Design Practice
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Lecture – 18
Elements of concurrent engineering: Optimization in product development

Hello and welcome to the design practice module 18, discussing about a cals C E case study, reported by the electronics systems working room report by Linton. Linton at all made in 2000 1992. So, we looked into the various aspects of the major elements for AC environment which included organizational requirements or organizational details requirement details communication details and now, we are left with only the product methodology.

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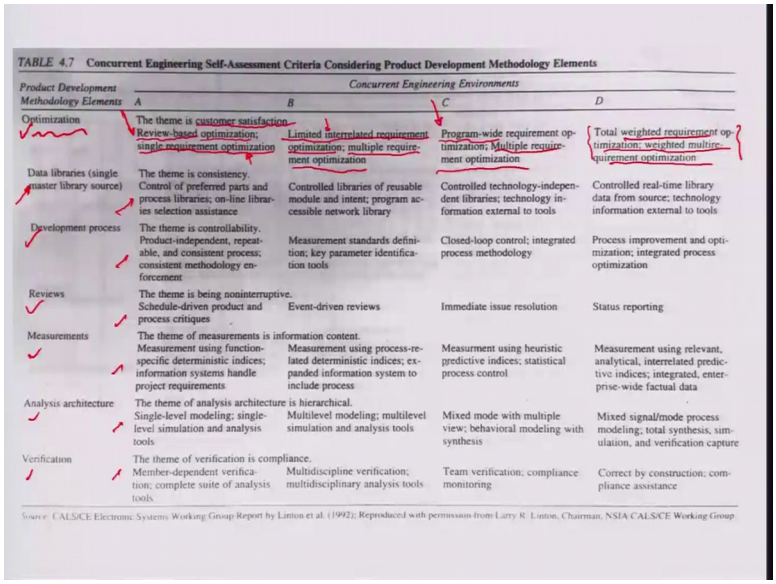

TABLE 4.7 Concurrent Engineering Self-Assessment Criteria Considering Product Development Methodology Elements

Product Development Methodology Elements	Concurrent Engineering Environments			
	A	B	C	D
Optimization	The theme is customer satisfaction. Review-based optimization; single-requirement optimization	Limited interrelated requirement optimization; multiple requirement optimization	Program-wide requirement optimization; Multiple requirement optimization	Total weighted requirement optimization; weighted multirequirement optimization
Data libraries (single master library source)	The theme is consistency. Control of preferred parts and process libraries; on-line libraries selection assistance	Controlled libraries of reusable module and intent; program accessible network library	Controlled technology-independent libraries; technology information external to tools	Controlled real-time library data from source; technology information external to tools
Development process	The theme is controllability. Product-independent, repeatable, and consistent process; consistent methodology enforcement	Measurement standards definition; key parameter identification tools	Closed-loop control; integrated process methodology	Process improvement and optimization; integrated process optimization
Reviews	The theme is being noninterruptive. Schedule-driven product and process critiques	Event-driven reviews	Immediate issue resolution	Status reporting
Measurements	The theme of measurements is information content. Measurement using function-specific deterministic indices; information systems handle project requirements	Measurement using process-related deterministic indices; expanded information system to include process	Measurment using heuristic predictive indices; statistical process control	Measurement using relevant, analytical, interrelated predictive indices; integrated, enterprise-wide factual data
Analysis architecture	The theme of analysis architecture is hierarchical. Single-level modeling; single-level simulation and analysis tools	Multilevel modeling; multilevel simulation and analysis tools	Mixed mode with multiple view; behavioral modeling with synthesis	Mixed signal/mode process modeling; total synthesis, simulation, and verification capture
Verification	The theme of verification is compliance. Member-dependent verification; complete suite of analysis tools	Multidiscipline verification; multidisciplinary analysis tools	Team verification; compliance monitoring	Correct by construction; compliance assistance

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, when we talk about again product methodology, as you have already been told earlier, there are various sub elements, which related to how the product development methodology can go within organizations. There could be an optimization based the strategy.

For example, here the central theme could be customer satisfaction. So, whatever is done is optimized based on reviews ok, reviews received from again customers who are the end users.

Now, there could be sort of a single requirement-based optimization at a certain elementary level of the c environment, where a certain review which comes or a set of reviews which come are used as criteria as for optimization of a certain design parameter. There could yet be another level which we talk about for sort of limited interrelated requirement optimization.

So, out of these needs which are arising here, based on the reviews, there is some kind of interrelated requirements would get generated and there are certain multiple requirements of the of this type which can be used for finally optimizing ok. Some themes or adding some optimized themes to the design. We have yet another level where we talk about the same sort of a requirement optimization not on single section-based requirements, but almost on a program wide scale.

So, there also you have multiple requirement optimization strategies which are to be used. And then finally, you have the most desirable c environment which talks about a sort of a weighted requirement optimization. So, here also, within the program wide needs which are there for optimization, there can be certain areas which are to be weighted more for optimization because, they would affect the overall order winning criteria in a more appropriate manner in comparison to those which are weighted less.

So, there is some kind of a choosing and priority of one over another when we talk about such requirements for optimization. So, this could be one of the basis for doing product development in terms of design changes etcetera. So, here we are referring to mostly process libraries or part libraries ok, the theme there is consistency. Similarly, there are other product development methodology elements like the development process and the controllability over the process reviews.

You know, reviews may be related to schedule driven product or process critiques or even driven reviews, some immediate issue resolution based reviews or status reporting reviews based on which all these environments can be set in there are other elements like measurements analysis architecture and verification and you could actually go through all this list here right for the different levels A to D for different concurrent engineering environments.

Given this, we are now, in a position to sort of do the next step or the next phase which is analysis. And I would like to do the analysis with respect to a sort of a case study which I mentioned here.

So, let us suppose, given all this requirement from the cals C E concurrent engineering facility or group, we are now left with sort of some kind of an optimization. So, we will consider the following example.

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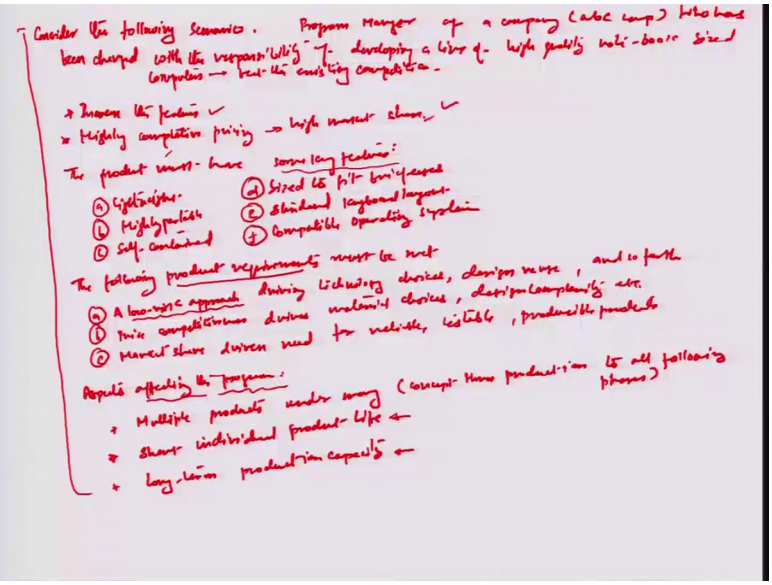

So, let us say, we consider a scenario where, there is a program manager of a company, we just call it some fictitious a b c company ok, who has been charged with the responsibility of developing a line of sort of high quality notebook size computers. Some constraints have been given based on which he has to typically beat the competition. So, the goal here is to beat the existing competition. There are already a lot of such notebooks existing in the market. And so, one has to do a careful analysis as to how you know the various elements or the influential dimensions can be controlled to place the company somewhere which will take it at a level which will beat the competition.

So, the idea is to market with increased features. So, obviously, the first goal here would be to increase the features in the existing notebook. It should be the pricing should be highly competitive ok. So, let us say, highly competitive pricing is another goal, that overall would be for setting up such a concurrent engineering environment. And this would definitely result in a high market share.

So, obviously, when we talk about features, the product must have certain key features. So, the product must have some key features like, for example, it should be lightweight model compared to the existing which are there in the market already. It should be highly portable. These are features which are almost granted when we talk about notebook sized computers; it should all be self-contained in a single casing.

There should not be separate keyboard or separate display unit or central processing unit. They are all to be on board on one particular packaging, there should be also some size constraints. So, size to fit briefcases is what the buzzword is for getting into the world of making these no notebooks I species.

Generally, it is advisable to have a standard keyboard layout just so that, you could, you know, everybody around the world could use and it could be an international product with international competent competition. And then, finally, it should have a compatible operating system, which is repairable everywhere or which is trouble shooted everywhere equally well. These are some of the key features that the product should have ok. The assignment also possesses a number of requirements or needs that drive these product attributes and constraints and let us list some of the product requirements.

So, the following product requirements must be met. So, the first requirement is that, a low risk approach necessitates you know, the sort of important technology choices that one needs to make or design reuse and so forth. So, that is what the assignment is going to be off. So, let us say, the program manager decides to go for a low risk approach driving technology choices we want to make it low cost for example. So, this is very important to have something unique, but at the same time not very expensive ok, if you possibly have reuse of the design, which is set forth.

So, there is also a price competitiveness constraint which would drive material choices, design complexity, etcetera. So, let us say, it should not be too weird in terms of the design. It should have a low price. So, price competitiveness drives aspects like material choices, design complexity etcetera. Also, the market share, we need to have a high market share; that is, the constraint given to the concerned individual ok. So, high competitive pricing leads to this market share.

So, that drives the need for a reliable testable producible product. So, these are the requirements coming out of some of the requirements frame for beating the existing

competition by the manager. So, let us say, we call this market share driven need for reliable, testable, producible products some of the aspects then finally, which affect the program of the program structure affecting the program include multiple products underway at various stages. I mean, it could be the concept stage or production phase down all the way up to the, you know marketability sale stage.

So, multiple products are underway ok, that is one of the aspects which might affect the program. You need to produce something which is very unique and so, there should be iterations at almost all levels. So, I will say, concept through production to all following phases, there can be multiple products with multiple designs. in order to beat the competition and be in business the pricing model that is made, should kind of signify short individual product life.

At the same time, it should not jeopardize the quality. It should be that you know, the product design changes quite rapidly, so that, there is a need for upgrading the product because, some of the issues like software's, etcetera become outdated because of the advancement made in the product after a few years. So, one has to discard or dispose off.

So, that is what short individual product life means. And then, of course, you should have a long-term production capacity. So, if it gets discontinued, at least the production should be such which is willing to accept some of these changes as a function of time, etcetera which gets considered. So, given the scenario of the need for marketing a line of notebooks, there is a certain c environment which has to be found out by looking at what is the existing environment which is there and how it should be changed, and this calls for analysis which is actually the 3rd phase for the cals C E (Refer Time: 14:04) case study.

So, we will like to look at the analysis part now point by point. So that, we are able to figure out what is the existing level of the c environment and how we want to change that, so that, this line of notebook can be introduced in this particular c n n environment.

So, the analysis phase happens on the basis of the scenario which has been drawn here and in comparison, to what we had analysed earlier for the various influential dimensions as well as the requirement elements or the elements for the concurrent engineering environment.

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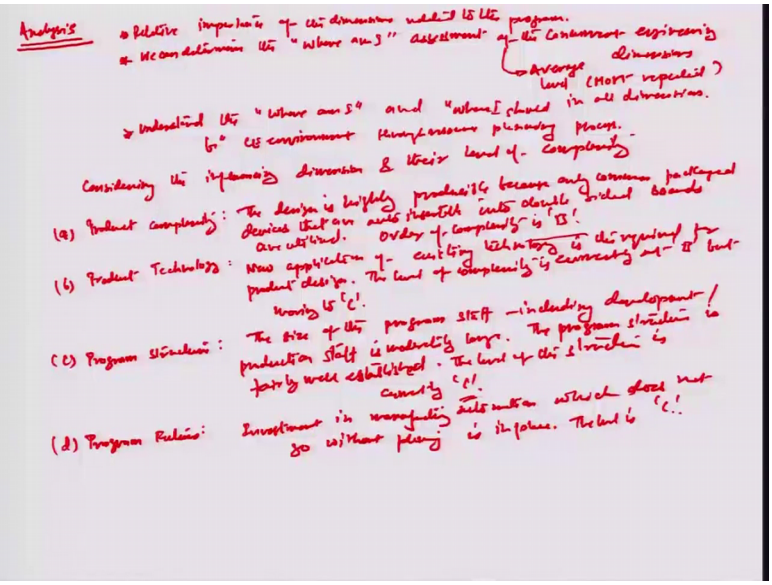

So, let us carry out phase 3, that is analysis in this particular problem example. So, if we use the information on product features, product requirements and some other aspects that affect the program, obviously, subjective decisions regarding the levels of all the influencing dimensions on an individual basis are established. And this knowledge may also be staying within the organization because of it is previous experience in several lines of similar products you know, done earlier.

So, the relative importance of the dimensions is considered, this establishes what you call the, should be concurrent engineering environment, because the relative importance that is there of the various dimensions would gauge the level of the concurrent engineering environment to be one out of the four.

And because of the overall tightness in the competitive environment, it is desirable to move up scale. So, once that is level is established, it is not very difficult to gauge what is go to be the next level for which you have to now draw a set of requirements as per the analysis the elements, you know, draw the elements at certain levels as per the analysis given in the last two lectures.

So, let us look at the whole map of analysis by finding out number one, the relative importance of the dimensions related to the program to be launched; that is, the line of new notebooks. So, we can determine the where am I assessment of the concurrent engineering dimensions looking at what are the most influential dimensions and what is

their average level in the existing scenario. So, this is average level or most repeated level. So, let us say, most repeated average level in all dimensions.

So, given this, the goal here is to understand, the where am I and where I should be, c environment through the resource planning process. So that, adequate resources can be routed into the different aspects which would shape up the different C requirements ok; C elements could be requirements elements could be organizational requirements, product requirements, you know, communication requirements, development methodology requirements and so, you can actually focus on where you want to divert the resources so that, the overall engineering element or overall dimensions can change from a certain level to the next level.

So, in this particular case, let us start doing the analysis, we consider the influencing dimensions at the level of complexity one by one. So, considering the influencing dimension and their level of complexity; let us say, we talk about the first dimension which is product complexity. We know, in our case, the design is highly producible, because, you know, it is easier to use only common packaged devices that are auto in certain build into double sided boards.

And therefore, there is a sort of an order of complexity which you can, which you could say to be little state of the art related to the product line, but may not be exactly as for the product line. So, you could gauge this as level B for the product complexity. So, let us write this down here.

So, the design is highly producible. Obviously, we want to make it highly producible because, there are repair issues or after sales issues, which would only happen in a design which is not too complex ok. So, highly producible because only common packaged devices that are auto insert able into double sided boards, are utilized. So, let us say, the order of complexity is B in this case ok. I am going to tabulate this all this later so that, we can have an idea what is going to be the existing level of the c environment.

So, let us talk about the next dimension which is product technology. Obviously, new application of existing technology is required for the overall product design because; we want to beat the competition. There already existing lines of notebooks which are there in the market and if you want to really beat that line, you need new applications of existing technology ok. So, obviously, you cannot think something completely out of the

box because, that may put you at risk. Number 2 is the fact that, these are technologies which are not very high lifetime technologies. So, therefore, if you do this in the market once it may be possible that you are run over by somebody else who will take a sort of a higher-level technology and your product life cycle gets shortened because of that. So, you are investing more and getting less return.

So, it is a better idea to sort of have new application of existing technology. So, this is required for the product design. So, we can say that, the level of complexity is now B, but it can move to C where there can be slightly newer application in mind although, not the invention of core technology new core technology is involved ok. So, that is level D. So, we will say that at the level of complexity is currently at B although it may be moving to C to beat the competition.

Let us talk about the third influential dimension, which is about the program structure, how the program is shaped to carry out this whole introduction of the new line of notebooks. So, the size of the program staff including development and production is moderately large. Remember, we have in our initial criteria, laid out; I have mentioned that, multiple products should be underway at various stages so that, there is always a higher chance of success of the product in the particular market. So, therefore, moderately large staff is needed for handling such a reasonably big program.

So, the size of the program staff or including of course, you know people who are involved in the development as well as production, including development slash production staff is moderately large and that is because of multiple products being underway from various design to you know, production phase or even down the line sales and marketing phase.

So, the program structure is fairly well established. Otherwise, this could not have happened and will not be utilize something which is already there. So, we can use the program structure for this purpose. So, the level of the structure is currently at C you can say corresponding to a level, where we talk about multiple locations, formal communication among them and maybe not a very deep reporting structure. But then certainly manageable level of reporting among the various stakeholders of the program is what level C is all about, which is actually the case here in this case of the company

introducing a new line. There is of course, some experience from before and some program structure in place already which can be utilized.

We now talk about the next dimension of determining the, for the particular program that is in question which is about program future. So, here the investment in manufacturing automation has to be made because of the somewhat new design to the existing designs which are already there.

And therefore, there has to be some kind of a planning in place about how the program feature would typically look like in a in a few years time. And so, therefore, I would say that the level of program features in this case is C. So, let us say investment in manufacturing automation, which does not go without planning is in place and that is the level of program future is let us say C.

So, we will also talk about maybe in the next few slides, in the next module, the other aspects of the different dimensions related to again the product line in question, which is about business relationships or resources or schedule tightness of the team scope, so on, so forth. And then, we will try to map an overall level for of operation and where it should go to if you wanted to introduce this line of notebook. So, I like to end this lecture here in (Refer Time: 27:51) time.

Thank you very much.