

Advanced Green Manufacturing Systems
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Lecture – 01
Significance of manufacturing

Good morning everyone. Welcome to the 1st lecture of the course Advanced Green Manufacturing Systems.

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Advanced Green Manufacturing Systems
Introduction

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Learning Agenda

- Course Dynamics → What this course is all about? (Forum Concerns)
- Significance of manufacturing ✓
 - Globalization and world economy —
 - What is manufacturing? —
 - Product lifecycle —

⇒ Introduction and also answers the "why?"
⇒ Gives you the reason (or) Motivation behind this course

Lecture 01

This is a new course that is a 30 hour course brought by IIT Kanpur under the MOOC's. And both me Dr. Deepu Philip from IIT Kanpur and Dr. Amandeep Singh Oberoi whose also a PhD from IIT Kanpur and he is also working as a research engineer. Both of us are got teaching this course. And this course is about a new look at manufacturing, manufacturing which is a value added process which has taken as centre stage in India under the make in India dream of the prime minister. Everybody is talking about how to bring the manufacturing sector of this country up and high and those kind of things.

And or of late we have found that from 2005 onwards, the contribution to GDP in Indian manufacturing has always being stagnant at 17 percent. And the dream of the prime minister and the government is to bring it up to 30 percent. So, to do that we have been

pushing for more manufacturing endeavors, more businesses, more opportunities, but in that process the one thing we also need to consider is through the manufacturing process, we should also not harm the environment. We should keep into consideration the ecology, the environment, sustainable aspects and ensure that manufacturing does not compromise on the future generations and their ability to leave a sustainable and successful life.

So, without spending too much time on the other aspects of it, let us get into this course quickly. So, if you look into this, this course is titled as advanced green manufacturing systems so, there is a basic course that we talk about sustainable manufacturing. So, this is the advanced version of this course. And I am Dr. Deepu Phillip from IIT Kanpur; I am from the IME department - Industrial Management Engineering department. And Dr. Amandeep Singh Oberoi; he is now he did his PhD from IME, but he is now working as a research engineer at the mechanical engineering department.

So, today what we will discuss that main thing is that the course dynamics is like what this course is all about ok. So, that is the major question that lot of people have been asking this question in the in our forum. So, this will answer your forum concerns on what this course is all about ok. And the second part of it is we will do the significance of manufacturing, which will entail a discussion about globalization on the world economy and what do we talk as manufacturing and then we talk about the product life cycle.

So, all these three things put together is kind of like introduction, and also answers the why, answers the why ? Why means why am I taking this course or gives you the reason gives you the reason or motivation or motivation behind this course ok, behind this course. As seen this is the 1st lecture of this course and I hope that you guys will have a fun time learning this course.

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| <u>Course Outline</u> (Major outline) | |
|--|--|
| (1) Introduction to Advanced Green manufacturing Systems. | |
| (2) Statistics for <u>Sustainability</u> <u>quantifications</u> . | |
| (3) Optimization for Sustainability quantifications. (tools & technique) | |
| (4) Design for Environment Concepts (Ecofriendly designs). | |
| (5) Value engineering (Green plan) \Rightarrow attribute values of greenness. | |
| (6) Green manufacturing techniques \rightarrow (popular and most recent) | |
| (7) Life cycle assessment (product lifecycle, lifecycle cost) | |
| (8) development of <u>Sustainable manufacturing facilities</u> . (examples/cases) | |
| (9) Key requisites for Sustainable development. | |
| <u>Content</u> 50% - by DP | 30 hours (duration) - 15 hours (DP) - 15 hours (ASO) |
| 50% - by ASO | |

So, the first and foremost question is the outline of the course. What is in this course, and what is new aspects in this course. So, the major contents of this course as far as we are concerned for this, the 1st part is the introduction to introduction to advanced green manufacturing systems green manufacturing systems. And we introduce the advanced green manufacturing aspects of it. Then we talk about statistics for sustainability quantification, how do you quantify sustainability, so, we talk about this statistics for how do you quantify the sustainability aspects of it. The sustainability quantification, the statistics necessary for that.

Then we also talk about the optimization for sustainability quantifications we talk about the optimization the major tools and techniques so ok. This is not an optimization course, but we would be spending some time in this aspect. Then the 4th concept for us is how do we do a design for environment, concepts the concepts related to it ok, or we can think about this as eco friendly designs that is the 4th aspect of this course. We will talk about that thing in this course.

Then value engineering specifically we call it as the green plan ok. Value engineering green plan so which means how do you plan for doing the green or what is the attribute values of greenness attribute the value of greenness so that component discussion value engineering will be new in this course. Then we talk about green manufacturing techniques, green manufacturing techniques.

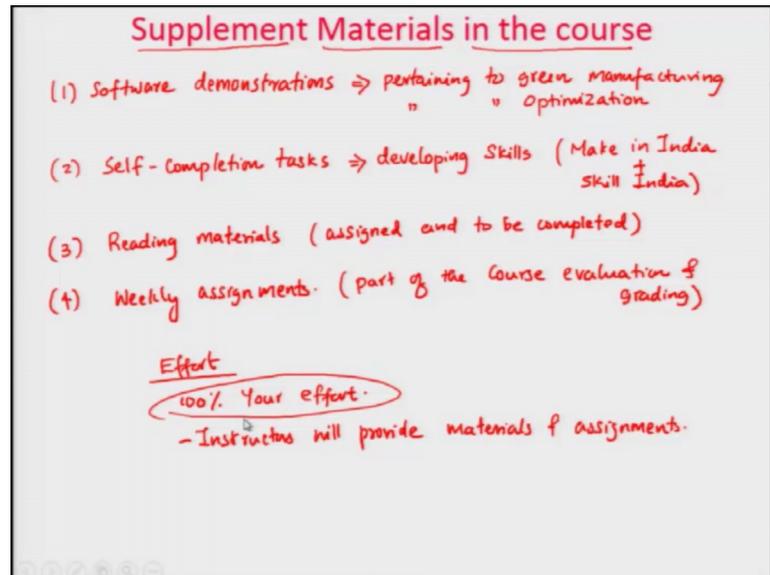
So, what are these like the popular and most recent we are discussing the most popular and the most recent ones green manufacturing techniques there are pertinent to this course. Then we also talk about life cycle assessment, we will try to spend some time on product life cycle and life cycle cost also, how do we calculate life cycle cost and how why is life cycle cost and important thing in the green manufacturing aspects.

Then the 8 common and of it is development of sustainable manufacturing facility. We discuss about various sustainable manufacturing facilities across the globe and what makes them sustainable manufacturing facilities and what are the things that they have done and that is unique. So, this is lot of case studies and example. So, this is examples and cases we will be discussing here in this particular case ok.

And then we also talk about the key requisites, key requisites, requisites for sustainable development ok. How do you do sustainable development and what are the prerequisites for it ok? So, the lot of these techniques and things we will be interchangeably teaching so, about 50 percent of the course will be covered by me and 50 percent of the course will be covered by Dr. Amandeep Singh Oberoi ok. So, this is how we are splitting the content and therefore in this course. And the lectures will be interchanged, so that you are not really seeing one person alone and you do not get bored by hearing my monotone.

The primary materials the this slide actually talk do you about what is the major outline of the course. So, this is the major outline ok. This course also has because it is a 30 hour course. So, the total duration is 30 hours. So, approximately 15 hours by me, and 15 hours approximately by Dr. Amandeep Singh Oberoi, so that is the total hours of this one course. So, this is the content split up the content is developed and then the duration. Duration is also split a almost accordingly the same fashion all right.

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Now, this course will also have a lot of supplement material supplement materials is in addition to the regular lectures and other things that you will be doing in the class. You will have major additional supplementary materials that are associated with this course. And this will be on the top of the time that you are spending in this course. So, the major ones include software demonstrations, software demonstrations. This is an important aspect of this course because lot of the time these kind of things require influence of software.

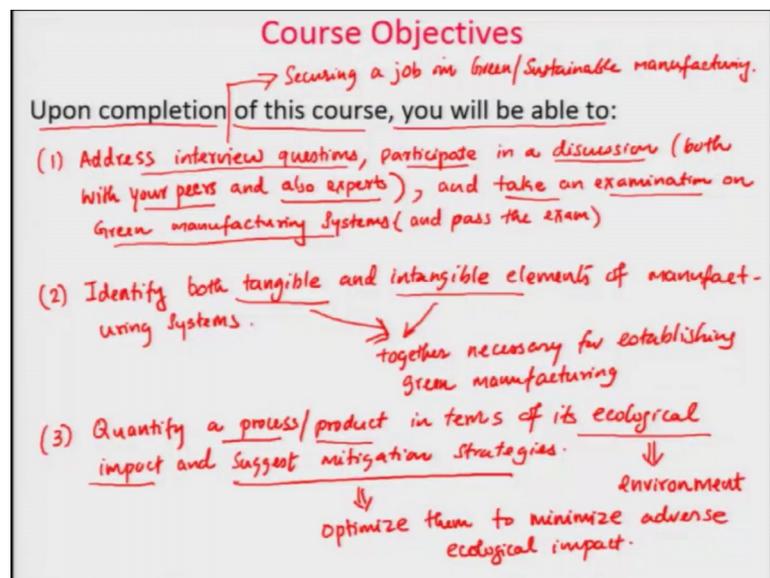
So, this is pertaining to green manufacturing green manufacturing. And we will also talk about pertaining to optimization as well, because this course have a reasonably good content of optimization how do you optimize the an existing manufacturing system for a green manufacturer system we would have a discussion as part of this. You will also do self completion tasks you will be assigned. So, this is more aimed towards developing skills. So, this course is kind of a marriage between Make in India and Skill India if we can think about it.

So, people talk about just Make in India, but we are thinking about how do you make the skill also as a part of it. So, self completion tasks are designed it to ensure that you develop appropriate skills in this course. And then there will be obviously, reading materials assigned a reading materials. So, these reading materials will be assigned and

to be completed yourself ok. So, duration of this course, you will have to go through this assigned reading and you have to complete this before the course gets over.

Then you also have weekly assignments . So, these assignments will be part of the part of the course evaluation and grading, evaluation and grading that will be the second. So, these supplementary part of this, so here the effort will be close to 100 percent your effort. So, the materials will be provided, the instructors will provide the materials and assignments, will provide materials and assignments and you have to complete all of these by yourself that is all what we do, so that is why it is called a supplementary materials of this course. So, this is 100 percent of the time, it is your effort all right.

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So, then the major aspect of this is course objectives ok. What are the major course objectives and what are you suppose to gain out of this. So, upon you completion of this course, once you finish this advanced the green manufacturing course, you will be able to or your capabilities will include number one the first capability will be address interview questions interview questions, participate in a discussion, participate in a discussion both with your peers with your peers and also experts ok.

I will explain this to you what we envision by this experts, then and the third parties taken examination on green manufacturing system, green manufacturing systems. So, the major part of it is you should be able to participate in a reasonably good technical interview. So, you should be able to answer the interview questions about this because

lot of the organizations are focusing on green manufacturing and so this will help you in. So, this is more aimed towards securing a job a job in green or sustainable manufacturing that is the one part of one aim of this course.

Second is in participate in a discussion, participate in a discussion can be group discussion, general discussion or something like that, but it with your peers the people who are your fellow workers another things. And you can also should be able to have enough knowledge to participate in a discussion hall to your on ground with experts in this area. And finally, you should also be able to take an examination on green manufacturing system and pass ok. So, and obtain a passing grade and pass the exam ok. So, these are the three measures. Also the first thing is broken down into three make you capable of in an interview, participate in a discussion with both your peers and experts, and you should be able to taken examination and pass the exam.

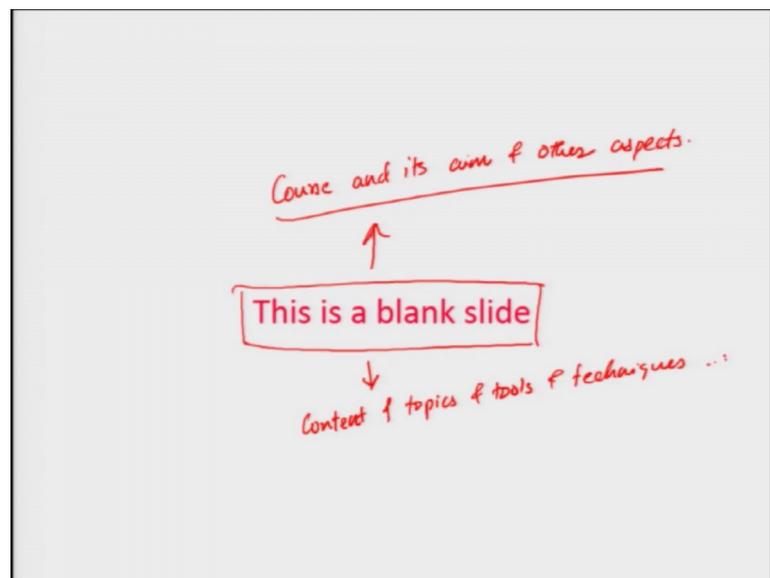
The number 2 part of it the second broader agenda the objective of the course is to ability to identify tangible both tangible and intangible elements of intangible elements of manufacturing systems; elements of manufacturing systems. So, what we are talking about here is identified tangible, tangible means things that you can touch, you can see, you can feel these are quantifiable. And intangible means these are not direct you cannot really physically see them, but that is in intangible benefit that is associated as part of it.

So, how can you identify both, because both of these we can say that together needed for together necessary for establishing green manufacturing systems ok. So, if you want to establish a green manufacturing facility or a system, you need to able to identify the tangible and intangible animals. And once you identify that you should also be able to manage them or you should be able to quantify them and control them ok.

Then the 3rd part is quantify product or a process or a product in terms of its ecological impact in terms of its ecological impact and suggest mitigation strategies, suggest mitigation strategies. So, one of the example is you should be able to take either a process or a product and then you should be able to quantify its ecological impact or what it impact it is going to have on the environment. You should be able to quantify that. And then on the top if it, once you quantify you should be able to suggest mitigation strategies what should be able to optimize them to minimize adverse ecological impact.

So, you are also not just focusing on cost, money and other kind of things. You are also able to work on a process and a product and trying to mitigate the ecological impact of the same. So, these are the three major objectives and each objectives of broken down and envisioned with a clear cut thought process in such a way that once you finish this course, because this is an advanced course. You should be able to accomplish more than having a basic knowledge, it is more about having a workable and tangible knowledge that will allow you to become a practitioner in this in the real life.

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So, with this we are leaving this, this is a blank slide it is kept there for a region because up to this point we were talking the. So, before this we were talking about course and its aim and other aspects. So, this is about the course and what we are going to do. From here onwards below this slide, we are going to talk about the contents of this course content and topics and tools and techniques etcetera ok. So, from here onwards it is the content of the course ok. So, just this slide is kept there, so that you understand before this is the other aspects of the course.

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So, we will start with the most famous topic the world economy and globalization. So, everybody has heard about this time people know about this and other things. So, let us start with the first term called globalization, what is it globalization. And there are lot of definitions available, lot of people define globalization in a very very different fashion.

But, for the for this class this is for our course, we are going to define it for this course in this particular fashion. We call it as the free flow of goods and services we free flow of goods and services also the free flow of labor and capital ok. So, free flow of goods and services, free flow of labor and capital around the world or across the world you can think about around across it does not matter world aided by communication and transportation.

So, we are calling globalization as the free flow of goods and services, labor and capital around the world or across the world and how is this free flow happens, what is shading this free flow. Both communication and transportation are the two tools or two things that is aiding the free flow of good services and the labor and capital around the world.

So, before globalization so that is like when we say before globalization before globalization, what happened was the united states of America and the Europe. Both the USA and Europe, they accounted for majority of the world or major share or majority major share of the world economy in both products and services in both products and services.

So, what are we talking about is both the USA and Europe, America and Europe accounted for close to I would say 60 percent of the global economy. And then if you add Japan and Indonesia countries like that, then it would probably be close to 80 percent of it ok. So, there contour for majority of the world economy share.

Then after globalization, when we allowed for the free flow of goods and services labor and capital across the globe, about half of the about half of the global economic output the economic output is accounted by is accounted by the emerging world.

We use the term emerging world not so US and Europe was called as the you know advanced world or we can call it as the developed countries. This emerging world is the another term for the third world nations third world or poor nations poor countries. So, when we say emerging world, then we are talking about the developing economy right. So, the more about half of them, so that means the emerging economy, it has taken a major share or not equal share of what the developed economy was there before.

And what does what is the cause, why has this happened, what is the cause behind this, how come the emerging economy is able to take a lion share of the global economy. The major thing is that emerging economies emerging economies how something, what do they have large pools of inexpensive, inexpensive and relatively skilled workers the skilled workers.

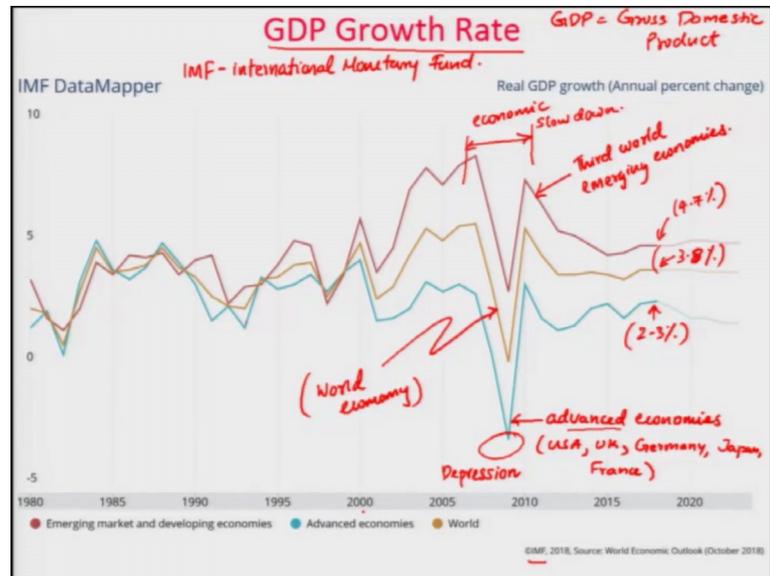
This has helped in reduction, reducing manufacturing cost manufacturing cost. So, the third world economies or the emerging economies they have large pool of inexpensive, and relatively skilled workers. This has helped them in reducing the manufacturing cost, which are made them competitive. Competitive and even sometimes better than what the US and Europe the developed countries have.

But, what we should watch for in this regard is but these countries lack or they do not have matured processes that means, when you talk about the manufacturing processes, these countries do not have such highly matured manufacturing processes as that of the America and the Europe.

So, they are inferior compared to the developed economies inferior compared to developed economy, so because of that even though in the attempt to reduce the cost of

manufacturing the processes might not be matured enough. And this might result in something called as you know non-sustainable or non-green manufacturing process.

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So, let us take a look into the GDP growth rate of the globe with for an example. To make an idea of how this is working. So, we think about in the eighties this is from minus 5 all the way to plus you know larger number. This is the growth rate of the GDP. GDP is stands for GDP is equal to Gross Domestic Product ok. What are we producing at the end of each year, so it is the GDP.

And this data is taken from the IMF; IMF stands for International Monitoring Fund or this is in another ways people call it as the World Bank. So, IMF is international monitory fund or the World Bank as people call it.

So, this is the real GDP growth rate on an year. So, 1980 you can see that, so this blue line this, line this blue line what we talk about this line is that of the advanced economies. So, let us call them as USA, UK, Germany, Japan, France etcetera. So, this is mostly us Japan and Europe. So, this is the advanced economies, which is represented by this blue line that is traveling like this.

Then you have the emerging economy so or the developing countries what we call as the third world or emerging economies or emerging countries economies. They are represented by this brown line. And this line in between which we call as this yellow line

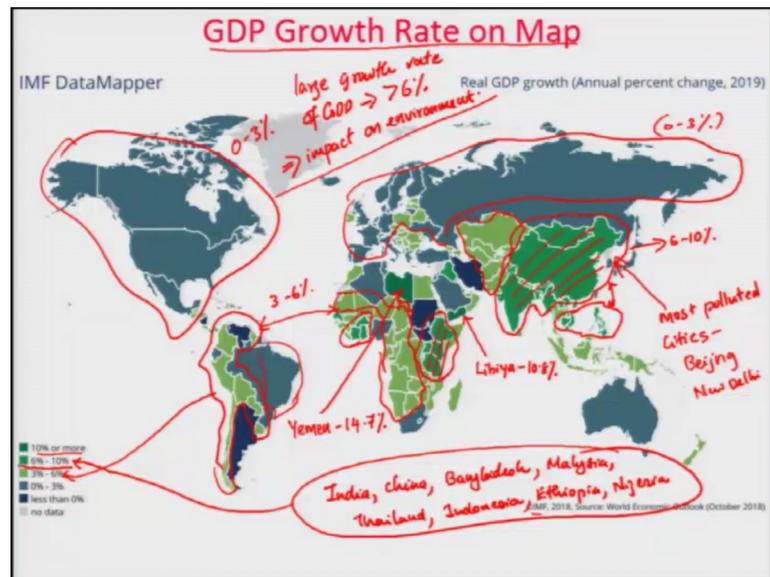
not yellow, which can of like in a weird color of like. So, color between brown and yellow viably that color this is the world economy world economy, which is a some of the other two economies.

So, if we think about it the global economy this the advanced countries, they had a negative growth rate in somewhere close to 2010, this you can think about it as a depression. If you want to think about what is the depression, this is what is amounts to depression? Everybody is productivity when below, so below 0 means is you know you are producing more than you can consume.

And now they have grown back, and they grown back to now close to you know 2 to 3 percent of the growth rate the GDP the gross domestic product is growing by 3 to 2 to 3 percent. And the you can think about this is these guys which is a developing economies, there growing close to you know 4.7 percentage approximately across the globe. And this is growing to 3.5 3.8 percentage ok. So, if you think about it that way the developing countries or the third world economies are growing at the GDP growth rates are way much higher compare to the advanced economies.

And we can see its projected that in 2020 you know, they will have a law of and the global production will stabilize kind of a thing. But, you can see that this time period is where the you can talk about as the economic slowdown has happened ok. So, I were showing you these graph purely to tell you about how the economy or the behavior in the economy affects the manufacturing, and the other aspects of it ok.

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So, with that now we let us take a look into the global GDP growth rate on a map, how does the different countries across the world shows a growth rate. So, this growth rate this one 10 percent or more ok. (Refer Time: 30:58) not many countries who are actually doing that expect that that there is few countries that you can talk about there is one which is this one it is Yemen is at about 14.7 percent, this is again from IMF 2018 data 14.7.

And then there is another country here Libiya, now that is a war tone country, but they were showing close to 10.8 percent growth. These were the two countries who are accepting 10 percent or more growth in the whole system. But, you can see the 6 to 10 percent this green color 6 to 10 percent or more you can see this entire belt India, Bangladesh, China this is all the 6 to 10 percent belt ok. And or it also includes Indonesia this areas as well. This is also part of this their combined with this.

And then there are some African countries here, this is also the 6 to 10 percent and some of the so this is like Ethiopia and those kind so we have we can say that India, China, Bangladesh, then we can we also have Malaysia, Thailand, Indonesia, then in this side you have Ethiopia, Eritrea, Nigeria like this these countries are also showing.

They all fall within this belt of 6 to 10 percent and more. And the 3 to 6 percent growth is exhibited by different parts of India you can see, this is the 3 to 6 percent growth mostly

ok. And this is the other 3 to 6 percent growth. This is mostly funded by china in Chinese money ok. So, this is the 3 to 6 percent growth the

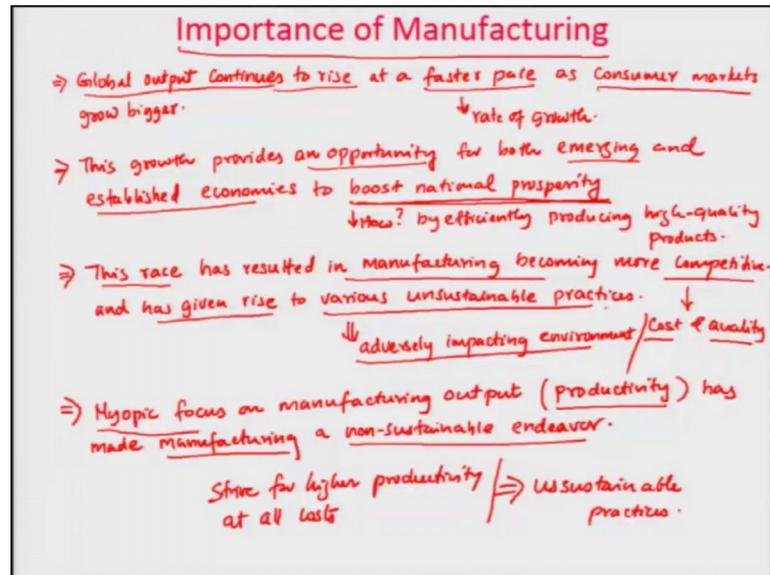
African continent majority of the African continent part of the south America, and you can also see parts of the block that actually came out of the Russia that includes a forgetting the nations, but that is the countries there are part of that. It also includes some of the middle east countries as well which are growing at a rate of between 3 to 6 percent. So, these are the 3 to 6 percent countries ok and 0 to 3 percent the study growth ok. This is the 0 to 3 percent and here is also Russia and Europe majority of this that is the 0 to 3 percent.

So, you can kind of see that how these countries is brazil also shows 0 to 3 percent, how these countries actually exhibit, how different countries across the globe exhibit different growth rates and because of this different growth rates you know what is happening and things like that. So, we can see this belt this entire belt is a very heavily growing area and this area as well.

So, when it is growing heavily or when you are actually talking about real growth in GDP, then what we are actually also doing is we should also be worried about what is the impact of this drastic growth on the ecological content. So, the large growth rate of GDP growth rate of GDP ok. Let me call it as greater than 6 percent. We have to always think about impact on environment.

We know that some of the most polluted cities are in this area most polluted cities in this area this includes Beijing, then we have new Delhi, then Luck now many of the cities that are most polluted and really bad are also in this area. So, what we are trying to say is that while GDP growth is great and all those kind of things it, introduces new facilities, larger growth rate and other things in your country. And it also improves the economic standard the standard of living and those kind of stuff. But, it also do come with adverse impacts of the environment, and that cannot be ignored ideally speaking.

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With that we move to the next topic of our discussion, which is the importance of manufacturing. Why is manufacturing important and what are the major aspects of manufacturing. So, the first consideration, the major consideration that we have to think about is global output continues to rise at a faster pace as consumer markets across the world consumer markets grow bigger.

So, the population is growing and when the population is growing, the consumer markets are also growing. When the consumer markets are growing, then the global output how to rise continues to rise. And the rate at which it is rising it is a faster pace. So, this is the rate of growth rate of growth is pretty high.

So, this growth when we talk about this growth of the global output, this growth provides an opportunity an opportunity this growth provides an opportunity for both emerging and developed economies emerging and developed or established economies. Let us give the term established economies so, the emerging economies and established economies both of them with opportunities.

So, this provides opportunity for both emerging and developed economies to boost to boost national prosperity, how can I boost national prosperity, so boost national prosperity. The question is how are we with boost in the international prosperity. And this is by efficiently producing efficiently producing high quality products, high quality products for the time being by producing high quality products both the emerging and

established economies get an opportunity. They are given a golden opportunity to boost their national prosperity. National prosperity means, improve economic growth improve the standard of living and stuff like that.

Now, the 3rd parties this race this race has resulted in manufacturing this race has resulted in manufacturing becoming more competitive more competitive ok. So, the manufacturing has become more competitive. And has given rise to various unsustainable practices.

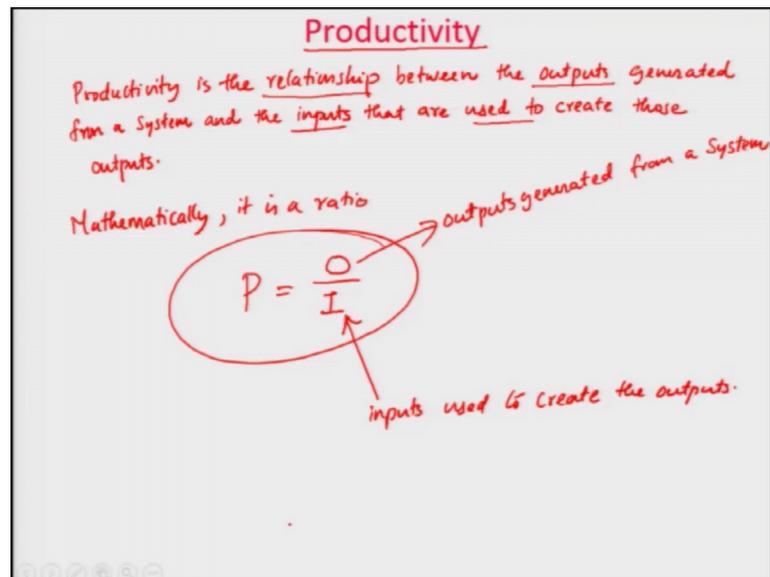
So, what does happened is this race or this particular growth opportunity has put so much of pressure on the manufacturing. And what has become is manufacturing become more competitive that is in both cost and quality. So, it is the customer is highly quality conscious, and there also cause conscious which means high quality products and the low cost.

When that kind of a demand has come in then what happened is it is given rise to various unsustainable practices, unsustainable practices in this regard what we are arguing is they have done with things that is adversely impacting environment. So, this was created lot of practices, which has resulted in the adversely impacting the environment. And this global output rise at a faster price has put that much pressure on the manufacturing.

Then finally, what has happened is myopic focus myopic focus on manufacturing output or most popularly known as productivity myopic focus on manufacturing output or productivity has made has made manufacturing a non-sustainable endeavor made manufacturing non-sustainable endeavor sustainable endeavor.

So, what we are saying is that the there is a very myopic, myopic mean short sighted. Myopic focus on the output or the productivity of the manufacturing this myopic focus has resulted introducing lot of non-sustainable practices or has made the manufacturing a non sustainable endeavor. So, this has a resulted in or this drive or what we call as the strive for higher productivity strive for higher productivity at all cost at all costs has resulted in unsustainable and or unsustainable practices, best example of this is China. Most of the Chinese manufacturing techniques are really not environmentally friendly.

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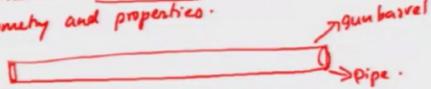
Now we talk about productivity and productivity are something that we told that it is kind of focus on the myopic focus on the output. So, I will define or for this course we define productivity, productivity is the relationship between the outputs generated by outputs generated, the outputs generated from a system a system and the inputs the inputs that are used to create those outputs, create those outputs.

So, if you really think about this definition it is a relationship between the outputs generated by the system what are the outputs are produced by the system to that of the inputs that are used to create those output. So, productivity in a mathematically speaking it is a ratio, mathematically it is a ratio. What is the ratio that is productivity is equal to ratio of outputs over inputs. This is what we define productivity as about. It is the outputs these are the outputs generated by the system generated from a system. So, these are the inputs used to create the outputs, so that is the definition the broad definition of productivity as far as we are concerned in this course.

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Manufacturing Systems & Productivity

- Manufacturing is defined narrowly as Conversion of raw materials to desirable products.
- Conversion process requires the application of physical and chemical processes to change/modify the appearance and properties of raw materials.
- Also considered as means to add value to the raw materials by changing its geometry and properties. → value addition by conversion.
- This conversion process is usually known as Transformation process.



Now, let us talk about what is the you know manufacturing systems and its and the importance of productivity in the case of manufacturing systems. So, most the lot of definitions to manufacturing, but most of those definitions, manufacturing, manufacturing is defined narrowly most of the time is defined narrowly as conversion of raw materials to desirable products, materials to desirable products desirable products.

So, what we are saying here is this definition is a very narrow definition because we are just talking about converting the raw materials, raw materials are the inputs to desirable products which are the outputs. Just is just we are talking about the conversion of raw materials into desirable products. The another aspect of it is the conversion process the conversion process requires the applications requires the application of requires the application of physical and chemical processes chemical processes to change or modify, change or modify the appearance and properties of raw materials the appearance and properties of raw materials the appearance and properties of raw materials of raw materials.

So, what are we saying here is that the conversion process because it is a conversion of raw materials into desirable process and this conversion process requires application of both physical and chemical processes that application results in or changing or modification of the appearance and properties of the raw material. So, in another way to think about this also considered also considered as means to add value to the raw

material. So, we are considering it has mostly the means to add value to the raw material by changing its geometry and properties and properties.

So, like for example is if you take an iron rod like this and then you drill a hole in between then you can use it as a gun barrel if you want or we can use it as a pipe also. So, that conversion of a raw material into a desirable product is what we talked. So, what we are just focusing on is how can this conversion happened. So, this conversation adds the value, value addition by conversion by conversion that is what we are talking about here. The conversion the value addition is happening when you convert this steel rod into gun barrel or a pipe.

So, this conversion process, conversion process is usually is usually known as transformation process. So, in this class instead of the conversion process, we call it as the transformation process. So, the transformation of raw materials into desirable products that is the instead of the conversion we use a term transformation, this is the term that we are going to use mostly in this class. So, what we will do is we will take a break at this point and then we will get back into the transform more on the transformation processes and other aspects of this course soon.

Thank you.