on hand is below the order point.

If there happens to be a quantity of the item on order, then enough of those itmes on order will be expedited to bring the quantity on hand up to the proper level.

If there are no open orders for the item, or if the quantity on order is insufficient, then a request for bid would be created to order an additional quantity.

There are other ... events which ... flow through certain of these nodes. One example would be that, when more stock is received, the inventory balance on hand would be increased. The quantity on order (would then be) ... decreased and a new average unit value calculated.

26. Let me make the point ... that there are often elements of organization which match these process nodes, such as:

A. "Reduction of inventory balance" is the organization "inventory control;"

B. "Increase expense account" is the organization "cost accounting;"

C. "Decrease inventory account" is the organization "general accounting."

It is not organization ins this case which really causes the flow of information ... but the way in which the information system reacts to events.

27. The next point is that at each event process node, there are different collections of information associated with the event, and there are different logical sequences of multiple occurrences of such collected ... information.

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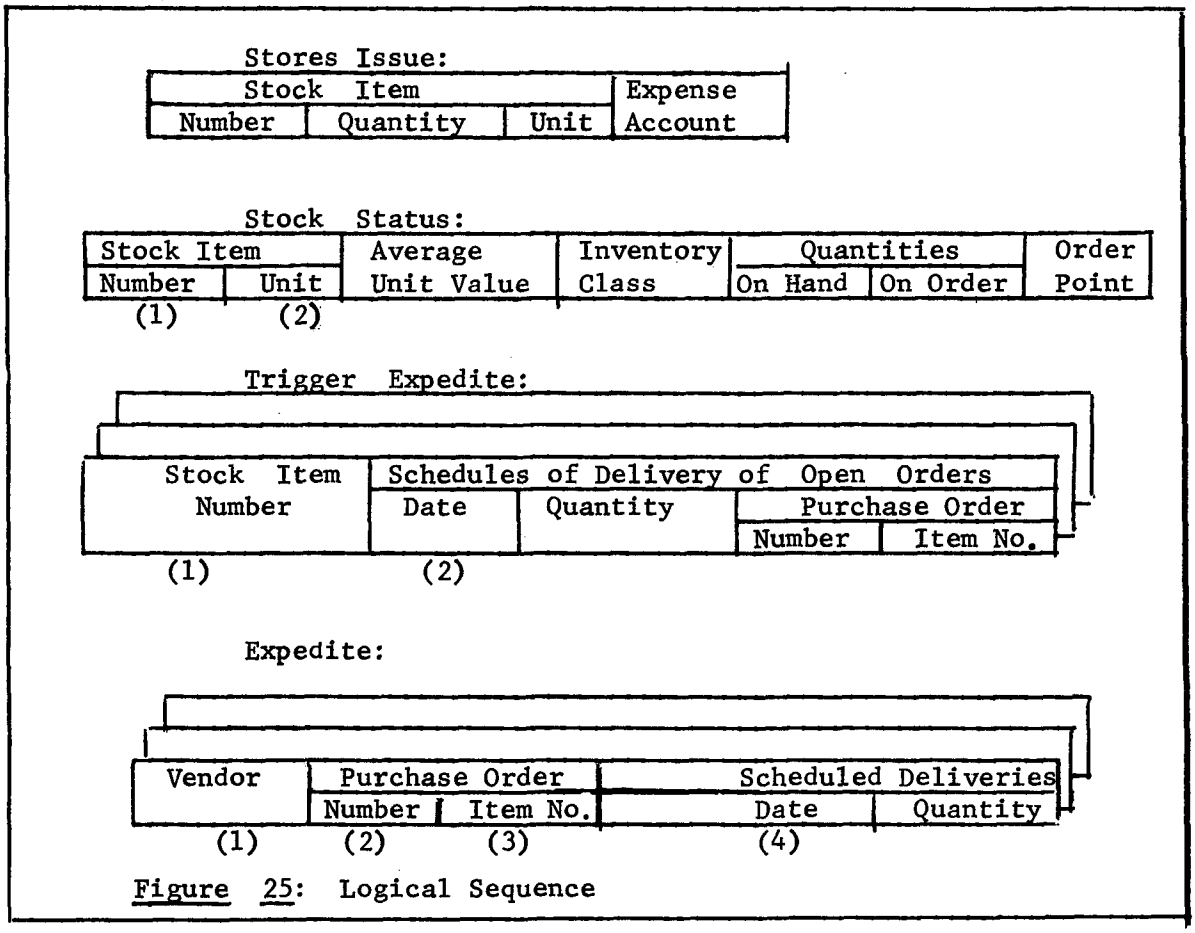

Figure 25: Logical Sequence

28. Figure 25, above, illustrates ... that at each process node of the event network of our original example of the "stores issue event," certain information would probably be considered for the

A. Issue,
B. For the reduction of inventory balance,
C. What would trigger expediting of any open orders, and
D. How open orders could be expedited.

For the stores issue, we would think in terms of the stock item number, the quantity issued and the unit of expression of that quantity.. The expense account to which it would be chaaged is, for the benefit of the accounting system, not necessarily for either the user or for inventory control.

(We could consider) ... the stock status in the inventory control system in terms of the stock item I. D. number,and unit of issue, the average value of each unit, the inventory class, quantities currently on hand and

on order, and the order point.

These logical collections of information about ... individual inventory items (could) ... be thought of as being in the sequence of unit within stock number.

At the "trigger expedite" node, we have ... (several keys) ... but (a probable sequence) is ... scheduled delivery date within stock item number. ... The expeditor (might) ... think in terms of (a different sequence at the "expedite" node) ... date of scheduled delivery within purchase order item number within vendor.

(Thus) ... information itself causes information to flow through the system.

We will next (consider) how organization causes a flow of information through the system.

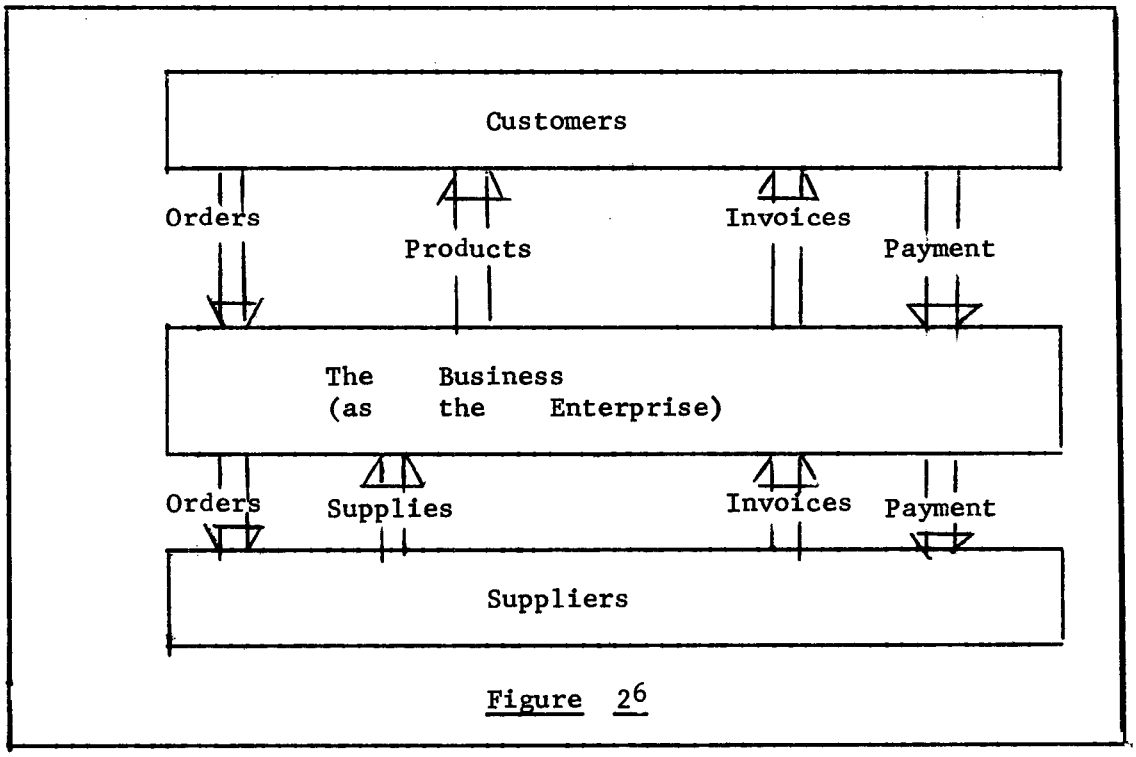

Figure 26

29. So that we can understand the significance of organization upon information, let's ... look at an enterprise which is the total business.

Here we have a relationship between customers and the business and a similar relationship between suppliers and the business. We (shall) ...

focus our attention upon the relationship between customers and the business.

This is a business that is either a one-man operation or one which has so few people (employed) that, from an information standpoint, they do not "get in each other's way."

Figure 27 ... shows a sequence of events, consisting of

A. Customer orders products,
B. Products are shipped to the customer,
C. An invoice is sent to the customer for the products,
D. The customer pays for the products.

From information-processing standpoint, the following process might occur:

E. When the order ... is received, a sales order form is prepared and placed in a collection of such (completed) ... forms, referred to as "open orders,"
F. When these products are shipped to the customer, a shipment form is prepared, and attached to the sales order form, the two forms being placed together in a collection ... called ... "pending invoices,"
G. When the customer is sent the invoice, a copy of it is attached to the sales order form and to the shipment form, and they are moved to a collection ... called ... "open invoices,"
H. When the customer sends his payment, notation of its receipt is made on the invoice previously retained, and the sales order and shipment forms and the (revised) ... invoice are all moved together into a forms collection referred to as having been "completed."

Thus for each customer order, there are three pieces of paper, which move progressively through four stages.

(Imagine now that the business prospers and expands, and it grows to the point where there now exists "organization.")

* * *

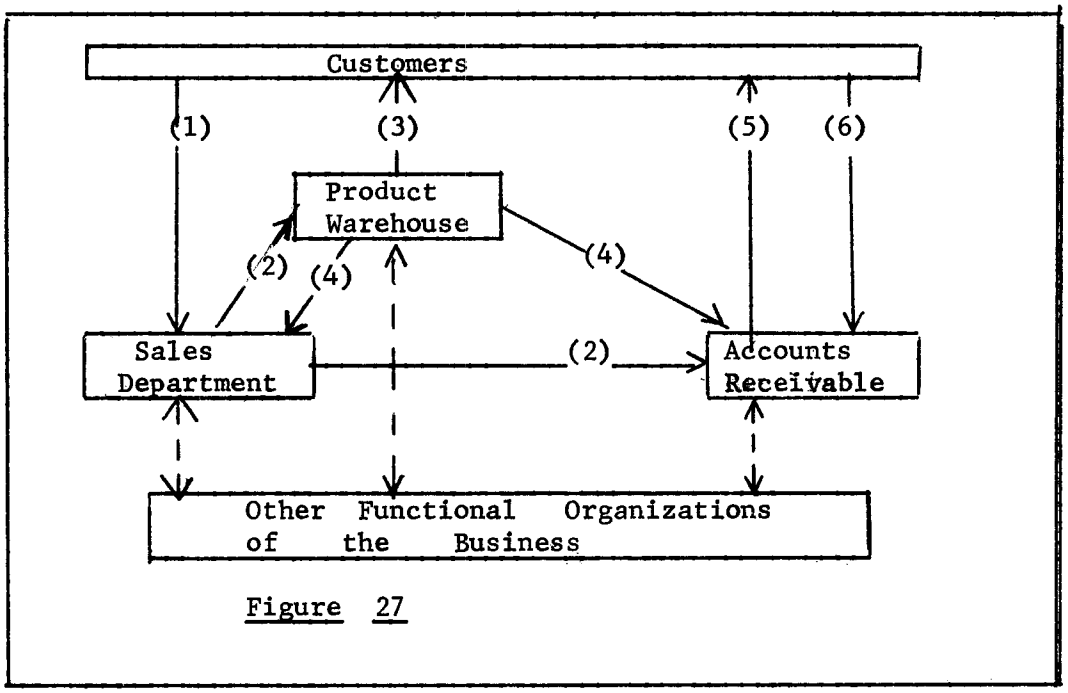

Figure 27

30. Figure 27 ... illustrates what organization has done to that portion of the business associated with the customer. It now has both a sales department and an accounts receivable, department, and a product warehouse. There are ... other functional organizations, but we'll pay no attention to them.

There are still ... the same basic forms, and the same basic functions (discussed in the previous paragraph)..., but now there are three organizations which must share information.

Here is how the new organization might operate. When the sales department receives an order for products from a customer (1) it prepares three copies of the "sales order form"(2).

* One copy is sent to the product warehouse and is an "action copy."

* Another copy is sent to the accounts receivable department as a "pending action copy."

* One more copy is retained by the sales department as an "information copy."

When the product warehouse ships the products to the customer (3), it prepares three copies of the "shipment form" (4).

* One copy is sent to the accounts receivable department as an action copy.

* Another copy is sent to the sales dapartment as an information copy.

* One more copy is retained by the product warehouse as an information copy.

Accounts receivable department prepares an invoice and retains a copy (5), and when payment is received from the customer (6), a notation of payment is made on the invoice copy, retained previously.

You will note ... the same actions and forms ... were used, except that copies of forms are prepared and separate collections of forms have been maintained.

Now there are still three basic pieces of paper, but there are seven copies, and instead of four collections of paper, there are now seven.

Thus, in this example organization causes redundancy of forms within the enterprise as well as a physical flow of information....

Because organizations often tend to be functional and subject-oriented, it would appear that ... (increasing) organization within an enterprise -- while it may cause physical flow of information because of information-sharing -- does not cause the internal information flow (as contrasted with physical flow.) It is because of relationships between subjects that the information flows.

The real significance of organization is ... that if the enterprise is established at a low level of the hierarchy of functional organization, the span of control of ...(it) can neither control the physical flow or relational flow of shared information.

In our example, if the enterprise still included the functions of the three organizations the system could be improved, but if the enterprise of interest has dropped down to the functional (level) ... of aocounts receivable, it would depend on other organizations for (most)... of its information, and would be able to improve its information system only to the extent of cooperation (between) .. the sales department and the product warehouse. (In a competitive environment, voluntary cooperation is hard to "bank on.")

It is now appropriate ... to point out that in many businesses, at any moment in time, the physical flow of physical collections of information ... (and)the relational flow are probably "out of sync." In (such) ...

businesses, ... only at the end of fiscal year, and after extended "closing of books," ... is the (information) system ... stable. This means that if management wants related information from different functional organizations, the information will probably not be in agreement.

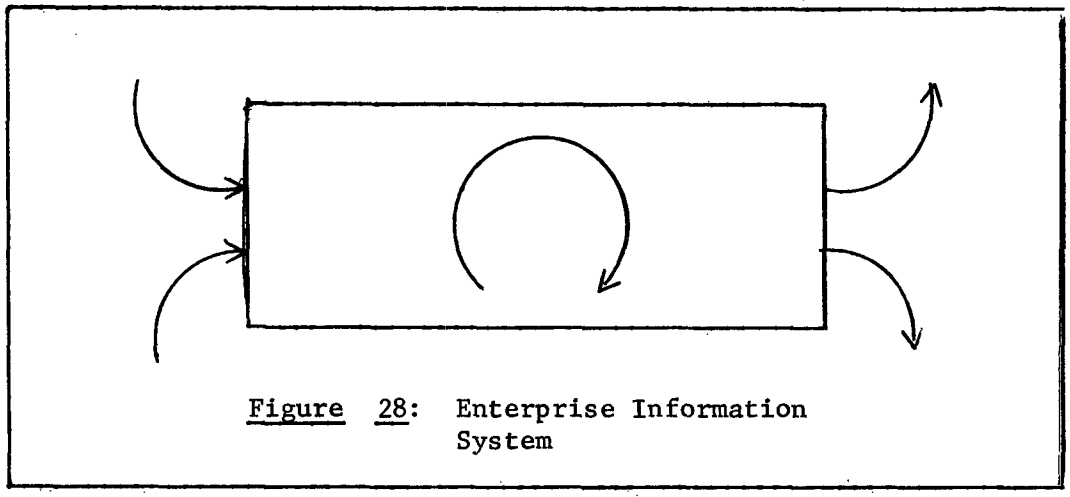

Figure 28: Enterprise Information System

31. The ... diagram of Figure 28, above ... summarizes the flow of information into, within, and out of the enterprise.

On the left are ... (shown) two kinds of input information.

A. Information which causes the enterprise to perform a function for which it was created.

B. Information which must be provided so that the enterprise can perform its function.

On the right are (shown)... two kinds of output information.

C. Information which communicates the fact that the enterprise has performed its function.

D. Information which the enterprise must provide to external organizations so that they can perform their functions.

Within the enterprise, there are five causes for information flow.

E. Relationships between subjects of concern.

F. Relationships between pieces of information.

G. Events, and their process nodes.

H. Logical collections, and sequences, of information.

Tutorial ... What is a Data Base? (Tellier) continued

I. Organization of the enterprise.

... Again let me point out that each element of a hierarchical organization has the same pattern of inputs, outputs and internal flow of information, but the lower the organizational level is established as the enterprise, the less control it will have over its input ... and the more it will ... depend ... on the cooperation of others.

32. Examples of functions of an enterprise information system:

* Need	* Authority
* Specification	* Custody
* Catalog	* Control
* Responsibility	

I realize this list is not complete, ... but ... hope to see one of the ... SIG's ... work on this problem and develop a list which is complete.

... We started out with a definition of "data base system" as ... a computer system to which ... certain functions related to enterprise information have been assigned. ... I would like to make a few points that have not come out in the discussion so far.

... We know about the external influences such as law, regulations and contracts.... But there internal influences in addition to the assigned responsibilities of organization, and those are the influences of management specialists, such as operations research (people) ... and (those with specialties such as) ... systems and procedures and industrial engineering.

Not to be overlooked is the information required to maintain the enterprise information system and the information required to operate and control the information system.

Specification: This term has been used here in ...(a) broad sense ... -- the descriptions of subjects, events, processes, users and operational data .... this is a key area ... very seldom are information systems ... adequately documented.

Catalog: This term (is) ... used in the sense of making available to the information system, as well as to the users, a complete body of knowledge about what information is available to the system and to users ... with sufficient description ..., so that it can be used properly and with confidence.

Responsibility: (This) makes ... reference to the assignment to users of processes of the system, accountability for gathering of information, recording, custody, control, editing for consistency, maintaining of integrity of values and relationships, and the many other responsibilities ... someone must be assigned.

The companion of responsibility is authority, and authority to use the functions, as assigned to users and ...system components ... must be controlled. A key issue is that of which element of the information system, as we have defined it, is responsible for integrity of the relationships which exist between ... subjects and the ... information about the subjects. (We must recognize) ... that these relationships are dynamic because of the changing environment in which the enterprise exists in the changing world we live in today.

Custody is associated with the problem of information as a resource of the enterprise, and treating it as such. The days of information ownership by functional organizations, or occupational classes of employees, is either gone or "numbered."

Industrial espionage, security, and invasion of privacy are all terms referring to the ... problem of protection of the resource through custody and disciplined usage.

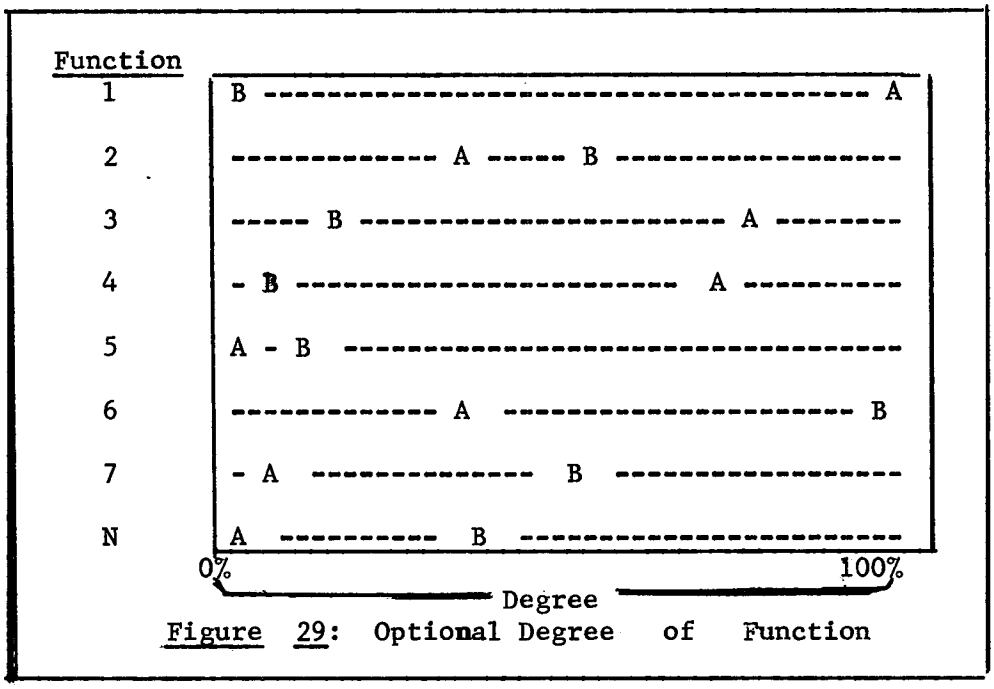

Figure 29: Optional Degree of Function

Tutorial ... What is a Data Base? (Tellier) continued

33. (Figure 29) illustrates the fact that desire for function is a matter of degree -- the extent to which enterprises "A" and "B" desire the individual functions (will vary) from zero percent to one hundred percent. For example, function "1" could be "security" ---"B" doesn't want any, while "A" wants all it can get.

However, remember I said that function was, when first available, often limited in capability and expensive. The example given (in the paragraph above) might look altogether different if the function "security" were available at maximum capability and if it cost nothing. In "that ball game," "B" might discover it really wanted security, and obviously "A" would be happy.

34. Conclusion

... What we are discussing under the banner of "data base systems" is the degree to which information systems functions ... can be assigned to computer systems, and identification of additional functions (or higher degrees of existing functions) which should be made eligible for assignment to computer systems.

If you believe that we of the computer community still have homework to do (to) ... understand... where we are today ... and where we want to go from here, I believe that both (these) SIG's would ... welcome your participation in their activities.

* * *