Fundamentals of Manufacturing Processes
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Lecture – 05
Classification of Manufacturing Processes

Hello, I welcome you all in this presentation on the subject Fundamentals of the Manufacturing Processes. Today's presentation on this subject is based on the classification of the manufacturing process, and this will have basically 2 aspects one is the need to classify the manufacturing processes, and another is the different factors based on which we can classify the manufacturing processes. So, we will be starting with the need of classification need to understand the classification of the manufacturing process.

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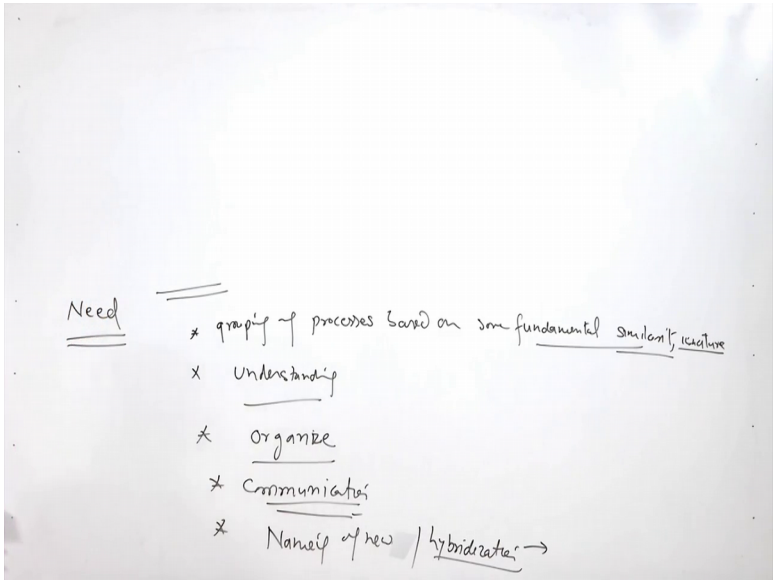

It basically involves in grouping the processes; grouping of processes, based on some fundamental similarity in nature. So, this is one that in which way we can put the different manufacturing processes in certain groups, like joining or the, casting or the forming so they are grouped on the basis of a particular way or some kind of the similarity in the way materialist processed for manufacturing process. So, this is the first we can see how the particular process is fundamentally similar to the other process or it is different, in that way this is one. The second is in developing the understanding on the

process, it helps to have the clear understanding on the subject on the process to distinguish from other processes in light of the fundamental aspects associated with that particular process, further it helps to organize the processes in better way organization means, since the process are very large in number. So, they can be grouped on their on the basis of their similarity of the certain features, and that in turn helps us in grouping, communicating, classifying the processes in better way.

Similarly, communication effective communication of the processes like the forming based processes, or all those where some kind of deformation will be take place, or casting based processes where the melting of the metal will be involved followed by the solidification into the mall to get the desired shape. So, the different category of the casting process can be easily put together under the casting, and so we can easily communicate the meaning of the process by which the material will be processed or material will be treated in course of the manufacturing. Another purpose of the classification is that, it will help us naming; naming, of either new processes based on their fundamental aspects and fundamental characteristics or like based on the hybridization, like if we are putting 2 processes together to have the better capability in terms of the like, say shaping, or providing the desired finished, or controlling the dimensions more closely.

So, that will help us in naming the newer processes which are being hybridized using 2 or more technologies, like say the laser beam can be used for assisting in deformation in along the particular region, or like the machining process, may be clubbed with the electrochemical action, to increase the removal of the material so, that the desired surface dimensions; desired dimensions, in the component can be achieved.

So, these are the things which can be achieved when the processes are grouped in the different categories, and this is what has been mentioned here, like the grouping to the need of the classification is to group.

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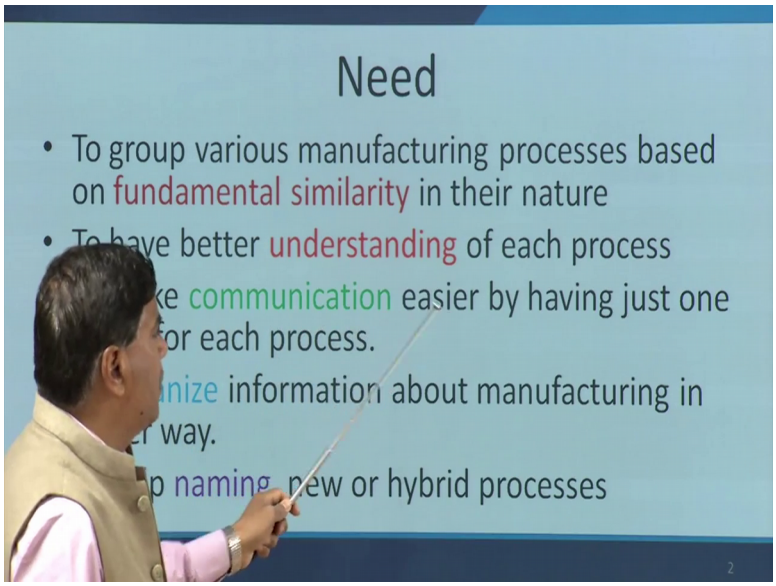

The various manufacturing processes, based on the fundamental similarity in their nature to have the better understanding of the each process based on their grouping, and to make an effective communication or it makes the communication easier, by having just one name of each process, like the send mole casting, or die casting, or centrifugal casting, all those these are of the processes which where the molten where the given material will be melted and, then it will be processed into the molt, to get the desired shape. However, the processing may be different the approach of the processing during the casting may be different.

So, that is why that is how the communication becomes easier, when the processes are grouped a based on their fundamental similarity, and it also helps to organize the information related to the manufacturing processes for example, one particular product is to be made, 0 then we can mention that first of all primary forming, or primarily shaping; primary shaping, will be carried out using either casting followed by machining, and then heat treatment. So, these are the 3 broad group of the processes.

In casting primary shape will be achieved machining will help to achieve the desired dimensions and finish, and followed by heat treatment that is another big group of the processes, where desired combination the properties will be achieved by altering, the structure of the material in the solid a state, so this is what we can say as a purpose of the

classification or need of classification, Now, will see the different technical factors on the basis of which the manufacturing processes can be classified.

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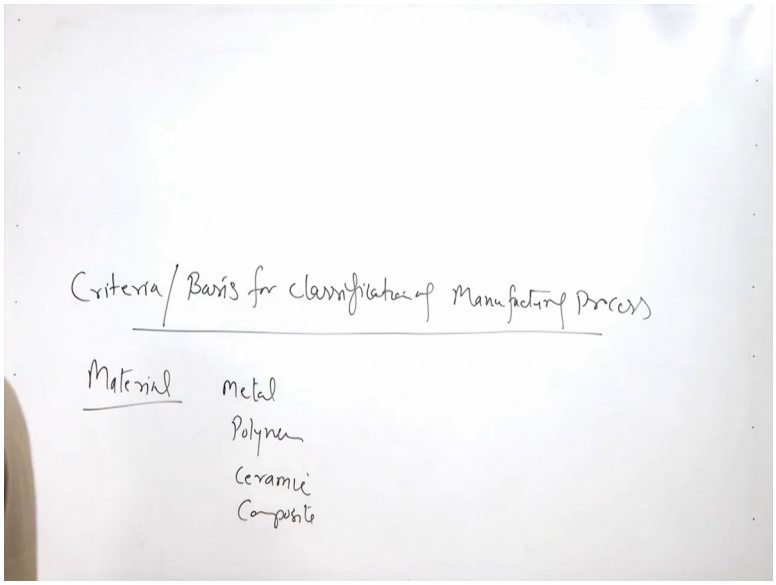

So, we can say either criteria, or the basis for classification of manufacturing processes.

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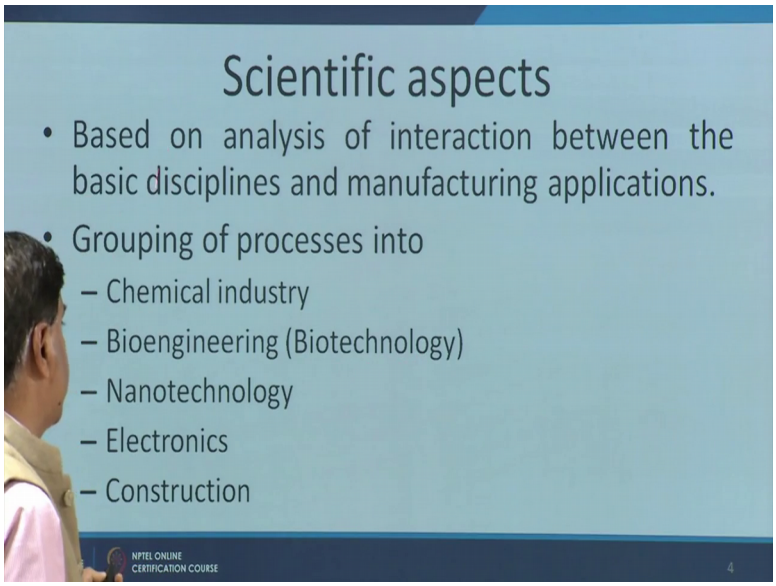

So, basic discipline and the manufacturing here, like that if the chemicals are involved its chemical industry, or the biotechnological technological aspects are involved, it is a bioengineering, or if the nano technology for those processes or the which are using the nano features related with the production or the manufacturing of the goods, and

similarly for electronics, and the construction as per the kind of that basic discipline and the manufacturing process involved.

Second is the material, the kind of material which is being used for processing purpose. So, here you will see if it is the metal, or the polymer or, it is the ceramic, or composite.

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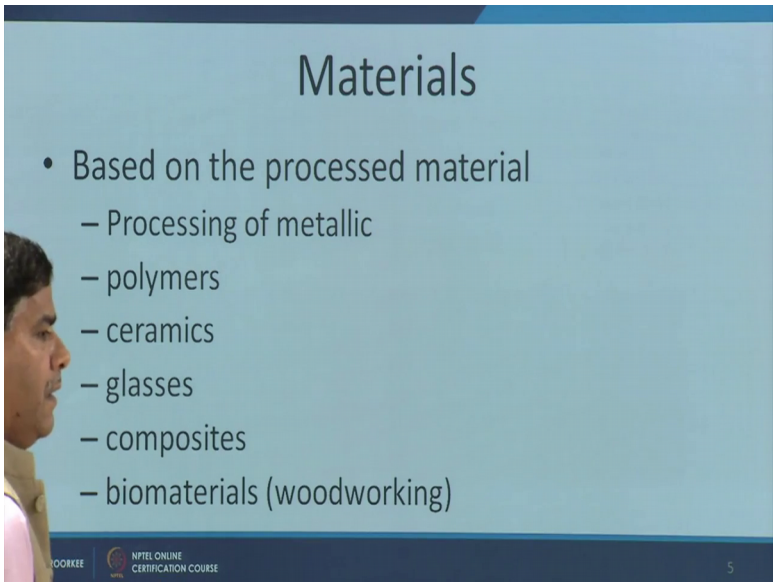

So accordingly we name the process accordingly like, the kind of material being used for processing; processing, of the metallic materials involved in manufacturing, or the polymers are involved ceramics, or glasses like the glass industry, which is used for making the glass based products, or the composite the processing, or the biomaterials like woodworking.

So, the manufacturing process based on the material being used for processing can be grouped as a metal processing, polymer processing, a ceramic processing, glass processing industry.

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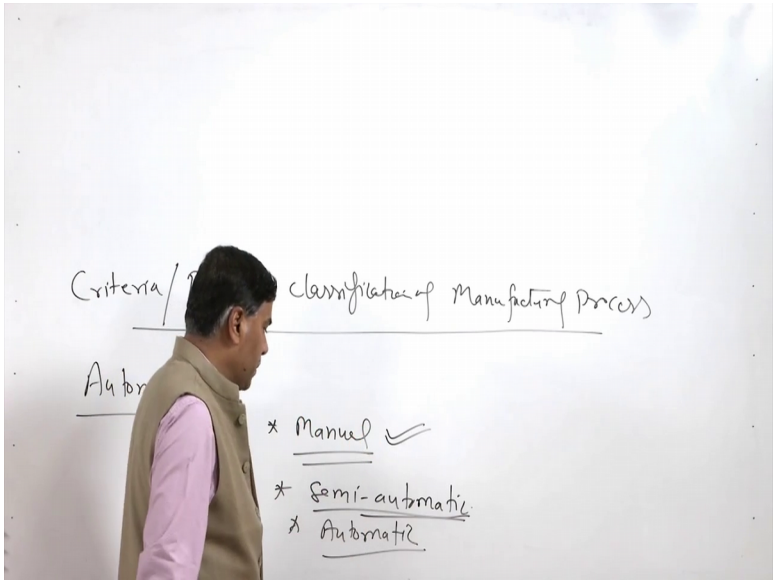

And the next the factor is the extent of the automation automation. So, here what we can see whether the industry or the given manufacturing unit uses the manpower for exerting the energy exerting the force, so like the mostly the controls are manual or here. The control is a partial manual control is partial so, it becomes semi automatic or the fully automatic where manual interactions or intervention is not much needed only the raw stock is to be fed for ensuring that the process continues smoothly.

So, in case of the manual all relevant controls are achieved manually, and a semi automatic it requires lot of the manual interventions or intervention of the human being to ensure the success of the process, and in the in case of the automatic. Mainly the feeding of the raw material is ensured manually to see that the process goes on is smoothly, or whenever it requires the it starts malfunctioning, then it needs the intervention of the human being to ensure that process is brought back into the action.

Then the treatment the way by which material is treated.

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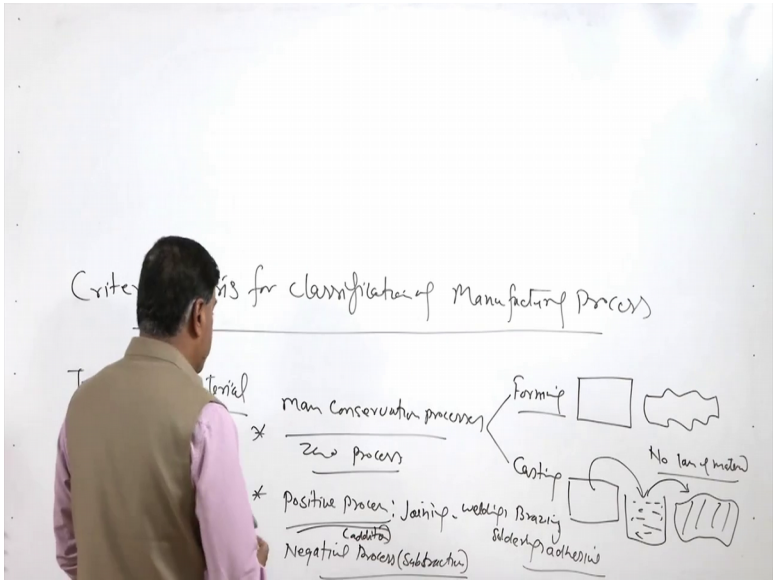

So, the treatment of material, so here basically this is another bigger classification of the process where, the way by which h material is treated for example, mass conservation processes. So, there are 2 processes in this category one is the forming, whether it is bulk forming, or the sheet metal forming, or the casting. In both the cases what we do in case of the forming, the given volume of the material is taken, then using the force it is deformed as further requirement. So, there is actually no loss of the material, so this kind of shape may be achieved after the deformation, in this process there is no loss of material only the shifting of the material from one region to another region takes place.

Similarly, in case of the casting we take one amount of the raw material, and then it is brought to the molten state, and then the same is poured into the mold to get the desired shape of the component, so the product that we get you see its shape only shape is changed from the initial raw material, it is converted in the molten metal, and then putting into the mold at the desired shape is achieved. So, technically there is no loss; however, little loss may be involved that material is getting lost in form of slag or, in form of the impurities, or oxidation, but those losses are very negligible that is why the forming in casting both these process are category are put under the mask conservation, or the zero processes because there is no loss of the material only the shifting of the material takes place from one region to another using the 2 different approaches in one case the force is applied, and another case the metal is brought to the molten state.

The second one is the positive process, wherein the desired size and shape is achieved with the addition of the material like simpler shapes, if this is the one shape and this is another then 2 can be brought together through the joining processes, so that the desired one can be achieved, so, since the 2 members are brought together, and they then the metallic continuity or the joint is achieved between the 2 in order to get the desired size and shape. So, this kind of processes are known as the positive process. Under this category we have basically joining, under the joining we have the welding, we have brazing, and we have shouldering, and adhesive joining, in all these processes what we do, we try to bring the 2 components or 2 or more components together. So, that the desired size and shape can be achieved under the third one is the negative process.

So, here we can say the positive processes are addition processes, because things are brought together, and the negative processes or you can say subtractive processes. So, in case of the negative or subtractive processes primarily we have machining, in case of the machining we know that desired size and shape is achieved through the removal of the unwanted material from the stock or from the raw material.

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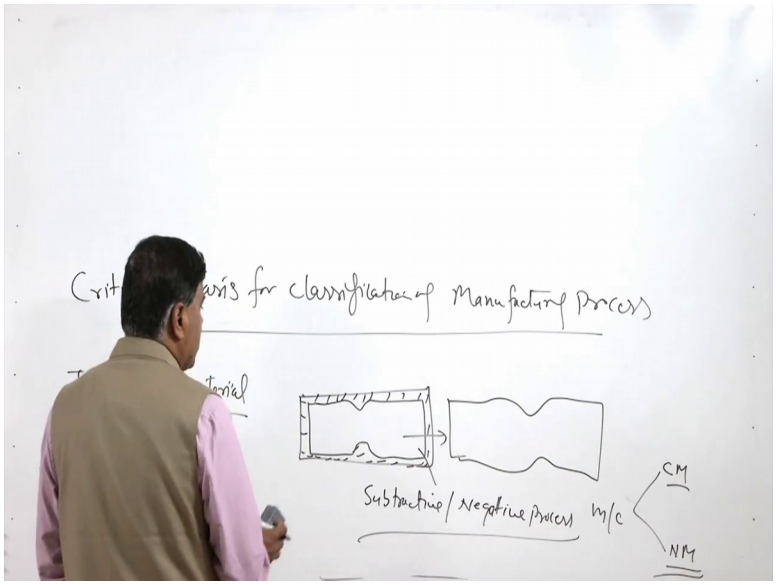

So, as I have said this is the stock in the beginning, and if you have to achieve any particular shape like this, then whatever is the extra material that needs to be removed so, what we do this material from this hatch decision will be removed using a combination

of the processes; combination of the machining processes, in order to achieve the desired shape which is to in the component which is to be made.

So, since the removal of the unwanted extra material from the stock material is involved in this process, that is why this is called subtractive or the negative process, or basically this is the machining process. In machining again we have the 2 variants one is the conventional machining; conventional machining, and another is newer machining or it is also called unconventional machining, so, unconventional machining is used for those which are very difficult to machine using the conventional machining methods.

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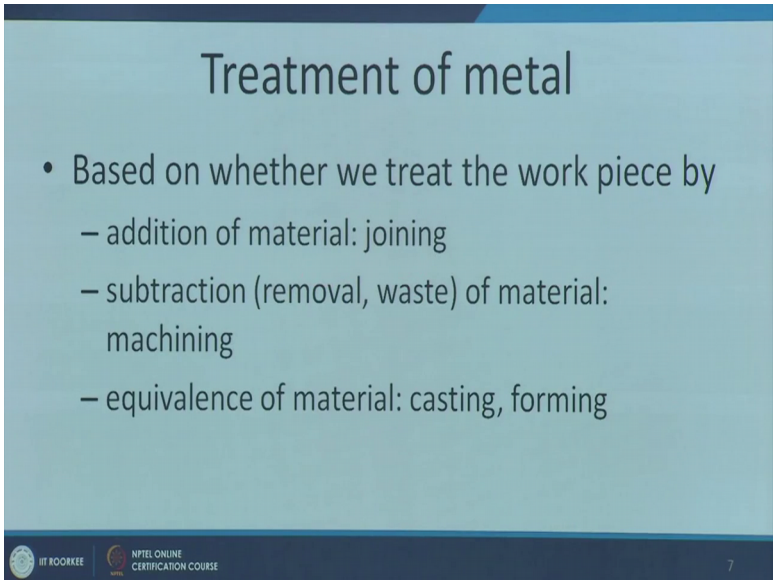

So, this grouping was based on the treatment of the material like the addition of the material involving the joining processes, like here based on the whether we treat the material how the work material is a treated, in course of the manufacturing addition of the material is involved in joining, subtractive processes, involving the removal of the material, like in machining, and the equivalence of the material, which is involve like shifting of the material from one region to another, like in casting, and the forming processes.

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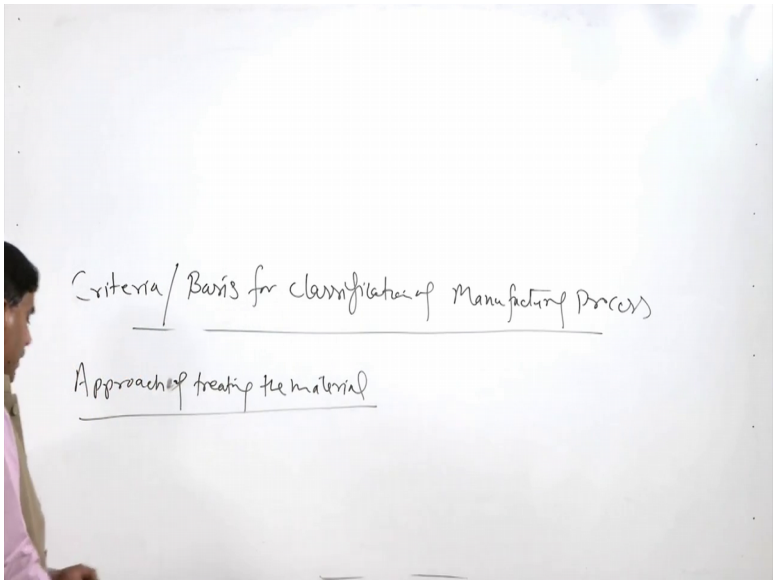

Then coming to the, another classification where the approach of treating the material, approach of treating the material. Approach of the treating material, if there are 5 different categories, like the processes I will explain this here, itself the processes based on the fluidity and solidification of the material.

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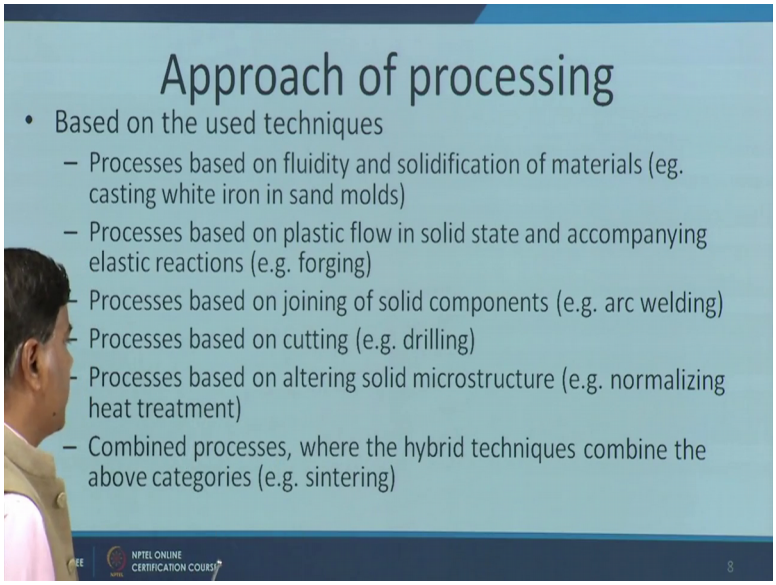

Like all those processes in which the material is brought to the molten state it is allowed to flow into the mold. So, that it occupies the shape which is to be made, and then subsequently solidification of the material results in the making of the component which is to be made, and this category of the processes are called like casting processes and there are various casting processes which will be put under this category.

Another process another grouping is based on the processes, which are based on the plastic flow of the material in solid state, and which are also involved with the elastic reactions, and we are like say those processes where the plastic flow of the material using the external forces were achieved to get the desired size and shape. Like, in the forming processes of bulk material forming or, of the sheet material forming they, will be placed, in this group rolling, forging, extraction, drawing, deep drawing, bending etcetera all those processes, where this kind of the treatment or approach is involved. And then processes based on the joining of the solid component like, in this case what we do the 2 members to be joined are the 2 members are brought together to get the desired size and shape in the component, so there may joining may be achieved through the fusion of the faying surfaces of the 2 components to be joined, or by just heating 1 of the components heating the base metals, and by putting the low melting point material between the members to be joined and thereby facilitating the joints.

So, in case of the joining by melting of the faying surfaces like fusion weld joint is achieved like this, and in case when the heating is involved of the edges of the members to be joined followed by putting in the low melting point material between the faying surfaces and their solidification results in the development of the joint in the processes, like brazing, and the shouldering.

So, this is like you say the fusion welding, and this is brazing, and shouldering there is another category, where just the plastic deformation of the material between the joint ensures the metallic continuity and for this lot of mechanical action is used to ensure the flow of the material from one side to another, so that there are 2 members to be joined can be brought close enough to each other, so that the metallurgical bond between them can be created.

The processes based on the cutting like the drilling, milling, machining. So, this is another group of the processes; the processes, based on altering the microstructure solid. Microstructure so, this group of the processes is used for altering the properties of the materials through the heat treatment approach. So, the basically the component whose properties are to be changed, they are heated to the high temperature, and then after soaking to the suitable time, it is cooled at a different rate in order to achieve the different set of the properties.

So, basically this is this involves altering the microstructure in the solid state, it basically involves the heat treatment process or the combined processes where the different approaches are used to get the desired size and shape, and the sintering is one of the examples for example, like the combined processes where hybridization techniques are used. So, this hybridization may be may be involving one or more of the approaches to make the components.

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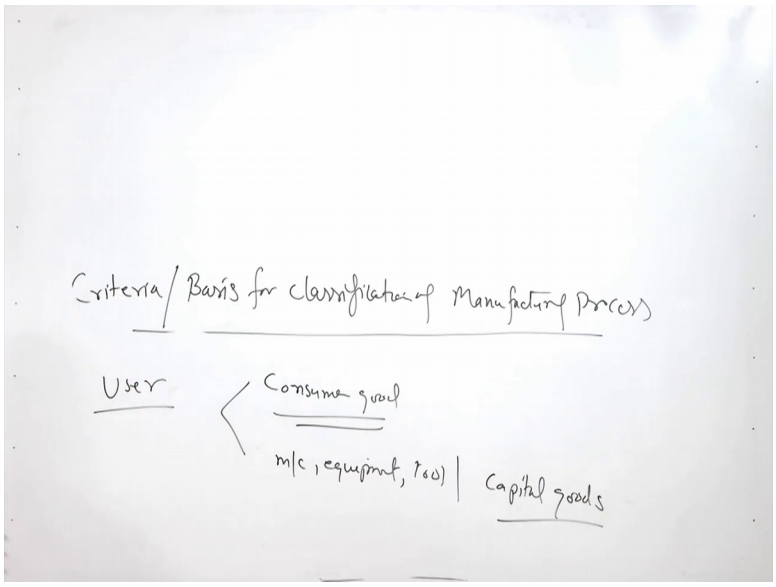

Now, coming to the, another classification the next classification is based on the user who is the user of the product being made, so based on this there 2 categories one is the consumer goods the products which are used by the public. So, the manufactures will be making those products and they will be used by the consumers or by the public so, they are termed as like the toothpaste, or bicycles, or cars, all these are the consumer goods. And the products are the machines; machines, equipments tools which are used for making the consumer goods are called capital goods this is another one capital goods. So, this is another grouping of the manufacturing process, the consumer goods industry or the capital goods industry.

So, those which are making the machines equipments to be used for further manufacturing of the consumer goods, they are termed as a capital goods industry, and the industry which will be making the products, for use by the public are will be following under the consumer goods. This is what we can see the based on the user we

can put the things like consumer goods, car, pens, motorcycles etcetera. And the capital goods which are to be further used to produce the consumer goods, and the services.

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Based on the production a strategy, like hard products where basically the job shops are used to make the customized products, and the soft products where the things are means the manufacturing system is designed in such a way, that the material raw material is used takes the entry in the beginning, and at the end we get the finished product.

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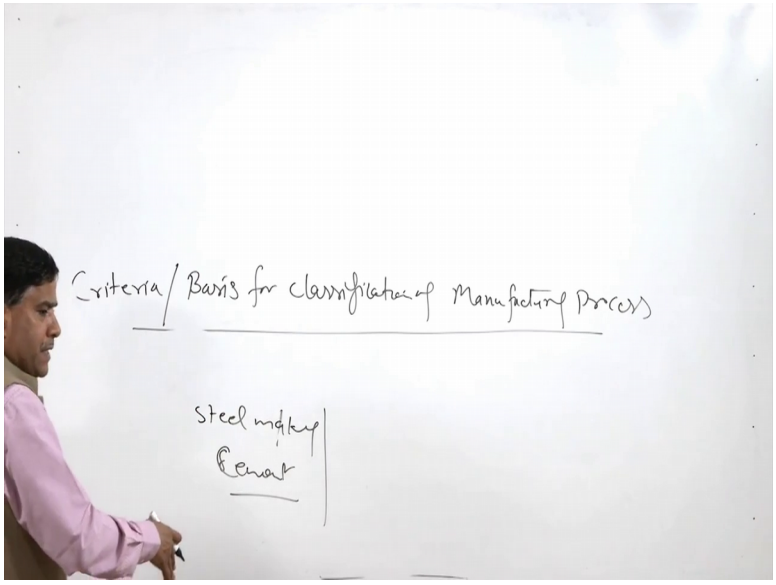

So, there are various industries like the steel making industry, cement industry, these are the examples where the raw material enters in the initial stage, and then comes out in the final form of the product to be used. So, depending upon the volume of the product to be produced, we can have the hard products or customized products which will be facilitating the requirement of the individuals or the mass products, they will have all the products which are being made they will have similar feature, and it will be serving the demand of the so many people.

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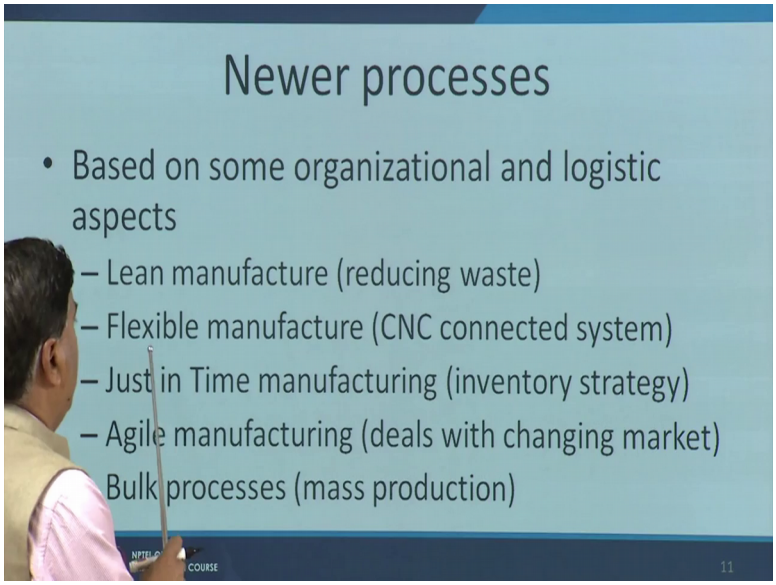

Then based on the system organization like, this is another classification where the system organization, with the emphasis on the final product the discrete manufacturing, and the continuous manufacturing. In case of the discrete manufacturing a number of the separate operations is involved and independent in the sense that these operations can be separated arbitrarily, in the time and space, means 1 product can be made at 1 time, at 1 location, then the another product can be made another time at another location, then 2 can be brought together to assemble the things.

So, the production of the twice computers and cars is based on this kind of logic, where the different components can be made at the different locations at different times, then they will be brought together to be assembled so, that the desired final usable products can be made. The continuous process or continuous manufacturing, where the material raw material is used in the, enters in the beginning and then comes out in the form of

final product at the end. So, there is a continuous flow of the material from beginning to end until it takes the final shape of the final product, and the examples of the continuous processing is like production of the bread or paper or they steel rolling etcetera.

Coming to the newer approaches which will be involving the newer logics, and newer approaches for the manufacturing, the based on the some organizational logistic aspects for increasing the productivity, and meeting the demand of the customers like lean manufacturing which is used for reducing the wastages related with, and the flexible manufacturing, which uses the robots, or the automated guided vehicle, or the CNC machines all are interconnected with each other. It can be used for manufacturing the variety of the products in a smaller volume to satisfy the demand of the customized products. Just in time manufacturing is the inventory strategy, which helps to reduce the strain on the storage, and it helps to have something whenever it is needed for the purpose of the manufacturing gel manufacturing it deals with the fast changing demands of the market, and bulk manufacturing is about the mass production.

So, here I will now conclude this presentation, in this presentation I have talked first about the need of the understanding the classification of the manufacturing processes, and thereafter the different technical factors on the basis of which manufacturing processes can be classified.

Thank you for your attention.