Manufacturing Systems Technology

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Module – 01

Lecture - 03

Welcome to module 3 of Manufacturing Systems Technology,a brief recap of what we did in the last module.

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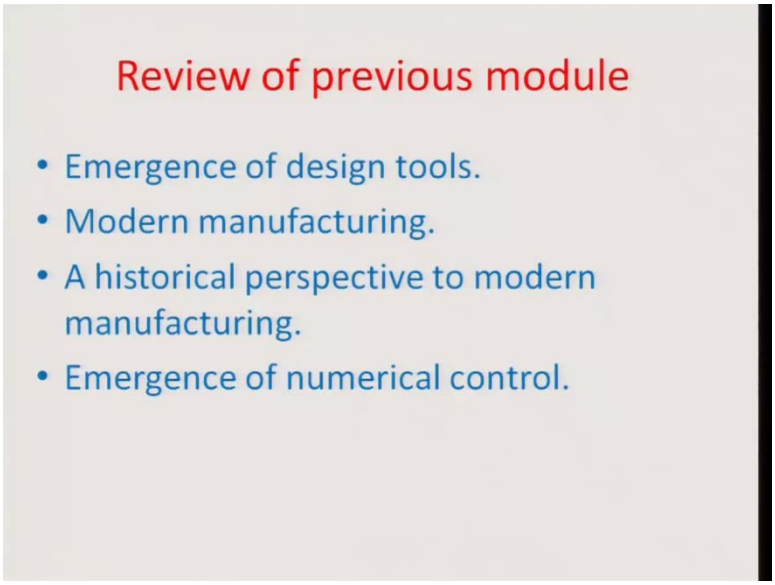

So, we talked about the emergence of various design tools particularly from the, you know the 2D drafting to the 3D drafting,all the way to the assembly level modeling and even now, very expense I mean very expensive and very complex intelligence systems like process knowledge based modeling, etcetera.

So, we also discussed about, what really is modern manufacturing, what is the essence behind this sort of modern manufacturing and how it evolved, we looked at the historical perspective of how it began from all the way to 1776, when people started talking about goods and capitalism and economics to the first form of the assembly line, which generated in Ford motor company back in the 1900's, early 1900's and followed by that

series of developments, which led to the, so called current day highly computer integrated product designing and manufacturing CAD/CAM kind of an environment or setup.

We also looked at the emergence of numerical control by the development of the simple controller in 1946 all the way to 1980's, when it emerged into a micro controller driven independent unit as a machine unit rather than a global control, which was earlier practiced as a convention.

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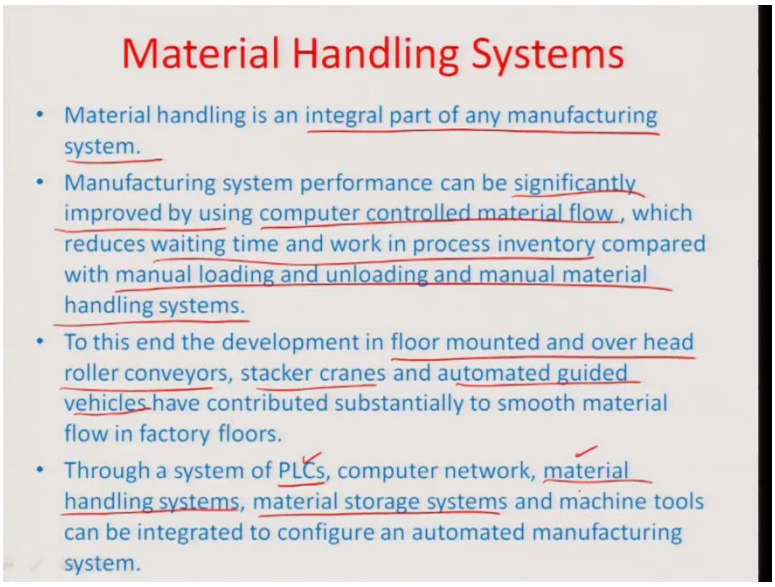

We would now like to look at material handling systems; obviously, with the manufacturing process there was a huge emergence of material handling systems also, which would not allow, which otherwise would not allow the kind of optimization levels that are being looked at in modern manufacturing. So, it is becoming an integral partof the modern day manufacturingand we would like to delve into the details, right now it is only introductory.

So, as you already know computer controlled material flow systems are quite existent with in industries these daysreduces waiting time working process inventory.And also basically these are much, muchabove the manual loading and loading on manual material handling systems, which have been there earlier.And there is also the socalled concept of inventory planning and control and reduction of inventory by doing more and more direct online supply of different materials.

So, the idea is how to squeeze inventory; that is the overall global idea and very intelligently, if the planning or the information of what has to be planned as a production process can come from the later stage to the former stage. So, that the manufacturing can be pushed according to that plan which arrives, this concept emergedand it is also known as subsequently lean manufacturing in the Japanese context,whenever we talk about car making.

And, what happened is, because of this overall philosophy of what is needed has to be produced at the right time in the right quantity,there has been a global change in the way that you look at material handling systems.And then; obviously, there are certain tools of the material handling systems and these are engineering tools, mostly which were developed for the concept of 1 by 1supply and fitment.And these include floor mounted and over head roller conveyors,stacker cranes, Automated Guided Vehicles AGV's, which are contributed immensely to the handling of the assembling process in a much smoother manner.

Supposing you want to supply parts like, let us say bumper to a car body at a certain stationor if you want to supply something related to the doors, best idea if it is on a regular basis that you need to consume these.For example, rear and a front bumper gets consumed on every car,which goes out of the assembly line. So, a better idea is to sort of keep track on the supply system from the central stock or the stock area of the bumpers through socalled automated guided vehicles,which will go on their own paths and get stored in the stock as when needed and will come out with the empty bin or the carriers,which would again go back to the stores of the stock point, where they can be loaded and sent back.

So in fact, the whole system of manual unloading or loading of parts have been removed in certain cases using automated guided vehicles.So, we will have a very close look at, how to plan the AGV parts etceteraas the function of the demandand function of how the manufacturing systems go through this course. So, also there has been a lot of emphasis on the programmable logic controllers,which are typically used nowadays to operate all the type, different type of conveyors with the rates overhead or slat or any other kind of conveyors.

They have the concept of Poka-yoke, which means fool proofing, wherever there is a small error or wherever there is a small abnormality related to a process, almost immediately there is a way out to stop the line and alarm the management about that particular defect.So, that there can be a completely new aspect of production,whichwould happen between various such stocks and working center. So, a lot of emphasis is given to PLC's in fact, which are used for doing all these program management activities particularly related to assembly line conveyors or any other overhead conveyors,where such defects can be indicatedto the higher management by a fool proofing stoppage of the production through warning light system.

And these are incidentally all also a process of lean manufacturing, which gives the highest level of optima in terms of inventory, in terms of manufacturing management, in terms of quality,in total quality control, soon and soforth.So; obviously, we would be looking into PLC's we would be looking into material handling system, we would be looking into storage systems and here I would like to mention that modern day storage systems include…

Particularly those places, where you have smaller items and more number of items,there is a question of indexing and keeping in a proper manner. So, earlier manual systemof racks used to be preferred, but nowadays there is something called a automated storage retrieval system, which is actually by design. So, you can actually through a computer pick and choose a part, which is kept in one particular column one particular row of a rack and the rack is able to, it is a motorized rack,which comes out and delivers to you the particular partrather than you going to the particular rack,as the library of the parts it comes out and delivers to you.

So, such systems are quite common place now and in fact, this industry of material handling has emerged parallel to the emergence of the modern day manufacturing and has aided greatly the manufacturing system. So, definitely we will be looking into some of these material handling systems theaspects also along the duration of this course.

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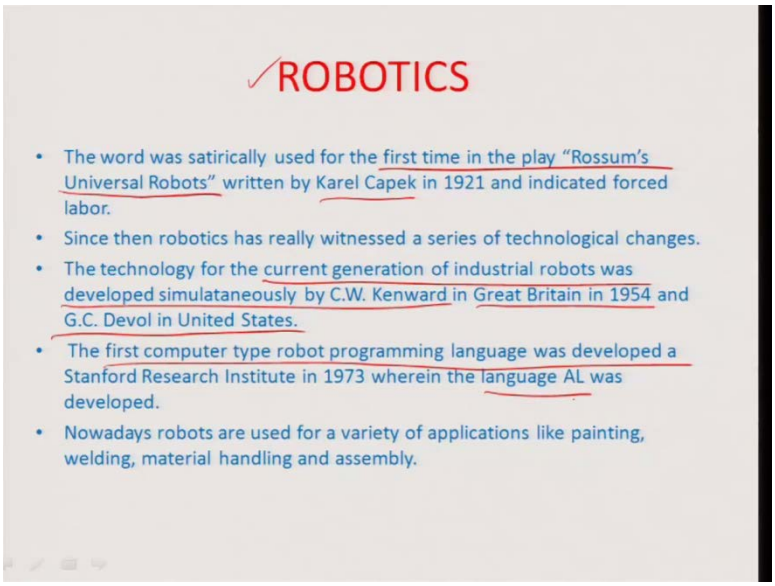

And then; obviously, I was also talking about robotics how that helps in doing modern day manufacturing. So, historical perspective if you look at really in 1921this famous play by Karel Capek called Rossum's Universal Robots.Although it was written in a derogatory sense,because he wanted to indicate forced labor, butthis was really the start of the idea that,what would happen if supposing human labor could be replaced by a machine and subsequently there were many technological changes.

For example, you know the current generation of the industrial robots that was developed simultaneously byC.W. Kenward in Great Britain in 1954and then, Devol in United States, who also incidentally was known for developing the first controller in 1946, soon and soforth. So, the first computer type programming robot language,which was also known as language ALwas written at Stanford Research Institute in 1973.

And nowadays of course,there are many companies around the world which produce industrial grade robots,which would do multitasking of similar kind of tasks.For example, if supposing you were to weld a sheet metal in a car weld assembly and let us say there are very,the very inaccessible kind of areas, where otherwise an operator would mean a lot of hazard.Potentially those places are completely replaced; nowadays by robotics systems, where you have a programmed path of the robot anda very high level of maintenance of course, is needed on a preventive basisof these.

So, that there is no interference and then, you have a monitoring system, which sees at the end of that robotized line how thesespots are quality wise are spacing wise or they going to have any major changes and that regular monitoring gives you way out of whether a battery of robots, which are actually operating, now on the car to weld different places or performing their job in a good manner or not.

So, the associated problem, which comes with robotics of course,as a production man would like to say is that you have to have a lot of emphasis on the quality aspect almost on the real time basis. So, moment there is a detour from the quality there has to be a sort of a maintenance check on the robotic line and there may be emergency situations,where the line stops. So, therefore, idea is to sort of keep on doing it everyday and keeping the maintenance hours away from the production hours.So, that there are no line stoppagesand; nowadays robots are used heavily in car making industry for welding painting you know even material handling assembly, soon, soforth.

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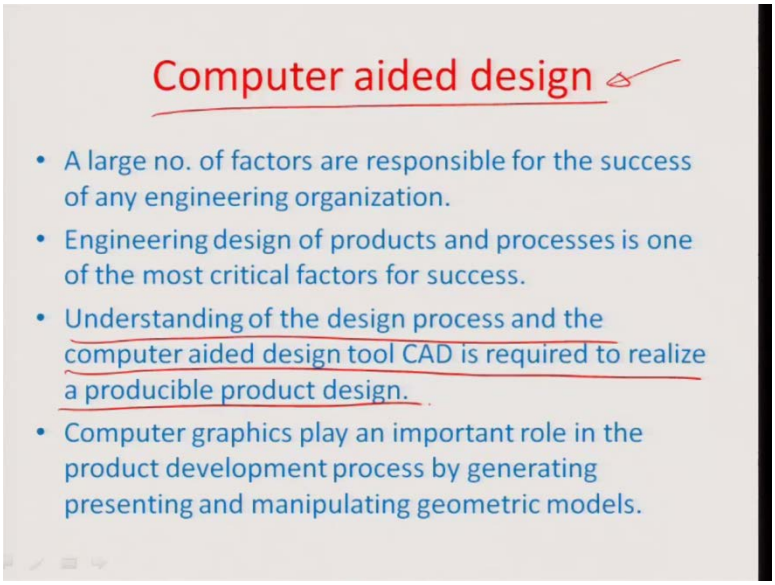

So, that is about the whole context of modern day manufacturing, now I am going to start on the subject material and first of it is computer aided design. So, as you know that the first step behind the product design needs or necessitates a computer aided process or a computer aided design process. So; obviously, a large number of factors are responsible for the success or failure of any engineering organization and the first step of product designing process is really a very key step,which would ensure whether you are going to

be in business there are two aspects of design one is that can be mapped the need directly and another aspect is you make a design, which is more robust.

And, sothat at the design stage itself you include, somuch flexibility that you would be able to really be a market leadertowards the end of the manufacturing process,where you deliver those process. So, understanding of the design process and the computer aided design tool is really required for a producible product design and the most important tool that comes handy for looking at product designs is computer graphics,where you would like to visualize, what you think as the design of a product.

And there are many ways to geometrically manipulate or present the objects in a manner, sothat you could visualize the drawing into various aspects and one of them is the simple orthogonal coordinate system through, which you can actually envision or lay out and object and change it rotate it relocate it to a different place etcetera.So, in the process of learning of the design we would also like to see at, what really is happening behind the cad package in terms of the change of the position coordinates or change of thelocation coordinates of points or lines or objects.So, that you can do this flexing of the design according to your aspirations of visualization that you would like to enable your cad package to have.

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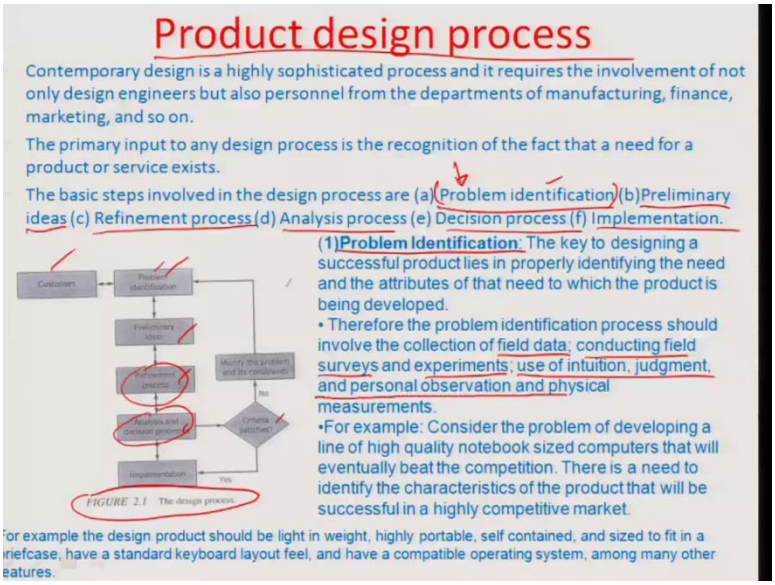

So, let us look at product design as a process to begin with so; obviously, the whole design process is split up into about 6 steps it talks about the identification of the

problem. So, the problem or the need which needs to be mapped, sothat you can decide, what product is a preliminary requirement,then; obviously, after the need finding step has been done and this is the most important step and probably the most long step in the whole process of product design.

So, then you actually do the preliminary ideation, where all the people, who are associated owners of the process would sit together and ideate about,what kind of solutions could match the need and these are only the ideations they do not really need the involvement of any engineering specification or any manufacturing capability and, sobasically it is like a brain storming kind of ideation, where each and every idea is evaluated or is put on the tablebefore starting to evaluated.

Then; obviously, you have the refinement process, where some of these ideas are now, started to refine and some practical ideas, which has emerged out of all these different. So, called you know suggested ideas they are further taken they are not the whole lot of the ideas, which are being given, but at least some of them,which appeared to be feasible and then,you do a whole analysis process decision process and then finally, the implementation process, which would involve the preparation of the engineering specification etcetera.

So, the whole design process has been illustrated in the figure here, which starts with the customers likes and the dislikes and as a need finding for the customer and then, gives preliminary ideasrefinement process and analysis process and decision processes. So, now, you have to really look at whether the idea that you had refined is it really satisfying the criteria that had been laid out if not then, you have to again go back to the problem identification step and see whether the analysis, which has been carried out really includes all the parts of the problem that are necessary you for designing the product.

And then finally, if supposing the criteria is satisfied from the question of engineering lay out of the change comes into picture. So, the identification step for example, is a key to design successful product and therefore, the problem identification process should involve the collection of field data the conducting of field surveys and experiments use of intuition and judgment personal observation and physical measurements, soon, soforth.Let us consider an example suppose you wanted tohave a high level note book

size computer, that you would eventually like to beat the whole competition in the market.

So; obviously, some of the design attributes that should be had and if you talk to variety of customers they will give their own perspectives is one that should be light in weight it should be highly portableit should be self contained it should be sized to fit in a briefcase. So, that you can have a carriability or move abilityof the product and you have a standard keyboard, which is accessible by everybody irrespective of,what is his education or training level.

And it should have a compatible operating system, sothat not many software should be able to erratically interfere with the system and there operating system should be able to handle all the operating software's that you are talking about. So, these can be some of the key features probably, which would do the need finding or the problem identification step actually. So, this is a sort of a looking into initial aspirations of customer when you are trying to design a computer size notebook,which is the first step towards making different ideas.

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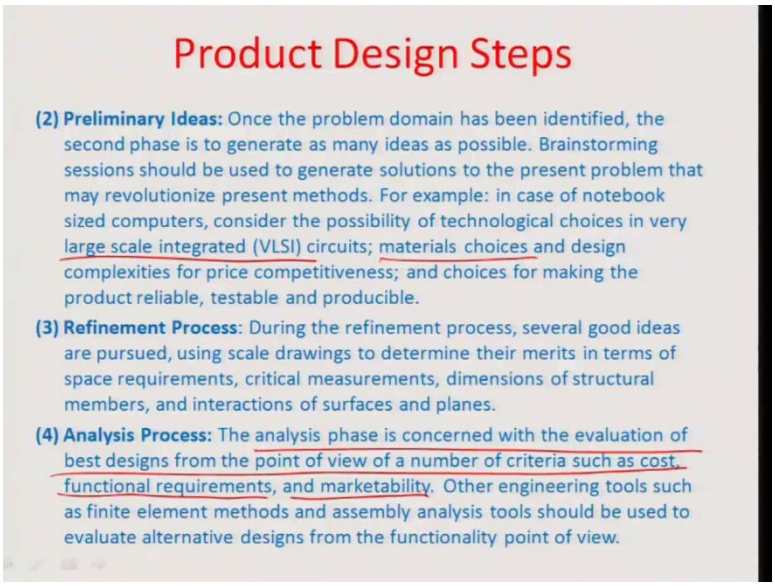

So, in the preliminary idea step in the same process of the notebook selection you may have things related to,let us say you know what is the sort of a VLSI circuit or very large scale integrated circuits,which needs to be used or what are the material choices for

example, what are the design complexities for price competitiveness the choice for making the product reliable testing testable producible.

These are some of the aspects,which now come in the preliminary idea step,where brain storming should be involved by experts particularly in this areaexperts who were related to the business of,let us say computer notebooks.And they would give out now,a set of requirements which would generate on the basis of preliminary needs that the customer would have would have for a computer notebook as given in the last step.Finally,when this preliminary idea step has been overdone,then there is a refinement process.

So, there are several good ideas, which are pursued for example, certain things like specific requirements the critical dimensions, which theparticular product would have the let us say structural members their interactions of the various surfaces and planes. So, that it can be aseptically good it can be more comfortable for the customer they are looked at in the refinement stage.Now, you are basically trying to refine some of the various ideas you have made in the preliminary stage.

So, that you are now,zeroing down on the refined specification or drawing and then; obviously, the analysis phase,which is concerned with the evaluation of the best design from the point of view of number of criteria such as cost functional requirements marketability, soon, soforth.Out of some of these it may be quite impossible that you are looking for a computer notebook in a certain price range and there may be a possibility that some very complex VLSI circuits may sort of uplift or change the overall pricing structure and make a product outside the range that you are looking at.

So; obviously, now analysis is neededto see whether the range that you have determined the quality range that you have determined the needs that you have determined whether they are being met by the refined process data that has been generated for example, you have generated space requirements,critical measurements or scale drawings of certain items or partsare they going to be within the cost structure are they going to be within the functional requirements, are they going to be meeting all the marketability norms these are the things, which have to be looked at the analysis process.

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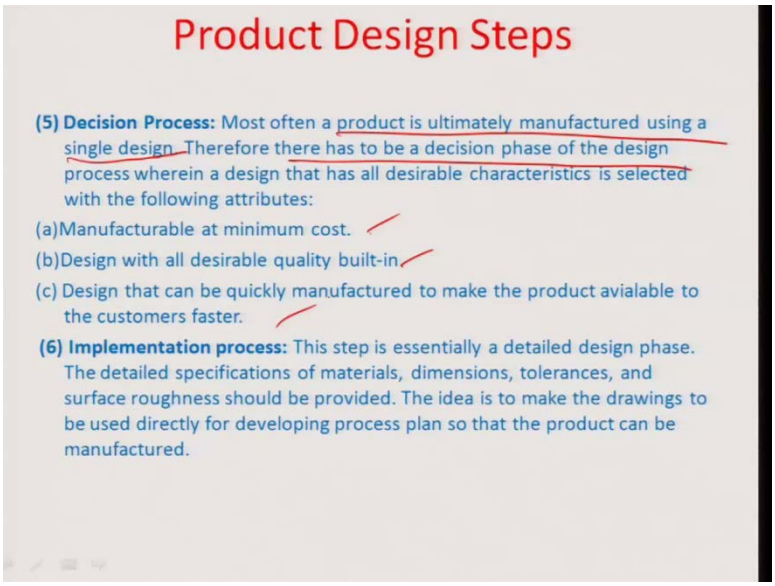

And finally if all the norms are met, then the important part is the decision process,where the product has to be ultimately manufactured using a single design and emerging design.And therefore, it has to have a decision phase now, sothat whatever these analysis data pinpoints you, now decide on the best alternative in terms of manufacturability at minimum cost designwith all desirable quality built in probably design that can be quickly manufactured to make the product available to the market of the customer.

And then,finally, the implementation process is essentially now you start looking into the hardware aspect of the process where you do the detailed specification mapping the tolerances the dimensions the surface roughness'sif the circuits need to be producedwhat are the kind of accuracies within which the production process can enable the circuit to be produced, soon, soforth. And the idea is to make the drawing, sothat at this stage, sothat it can be directly producible in the manufacturing layout or setup that you have.

So, this is how the design process of a product emerges I mean if you can look into this process at various steps really it is about visualization and visualization.And therefore, the next topic that I would like to begin following this, which is computer aided designwould in terms of really actual coordinate data is necessitated. So, that you can learnthat how a cad package offering flexibility,what it really means in terms of the backend computation thatis happening. So, that flexibility can be asserted in a package that would be in the next module.Thank you.