

Embedded Software Testing
Lecture 7
Seer Akademi-NPTEL MOU

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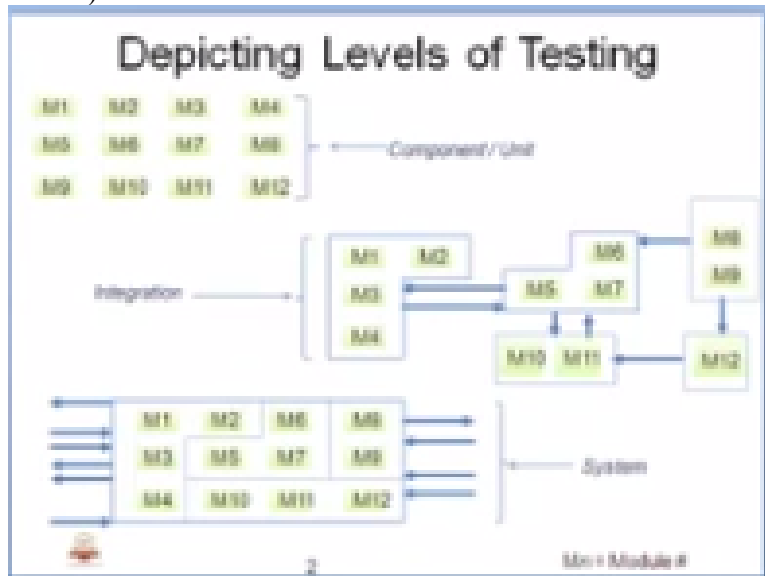
Exercise for Lecture 6

Why Simulators can't be used for the complete testing? What is the major difference between Simulator and Emulator?

- Why do we need the EST test setup to be configured?
- Provide a brief sentence for the below:
 - Test Harness
 - Test Bench
 - Fault Injection
 - IO
 - ICD
 - Breakpoint
 - Simulator
 - Emulator
 - ICE
 - Profile

Welcome you to the next session of embedded software testing I think privies session we had seen some of the levels of testing.

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In terms of how different models are organized taking an example of how hotel modules of how testing level it is getting organized integration testing system testing we had detail about.

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Unit Testing

- Unit - smallest testable piece of software
- A unit can be compiled/ assembled/ linked/ loaded; and put under a test harness
- Unit testing done to show that the unit does not satisfy the functional specification and/ or its implemented structure does not match the intended design structure

Each core modules or components how it is integrated degraded in a higher level then we discuss about setup.

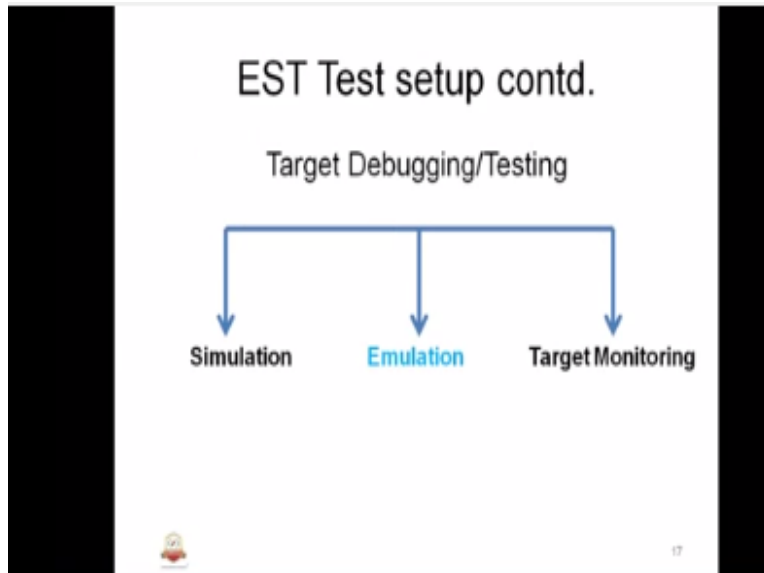
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EST Test Setup contd.

- **Target:**
- Used to test hardware dependent codes.
- Target – also used to run monitor

Host and target how looks like what will be the page development and testing what will be our target based development and testing so what is a likely in orbit so what is test system that is going to be used and test system with a realistic input provide from the system perspective.

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Then we have seen through some of the target builder giving techniques simulation, emulation, target monitoring simulators emulators reporting subtitles Emily does not written about the yes the emanation what are the emanation techniques that are used then we have the target monitoring where up to monitoring program will look in to target events the data which interacts with the target so the tools and there usage also this disused how should be used I think today we will go to some go this commercial tools.

So and then an example we will come to know so these are tools of basic tools with you instead out in the earlier class of course we have went to some of the embroidery systems or embroider system words we need to be aware of these words so the next session I will provide you a few questions if you can take it out but with the few questions on what we had studied in the previous of class and capsicum the first one is about to Why simulators can't be used for the complete testing? What is the major difference between simulators and emulator?

So we just need you to tell but it cannot be used for the complete testing what is difference between simulators and emulator? Why do we need EST test Setup to be configured? Now why should we configure? Then the last one will being provide a brief sentence for the below, Test harness, test bench, fault injection, IO, ICD, breakpoint, simulator emulator, ICE, profile, so this are the privies questions okay.

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T-Emb Method

- Testing approach differs per embedded system under test
- There is no unique test approach available
 - Ex. Testing a mobile embedded system differs to testing a braking control unit system of the car.
- But in general, there are similarities in issues and their solutions.
- These can be organized as structured testing using T-Emb method.



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we will discuss about the T-EMB method supported we have seen several approaches and we have seen how to create a test cases and test design and testing approaches in an generic way I have given you different examples all that there is one unique way of definition that they have used basically defined by bar broke man and Edwin that is a book it a book called testing and minutes of air by bar broke man and Edwin you can download all like a Google it it's a good book about T-EMB method basically what chapters we had discussed about that T-EMB method of the embedded system so I had highlighted some of the points of that book we will walk to that end up in detail that you can go to that book and division to the Kentucky sausage and of the T-EMB method okay.

Testing approached the embedded system we know that different embedded will have different proposals it could be computer electronics or it could be a moment at home or it could be an atomic you perfectly calm although phase change what are better constrictor embedded system can be used so that already was powerful still are different supporting effects this wasn't followed this tall you disappoint the gullible I'm saying who take up to a stop a period that would you be definitely different topic it offends are the basic criteria or another uniqueness or between two embedded systems are not constant.

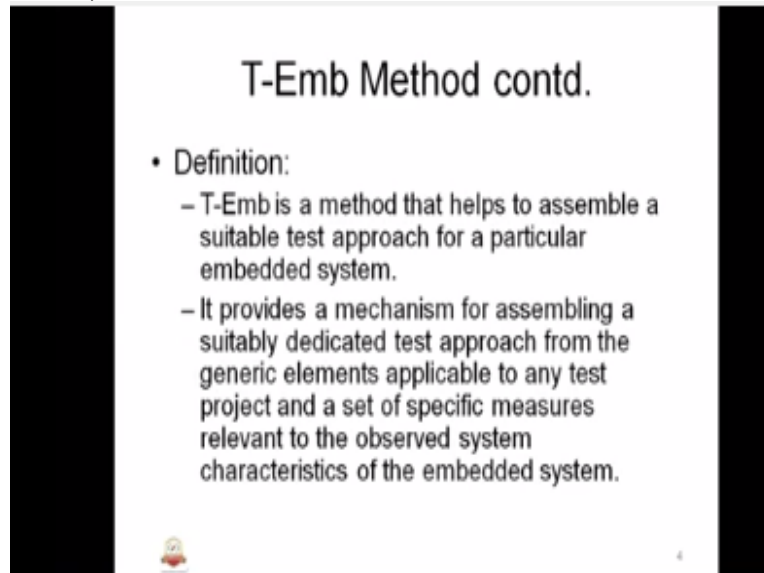
So there I would say there is no unique test approach that is being at test for doing test example testing mobile the first test again take proof system you know a mobile is small device having 0102 or major process or couple of interface devices and breakable lady is another based component that is having complex algorithm etc. complex interfaces well be used in a car let us say so definitely the testing approach will be different in this two so we cannot apply some method that I have defined for testing a mobile okay.

The same method I will use for it I don't have a unique approach but we will pick her when you go through the approach that we have used all though some of the finer elements of this approach definitely there are similarities, similarities in though since when we are testing it we will make it either issues or we will give it to the intermesh of test case or design interims fixing the

module or retesting it whatever it is they are nothing but issues and the solutions for those issues in an embedded testing methods.

So these similarities are cleanly organized inspected there is nothing but T-EMB method to T-EMB method is nothing but organized way of embedded system testing having identified the similarity of a different embedded systems so probably there are some to the definition that are used.

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The slide is titled "T-Emb Method contd." and contains the following text:

- Definition:
 - T-Emb is a method that helps to assemble a suitable test approach for a particular embedded system.
 - It provides a mechanism for assembling a suitably dedicated test approach from the generic elements applicable to any test project and a set of specific measures relevant to the observed system characteristics of the embedded system.

At the bottom center of the slide, there is a small cartoon character icon.

Definition is a method that helps to assemble a suitable test approach for a particular embedded system. a stable disappointment that means we will define the stretched approach from there we will define some of the stretched approach from there you will have some dispute which will be suitable for an air particular it provides mechanism for assembling suitability suitably dedicated test approach from the generic elements applicable to any test project.

And a set of specific measures relevant to the observed system characteristics of the embedded system so what it means is it provides a mechanism for stability means we have a generalized a structured approach so we will pick up a suitable dedicated test approaching from the Hedrick elements which could be applicable to animate for our device whatever it is it could be any project we do they build a system for a very short form given dives and followed by the we use specific measures relevant to the embedded system.

So what we do is we basically we interchange the particular seemliest or is calling characteristics for this observed characteristics there are specific measures so that will be used in an embedded system so these two are very important one is the characteristics of the system and specific measure that are relevant to the observed system so this are very important the while taking the T-EMB method so this what the definition of T-EMB method because we're clearly defined by T-EMB method approach documenting currently book by bar broke man and Edwin okay.

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T-Emb Method contd.

- **Overview:** Structured testing comprising of *lifecycle, infrastructure, techniques, organization (LITO)*.

Figure 2.1
Overview of the T-Emb method: the dedicated test approach is assembled from generic elements and specific measures, both related to the four cornerstones (LITO) of structured testing



So let us go in to the T-EMB method overview so what is structured embedded method so structured testing comprising for the four elements of lifecycle, infrastructure ,techniques, organization are also called as short form editors so this four elements are structured is will be T-EMB method you can see a diagram which explains the more view of the LITO me whatever you want that means that is all measured so all these are related to be structure testing of the T-EMB method is basically based on this thinks.

So what we do is we will define the T-EMB method we will be using specific measures of this particular system then we will apply using a mechanism cod it'll basically perfect your technique that will also gain a method called dedicated approach so what is the overview of T-EMB method.

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T-Emb Method contd.

- **Lifecycle.** This defines which activities have to be performed and in what order. It gives testers and managers the desired control over the process.
- **Techniques.** This helps with how to do things, by defining standardized ways to perform certain activities.
- **Infrastructure.** This defines what is needed in the test environment to make it possible to perform the planned activities.
- **Organization.** This defines the roles and required expertise of those who must perform the planned activities and the way they interact with the other disciplines.

You we will take up each of these lifecycle, techniques, infrastructure, and organization so what are life cycle? This defines which activities have to be performed in what order. It gives testers and mangers the desired control over the process it uses this term and then we will have it written

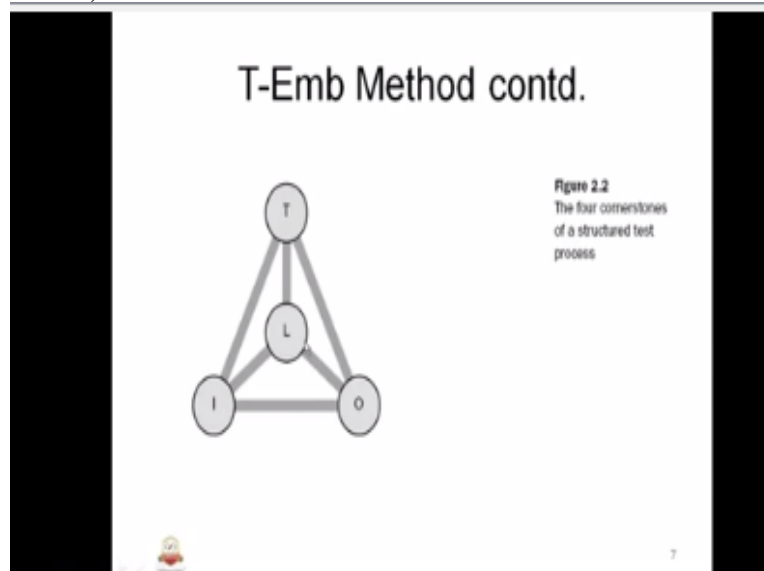
on the life cycle in the next or the forthcoming classes that will be till about a life cycle testing lifecycle model or else I disagree but.

A shorter form the lifecycle defense witch activity have to performed and what order it has to go through their thing called an entry and exit method so but we will define all the object to outputs and the process items so basically the life cycle gives a dished control for managers as well as well as to the testing team of the overall process next will be techniques this helps with how to do things by defining standardized way to perform certain activates that mean techniques will identify how to do testing by defining standardized ways to perform certain actives once we have these two then we will have infrastructure it is for the above techniques whatever needed involvement so what we infrastructure that is needed.

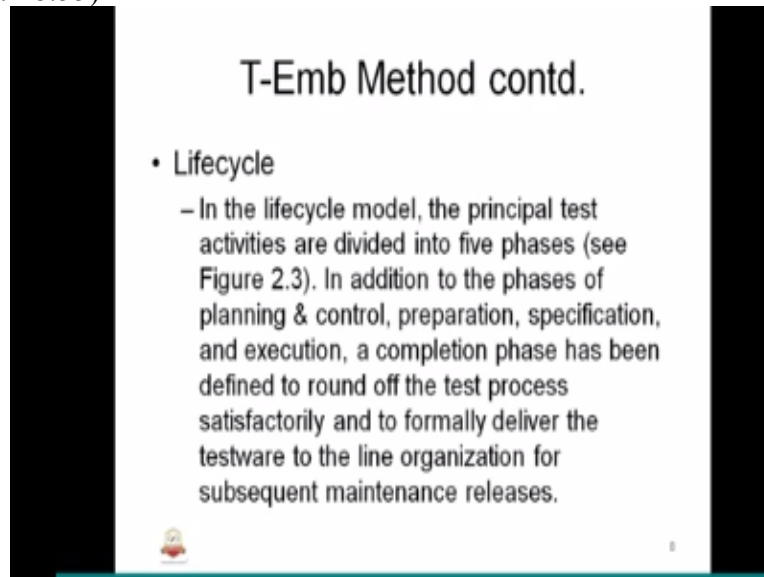
So this will define so what is needed in the test environment to make it possible to perform the planned activities this we have defended planed here technique and what it needs to use it expects what we saw second element infrastructure defines at the T-EMB elements this three items out there that we are going to have one call organization this basically defines the roles and requited expertise of those who must perform the planned actives and the way they interact with the other disciplines, that mines the organization defines the varies role for the responsibilities of required people for context.

So that will basically identify different people or expertise so In three things we have defined plan we have defined the techniques and we know what infrastructure is required once these three are read out we need force to do all this who should do has to do you should do what actually you should be leader who should be with some clarity you do what?

So all these things will be covered and done this is very important lifecycle techniques infrastructure and organization once again I will go to the previous plan why because to make it clear that LITO is an outcome of the T-EMB method which will be applied for the test impression subject so for LITO basically we allow specifically for the particular dived system and there are generally approaches and combining together will come up for all of these two basic element mechanism will work out LITO lifecycle technical infrastructure and organization (Refer Slide Time: 17:38)



So this four are how or vent is what is being educated is a bigger figure 2.2 actually figure 2.2 is a reference to the book which I was telling now testing embedded software I think I put the difference module so probably you can make a not on this (16 to 17) so is the poor core important items of the T-EMB there is life cycle, technique lifecycle is an organization infrastructure is supporting it technically in the next thing then we have to origination a surrounding this life cycle will be organized.
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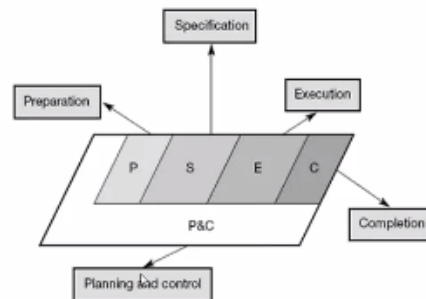
So let's go in the further step having a little detail about life cycle model the life cycle model principal test activities are divided into five phases what are the five phases I will tell basically the life cycle model is five phases in addition to the phases planning and control preparation specification and execution a completion phase has been defined to round off the test process satisfactorily and to formally deliver the test ware to the line organization for subsequent maintenance releases.

So what it will basically provide different faces and it also will help planning and control preparation specification like given a complete faces having different elements basically now come off for life cycle is remain out of that are compelling second a result of the testing.

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T-Emb Method contd.

Figure 2.3
The five phases in
the lifecycle model



so what are the five faces that are define under life cycle the preparation, specification, execution, complications this four all under other boxes called a PMC there are nothing but planning and control so bring their preparation phase where are prepared are the test planning is done then once the testing planning is done we are going to defined specification it id nothing but test specification that will identify test senores and all that and then soon we have define take late to be all it comes into specification then the last one is a completion it will reporter the reporting the result capturing logging an electric engine free part of the complete this also can have a repeat of extra.

So altogether this will be then we can of the origination for physical planning a face planning and control so five phases basically divided into you present specification execution complication all being comprised onto the planning up control okay.

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T-Emb Method contd.

• Techniques

- This cornerstone supports the test process by offering testers elaborate, proven, and universal working methods, as well as enabling the management (and auditors) to track the progress of the test process and evaluate the results. In principle, one or more techniques can be devised for every type of activity. New techniques are developed somewhere in the world almost every day. Whenever an activity exists which is likely to be repeated several times, the future test process would be supported by devising a specific technique for that activity.

let's go to the next one it is nothing but techniques so what do we do in the techniques as we said all the testing methods all the testing mechanism all have to defined under techniques so this

cornerstone supports the test process by offering testers elaborate proven and universal working methods as well as enabling the management that is auditors to track the progress of the test process and evaluate results in principle type of activities.

New techniques are developed somewhere in the world almost every day the teams of track the progress of test process evaluate insert it means technically elemental will have this person in the top celebrating a proven method or universal working with methods for us to pick up with a pedestal so this will also help how it can be helping the management or the quality team to track the progress of the testing process evaluating the outcome of testing.

As you use one or more technical can be devised for every type of activity see with this techniques basically given to be different activities manual lot over here and white box black box is all this we can have anymore the divisor technique this over the world all most every day whenever an activity exist which like to be repeated several times the future test process would be supported by devising a specific technique for that activity does we have several technique all that.

So we are going to have all under this techniques method so which will be used for attracting and monetizing the testing process so this all are the parts of the techniques so this can have any activities that is part of the test process in terms of deafening and testing all will be the part of the techniques part of their technical and of course we can define a technique to have aspect in addition I'm telling about basically it will help complete picture of testing, test design test automation this could be form a test data it could have a process etc.

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T-Emb Method contd.

- Infrastructure
 - The infrastructure for testing includes all the facilities required for structured testing. It can be divided into facilities needed for executing the test (test environment), facilities that support efficient test execution (tools and test automation), and facilities for housing the staff (office environment).

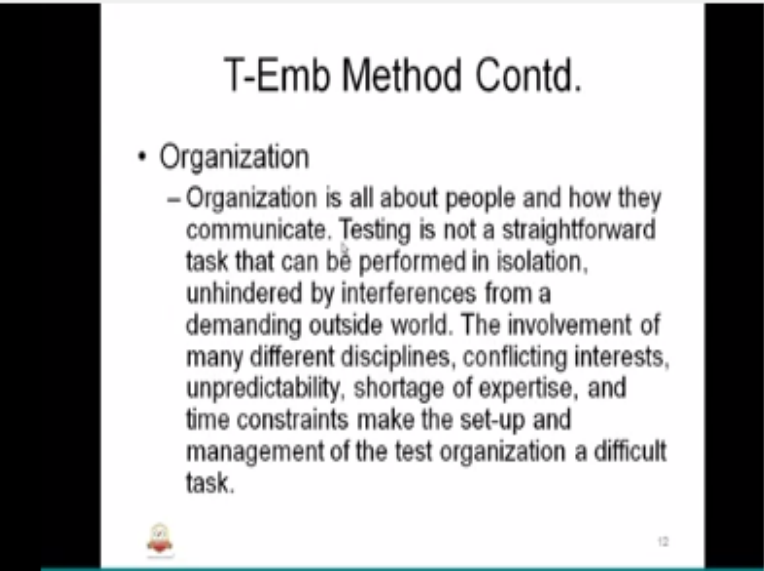


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So all this can be part of the techniques so that is about the first one life cycle second one as a techniques thread is infrastructure so far we had defined lifecycle we had defined techniques the infrastructure for includes all the facilities required for structured testing it can be divided into facilities needed for executing the test (test environment), facilities that support efficient test execution (tools and test automation). And facilities for housing the staff office environment all will be the part of the infrastructure it can also include the facilities for housing the staff would need in terms of taking premeds or internet.

Or any support tools anything or anything cared of efficiently you studied what is a infrastructure items that have been required and it can have hardware software it can have data base any equipment's well be needed they broad categories that Book we talk to go back maybe we cannot test basis method separately in a different class little about each of the elements under the infrastructure obviously not meant for the support start can also be part of this infrastructure okay.

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The slide is titled "T-Emb Method Contd." and contains a single bullet point under the heading "Organization". The text of the bullet point describes the challenges of testing as a team activity, noting that it is not straightforward and is hindered by external factors like conflicting interests and time constraints. At the bottom left of the slide is a small cartoon character, and at the bottom right is the number "12".

- Organization
 - Organization is all about people and how they communicate. Testing is not a straightforward task that can be performed in isolation, unhindered by interferences from a demanding outside world. The involvement of many different disciplines, conflicting interests, unpredictability, shortage of expertise, and time constraints make the set-up and management of the test organization a difficult task.

coming to origination now we have defend lifecycle , techniques, infrastructure have from that all this have been placed documented are available now T-EMB how it is organization different roles for varies peoples this is all about people communicate it is not just be able to have people there should be a mechanism how people interact and interims helping each or reporting or work as team work mostly by building will be done been given a team Sigma maybe we all need you to take up part about you or else is gone be part signature here in the industry to basically get unbiased tantalum okay.

Testing is not the straightforward task that can be performed in isolation unhindered by interferences from a demanding outside world the involvement of may be different disciplines conflicting interests unpredictability shortage of expertise and time constraints make the setup and management of the test organization a difficult task so basically this tell the properties what are the various one.

I think it is more for having a nomination having the variance of people what are the challenges that people will have whether the people who are a team people that is going to do the testing is a expertise or any age of the lack of attention here or picture having exploding or interesting to target area should be allocated accordingly so what do you think exactly after we can have some new plans at all this will be makings this organization complete bring about LITO, life cycle, infrastructure and organization.

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T-Emb Method contd.

- Mechanism for assembling the dedicated test approach:
- Basically so far it explained the principle of using system characteristics to state what it is that makes the system special. It is important to note that the T-emb method does not aim at achieving a scientifically accurate and complete taxonomy of embedded systems. Rather its purpose is entirely practical and purely from a tester's perspective. It aims at assisting the test manager in answering the question "What makes this system special and what must be included in the test approach to tackle this?"



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so some of the points is mechanism for assembling the dedicated test approach that we know basically so far it explained the principle of using system characteristics to state what it is that makes the system special it means we will define some of the characteristics we know that we will identify the characteristics then for testing those characteristics we need to have test approach that is nothing but dedicated test approach it is important to know that the T-EMB method does not aim at achieving a scientifically accurate and complete taxonomy of embedded system rather it is purpose is entirely practical and purely from a testers perspectives.

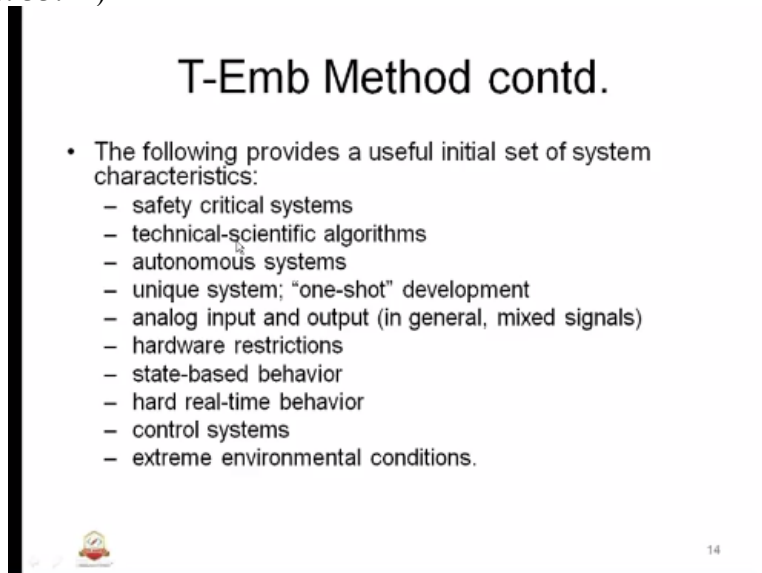
As you said the test approach and the methods are being used have to be purely form a realistic or practical nature so in this cause we cannot design a test case have to be all this tested and solution come so we need to visualize from practical test that is very important, I will just underline few things that are very important for doing the embedded testing characteristics so basically we need to have an furan understanding the system that means bigger picture have located there for the system.

Which is under the test ones you identify their characteristic of that system they need serial for making us writing the test approach and other thing is it must be very much practical whatever we write test case or test procedure have to be realistic and practical we cannot have something which cannot be tested or which cannot be identified some short of values suppose assents are supposed to take something like 30⁰ to 48⁰ of input and this is limited with the betide code we cannot offer to provide some - 100⁰ or 300⁰ incite grades.

So we should see all this practicality and particular sensor in order to make it realistic test approach and it should be purely defined and have the ownership of the tester so it is from the testers perspective because he is going to test it that is why it is very important to have this test in place for T-EMB method so it will also help in assenting the test manger in answering the question like what makes the system special and what must be included in the test approach to tackle this? so this system he has not understand he will know what is making this and what should be include to make this system testable that is test approach so this are some of the key

items that make to the understood or used before dividing the T-EMB method are using the LITO principal okay.

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The slide is titled "T-Emb Method contd." and contains a bulleted list of characteristics. At the bottom left is a small logo, and at the bottom right is the number "14".

- The following provides a useful initial set of system characteristics:
 - safety critical systems
 - technical-scientific algorithms
 - autonomous systems
 - unique system; "one-shot" development
 - analog input and output (in general, mixed signals)
 - hardware restrictions
 - state-based behavior
 - hard real-time behavior
 - control systems
 - extreme environmental conditions.

So we said that they are few characteristics or complete characteristics of the embed system to be used once we have that characteristics we are going to have VELS, VELS is the test approach how we are going to do for that characteristic some of the characteristic that are usually used in any of the embedded system are as below all these I have to be considered for doing the embedded system testing.

So safety critical system, technical scientific algorithms, autonomous system, unique system one short in general, missed signals, hardware restrictions, state based behavior, hard real time behavior, control system, extreme environmental conditions embedded system like safety critical system arrow space or auto motive so which have to be safe because that it is very important that the systems cannot go for quality which will resulting then there are certain systems having a technical or a scientific complex algorithms those related this also we have divider a testing method that elastic.

We should be having it is own technical property or design the methods one shot development or rapid development control the system which will be used in a short cycle then we have systems with un-log purely with un-logging inputs and un-log outputs because it is not tested here because most of there , almost all the units it will have so it does it mean that un-log will be there always this is the one of the characteristics that is been used and any hardware limitations are restricted that are to be consider and then state is based to be different system character they are exits and any hard real time behavior like, you know what hard real time system this system something like a typical system which are scanning a human helper ever hard real time behavior because it can offer to may be deadlines are going choose result in any of the damage results to the human and of course we have a control system just go look over book whatever it is motor deriving system and there are system like to build the applications they use extreme environment conditions they also have to be considered so these are some of this characteristics that are used


in the T-EMB method so this are very important thing that needs to be considered for developing approach I developed for one short development i would say this system itself which cannot come back or it cannot be repair or repaired also called as one shot development which are long to only ones which cannot be maintained we cannot maintained very difficult but now a days there are settles and all are there which will help on support in terms of operating software and all but this current system relished cannot be used for maintenances .

T-EMB method so we know that the T-EMB method has four cornerstones and with the help of a this four cornerstones life cycles techniques infrastructure and all this we will revise the T-EMB method and before we develop the techniques we use one special measure for certain of characteristics methods and below ones of course they are other thing which are discussed in the book may be I will just teach between the when it is possible they say it I think we can use it I think we can touch with inter matrix and the one of these.

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T-Emb Method Question

- How T-Emb method is different than normal embedded system testing?

 So this is the questions for T-EMB method please makes note, how T-EMB method is different than normal embedded system testing? So we all go through normal embedded system testing in earlier sessions in terms of test case all that how is this unique or defended them the general embedded system testing so that is about T-EMB method.

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Commercial ES/T tools category

- Test Equipment (oscilloscopes, DMM..)
- Diff Merge tools (winmerge, beyondcompare)
- Static Analysis and metrics tools (understand for c, testlink, bugzilla..)
- Text editor tools (notepad++, textpad)
- Code checker (coverty, Misra C (2004, 2011..?))
- IDE, Debugger and related tools (IAR, Eclipse, Lauterbach, Multi CCS from TI)
- Hex editor/viewer tools (raw files..)
- Reverse engineering, disassembly tools (- call tree mechanism)
- Dynamic Analysis Tools (runtime profiler, profilers, stack trace.., time m/c complexity measurement : mccabe complexity understand for c/c++)

We are now gone through various of embedded system approach and environment method of environmental so i would like to categorize for embedded system some of the tools how they are being used or how they are organized basically for embedded systems so these are some of the master tools that has to be there of course the same tolls can also be used for development also so the categories are something like this test equipment, test equipment will have a scope logic and analyzers etc.

We have a diff merge tools are used for test cases, test procedure there are varies version so that test development team need to do while doing the changes and all that be on compare this are some of the tools, I am just writing the examples then we have our static analysis and matrices tools such as understand for C the we may have bugzilla test links so many are there next we have text editors tools, note paid+++text paid.

You can use it for evaluating the test results and all that so not only it is used for development this also can be used, code check something like quality they use checking the code checking is not that, or are whatever language taking it is a something like alignment and as pre coding the guidelines it is there are not so this will cover basically of course we have a rules coding rules something it is called.

So see you think a 2004 and not linked to 2011 also overcame not sure about that but these are some of the stinging guidelines for validating that we move some of the code checker tools from till logic and all of them so we know that ID like IAR, Eclipse then now we have lauterbach, multi what is that the multi CCS ever meant filter of course we have quad compass for TI is also used, hex editor some of the binary or images.

Raw files all that you want to leave it you need a hex editor or hex viewer tolls are there and the reverse engineering you can be static tools so that they binary and all that you can understand which will have the call tree mechanism which will used for reviewing and all that so they are very useful to have a reverse engineering tools for some of the testing so the more, more complicities it is batter to have control of the system of the control through some of these quality enter.

Then how the code is structures or how the model are in the system is structures so it is useful and helpful this assembly tools are inbuilt along with the line which will the disassembled the object code basically then we have what dynamic analysis tool run time of profile and profiles are part of the stack trace, time machine some all are to them sorry multi so like this the very stone so this does it but basically these are some of the categories that are commercially used for an embedded software testing other than this there could be the manual tools also which will be developed is hours that is a need basis there are other tools.

Like static analysis and data EST actions like quality then for complicity measurement we use is one of the important thing that needs to be done in a minute system we cannot have a certain amount of complicity going up but the measurement systems it has to be limited it is called McCabe complexity the user understand for C/ C++ is one of the good tools use it to analyze the complexity of the code then generate tools to visit that and then come find us a machines are all Houston so these are some of the commercial tools category okay.

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PHASES	Purpose	Tools Used	Version	Automation
Development Phase	Requirement Management	DOORS		
	Code Development	MIPSxxx Series Target/Eval Board, IDE - GHS Multi	Green Hills, v5.0.6	
	Requirement Support	Microsoft Office 2007 suite: Word, Excel, Visio	2007 or later	
Configuration	Configuring all Cts and deliverable artifacts	Sigma Dimensions CM	10.1.1	
	Test Case Development	Microsoft Office 2007 suite: Word, Excel	2007 or later	Truth Table generator - helps in identifying possible Test Scenarios and develop TC.
Verification	Model-Based Coverage	MTC - Model Test Coverage	TBD	
	Model-Based Testing	Scale-OUT (Qualified Test Environments)	TBD	
	Testing & Coverage	RTBT	7.5.0.0	Batch: RTBT Regression Tool which takes up each .ctu and builds it independently and executes and stores the result.
	Debugging	IDE - GHS Multi	Green Hills, v5.0.6	RC scripting
	Reviews	Microsoft Office 2007 suite: Word, Excel	2007 or later	Tools to verify correctness of the checklist
	Analysis	Microsoft Office 2007 suite: Word, Excel	2007 or later	Stack analyzer (based on C source and not file)
	Stack analysis	Manual		
		Flac C/C++		

I had put an excel sheet covering some of the embedded system tools that is used in industry and then example so do not take it as it is used in certainly in a project or product I just generalized so as an example so we can just have a look at how it is I hope your period here okay so this test basically left out tools and automations and what are the tools that is being used in different phases?

I have covered for all the phases for the embedded system development phase conjugation phase or expression phase I use instability and target cracking or the management these are some of your phases and each phase will be have what is different activities like development phase we have requirement co-development requirement support in the consultation we have contact on quantity of magnums and roulette actions and verification of course top it with that this case is we have to look and increase your model then model based coverage we do and model-based testing we do in sting in coverage we take care debugging is also used as one of the interesting tech review will be using it and then it is static, static analysis etc.

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Activity	Tool	Version	Notes
Debugging	IDE - EMS Multi	OpenHLS, v3.0.8	PC scripting
Reviews	Microsoft Office 2007 suite: Word, Excel	2007 or later	Tools to verify correctness of the checklist
Analysis	Microsoft Office 2007 suite: Word, Excel	2007 or later	
Stack analysis	Manual		Stack analyzer (based on C course and list file)
Code Review	For C/C++: 1. QAC 2. QAC++ 3. Source Monitor 4. Coverity 5. Code Collaborator 6. Telelogic Logoscope 8.8.3, MISRA Rule Checker For ADA: 1. PC Unit 2. Telelogic for ADA		
Traceability	Traceability for Test cases -> test scenarios -> test procedures -> test results, both upstream and downstream, TC, Req		TBD
Project Tracking/ Test management / Metrics Management	Test and Defect management	Testlink - Bugzilla	Python/Perl tools to extract data and populate the Traceability Sheet. Integration with SVN or GIT is possible

We have for the views code review and any checklist that we use for reviews that also is one of the activity then we have a traceability facility what is this awesome or both upstream and downstream I will tell you what is upstream and downstream and disabilities is very important part it is not just a finishing the test case easy so easy to requirement also needs to be transferred to the acreage of testing for all the required requirements this SVP inverts the plan or test plan i would say software plan and before the project management in tracking we use this deficit management artifacts okay.

Now coming to tools what are the tools used for developer phrase for recurrent management to use those it is um IPM then we have a rectifying but then for code development can use their pc cleaning target or revaluation board PC is nothing but iteration power scale board diverter the easy since you are on a scale we use for development and debugging the ID integrated development adjustment is just an example it would be different for different energy systems and for the recover meant support.

We capturing all the requirements making with the tabulated and all that we use Microsoft office word excel and designing and all let them continue you or any of the design tools which one should also be stood next to the configuration is very, very important aspect of the embedded systems the items which are under test which are under development have to be configure it should be configure it should be controlled so that will be done with the dimensions or SVN abortion this case also.

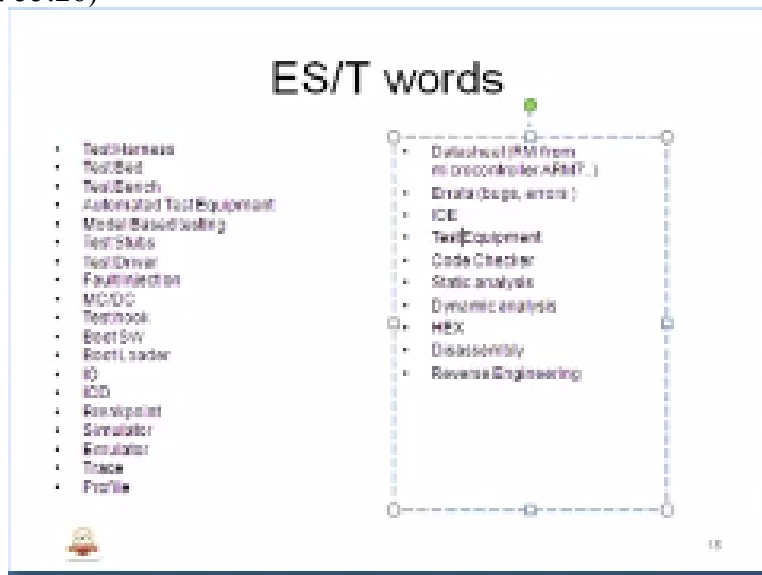
You know we use templates we have discuss in the excel sheet for having the test cases identified for model-based coverage we use MDC some of the more interesting model test cases we use a scale cutie qualified just a normal for testing and coverage RTRT is used it is an operational this is one of the good tool they use it of course there are other tools like India Rey picked cast etc. debugging the NSA collects all the same ID is being used according to develop actor like development cycles of course.

We have various cycles process with the help of excel sheet analysis can also be done with help of a microphone offices strake analysis to one of the important thing that can be embedded

systems have to be tested stack that is the thing but the memory aspect of the system that is running how much packet is using what is the maximum we can link and whether it is clearing it all editing the stack it is a strange of course for reviews as a separate phase we have saw reviews C and C++ code review QNC source monitor cover tea cocoa it is logical and scope root checker other language.

We use a PC illogical other logical we uses for its reduce visibility is not the point estimation you can automate on aspects on it is for the test cases whatever to cover it and any output of expect you can eared by excel sheet report so that is what I have mentioned you can automate come on power to extract the gate and populate it is already so basically all the test cases and procedures they will have unique ID those unique ID for used to develop the Prince ability and how they are done is with the help of automotive tool such as Python or Paula script that are being used in development for test effects and management we use test link and bugzilla may be we will have a separate sections how it is look like and how it is getting used and also there is possibility is that SVN Interject also can use for test effects and dies management okay.

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So these are some of the tools that are used for a technical embedded system so that is about the commercial tools categories in general I had listed out as an example an example of a commercial embed system development and testing tools okay so again you will system I have brought is words which we have gone through or if it should be growing all the time test our names just participants automatic test equipment model-based testing disturbs.

MCDC software or loader input-output NCD in portable document break point to simulator emulator placing profiling and data datasheet and last time we stop with this now today I already equipment or you can say test equipment which will have all the necessary, necessary distant normal items like this are elements part of it test equipment it also can have all items such as also US Coast logical scope and any of the measurement equipment's then inside the code checker the code we use and all that static analysis dynamic analysis etc. profile editing efficiently some object form and then be aware listing so these are some of the embedded system, I think are the

questions I have for this class T-EMB method question how T-EMB method is different than normal number system and normal embedded testing okay we will see you in the next class.