Manufacturing Systems Technology

Prof. Shantanu Bhattacharya
Department of Mechanical Engineering and
Department of Industrial and Production Engineering
Indian Institute of Technology, Kanpur

Module- 01

Lecture- 02

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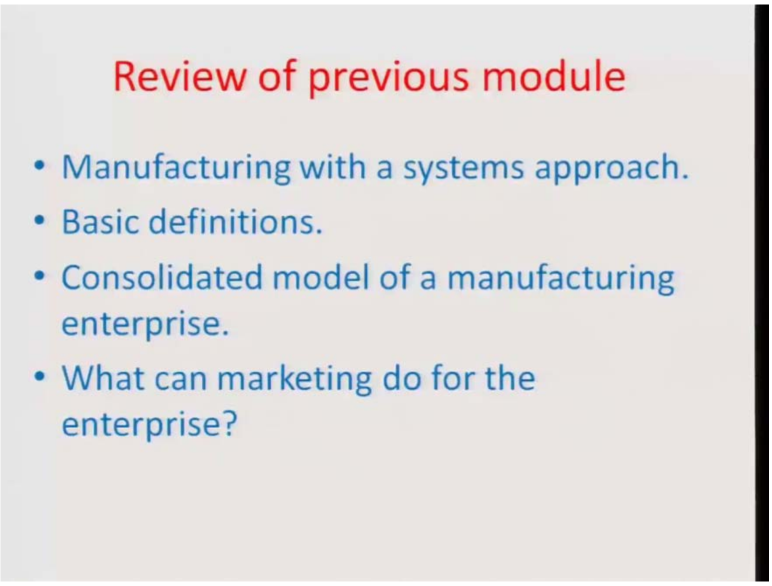

Welcome to this module 2of Manufacturing Systems Technology.Briefly review or recap of what we did in the last lecture.We talked about some basic definitions of manufacturing technology also worked on manufacturing systems approach.How a manufacturing system would work with a core full of manufacturing processes.We talked about various consolidated models of manufacturing enterprise how a different you know, wings of manufacturing enterprise can function with customer centric approach; where these wings can intercommunicate and also communicate with customers to have a good, you know the management of the whole enterprise activities.We also saw some of the aspects of,what?

For example, marketing as a very important tool and function can doto support the enterprise, where with a smooth flow of demand from the customer,it can always ensure that the harmony and the balance of the manufacturing system can be maintained.So, it definitely plays a very key role with the time to time updation ofwhat the customer thinking or philosophy in terms of demand.The whole idea is to be able to give a smooth demand pattern to the remaining part of the enterprise. So, that there are not many disbalances in the enterprise itself.

So, another very important aspect that,any product which gets realized is basically the design of the product and it is the design which actually restarting process to map the customer thinking in terms of something, which is a need or want of a particular customer. So, we will definitely like to have a historical perspective of how design can be done; obviously, nowadays product designing involvesvery complex CAD tools:Computer Aided Design Tools, where there is a huge flexibility offered to the design of that the product designer,to visualize whatever he thinks in terms of mapping of needs of a customer.

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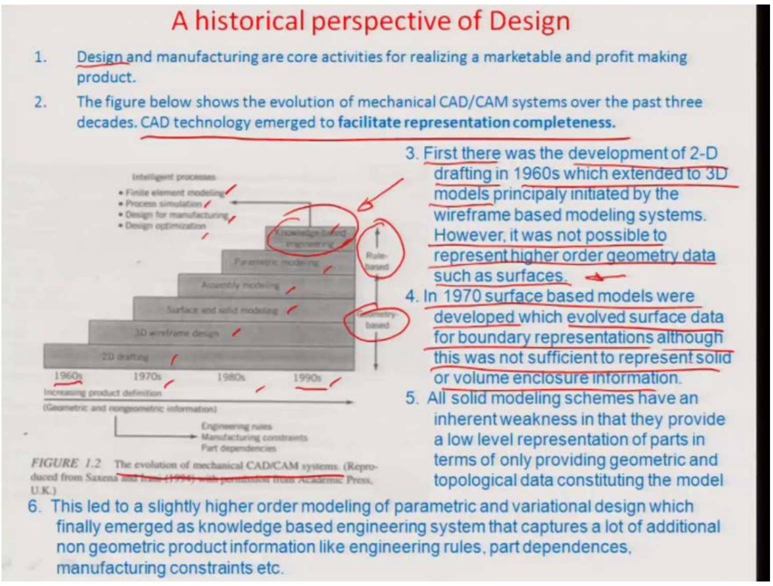

And so we want to do a little bit of historical perspective of design and as we have already seen design and manufacturing formulate core activities,for realizing a marketable profit making system.And therefore, it is very important that design be done in an appropriate manner. So, that not only from a stand point of mapping needs of the customer, but also from a standpoint of giving a high quality product design is a very very important tool.In fact, there is a concept called Robustness by design itself,which is the primary you know envisioning of the product capability of a system itself.And if robustness can be introducedat a primary level or a initial stage,then there can be a huge tolerance or variation that it a product design can take in terms of the deviations of the manufacturing process and still be able to manufacture the quality which is needed. So, that aspect is very important aspect of any modern day manufacturing enterprise.

So, if you look at the figure here,which says the evolution of mechanical CAD/CAM systems;you can see that there are various levels in which the design software which have enabled the designer hugely have emerged over different years starting all the way from 1960 to the 1990s. So, definitely the Computer Aided Design technology has emerged over the years to facilitate the at least you can say that representation completenessof a design which is envisioned.And without doing that, that is the first step how do you do the engineering specification it would then get translated into exact product requirement,somanufacturing process requirements etcetera. So, the first step; obviously, is the very good design, flexible design package which can handle the various design issues related to the product design.

So, the first step you know, the history if you look back in the 1960s, was the development of the 2-dimensional drafting system.Which was extended to the 3-dimensional models,principally initiated by something called a wire frame based design model.If when we are going to do CAD,we are going to address what exactly is a wire frame design.But it is actually a sort of you can say pseudo 3-dimensional representation,of at least the edges of an object through which you can define the whole object.So; however, it was not possible to represent the higher order geometry data, particularly data related to surfaces.Because when we are talking about edges,you do not have any inter connectivity between the edges on aApriori basis.It is just the representation of the edges in the wire frame model, but if there is a inter connect between such edges where they are exact location coordinates etcetera, which has specified.Then the question of the surface mapping would come into picture.But here it is only the wire frame and it is assumed that the person who is visualizing the wire frame model would be able to sort of map this surface on his own,without the CAD package going into the great details of how the surface topology is going to vary between the edges.

So, that is what the 1960s was; obviously, in the 1970ssurface based models were developed because the need was felt.For example, for complex topology surfaces how a representation can be done interms of numerical data or coordinate data. So, higher level CAD evolved where not only the edges, but the surface became a very prominent application.And you know, it evolved the surface data for boundary representations, although even this was again not very sufficient to represent a solid volume enclosure.Or for example, information related to what would be the volume of the particular object,if it is not a regular object cannot be just had by looking into the surface data or the edge data.

So, there were other versions which evolved over time and there were a great many modifications which happened over the 70s,80s, and 90s.And you can see that from the 2-Ddrafting to the wire frame design to the solid and you know surface on the solid modeling; and then finally, the assembly modelingwhere which means that if you have 2different solid objects can I combinedthem together and contain them within certain volume,that we are looking at.And then finally, parametric modeling and knowledge based engineering which I am going to mention just about in a few minutes started evolving with time.

So, typically all the way up to assembly modeling from 2-D drafting can be categorized this geometry based modeling.And then these two other quantities which are or two other forms of drafting which is called parametricmodeling or knowledge based engineering,they are more like rule based.And; obviously, they involve a particularly the last step which is the knowledge based engineering they involve a lot of intelligent processes like,not only just the geometry, or just the volume, or just the design; but the finite element modeling aspect the process simulations for some physical phenomena associated with the designthat you are mapping,and againthe complete design for manufacturing and also a very important design optimization. So, this is basically a intelligent thinking system which is now evolved, and nowadays all the software which comes in the CAD area are really process knowledge based engineering;with that approach you basically start all the engineering of design engineering.

So, as I told you that up till 70s, when the surface based models were still not very sufficient,then the question of how to map 2 objects together or inter connect 2 objects together did not exists.There would be a sort of a emergence of the assemble modeling approach.All the solid modeling schemes do have an inherent weakness in that they provide a low level representation of parts in terms of only geometric and topological data constituting the model.And as I told you the finally, emerged knowledge baseengineering system,not only includes the only the design; but also the rules based designing, particularly the engineering rules based designing.Like what kind of tolerances are there,what kind of part dependencies are there between the different let us say surface finishes of the different structures which were trying to assemble so on and soforth. So, these are not related to really geometry, but some process rules which govern the designing process, but then that is the modern way or modern approach of doing all product design.

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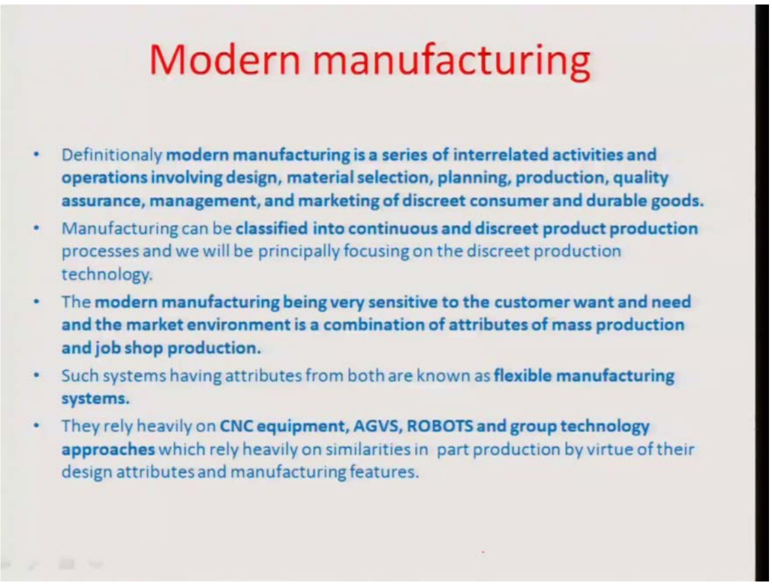

So, that is a sort of a historical perspective to design.Let us look at the manufacturing part. So, modern manufacturing,if you can just split up into really a series of interrelated activities and operations and that can involve let us say design,that can involve: material selection, planning,production, quality assurance, management,marketing of discrete consumer and durable goods so on and soforth. So, there is a huge scopethat there has to be synergism between the various wings that have been mentioned;right about now within an enterprise for a successful production in a modern manufacturing environment.There are some other attributes to modern manufacturing: one of them is a classification, you can classify manufacturing processes into continuous and discrete systems depending on the product line.

Talking about manufacturing of oil and natural gas or maybe you know production of something like sugar,it all necessitates a continuous production process.Now this course will not be intended for such systems,mostly this course focus more on a unit by unit or discrete production system what happens in assembly line.And all the theorization that we do in the following few lectures or modules will be related to mostly discrete process,discrete production processes.

However, modern manufacturing does include a very very flexible attribute where you can combine mass production with job shop kind of productionand these systems therefore, are also known as flexible manufacturing systems.There may be some processes which necessitate a continuous activity for example,sheet rolling in a car making industry is a continuous process.Butthen the moment it gets into a press shop and the sheet is pressed into different parts,it becomes a discreditized process. So, if you wanted to backwardly integrate at some point of time you have to combine really,the continuous flow production with the job shop kind of or the discretized kind of production unit systems which will probably focus more on this along this course.Also the attribute of modern manufacturing systems are to a variety of modern tools which are available from the engineering technology side,which includes things like computer numeric control, which includes things like let us say automated guided vehicles with their different aspects.And also heavily relies on robotics and also group technologyapproaches, which eases out the manufacturing sequencing or the process sequencing in a manner. So, that you always tend to produce optimum yield in any business environment of any kind of pressure whatsoever.

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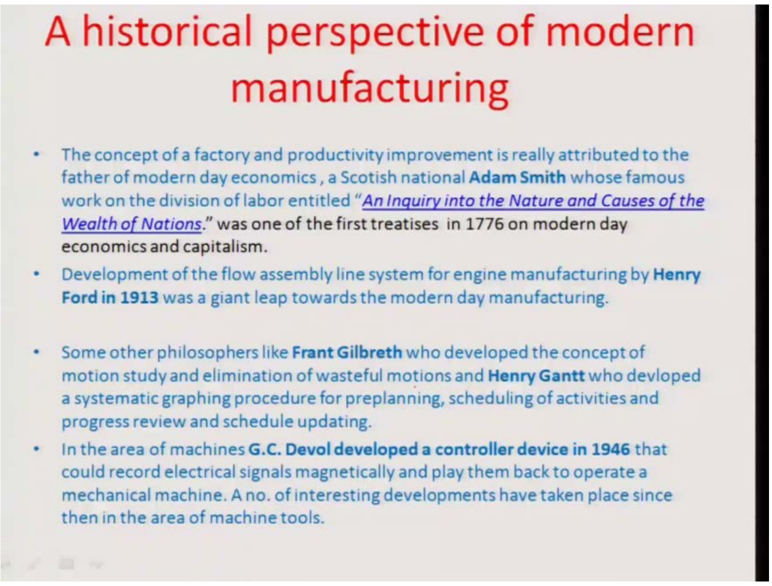

So, these are some of the attributes related to modern manufacturing.Let us actually look at a little more historical perspective of how modern manufacturing had evolved.And you know the concept of a factory and productivity improvement is really attributed to this Adam Smith,he was a Scottish national.And he had this famous work on the division of labor entitled and enquiry into the nature and causes of the wealth of nations.This is one of the first treatises drafted in 1776which talked about the modern day economics or capitalism and concepts related to how manufacturing would augmentsuch economic systems over in the world.

So, following this in 1913th,the manufacturing really had to see the day of in about next probably 2 centuries. So, a giant leap towards the modern day, so called manufacturing happened in United Stateswhen Henry Ford for the first time introduced, the first concept of assembly line. So, this was in relation to domestic cars and this was one of the first initiatives where people realize how important it is;when you chain up the sequence of process in a complex engineering object like let us say a product like car. So, that you have the zeal and enthusiasm to keep producing on a mass production basis on a unit by unit basis, these technology products.

There was some other philosophers like FrankGilberth and Henry Gantt,they developedthe concept of motion study and elimination of wasteful motion. So, this was a ice on the cake of what,Henry Ford had developed earlier.In an assembly line there was a continuous use of skilled expertise of variety of people at a certain rate,and there is always something called wasteful activities or non value added activities which will happen in the process of the assembly.For example, in a car assembly there may be a tendency of all the people to do their job in a manner which they probably do not realize because that is the easiest approach that they have.But they are doing a lot more than what they should have done. So, there is a philosophy that in an engineering way or in a very logical manner if you can observe the motion sequence of a particular operator associated with an assembly line,and then try to identify those areas which are really non value adding in nature and eliminate them.In a way sothat it does not feel any uncomfortable,you know situation.In that case you can save a lot of time.

So, basically these FrankGilberth and the Henry Gantt were two such people who were associated with some of theseelimination of wasteful motions, and also a systematic graphing or a planning approach. Sothat, you can always have the bottle necks of a manufacturing process in terms of the most critical and the least critical. So, then also things like related to scheduling of the activities or related to let us say the progress review or regular updating of data related to the manufacturing process in a very easy manner can it be represented. So, that everybody around can have knowledge about the manufacturing process itself, without really having to go into the depth of the process.

So, these two were really very good value additions again to the modern day manufacturing.And then; obviously, the breakthrough which was done byG.C.Devol can be taken as a again a very important historical step towards modern day manufacturing; who developed the controller device in the year 1946,that could record electrical signals magnetically and play them back to operate a mechanical machine. So, this actually was the advent of the computer assisted machine systems, which later on emerged as the highly technological in most advanced domain of computer numeric control machines.

So, this is the way that modern day manufacturing kind of evolved from the very first work in 1776, all the way to the current you know with the last century.And; obviously, there was some grade breakthrough which weremade after this controller device was launched.One of them was the first numerical control machinewhich was developed at MITunder a subcontract from the Parsons Corporation,Michigan on air force funding in 1950.There was also the development of automatic tool changers and indexing work tables that were added to this CNC machine in 1960,and then it started an era of manufacturing.The people started talking about integrating such numerical control machines into a one particular industry or one particular area, where they would have a direct control of a central processor governing many such NC or numerical control machines. So, there would be one processor which would be governing more than one numerical control machine.

So, the control system development in 1971 was again the next milestone, which led to the development of the micro controller controlled NC. So, called CNCor the localized or the globalized control by the direct numerical controlling, you know system or software againmerged into a manner. So, that you can have now, the control at local level of the machine without that global monitoring or global computing being required anymore.And nowadays the whole integrated one machining unit would have one controller of its own,and that controller can be linked to some other master controllers which would control; but then the processing capability,the intelligence capability are all now sort of synchronized to with a particular machine tool rather than the global system of machine tools that was before in the DNC setup.

So, the major advantage of CNC machine is its ability to store path program. Soalso interact with controllers of central computers,as I just told.And the power of NC machine was further enhanced in 1980 by making them capable of carrying hundreds of tools having multiple spindles controlling movements up to six axis so on and soforth,sothat very complex parts could be produced. So, I think this is a sort of a evolution process of how modern day manufacturinghas evolved,there are many other systems which have been added to the manufacturing like very good material handling systems, very good automated you know robotics system,which would always assist in optimizing the existing manufacturing rate with lesser and lesser inputs. So, we would like to conclude this module at this particular stage and start with the next looking at some of the fundamental material handling systems etcetera,and start some basic CADin the next module.

Thank you.