Applied Ergonomics

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Module – 03
Lecture – 12
Human Errors

Hello and welcome to this applied ergonomics lecture 12. This is lecture on industrial safety accidents and human errors and we would like to think; I had in the previous lecture also summarized this; we would like to classify the different practices that are carried out with an industry in a very organized knowledge framework. So, that we are able to look at the potential hazardous activities or where safety of the concerned work force is jupitised in a very provident manner and you know the whole idea is that workplace being safe would really mean a lot of betterment and productive value addition to whatever is the line of product or line of service which our system is delivering.

Also it is important for me to mention that there are certain legal restrictions and there are certain legal impositions which are being made by the governance for looking at such works; work systems in line with the industrial safety aspects and this lecture will also discuss some of them particularly the guidelines formulated by let us say OSHA which is the occupational health and safety agency or NIOSH which is another national institute of organization safety and health. These are some of the agencies which have been formulated to either do educational or let us say pilot studies and try to characterize make norms suggest it to the governance. So, that it can be legally implemented in terms of guidelines and auditing be carried out.

So, this is a strict enforcement which is done in terms of some of the norms which have been set up by governance looking at both the worker side as well as the side; you know the side of the industrialist of the; so, although there are certain misnomers that agencies like OSHA may act more in unison with the thinking of the industrialization or industrial growth, but still it does mandate certain important guidelines which can be looked at for organizing this you know industrial safety on a on a bigger scale.

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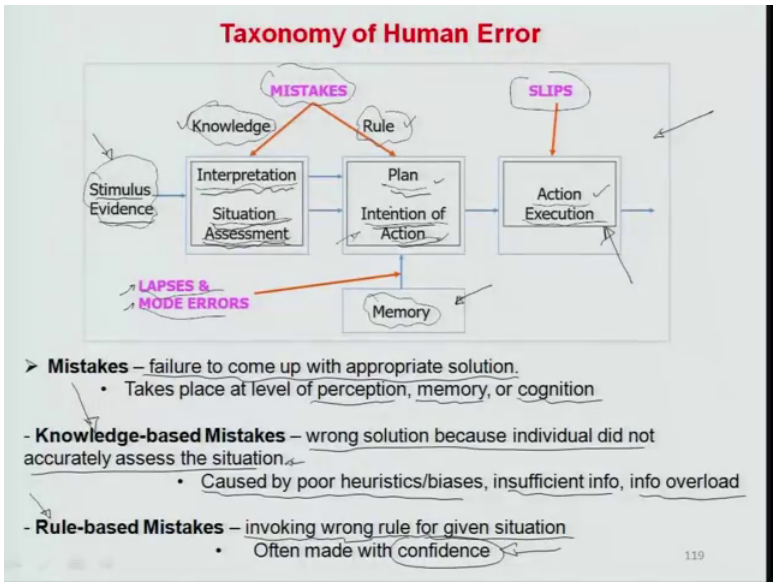

So, let us look at first human errors we were talking about these human errors and we were discussing the taxonomy of human errors. So, basically these model rights here suggest; what are the kind of reasons which would lead to such human errors propping up during any work study or in done any work carried out in a bio work system. So, here the impetus is given through a stimulus or an evidence that there is certain operation or certain action to be initiated by the work system and; obviously, there is an interpretation of this evidence and there is a situation assessment which are needed for a particular work centre of a work system to make a plan or an intent of action.

So, basically there is a previous knowledge base which exists in terms of metal maps of particularly human subjects associated with such work centers would have done under a same stimulus a certain deliverable for the last few periods or last few cycles and so there is also a memory aspect involved in how to interpret such a stimulus which is coming to a system which initiates an intent of action or a plan and then later on action execution and then there can be as far as memory is concerned, there can be many lapses or mode errors details of which I will mention in the next slide, but because of certain ill defined ways of cognition or thinking, there may be a probably defined knowledge base which may be used from memory to plan something which is in appropriate or even act in the manner which may not be very prudent and so, there can be mistakes which can be made also in the knowledge to main as well as mistakes made for rules.

So, what are really the mistakes; mistakes are failures to come up with appropriate solution and so, it can take place at the level of perception it can take place in the memory of memory or cognition and if I looked at just knowledge based mistakes there could be some wrong solutions because individual did not accurately assess the situation that could be some kind of a knowledge based mistake or it could be caused by poor heuristics or insufficient info or sometimes information and action overload on the part of human subjects particularly associated with such work systems and so, therefore, there can be mistakes which are made from you know the knowledge domain by maybe the wrong interpretation.

And sometimes the mistakes are made based on imposed rules by human subjects for example, one could invoke without a deep interpretation of the situation a wrong rule for a given situation and this can often be made in confidence by human subjects which may result in again inappropriate plans or intent of actions done by such subjects and so, therefore, the final step which is the execution of the action may not be very very safe because of miss information which happens from the knowledge based and the rule based mistakes which people generally carry out while preparing a plan or an intent of action from a particular stimulus which comes to a certain situations.

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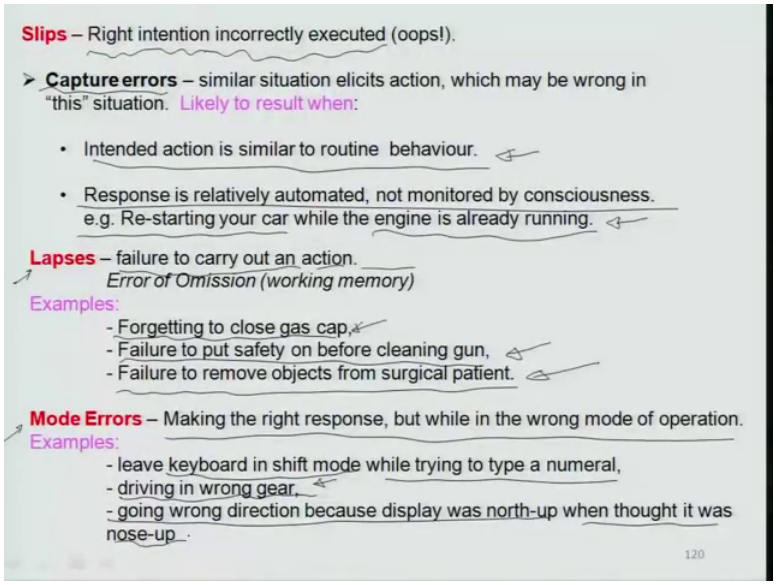

So, having said that now while the intent of action has been prepared and it is being delivered and there is a mode of action which is to be carried out in that process, also

people may commit errors for example, there may a overall right intention coming up from the plan of action which has emerged, but it may be in correctly executed and something like when you are doing some repetitive task there may be a possibility that a person between one cycle and the next cycle may make an error unknowingly or inadvertently and must the error is committed he realize that there is an error. So, these are sort of slips or mistakes of the part of individuals who know what has to be done in a proper manner, but they are not able to execute it because of the cyclic nature or overload or maybe something which is related to span of attention of that individual for that particular operating cycle.

So, there can be capture errors; similar situations illicit action which may be wrong in this situation likely to result when the intended action is similar to routine behavior. So, also the response is relatively automated not monitored by consciousness like for example, restarting your car while the engine is already running is a very common problem which happens. So, is not that people do not know, but out of the you can say auto response to a situation that a person may generate while sitting in a car the first thing he does is automatically the hand goes to switch on the ignition key. So, such or some something like this instead of the fact that it in your knowledge domain is misappropriated or misinterpreted and still acted upon and that can be considered to be sort of slip there can be other reasons because of which safe you know unsafe fact or human errors may happen. For example, let us say if there are lapses; that mean, failure to carry out an action. So, I can give you some examples.

For example, let us say forgetting to close gas caps while filling you know gasoline in the automobiles is sort of a lapse on the part of operator at the at the gas station and. So, is the failure to put safety on before cleaning a gun it may accidently fire because the safety button is not on and the gun is in the operational mode while you are cleaning particular gun or failure to remove objects from surgical patients and stitching before the object is removed second another very commonly occurring omission which is basically a lapse on the part of the working memory of an individual. So, the human errors which are caused during the process of; I would say intent of action being prepared and executed can be because of such lapses.

It can also be mode errors for example, at times we can make right response, but while in the wrong mode of operation I am operating a keyboard of a computer and I may be able

to I may be trying to type a numeral when the keyboard is in shift mode and the numeral is not working or maybe I am driving in a wrong gear that could be something.

Which is we; I am not sure what is going to be the torque rpm ratio requirement of an engine and I just put it in the non gear and the engine stalls. So, that can be a mode error, there can be you know a mode error of the type where going in wrong direction because the display was north up; when it was thought, it was nose up could again be something which is related to the mode of operation the wrong mode or selection of the wrong mode of operation just because of certain mis-information or let us say certain inappropriate stimuli which is very common to the human system. So, in this particular model that I said you can see that there are knowledge domain mistakes there are rule domain mistakes again there are mistakes because of lapses.

And such mode errors you are not sure what mode you need to operate system or there are lapses in your action itself and then of course, there are slips or forgetfulness associated with human subjects where whatever is being planned is not executed because is probably very cyclic very reparative very loading and person forgets the short term memory which is there just elapses or omits. So, these are some of the classifications which could be made for studying the various reasons of human error. In fact, it is a detailed subject for the cognitive sciences to look at very deep details about the memory process as well as while such slips or mistakes must happen and how they can be controlled.

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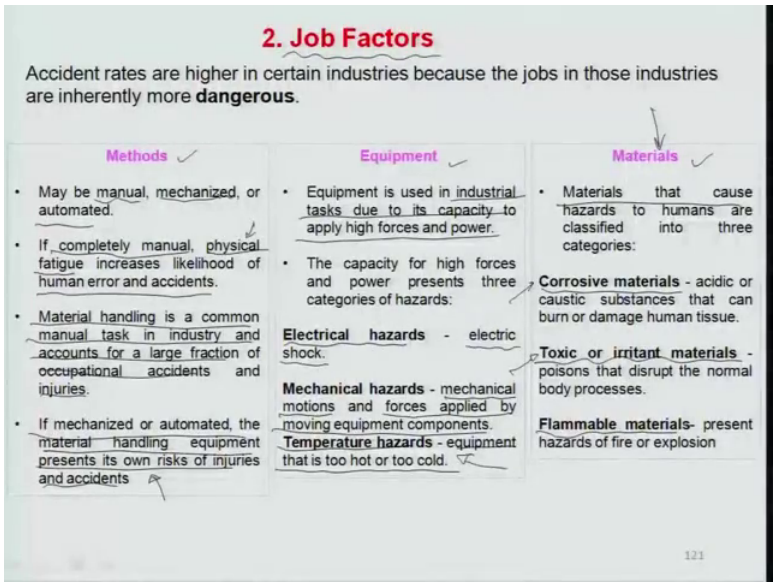

So, these are human errors there can be errors in particularly ergonomics related to the job factors and the job factors typically include things related to the methods being practice the equipments that are being used and also the materials which are being used accident rates are definitely higher in certain industries because the jobs in those industries which are coming out because of you know an overall intent of producing something or providing service are relatively more dangerous in comparison to the others and therefore, a proper classification of the different jobs factors in terms of the potential danger that they would cause to create an overall atmosphere which may be industrially unsafe is coming out of those job factors.

So, one of these job factors is methods. So, method could be manual it could be mechanized or it could be automated I think I have given enough description for different systems including fully automated systems or worker machine systems or again manual systems earlier. So, if completely manual there may be an issue related to physical fatigue there may be increase or there may be a likelihood of increase of human errors and accidents because of such physical fatigues because; obviously, not much mechanism is being used or utilized again material handling is a very common manual task industry and accounts for a large fraction works occupational accidents and injuries particularly handling related to inflammable product handling related to dangerous or potentially hazardous products may have to be very closely monitored and methods may

be very appropriately defined. So, that there may not be much danger post if the method is in good audit and good repeated mode.

If mechanized or automated the material handling equipments presents its own risk of injuries or accidents look at for example, how many deaths happen because of collapses of cranes in the construction industry or let us say look at in normal industrial framework as well when we are talking about more environmental dependent processes like in the mining sector there has been often on many mining accident. So, people have been trapped under ground; there have been less oxygen, there has been an issue because of although the equipments were there, but some failure happened related to mechanized or automated systems.

And therefore, it is always prudent for industrial safety program to gage some of the occupational safety hazards which should be coming out of methods, it could come out of equipment; equipment can be used in industrial task due to capacity to apply high forces and power and so, once we are doing powered or we are using power equipments there can be potential electrical hazards because; obviously, sometimes a majority vast majority of equipments are about conversion of electrical power to mechanical power.

There can also be mechanical has its mechanical motions; for example, let us say we talk about a machine shop and we talk about loose hair of an individual standing close to the machine shop or the particular machine and getting caught up because of loose clothing or loose parts loose hair. So, there is mechanical has it being post they can be force; force in terms of forces applied by moving equipment components there can also be temperature hazards the equipment that is not that that is too hot or too cold also can lead to burns and so, one has to define very specifically if it is a high temperature system or if its electrically shock prone system or if there can be conditions of mechanical hazards imposed by particular machine tool and so, therefore, equipment has to be looked at from a industrially safe point of view and wherever needed accurate displays or very big hoardings which seek attention of users and people who are nearby have to be deployed.

So, that they do not go very near or they do not you know handle such equipments without putting lot of care and intelligence there are hazards again related to materials for example, materials that may cause hazards to humans are again corrosive materials this is the major problem in industries where there may be acidic or caustic substances of

products which are involved there can be substantial amount of human damage in terms of burning of tissues etcetera which can happen because of such miss handling of such corrosive materials there can also be toxic or irritant kind of materials.

For example, poisons that normally disrupt body processes sometimes gases or a major career for this toxicity in industries where there may be a chemical plant or something which is generating a byproduct there may have been lot of hazards related to such gases; for example, if you look at the Bhopal tragedy in our own country it was because of methyl isocyanides gas which created a lot deaths because it was not properly managed.

So, we have to really look at the materials aspect while job factor design takes place for incorporating certain safety norms or safety standards into the way that these material should be handled another very major category of materials a flammable materials which are mostly prone to hazards of the fire or explosion materials particularly let us say LPG cylinders or LPG gases which or other gases which have a high probability have to be safeguarded through protective measures and putting systems in place which would generate a very accurate know how of leakages and would immediately terminate generating processes and there should be a close control in handling such gases in the semiconductor industry such another such very important gas asylum which actually causes it is a highly-highly flammable gas as well as it does cause a lot of reactions physiological reactions with the human body.

So, whenever handling silent there have to be specified silence systems with certain safety norms which are in place. So, once silent gas is there it has to have a productive system around it and that is a very major challenge in the semiconductor industry where associated equipments or parafilaria associated with the major processing equipments get developed because of handling of such potential hazards potentially hazardous gases which have some utility in terms of product processing. So, the job factors classified in terms of the a various methods utilize the equipments which are there the materials which are being uses are generally upward study when it comes to industrially safe practices and designing industrial safety awareness as such there can also be other factors like environmental factors or conditions.

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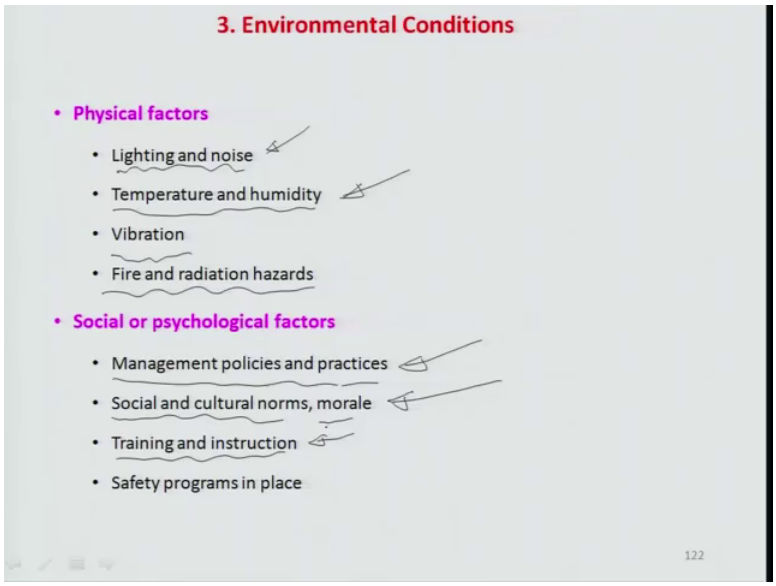

Which main influence the general industrial safety level for example, look at a airplane flying and heating lightning strike which is an obvious cause of fire and if the airplane is not protected against such lightning strikes, there may be a possibility that while in air; the whole system catches fire and there is a issue related to human lives or losses generated because of such strike.

So, lightning and noise are something which are post by the environment we do not know the randomness of these when they would come and. So, if you are applying in conditions where there may be more closeness or proximity to such factors you have to make full prove systems which would actually be able to with stand sustain such factors then there are temperature and humidity issues sometimes these also cause a lot of significant damage and make a practice on safe industrially unsafe.

So, if temperature and humidity are again very randomly controlled environmental conditions or randomly coming environmental challenges to a system the product has to be designed in light of such physical factors. So, that it does not get affected; there is vibration which is again another physical factor which may create the problems related to lesser equipment life more breakage associated with the tooling, etcetera, where it may get into the domain of being unsafe because of this; such vibrations.

Then there are fire and radiation hazards again which are again part of physical factors which can be potential challenges and environmental challenges posed for necessitating

safe practice design within industrial situations, there can be other social or psychological factors. For example, management policies and practices are again some very significant environment related conditions which can create a lot of disruption of the minds of at least the human beings you are working in a particular work systems and if the policies and practices are not in place they are not in order, then it may create problems related to deputizing the safety of and work system there may be cultural and social norms on moral which is again responsible for creating a highly safe environment for any work system to function.

For example, if I look at the way that Japanese production units; work safety is at every level very very pertinent factor and their social training or their culture has of the subjects who were working there has been made in the manner; after they have been inducted in a company and working for a company that they have this imbibed at every level and so, therefore, basically a person needs to know in the specific span of area that he was he is working what is occupationally a safety practice and unsafe practice.

And this is also a matter of the acceptability of the knowledge base given by the higher level supervision who is designing the process and also the carrying out of maybe extra tasks if need be for maintaining the general safety. So, if socially and culturally people are trained to handle and understand the importance of industrial safety it is going to be a much lesser challenge in terms of a designing work systems research norms can be easily built in of course, social physiological factors would also include training and instruction. So, in a place which is more earth quake from own like let us say for example, again; I will take the example of Japan even a school boy at the school level has a mandatory requirement of doing a drill in case of an earthquake.

So, theses strategy there has to be followed by an individual to come out and seek a place in the open and do a certain follow up of a safe practice is such an earth quake happens is carried out routinely by people just from the school level. So, training and instruction also is a very very big social and physiological factor which gives you an environmental condition through which you can actually improvise the safety awareness same is true with safety programs being in place. So, we have tried to look at the industrial safety in terms of human factors and how human factors are responsible; we have tried to look at in terms of job design or job factors again different components associated with the job

factors and then we have also tried to take care of some of the environmental conditions where the industrial safety awareness can be affected because of such conditions.

So, let us now look at the various safety programs. So, safety programs typically have three fold sort of strategy to be implemented one is basic safety program.

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Really begins with identifying the risks that are there to the company risk could be in terms of identifying those areas of systems or subsystems which would be termed as hazards it could also be about how to control hazards once he has it has been set in on a particular let us say industrial framework can we really 0 down through our methods of practices systems which can ensure that such you know hazard a systems are potentially hazard s systems do not play havoc or play a role in creating havoc.

It also identifies the sort of frequency of accidents associated with such hazard centers and also identifies in terms of the losses that the company would face due to accidents or incidents or claims and so, this is the first step for introducing any safety program; just its key step towards what are the areas where the industrial safety program should aim to begin with for removing most of the highly contributive; let us say unsafe practices for associated with the work system.

The next goal that a safety program typically has its to implement such programs and this includes again management involvement wherever necessary your having an accident

because of an operator picking up let us say press panel with a sharp edge and loading on the corresponding die which would be used for welding such a panel to complete maybe let the back door or the side body of a automotive system.

So, the operator involved in picking up this panel from pallet which comes from the press shop and leaving this panel or let us say resting this panel on the top of a die or a jug typically uses a certain sort of gloves where there is a possibility that because of the sharp edge; there is a puncture and there is a exposure of the hand to the panel which may increase the chances of the person getting a cut injury. So, if management involvement is there and it gives the necessary resources in that area to maybe increase the number of layers of glass that a person where is; maybe change the material of the gloves to little more expensive little more protective material and ensures and enforces that any such operator working in such system would be using those pair of gloves in order to pick up the sheet panel and take it to the next station that would actually lead to the introduction or implementation of a safety program and such programs are immense there are many in numbers when we talk about beg industrial a work systems.

There is also a very important measure played by something called accident investigation you use any accident which happens new; where we do not have any knowledge as to how this accident has taken place or how it may recur once the accident is happened total detailing of the reasons. They are in of the accident and what are the failure modes which led to the accident occurring has to be not only drafted by some safety conscious people, but also have to be percolated across the other stakeholders particularly the human stakeholders associated with such a system. So, that such awareness may not; may give a sort of a you can say full proofing awareness that if I follow this practice or do this practice in this manner there will not be such an accident in future. So, that awareness increase is again the role of the investigating team.

So, any accident have to be treated number one with at most seriousness the in reasons there in have to be investigated in a very prudent an appropriate manner and then some countermeasures have to be suggested by such a team and then it this awareness of to be spread across all the human stakeholders associated with the system; even if there are administrative stakeholders and who do not need to directly participate in the process of let us say physical assembly of products of physical; let us say putting together of things, they must also be aware apart from the major stakeholders who are the workers that such

an accident is happened there can be some recommendations for particular equipment specific equipments which need to be utilized. For example, safety wears; use a helmet on the head while you know working under an assembly line; walking aside an assembly line because there may always be a possibility that the particular powered gun which is being utilized for you in a quick manner adding fasteners or nuts name is fire and because of that there may be a sleep edge and there maybe always a projectile which may be generated which may come on hit you.

So, the first protective measure that you should take is probably in terms of the head gear that you are using a helmet as well as may be a sort of a let us say goggles or a glass; productive glass which saves your eyes and your head. So, if I recommend the piece of equipment to be utilized whenever there is even single visitor who comes to visit in assembly line and tries to see the processes and all the stakeholders there in who are working in the assembly line, then automatically I am preventing some of the very major accidents to happen. Now, there has to be a system in place. Now there is also a issue of compliance once the system has been laid out by the management the compliance to that system merely depend on the ability of a human being to listen to the pedagogy which has been delivered or let us say the instruction which has been given and sometimes there are many such cases of non compliances where accident may recur.

But then they will not be able to blame the system of not having something in place if there is a system in place, if there is a safety system which is actually being utilized a being educated emphasized upon and still not being complied to there has to be again a strategy that the management follows to have a; let us say shift wise check or something by the shop the DPM or even the shop manager or maybe even higher level managers. So, that there is sort of a fear factor that why somebody is not using a safety gear among the stakeholders of the workers. So, such things of recommendations for equipments should come down form very active involvement of the management. So, that safety programs can be implemented there have to be some safety rules and necessary audit associated with these rules there have to be again PPEs personal protective equipments there has to be employee training there has to be safety promotion all these things are a part of how to implement the safety program.

And put it in place; there can be also third step yet where after identifying and implementing the safety measures, there has to be some measuring of the effectiveness

and this has to be in terms of evaluation of safety behaviors, I just mentioned in the last example that a higher level management professional should be involved in evaluating such safety behaviors once the system has been in place the people should be audited from time to time whether the practices are being followed. In fact, some of the ISO based audits do point out a lot about product safety and if such an audit has to be done on a global level it necessitates lot of strategies which show that there is a follow up on plant safety measures and properly implemented. So, there is always a sort of monthly follow up or a schedule for the follow up turn on measuring the effectiveness of such a program.

The monitoring has to also be done at the level of the management where accidents or incident rates are evaluated particularly number of injuries or deaths coming out from such accidents; they should be almost on a 0 tolerance side. So, the management plan should be that every year we must reduce whatever is the current level of accidents by almost hundred percent. So, that is how the strategy should be for implementing such safety programs there cannot be even one such out of the way incident which can be afforded if it happens it should be perchance and if there is a perchance angle to such a even there has to be a proper organized study.

So, that that perchance does not happen again and so the number of days due to the injury; or you know associated losses which are there in the system because of not implementing a safety program or an awareness has to be communicated to all the stakeholders and strict enforcements have to be made. So, that the stakeholders do follow such safety practices and in a way these programs are very very important consequence for any work system to work effectively.

So, I will like to close today's lecture here, but then what I am going to do is to sort of speaker little bit upon some of the legal guidelines which are available from some agencies about safety and beyond which we will probably look at the topic of work ergonomics. So, thank you very much again.

Thank you.