Design Practice
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Lecture – 17
Product Development Methodology

Hello and welcome to this Design Practice Module 16 and 17.

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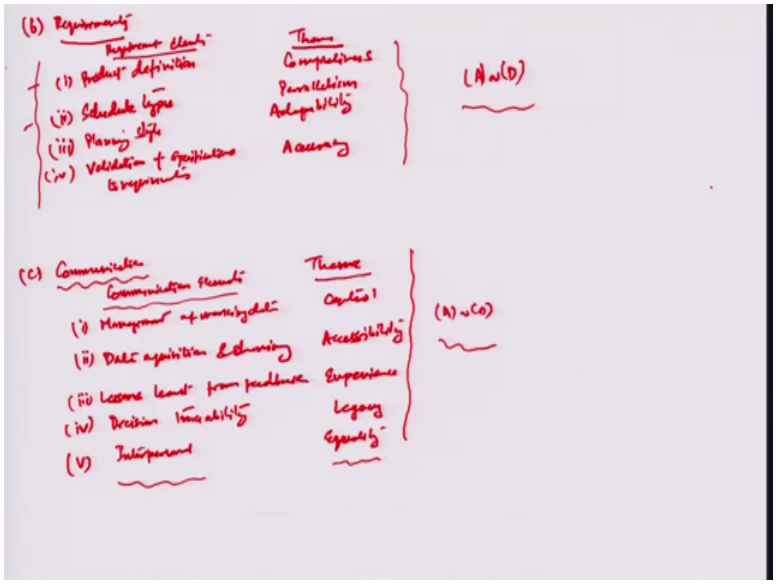

So, the next major elements for a concurrent engineering setup are basically the product development methodology. We started with organisational unit you know needs when we start all the requirements which are going to be there by the organisation. We also discussed about the communication structure.

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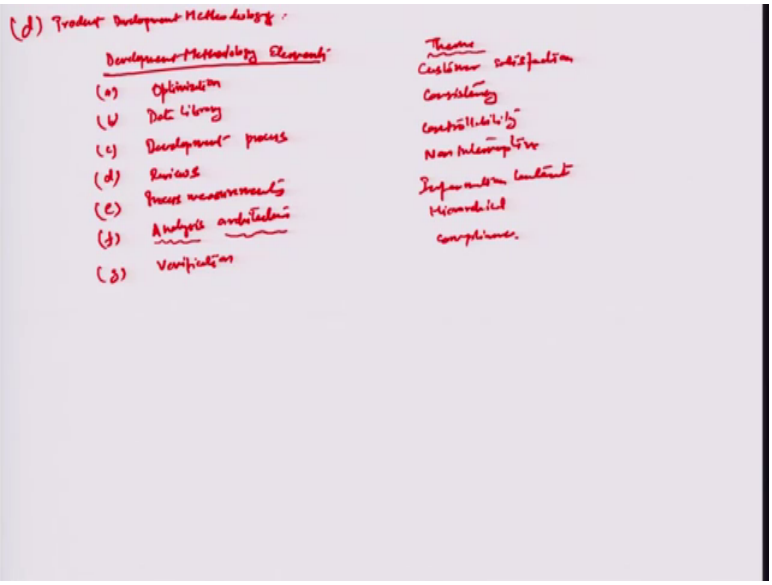

So, the fourth issue here which is of importance and one of the major elements of concurrent engineering environment is what is the methodology, that is being used for product development, ok. So, I just call it product methodology or let say we call it product development methodology and you know that product development being a very complex process involving number of people from various functional areas, the methodology for development of products really includes all the activities involved in customer requirements planning. For example, the total product development process the design of manufacturing process, design of the product support process, all stages of life cycles are some or other involved in determining what is going to be the product development overall mythology.

So, the various sub elements if you wanted to consider what kind of you know development methodology elements may be involved. So, one could be that the whole development process is based on optimisation techniques, and optimisation could be with an essence of central theme of how customer is satisfied, ok. So, optimization in the sense that whatever increases the customer satisfaction index should be a basis for carrying out the optimisation for all the designs that have been developed ah.

Similarly if we talk about let say data libraries for different products which already exist, so in this particular case you know the theme could be consistency that what is new, what is already there ah. So, it should be a part of the development plan or the development

methodology ah. We can also talk about development processes as such, ok. So, is this something which you need to be in your control or you want just the free ideas to flow.

So, there can be a central theme of controllability that how much of it you really want to control in terms of you know the process of the product development because obviously, that one to be schedules which you need to meet as a management and management need to always going to be how to control such development process here. The methodology can also be formulated based on whatever the reviews you know received at every stage of the development process.

So, there should be typically non interrupted product development even if you know the reviews, the detrimental, there should be a sort of an adaptive planning process which can formulate the strategy in a manner which is commiserate with the reviews obtained we can also think a process measurements as a part of the development methodology.

So, the process method measurements could be based on central theme of what is going to be the information content of the measurements is it going to be a part of influencing the development strategy for example, when we add robustness to a design, that is always almost the case that we learn from sudden failures which are there related to the quality of performance functionality so on so forth and add on to the product and they are you need process measurements, in the development of methodology to make the design robust.

So, the central theme could be related to what is the kind of information level that is needed for the design to make itself robust with every iteration. So, that is how the product development methodology can shape up. So, that can be one of the important elements. Then, also it can be about analysis architecture whether it is going to be a hierarchical architecture or what is the level of hierarchy, it could be even a parallel architecture, ok.

So, I need to sort of think of what are the analysis strategies which are to be used for development of a sort of a map about how effective is the development process, ok. So, it could be hierarchical or non-hierarchical. That is how the analytical architecture could be and then, finally in the verification you know in the product development methodology, there can be a verification step which talks about compliance to standards for example. So, the different elements like communication for example or the requirements or the

product development methodology also have their further categorisations into levels a b c d depending on what is going to be available complexity in each.

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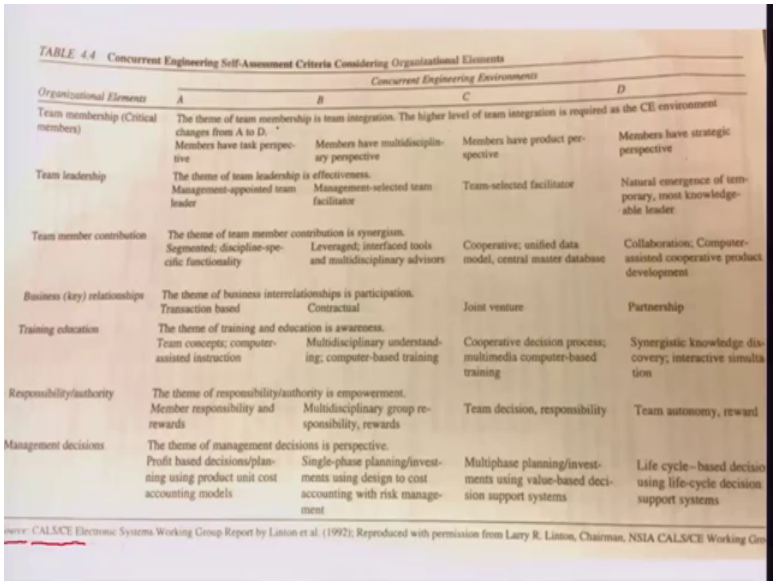

TABLE 4.4 Concurrent Engineering Self-Assessment Criteria Considering Organizational Elements

Organizational Elements	Concurrent Engineering Environments A	B	C	D
Team membership (Critical members)	The theme of team membership is team integration. The higher level of team integration is required as the CE environment changes from A to D. Members have task perspective	Members have multidisciplinary perspective	Members have product perspective	Members have strategic perspective
Team leadership	The theme of team leadership is effectiveness. Management-appointed team leader	Management-selected team facilitator	Team-selected facilitator	Natural emergence of temporary, most knowledgeable leader
Team member contribution	The theme of team member contribution is synergism. Segmented; discipline-specific functionality	Leveraged; interfaced tools and multidisciplinary advisors	Cooperative; unified data model, central master database	Collaboration; Computer-assisted cooperative product development
Business (key) relationships	The theme of business interrelationships is participation. Transaction based	Contractual	Joint venture	Partnership
Training education	The theme of training and education is awareness. Team concepts; computer-assisted instruction	Multidisciplinary understanding; computer-based training	Cooperative decision process; multimedia computer-based training	Synergistic knowledge discovery; interactive simulation
Responsibility/authority	The theme of responsibility/authority is empowerment. Member responsibility and rewards	Multidisciplinary group responsibility, rewards	Team decision, responsibility	Team autonomy, reward
Management decisions	The theme of management decisions is perspective. Profit based decisions/planning using product unit cost accounting models	Single-phase planning/investments using design to cost accounting with risk management	Multiphase planning/investments using value-based decision support systems	Life cycle–based decision using life-cycle decision support systems

Source: CALS/CE Electronic Systems Working Group Report by Linton et al. (1992); Reproduced with permission from Larry R. Linton, Chairman, NSIA CALS/CE Working Group.

Let us just simply consider that has been taken from the calsace. See electronic systems work book report and that is how the source lies here. So, this is about let us say the organisation elements which I have already sort of discussed earlier.

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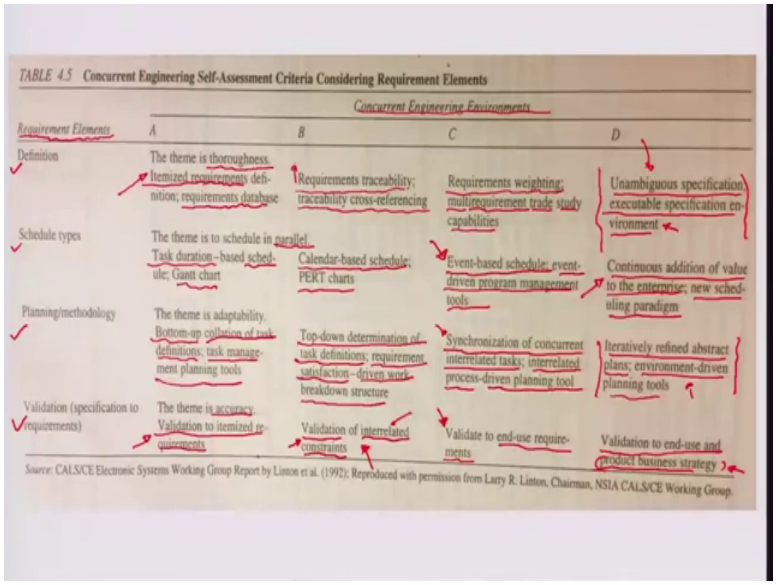

TABLE 4.5 Concurrent Engineering Self-Assessment Criteria Considering Requirement Elements

Requirement Elements	Concurrent Engineering Environments A	B	C	D
Definition	The theme is thoroughness. Itemized requirements definition; requirements database	Requirements traceability; traceability cross-referencing	Requirements weighting; multirequirement trade study capabilities	Unambiguous specification; executable specification environment
Schedule types	The theme is to schedule in parallel. Task duration–based schedule; Gantt chart	Calendar-based schedule; PERT charts	Event-based schedule; event-driven program management tools	Continuous addition of value to the enterprise; new scheduling paradigm
Planning/methodology	The theme is adaptability. Bottom-up collation of task definitions; task management planning tools	Top-down determination of task definitions; requirement satisfaction–driven work breakdown structure	Synchronization of concurrent interrelated tasks; interrelated process-driven planning tool	Iteratively refined abstract plans; environment-driven planning tools
Validation (specification to requirements)	The theme is accuracy. Validation to itemized requirements	Validation of interrelated constraints	Validate to end-use requirements	Validation to end-use and product business strategy

Source: CALS/CE Electronic Systems Working Group Report by Linton et al. (1992); Reproduced with permission from Larry R. Linton, Chairman, NSIA CALS/CE Working Group.

So, just as we did for the organisational elements, you know in the last one of the slides and we categorise them into various levels, we are going to do the same thing for the

requirement elements now and these elements are for example, definition. Definition could be sort of an itemized requirement either at level a or. So, they are based on this itemized requirement; there is a database which is available.

So, theme is thoroughness. So, how well defined the requirements are, how thorough they are for setting up the considered you know concurrent engineering environments, there could also be a level b which talks about requirement traceability. So, first level is of course what are the itemized requirements and other is how easily you can proceed traceability could also mean cross referencing. For example, equipments or items needed for one part could be cross reference by some another user very easily. So, there is some indexing which is there probably.

So, that is at level b. So, some organisational aspect added to what you call rick itemize requirements in the previous level. There could yet be another level see where you talk about requirements waiting that not only their index property and not only their itemize properly, but then you have to, you have some kind of way depending on what are the requirements you know of the particular trade.

So, you have certain requirement rate study capabilities added on to the list of items for which are required and then, of course there is the highest level d which talks about unambiguous specifications. This could be executed specifications according to the environment real time changes in the specifications as needed you know in the definition of the requirements. So, this is typically the most desirable level when we talk about concurrent engineering environment are all companies are not at this level. So, therefore, it is important to trace what level they are done and what should be the constitution of the should be concurrent engineering in atmosphere environment.

Also, I mentioned is a schedule types. So, you can see the theme here is running in parallel. Mostly schedules could be either based on task duration. Individual tasks are to be split up for the whole work study and can charge could be plotted and scheduling can be done based on what are the number of tasks which are involved. They could also be a sort of presidents requirement put in all the tasks what proceeds what and then, there is a calendar based schedule which talks about what point of time in the month or may be on planning horizon which is slightly more than day, how the schedules are sort of running parallel to each other.

There could also be even based schedules; even driven program management tools can be used. For example, if there were a shortage in some material, then what is the kind of task that exists for meeting that particular type of shortage? So, it is even based and so, there are several such events which formulate the basis of making this level c. There could still be another higher level d where we talked about continuous addition of value to the enterprise. So, this is a sort of a new scheduling paradigm that how it can be better by the day, how the schedule can improve voice plus delta every time. So, that kind of schedule based on the learning of day today is more or less real time schedule based on our, schedule based on real time learning.

So, that is the most desirable for concurrent engineering environment. Similarly you have planning methodology based requirements for him is adaptability. So, in the first level could typically be a sort of a bottom of strategy of collection of all task definitions and then, use of task management planning tools to sort of see how they are labelled with respect to each other. So, split up to the very fundamental level of individual tasks. Then, you have a methodology which talks about top down determination of the task definitions, ok. So, you talk about requirements related to satisfaction driven work you know and then, what is the breakdown structure for a particular task.

So, up to that level there is some kind of ah, some kind of inclusion in the planning methodology, there could also be another level where we talked about syncretisation of the concurrent inter related tasks how in time in they are spaced with respect to each other, the inter related processes, do they have a planning tool to lay them out parellely in time as well as you know sequentially.

So, that is what the level c for such planning methodology would be and yet another level c. The highest level is basically the iteratively refined task, the abstract plans which are environment. So, if the environment changes the planning methodology changes based on its ok. So, this is something which is the most latest you know and the most I would say highest level of requirement elements that could be offered to concurrent engineering by a concurrent engineering environment.

Then, there is of course validation of specific requirements where theme is accuracy. So, we talked about validation to itemize requirements which are laid out, well laid out in the

specs or validation with respect to the given particular specifications. There may be some inter related constraints which are there.

So, validation of the design that constrained that could be the level b, however this is a much shorter planning horizon, but if the horizon were about the end use requirements of certain product of system, then accurate environment would typically look at the validation to that induce requirement rather than just locally focusing on what is go to the next step and that of course, there is still another very complex level will be talked about validation to end use and product business strategy as such. So, there is a life cycle concept embedded in this kind of level. So, in a similar manner, we want to do the same kind of structuring in terms of different levels for the communication elements.

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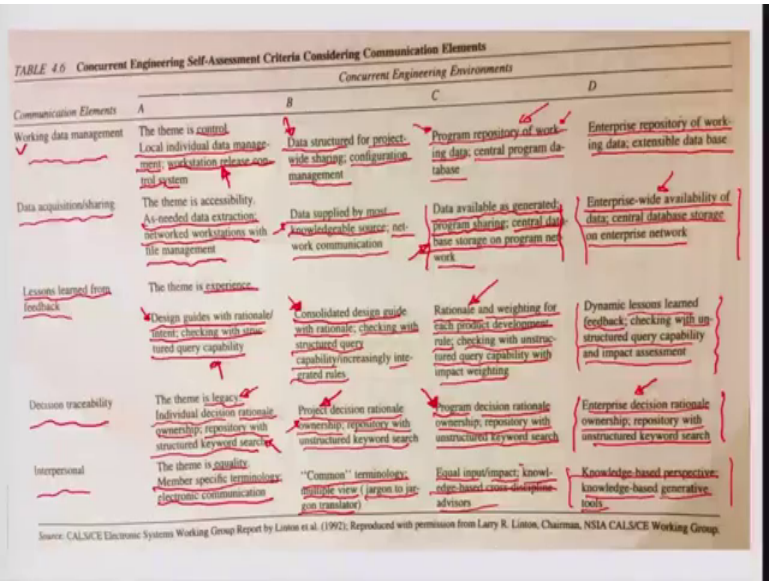

TABLE 4.6 Concurrent Engineering Self-Assessment Criteria Considering Communication Elements

Communication Elements	Concurrent Engineering Environments A	B	C	D
Working data management	The theme is control. Local individual data management; workstation release control system	Data structured for project-wide sharing; configuration management	Program repository of working data; central program database	Enterprise repository of working data; extensible data base
Data acquisition/sharing	The theme is accessibility. As-needed data extraction; networked workstations with file management	Data supplied by most knowledgeable source; network communication	Data available as generated; program sharing; central database storage on program network	Enterprise-wide availability of data; central database storage on enterprise network
Lessons learned from feedback	The theme is experience. Design guides with rationale/intent; checking with structured query capability	Consolidated design guide with rationale; checking with structured query capability/increasingly integrated rules	Rationale and weighting for each product development rule; checking with unstructured query capability with impact weighting	Dynamic lessons learned feedback; checking with unstructured query capability and impact assessment
Decision traceability	The theme is legacy. Individual decision rationale ownership; repository with structured keyword search	Project decision rationale ownership; repository with unstructured keyword search	Program decision rationale ownership; repository with unstructured keyword search	Enterprise decision rationale ownership; repository with unstructured keyword search
Interpersonal	The theme is equality. Member specific terminology; electronic communication	"Common" terminology; multiple view (jargon to jargon translator)	Equal input/impact; knowledge-based cross-discipline advisors	Knowledge-based perspective; knowledge-based generative tools

Source: CALS/CE Electronic Systems Working Group Report by Liston et al. (1992); Reproduced with permission from Larry R. Liston, Chairman, NSIA CALS/CE Working Group.

So, you know that communication elements again have been split up into working data management with the theme is control. So, there could be a certain level of certain concurrent engineering environment which talks about just local individual data management requirements, ok. So, it is related to just workstation release control systems. Think about operator punching the chassis number of a car which is passing the assembly line or assembly stage.

So, this would be something related to just that workstation based data generated which keeps an individual data record you know for number of vehicles or chassis. Chassis of vehicles which have role, there could be slightly higher level where you have structured

data for project wide sharing maybe some useful information is generated out of the data that is there which would help you in sort of further management or of related to different futuristic tasks.

So, we configure some of the data to find out an implication of the data on the general work environment of any system. So, then there can be yet another level which talks about program repository of working data. So, we talked about just along the time horizon here where we have stored from few months or few years and there is a central program data based on which everything has been recorded.

So, from there could we have some work in data which gives us experiential learning from the past and then, of course there is again very high level environment which talks about enterprise wide repository of working data. It is not only related to local environment, but across the domain of the whole organisation, how data is being managed and how you can extend that database to variety of some functions related to direct working of the environment or even indirect working. So, that is what the different levels should be for the work data management.

Similarly, you have communications related to data acquisition and sharing this is a sub element where the theme is accessibility. So, there could be the first level which talks about as needed data extraction. So, if you are requiring something that is a proper procedure for requiring for showing you are ah, you know justification and then, through network work station and file management systems, you could actually trace that data or extract that particular data, however exposed to the whole data ah, there is also another level.

Now, in the data acquisition which talks about data supplied by most knowledgeable sources, so these are the most reliable data and you have certain degree of control on that in terms of accessibility ah. There could be some communication involved here. So, network communication is typically what is enabled in such environments for doing that most reliable knowledgeable source data sharing.

There could also be again a third level which talks about data available is generated. So, it is like almost the whole control of the data for a particular task or task structures. So, we could do some program sharing here, some central based storage and program network through which you could actually get a tab on most of the data, share most of

the data as needed by your particular domain on the area and the third and the forth category is again typically one where there is a enterprise wide availability of data, ok. Some on the, it is the data, the data structure or the data acquisition of sharing scheme is just functionality. Remember it is available across majority of the functions to each other.

So, that is another mode of how data can be acquired or shared. So, typically this is what is needed as a highest level in concurrent engineering environments. Then, there are again communications, communication elements related to experiential feedback where theme is again experience and here there could be the first level which talks about only design guides with rational intent checking, with structured query capability that kind of a program ah, there could also be a level b which talks about consolidated design guidelines with rational. So, just not a single design, but talking about the overall let say concept or ideas which is involved in the you know in the existence for an organisation that can be of that is made available is a consolidated design, ok.

So, you can check with structured query and your capabilities are enhanced by integrating certain rules through which you could actually go into different portions of this consolidated design guide ah. There could be another yet, yet another level of experiential learning which talks about again the rational in the waiting for each product development rule, checking with unstructured query capabilities with impact weighing.

So, at this level we are thinking about taking some kind of artificial intelligence for which looks into a data structure with some kind of a query capability and with giving a sort of weightage or an impact to what would be the most useful query in a particular situation. So, you kind of defining or driving the rational also by using weighing factor. So, that could be a level of you know explanation learning.

Then, finally the highest level which is about the continuous shot of a dynamic changes, you learn kind of a situation where whatever lessons are learnt through feedback are almost immediately routed into your on structured query capability, so that you know the impact assessment for every question that you pose for getting feedback sort of vary is based on the real time aspects which are there in the dynamic environment that you are working in. So, these are the different levels again of experiential learning. Similarly, they could be decision traceability in terms of who is the owner of a particular decision.

So, there could be a individual decision making rational or an ownership that could be used as a model for a certain environment, for work or you could have repository with structured keyword searches which talks about pin pointing to a certain you know centre for sudden decision to emerge something like that. There could be another level which talks about the project decision rational ownership repository with unstructured keyword searches ah. This typically would talk about legacy level where there are certain decisions which have been made through a certain you know thinking process or logic and it has certain kind of ownership history associated to team or a set of teams which may have been involved in such a decision making.

So, making such an repository with some kind of unstructured keyword search could be one of the basis for doing decision traceability. You could also have another, yet another level of a concurrent engineering environment which you can talk about probably again instead of just having a project overview, you have a program overview for the whole set of activities which are involved in may be incomplete product line or something and not just looking into specific activity related to a certain aspect of a product.

So, whole program of a certain line in which has been created, you have the decision, decision rational and unstructured keyword search option available for all such decisions which have been made in the past for in to learn from them and then, of course there is an enterprise wide rational with again unstructured keyword search which talk about at what level is, what decisions are being taken and who are the concerned owners, for running the whole enterprises search which may be considered consisting of several programs or only one program.

So, we are talking about more like a global decision traceability matrix which would be there. So, these are again the four levels ah. We can talk about the fifth you know communication element which is about the interpersonal relationships are communications theme is equality. So, they could be sort of members specific terminology that could be a kind of business environment and this terminology can be shared with each other through electronic communication. There also could be some kind of a common terminology which could have multiple views, and then, there can be some translator to translate between let say terminology used in one section or part and terminology used in the other section or part in terms of personnel who are owning those to the different sections. So, there could be equal input from all sections which would

create some kind of an impact which increase the overall knowledge level and based on that, this knowledge tool can be used for all the kind of communications, interpersonal communications between the different sections.

Then, you still have another level which is totally based on the knowledge based perspective. So, you have any generative tool which works on what knowledge sort of comes out because of these interpersonal discussions to be used for some overall goal for the organisation etcetera.

So, this is how a communication element setup can be split up into multiple sub elements and their different levels. I am going to also look at the product development methodology and then, start with analysing a certain situation of introducing sort of a line of product for which we see what is the existing environment and map into what is going to be the ah, should be concurrent engineering environment for something.

So, process improvement can be based on that and decisions can be taken at the management level on the base of which are those elements or which are those influential dimensions which should be mapped in finally for the final environment that the organisation should be in. So, with this I would like to end this module.

Thank you very much.