Social Innovation in Industry 4.0
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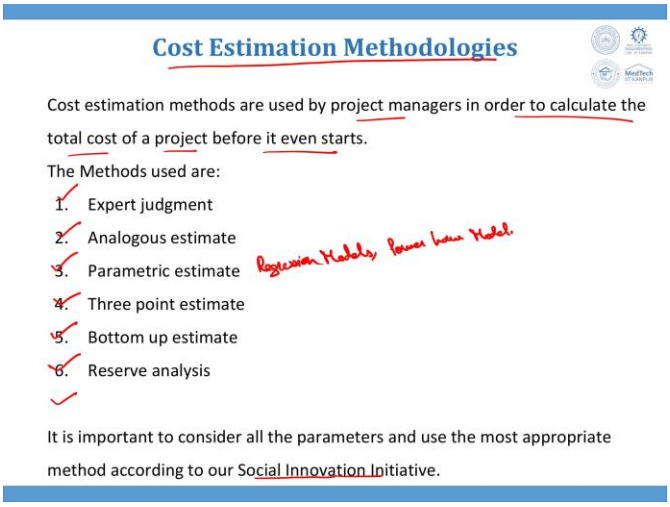
Lecture 23
Cost Estimation Methodologies

Welcome to the third lecture of this week. We are trying to continue what we are discussing in the last lecture, and I will gradually focus upon the Cost Estimation Methodologies in this lecture.



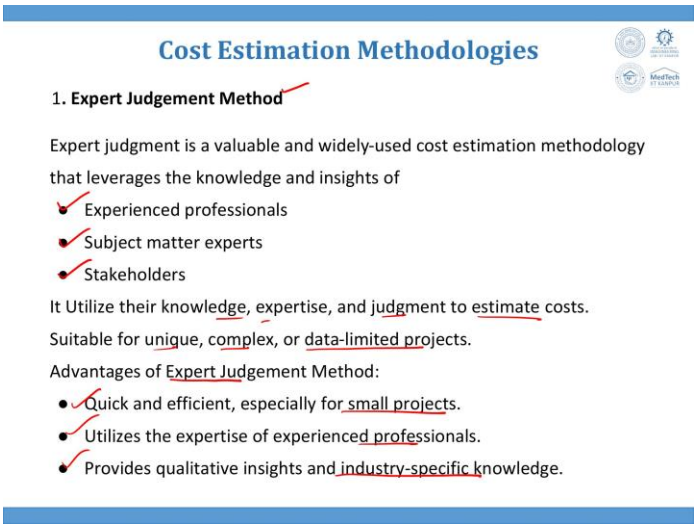
Cost Estimation Methods are used by project managers in order to calculate the total cost of a project before it even starts. There are certain methods, and these are the few methods, which are I have jotted down here, which are used in the projects which are having Social Innovation at their focus. Number one is expert judgment. What is expert judgment? It is valuable or widely used Cost Estimate Methodology, where experienced professionals take or give their judgments based upon their experience and this is used to estimate the cost.

Then, we have analogous estimate in which the cost of the similar project is taken. And, for the similar projects the cost are taken, and those are projected upon the present project that we are trying to work upon. Then, you have parametric estimate. Parametric estimate means it is a statistical estimate in which the regression models are there.

Then, we have power law model. Three point estimate is also one of the methods, in which three points, when I say three points, three major points are taken, or we call it best

case estimate, worst case estimate, and most likely estimate. Then, comes the bottom up estimate, as I talked about the bottom up and top down estimates in the last lecture. Here, bottom up estimates where a detailed and comprehensive approach of breaking down of a project into smaller components, then, estimating the cost of each component or individual elements, then try to estimate the overall project cost. This is what is bottom up estimate and this will be discussed.

Then, we have reserve analysis. Reserve analysis means that certain uncertainties are there, certain risks are there. To address the potential risks or the cost over hence, or may be schedule delays are there, these methods are used. It is important to consider, that all the parameters and use of the most appropriate method according to our own Social Innovation initiative. So, we need to understand all of these.



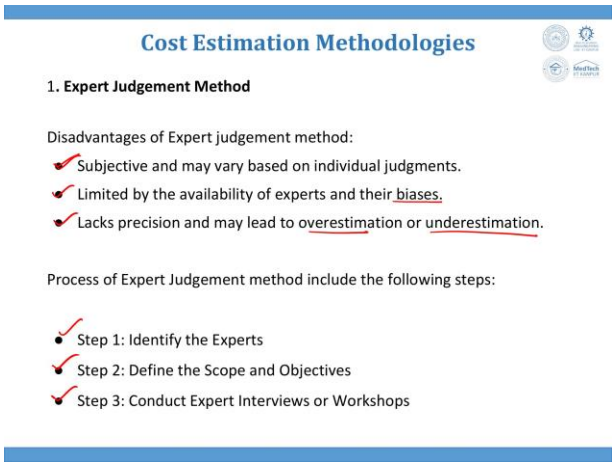
Based upon the innovation, or the kind of the information, or kind of the data that we have, we need to select one of the methods. Let us try to discuss, all of these one by one. Number one is, expert judgment method. Expert judgment method is a valuable and widely-used cost estimation methodology that leverages the knowledge and insights of experienced professionals, subject matter experts, stakeholders. It utilizes the knowledge, expertise, judgment to estimate costs.

It is suitable for unique, complex or data-limited projects because, we do not have much data for the product, or the product is very new or the product is introduced into the new market, and there is no past data or historical data. Then experts who have worked upon the similar projects they can may be think of some product that is representative of the current product. They can say okay this kind of the market has, these kinds of needs. For

example, the markets in the remote area have the very basic needs which are there in the urban area. They might need electricity in a more approachable way.

They might need the connection to the internet in a more approachable way. So, these kinds of the judgments can be given by the experts, and this method, because we need to find the experts which is a challenge, which is a starting point of this. Once experts are considered or taken into account or are identified, then this method is quick and efficient, especially for small projects. It utilizes the expertise of experienced professionals. It provides qualitative insights, and industry specific knowledge.

Industry specific knowledge because the experts are from different fields. The experts could be from production, experts could be from the IT background, it could be from the marketing background, it could be for the financial background, it could be from the sales background. They can tell their opinion and with a consensus of their judgments, of their opinions we can estimate the cost.



In this certain cons are there, for example, judgments are subjective and these may vary based on individual judgments. It is also limited by the availability of experts and their biases.

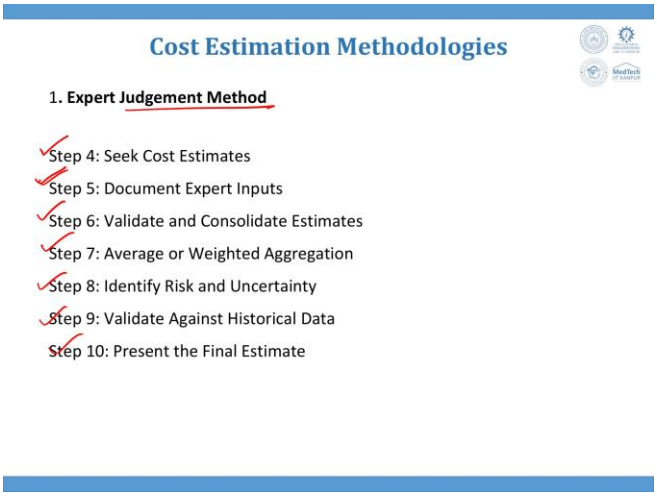
Sometimes, the experts are biased to the specific field that they have worked upon. The production manager sometime is not able to understand what the new product that includes Industry 4.0 would be responded in the market. Because he is majorly talking about or may be concerned about the production methodology or the production time or the production cost only. So, sometimes their biases are there.

Then lacks precision and may lead to overestimation or underestimation. Because we are missing the data, because we are missing the information on the product, only then this expert opinion method is used. The process of expert judgment method includes the

following steps. Number one is identification of experts that means experienced professionals, or stakeholders, or subject matter experts are taken or identified, and they are convinced to be part of our project. Then, step two is define the scope and objectives.

That is, we outline the project objectives, requirements, timelines onto a page, that means onto a document and try to communicate this to all the experts. Then, we conduct expert interviews or workshops that means to gather expert opinions or cost elements we need to have expert interviews. The interviews of the experts, it is an important point, could be sometimes individual. If sometimes, the one of the expert may be influenced by another expert who is an experienced person, example, production manager is having an experience of 20 years in a big concern, and a marketing manager is having a 5 years of experience in market. The 20 years experience person may be could be more dominant in talking.

So, sometimes individual interviews are taken, their judgments are taken or put onto a paper, then whatever common things those are taken. This all is analyzed by a central person who is known as the facilitator. Sometimes, take the judgments as blindfolded that means expert would not know each other or would not communicate with each other. Sometimes, these are called upon on a, or the most of the time these are called upon on a single platform on a single time, that is a combined meeting or collective meeting is called upon. So, conduct expert interviews or workshops to collect the data.

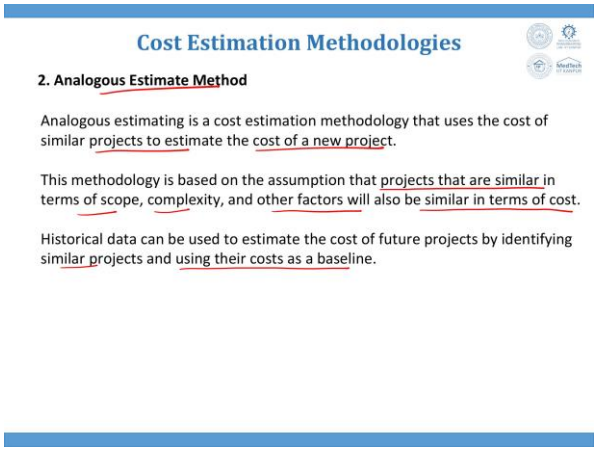


Then, we seek cost estimates from the experts that means the cost for the materials, labor, overheads, the communication all the cost that we discussed in the previous lecture are taken or may be estimated by the experts based upon their experience only. Then, we document the expert inputs that means experts cost estimates and assumptions are also

laid down here. Validation and consolidation of estimation is very important, because whatever experts have said, these are to be validated by a separate set of experts. Separate set of may be, if you suppose, we have identified 10 experts, we will keep 6 or 7 experts as our core experts, then 3 experts will be validating people. Those who would get okay these things are there, because sometimes the bias, if it is there, the validating team could help us to get away with that bias.

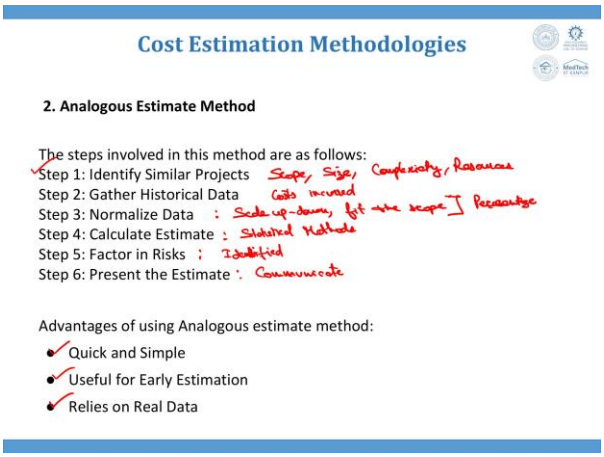
Consolidating of estimates is taken in this step 6. Step 7 is, averaging and weighting the aggregation. That is, we calculate the average of the estimates given by each of the experts, and we also try to give the weight to the experts who are more close or considered to be more experienced in the specific kind of the innovation that we are trying to come up with. Step 8 is, identifying the risk and uncertainty, that is potential uncertainties impacting project costs are identified. Then, we validate against historical data, that is we compare estimates with data from similar projects.

If the data is available, we try to compare, otherwise we try to see a representative project from the past and try to validate it according to the whatever the available data is. Then, present the final estimate that is the compile and present the cost estimate to the stakeholders. So, this is the expert judgement method.



Next is the analogous estimate method. By the word analogous, itself means the very common or very basic estimate methods, in which the Cost Estimation Methodology this is used where the cost of the similar project is taken to estimate the cost of new project.

This methodology is based upon the assumption that projects that are similar in terms of scope, complexity and other factors will also be similar in terms of cost. Historical data can be used to estimate the cost of future projects by identifying similar projects, and using their cost as a baseline.



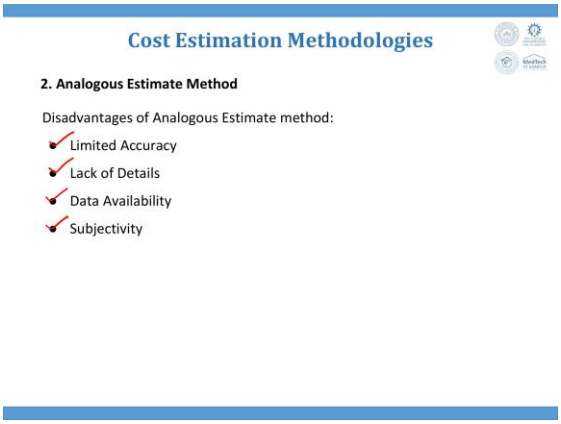
So, the steps which are involved in this kind of the cost estimate that is the analogous estimate method are, number one is identification of similar projects. When I say identification of similar projects, again it was mentioned the scope, the size and complexity of the project is taken, and the resources which are required for the project should be similar. Then, we gather the historical data that is the cost incurred historically or the sources utilized are gathered from the historical data.

Then, we try to normalize the data. Normalizing means adjusting the historical data to the current situation. For example, if there are certain differences in the scale of the product we try to calculate it according to our current scale, or if the scope is different we try to overestimate or underestimate based upon our own scope. So, we try to scale up or down, then fit the scope this is known as normalizing the data, or we can also normalize it based upon the percentages. For example, if 100 pieces of this innovation is to be produced, what is the scale required, how many machines are required, we can normalize it to 100, that is percentage.

Per 100, or per 1000, or for 10,000. So, this is how we try to normalize the data for a specific size or specific number here. Then, we calculate the estimate that the cost of the current project by averaging the cost of the similar projects or may be using some statistical methods. Then, factor in this, which means there might be certain factors which impact the accuracy of the estimate. So, these factors are identified.

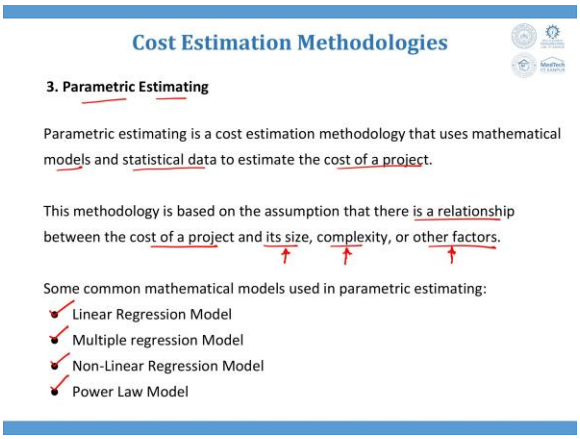
Then, we present the estimate that is only communicate the estimate to the stakeholders or the project team. So, this method that is the analogous methods is quick and simple because it is straight forward. We are only trying to estimate based upon the historical data and this is less time consuming than the other methods, that I am going to discuss further. It is useful for early estimation though the data that is available is only for the similar project of the past, but still early estimation, or the basic idea, or the base cost too

comes from this kind of the estimation. It relies on real data which is also one of the pros of this kind of the estimates.



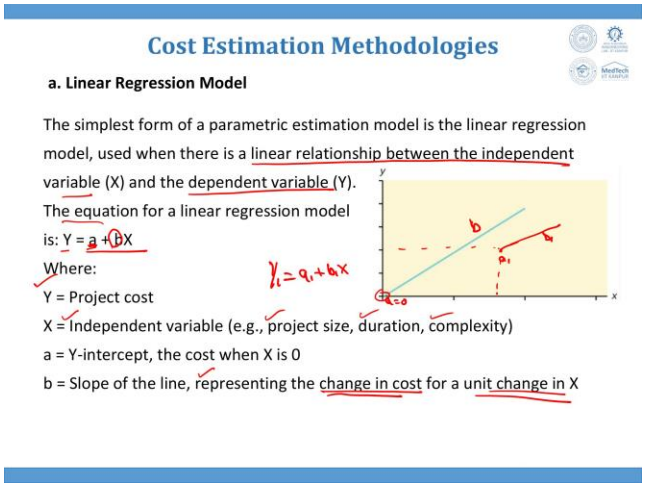
There are certain demerits or disadvantages that means it limits the accuracy. Because accuracy of the estimate heavily depends upon the similarity of the current project to the past project. If similarity is less or dissimilarity part is also there, the accuracy is limited. The lack of details of the current project is also there, because the method may not account for specific small changes or nuances or unique aspects of the current project. For instance, if I am trying to develop a similar kind of the, maybe mitticool refrigerator for the people in IIT Kanpur campus, that could be different than what I have developed in a rural area or that we have developed in an area in the city.

The willingness to spending capacity could be different for the people at the campus or for the people in the city Kanpur. So, lack of details sometimes is there and data availability sometimes is limited for the past, or the historical project data that is there. So, we are only using the data whatever is available to project the cost of the current project. Subjectivity, which means the estimate may still be influenced by the judgment and experience of the estimator only, because he is studying the past data that is only the difference from the judgmental estimate method. But, still it has little more detail because at least we are trying to pick a historical project, which is almost similar to the current project as far as possible.



Next comes the parametric estimating. The two methods that I have discussed were majorly dependent upon the experts opinion. Though analogues method that the data from the past but still there are only experts who are trying to work upon this data. Now, we have parametric estimating. When I say parametric estimating, the parameters which are influencing the project or the product are taken into consideration. When I say parameters, that means the variables.

These variables are independent variables, in which dependent variables are our regression models dependent variable, which help us to tell whether to take these parameters, or not, or what should be the costing based upon the specific parameters or specific independent variables. So, this is known as parametric estimating which is a statistical method. Parametric estimating is a cost estimating methodology that uses mathematical models and statistical data to estimate the cost of a project. This methodology is based on the assumption that there is a relationship between cost of a project and its size, complexity and other factors. So, this size, complexity and other factors are all taken as our parameters or the independent variables.

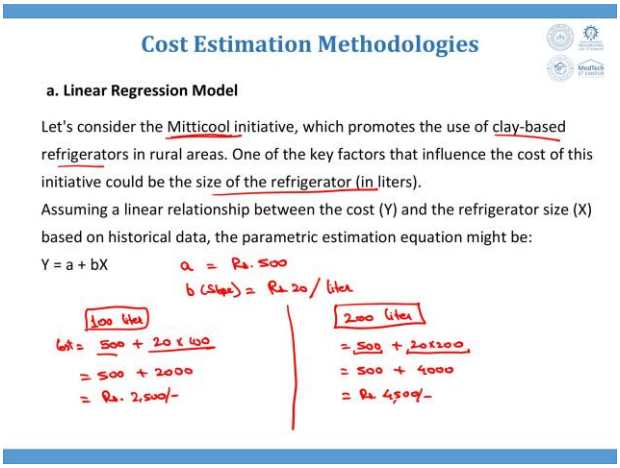


So, when I talk about independent variables and a dependent variable, definitely linear regression will come into play. Linear regression is, when we have one independent variable and one dependent variable. When more than one independent variable is there, we come up with multiple linear regression model. Non-linear regression models where the parameters are also related to each other, or maybe if it is not a first degree regression model, it is an higher order degree regression model that becomes a non-linear regression model. Power model is also one that we will discuss in the forthcoming slides which is also a parametric method to determine the cost of a Social Innovation.

Number one, linear regression model. It is a simplest form of parametric estimation, and it is just determining the linear relationship between the independent variable x and dependent variable y. There is a simple regression line that is Y = ax + b. Here, the value of a is 0, and this is slope b, this is line, where Y = ax + b. So, if suppose the line is here, so, this is my slope, b1 here, and this is value a1, which is having specific distance from here. Here, Y1 = a1 + b1 * x, where y is my dependent variable, that is the project cost which I am trying to determine.

X is the independent variable that is project size, duration, complexity any of these. a y intercept when the cost x is 0. Here, a is 0 in this graph, b is a slope of the line, that is representing the change in the cost for a unit change in x. If x is 5, the b becomes 5 times of the value. Now, b is a slope, it is also known as a contribution to y. a is a constant value, b is my contribution.

If x turns to 2, the b is 2 times contributed. If x turns to 5, b is 5 times contributed that means b is my change in cost for a unit change in x.

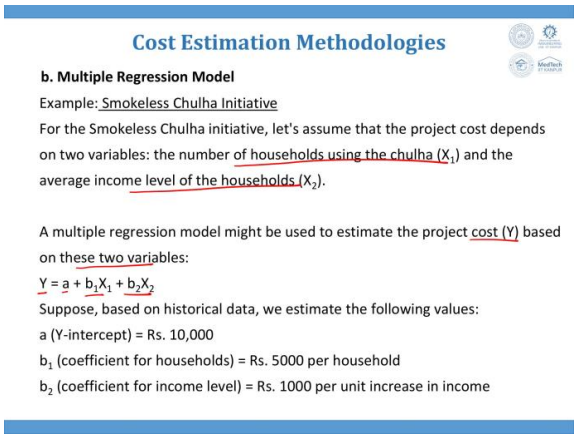


Let us talk about the initiative that is the Mitticool initiative which is a Mitticool refrigerator. So, it is a clay-based refrigerators using rural areas. One of the key factors, that influence the cost of this initiative could be the size of the refrigerator in liters.

So, assuming a linear relationship between cost y and refrigerator size x based on historical data the parameter equation might be. Let us try to take an example, values here. Let me say the person has put the value of intercept that is value of a by intercept as rupees 500, that is even for 0 liter capacity rupees 500 is the refrigerator cost base, and per liter cost which is b, that is slope, this is equal to rupees 20 per liter. Now, if suppose a 100 liter capacity refrigerator is to be taken. So, this value or the cost would be value a, that is 500 + b * x, b is 20 * x = 100.

So, this is equal to 500 + 2000 = Rupees 2500. This is for a 100 liter capacity refrigerator. This is just a simple linear regression model with one independent variable.

Now, let us also see for 200 liter capacity, suppose, how does the cost vary? This cost could be 500 + 20 * 200 = 500 + 4000 = Rupees 4500. This is a simple example of linear regression model.



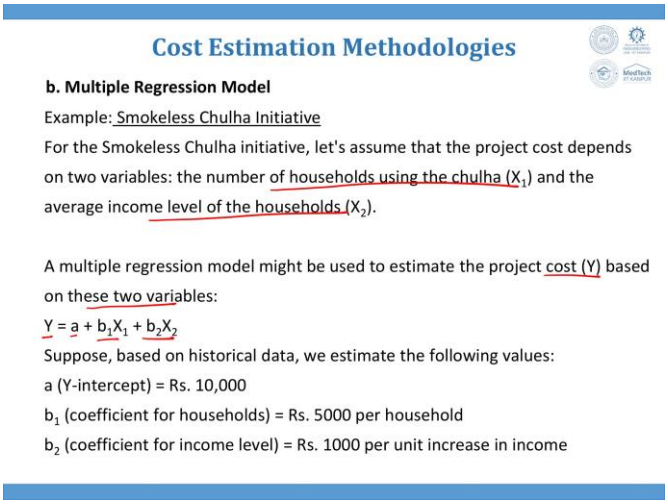
Now, this regression model could also be multiple. When I say multiple, it has more than one independent variable. So, here multiple independent variables come in multiple regression model this influence the project cost, because it is not even the capacity, it is also the robustness, it is also the transportation cost, that where this refrigerator is to be moved to, or transported to. In this case, the other variable should also come.

So, this is known as the multiple regression model. It takes into account the combined effects of all the variables. The equation for multiple regression model is, such as,

Y = a + b1x1, that is contribution b1 for the variable x1, that could be size. Then, contribution b2 for the variable x2, that could be transportation or the distance, then, so on contribution bn for a variable x_n, where Y is the project cost, x1x2 so on up to x_n are independent variables. A is again Y intercept, that the cost when x variables are 0. And, b1b2 so on up to bn are the coefficients representing the change in cost of a unit change of each of the x variable, or each of the respective x variable, I would say.

Final equation will be:

$Y = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n$



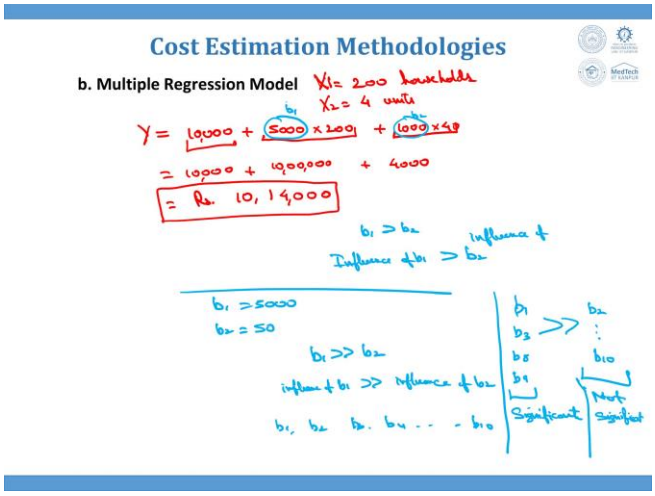
Now, let us take an example of smokeless chulha initiative, here. For the smokeless chulha initiative, let us assume that the project cost depends upon two variables, that is the number of households using the chulha. For example, the smokeless chulha is put in a village. And, in this village, more than one household is called use a chulha, something like this, and average income level of the households. A multiple regression model might be used to estimate the project cost y based on these two variables.

$Y = a + b_1x_1 + b_2x_2$.

Suppose, based on historical data, we estimate the following values. Y = 10000. b_1, that is the coefficient of household is rupees 5000 per household, I am talking about a big size chulha, the cost is very high here. b_2, the coefficient for income level is rupees 1000 per unit increase in income.

Then, what would my model look like. So, it would be

Y = value of intercept is 10000, then 5000 * x_1, then 1000 * x_2.



Let me say, I am making a model for 200 households and income level of 4 units. That means, this is my x_1 value, this is my x_2 value. So, here,

Y = 10000 + 5000 * 200 + 1000 * 4

= 10000 +1000000 + 4000 = 1014000

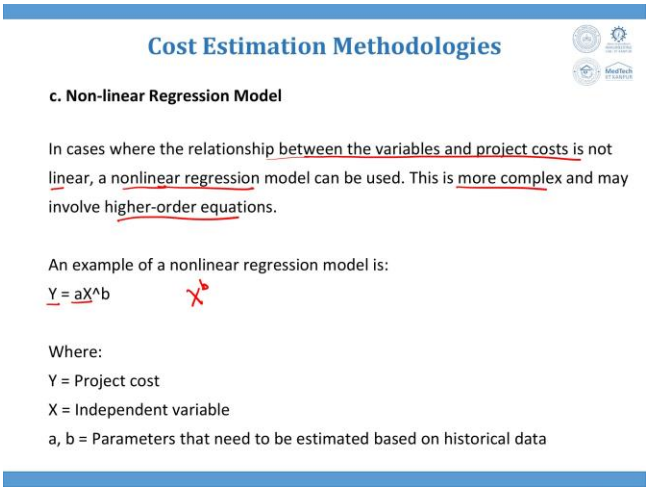
Which is quite high. Though, this cost might not be realistic, but the point, that I am trying to make here is, the factor which is having higher contribution determines the cost more.

See, this b_1 value is 5000, this is b_2. With even 1 unit increase of b_1, 5000 rupees cost increases for the product, that I am talking about. With even 5 time increase in b_2. For example, from 4, if it turns to 9, then only contribution would be 5000. So here, b_1 is a major contributor.

This depends, because b_1 is larger than b_2. So, that means influence of b_1 is larger than b_2 or is larger than influence of b_2. In case, suppose, this b_1 was 5000 only and b_2 was 50. Then, you can say b_1 is very large than b_2, and influence of b_1 is very large than influence of b_2. Then, b_2 factor even could be ignored, because it is not contributing much. So, in this case also, if we have multiple factors, b_1, b_2, b_3, b_4, so on, up to values, up to maybe b_{10}.

So, all the factors which are larger may be b_1, b_3, b_8, b_9. These are very large than the other factors, may be b_2 and so on, up to b_{10}. So, then b_1, b_3, b_8 could be called as

significant factors that means they are having significant change in the cost with even one unit change in them, and these are not significant, that is they have smaller contribution.

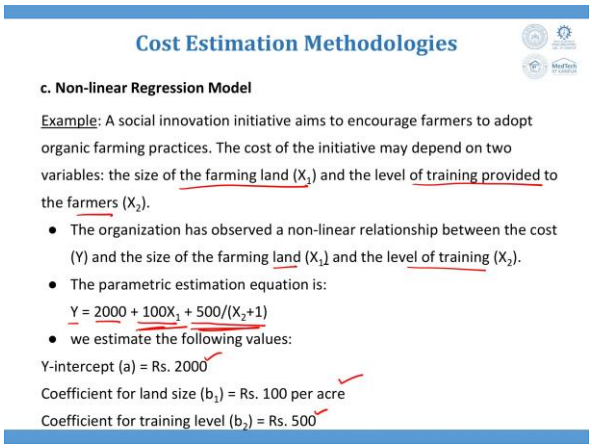


Non-linear regression model, non-linear as I said, the term when the equation is not just a linear model, when the power units are also recused or the higher order equations are there. In these cases, where relationship between the variables and project cost is not linear, and non-linear regression model is used.

This is a highly complex method and may involve higher-order equations. For example,

$Y = aX^b$.

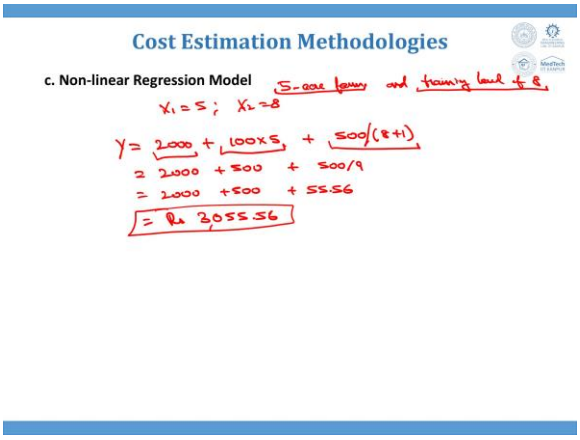
When I say, X^b that means with even one value of change in X, the power is depending or increasing it to very large extent in comparison to what linear model was doing. So, where Y = project cost, X = independent variables, and a and b are the parameters, that need to be estimated based upon the historical data. So, this is one of the non-linear model, there could be multiple non-linear models. It could be X^{b1}, then X^{b2} so on.



So, here, an example that is put for the non-linear model could be a Social Innovation initiative that aims to encourage farmers to adopt organic farming practices, the cost of initiative may depend upon two variables. That are, size of farming land, and level of training provided to the farmers. Now, x_1 and x_2 become two variables. The organization has observed that non-linear relationship between the cost y and the size of farming land x_1, and the level of training x_2 is to be determined.

Now, this is the parametric estimation that they have put.

$Y = 2000 + 100X_1 + \frac{500}{X2 + 1}$. This is also a non-linear model. We estimate the following values. Y-intercept value as 2000, coefficient b_1 as rupees 100/acre, coefficient of training level is rupees 500/training. Now, let us try to calculate the cost estimates.



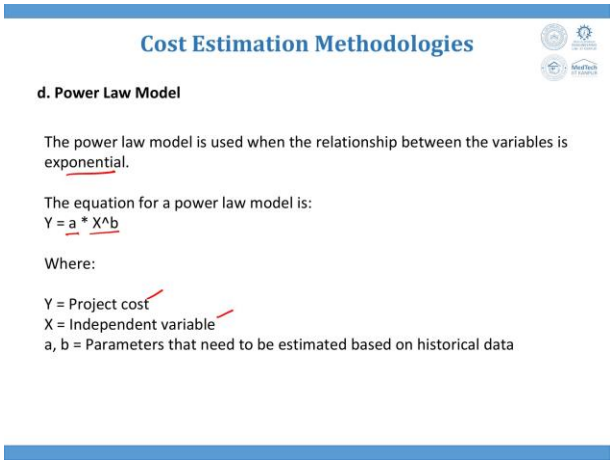
If I say, we are working on a land with 5-acre farm, and training level of 8. So, you see, my x_1 is 5, my x_2 is 8. Now, let me draw it on the model here. It is a project cost is equal to 2000 plus.

Let us see the value of the contributions here.

$Y = 2000 + 100 * 5 + \frac{500}{8+1}$

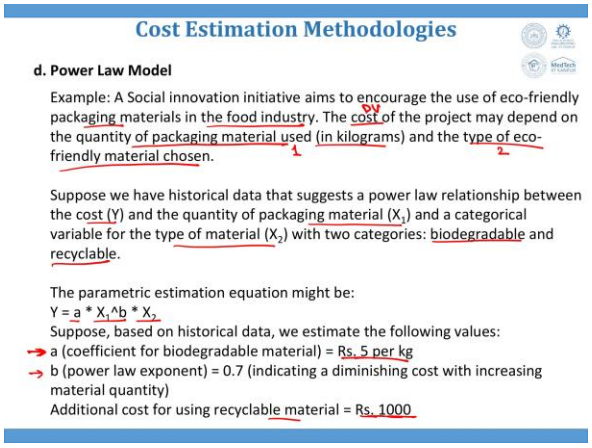
= 2000 + 500 + 55.56 = Rupees 3055.56

So, based upon a non-linear regression model, we can say for an organic farming initiative with a 5-acre farm and a training level of 8 the approximate cost of the project would be rupees 3056. This is non-linear regression model.



Similarly, we have a model known as power law model, which is also kind of a non-linear model but here always power is used. Though the non-linear model could use power, could use other estimates, which we just took that because the variable was in the reciprocal so that was also a non-linear. So, here the power law model is used where relationship between variable is exponential.

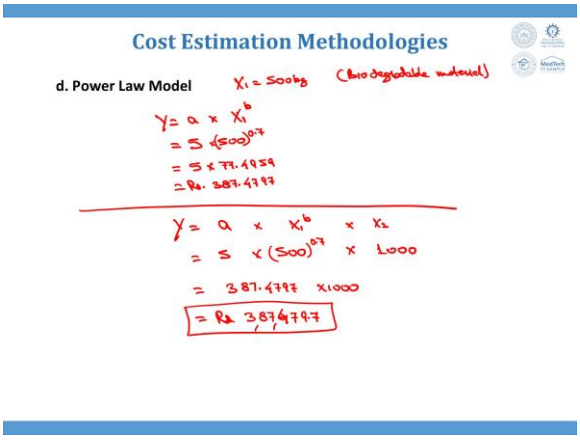
That is equation of the power model is, $Y = a* X^b$, where Y is equal to project cost, X is equal to independent variable, a and b are the parameters that need to be estimated based on historical data.



In the power law model, example, let us take a Social Innovation initiative that aims to encourage the use of eco-friendly packaging material in food industry. The cost of the project may depend on the quantity of packaging material used. That is in kilograms, this is the first factor.

And, type of eco-friendly material chosen, this is second factor. We need to determine what cost which is our dependent variable. Suppose, we have historical data that suggests a power law relationship between the cost Y and quantity of packaging material X_1 and categorical variable, that is type of material X_2 with two categories. Biodegradable material and recyclable material. So, X_2 has no two categories and x_1 is a metric model which is type of material.

The parametric estimation equation might be $Y = a * X_1^b * X_2$. Suppose, based on historical data, we estimate the following values that is a, which is coefficient of biodegradable material is rupees 5/kg and b, that is the power law exponent is 0.7 indicating a diminishing cost with increasing material quantity, additional cost using recyclable material is rupees 1000.



Now, let us try to calculate in a situation, where eco-friendly packaging for 500 kg of biodegradable material is there. When I say 500 kg of biodegradable material, that is my value of X1 is 500 kg, this is biodegradable material. Now, simply if I say,

$Y = a * X_1^b$, this becomes, Y is equal to what is value of a here.

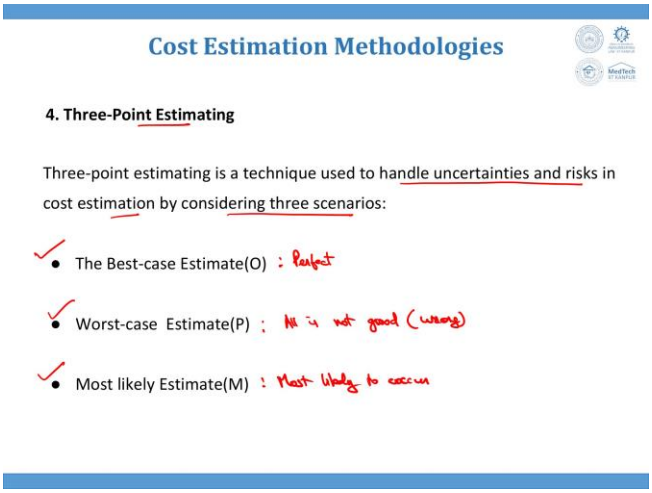
$= 5 * (500)^{0.7}$

= 5 * 77.4959 = Rupees 387.4797.

Why have I taken four pieces of decimal, to just know? Now, let us taken the second case, where the material is recyclable. If the material is recyclable, then we have recycle material cost, which is factor X_2, this also comes into play.

Now, my model becomes $Y = a * X_1^b * X_2$.

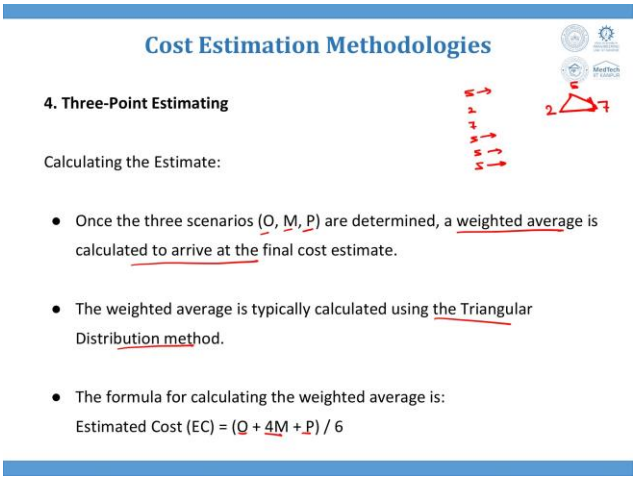
$= 5 * (500)^{0.7} * 1000 = 387.4797 * 1000 =$ Rupees 387,479.7. This is power law model. These were a few parametric model that we have discussed.



Now, there are certain other models, which are not directly parametric, but they use the probabilities. When I talk about probabilities there could be estimates. The three point estimating model is one of those, where three-point estimating is a technique, which is used to handle uncertainties, and risks in cost estimation by considering three scenarios.

The best-case estimate, the worst-case estimate, and the most likely estimate. The best-case estimate is the estimate of the cost of the project, if everything goes perfectly. Worst-case estimate is everything goes wrong, all is not good. Even in place of not good, I would say, all is almost wrong. Still this cost would be there.

Then, most likely estimate is in between the best-case and the worst-case. So, this is the project that is most likely to occur.



So, in this case the three scenarios are determined, that is the best case-scenario, the worst-case scenario, and most likely scenario are determined and a weighted average is calculated to arrive at the final cost estimate. The weighted average is typically calculated using triangular distribution method, because triangular distribution method is used when the number of the points or the data points which are available are very less. It could be three points, five points.

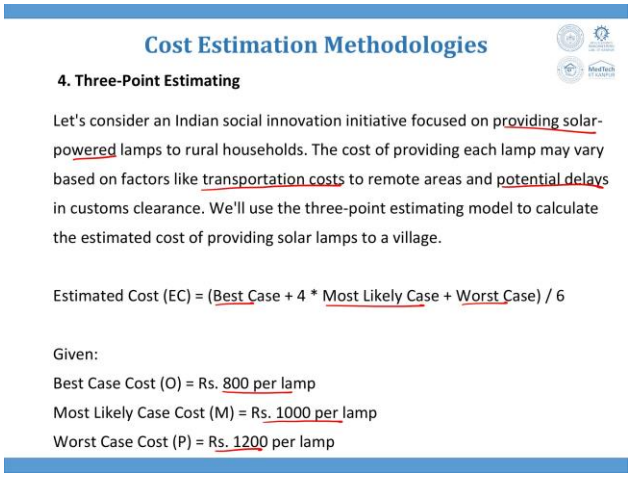
Then, we have two extreme values and one value which is generally the mode value. The most likely is the value that is most likely or the most of the time is going to occur. So, this is the triangular distribution characteristics, that I am trying to talk about. For example, if you are taking average of something, it is coming 5, 2, 7, 5, 5, 5. So, most of the time the mode value, that is mode number of time 5 is occurring.

So, here the value, that is minimum is 2, maximum is 7 and above we have 5. This makes a triangle. So, that is why, it is known as triangular distribution.

The formula for calculating the weighted average is,

$$\text{Estimated Cost} = \frac{O + 4M + P}{6}.$$

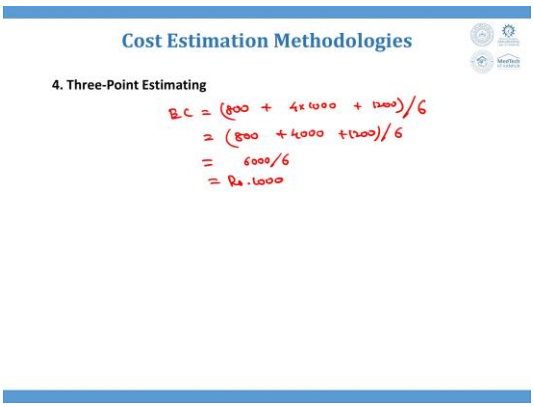
There are six values taken 1 plus 4 plus 2, and it is divided by 6.



Now, let us take this example. Let us consider Indian Social Innovation initiative focused on providing solar powered lamps to rural households.

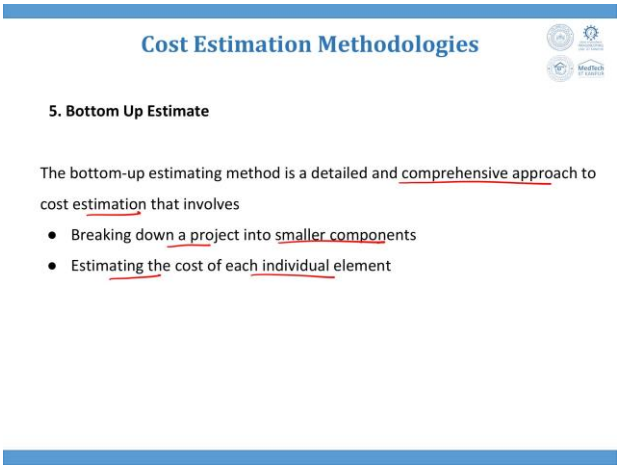
The cost of providing each lamp may vary based upon factors like transportation cost, remote areas, potential delays in customs clearance. We will use three-point estimating model to calculate the estimated cost providing solar lamps to a village. The estimated cost here is as it is mentioned in the previous slide, best-case plus 4 into the most likely case plus worst-case divided by 6.

Now, best-case cost is rupees 800 per lamp. Most likely cost case is rupees 1000 per lamp. Worst-case scenario when everything goes wrong, then the cost is rupees 1200 per lamp.

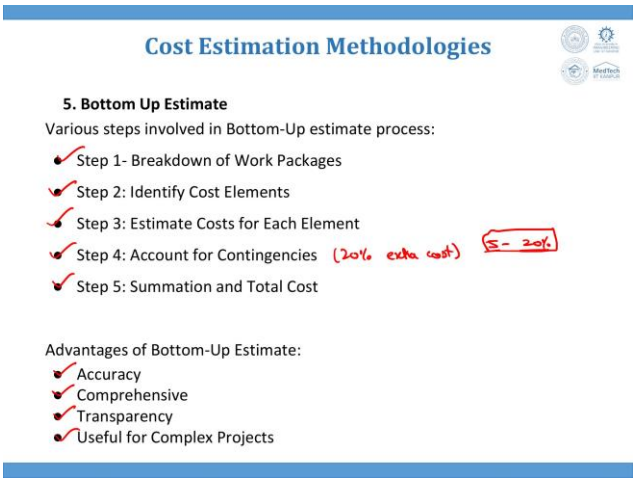


Now, let us try to calculate this cost for three-point estimation. Let me say, the estimated cost for three-point is equal to the best case scenario

$\frac{800 + 4 * 1000 + 1200}{6} = \frac{800 + 4000 + 1200}{6} = \frac{6000}{6}$ = Rupees 1000. So, therefore, the estimated cost for solar lamp using three-point estimating model is rupees 1000 considering the three cases, the three scenarios, that is the best most likely and worst-case is for transportation and customer delays in rural areas.



So, next comes, another approach, which we talked about in the previous lecture, that is the bottom up approach. Bottom up approach is estimating method, that is a detailed and comprehensive approach of cost estimation. Because we break down a project into smaller components, then estimating the cost of each individual element is taken into account and we try to understand or determine or estimate the cost for the overall project. Now, there are certain steps to it.

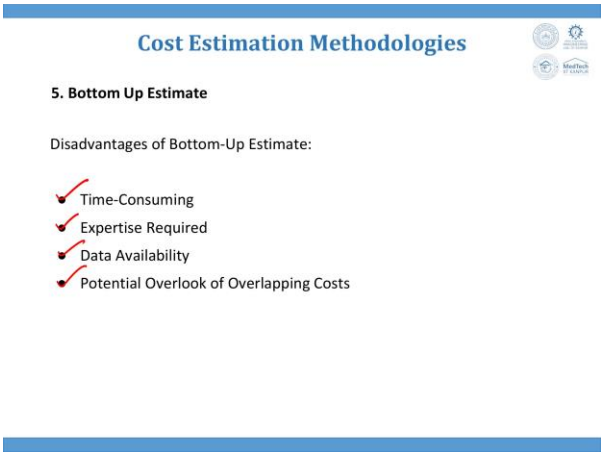


First step is breakdown of work packages, that is divide the product into manageable work packages. We do not have to divide the overall project into the smallest components, smallest element. The work package could have may be 10 or 12 elements in it, but the overall elements of the project which are may be 1000 could be divided into small work packages.

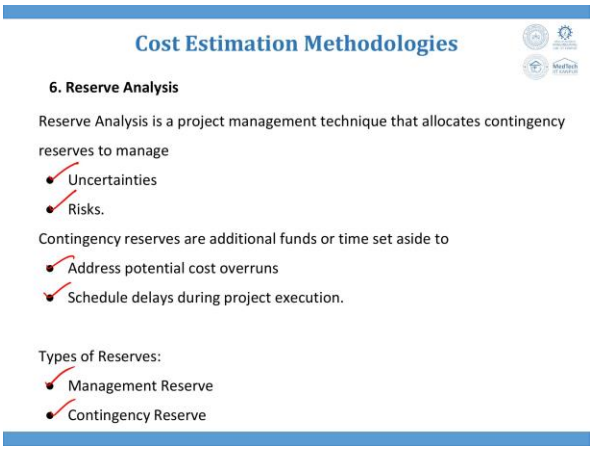
Then, identify cost elements. Cost elements that means determining the material cost, labour cost, equipment cost, land cost, all these cost factors are determined here or elements are determined here. Then, we estimate the cost for each element. That each element based upon the quantity, based upon the rate, based upon the quotations you get to determine the cost. Then, account for the contingencies.

Contingencies, that means the reserve, the unforeseen events, the risk all the cost are also included in it. May be generally 20 percent extra cost is given, if the product is very innovative. It may vary from 5 to 20 percent. I am telling 5 percent because if you are deterministic it could be 5 percent. If the product is highly variable, 20 percent cost is generally given.

Then, summation of total cost that means sum up all the cost to have the total project cost. Now, advantages of bottom up estimate is that accuracy is high because it is a detailed criteria, it is highly accurate, it is comprehensive, it is details and no cost is overlooked and each element is involved, each element is considered in the cost calculation or the cost estimation here. Transparency is there because we provide a complete breakdown of cost for the stakeholders and the stakeholders are also giving the cost of each of the elements. That is why, it is transparent and comprehensive. Then, it is useful for complex projects because complex projects have numerous tasks and activities and each of the activities taken into account. So, it is highly useful in them.

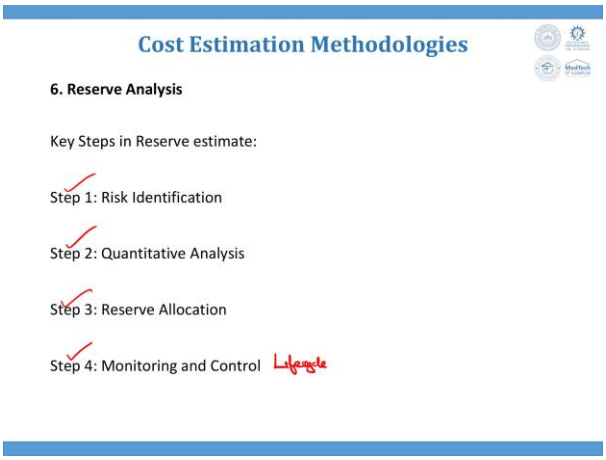


Yes, it is time-consuming. This just becomes one of the disadvantages. Expertise is required to properly bake, the work baked structures to adequately divide them into small elements, or to estimate even, or to get the cost of the each of the elements. Availability of data, that is reliability of historical cost data impacts accuracy. Potential overlook of overlapping cost is generally there, when we talk about the bottom up estimate.



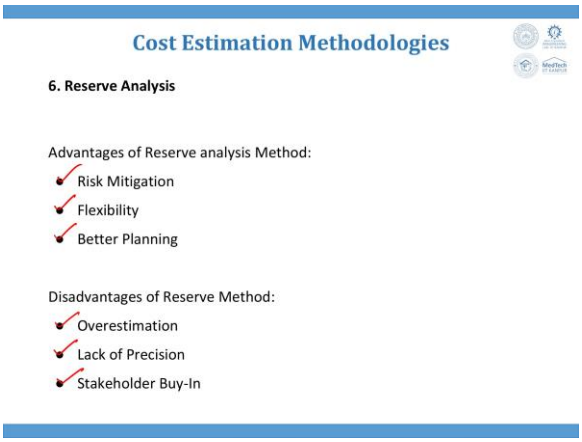
Next comes, the reserve analysis. Reserve analysis is a project management technique that allocates contingency reserves to manage uncertainties and risks.

Contingency reserves are additional funds, or time set aside to address potential cost overruns or scheduled delays during project execution, as I said from 5 to 20% of the cost is meant for contingency. The types of reserves could be many. It could be management reserves, it could be contingency reserves. So, all these reserve costs are there.



There are key steps for the reserve cost calculation. Number one, risk identification, which means to identify the potential risk and uncertainties that could impact the project cost and schedule. Then, quantitative analysis is also there. Assess the impact of the significant risk, that is quantitatively to determine the required contingency reserves.

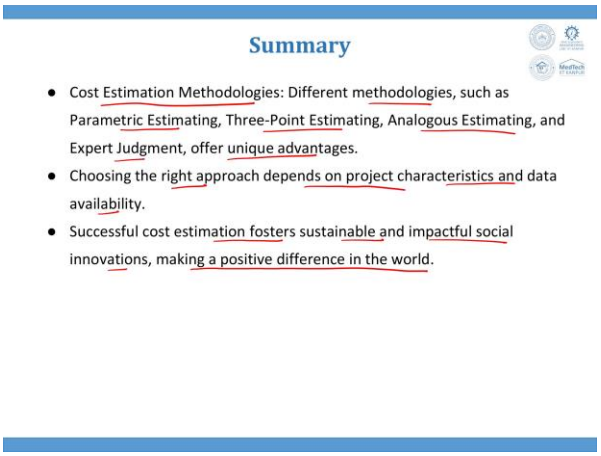
Then, reserve allocation is important. Allocate the contingency to the specific kind of the risk that could come. Monitoring and control of continuously going on project, or to manage the reserves throughout the life cycle is very important.



There are certain pros and cons of these, that is risk mitigation is taken into account in the reserve analysis. It provides financial protection against unforeseen events.

Then, flexibility is there. That mean, it allows the adjustments as project progresses. Better planning is taken, because it helps to maintain project budget and schedule integrity always. Disadvantages are over estimation is there. Over estimating reserves can tie up resources unnecessarily. 20% of the cost that you are taking you need to take finance from different investors, you may have to pay back the interest.

So, over estimation is there. Lack of precision is always there, because it is always difficult to precisely predict, what kind of risk would come what would actually impact your product. Then, stakeholder buy-in that means, one may face resistance from the stakeholders to allocate additional funds for the reserves. With this the Cost Estimation Methodologies are complete.



To summarize, Cost Estimation Methodologies, different methodologies such as parametric estimating, three-point estimating, analogous estimating, and expert judgment, offer unique advantages. Choosing the right approach depends upon the characteristics and data availability. Successful cost estimation fosters sustainable and impactful Social Innovations, making a positive difference in the world. With this the major calculations or the methodologies are discussed for the cost estimating in Social Innovation. Social Innovation impact analysis or social impact analysis would be discussed in the last lecture of this week, where I will try to cover small other points in Social Innovation in Industry 4.0.

Thank you.