MINERAL ECONOMICS AND BUSINESS

Prof. Bibhuti Bhusan Mandal

Department of Mining Engineering

IIT Kharagpur

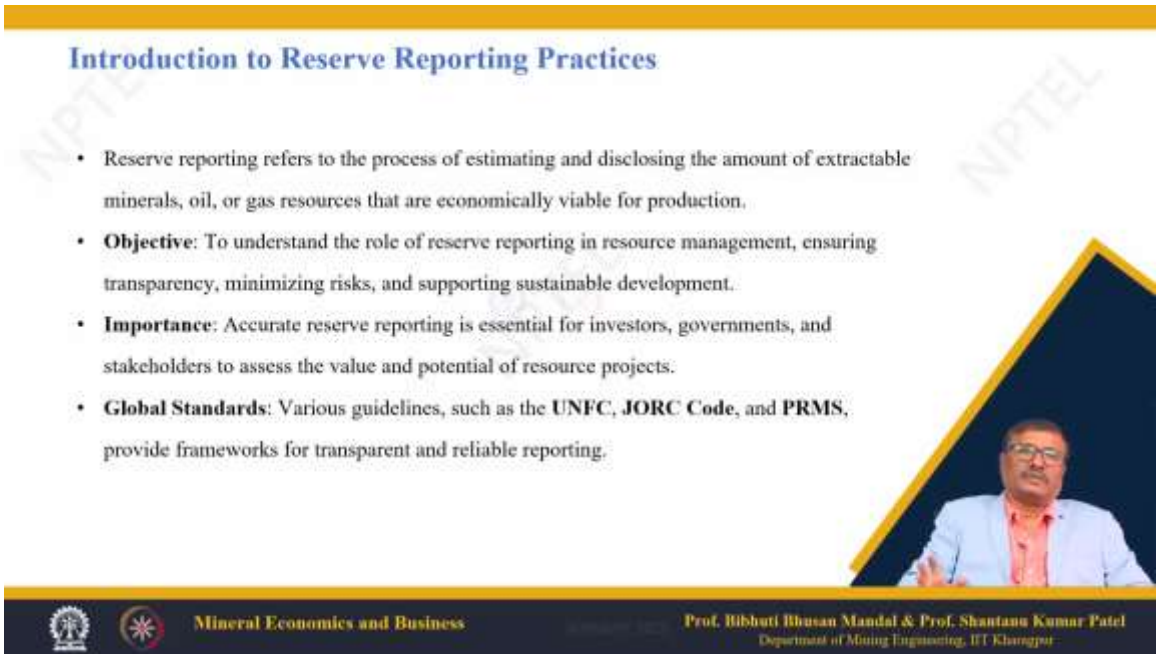
Week 2

Lecture 06: Reserve reporting practices

Hello everybody. In today's lecture, we will be learning about reserve reporting practices. How to report a mineral reserve with clarity, technical accuracy, and transparency to make informed decisions and properly evaluate the prospects of any mining project. Now, what are the concepts that we will be covering here? Different practices—we will start with the UNFC today—and how it relates to market speculations, and why these reporting practices are very important in the context of market investment, especially. So, reserve reporting refers to the process of estimating and disclosing the amount of extractable minerals, oils, or gas resources that are economically viable for production.

We know that we have some information about the occurrence of minerals, which gives us an idea—yes, we have a resource here. That does not mean that the entire deposit is economically and technically extractable—you do not know that yet. The occurrence will

just give you some idea about the resource, the existence of any resource. For that, if you want to conduct a detailed study to understand the economic implications or the technical viability, we need to gather more detailed information. Now, the objective is to understand the role of reserve reporting in resource management.



As I have been saying, you have information—how do you manage these things? How to ensure transparency, how to minimize investment risk, so that we can support sustainable development in the mineral sector. The importance is that accurate reserve reporting is essential for investors because they always seek full information about the reserve. And only then will they invest, as they want to minimize risk and maximize profit. This is important for the government to know the wealth and property we have, which offers economic prospects in the future.

The stakeholders all stakeholders not only the investors the people who are ah in the mining practices business. So, that we assess the value and potential of the resource projects all the projects connected to that ah mineral resources. The global standard the very popular I think you all know about this thing the UNFC or the later the JORC code and PRMS these are very well known global standards. They provide frameworks if you follow that then we can transparently ah inform rather ah ah the investors or all the stakeholders about the resource.

So, that people can take their own decisions and they are they become also reliable and since they are comparable we if you are follow following same practice same code. same framework, then we can compare with each other. This I mean we should not follow different codes in different countries, then it is very difficult to understand I mean what one country is saying. So, these are certain global standards that we are following like UNFC or JORC code, these are most popular. What are the key consideration in the reserve reporting practice?

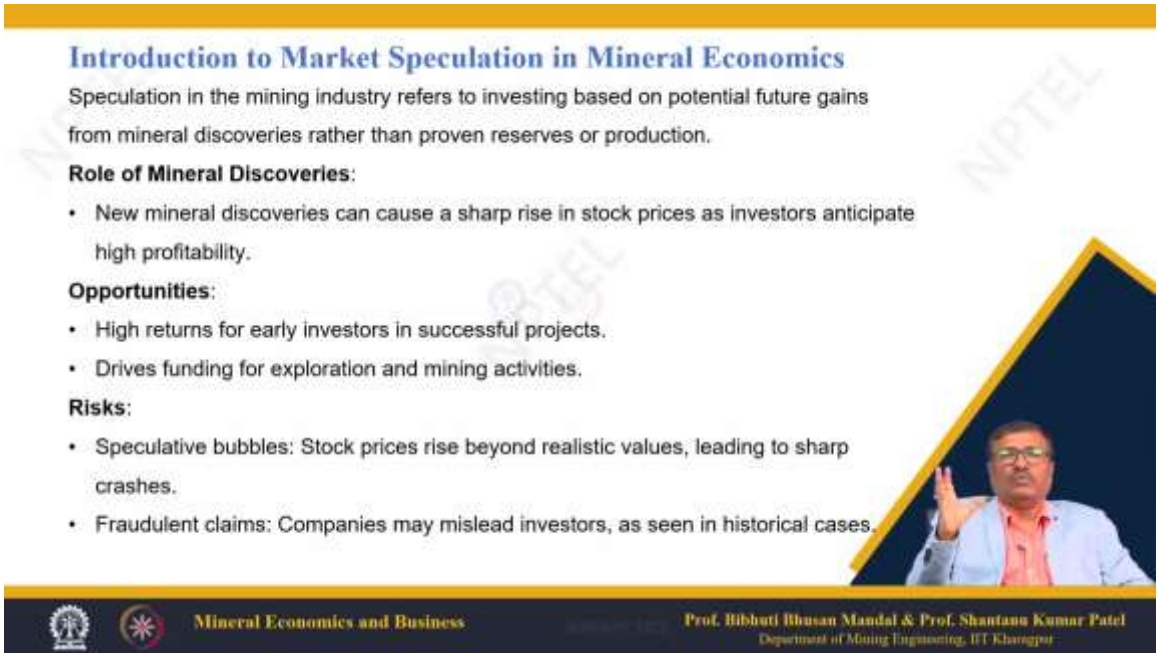
That takes into account the geological data, the extraction technologies involved, the market conditions and the economic viability of this reserve. Now, what are the, what is the market valuation of this? How it is related to this? So, accurate reserve reporting impacts market valuation. Because if it thoroughly especially both the things not only the quantity the quality, but also how technical things are geotechnical things are involved in describing a resource that is very much important.

So, from there we will be able to know the technical feasibility and economic feasibility also. From there we can assess the overall economic viability of the project. So, this will impact the market valuation, which means the people engaged in the valuation of the project will have more accurate information. So, they will be able to prepare the report in such a way that the investors will be very comfortable in making the decision, whether

positive or negative. Now, reliable resource estimates, such as ore reserves or mineral resources, support fair market pricing and informed investor decisions.

There is no doubt about what we are saying. In that case, the pricing, the cost involved in extraction, and what we expect from the market as a return will be calculated very easily with more confidence. In project planning and decision-making, reserve reporting guidelines guide companies in planning, development, investments, and operations in all phases because you need to have complete data. For planning all these things, and then development, the investment planning, and the operations also need to be planned. Clear data on resource quality and quantity aids decisions on mine design.

As I was saying, what is the geotechnical scenario of the resource? So, if you have all that information, then the mine design, the technology, the feasibility—all those things can be easily understood, and you can plan it and expect the return as planned for the whole life of the mining project. Why is it important? Now, as a whole, it reduces speculative risk, meaning you do not have to speculate whether this is going to happen or not. So, it is not somebody telling you, 'Invest there, you will get more money,' unless you have proper information.



If the information is there you with your team rather your team can easily evaluate And, then you do not have to depend on rumors and uncertainty. Rather you can invest with more confidence. Now, it prevents overvaluation also. This I will also give examples today, how the overvaluation matters a lot.

So, accurate classification avoid inflated ah valuation. So, unnecessarily if you are giving more ah attaching more value to the ah project or you are unnecessarily inflating the whole valuation. So, that will attract people and later they will be cheated. So, this these things are to be avoided through a specific framework which is globally acceptable. It also builds as I said investor confidence because they are more informed.

So, they can take even long term investor decisions. Now, it sets realistic expectations as I was saying earlier also that you can expect something accurate data that will stabilize the market sentiment, avoid volatility like in the breaks case that I will be discussing today also in this lecture. It prevents fraud. If you are adhering to standards like JORC, they will reduce the risk of misleading claim. That means it is not only the information, JORC also attaches the responsibility.

They will identify the people who have prepared the report. So, they cannot just submit the report and go away. So, in case there is a fraud in the reporting process, then they will

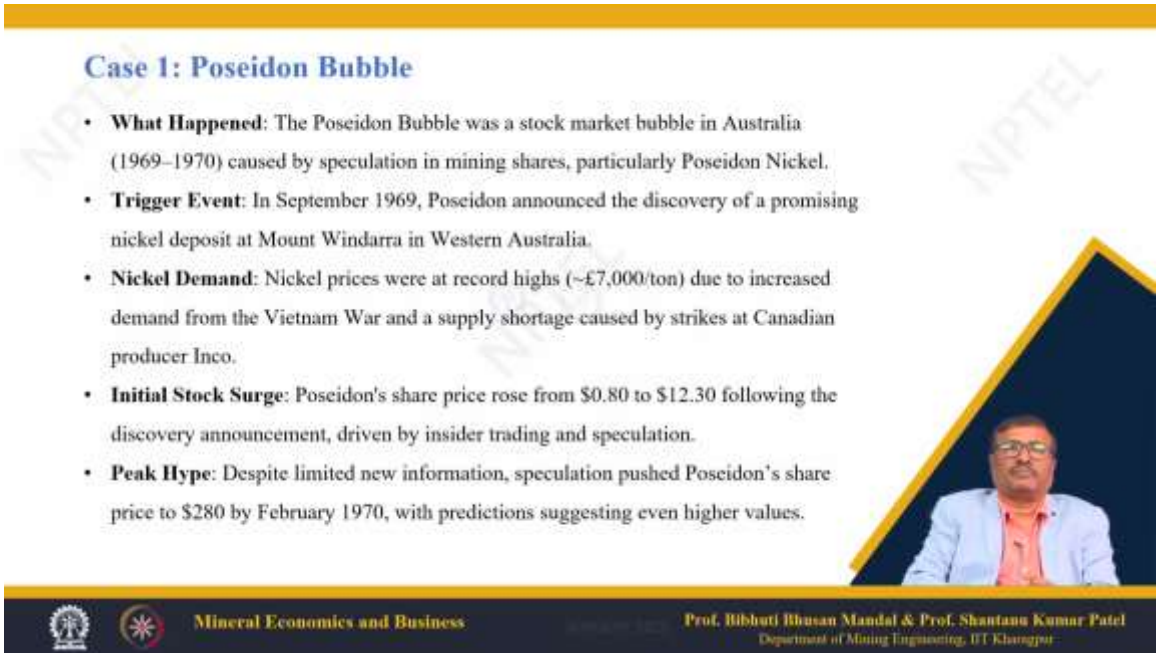
be held responsible for this. Now, it also stabilizes market valuation. because the clear reporting ah process that will align with the stock prices with the actual economic viability of any resource.

So, there will not be unnecessarily market valuation of certain stock. So, that will stabilize it and give a rather a realistic growth of of any stock. Now, the ah market speculation and what is the role of the mineral discoveries and resources in in in this market speculation practices. So, any new mineral discovery Especially, when we claim that there is a large discovery, you will hear so much of gold has been discovered in such and such state or you can have here more nowadays about lithium.

You sometimes you will see that China has got a huge gold reserve or resources that is going to give them so billion dollars like that. So, that will immediately attract investor in that sector. So, that can easily cause a sharp rise in stock prices as investors will be attracted, they will anticipate high profitability in that. This also offers opportunities like high returns for early investors in successful projects. It drives funding and exploration and mining activities because when you get that information correctly or fully, then you easily attract all those people who are into the detailed exploration and also the mining operations.

Now, what are the risks involved here in this? That speculative bubbles. As I will be talking about the Posidon bubble here, the stock prices, if you are not doing it properly, then the stock prices will surge beyond realistic value. They will lead to sharp crashes because when you ultimately see that these things are not correct, then you will certainly see that the whole thing collapses, which will affect other things like the confidence of the investors and the credibility of the mining sector itself. And there are fraudulent claims also; companies may mislead investors, as seen in historical cases.

So, these are certain risks, and they are very important. So, we need to be very careful in the whole reporting practices. So, that they are not unnecessarily inflated, and the investors should be properly informed. We will take the case, and it is important for the assignments also, who are listening to these lectures. The Posidon bubble, if you also search on the internet, you will get a lot of information on this famous, rather infamous phenomenon.

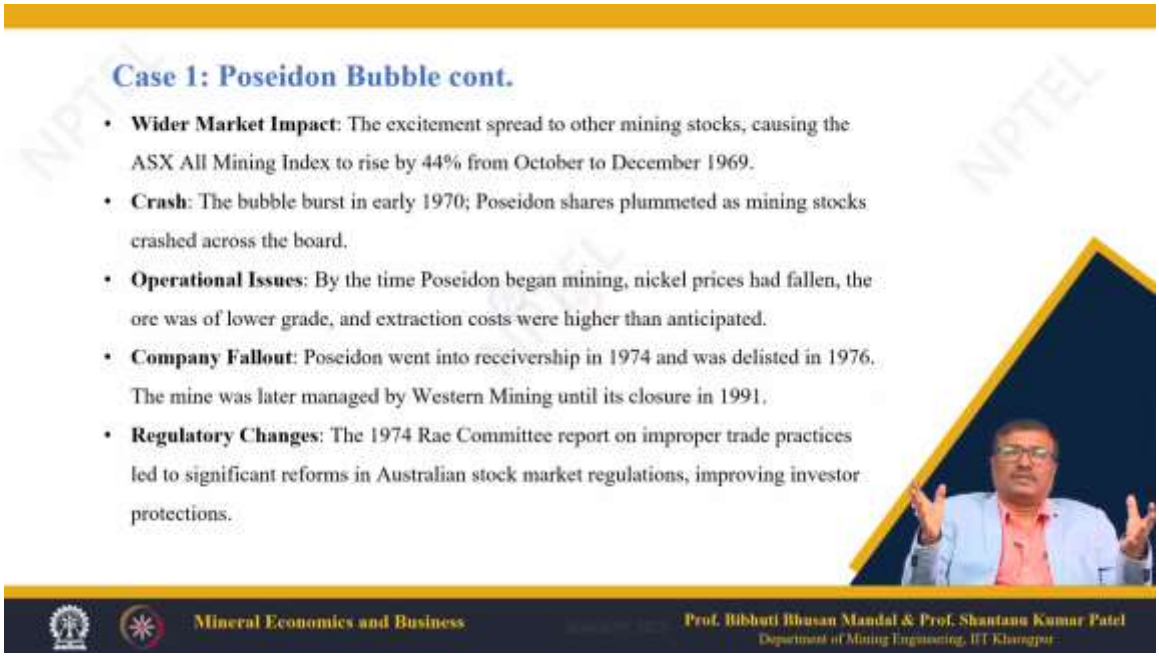


What happened? The Posidon bubble was a stock market bubble, which means it was unnecessarily inflated in Australia in the years 1969 and 1970. This was caused by speculation in mining shares, particularly the Posidon nickel. So, what happened in September 1969? Posidon announced the discovery of a highly promising nickel deposit at Mount Windarra in Western Australia.

So, you can remember you can understand this the the the information immediately attract so many people to invest in the stock. So, nickel prices were at record high 7000 pound per ton due to an increased demand from the Vietnam war and a supply shortage caused by the strikes at Canadian producer INCO. All these things are connected also, it is not only a bubble. But, there are certain things which also at the same time they also acted with each other and they caused the entire thing to happen.

So, the initial stock surge since there was a shortage in supply and there was a news of a highly promising nickel deposit where people would like to invest and earn and there was a demand also. So, what happen there is immediate initial stock surge like the Posidon share price the Posidon nickel share price rose from just 0.8 dollar to 12.30 following the discovery announcement just by announcing it became 0.8 to 12.30. Now, this is because not only because of the news, but the insider trading. Now, there are lot of control on the

insider trading just by selling and buying within a close group and lot of speculation. Yes, this can happen.



So, you should invest immediately, do not wait like that. So, the peak hype that occurred when despite limited new information. So, people were carried away with the that sentiment and the speculation pushed to reach 280 dollar imagine. So, in the beginning 1969 it was 0.80 this becomes 280 dollar by February 1970 with predictions suggesting even higher value just imagine what can happen.

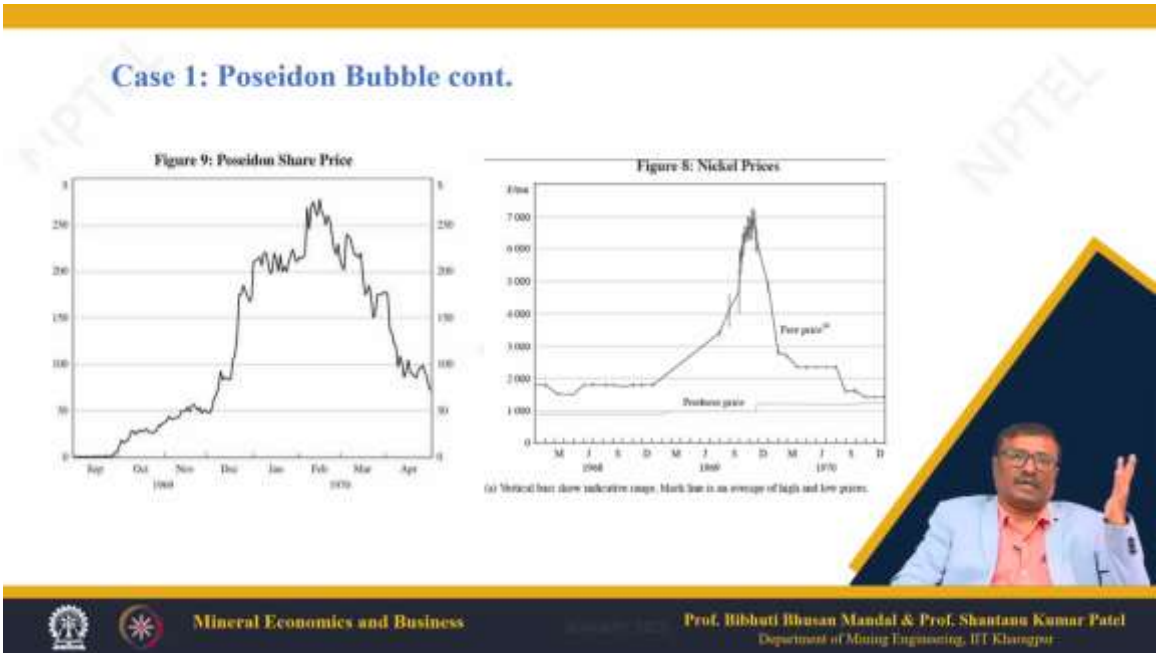
Now, the wider market impact the excitement spread to other mining stock because see people think this can happen this can happen. So, why why only nickel you should invest in others also. So, causing the ASX all Australian stock exchange all mining index to rise by 44 percent between 3 in 3 months October to December 1969 everything went 44 average was 44 percent in a surge. Then what happened in early 1970 not much later Posidon shares plummeted as mining stocks crashed across the board.

What is the operational issues? By the time Posidon began mining nickel prices has fallen. the ore was of lower grade expected as we expected it is a high grade ore and large reserve it was of a lower grade and the extraction cost were higher than anticipated. So,

the cost wise also we are investing more and and the return wise also you are getting less less money. So, what is happening both we are losing the stock crashes.

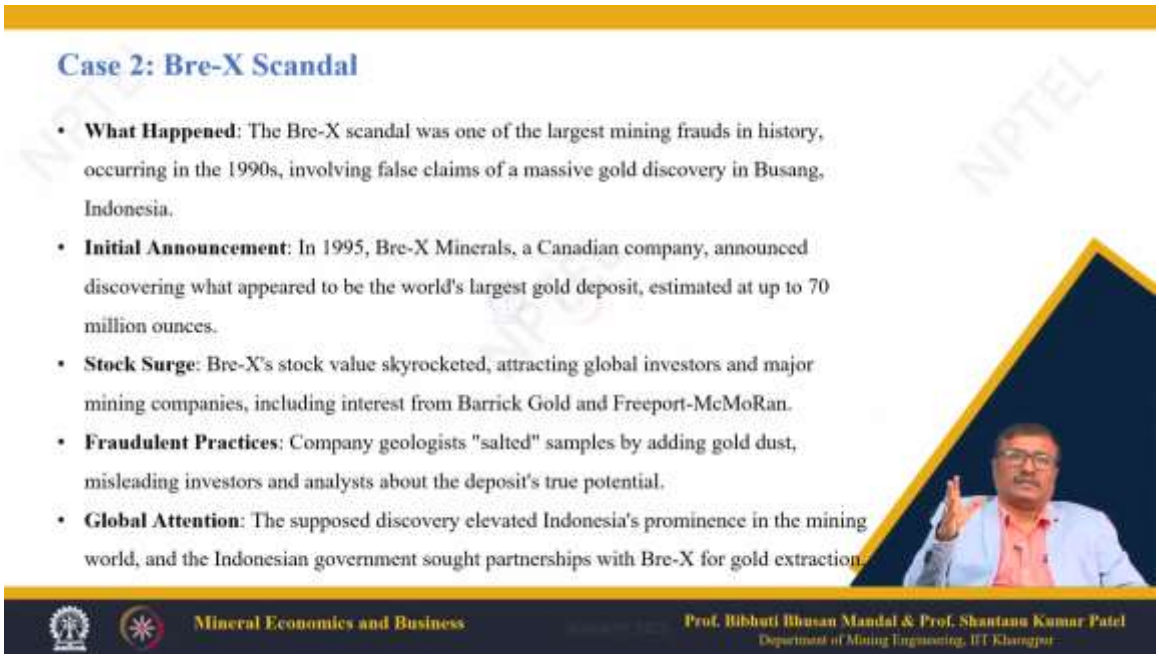
The company Positon Nickel went into receivership in 1974 such was the condition and was delisted from the exchange in 1976. It was later managed by another company. Due to this which has triggered lot of interest in understanding the mining stocks, the mining business. In 1974, Rai committee report on improper trade practices such as happened with the Posidon bubble. led to significant reforms in Australian stock market regulations improving your investor protection.

So, that unless you are protected in next time if you say that so much of gold has been discovered or silver is discovered somewhere people would not believe even though that is that could be true. Because, once they have they have been cheated by this position bubble, then what happened? In that case this the the prospect of business will go down because of this kind of uncertainty. So, the to protect the investor interest we need to have a So, significant reform in the reporting ah practices for the resources and mineral reserve.



As you can see just just just see the ah stock prices on the left side and the nickel prices on the right. There is a ah this is the so called in a positive bubble sudden absurd and a great crash ah in both the both the things. Now another case the first one was ah one was

ah speculation which was far away from the reality. That means the grade was low the quantity that we thought was lesser than we expected and due to other factors the the market prices crashed. So, the return was less and the operating cost was much more than what we thought about in the case of positron nickel.



So, that was a combination of so many factors. In break scandal the manipulation is involved, I will tell you how. The break scandal was one of the largest mining frauds in history, mining history occurring in the 1990s involving false claims of a massive gold discovery in Indonesia. Initially it was announced that Brex Minerals, a Canadian company announced that what happened to be the world's largest gold deposit. A huge deposit they said in Indonesia estimated at up to 70 million ounces.

This is big amount, big quantity. Now in what happened immediately like that as it is in a ah in the capital market what happened? The breaks stock value skyrocketed immediately because of the huge property that they are claiming. Attracting global investors and major mining companies including interest from Barrick Gold and Freeport McMoran all they have invested into the ah ah into the gold ah into the company. Now what was fraud inside?

that they manipulated the sample results. That means, when you are taking the exploration samples, estimating the ah grade of the ah gold ore that you are ah ah using for the purpose of estimating or evaluating the project. What they did? The company geologist salted samples means they simply manipulate the results. How?

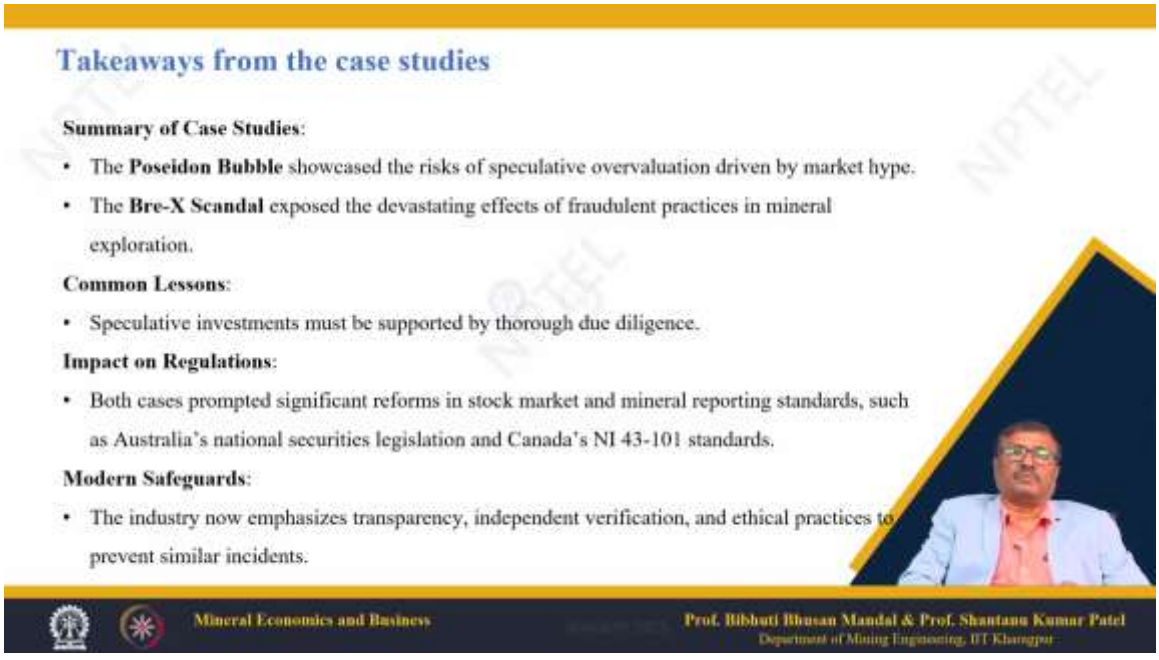
By adding gold dust into the sample So, that when you chemically examine it, test it in the lab you will see the results are very very high. They this results simply misled the investors. And they also ah what happens they completely manipulated the all the analyst that means, all the analyst involved they are also cheated because the deposits true potential was actually not as good or as high as it was being projected by the breaks can breaks geologists in the project in the in the in the ah information that ah they are providing to the investors. They supported this discovery elevated Indonesia's prominence in the mining world naturally because it was having the biggest gold reserves and the Indonesian government sought partnership with Brakes for gold extraction.

Now, in 1997, due diligence by Freeport-McMoRan, which was a partner in the business, revealed that the gold claims were falsified after they invested heavily. That means it was intentionally falsified, as independent samples showed no significant gold content in the deposit. So, what happens? The investors lose first, and their stock becomes worthless

overnight. That means it went from very high value to almost nil, and investors worldwide lost billions of dollars in the stock.

Now, regarding the impact on mining regulation, the scandal led to stricter standards for public disclosure of mineral resources. This is very important: public disclosure of mineral resources—how you inform the public, either through documents or in newspapers. When issuing shares or stocks, an initial offer, or any extension or expansion project, you must provide information to the public. This is our property, a natural property that we are going to mine. So now, the regulation must be stricter, with more clarity and transparency, and we must hold people accountable if there is any fraud.

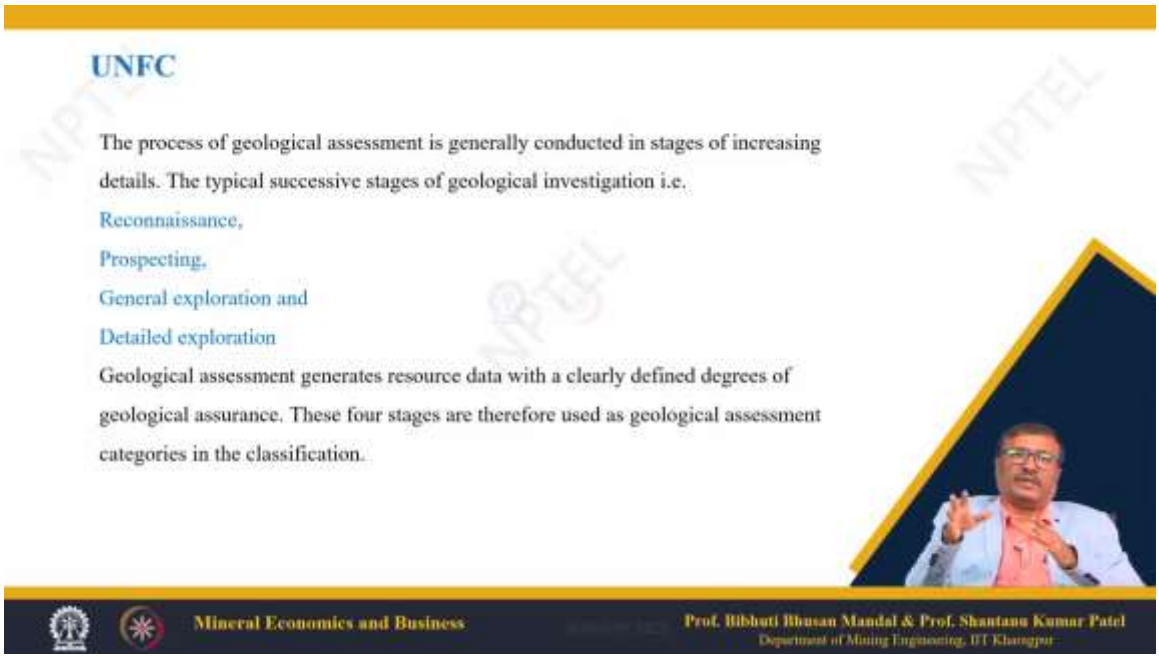
So, we have standards like the NI 43-101 standard of disclosure for mineral projects. The legal and ethical fallout includes several lawsuits being filed, but the key geologist involved, Michael Guzman, reportedly died under suspicious circumstances by falling from a helicopter. You cannot even know what exactly happened. But now it is known that the report was falsified.



We do not know other stories, the fact is fact. Now there is a great damage to the reputation, the break scandal severely damage the investor trust in the mining sector that this can also happen that you add some gold dust in the sample and then you increase the ah the grade and you make a hype that there is the that is the most prospective gold reserve in the world. So, that it requires the rigorous independent verification and

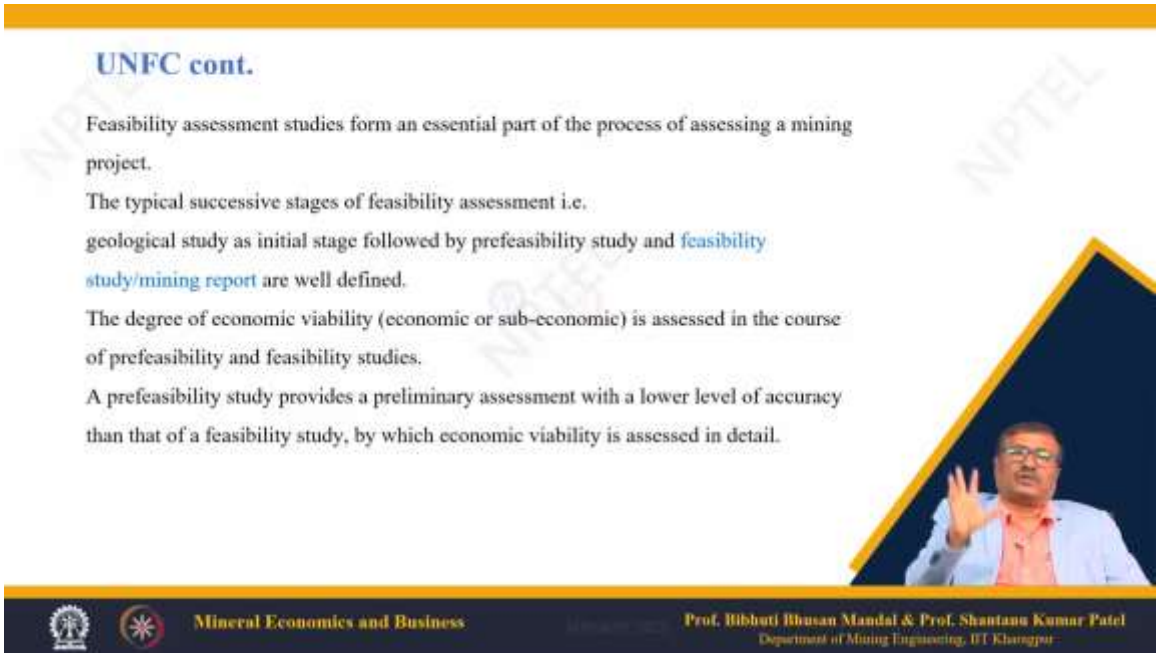
transparency in mineral exploration that is very much required. What we understand from the case studies that positive bubble showcase the risk of speculative overvaluation. by simply by a speculation.

So, it created a market high and in Bre X scandal this expose the devastating effects of fraudulent practices in mineral exploration and the analysis and misreporting wrong reporting. So, this speculative investment must be supported by thorough due diligence. You first study or you engage a team who which can understand the report properly and ask questions, get answers from the people who have prepared the report. Now, in both the cases is it prompted significant reforms in stock market and mineral reporting standard as we have said Australian national security legislation or Canadian standard. Now the industry emphasizes transparency in general everywhere including India, independent verification that if you just submit a report it will not be accepted, it will be again verified by other third parties.



And the ethical practices to prevent similar incidents so that no investor is cheated. we will come to one of those reporting practices which is very well known throughout the world is called the UNFC United Nations Framework Classification of Resources and Mineral Resources and Reserves. This process the process of geological assessment in UNFC is generally conducted in stages of increasing details. UNFC has 3 I will show you the axis 3 axis a framework in which we have geological and economic and the ah

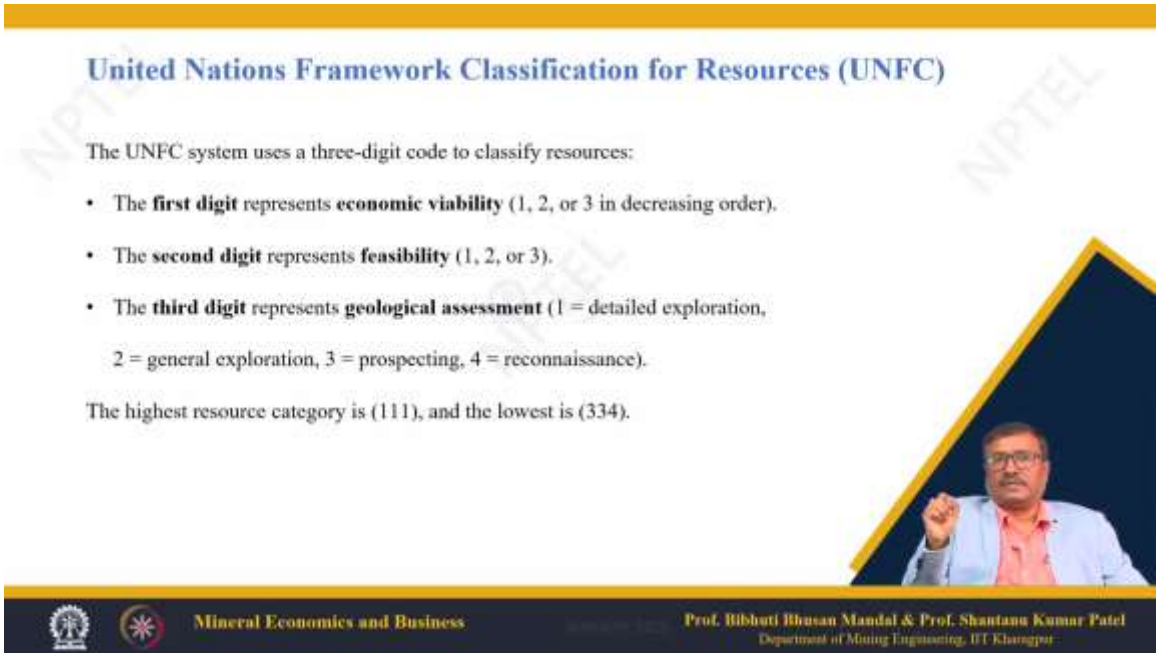
feasibility all these 3 together. In geological part, where is very important to know the know the quantity and then ah quality or the grade of of the mineral that you are going to mine.



And the geotechnical data, the hydrogeology, the fractures, the faults, dikes, faults anything and everything, what is the top cover all information are to be studied. Now, in the typical successive stages of geological investigation. ah like the that is in the beginning before the prospecting started just to have an idea of what is the what is what kind of resource it is and then we go for prospecting some preliminary exploration part by trenching pitting like this thing. Then you go for general exploration and then later on detailed exploration. So, we have 1, 2, 3, 4 stages.

So, recognition means a very primary idea that means you have the least confidence of this, but when you have detailed exploration the size and shape and the grade of the material then you have the maximum confidence. So, it clearly defines the degree of geological assurance. Remember geological assurance that means, the geological data is giving you an assurance that at what level you should consider your confidence in assessing the economic prospect of the project. These 4 stages are therefore, used as geological assessment categories. in the ah classification.

Now, in the feasibility assessment studies they form an essential part of the process in mining project. The typical successive stages of feasibility is geological study as initial stage followed by pre-feasibility study this is very important also. Instead of going directly to a detailed feasibility study of any mining report we do a pre-feasibility study. So, that will give you an idea whether we should proceed further or we stop there. Now, the degree of economic viability economic or sub economic is assessed in the course of pre-feasibility and feasibility studies one by one.



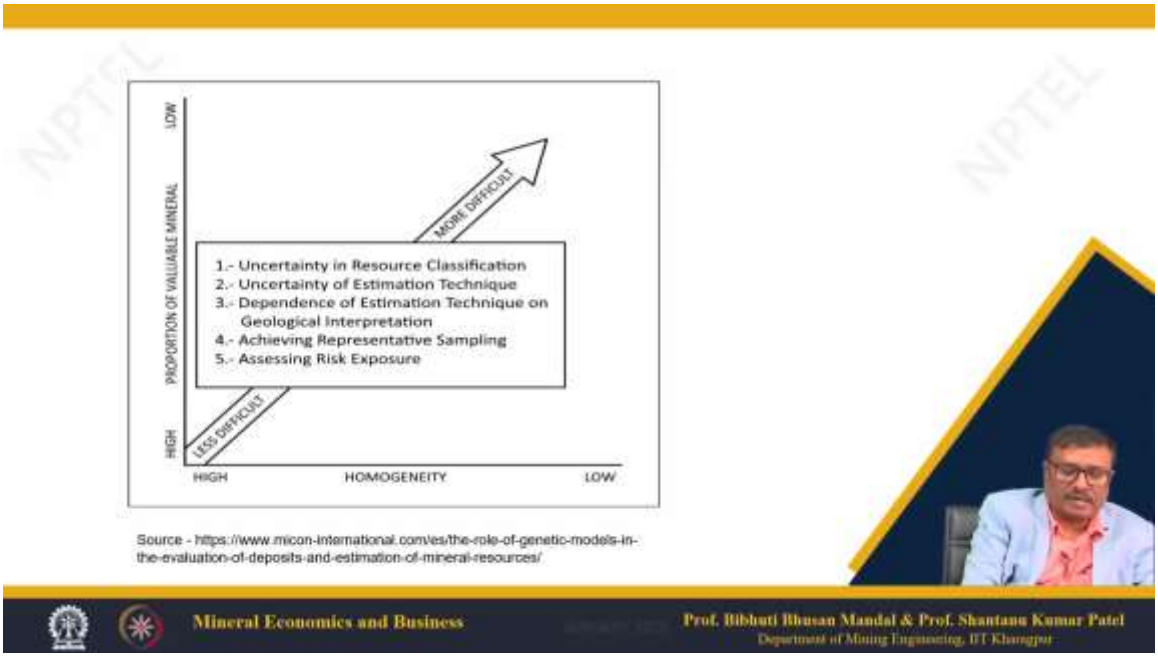
The pre-feasibility study provides a preliminary assessment as I was told I was telling with a lower level of accuracy. So, unless it do go for a complete feasibility study detailed feasibility study. then only we will know the economic viability in much more detail and with more confidence So, the UNFC or the United Nations Framework Classification of Resources uses a 3 digit code, there is a code. So, if you are experienced in that otherwise you can refer to the manual or the document which is easily available on internet also.

So, from there you can understand what kind of resource or reserve it is. The first digit if it is a 3 digit code, the first digit represents economic viability 1, 2 or 3. So, this is a decreasing order. The second digit represents feasibility 1, 2, 3 again and the third digit represents the geological assessment now it is in 4 stages. Detailed exploration that

means the maximum competence, general exploration slightly less, but good enough, prospecting and the last one is recognition that is very preliminary.

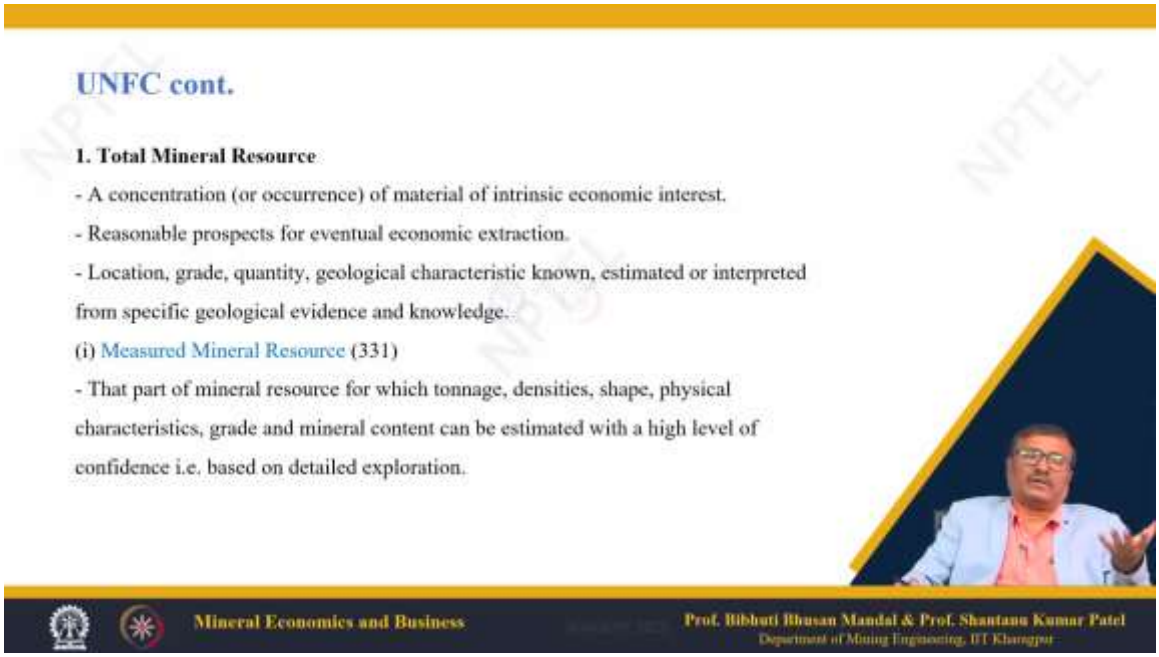
That means, from all these three the statements that we have given the categorization that we have given earlier, we can say that the highest resource category is 111. That means, the first digit 1 is the highest economic viability, the second one is the most feasible then third one it has got a detailed exploration report, detailed exploration report. Now, this 111 will give you the highest resource category and similarly from the above information you can understand the lowest will be 334. So, economic viability 3, the feasibility is 3 and of course, the your ah reconnaissance stage that means, the 4.

So, 3 3 4 is the lowest category that you can express in the UNFC classification. If you plot it, just to get an idea of the origin where both words are high, that means, where all these things are with high maximum confidence. As you proceed towards the end of this axis, x and y both, and as you can see, as you approach the origin, it is high, and the other end is low. So, if you plot it where everything is high, that means you can have more confidence, then it is less difficult in all terms.



But it becomes more difficult when you have less confidence or less information about all these three. So, 1 1 1 will give you the highest confidence, meaning we have the least difficulty in understanding the prospect, and we have high expectations from the project. Whatever you plan, whether to invest or not, is a decision you take, but you have

maximum confidence when you have the most information. And if you do not have, as you proceed towards the extreme, you face a more difficult situation because you have less information about the reserve or resources. Now, this total mineral resource will have a difference between resource and reserve unless we have detailed exploration data and mining viability; we cannot call it a reserve, but initially, we call it just a resource.

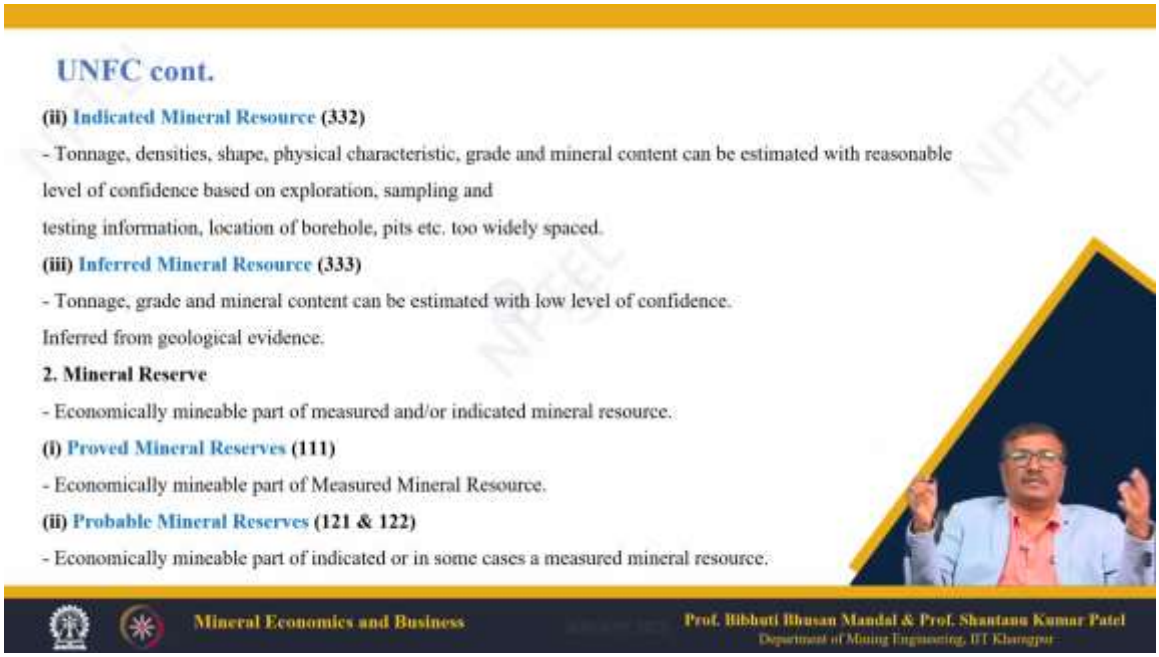


So, any concentration or occurrence of mineral. If this has economic interest, we can call it a resource. And later, we need reasonable prospects for eventual economic extraction, meaning there could be economic extraction for this. We must know the location, grade, quantity, and geological characteristics, known or estimated or interpreted from the data. The first one is the measured mineral resource; we are still in the resource part.

So, that part of mineral resource for which tonnage, density, shape, physical characteristics, grade and all mineral content can be estimated with a high level of confidence. So, we will call it 333, 331 and I will call it measured mineral resource. Similarly, indicated mineral resource the tonnage, density, shape, physical, grade and mineral content, but with reasonable level of confidence. on exploration.

So, the density of boreholes, number of samples that you have analyzed, the modeling, the prediction, but the borehole surface may be widely spaced So, there are lot of ah

extra interpolations ah to understand the the ah the resource. So, based on that you can only indicate not not not truly measured, we call it indicate ah indicated mineral resource and we term it like 3 3 2. And where your information is much less and we have a low level of confidence, we call it inferred mineral resource. Tonnage grade and mineral content can be estimated, estimated from the evidences, but not with full confidence.

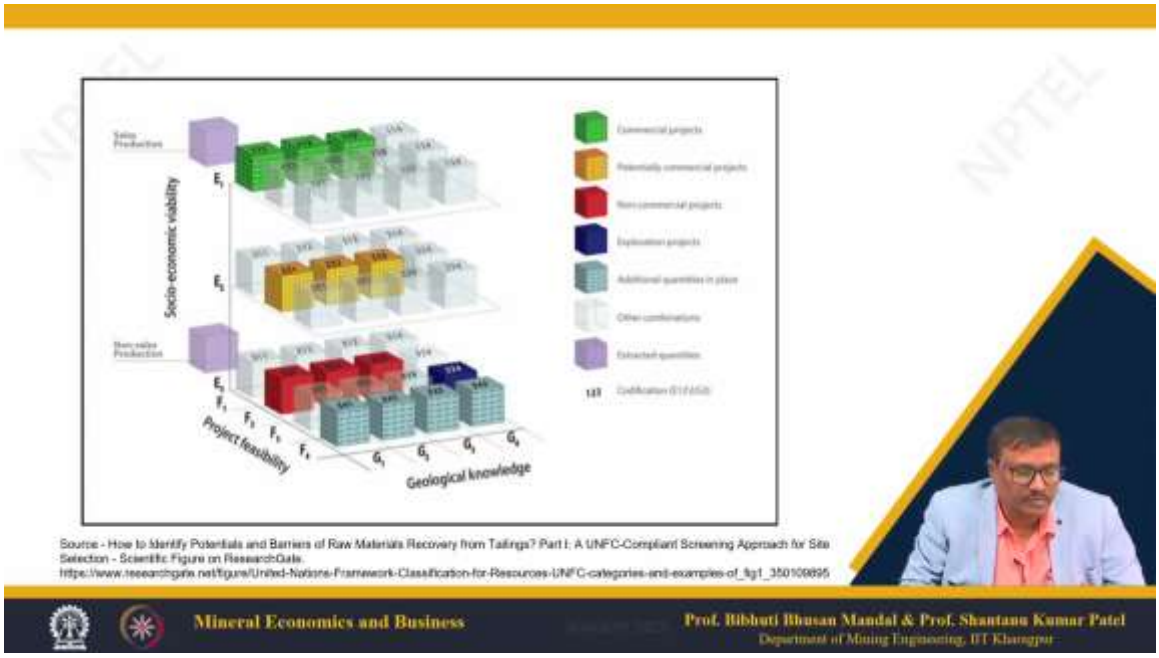


Let us go to the reserve part, mineral reserve. So, the economically mineable part of the measured and or indicated mineral resource that we will take it as a reserve, not from the inferred category at all. So, the proved mineral reserve this is the highest category as we said 1 1 1 economically mineable part of measured mineral resources and the probable mineral reserve the next one is 1 2 1 and 1 2 2 both. The recognition of mineral resources 3 3 4 as we said earlier that estimates based on regional geological studies and mapping airborne indirect method. preliminary field inspection this will give you 334 that is basic.

Now, we are coming to the feasibility mineral resources like 221 and 222, that part of an indicated or, in some circumstances, measured mineral resource that has been shown by a feasibility study only to not be economically mineable. Or possibly economically viable, subject to changes in technological, economic, environmental, or other relevant conditions. So, what is the feasibility mineral resource? It is given as 2 to 1, that part of measured mineral resources which, after a feasibility study, has been found to be

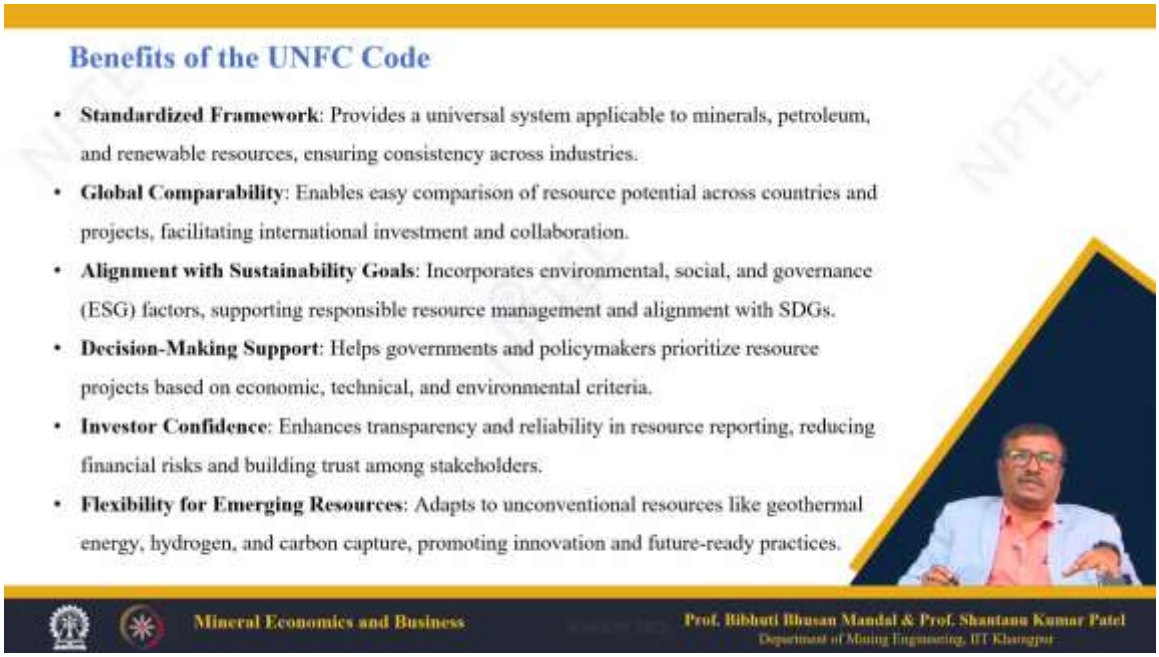
economically not mineable or, again, possibly economically viable, subject to changes in technical, economic, environmental, or other relevant conditions.

So, these are somewhere in between. If you plot these things in a three-dimensional presentation, here you can see that the project feasibility from the origin, you see F1, F2, F3, and F4. And then again, E1, F2, E2, and E3 on the y-axis, and on the z-axis, you have G1, G2, G3, G4. Now, you see that if you just look at different stages, E1, E2, and E3. So, E1, you see the green one, that will give you the commercial project.



That means, this is actually 1 1 1 1 1 2, 1 1 3, but the most prospective is 1 1 1, that you see the green on the leftmost side. So, in between, the yellow boxes that you see, those are with less confidence, but they have enough information for you to go for further study. And then you can transform them into economic projects, but the lower part, the red one, this part is actually, at a glance, not economically attractive. So, this is how we can graphically represent the idea of the UNFC categorization, how they have categorized different results.

Now, this ah ah benefits of the UNFC code use of the UNFC code ah is that it is a standardized framework. everywhere in the world this UNFC code is ah used for the reporting practices for the minerals, petroleum and renewable resources. So, that gives a consistency across the countries across the industries in different countries. So, we can compare them take ah all these things globally and it aligns with the sustainability goals because about the ah different aspects of this reserve. And therefore, sustainability of the of your objectives can be easily understood.



You can take decisions, it helps governments and policy makers prioritize resources which is because if you have no if more about certain reserve, then you invest there you you you invite the investors to invest there because you have more information about that. It gives more confidence to the investors. as well as easily understood and it has the flexibility for emerging resources. So, it adapts to unconventional resources like

geothermal energy, hydrogen. I mean similar coding practice can be extended to other resources and an universal guidelines can be framed where people can compare between two different projects and easily take decisions as to what to do about that.

Summarily what we can say that the Posidon bubble and Brex scam it highlights the risk of speculative investment and also the fraudulent practices as I have discussed in detail today in the in the resource sector. These cases underscore the need for transparency and the due diligence required in resource reporting and management. The UNFC code ah as I I discussed today this gives a standard framework for the resource viability based on economical, technical and geological factors. So, by promoting responsible practices and reducing uncertainties this UNFC will give you more ah reliable and sustainable resource development. So, the importance of rigorous classification and regulation will prevent the future market failure.

So, the importance of UNFC coding lies there. So, these UNFC guidelines help foster investor confidence and long-term growth of the mining sector. So, the reserve reporting practice is very important. Based on which further activities, not only the further studies or the project evaluation, are very important. Because based on the feasibility reports, overall feasibility, economic feasibility—all these things are based on the resource and reserve reporting practices.

And the investors will decide whether they want to proceed further with the project proposal or not. These references you can use from the internet, and the Indian Bureau of Mines—number 3, Indian Bureau of Mines UNFC guidelines—there is a published report or document issued by the Indian Bureau of Mines that can be downloaded. Of course, there are certain important differences that I have mentioned here. There also, you will get a lot of information about these reserve and reporting practices. Thank you very much.