Health, Safety and Environmental Management in Offshore and Petroleum Engineering

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Module – 02
Operational Safety
Lecture – 08
Financing Risk: Example problem

Welcome friends to the online course on HSE practices in offshore and petroleum engineering. We are discussing about lecture on module two, where we are focusing on operational safety.

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Today, in lecture eight we are going to continue with the problem where we are going to explain the concepts of financing risk. We will talk about the example problem, after we understand the Frank and Morgan method of risk analysis quantitative. We looked at the last lecture. We rewind and see what we have discussed in the last lecture. We said that risk assessment should have the economic problems associated to it. It should address the whole risk problem in economic perspective.

So, Frank and Morgan gave a model in early eighties, which we were discussing. And, we said in the step number one, after you divide the whole processing plant into various departments. In step number one, you compute the hazard score, the control score. The hazard score computation is what we call as a first level of risk assessment. Then, you compute risk index, which we will be the control score minus hazard score. So, risk index can be positive, can be negative. Of course, ideally it can be zero as well.

So, let us continue with the next step on the same problem or in the same issue then we will take up an example and try to understand this. So, in step number two after computing the risk index, we are interested to know the relative risk. The relative risk will help you to compare the departments locally in a given plant. So, the objective of this specific step is to rank the departments and not the individual hazards present in the department.

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This, already we have done in step number one itself. What we call as first level of risk assessment. They are already done. We want to improve on this. Therefore, we are not interested any more in ranking the department based on the hazards present in the department. You already know them, but we really wanted to relatively rack the department based on the risk because now we are looking along with the hazard, the

control measurements what each department has in place. So that, if at all the hazard scenario gets realized to become a risk or to mature to become a risk, then what are those control measures each department has individually or the whole plant has as a coordination to control mitigate or avert the happening of the risk itself from that of an hazard.

So, what we said is a control measure. So, for both of these we already said in the last lecture that one can also refer to the standard table given by Frank and Morgan. Or, one can also, in fact ideally prepare a check list of their own, depending upon the expertise, experience and passed judgments what they have based upon the case studies occurred or visualized or understood or educated. So, one can prepare the check list, prepare each group and try to give a hazard score and control score for each department of your choice. In fact, every control or every process industry do have this check list with them, which is prepared based on the expertise in experience personal, they have in both.

So, the relative risk which you are going to estimate the second step, essentially aiming to rank the department relatively. But, not the hazard present in each department which has already done. So, it is an improvement from step number one. Now, one can ask me a question how relative risk will become important in the scenario of risk evaluation. Now interestingly, let us say you have a department which has got the highest risk index, to be very specific, highest positive value.

What is it mean? Highest positive value means the control measures in the department are extremely good in comparison to the other departments. That is what it means. So as a financer, as an investor, as an employer, as a capitalist, as owner, as a company CEO, I do not have to invest much towards hazard mitigation reduction to this department, on this department. Such departments are called base reference departments.

So, amongst the given departments of let us say six or seven or ten, one or two can also become base departments or base reference departments. So, their risk scores are considered as base reference for the whole analysis. Now, one can ask me what is the use of identifying the base reference risk course, amongst all the departments.

Interestingly, since I am going for a relative risking or relative risk ranking, now I would like to normalize the risk score of all departments with respect to the base department. So, I need to normalize the risk scores of all departments, with respect to let us say the best department or with respect to the base reference risk score which I have with me now. So, that is what you are going to do subsequently. So, that is what we are going to do now in this step. And therefore, this is done. How do you do the normalization? It is very simple; mathematically, subtract the risk score of the best department from the risk score of the concerned department.

Obviously when we do this, you will notice that the relative risk of the best department will be zero. That is what we are going to do in the second step. So first step, we are finding the risk index; second step, we are finding the relative risk ranking by normalizing the scores or risk scores of all departments, with respect to the best department. The best department is that department whose control scores are much higher than that of the hazard scores. Or, on the other hand whose risk index is highest positive number, mathematically.

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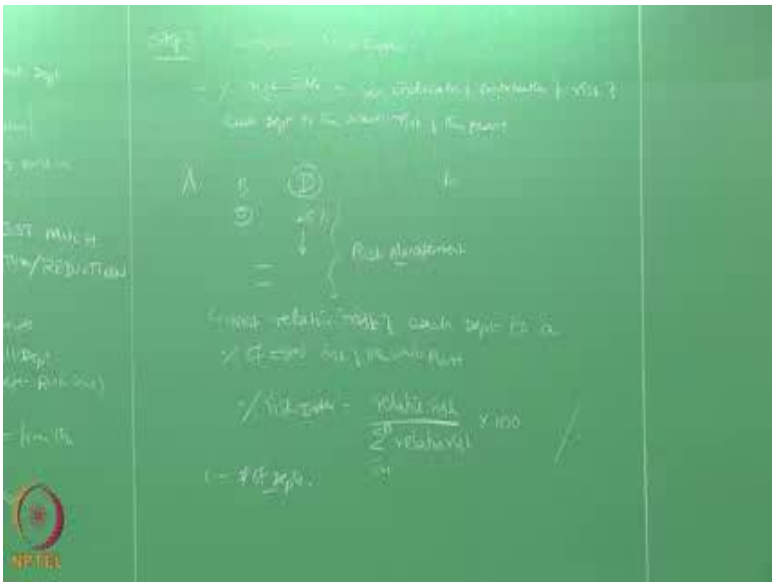

In the next step, we will now compute percentage risk index. This indicates relative contribution of each department to the total risk of the plant. So, the percentage risk

index is an indication of contribution of risk of each department to the overall risk of the plant.

So, ladies and gentlemen, these are very important step in risk management. For example, in the given departments of A to E, if you know that let us say the department D is contributing maximum, that is the percentage risk index of the department is about let us say 25, which is lower than any other department. May be the reference department in this case is B, whose is zero. This reference department on of the best departments let us say.

So, now it is very clear that the management has to look into or pay attention more to the risk managing issues or hazard management techniques adopted by department D because department D is the major contributor for the risk of the whole plant. So, for example, the management can think of replacing, recruiting new professionals in terms of HSE perspective. Invest more or plant invest more on the control measures what the department is supposed to have, improve more on the maintenance part of machinery in the department, which is leading to a very high hazard score. So, there are many issues which can be looked at this level segmentally in each partition of every department, which is the very good step towards risk management.

Now, as a whole if we do not have a mathematical convergence in terms of arriving at a number, which is an indicator of poor or better performance of every department in the whole plant, as a manager, as an executive, you will not be able to corner or coin down a specific department or a specific personal, set up personal in the department to really highlight his weakness and his strength.

Therefore, relatively, qualitatively, taking to each of them, each one of them in a departmental meeting or advising them in general to say that hazards scenario is very bad. Training them in general, towards risk management will not going to help, we are got to be very specific down the line. We are to be very particular in saying what are those steps they have got to do, why their control scores are very low, or on the other hand, why the hazard scores are very high. To be very specific, why the risk index is so high?

Secondly, if we are talking about incentive which I said in the earlier lectures to promote risk, you have got to create a feeling that risk need to be adapted, need to be practiced, need to be become a culture. So, for maintaining this practice to promoting this culture, generally management can also start thinking of rewarding people, who are maintaining very good risk control mechanisms.

So, this particular step will help you to know how amongst the departments you need to create a difference in rewarding or creating incentive for the best department towards risk control or primitively punishing the worst department towards risk control, in terms of lack of incentives; because this will create competition amongst the personal in each department to compete for the best, which will ultimately result in a best way of risk management by itself; because as I just said in the beginning, risk management is always a success only when the people who are at risk feel themselves that the risk management is their part of the duty. It is not the employer, it is the employee who was got to take it into heart and practice risk measurements and risk management techniques at every step in every walk of his production line, during the processing plant.

So, this step will also help you to do a very good management, in terms of creating or declaring incentive for the best department and for the worst department. So, that is how generally if you look at the oil companies sector, the payrolls, the incentives, the payrolls will have about three to four bifurcations. The basic salary, the extra work hours what you put, plus the incentives towards your achievements, this can be one of the segment in the payroll itself that if a HSE practices are found to be good, dominantly better other than the departments. Then, you will be given the following incentives. So, this can be also a part of the HSE policy of the company.

Therefore, the company in the beginning stage inculcates the feeling in every employee during the recruitment. If you practice as risk management or if he, if he follows risk procedures very clearly and avoid hazardous situations in a set of our working, he will be rewarded. So, that is going to be a very interesting way of looking at the risk assessment, which is actually opened out by a mathematical technique given by Frank and Morgan.

So, in step number three we look at competitioning, computing the percentage risk index. So, in this step we convert the risk of each department or the relative risk of each department to a percentage of total risk of the whole plant. That is what we do in step number three.

So, step number one we did risk indexing; in step number two, we did risk ranking based on the relative value; step number three, we are going to do the percentage risk index. And, every step is important. Every step will give you very interesting information towards risk mitigation, risk management, risk avoidance hazard identification, all are mingled together. However, as of now you will really notice and appreciate. You may have a doubt in mind, where is the economic perspective coming into play here, whether there is whole issue, what we started with the whole model. Let us talk about it straightly, please wait.

So, now the total risk of all departments will lead to the total sum of the entire risk of the department. So, the percentage risk index can be mathematically said as; can be mathematically said as relative risk by sum of relative risk sum of from i is going to one to n into 100, where the count i will be the number of departments. So, therefore I get this in percentage. That is what I get in step number three. Let us see what we get in step number four.

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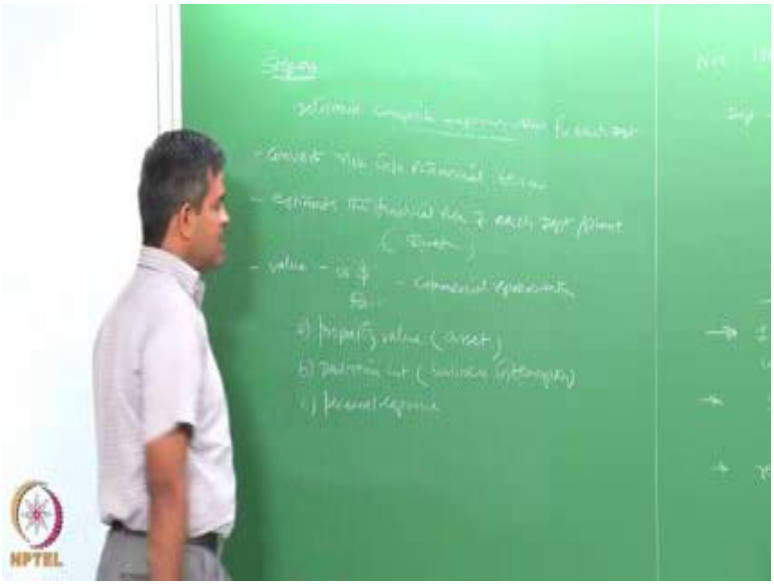

In step number four, I am going to determine the composite exposure value for each department. What does it mean? Interestingly, this step converts risk into financial terms. So, this is a very important step. Actually, this step estimates the financial risk of each department or the whole plant, which is a very big botheration for the investor.

So, now let us see what do we mean by composite exposure value. The composite exposure value may be given in any currency; may be in US dollars, may be in Indian rupee. Any currency; we can say this Indian rupee, any currency. But, it is actually a commercial representation, please understand. Now, let us see who or what will be the components of this exposure. So, the term very clearly says risk is always envisaged only when they are exposed. Hazard is a presence as a scenario; risk is a maturity of hazard.

So, the personal experiences or getting expose to risk is only we are got interpret about. That is what we are saying individual risk, so central risk or what we have calculated from the international regulations as we see in the previous lectures. So, the important components based on which the commercial representation of risk will be given is divided into three parts. One is what we call the property value; what we otherwise call as asset of the department. The second could be the down time cost. I will put this as business interruption. I will explain this.

Third could be the personal exposure. Let us explain each one of them in detail to understand how do they contribute to the composite exposure. Let us, for example, take the property value.

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What do you mean by property value or asset of each department? So, each department has an inventory, machinery, equipments, each has a salvage value and represent market price, which accounts for the depreciation of the equipments. Of course, every department maintains its record as a part of S and P; that is nothing but stores and purchase.

So, every department will clearly have the commercial value of the equipments, plants present in the department. Therefore, it is very easy for us to really convert or identify or value the asset of every department. So, there is no big business in big deal in getting this. And, obviously you will know that this may not be common and same for all the departments. Some department may have this very low; some departments have this very very high. Depending upon the investment what the department made towards the machine in equipments, tools and plants.

The second is now the tricky. That is the down time cost or what we call business interruption. Now, let us say in case there has been an accident or a near-miss event, the production line need to be shut down because when there is an accident of an event, you obviously cannot continue with the production. And, we all agree that the total outcome of production of the department or the plant, sorry, of the plant is sum of contributions of different departments. Every department should work together in alignment, so that the production is maintained.

So, the production line will have contributions from different departments. For example, if any one department which is having a very high hazard index or very poor control measure is likely to face an accident. If it faces an accident, so that will not be contributing to the production line of a department of the plant, that is what we say the downtime cost. So, this depends upon how much important is this department in the production chain. Obviously, all departments may not be equally sharing the percentage of production contribution. It varies.

So, this is very important. So, this will give you a very clear picture where do you stand. Now, the question is if I am belong to department A, if you belong to department B, if she belongs to department C, everybody would like to say that my department is contribute to the maximum for the production line. So, that is not you, it is your choice. It is actually by the layout of the production line. You are pre agreed upon that where do you stand as a contributor to the whole production system. For example, drilling and delivery are two departments, let us say.

Drilling will have more importance because that is where the drilling happens, whereas production is got there discharging out to the market. Though, it is also important. But, if you do not drill, there is no production and there is no delivery. So, therefore the importance of the specific department in the production chain is pre agreed upon in a meeting or in the meetings. And, we all know where we stand as a contributor for the whole production system. So, this is also known.

The third could be very interesting. It is the personal exposure. I can give an example. Let us say your department has only two employees. Let us say employee a, may be

drawing a salary of 10,000 US dollars, let us say works for 8 hours. Employee b does the salary of 6,000 US dollars and saying monthly 8 hours. Only two employees are present in one department. Let us say D. The person, who is drawing a salary of 10,000 dollars of month into 8 months, into 8 months, you get a total sum of investment in terms of money which you are paying to the employee, which includes of course insurance cover, all blah blah every (Refer Time: 27:08) is the total value, let us say.

I know the total investment what I am doing towards these two personal for a year. So, that is my exposure value, in terms of personal. Obviously, department A has 10 employees. Each one of them having so many years, dollars, again they will have a sum.

So, obviously you will see and you will notice that every department depending upon the employees enrolled in the department, hired by the department for a specific condition or the job what the department performs, the personal exposure will vary. And, we all agree that the salary or the (Refer Time: 27:54) are fixed upon the nature of job, nature of qualification, nature of experience the personal have, all will be included. Obviously, a person who is very highly experienced and educated and qualified would demand more (Refer Time: 28:06). Therefore, that will reflect in the salary that will reflect in the department personal exposure. So, this will be an indication of HR, human resource, indication to the whole composition.

So, you can see here very clearly in the composite exposure value evaluation, three major components are getting involved in the commercial evaluation of risk. What are these components? One, the personal who are involved in terms of money, in terms of hours, let us say duty hours. To how much the department is important? Because the contribution of the department in the production line is well known, that is what we call business interaction cost.

We do not say percentage. We say the cost. All should be in terms of financial value. And of course, the property of the asset of the department which depends upon the inventory machinery and equipments, the department has and the current market price for these equipments, depending upon the depreciation of these equipments. So, this can be

computed. So, all put together will be added. And, this will give you the commercial value, including personal of the department in the whole plant.

So, why they call composite? Because nature of three immovable or real value property, downtime which is flexible and dynamic in nature; in case the business is interrupted and the personal, which is also in dynamic in nature; because today you may hire a person a, who is of this salary. After a month, you, this person resigns, you have to hire another person equivalent to a and his salary may not be as same as this depending upon his availability or his non-availability. So, this is again dynamic in nature. So, all these put together are taken under one bracket. That is why the word composite comes into play.

Why they are exposed? Because we are not talking, we are not thinking about paying a person for his qualification. We are talking about paying this person for his exposure hours. For example, if his exposure hours or duty hours are reduced to four hours, obviously you will see the salary paid to this person is also reduced. So, it is all depending upon how many hours is exposed or he is on board, so therefore exposure. Similarly, at how many intervals and cycles and depreciation, the machinery is exposed during production line. And, of course you will clearly see here. This is a direct relationship to exposure because the downtime will always occur only the business interruption will always occur only when the machinery or the whole plant is exposed to the production line. If the plant or the department is not exposed to production line, let us say there is no business interruption at all.

So, all these are related to how much, to what degree they are exposed to risk. That is why it is called composite exposure. Why value because all of them, I want them in terms of commercial value. I want them in terms of financial figures; may be in dollars, may be in Indian rupee, whatever may be the currency that does not matter. But, we are interested in getting the conversion of these algorithms, in terms of financial values.

Now, you will very clearly see in this step that economic perspective of risk is introduced in the modelling. That is a very important step, which Frank and Morgan is really appreciated even today for proposing this kind of model, which is very easy and very practical and self-understanding model, which helps many industries successfully to run.

I will give an example. You will be amazed to know that how simply and easily we can solve this example. And, we can derive very more important informations from a simple problem of this nature. So, in this particular step it is very clear. We have understood. I agree that you have understood that how the economic perspective is introduced in risk assessment.

We will move on to next step. So, before you move on to next step, let us quickly summarize what we have done in this step. The property value is estimated by the replacement cost of all material, inventory, and equipments, present in the departments which are at risk. Business interruption is computed as the product of units, cost of goods, in terms of business interruption. For example, if this would have been the production unit, produces so many barrels of oil a day by drilling. If so many oils of, barrels of oil per day is not produced, what would be the cost or the loss involved because of this department not participating in the production line. That is what we are trying to calculate here.

Personal exposure is a product of total number of people into the salary or the populated shift and monitory value of each person working in the departments. So, we summarize them. We say why it is composite, we say why it is exposure and we all agree it is going to be a financial value. Therefore, composite exposure value; let us move on to step number five.

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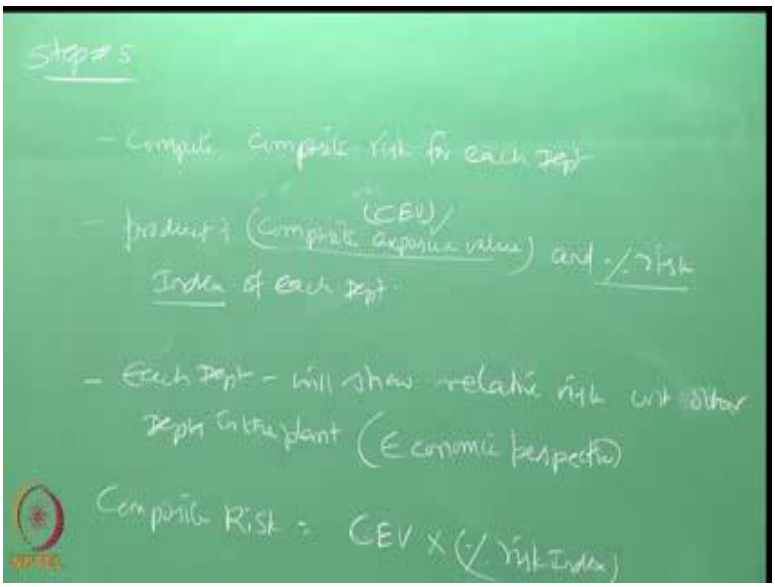

So now for each department, I have the composite exposure value. I will compute now composite risk for each department. It is nothing but the product of composite exposure value and the percentage risk index of each department. Percentage risk index, already we have calculated in the previous step. Composite exposure value, we just now calculated in the previous step in step number four. So, multiply these two value and get the risk converted in terms of financial value.

So, now in this step each department will show relative risk with respect to other departments in the plant. Now, one may ask me a doubt, one may ask me a question, which I wish one should ask. "Sir, relative risk was computed in step number two also, first level discussion is also, done in step number one as hazard level, what is fun in doing relative risk once again in step number five? Very good question, very interesting; you are actually in line with the class.

Relative risk in this level is in financial perspective made here, is an economic perspective here; because I have already converted risk into financial value. Now, I really know which department is going to cost me the maximum loss in terms of money. See, loss can happen in many ways. It can be human loss, it can be equipment and plants and machineries, etcetera.

Ultimately as an investor, as an CEO as a risk manager, as a risk executive, as a HSE operator executive, etcetera, my object is to look only into what is the commercial loss I will get, I will land up, if an accident is cost. Who is going to be the black cat amongst the whole departments, which is going to be vulnerable to create this accident? So, I am interested in getting the commercial aspect, perspective of the whole risk index as a manager, as an inventor, as a insurance authority, as a CEO, as an HSE executive, leader of HSE team, I have to ultimately present the financial terms to my stake holders. Stake holders will not understand and agree whether my risk is so many percentage, etcetera.

What is, what they will ask me in the board meeting is that "Sir! what would be the financial loss if the accident would occur? Can you identify which department is actually causing this trouble?" It is not the question of (Refer Time: 27:10) the department or punishing one. It is the question of investing more towards the control scores of the department. So it means the CEO, the HSE executive, the HSE team will be given a indication, "Sir, this department is weak, amongst all the departments. The control scores are very poor. We should invest more budgets to the department towards improving their control mechanisms". So, in the right spirit this is what it is.

But, however when you look at the incentive, you have to be very careful; you have to be impartial. You have to say department D, may be, is not performing; department A is performing. And therefore, A should be rewarded and D should not be rewarded. That is how the competition can be.

You cannot normalize the rewarding concept, in terms of looking at the personal capacity of the department. No. So, in one way it is bad because it will explode, expose the department who is contributing to the maximum risk of the plant. One way, it is very good. It is explicitly showing me which department is contributing to the maximum risk. So, I can be careful to invest more on the control scores of improvements of the department. So, the risk level of the whole plant can be reduced. That is the whole objective here. Very interestingly, very nicely, very smoothly, risk which is a mathematical term, which is the statistical approach, is converted to financial terms by Frank and Morgan in early eighties. This has been a very successful model for every

process industry as recommend by them, which we will also use in one of the examples here, in this class.

So, in step number five I am converting or I am estimating relative risk. But, this relative risk is different from the earlier steps because this is in terms of economic perspective. Therefore, composite risk which I will compute in this step is equal to the composite exposure value. Can I write CEV because I can say CEV is composite exposure value multiplied by percentage risk index? I get this; step number five. So, there are six steps in Frank and Morgan. The last step is risk ranking.

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Now, fundamentally one would like to ask a question. So, why do we have to rank the departments? It is not depending on performance made here. I am not giving a rank on the best performer of the year; nothing like that. I really wanted to know amongst the six, seven, ten departments, who is the most vulnerable black cat, who is going to contribute to me accident. If at all the loss is going to happen, who will be responsible for this. So, I pay attention to the person more. That is the point here. So, risk ranking is a final step, in this process. Risk ranking is actually based on, I should say only on, the composite risk.

Now, this is where which is unique to offshore industry. Risk, if I look at the general definition expressed in fatality accident rate, may be individual risk, may be societal risk, all are related to fatality accidents only. It means the number of person exposed to working hours for the specific incident or an event and out of which how many people actually died. So, it is all about personal. Whereas, here the risk ranking in offshore industry is not only personal because personal is also included. As you see in this specific step, we said personal exposure is a part of composite exposure value.

So, personal value is also included. But, it also includes asset, maintenance, downtime cost, importance and feeling of the department towards risk management. You can say how feeling is included here; because depending upon every level of business interruption, you can always reward the departments. So, rewarding will come only when they perform; they will perform only when they feel.

So, risk management has been inculcated through this method as a culture or as a feeling, each department. So, that is a very interesting idea. That is the important goal what we wanted to actually establish in good. Let us say practices. So, in this specific step we get the final risk ranking, which is purely based only on composite risk.

Now, what would be the outcome of this step? There are many outcomes. The first could be you will know which department is weak, in terms of control score. You will also know which department had the maximum hazard. I am talking about hazard. And, is the same department has the maximum risk? It is a very interesting question. I will explain this with an example.

Third could be is the most important department. How do we get the most important department? Depending upon the downtime cost involvement on the production line is the most important department is contributor or is contributing to maximum risk. Now, if this question is, yes, you have got to revisit the whole plant design, once again. You have got immediately, pay attention to the HSE practices and improve certainly the risk level in this department; because this is one of the most important departments in the production line. And that department is contributing to the maximum risk. You have to be

very careful because it can cost catastrophic accidents, which can result in a very heavy financial loss to the company.

However interestingly, if this is not true, then one can say the risk acceptance level. This is where the acceptance actually coming in the play in oil and gas industries. Though the department is contributing risk, but can this risk is acceptable in the whole production line? Because the contribution of this particular department of the production line is a minimum, even there is a risk in this department; the production line will not be affected. It means your business interruption will not cause to a financial loss. You understand how risk is connected to financial terms.

So, it is a very interesting diagnosis part and (Refer Time: 44:44) of the problem, which has been done by Frank and Morgan model, which is very good to realize and understand and feel. How every level of risk assessment has been simply done in steps in easy methodology to handle?

So this, the next outcome what we have here last could be what should be the budget allocation to each department. Now, one can ask me a question. “Sir! how this budget allocation can improve the risk management terms?” Now, let us say department A, department E, department D, B was a referral department which is control score. I mean, the risk index is zero; reference department, best department. So, obviously we, should you have to give any budget to the best department? So, that should be decided. Should we not give or should we give more value of the maximal to the worst department; because the department E is showing the maximum risk index. Therefore, the control scores are very bad, should invest more on E to make it better.

So, these are decision points. And, let us say if E receives the maximum funding, E has to distribute this funding, amongst this three, is it not. This is a commercial aspect of the whole problem. So, therefore the members of this department who are employed will get more incentive. So, the salary structure will be different from that of people in other departments. So, your pay structure or your personal exposure value can be really dynamic, depending upon the risk assessment tool suggested to by Frank and Morgan, very interesting.

So, you can arrive at such decisions in the board meetings, only depending upon one simple example problem, which you can really do wonders with risk assessment tools, what has been suggested so far. So, now it is better that we have got to really understand a problem, take an example, solve it and then try to work out as a manager, as a HSE executive; these outcomes from the example problem, which we will see in the next lecture.

Thank you very much.