Systems Analysis and Design
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Lecture - 28

Last time, we are looking at a case study of finding out objects from a requirement specifications. And based on the requirement specifications of a small system, where items are received by receiving office in a company they check the item received or delivery note, against the order placed file. And based on that, a discrepancy note if there is any discrepancy is sent to the purchase office. Otherwise, the goods along with the delivery note is sent over to the inspection office.

The inspection office now physically inspects the goods. And those items, which feeds fields are alright. It accepts them and then it sends a document to the stores, to takes these items in to stock. Now, as soon as items are taken into stock, the store informs the accounts section to pay the vendor for the actual items delivered and found suitable. These submit substance, the summary of the particular requirement.

Now, this we discuss of course in earlier also, in relation to the data flow diagrams. And it is playing in great detail in the book analysis. And design of information system, which I have been following right through in this course. In the example also finds the place, in the object oriented modeling chapter of this book. So, what I am going to talk about, is really expanding whatever is in the book. And giving you a little bit of insight on, why I picked certain items as objects and so on.

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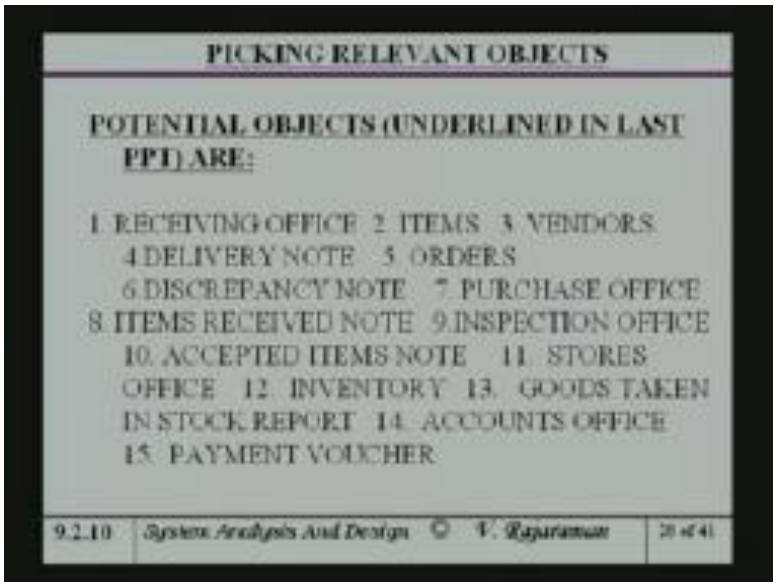

And first we find out, what are the potential objects. All the nouns are really a potential objects in the SRS. And so, I will list them here. Receiving office, items, vendors, delivery note, orders, discrepancy note, purchase office, items received, inspection office, accepted items note, stores, inventory, goods taken in stock, accounts office, payment voucher and so on. So, the point is there are fairly large number of possible objects, in this example.

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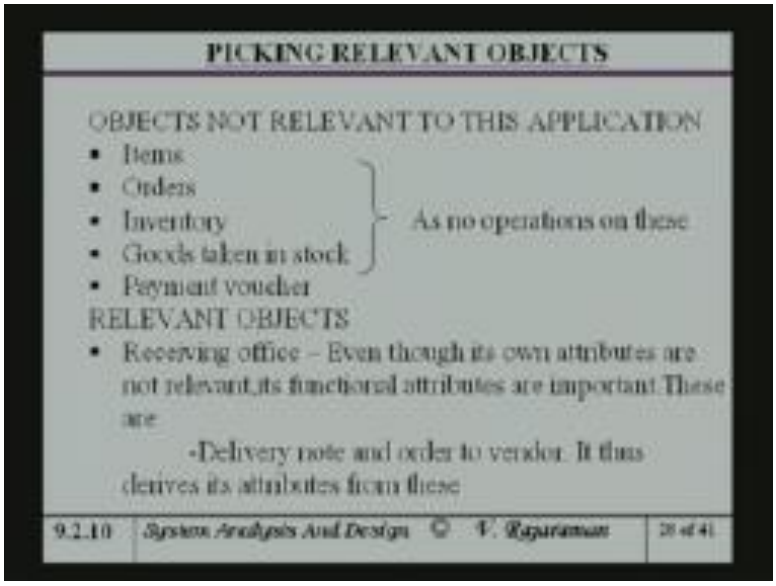

And I have to be able to select, those which are relevant or appropriate for modeling this particular problem. So, we first look at which are the possible relevance relevant objects. Now, the way in which you find the relevant objects is that, if an object attributes are not used in any operations. Then, there is no operation at all corresponding to that class. Then, that is not a class at all in the model.

Only those of the objects, are retained as object classes where the attributes and operations are performed on the attributes. So, based on that items orders, see items are essentially a physical items. And delivery note is more important. But, the items themselves are not important from the point of view of modeling. Orders actually are in a file or in a database. And it is not considered as an object in this modeling.

Inventory is in the stores. Again, it is a database goods taken in stock payment voucher. All these things are really documents, which will flow. And effectively, they are really the result of operations performed by classes. And as an output for instance a payment voucher is sent along with the cheque and so on. So, the relevant objects are receiving office. Even though the receiving office by itself was not attributes, which are there.

But, its attributes are derived from the delivery note and order to vendor, because the receiving officers job is to compare delivery note with the order to vendor. And based on that, it has to decide to send a discrepancy note or not a discrepancy note. And of course, to send also the items over to the inspection. So, from that point of view receiving object, receiving office is an object. And vendors looks like, a potential object. No operations are performed in this object.

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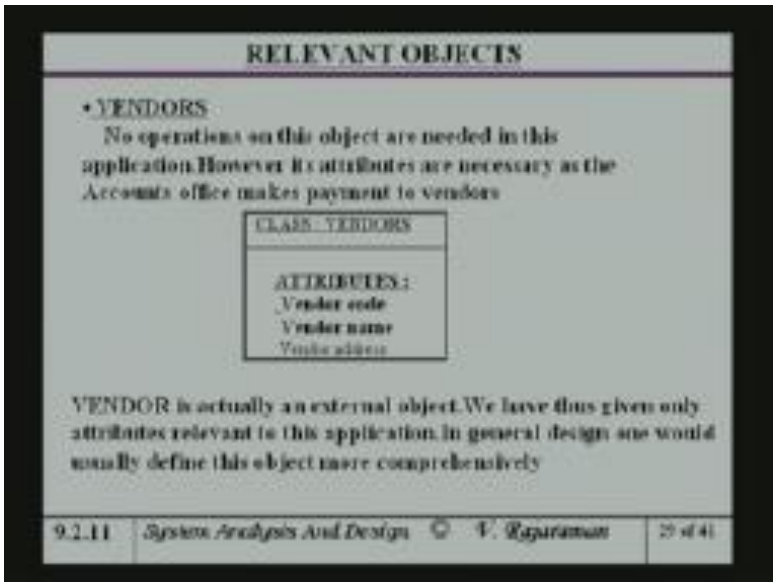

In this case however, it attributes are necessary. As accounts office makes payments to vendors for that, you need vendor code, vendor name and vendor address. So, it is actually an external object. Thus have give only attributes relevant to this application. In general design, one would usually design object more comprehensively. In this, that I have given attributes which are very small in number which are relevant only for this particular case.

So, the delivery note has got a certain number of attributes. One is the receiving clerk id. Again receiving clerk id is there for the purposes of audit trail. In other words, later on you want to find out who received the items? And who compared the delivery note against the orders has to be pin pointed. In order to be able to make sure that, no errors are committed. And even if errors are committed, you can pin point responsibilities.

And of course, the errors are one possibility. There could also be frauds committed. So, from that point of view it is very important for particularly when you get important documents like delivery note and so on. Into a company, the id of the person who actually did this scrutiny has to be kept in the permanent store. Till such time, that this entire document gets whose system. And all the actions are performed or all the operations are performed.

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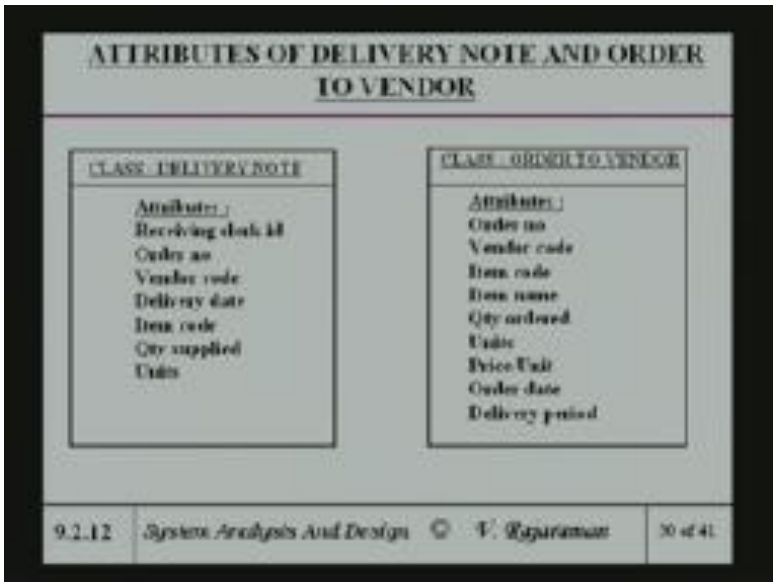

So, receiving clerk id is one of them order number. Of course, in order to be able to compare the delivery against the order. Vendor code and vendor delivery date, the date on which item is delivered. Item code, because discrepancy also means late delivery is a discrepancy, early delivery is also a discrepancy. Item code, quality supplied, units of course, these are all the attributes of delivery note.

And the order to vendor will have order number, vendor code, item code, item name, quantity ordered, units, price per unit, order date and delivery period. Because, the order date and delivery period are required to find out if the items are late or early, in delivery. So, it is one of the things which got to be found out in the discrepancy note. So, having found these two sets of attributes now, we find out the receiving office attributes.

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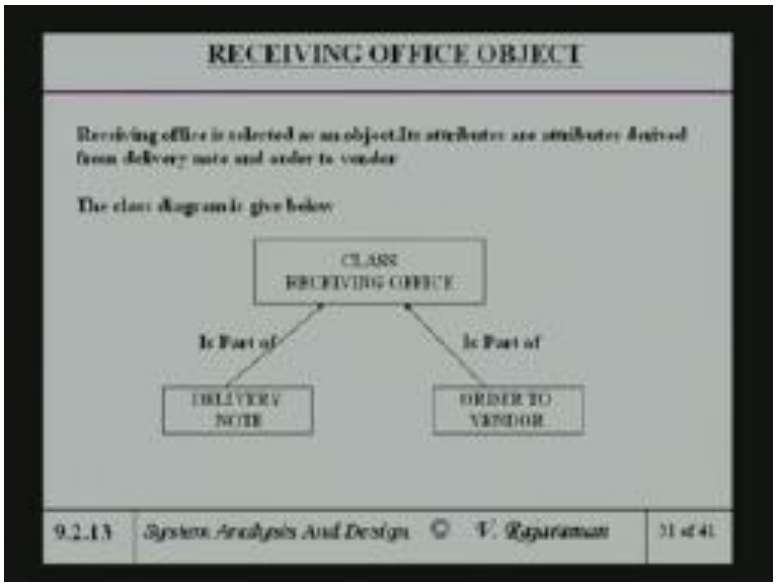

So, receiving office case delivery note is part of the cost receiving office. An order to vendor is a part of the class receiving office. That attributes of these two are used by the class receiving office. And they are derived from these two, you might say sub classes. So, the class diagram for this is given in this transparency. If I, so as if I look at the entire class structure is the class, with whose name is receiving office.

And the attributes are derived as shown in the last transparency, as namely from the delivery note and order to the vendor. These two are the ones, which are the form which it is derived. And this is becomes the class receiving office. So, attributes are fairly large in number because, the attribute belong to this as well as this, the union of these two.

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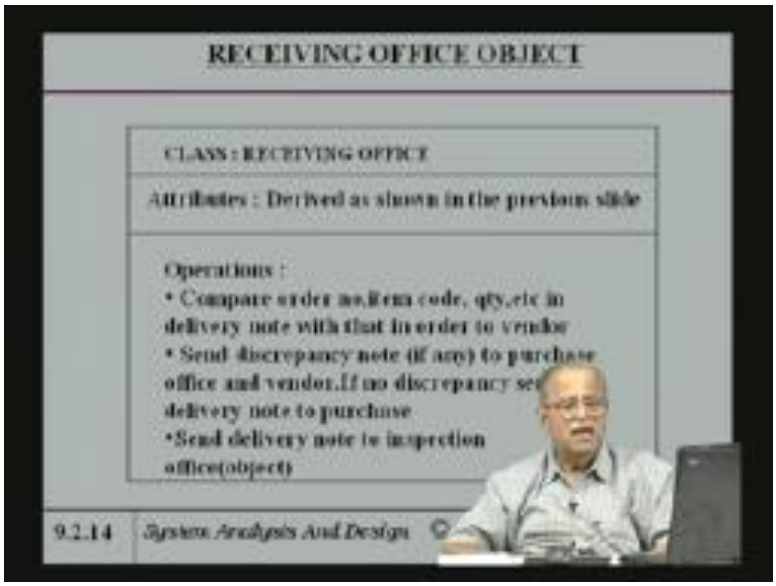

And the operations which are to be performed based on, say the message or order received you might say. In this case, compare order number, item code, quantity etc, delivery note with order in vendor order to vendor in order to find the discrepancy. Send discrepancy note if any, to purchase office and to the vendor. So, that the vendor is kept informed. And so, how do you send it to the vendor? You need the vendors attributes also.

In fact, here I have given in fact the vendor code only. The vendor code has to be used to find out the vendor address and so on. So, it may be a good idea to also put the vendor attributes, which is here as some more attributes. So, you might say the class receiving class office has attributes of both a delivery note order to vendor. Both of these, plus that a vendor in order to be able to if you decide discrepancy, in order to be sent to the vendor also. If you do not send any discrepancy note to the vendor, then it is not necessary.

But, normally it is a good practice. If you find a discrepancy, you better inform the vendor right away. Because, later on otherwise there will be some disputes. If there is no discrepancy, send delivery note to the purchase department. So, that the purchase can now, even otherwise even say discrepancy as well as no discrepancy either way, the purchase has to be informed, that the items have arrived. And send the actual delivery note of items, which came to the inspection office object.

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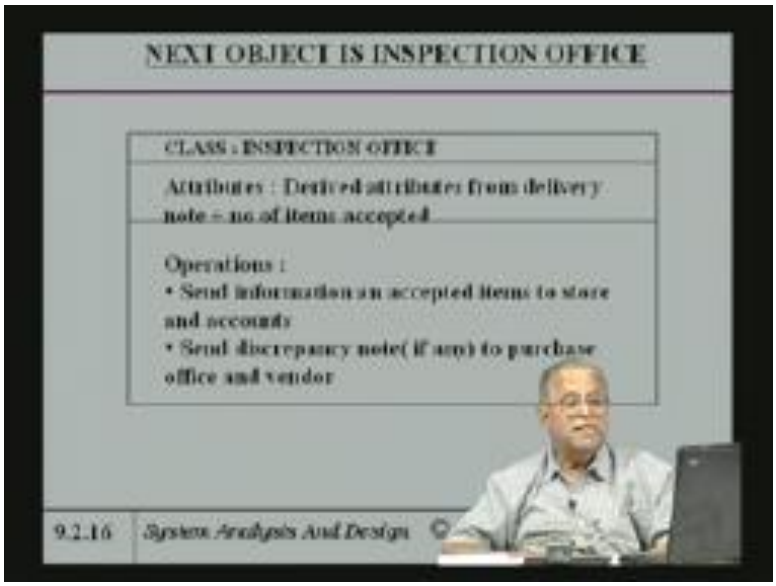

So in fact, inspection office is got to it. It is got derived attributes of delivery note and number of items accepted. Because if there is any discrepancy, the discrepancy and also this inspection office job is to actually determine what are the accepted ones? And so, the number of items accepted, becomes the part of the attributes. So, number of items delivered is, what comes in the delivery note? Because, some of them may be rejected because of poor quality.

So, operations are send information an accepted items to store an accounts. As soon as inspection is over, whatever information is to be sent on accepted items, it has a number and so on. As we send to the store and send discrepancy note to purchase office and to vendor. So, again in this case derived attributes of delivery note plus number of items accepted plus also vendor attributes has been taken.

If you want to say at very beginning of, or if you can leave it to the purchase office, to send this information to the vendor. Then the attributes of this inspection office, as well as the receiving office need not have them. The question is whose responsibility is, it to send the intimation to the vendor. Normally, it is responsibility of a single point namely a purchase office. So in fact, if I look at the purchase office thing, purchase office also if it sends the discrepancy note.

Then, purchase office also becomes an important class. Because, then it will got a function to perform. Or it is got some operations got to do. Otherwise, it is not part of it.

So, it is a question of to select some extents objective. See you have to decide, on what basis you do one or the other? And depends on the policies of the particular company, it may vary from company to company to company.

So, that is nothing which is very secret about this. There is a particular modeling method, because modeling method depends very much on the actual customer. The customer has to essentially tell you, what is the actual procedure which customer uses? So, operations of inspection office have already described.

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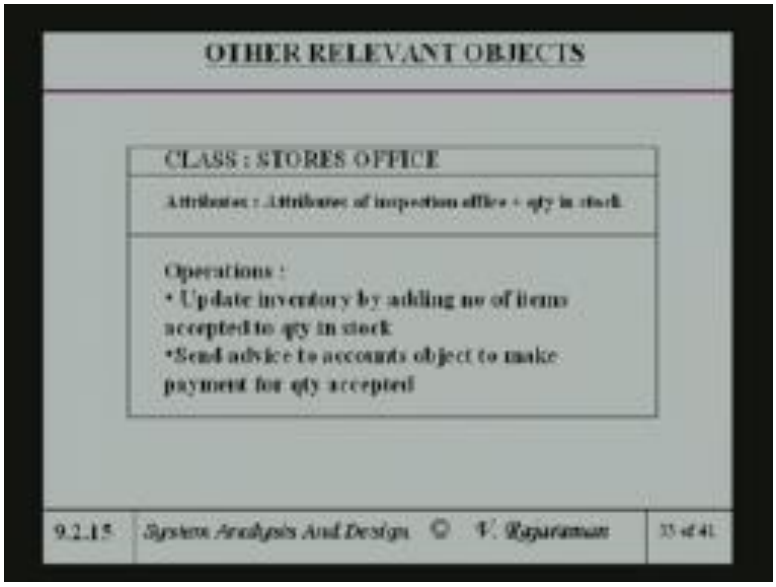

And stores office, attributes are that of inspection office plus quantity in stock. Because, now you go to update the quantity in stock by whatever is send by the inspection office. Update inventory by adding number of items, accepted to quantity in stock. And then, advice accounts object to make payment for quantity accepted.

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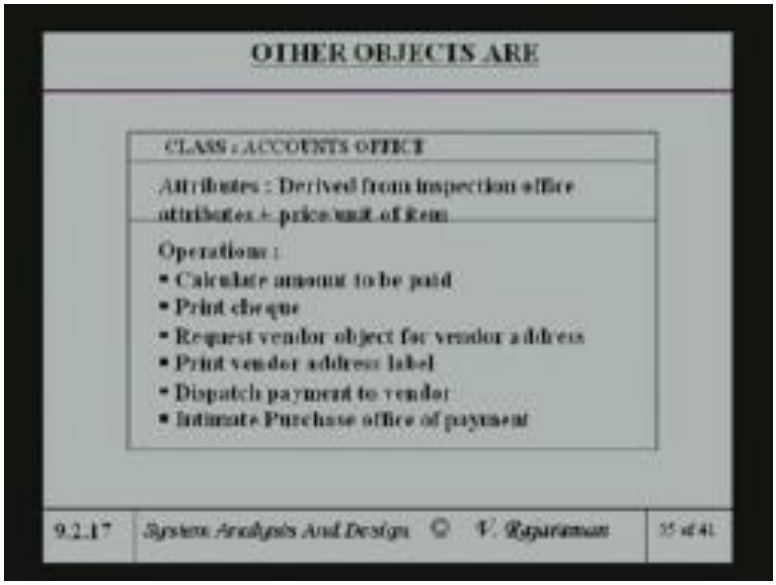

And accounts office, derived from inspection office attributes. And price per unit of item which is from normally, we derive from the order. But the, so not every it may be you know, the derived thing can be normally that of the order also. In other words, if I look at this order to vendor that, can also be part of this accounts office attributes. In other words, derived attributes are from the inspection office.

And also from the orders and also from the vendor, because vendor you have to send the print the vendors address label and so on. So, I think you have to add some of these things. And I am leaving it as an exercise to you. Kind of to, look at this again. And based on the stock, kind of update what I presented here into something which is to some extent complete. But, you can expect the following or you can assume the following.

And assume that, the responsibility of the purchase office is to send the discrepancy note. In this case, I have not done that. And the responsibility of the accounts office is to send the cheque payment. But, if you save the responsibility of accounts office is only to send a cheque to purchase for them to actually forwarded to the vendor. Then, it will change. Because, the accounts office now then, we only have to calculate the amount to be paid print cheque and send dispatch payment to purchase office.

Instead of dispatching payment of vendor, dispatch the payment cheque to the purchase office. Intimate purchase office at the payment in this case, you do not have intimate. Because, the payment responsibility will that be will that be of the purchase office. So, it

takes in other words the steps in the object oriented programming are first to find objects in their classes.

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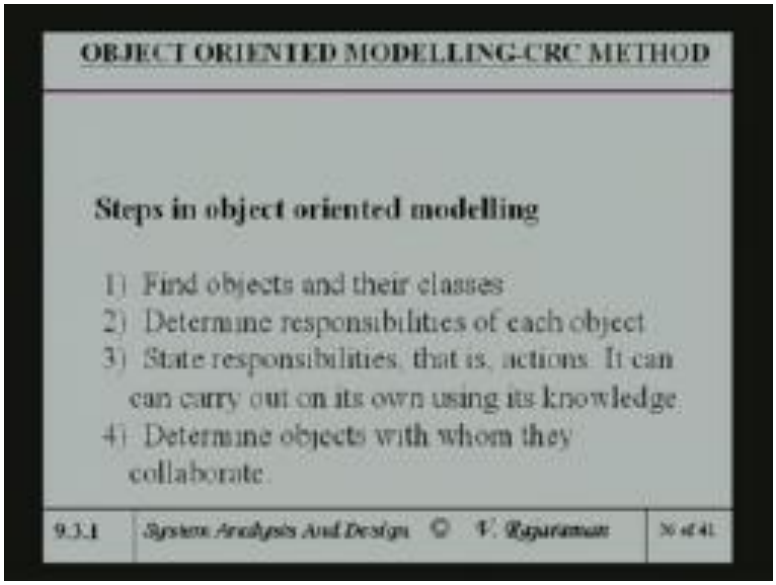

And picking objects from the classes is in fact, some extent subjective. And that is why, there is a separate op modeling method called CRC method, which we will discuss now. In fact, the CRC method CRC stands for the Classes Responsibility and Coordinators or Coordination. In other words, the whole idea is to find out the classes. Find out the responsibility of each class. And find out its collaborators, with whom it collaborates in order to be able to do its function.

Because, if I look at it looks at classes as contractors, which carry out contracts no contractor will carry out contracts by himself. He will use the help of other contractors. For some other aspects in the work, which he finds others are more expert in doing it rather than, he is expected doing it. Similarly, in this case a class when you break up something into set of classes, the whole idea is that the classes will collaborate or cooperate with one another to get the whole problem solved.

That is why it is called classes and each class is got a responsibility. And a collaboration and the collaborators and how the collaboration happens. So, the steps in this modeling method CRC modeling is actually, it is a method which is being proposed by three experts. And those three experts are the ones who kind of gave this idea. And so, as much of those experts have done a fair amount of practical work in companies and so on.

The method has been found acceptable many organizations. And it is not the only method. There are many other methods. Out of these methods, I found the CRC method to be a reasonably simple method to understand and explain. And that is the reason, I pick this CRC method in my presentation. So, in the CRC method you first find objects in their classes, which we have done in the example in the case study.

Determine responsibilities of each object. What they are supposed to do? You do not worry about how they are supposed to do. This is the most important thing. In all of this object modeling, you only are concerned about what the object is supposed to do? And what are the attributes which are relevant for that object, class to be able to perform. The operations assigned to it or responsibilities assign to it.

So, determine the responsibilities assign to each object. State responsibilities, that is operations that actions particular form. It can carry out in its own. Sometimes, some actions and using its own knowledge or it needs collaboration. Determine objects with whom they have to collaborate. Because, you do not have the information required. So, who are the collaborators? State contracts, each object has with its collaborators. In other words, what does it expect from the collaborator?

In terms of in other words, you the object will the object class will send a message to a collaborator, if some services required or is triggered by a message which flows to that. Message may actually be a nothing but, a document which flows. The document flow may actually a trigger, there a particular action. A collaborator either perform a requested action or gives information.

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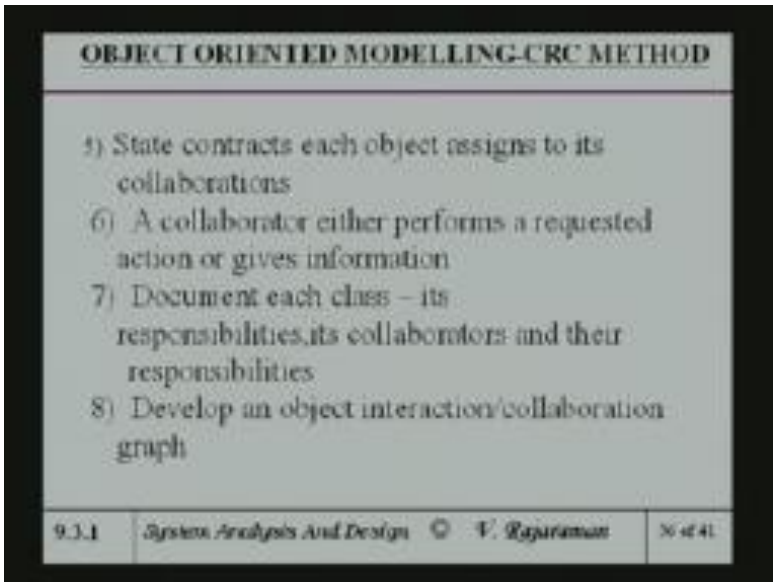

Like you now, you can think of vendor. As a class, the vendor does not perform any operations. But, the vendor is the collaborator in the sense that, when the inspection office or the purchase office or the receiving office requires information about the vendor attributes of the vendor. It sends a message to the vendor object. And request for the attributes, which are relevant. And the vendor object will return in that case that, would which are relevant.

So, if the vendor object has got that responsibility and it is a collaborating class, then it will have certain operations also incorporated into it. In our module, we did not do it, but can. In fact, we done. You can make it as a separate object. And how attributes, which are really to with which the operation, which are really to respond to request for the address and so on. So, you can say operations are send address. And send attributes of vendor when requested. Either, can be operation in that.

A collaborator either performs a requested action or gives information. Document each class, its responsibilities its collaborators and their responsibilities. That is when you do the actual documentation, because one of the most important parts of any modeling exercise is at the end of it, a clear document should emerge. And that document should become the basis on, which the entire modeling exercise takes place.

And in all modeling exercises, it is never one shot affair. Modeling is always iterative. In other words, you will do with a rough model. And while discussing the rough model with

your users and mainly with your own colleagues, we found that you may find that rough model has got some aspect, which it is not covered properly. So, in this case you have to go back and add more objects. Then in fact, I have done that, while I was talking.

To illustrate that point, that modeling is never a one step affair. You come up with an initial model. You understand, you suddenly realize or your colleague may realize or your user may realize and give you some further inputs. So, that you can refine the model. And that refined model is a one which is finally documented. But, normally even intermediate model were all documented.

So, that the versions change. And the final version is a version, which have been sent for actual design and implementation. So, the earlier versions will be there just for your reference. And depends I mean, if the too many of them you may just discard and keep only the last two versions. It is entirely up to the practices in a particular company. But, it is very important to document. And have a document at the end of the modeling exercise.

And so, there is a, the one of the parts of the document it is called an object interaction collaboration graph. So, you create such a graph and that gives the pictorial view of the classes, their attributes, their operations and their collaborators. And how do the messages flow between these collaborators. And how the actions, operations are actually what operation actually performs? The how the operations are performed as I said is really a detail of programming.

And that will be encapsulated inside the object. And one one know and those methods or programs can be changed, depending upon the changes in the environment. So, the CRC team as I said in this modeling exercise, it is never one man modeling. It is always a modeling, by a group of people. So, there is a it is always which proposed that, in order to come up with the CRC diagrams.

The CRC method ultimately ends up in a classes, responsibilities and collaboration diagram. So, in the process of doing that you start with a small term called users.

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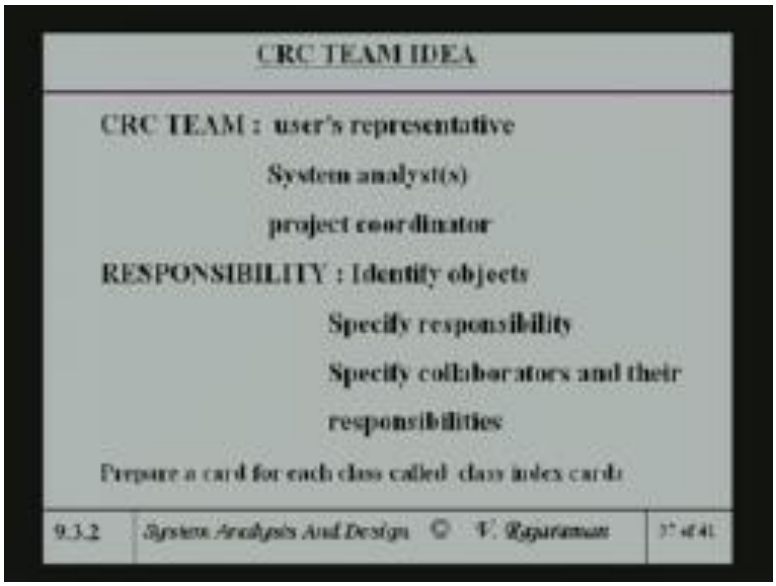

The team consists of users representatives, who are directly involve in giving you the SRS or System Requirement Specification. And System Analyst, who are analyzing the system any way one analyst involved, depending upon the size of the problem. The problem is a very small size problem, may be its one or two members only. We have a very large size problem, there may be more than two or three.

Normally it would not be too big, because handling more than about three are four people in one group is always very difficult to this project leader. So, that is also a project leader or project coordinator. So, project coordinator along with a small team and these are representatives. Form a, you might say a CRC team whose responsibility is to identify objects. And as I said, the identification objects and modeling exercise is never a one shot affair.

It is always an iterative affairs. Specify responsibility of each of the objects, specify collaborators and the responsibilities. And they, the designers the CRC method also expects, that a card is prepared for each class like an index card. In other words, have a small post card size thing, where you write out the class name like I have done in this example. That is, this is a CRC card you might say.

And in this, you have put each class and kind of arrange them in some order, because in the huge problem be to many classes. And of course, the whole idea of having this documentation is also reuse, later on. And so, if you got an index taking, the index can be

kept in the library. Library in the sense of soft library or digital library, where the equivalents of the cards are stored and indexed or you may have dictionary of classes.

And he may be able to retrieve, based on the class name or browse in dictionary and pick out things and so on. So, any way large project it need not be a physical index card that, it could be a virtual index card stored on a machine.

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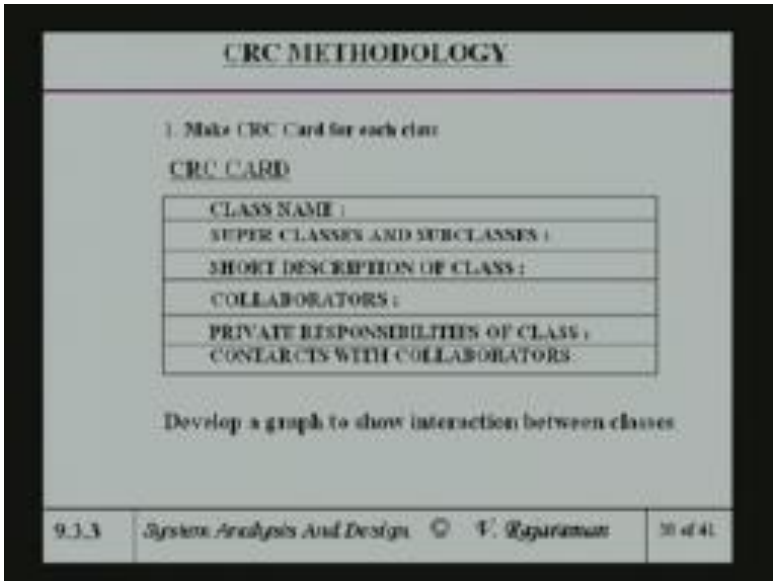

So, CRC card the information is more important. Whether it is actually a card or it is a virtual card in the machine, is irrelevant. But, when you are doing the iterative modeling it may be quite convenient. May be to have just set of cards but, then it is purely a question of test see. So, in this era where everybody has got a laptop, may be it is lot more convenient to have it on in the machine itself rather than having physical cards with you.

The CRC card consists of class name, super classes and sub classes. Short description of the class, what does the class do? That is in English, English description. And who are the collaborators and private responsibilities of a class and the contracts with collaborators. And so, this is the important items information which is contained about each of the classes in this particular set of classes, which make up the whole system. Develop a graph showing interaction between classes.

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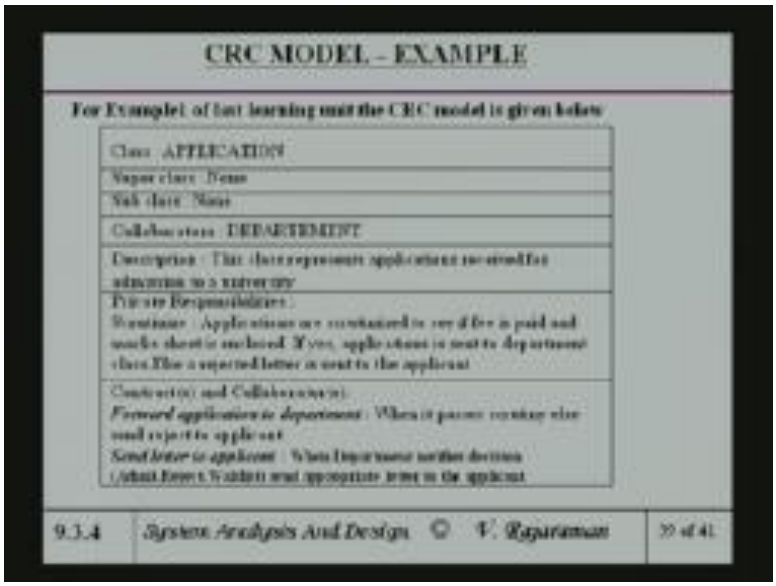

So, the CRC model for that, one example is given. Class is an application, super class is none. That is very very first example, which I took namely the applications send by a students to a registrars office. And registrars office essentially looks at the, while the application is complete and things like that. We looked at that example, in the last lecture. And super class is none, sub class is done. Collaborators are department.

Because, the based on the scrutiny of the application if the fees is paid and if the marks list is enclosed, then it is sent to the department to achieve the work of admit, reject or wait list. This class represents, applications received from for admission to the university. So, that is a description, private responsibility. Scrutinize application is scrutinized to see if the fees paid and mark sheet is enclosed.

If yes, the application is sent to the department else reject letter is sent to the applicant. We looked at the collaborators and the collaborators in this case of course, is the department. And for all the application to department and send letter to the applicant, when it passes scrutiny else send reject letter to a applicant. That is the applicant to department is forwarded and then this scrutiny is complete by the admissions office.

By registrars office, first scrutiny of course, it can reject otherwise, it sends to the department. Based on the departments decision, you decide to admit, reject or wait list. And send the appropriate letter. So, this is the overall one example of a CRC card.

Similarly, other CRC cards are made for department. Super class is none, sub class is also none.

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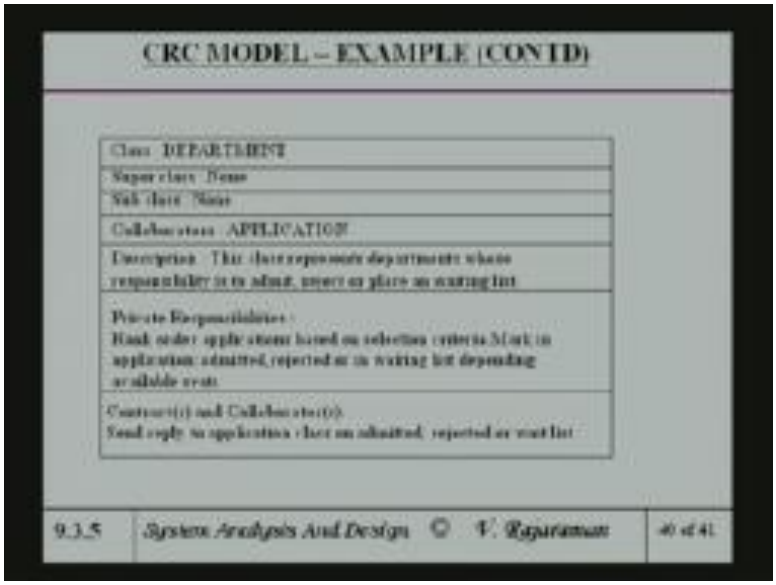

Collaborators application, application is one which based on which the entire action gets triggered. In other words, the application comes it triggers the action. So, description is this class represents department, whose responsibility is to admit, reject or place a student or an application or a applicant on a waiting list. And so, in turn of private responsibilities out of rank order, application based on selection criteria marks and application admit or rejected or wait list depend upon the depending on this.

You decide, responsibility of decide that admit, reject or put on wait list depends, based on the available seats. And contracts with collaborators, send reply to the application class on whether admitted, rejected or put on waiting list. In other words, the hits responsibility is to do this. And send the message back to the application class for it to do its own responsibility, of sending the letter to the applicant.

So, the effectively then the idea is to have in this case. Two classes, where the two classes collaborate one each one is got so responsibilities. And based on the responsibilities, it does the work. And then forwards, whatever is the result of that work for the requesting class to do its own responsibility or to fulfill its own responsibility.

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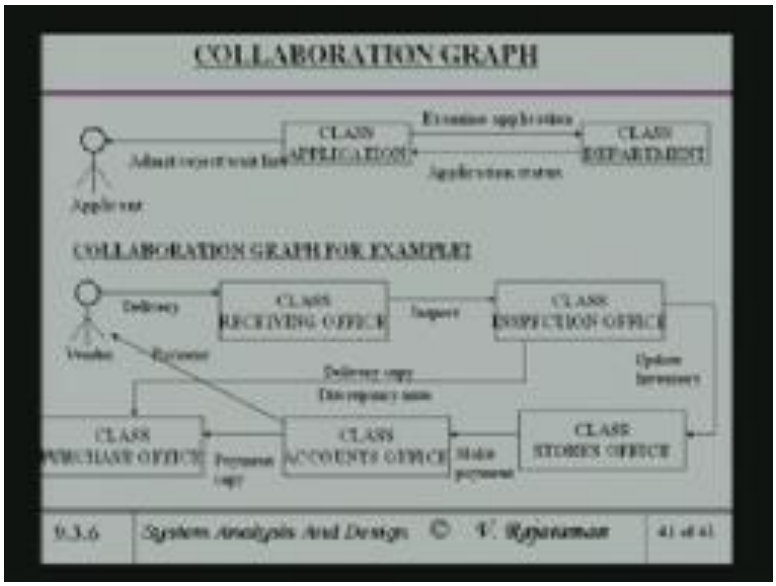

So, the top diagram here is an applicant. The class application has the responsibility of admit, reject or wait list. And class application sends a request to the class department. And the class department sends the application status, whether admitted rejected or wait listed to the class application. And that in turns, informs the applicant. Similarly, we can make a collaboration graph for a second example, whether it is a receiving office, inspection office, purchase office, accounts office and stores office.

So, we deliver delivery note is a one which triggers. The responsibilities of the receiving office, is to actually compare the delivery note against the order placed. This we are describing in great detail. But, this only gives you an interaction. And from that it collaborates in class inspection class, inspection office which does the job of inspection. Their private responsibility is to inspect and send a discrepancy note, if any.

The class receiving office also may send discrepancy note to the class purchase office. If it is done, if it so decided see as I said, it depends on the particular organization. It may decide that, only inspection office will send everything. And inspection office also has the responsibility to tell the stores office to update the inventory. And stores office has the responsibility, updating inventory and then informing the accounts to make payments.

The account office has a responsibility to make payment to the vendor. And simultaneously inform, the purchase office that a payment has been made. So, this kind

of completes the cycle of classes, their responsibilities and their collaborators. So, this general method which is used for the use for modeling objects. And there is exactly starting with in this, in this particular module we started with a simple question, what are objects and object classes?

We talked about Inheritance. We talked about Polymorphism. And then we talked about some examples of, how to find out actually classes from a word statement? Because, that is the most important part of the entire operation, having decided on having kind of known, what objects really mean? And what object classes mean? And what is the advantages of object oriented modeling? Then we try to do an object oriented modeling on a two problems for illustrative purposes.

And the entire exercise showed us, that is always an iterative process. It is not a one shot process. And a CRC team idea is very important. Because I said finding out classes is not the responsibility of the single individual. It is a responsibility of a team. And a team work is extremely necessary, particularly in the modeling stage. So, that later on design and so on will entail more or less programming and little little aspects of implementation of computer. But, the modeling is the most important part.

So, in this particular set of lectures I have not really got into great detail of about object oriented methods, in general and object oriented program in particular. As I pointed out, there are other courses which we will talk about them great detail. But, I am giving you a flavor of what the entire thing is about and how this is useful in the design and in the subject of systems analysis and design and in design of information systems, in general.

That is my primary aim of including this, in this set of lectures. So, I would urge you to look at some of the exercises in the book. Do it yourself and may be take some of the earlier examples, which we looked at in a structured method namely the decision tables as well as using structured English and so on. And also go back to the data flow diagrams. And try to kind of relocate them and model them using the object oriented idea.

And once you have a clear, simple data flow diagram and data dictionary gives you a lot of information, on which you can actually build objects and build object classes. I would really also suggest that, you mimic a small team with two or three of your class mates rather than, doing it yourself. And as a collaborative effort, you try to kind of make this

object modeling exercise. That also a kind of give you a flavor of cooperation, among system's analyst to be able to come up with a modeling exercise, particularly for a large model.

That probably, you have to do in your projects and so on. But to conclude them, the trend nowadays is to effectively use a object modeling as a standard. And object oriented system design as a standard, in large number of applications and this is really becomes relevant in programming in the large rather than programming in the small. In a very large problems and it actually the advantage is that, it allows reuse of earlier transcript design.

And it also allows, changes as things proceed and as general business who change. You can also easily adapt the objects, particularly the operations of the objects to the new environment or new requirements. So, it is easy to accommodate new requirements or modified requirements, if you do an object oriented modeling. And also do a good method of actually hiding the implementation details. And reuse, it is a very very important part of this entire exercise. So, having completed this we will go to the next topic which is actually designing of outputs.

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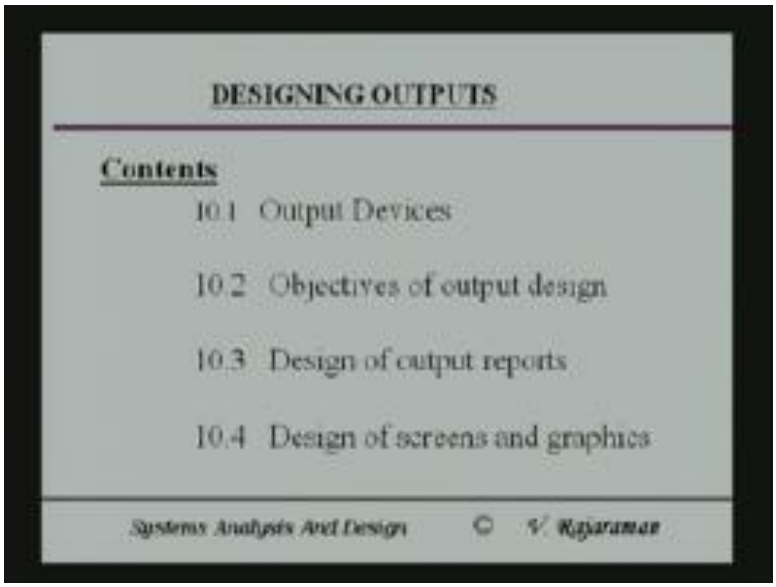

Because we looked at, how to design inputs, we looked at how to process these inputs. Now, we have to say how to design outputs. Because, ultimately the output reports. Or the ones which are given to managers and operation people, to act or to work. And so,

they are still important in many many situations I know. In practice, your design may be excellent. But, your outputs may not be satisfactory from the users point of view.

So, the users will require certain types of outputs which are relevant to them, which have met them understand the implication of whatever information system does, or system has been computerized system does. So, from that point of view it is extremely important to look at design of outputs. And I very quickly review, what device are normally available in a nowadays along with computers. Objects, objective of output design how to design output reports and how to design screens?

Because, nowadays apart from papers many of the outputs come on soft copy on the screen itself. In fact, so called paperless offices. They talking about, they want to reduce the paper flow. Instead of that, the entire organization is connected by local area network, to screens or to laptop machines or desktop machines. So, documents essentially may flow as screen inputs. Similarly, data inputs are done normally with a keyboard and a screen display. So, from that point of view screens and graphics display becomes important.

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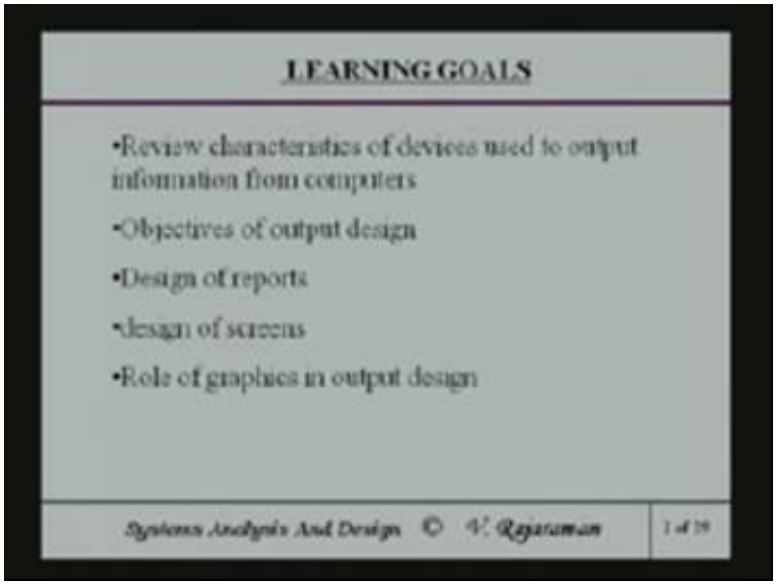

So, we will review the characteristics of devices, objectives of output design, design of reports, design of screens, role of graphics on output design.

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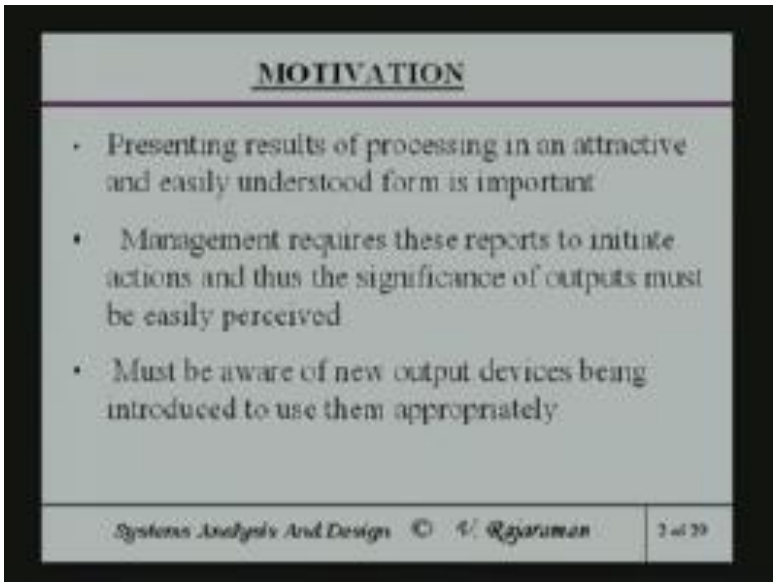

And you said, presenting results of processing in an attractive and easily understood form is very important. Whatever you may do, ultimately a satisfaction of a user depends up on how well you present the results to him. And management requires these reports to initiate actions. And thus the significance of outputs, must be easily perceived by the management depending on the appropriate level.

In other words, there will be certain requirements of by top level managers, certain other requirements for middle level managers and certain other requirements for operational or lower level managers. So, you have to fulfill all these three classes of requirements. And give reports appropriate to each class. Must be aware of new output devices, being introduced in the market continuously and use them appropriately. Something like you know, for instance about 20 years ago one never heard of color laser printers.

Now, color laser printers are available. In fact, black and the monochrome laser printer are black and white laser printers are become very inexpensive, comparatively inexpensive. And similarly, inkjet printers did not exist 20 years ago, even 10 years ago. They became very very popular in the last decade also, with the emergence of pc's and so on. So, I think the devices also change. And the latest in the devices are the so called Pen Drives.

The Pen Drives are replacing floppy drives, which are pen drive are nothing but, read only memories in which you can store up to almost 2 giga bytes of information. And they

are becoming easy to you. You know, is a less expensive than before and very convenient to carry around and store data and so on. So, what I am trying to say is that, from time to time to time devices also change. And you have to kind of update your own information about devices, what is available in the market.

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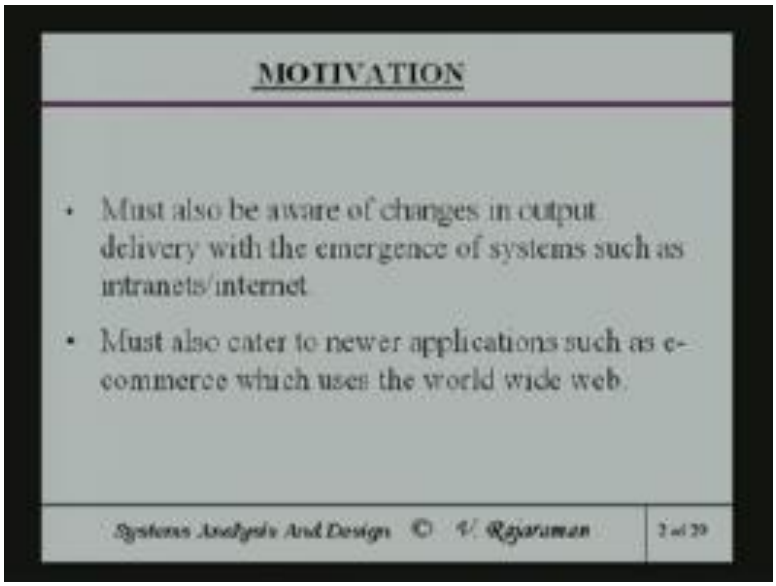

Similarly, you should be aware of changes in the output delivery note, with the emergence of systems like intranet internets and so on. We also have to cater to new applications like e-commerce, which uses a world wide web. So, there is a new method of inputting data and e commerce, the entire very often. The customer himself does the data input and does the order, by just clicking on a button on the screen. So, you have to design inputs appropriately the screens for such applications.

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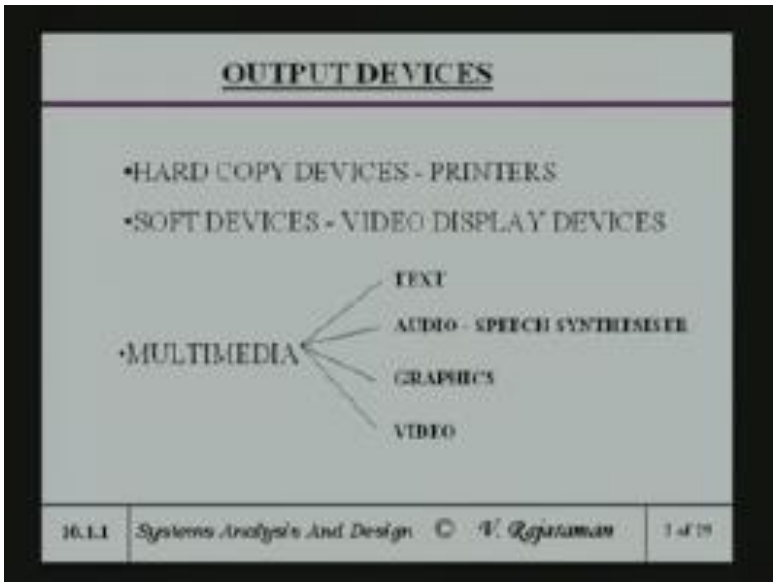

So, to very quickly review devices the hard copy devices and soft copy devices, hard copy devices are printers of various types. And soft copy devices are video display devices, which are also of two types. Majorly two, major two types, one is desktop machine with video display unit. And desktop machine with LCD screens, which are thinner and which are more. I would say that nicely focused multi color and so on.

And also laptops which have only LCD screens because, LCD screens are very light to carry. They do not require too much power, no high voltage and so on which require for videos. And also outputs are of various types now. Text is one, textual data is what we are mostly concerned about. But, this also audio output which can be essentially beeps because, every computer has got a little loud speaker built in. And can have a also speech output with speech synthesizer.

Text speech devices are now easily available. Graphics or pictures and video or moving pictures, all these becomes all together are called multimedia. And these also become feasible with video display unit, as well as LCD devices.

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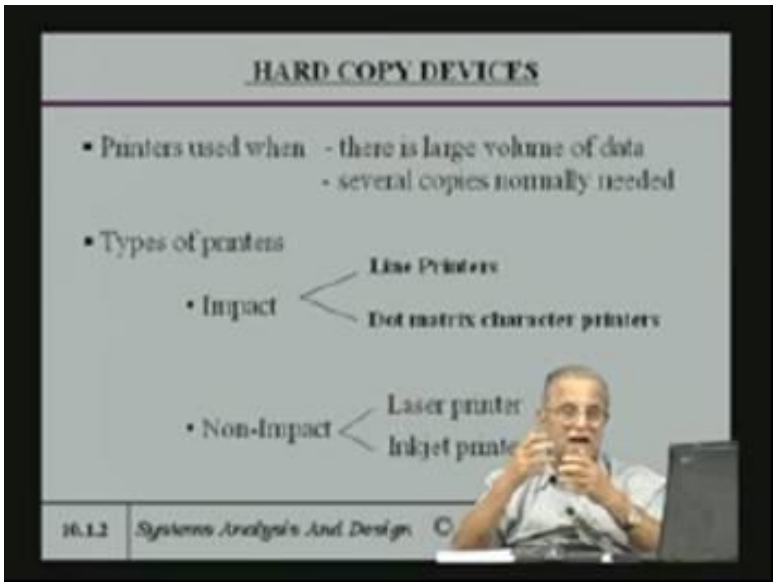

Printers are used on this large volume of data. And several copies are needed. And types of printers are impact line printers, dot matrix printers. They are impact printers non impact printers are laser printers and inkjet printers.

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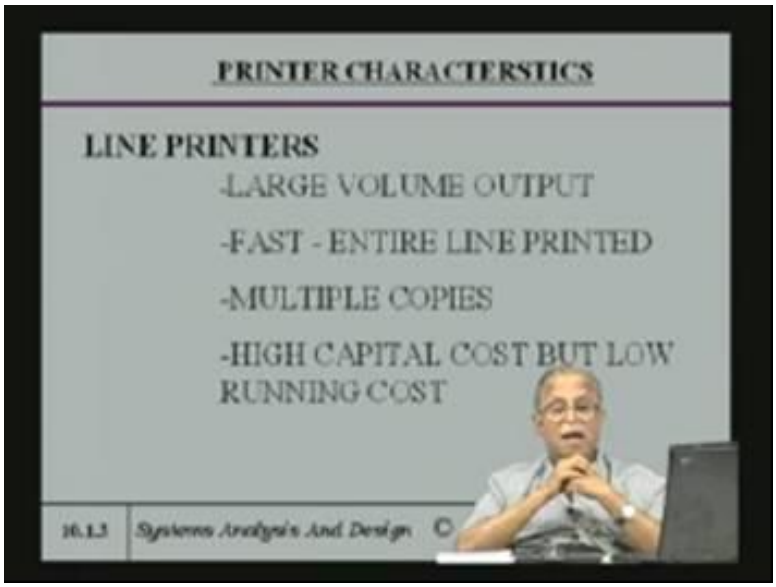

Line printers for large volume data like, if you want to put news examination results and or which, number of examiners may be running into tones of lakhs, then the output is always prepared in a line printer. Because, line printer can gives can give you almost up

to 11 to 1200 lines per minute. So, that means many many pages it can print. And a multiple copies can be printed with carbon sheet because, impact printing.

But, so the only disadvantages the capital cost is high. It runs into at least more than a lakh or could be 2 to 3 lakhs, depending on the type of printer. But, running cost is low because, only ribbon has to be changed. And ribbon cost are not as high as a cost of say, inkjet printers where the cartridges has to be change, or laser printers where again cartridge has to be change.

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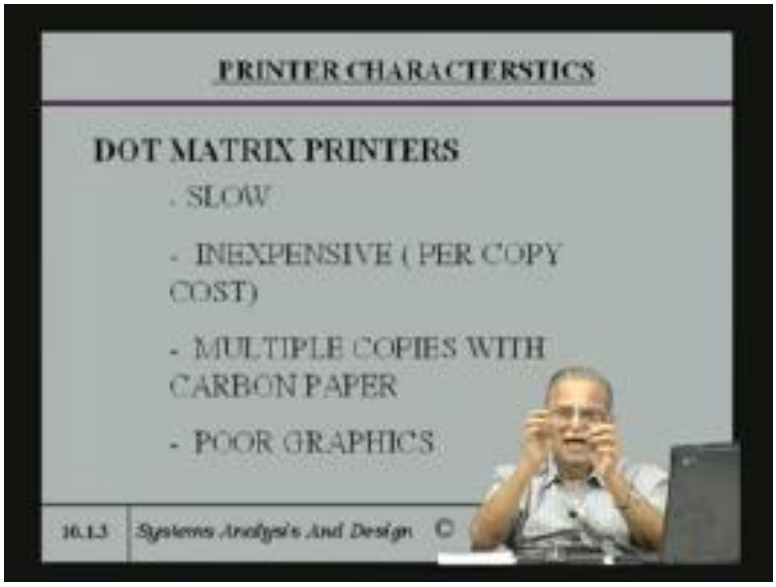

Dot matrix printers are for desktop users. They are slow. But, very inexpensive again only ribbon cost is involved. You can have multiple copies on by putting carbon paper. But, the graphics is poor. You do not have very good graphics, because it is all dots and it does not look nice.

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Inkjet printers can print both characters and graphics. And it also multi color, because all own computers nowadays have inkjet printers. Because, they are not expensive and they also give you color. And if you get pictures or photographs send by your friend on internet and you want to print that photograph. You can print using an inkjet printer. You have to get reasonable copy of that photograph.

And capital of cost is low. It only cost about 8000 rupees around less than 10000 rupees, depending on the type you want. But, the people would make money on the cartridge. You may very happy, you may be very happy to buy something like a 4000 rupee inkjet printer for home use. But, you will get shock of your life when after the inkjet cartridge runs out, you want to go and buy another inkjet cartridge. And it will, he will tell you that will cost 1000 rupees.

And so, one fourth of the cost of the machine, so in other words in fact, many of these companies make money and the consumables arise, on the machine itself. Because, consumables you continue to spend money. Whereas, capital cost is spend once and for all. And ink, the color would be slightly more expensive. And so, the point is another problem is with the inkjet is that, if you do not use it regularly. If you let it do not use it for week or so at home, it may dry up.

So, you by force you reuse. We are force to use it almost once in two days or preferably every day, at least one or two pages to be taken out. So, that inkjet does not dry up. And, but then as I said, you have to make a compromise between the cost and so on.

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Nowadays, they coming up with lower cost, refill stuff and so on. But you know, it is up to refill qualities are not as good as originals. But, hp itself is one of the inkjet manufacturers has come up with a new cartridge, for developing countries like China and India which costs lower than the old cost they had. Because, they are resistance from customers and so they reduce a price, a little. Laser printer, also have characters and graphics.

A multi color is there, but it is expensive. Black and white is not expensive. In fact, I saw an add for even 6000 rupees, you can get a good reasonable laser printer about ten pages per minute and so on. But, then the advantages of this is that, you get an excellent quality. And but, the capital cost as I said is coming down, but definitely much higher than the inkjet printer. Recurring cost is lower than inkjet for the same number.

The way you calculate is for, so many number of pages printed. How know, what is the cost for per page printed? First page printed on a inkjet, may run to about 5 rupees. Whereas, first page printed on a laser printer may be just about 2 rupees see. So, it depends on the, because inkjet. The inkjet itself is the cost. The cartridge and not the printer, here the printer is little expensive, but then the recurring cost is lower.

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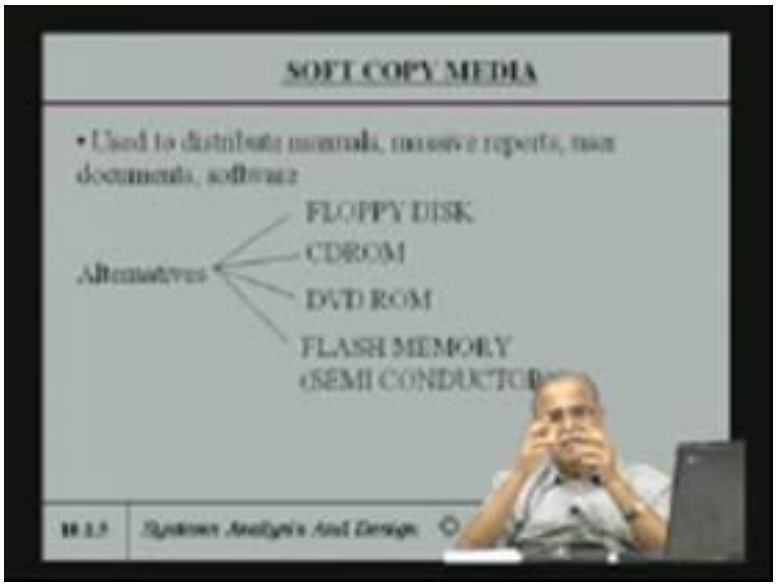

The lowest cost is of course, is the dot matrix. Soft copy media are, you know where program where distributed where you distribute documents and so on. The popular ones are a floppy disk, CD ROM, DVD ROM and flash memories.

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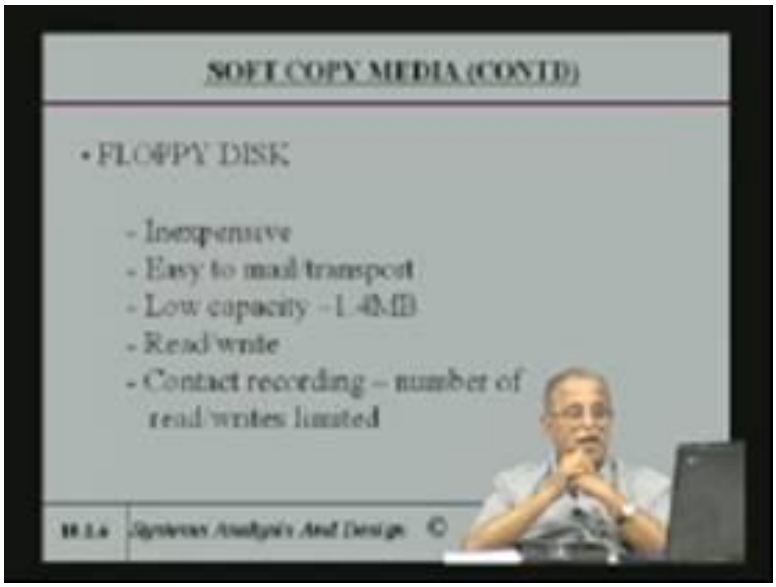

A floppy disk are inexpensive, easily transport or mail, capacity where 1.4 mega bytes. And it can read and write. It contact recording. So, number of reads and writes are limited.

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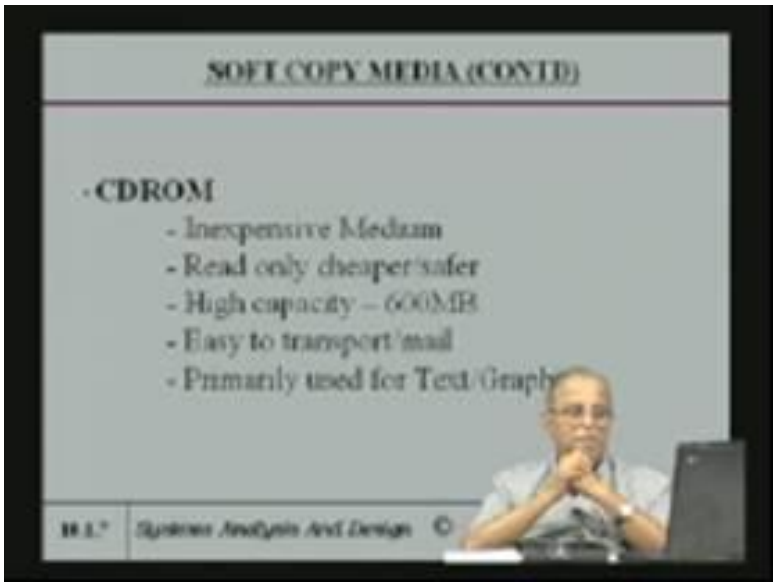

CD ROM is an inexpensive medium. You can buy a CD ROM, in buy for something like 7 8 rupees per CD ROM. Of course, similar quantities it may cost to 30 rupees and so on. Read only is cheaper and safer. You know, there are two types of CD ROM, read write and read only. Read write is more expensive, read only is inexpensive comparatively. But, read only you cannot over record whereas, read write you can over record.

High capacity, 600 700 Mb. 600 Mb is actually for formatted capacity. 700 Mb is a raw capacity. You will transport, add mail because, it is a small disk. Text and graphics, you can use it for storing. But most of the software distributions, they use CD ROM's. And also for many many other large document distribution CD ROM's are actually used.

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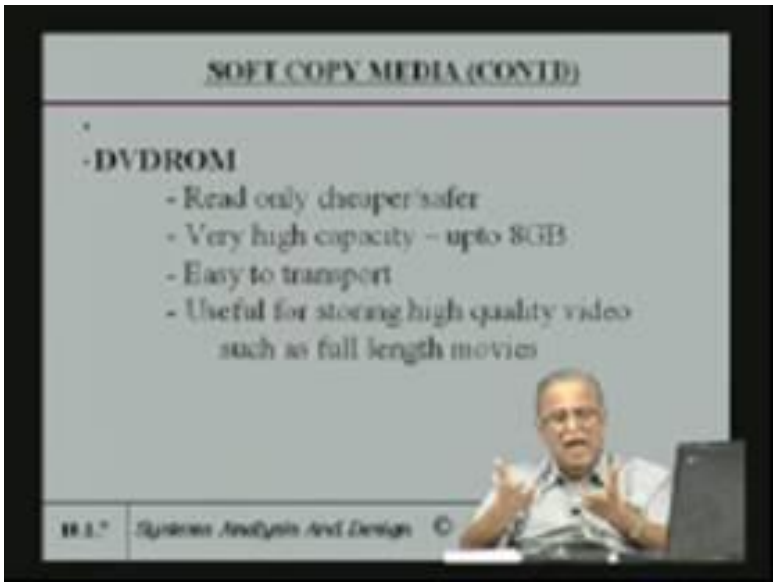

DVD ROM's are currently read only. It has a very large capacity, up to 8 Gb and easy to transport. Again it is almost a same physical device. If you cannot make a distinction between DVD and CD, when you look at a disk, Platter looks the same. But, technology are different and DVD ROM because of high capacity are very often used for movies videos and so on.

So, if you want to if you have a something like 10 hours of music or entire picture movie to be, you know. The video stored will normally as they have multiple CD ROM's to give you a movie or a single DVD ROM that is, the movies stored and useful for storing, high quality video such as full length movies.

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Flash memory, is read or write, read and write. It is purely electronic, small sizes on weight, no moving parts that is very reliable. Needs USB port on the PC, 128KB to 2GB sizes and very low power needs. And of course, it is expensive per byte cost. It is expensive compare to floppy and so on.

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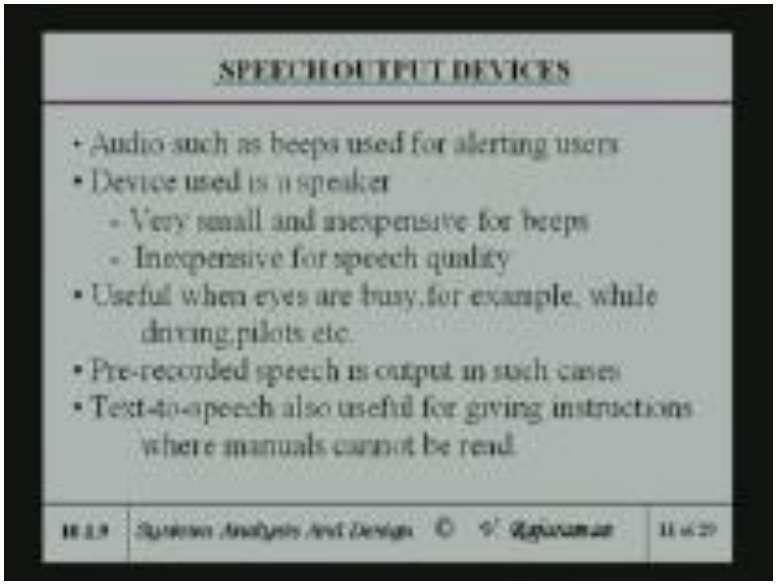

So, we always look at that per byte cost, when you compare storage devices and audio against, beeps used for alerting users. In other words, even when you kind of do a typing on a keyboard, some machines give you a beep every time you press a button. To give

you an audio feedback that, button is actually been pressed. Those types of things are very inexpensive. And beeps are also used for warnings and so on.

Suppose you end reach the end of a document, it may give you a beep saying that it is a end of a document. It is a small speaker with a small inexpensive, but beeps. Expensive speech quality, you can have speech quality also built in and for particularly about test speech systems. And speech system, where used particularly when eyes are busy, while driving or in pilots or in planes and so on.

If they get audio signals, while they are looking at the meters and looking at the outside, then it is always a better way to alert the person. Suppose you know even in a car, when you are driving a car, if you are running out of petrol or your oil is low or your temperature is high. To look at that panel, every time when you look at it, your attention is diverted from the road. So, there could be an accident.

So, that is why the audio signals very useful. And sometimes, pre recorded speech is output in such cases. For if you given an automatic kind of signal, text speech is useful for giving instructions. So, I will stop at this point and continue with the various devices. And also, the formats of reports and what types of reports are necessary for what types of people, next time.