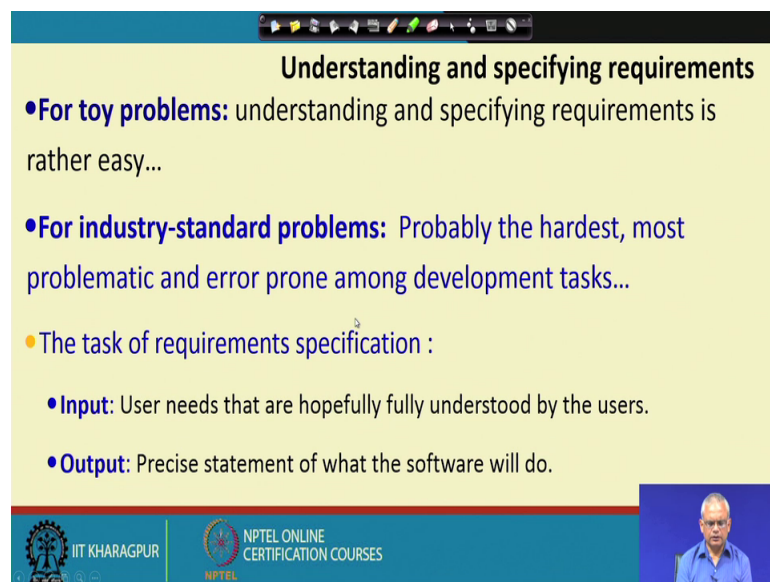


Software Engineering
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Lecture – 15
Introduction to requirement specification




Welcome to this lecture. In the last lecture we had started to discuss about requirements analysis and specification. Requirements analysis and specification is one of the most important phrases in the life cycle of a software development work. It has many skills to learn, this lecture will focus at how to go about carrying out the requirements analysis and specification.

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Understanding and specifying requirements

- **For toy problems:** understanding and specifying requirements is rather easy...
- **For industry-standard problems:** Probably the hardest, most problematic and error prone among development tasks...
- **The task of requirements specification :**
 - **Input:** User needs that are hopefully fully understood by the users.
 - **Output:** Precise statement of what the software will do.

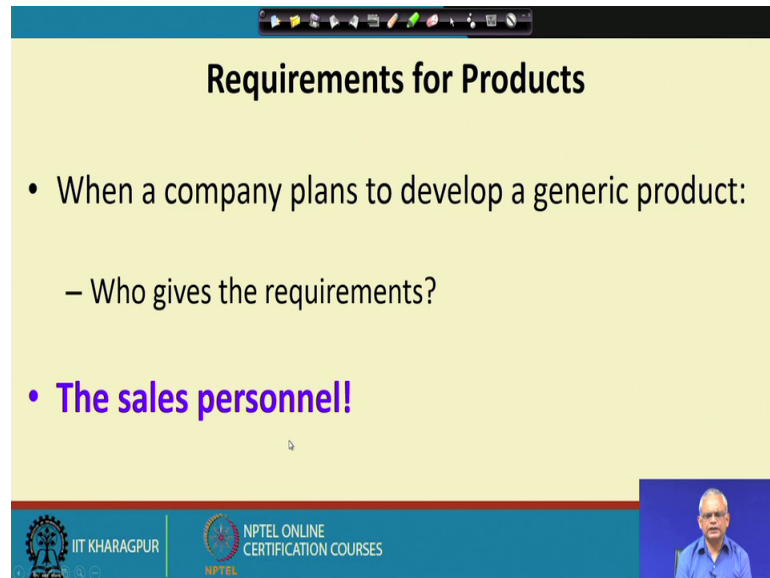
  

There are 2 aspects here one is understanding the requirements and the second is about specifying the requirements. If, you are developing a very small toy problem, then requirement specification is extremely easy, because the issues are rather clear and we can specify those. But then for a industry standard problem the requirement specification is typically the hardest of all the phases done by an experienced person.

It is the most problematic and error prone among the development tasks and it is important to note that any requirements error has a huge cost overhead, unlike a coding error or something which can be quickly corrected. A requirement error costs maximum; to understand what exactly is done during requirement specification, during this work the

input is the usernames hopefully the users understand what are they need to gather, analyze, remove problems from that and then document that and at the end of the requirements analysis, and specification will have a precise treatment of what the software will do and this is in the form of a SRS document software requirement specification document.

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Requirements for Products

- When a company plans to develop a generic product:
 - Who gives the requirements?
- **The sales personnel!**

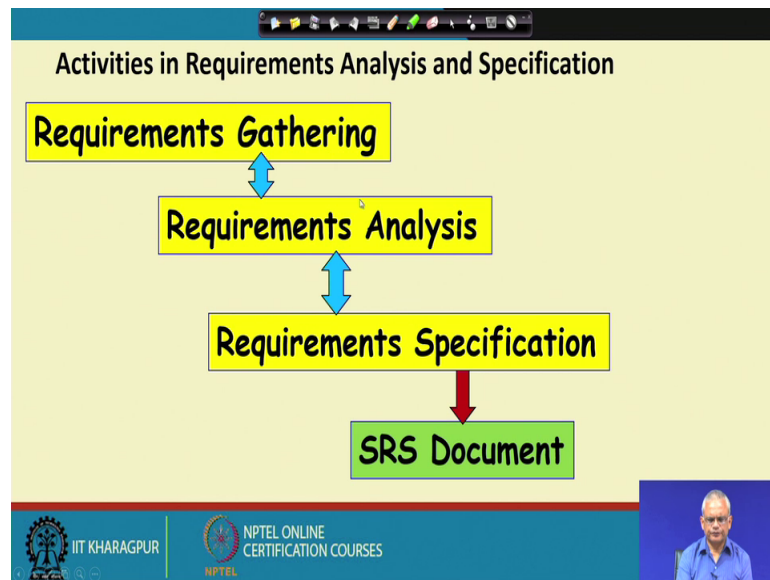
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So, far we have been saying that requirements are there in the clients mind and we need to gather it and document it, but what about the case where a company wants to develop a generic product? That is some product which may be useful to people there is no specific client here. The company wants to develop something hoping that there will be many buyers for it.

For example, a company might like to develop a health embedded product which will monitor various health parameters and give feedback to people, let say it undertakes to develop such a product. If, you are the customers are not well known they are not known at all actually, it can be purchased by anybody who likes it later, but then for development purpose who will the customer? Who will give the requirements?

Typically, it is the sales personnel who understand that what will sell well? What features are required typically would be demanded by the customers? And, they will be the clients they will act as the clients for the software and they will actually need the requirements.

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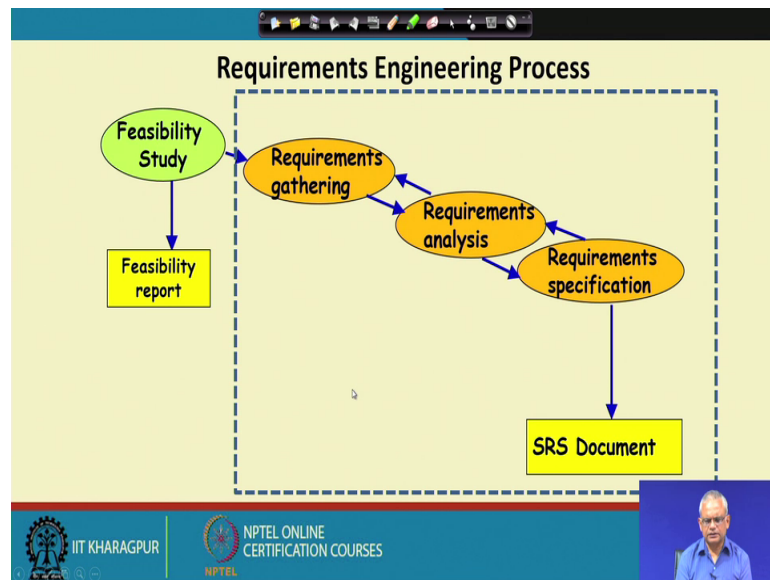


Now, let us try to understand in more detail the activities carried out during requirement analysis and specification. As, you are saying the first is requirements gathering, because the requirements are there in the minds of the users, we need together it we look at some techniques about doing it. And, once requirements is gathered start doing the requirements analysis, but during requirement analysis we might find that there are some requirements, which are missing, which are not clear and so on.

We need to again with the client and do more requirement gathering. And, once your requirements analysis task is complete go about specification, document the requirements and then the final outcome is the SRS document.

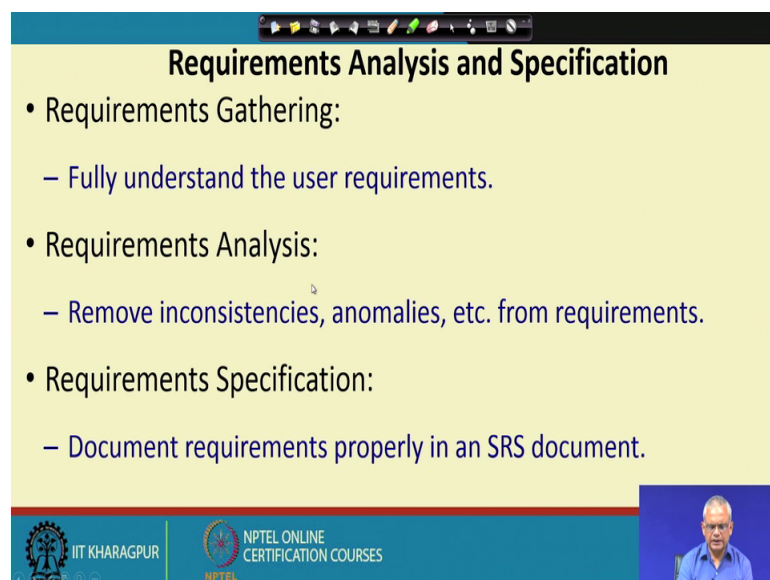
So, there are 3 main activities here requirements gathering requirements analysis and requirement specification and these are iteratively carried out, because even though one is complete we need to revisit it if required during the analysis and specification.

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We can also represent it in more elaborate way in this form, after the feasibility study, the project has been found feasible, the requirements gathering started. And, then this is a iterative work, because once we do the requirement gathering we start requirements analysis, but then we might find that need to do more gathering need to resolve issues and do requirement specification.

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But, then during requirement specifications we find that there are still requirements problem and might do requirement analysis and again do requirement gathering.

So, this is the iterative set of activities and at the end of the requirement specification, we have the SRS document produced. Now, let us look at these 3 activities in more detail requirements gathering, here the requirements are there in the minds of the clients we need to understand the requirements. And, then we need to remove problems here in the requirement for example, are there any inconsistencies anomalies and so on. And, then we do the requirement specification, where we document the requirements that we have gathered and analyzed.

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The slide is titled "Need for SRS..." and contains the following content:

- **Good SRS reduces development cost:**
 - Req. errors are expensive to fix later
 - Req. changes cost a lot (typically 40% of requirements change later)
 - Good SRS can minimize changes and errors
 - **Substantial savings --- effort spent during req. saves multiple times that effort**
- **An Example:**
 - Cost of fixing errors in req. , design , coding , acceptance testing and operation increases exponentially

The slide also features a graph with a vertical axis labeled "Cost" and a horizontal axis. A blue curve starts at a low point on the left and rises exponentially towards the right, illustrating how the cost of fixing errors increases significantly as the project progresses.

At the bottom of the slide, there are logos for IIT KHARAGPUR and NPTEL ONLINE CERTIFICATION COURSES.

Let us see why SRS document is an important document a good SRS document actually reduces development cost, because if you do not have proper requirements gathering and development starts there will be many missing requirements, incorrectly understood requirements and so on. And, these will be expensive to fix later even if the requirements are done well typically there is a 40 percent requirement change later.

But, if the requirements are not non done well is a not gathered documented well then there will be much more changes and the development will become very expensive. Good SRS can minimize change the errors and as we are mentioning if a error is found during the requirement specification, it leads to substantial saving because otherwise with a wrong requirement, you might go on doing the other life cycle activities.

And, then finally, come back and correct the requirements and that will cost multiple times the effort that we would put in the requirements phase to come up with a good

requirement. We rather spent time in the requirements phase try to make it as complete and as truly reflective of the customer requirement as possible, because any problems in the requirement has huge cost implication.

Because, the cost of fixing requirements error during the design, coding, and acceptance testing, increases exponentially, if during the requirements we fix the bug or the error then it costs very minimal. But, as the development proceeds the design, coding, testing, the cost increases substantially and the main reason is that, if we find the problem at let us say a requirements is wrong we realize during testing.

Then, we not only need to correct the requirements here, review it change the design document, review it and then again change the coding and again carry out the testing. So, the cost implications of errors is huge it increases exponentially, the more delay we have in identifying any error the cost implications is huge. So, it is really costs effective if we spend some time during the requirement gathering, analysis and specification and we produce a good SRS document.

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• Establishes the basis for agreement between the customers and the suppliers

• Forms the starting point for development.

• Provide a basis for estimating costs and schedules.

• Provide a basis for validation and verification.

• Provide a basis for user manual preparation.

• Serves as a basis for later enhancements.

What are the Uses of an SRS Document?

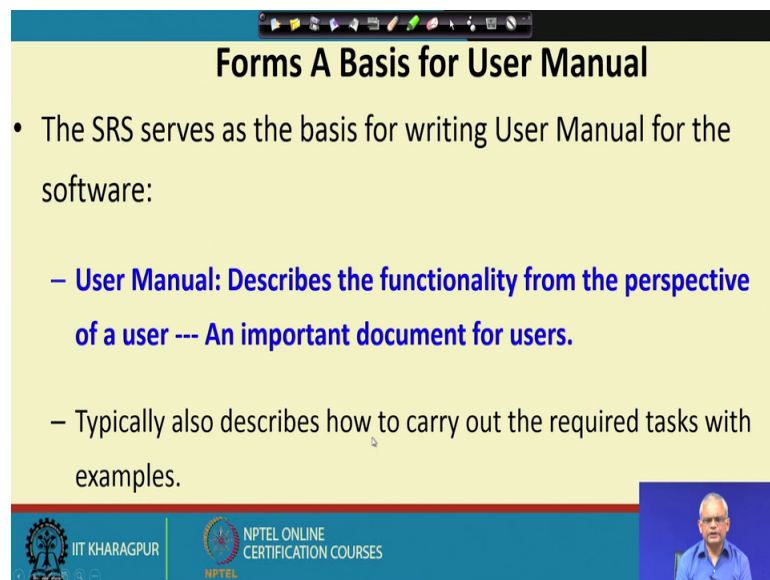
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Now, let us see if we produce SRS document in what ways it will be used? One is that it is agreement between the customer and the developer. As, long as the customer agrees to the requirements those reflect the requirements of the customer and the developer agrees to develop those. And, then the developers take up the SRS document understand it and start their design and development based on that. The project manager test the SRS

document and estimates the cost and schedule stops based on the number features that are mentioned in the requirements and so on.

The test team uses the SRS document they take of the SRS document and based on that they design the test cases for the system testing. The, SRS document is used for the user manual preparation because the SRS document contains all the functionalities to be provided by the software to the user. The user manual is typically based on the SRS document and also later when maintenance works start enhancements putting etcetera. Again the requirements document is taken up specific features to be enhanced and so on they are identified and then the work starts from there.

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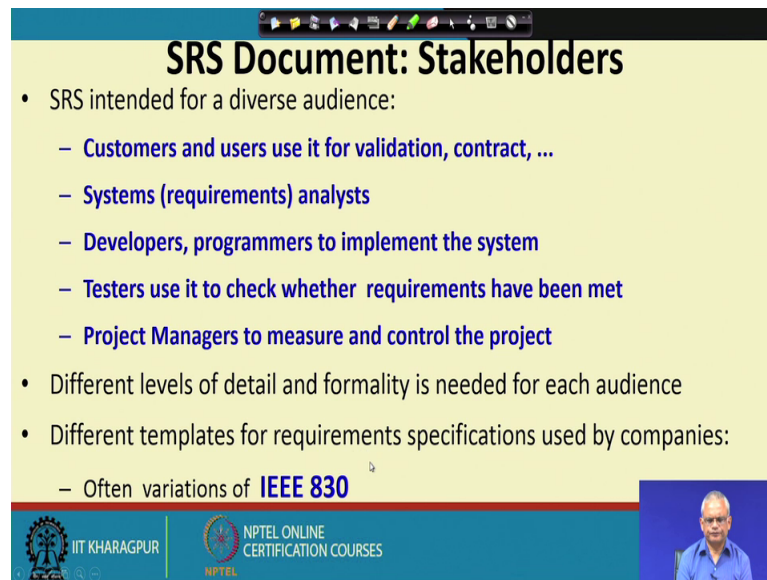
The slide is titled "Forms A Basis for User Manual" and contains the following text:

- The SRS serves as the basis for writing User Manual for the software:
 - **User Manual: Describes the functionality from the perspective of a user --- An important document for users.**
 - Typically also describes how to carry out the required tasks with examples.

The slide footer includes the IIT KHARAGPUR logo, NPTEL ONLINE CERTIFICATION COURSES logo, and a small video inset of a speaker.

So, the SRS document is a very important document, it solves for multiple purposes including the basis for writing the user manual. In the user manual in the document we describe the way the users can understand what are the functionalities that are provided by the software. The user manual is an important document of the user here not only that we write in the user understandable form, the various functionalities and typically we also illustrate the functionalities with examples. The SRS document as we had seen has various users.

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SRS Document: Stakeholders

- SRS intended for a diverse audience:
 - Customers and users use it for validation, contract, ...
 - Systems (requirements) analysts
 - Developers, programmers to implement the system
 - Testers use it to check whether requirements have been met
 - Project Managers to measure and control the project
- Different levels of detail and formality is needed for each audience
- Different templates for requirements specifications used by companies:
 - Often variations of **IEEE 830**

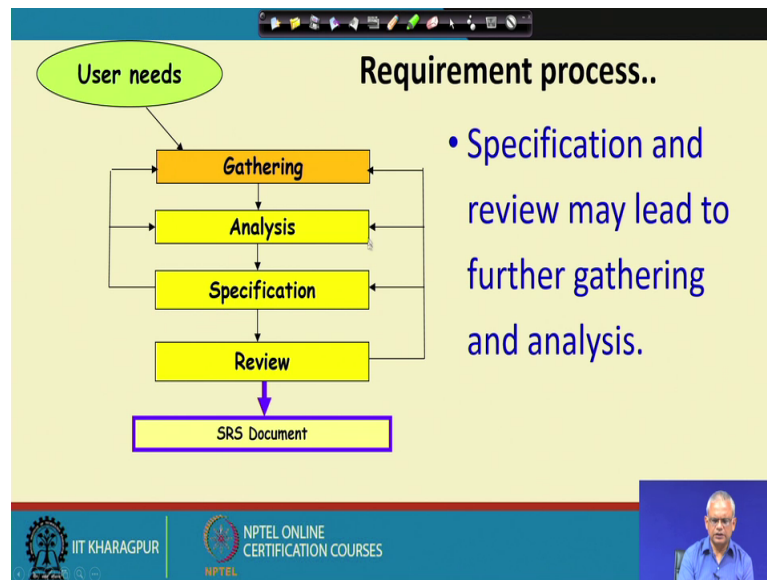
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And therefore, there are many users of the SRS document. The customers use it for checking whether the developed software is as per their requirement, the requirement analyst they develop the requirement, they write the SRS document, the developers programmer etcetera often referred to the SRS document, to carry out their work. The testers use SRS document to design test cases and to ensure that the developed software meets the requirements. The projects managers estimates that is measure the work that is required and then for controlling the project.

So, there are many stakeholders the SRS document should be readable and understandable to the customers, the developers, the testers, the project managers, and of course, the requirement analysts they write the document. Each stakeholder needs different types of information from the SRS document and in a way that they can appreciate.

Since, it is a very important document there are standards here and one of the well accepted standard is the I triple E 830 standard, we will look at the I triple e standard and typically the standard that is used in the industry as small variations of the I triple E 830 standard. We understand I triple 830 standard, how to document it? We should not only be able to read through requirements developed by others, but also we should be able to write requirements that are accepted by others.

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Before, that let us try to understand the requirements process. That is, what are the activities that are undertaken? And, how these are accomplished we had some discussion on that, but let us look at more elaborately. Here, the requirements gathering starting with the user needs we gather the requirements and then analyzed, but then we might have to go back to gathering.

And, then once this is done satisfactory the gathering is complete and the analysis satisfactorily complete, then we proceed to specification, but during specification also we might to have do some analysis and gathering if we notice problems during writing down the or documenting the requirements. And, once the SRS document is the draft is produced, it is reviewed by the customer to check whether all requirements have been captured, by the development team members whether these have been written in sufficient detail and so on.

The testers, whether the testing or the test cases can be satisfactorily designed based on the requirements that have been written down in the document. And, once the review is done the SRS document is produced, it is important to understand here that this is not a series of stages lot of iterations goes on here.

Because, during analysis you might realize that some problems need clarification from the customer, you need to do gathering are some requirements are missing and during specification also need to do some analysis and gather.

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How to Gather Requirements?

- Observe existing (manual) systems,
- Study existing procedures,
- Discuss with customer and end-users,
- Input and Output analysis
- Analyze what needs to be done

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graph TD; needs((needs)) --> Gathering[Gathering]; Gathering --> Analysis[Analysis]; Analysis --> Specification[Specification]; Specification --> Review[Review]; Review --> SRS[SRS Document]; Analysis --> Gathering; Specification --> Gathering; Review --> Gathering;
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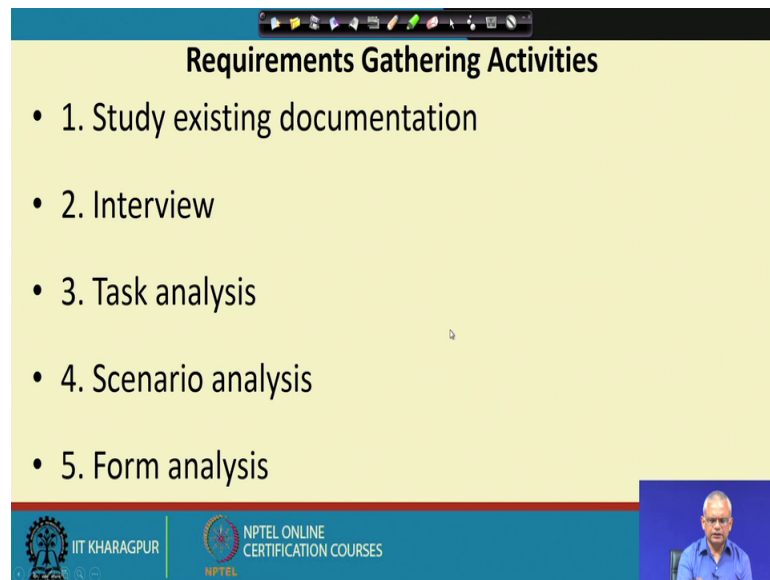
Now, let us try to see how to do the gathering that is the first task in the requirements process here. There are many techniques that are typically deployed, we need to use multiple techniques for gathering requirements; we will take up a case study simple case study to see how it can be done?

The first is that if there is a existing manual system or there is a existing software, which is something similar to the one that we are developing we need to study that. Let us say an office work needs to be automated we need to first observed that what work is exactly done in the office. If a software exists which is similar we need to use it and check what are all facilities it is provides and where all we want changes.

And, once we observe the work we need to study the procedures how this work carried out for this we need to discuss with the customer and end users. Also, need to do input and output analysis that is if there is any forms that are input, that let us take up a take the example of a office. If the students and the faculty need to fill some forms and submit in the office those are the input, you need to study what are the types of forms that are being used for input? And output with office produces some output, then what are the forms they use to producing the output what are exactly the data that is input the data that is output by the office.

And, based on this gathered requirement need to check, what exactly is to be done we will look at some more detail the gathering work.

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Requirements Gathering Activities

- 1. Study existing documentation
- 2. Interview
- 3. Task analysis
- 4. Scenario analysis
- 5. Form analysis

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The gathering activity typically we can say that there are 5 activities. One is study existing documentation, if there are documentation about the system to be developed we need to study that carefully, the second is interview. We need to interview the end users and also the customer who is trying to have the software developed. The third is called as task analysis that is based on the interview we identify that they use it for certain tasks they plan to use it for performing certain tasks.

And, then we need to do the task analysis to find out what are the exact procedure based on which the task accomplished. And, then for each task we need to do the scenario analysis, that is a each task consists of multiple scenarios.

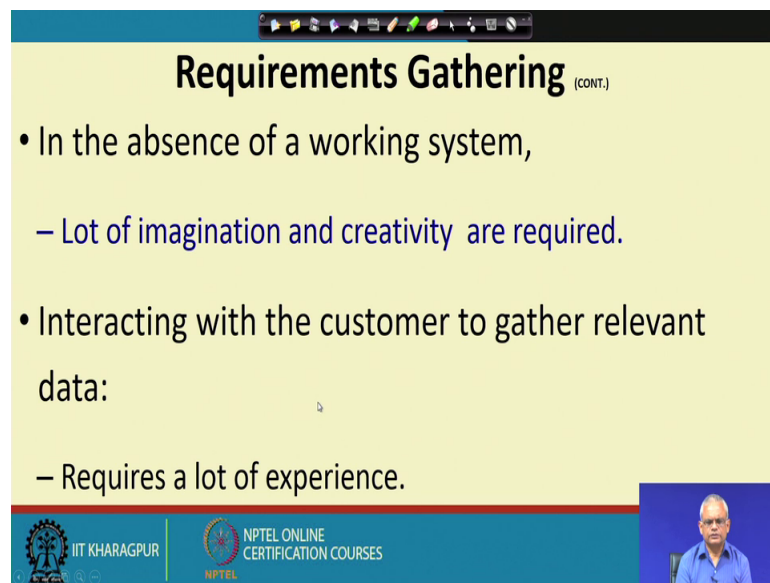
For example, let us just take a simple case of a student in the office of a department the students can take leave. One is that the students fill up form give it to the office or get it approved by the head of department gived in the office, but then that is just one scenario. The taking leave can have multiple scenario for example, they want to take medical leave or they want to take a semester withdrawal and so on.

So, these are the different scenarios where they might have to do a slightly different procedure. Even, though the task is applying for leave by a student that can have several scenarios. And the fifth technique to gather requirements is the form analysis, in the form analysis the forms that are used for giving information are the input and the forms that

are used for producing the output these are analyzed to find out what are the data that are input and what are the data that output.

So, 5 well known requirements gathering techniques studying existing documentation, interviewing the end users and the customer, task analysis, scenario analysis, and form analysis. If, you want to do requirements gathering for any project these are the 5 tasks 5 activities that typically we need to carry out.

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Requirements Gathering (CONT.)

- In the absence of a working system,
 - Lot of imagination and creativity are required.
- Interacting with the customer to gather relevant data:
 - Requires a lot of experience.

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Now, let us take up a case study simple case study. And, try to understand how these activities are carried out? Of course, many times the customer does not understand the problem well and here it is the duty responsibility of the person, who is gathering the requirements, to suggest to have lot of imagination and creativity and suggest to the customer what features might help and would be useful. Requirements gathering, even though it appears like a simple task not really it requires lot of experience.

Because, this is a crucial task need to gather all the requirements from the customer who has some of the requirements in mind, and others the person doing the gathering need to suggest to him and make him appreciate that what features might be useful.

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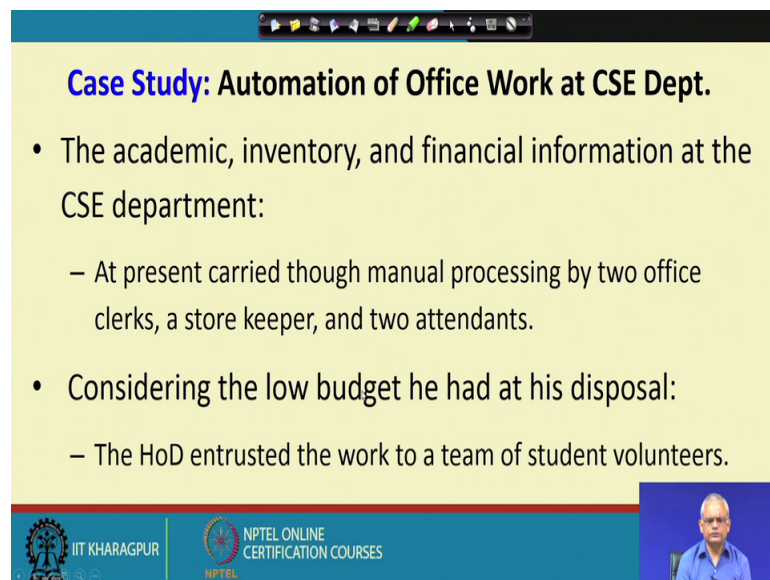


Requirements Gathering (CONT.)

- Some desirable attributes of a good requirements analyst:
 - Good interaction skills,
 - Imagination and creativity,
 - Experience...

The person doing the requirements gathering not only should have good communication skill, should have imagination creativity and experience.

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Case Study: Automation of Office Work at CSE Dept.

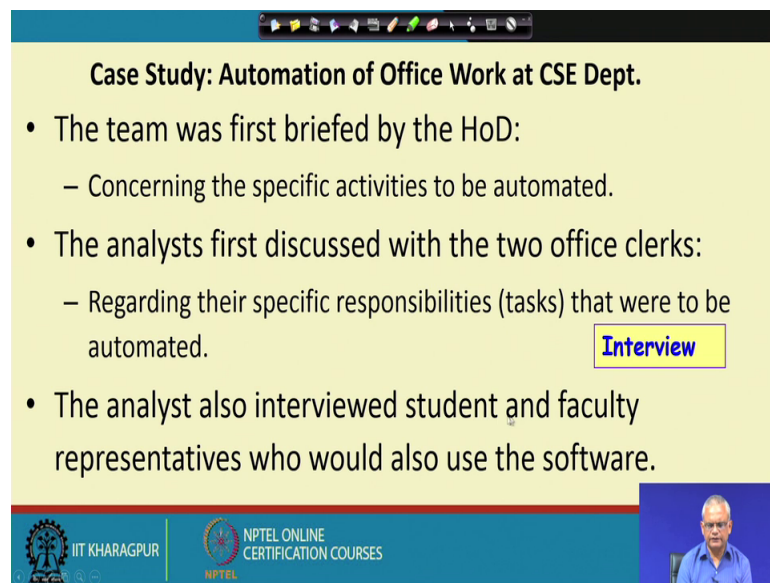
- The academic, inventory, and financial information at the CSE department:
 - At present carried though manual processing by two office clerks, a store keeper, and two attendants.
- Considering the low budget he had at his disposal:
 - The HoD entrusted the work to a team of student volunteers.

Now, let us do a case study. Let us say the computer science department has a office which is operating right now manually, there are 2 office clerks a store keeper and 2 attendants their main work is to keep track of the academic records, the inventory of different equipments and so on and also the financial information the department. And,

considering the low budget the head of department, he just entrusted these to a team of student volunteers to develop these office automation work.

Now, let us see how the student members of the development team, they went about gathering analyzing and specifying the requirement. They selected the most experienced and persons the student having good communication skill to carry out the requirement gathering.

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Case Study: Automation of Office Work at CSE Dept.

- The team was first briefed by the HoD:
 - Concerning the specific activities to be automated.
- The analysts first discussed with the two office clerks:
 - Regarding their specific responsibilities (tasks) that were to be automated. **Interview**
- The analyst also interviewed student and faculty representatives who would also use the software.

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They met the head of department first and then try to identify what exactly is required. So, the head of department is the customer and then they met the office clerks they are the end users because finally, they will be using the software. What are the tasks that they do every day that they would like the system to automate. Even, the other users they met like students who right, now manually submit forms and so on they would have to submit it through the software to be develop, their expectations of the software they interviewed the students and faculty who are also the stakeholders and so, the users of the software.

This task that was achieved by meeting the head of department, office clerk the student and faculty identifying in what way they will use the software? What is their expectation of the software? What features will be required this is the interviewer ask?

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Case Study: Automation of Office Work at CSE Dept.

- For each task that a user needs the software to perform, they asked:
 - Task and Scenario Analysis**
 - The steps through which these are to be performed.
 - The various scenarios that might arise for each task.
- Also collected the different types of forms that were being used.
 - Form Analysis**

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And, then after identifying the tasks they try to identify the steps through which these will be performed, and then the various scenarios that may arise for each task. And, this is the task and scenario analysis, and then collected various types of forms that are used by the office both for the users that is student faculty etcetera to fill up and submit to the office, and also the forms that office users to produce any output and this is the forms analysis.

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Case Study: Automation of Office Work at CSE Dept.

- The analysts understood the requirements for the system from various user groups:
 - Identified inconsistencies, ambiguities, incompleteness.
- Resolved the requirements problems through discussions with users:
 - Resolved a few issues which the users were unable to resolve through discussion with the HoD.
- Documented the requirements in the form of an SRS document.

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And, then the student members who were carrying out the requirements task, they looked at the requirements gathered identified inconsistency, ambiguity and incompleteness. These are the requirement problems we will just look at what are these problems and how to overcome them?

And, they identify the problems and overcome them by discussing with the head of department. And, then they went about documenting the requirement specification we will stop here this lecture and we will continue from this point in the next lecture.

Thank you.