Bulk Material Transport and Handling System
Prof. Khanindra Pathak
Department of Mining Engineering
Indian Institute of Technology – Kharagpur

Lecture – 60
Online Monitoring

Welcome students today is the last class of our course on this bulk solid handling and transportation we have discussed the different aspects of what is the meaning of bulk solid handling their importance in the present techno-economic scenario. Our in the scenario of that raw materials provisioning for various industry in that the bulk solid handling and transportation takes a major part.

And we have discussed the various type of systems and equipment which are used in this particular sector and we have tried to put a generalized information from mineral industry agriculture industry as well as we have talked about that how bulk solid handling is also there in our civil society whether the solid waste management in the municipality or in the arrangements of food supply systems.

And the across different industry different type of systems are used for how we will be storing material how will be preparing the materials how you will be transporting the material whether you will be doing a transport of short distance or you will be doing a transport transportation of long distance and in that we have introduced you a lot of different areas. Like your from the trucks of that your ordinary road trucks to 500 ton truck used in the mines.

We have talked about the conveyor belts of that traditional craft build conveyor to the pipe belt conveyor cable belt conveyor wide range of technologies which are being there has been introduced to you. At the same time while discussing we were indicating that how economics environment safety these are the issues in your bulk solid handling and transportation takes. Now also in our last few classes we have been talking about this safety maintenance automation just to introduce.

Today I will be introducing a bit of this monitoring system because the whole your productivity whole your economics of your performance your safer operation everything

depends on how you are monitoring it. Because the control of operations will be depending on how you are exactly equipping yourself with information for management. And as we say that you will have to measure the system and then only you will be able to know what decisions you will be taking for controlling it. So, that is why the monitoring is one of the most important business in any industry.

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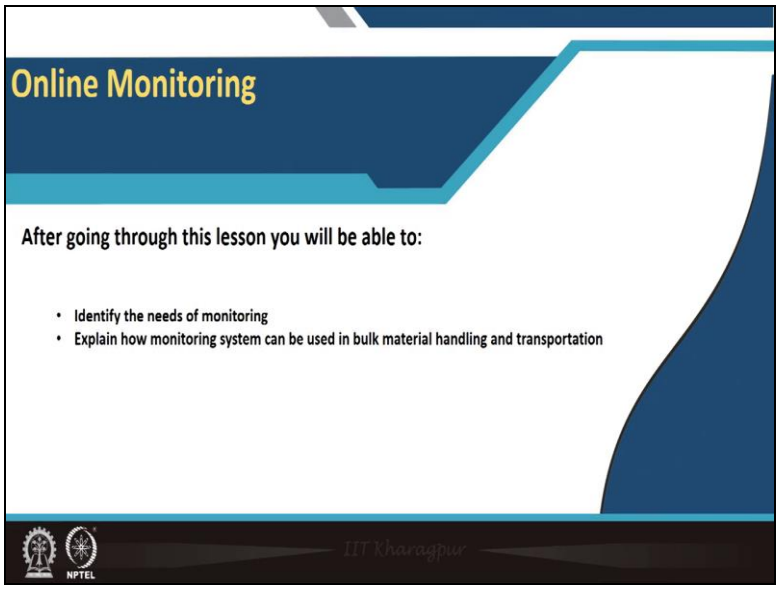

Now here of course we will not be going to the details of the monitoring technology or the detail of the monitoring management but we will be telling you just briefly what it is and how it can be how it is being used in our bulk solid handling and transportations. We will be just telling briefly what is the need of monitoring and explain the monitoring system that are being used in our bulk solid handling.

So, what is the monitoring? Monitoring is a continuous process of collecting and analyzing information about a system or element and comparing actual against planned results in order to judge how will the interventions is being implemented. Because whenever you are operating you intervene if there is something not going perfectly you will be changing something and after doing that change whether the performance is doing well or not it will have to be monitored.

So, there could be a lot of tools for monitoring that tools for monitoring will include number of your sensors for instruments and along with that will be the software we will be telling in this class that how digitalization is a must for your monitoring. Now, but before going to that

you need to know a difference with evaluation and monitoring. Evaluation is a process that systematically and objectively assesses all the elements of a system.

Or a unit or a machine or a component that is which will be its a design its implementation all that whatever the results it has achieved why we evaluate to determine its overall worth or significance that means whenever you are having a system in place or whenever you are having a small organization in place you need to evaluate first for performance evaluation that is how it is working.

So, you will be judging that whatever input you are providing into that organization or system or the machine or the equipment whether it is giving the desired output that what is that input output relationship that is the performance. And you need to also evaluate whether the impact of that is impact is what whatever you have your capital investment you have made how you are working out of that what is the impact of it.

Impact means how can you get some evidence on whether the changes observed are caused how they are exactly the changes are get taking place. Because whenever you establish a system say a transportation system or a crossing system or a screening system or a washing system they are exactly you want to bring some change somewhere the way doing that your the product or the material you want to give some value addition whatever you want to do those changes are taking place or not or if it is taking place how they are doing.

Now to do this evaluation whether you want to evaluate the performance or the impact you will have to have certain tools and those tools are not just like an instrument sometimes it is a just a method it can be a function it can be in even a tool can be an excel sheet it could be a software it could be overall integrated with sensors and software. And what they do ultimately you may do a cost benefit analysis or cost effectiveness analysis because to evaluate you will have to use certain indicators.

So, those will be varying depending on the type of industry depending on the type of systems you will you are going to evaluate. Now once you have learnt a subject of bulk solid handling each and every technology involved in a particular system you should be able to go deeper into it so, that you can do evaluations because there that your expertise will have to be developed.

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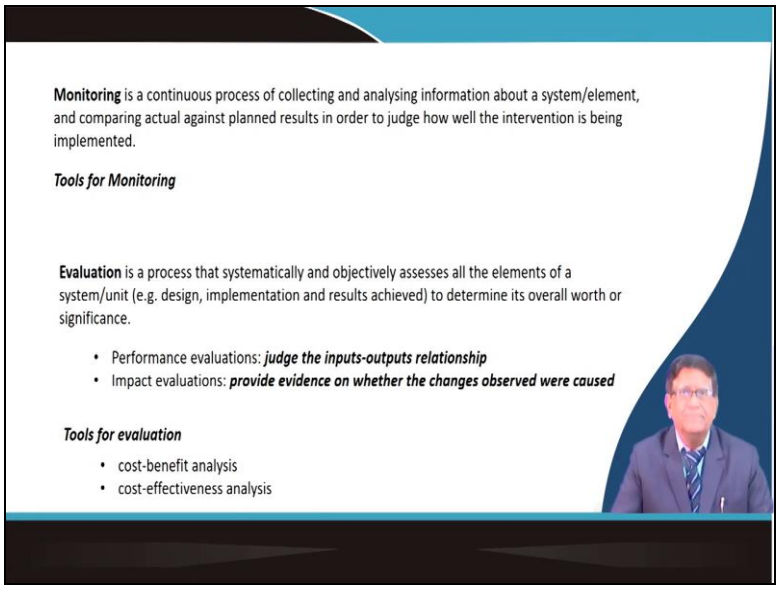

So, if you want to do a monitoring that monitoring system how it does? It exactly track monitoring means your tracking you are observing you are seeing you are finding out what is happening and for that your what type of resources you have invested into the system? Whether that resource are giving you the return or not need to be monitored and then the implementation of the activities that is your you will have to monitor or track the activities which you had.

Every activity you have planned or commissioned or installed or whatever your way you are doing you have got a particular that that the time frame that within this time frame we want to get these things done. So, you will have to track that whether you are being able to do it or not and also in certain systems you are generating goods or services. Now are they exactly as per planned it is going or not that is done what is in monitoring.

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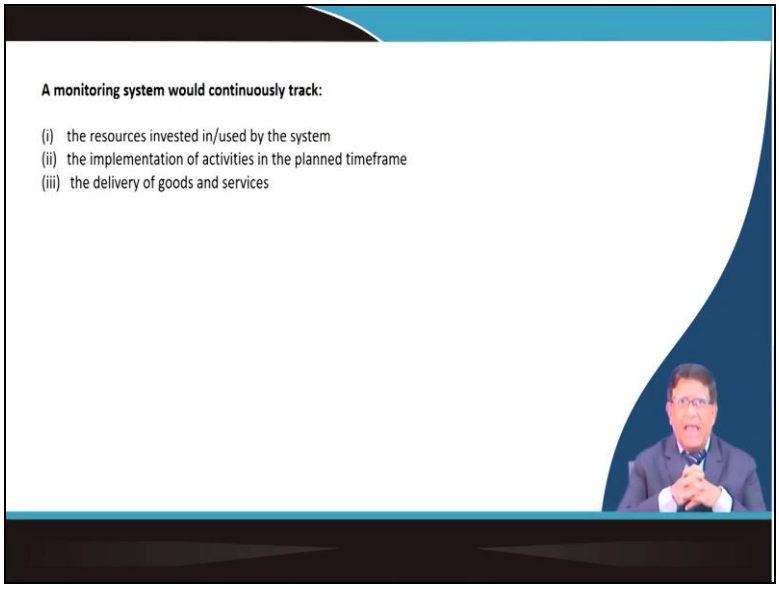

So, here you will have to take some activities of yourself make a list of a conveyor belt used in a steel plant to carry iron ore from raw material stockpiles to blast furnace. You have studied your stacking blending reclaiming if you remember we were using stickers and reclaimers we are making windrow you have been we discussed about that what is a window type of stockpile or whether it is a chevron type of stockpiles or an oblique layer of stockpiles.

Now from that stock files if you are to carry this material to a suppose it is in your raw material section of a steel plant there they bring all the raw materials for steel making and then they sand it and then ultimately they feed to the blast furnace. There is a lot of material handling operations involved there. Now dear you can you just study somewhere you get the information's if required try to have a visit to a raw material section.

And make the list of what are the components they need monitoring if you do not get an opportunity to go and really observe there but a lot of literatures available that in a stockpiles what are the things there how exactly what are the stakeholders, what are the reclaimer. Then whether the conveyor belt how many times that is your how many number of convertibles, how many master blades, how many slave bills.

Those things you need to find out and make a list that which are the vital components that which need to be monitoring for getting the services of that system. What are the activities need monitoring that what are the activities you need to make a list of the things if you go through that lectures we discussed about the staking blending and reclaiming. How the

stickers are going from one belt to the another there is a transverse table that how exactly the machine is shifted from one place to another.

If you are to do that job what are the activities will have to be done. So, do you have a sequentially maintaining that to complete this job will have to do these activities then in that activity what are the things you will be monitoring. How you will be sometimes you may do that what type of time and what type of activity, how they are related.

And from that system what are the results expected or that means what the impact of that work will be. So, make a list of it and that will give you a real that whatever you have learned from the subject from there when you can come to the monitoring and evaluation stage or not. Once you will be doing that you will be knowing that you are learning this subject for application.

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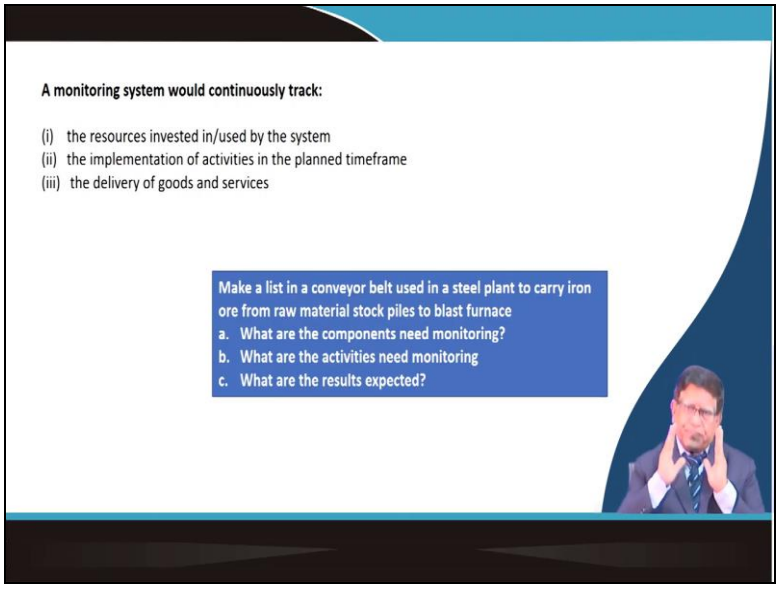

Now the monitoring system what it requires when you want to do the monitoring you will have to have some sensors. You will have to very carefully select those sensors or that instruments and along with that whatever the data it will be generating to get those data converting to an information you will have to process that data and then they will have to that represent it. And now this data in a bulk material handling system may be generated at number of places.

Whatever you will be intending to do for the for controlling or for improving that job for that information's may be there at a number of places right from that whether the operator is

being present there or not his attendance sheets to what way the information for the maintenance if you require when the operator will be giving that information to the maintenance department whether he is timely responding to it or not like that everywhere something is happening and you need to monitor it.

So, that is why you will have to first find out that how will you indicate that thing that. Whether the monitoring will have to be whether you are doing it properly or not there will have to be certain indicators or we sometimes in the industry will be hearing a very common word called KPI Key Performance Indicators. That you need to find out because if you know the key performance indicator then to get that what are the information's will have to be collected digitally and how the system will be generated that you will be knowing.

So, you provide indicators on outages and service disrupt disruption or degradation of the component of a system. That means you can ask the questions over there that is the conveyor belt running with a correct speed tension alignment are they all proper that whether it is giving a delivered output like that when you will be framing equations you will be knowing that in which way your systems held your systems performance or systems impact getting monitored or not.

Then what you have to do you will have to detect the service outages and abnormality when your system is not going to work under what conditions it should be stopped or when what are the conditions will be considered as an abnormality. So, if you if you are having a conveyor belt that is driven you know the end pulley is a drive pulley where you are giving a gearbox is coupled to the motor and that it is running.

That the driving motor it will be consuming its current depending on that what is the torque required. Now if you find that there is a all the time some current is fluctuating that means your system is somewhere working with a lot of vibrations or it is having a very disrupted load. So, at that time you can think of this is not a normal. So, you will have to develop certain system to track that when it is a normally how that exactly the current will be varying.

Now if that is going to be changing coming a pikes and things like that then you can get alert yes there is an abnormality need to be corrections and this is what is the performance or this is the where the monitoring does. So, here you can find out is the belt out of alignment that is

your normally normal operation is that your center line of the belt and the center line of your end pull is that is a it should be your perpendicular to the center line of the end pulley.

So, that if this alignment is not proper at that time what you will have to do you will have to take the proper actions. Now whether the belt is slipping that means is the that your driven pulley and the drive and pulley are they exactly going to are they going to work properly if there is any changes that is if there is a slip that means the RPM of the driven pulley and the RPM of the driving pulley are not proper.

That means belt is slipping it is not the motion or that your the your rotary motion when of the pulley is getting translated emotion of your conveyor belt at that time there is a gap that means full energy is not getting utilized in the belt. So, you can also find out whether there is a between two rollers the belt is shagging or that your return belt is shaking more you can find it out that means there is a something some problem with the tensioning.

So, how you are mainly monitoring the tensioning? How you will be controlling it. So, this is the way how you will have to find out that which are the indicators for your system. Then one thing is there you will have to be scalable whatever you will be monitoring you will have to quantify it and say sometimes you will have to do some your creative innovative idea that you can get a new monitoring system.

If you go to any industry you will find that if a convert belt is carrying coal or a powder or any in a cement plant if it is carrying out the limestones or in a steel plant if it is taking the iron ore you will find many a times that there is a spillage from the conveyor belt and the material is lying on the side of it. Now can you have a total scanning system of your sides that if your that normal condition it is like that and then wherever there is a spillage you can scan and find out that yes this is the area this much is the this much area is covered by the spilled material.

You can have a system of and some earlier type of sensors you can think of that is your what is the layer thickness of the spilled material can be found out. So, that means you can know that how environmentally it is managed or if it is in a dry seasons from all that your from the crust material when it is being conveyed through the conveyor belt there will be lot of dust

coming. Now your crushers there from there when the material is coming to the conveyor belt in the receiving sections or in the discharge sections there are hoods.

They are supposed to take your dust collected and then dispersed. So, if you keep a simple your system for monitoring the PM 2.5 or the PM 10 that 10 micron or 2.5 micron whatever you want to find out find out the concentration of the dust in the air and from there you can know whether your dust collecting system is performing well or not.

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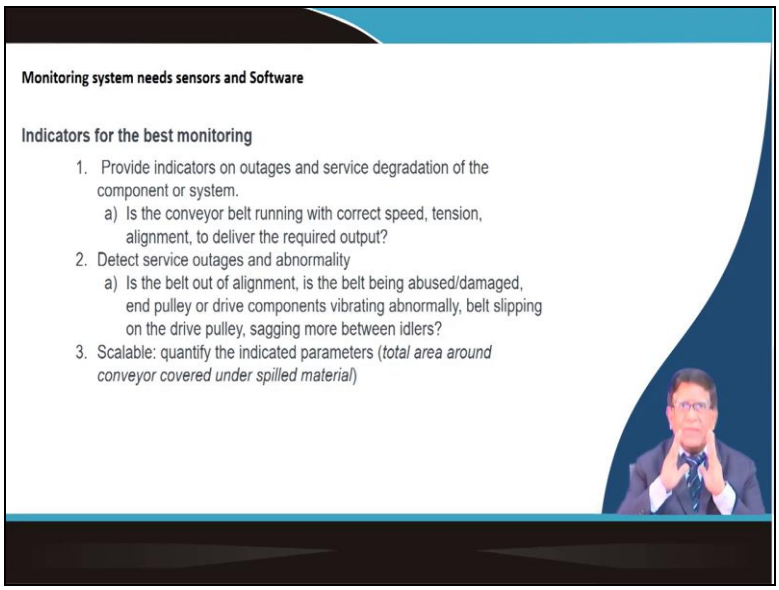

So, like that you will have to find out in your system how it is work. So, in any modern monitoring system requirements will be that whatever you want to monitor it should have the ability to handle and process huge amount of data because this is one thing is there that you will be having a lot of data every second data is generated system is continuously working. And there are some of the components they are very critical every second their performance it matters.

Because if you just if you fail to monitor that particular time when this problem has come then it will be creating and coming up more problem there may be certain things. So, that is why that monitoring data will be used. So, you will have to take it out and then and there you must process which are not required you can redundant that you can discard those data which are important you will have to keep this data.

So, that you will have to have this ability in your monitoring system collecting the this is your system application matrix that is what are the things being measured measurement in real

time you will have to put it over there. And then you can collect it there and then at your control room there they should be available. Ability to provide long term insights and better capacity planning this is also your monitoring system must have provide.

And highly available and reliable that means whether it is a very dry that temperature 50 degree or it is a that wind speed is coming very high in that area whether there is a heavy rainfall or storm your monitoring system should have certain available it should be available and also whatever data it will be coming it should be reliable. You will have to have a proper calibration system that whatever you are getting yes it is correct.

Then support all modern you will have to see this today the digitalization has come up to a great extent. But you will have to use your resources properly that is why today the container containerized system that is your and the cloud systems are using. Your across the company across your different systems they will be using whole things can be on a cloud and your at a particular at your terminal the demand for resources for monitoring and controlling and managing should not be more.

So, that type of shared resources will have to be used in your monitoring system support metric visit that is whatever you are measuring you will have to have some visualization tool. That is what is happening you will be presenting in front of you in a must that is with a data visualizations graphically it should be available there. Then even sometimes along with the visualization you may have a virtualization.

Whatever there is in reality in a virtual form it should be there. Nowadays you will have to think of how for the monitoring you will be using what is called digital tweening. That digital tweening will be coming in a near future in a big way for improving this and our industrial activities. Then you will have to have a good traceability your that monitoring system whatever is there it should be able to track and trace.

Have a good user friendly interface that whenever you are doing that you may have a operator level you may have a supervisor level you may have a manager level or it may have your there is a top and your monitoring system information should be placed in such a way that it will be your whole monitoring will be coming another concept you should say that that is called your now at a digital workplace.

Will have to work as a digital workplace in which that your data whatever is required for an operator level is for the operational purposes you will get the information top management will be finding out what is the techno economic planning will be required that data will be coming in between at different stages the processing will be done for different type of virtualization and different type of data visualization. So, this is what in the requirement will be there.

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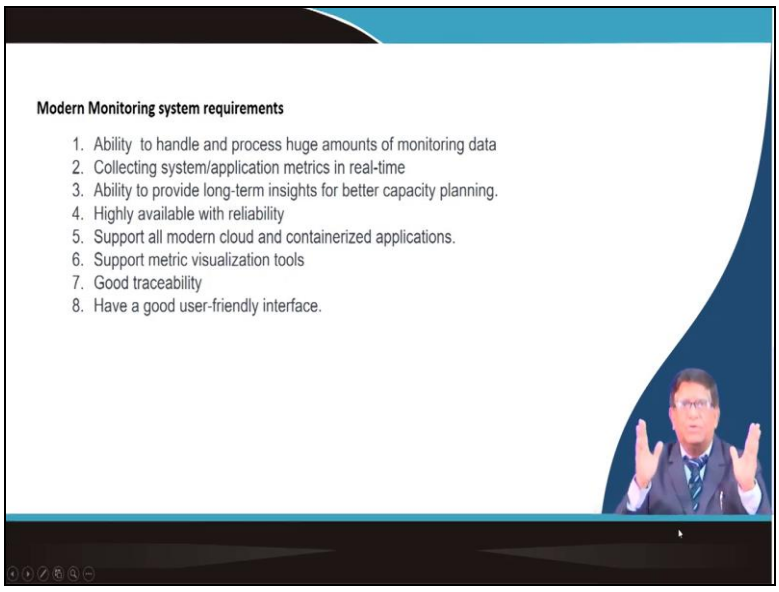

So, if we see that how in the monitoring will be done. So, here I am giving you an example I have told you earlier also that continental that company US company is a good conveyor belt manufacturing company they have been serving this conveyor belt monitoring systems lot of innovative ideas in the last about 10, 12 years they are working with it. So, you can have the cord protection system.

This is a steel cord conveyor belt which is used in the bulk material handling in the mines and in your steel plants. Here will have to have a cord protect system that is the cord on which this the carcass of the conveyor belt is steel cord. That cord will have to be intact and they are properly working or not that can be monitored by code protections. And multi protect system which will be just finding out whether the cord are damaging whether there is a longitudinal rip whether there is a your pipe belt.

If it is a pipe belt their positions how it will be at the type of turning whether the how the stresses are coming. So, that the belt may get damaged that need to be monitored and then the

splicing means this is coming as a strip of belt. Now that belt is made endless that when you are joining to belt that process is called splicing. Now in that splice if that proper strength should be there. So, you must monitor otherwise the belt will get damaged at the joint where that has been made.

So, that again the rip protection if there is a if the belt is getting ripped that is it is getting cut you will have to have the splice protect that how to protect that where you have joint there is it should be kept monitoring then the whole surface of the conveyor belt that also will have to be protected. So, for this there are different types of technology they are using.

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Now that to monitor this you will have to innovate innovative conveyor belt monitoring system will make it possible. To determine the exact condition of the conveyor belt at any time it will have to manage the belts condition to ensure that the system runs trouble free. It must identify and prioritize maintenance and repair by the system based upon the size and position of the damage.

Then to assist in identifying systematic issues that when addressed by that your proactive system maintenance activities will improve the bills operating condition that is what exactly the objective and that must be provided by the monitoring system. And also it will have to prevent the belt degradation it will have to extend the life of the belt and it must avoid the catastrophe that may if a belt failed it may be having a catastrophe maybe the whole build may get caught fire.

That if a fire comes on a conveyor belt it can be a catastrophe in a plant if they close a closed plant if you are having a fire that could be a catastrophe. So, and there are many points and I told you earlier also that there are many conditions under which a conveyor belt may catch fire if the belt is not a fire resistant belt. So, for that how you will be monitoring and avoiding those things are very important.

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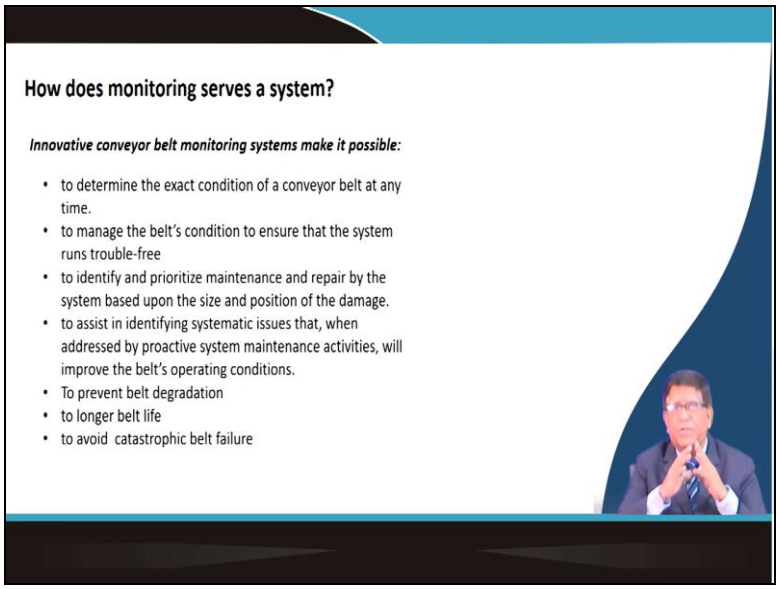

And these are done by different type of instrumentation system. So, for here in continuants that protect quad protection system they magnetize this part and then they come monitor that is how exactly the effect of the magnetization is coming on to each and everything. If there is a breakage if there is a rip or any cut on this they will be giving a different and by that you can monitor it. So, that in which a permanent magnet they magnetize the steel cobbles and then the conveyor belt it just monitor this is the system which is available there.

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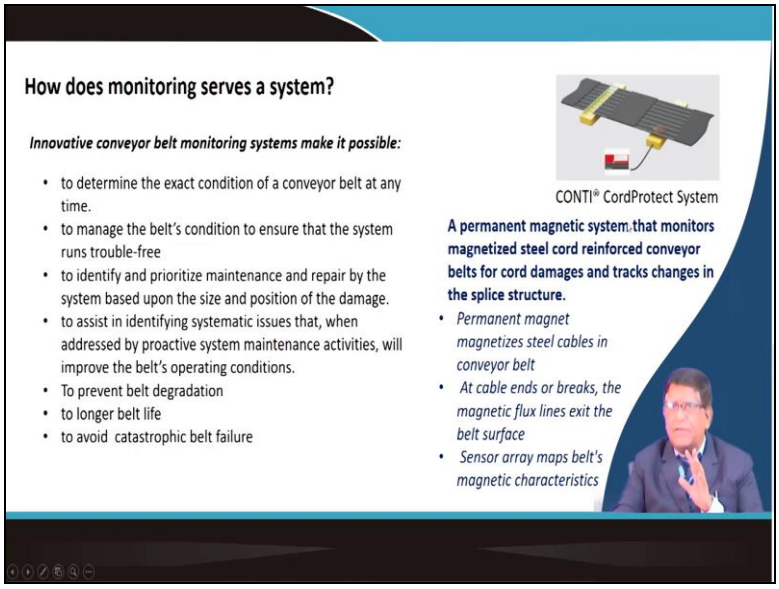

There will be the your the cord damage or the belt splice damage if anything is getting damaged you can have the your sensors even inbuilt inside the belt you can put it over there. So, that continuously it will be monitoring and that monitor data it can be either to a local your data logger it can come or it can also be sent to by wireless system for a central monitoring section.

So, by detecting critical damage the issues can be proactively addressed before it becomes catastrophic while avoiding major unplanned maintenance events. So, you can improve by monitoring your whatever the maintenance required exactly you can pinpoint and do that thing total maintenance period can be reduced which will giving more effective working hours for production.

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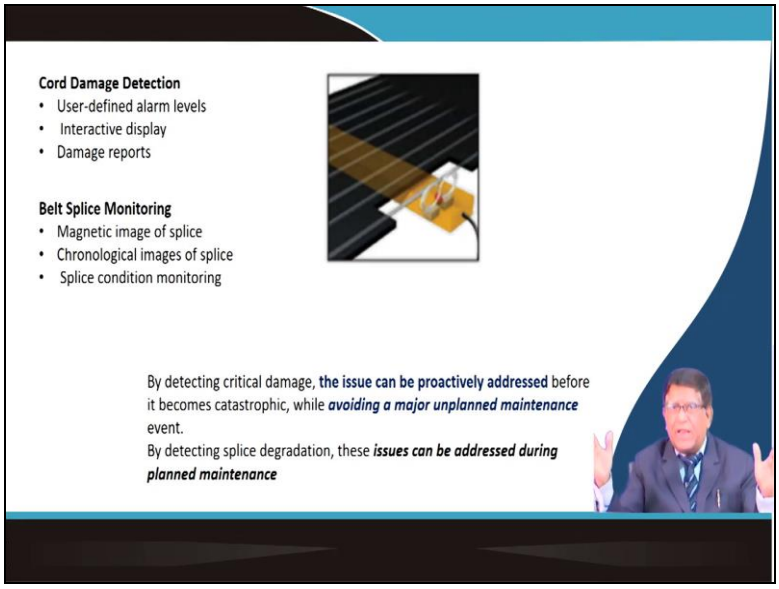

So, these are the systems over there that how they do the top cover monitoring you can have a all scanner laser scanner type of systems at a one end you just monitor that top cover what is this happening. And then you can give a profile sensors by the profile sensors you will find if that conveyor belt is getting any cut any hole any things that will be detected. Similarly that conveyor belt the top cover they do same thing can be done at the bottom cover also by keeping a sensors it can do it.

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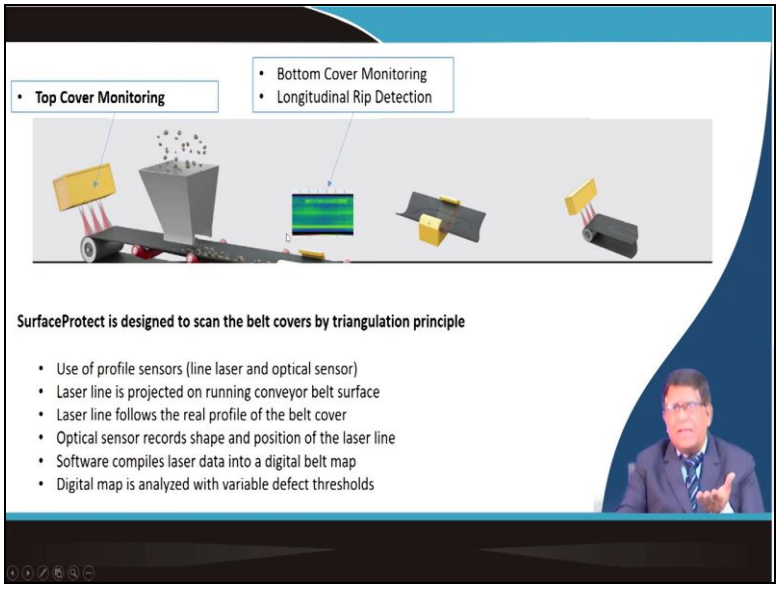

So, that all instrumentations which will be coming that will be that will be providing you a tool for your better decision. And then we will be doing a continuously monitoring and whenever there is a necessity there will be an alarm. So, take another your learning activity study the system to determine equipment alarm conditions and select sensors and instruments and communication system.

Wherever you are doing say whether it is a storage system in a silo or if you think of a how in the Indian railway wagons are being loaded by for the coal coming from the mines there are silo then in that system what type of alarm will be required you need to think over here. Many things should not be there in the book should not be there in the journal but you will have to observe there and think yes this should be there and that will exactly you will be contributing to the Make In India and then there will be new Indian business will be coming up provided you do it.

And for that now the time is for the wireless sensor network. So, you do a little bit of study that may be you are not going to be a computer expert or that networking expert but have a

general knowledge how a wireless sensor network can be useful because your whole say in from the mines ROM run of my run of coal will be coming to a your railway siding and from the railway siding it will be loaded to the wagon from the wagons it will be going to the thermal power stations.

In this whole things that; how your whole material can you track it and for that what type of sensors will have to be there as a wide sensors network.

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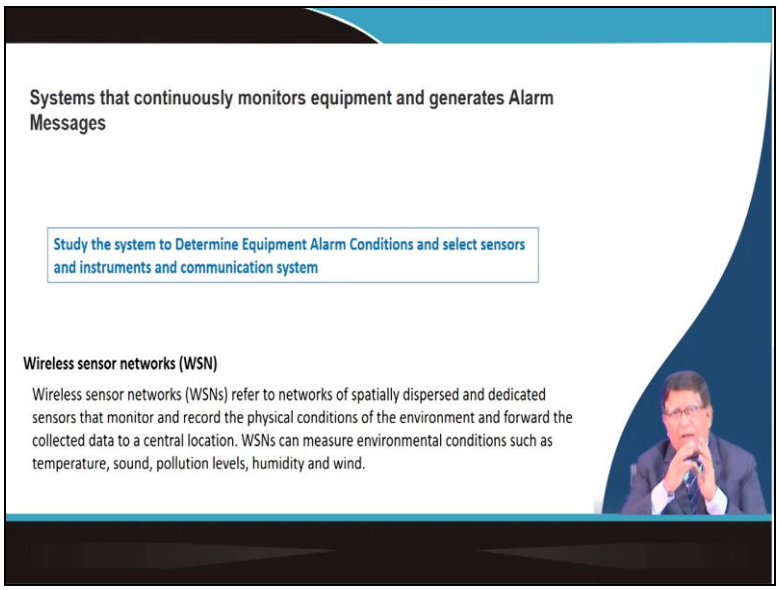

So, this a total sensor network and all which will be coming in the near future as a total digitalization of the system. And there will be having a zigbee that is your the total in a closed area the different sensors from there the data they will be going to wave of this your this when your that wave of things will be coming a wave of things just like internet of things it will be a wave of things that will be coming from different programmable logic controller.

All the environmental sensors will be working from your the crushing plant there all the information's processed and managed and analyzed locally that will be coming and they will be having all that your users there could be been Wi-Fi for the different systems that Wi-Fi will be giving you that wide area network will be giving you some information's here. And whole things will be now wave of things.

So, such type of system systems will be there in the bulk material handling you think of the total supply and collection of rice from different states to the warehouses and then to the stocks of our Food Corporation of India. How the food corporation of India's total material

handling can be brought under that that is your wave of things type of things or a new digitalisations you will have to imagine you will have to find out then only things will be coming.

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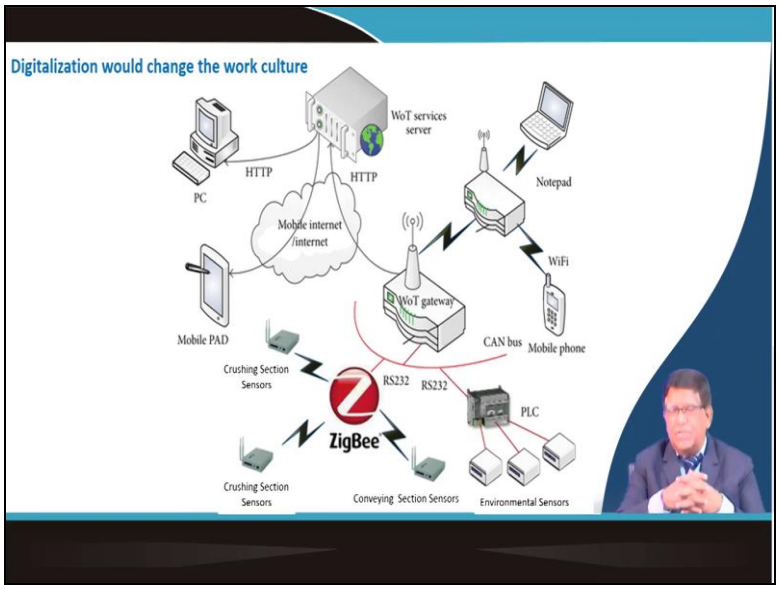

And for that to go towards that do some small project work as a learning project. How can we optimize the consumption of diesel in solid waste disposal in a city using wireless sensor network. I am giving you this is a small work you can do it at any town in a small town also your you may be having 10 or 15 trucks the contractor may be putting it over there for collecting the garbage's from different places and then putting it to a garbage dump.

Now we are talking of that how exactly we can make a clean city how can we go for a cleaner India for that is your Swatch Bharat for that what you have to do. You will have to see that this we should not consume more diesel for that purposes. So, that because the diesel exhaust will be coming into the city that that your city climate city air will be polluted. So, that means you will have to optimize the bulk solid handling over there and that bulk solid handling is your municipality waste.

Think of that a new innovative technology can come out of this project some of you can do it over there.

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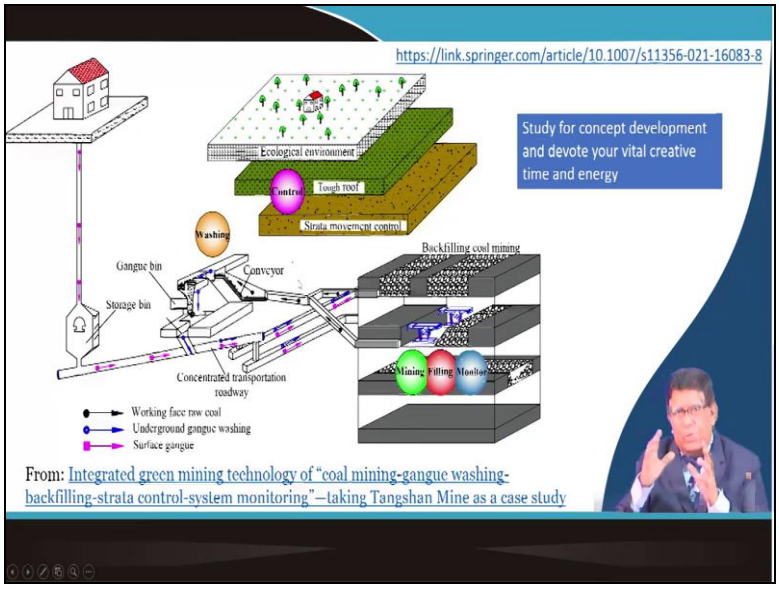

And then in those who are in the mining site you can think of that how you will be conceptualizing that your coal mines. If you are having an underground coal mine your after coal processing whatever the waste is generated can we put that whole waste inside the mine itself without coming if this is an example of a work I am giving it from china. How they are doing in that your that is your Tangshan, Tanghsan mine in china.

How they are doing the in the underground itself you are having the coal washing plant and all the rejects or the gang material they are putting again in the strata. So, that below the mining area this is mow stabilized there will not be subsidence problems environmental problem will not be coming. So, here the bulk material handling is a totally different type of things.

So, you can think of such type of that how exactly your waste will not be going to a far distance you will be retaining over there and that type of bulk solid handling and solid transportation system will have to be there.

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So, integrated monitoring and evaluation system can only bring us new ideas new concepts and that could be how exactly the your waste material will be fret how your waste material will be washed. Then what will be the total ratio of the mining that is how much material waste material is generated how will be putting.

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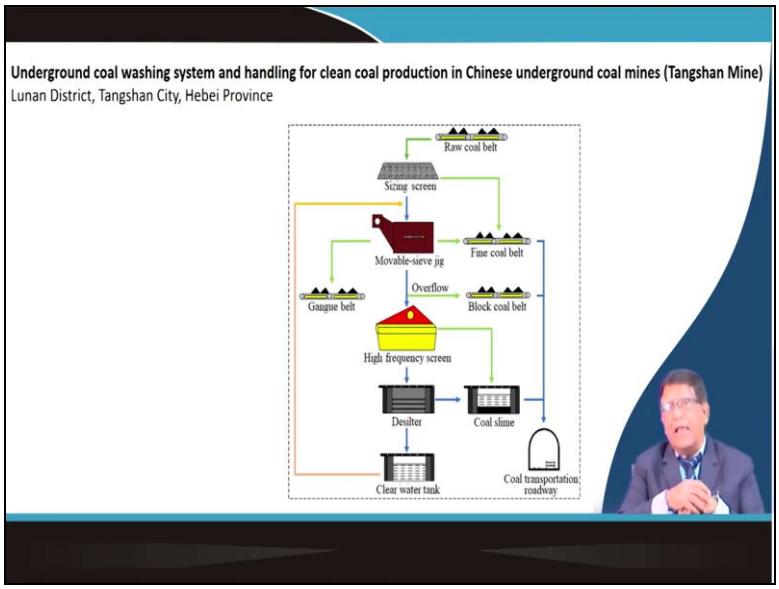

So, these are as an example you please read that some of the case studies how different people are doing and then in that this underground coal washing this concept. Can we have it in our input washing system. I have told you in the conveyor and inpit crushing system. So, that that our total that is a mill that a mine to mill concept where there are the old concepts where you wanted to do an energy optimization.

Now can we do this waste minimizations can we think of a new coal washing mechanism that the coal washer is that will be there in the pit can we have a modular washery development for that cleaning the coal and. So, that the waste materials and all are remaining in the pit. So, that it is not carried and not polluting elsewhere. So, this type of concepts you will have to think.

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And there are lot of books which you may have to read little bit outside your domain like that the book of this on monitoring system and industrial applications. Maybe this some of the articles in the journals you read it that how the things are done and that will give you new ideas.

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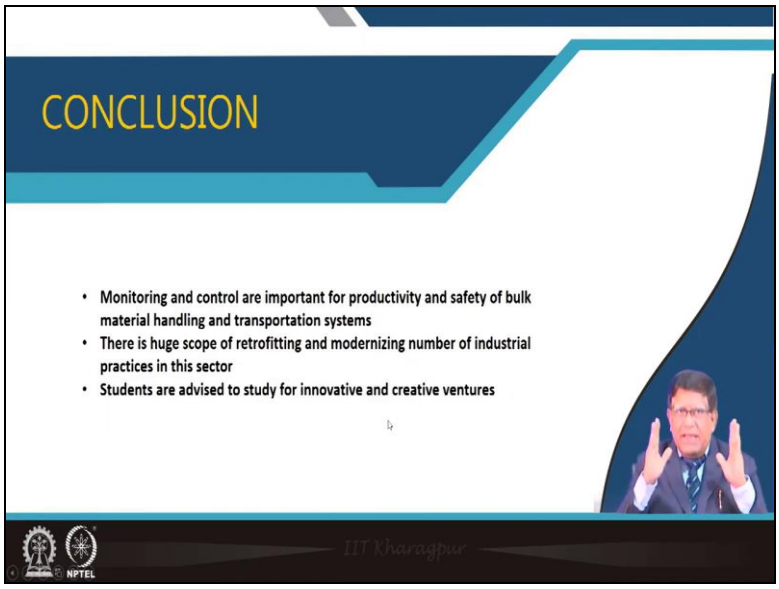

So, here we have just discussed some monitoring and control are important for the productivity and safety I have just introduced a bare minimum things. But as I said there are huge scope of retrofitting and modernizing number of industrial practices in this sector of bulk solid handling and transportations. You can find how much energy is wasted in this whole industry, how much exactly the manpower is over deployed.

Exactly that money manpower is not required where many locked human resources can be released of the system to do some more productive intelligent and more contributing work for the development of our country. Every person is a resource for this country's future development. There if you do not go for improving our systems you cannot use them. Then as students my advice is that please go on thinking some innovative and creative ventures and there I always tell **(FL).**

Think little bit and do it differently because it is the difference which will make the progress to happen. So, I thank you very much for taking this course and I hope during this period certain things you might have learned and then I have I will be maintaining the Moodle site for which I have sent you the passwords. There a student's forum is there in that forum you can put all your creative work what you want to do.

And there may be some of you will be bringing up systems which just like the continental and other companies that multinational company can market your product you get your IPR and that is where we dream with all my best wishes, thank you very much.