Technology forecasting for strategic decision making - An Introduction
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Aryabhata's experience in modeling and Live Solar Eclipse

Professor Bala Ramadurai:

Hello and welcome to technology forecasting for strategic decision making. We are here for a special special day. Today, it is a phenomenon that occurs once or twice a year. I will come back to that later. First of all, I want to tell you that I am here, right behind me you can see a sundial. A sundial is an instrument, a very rudimentary one that you can see behind me.

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It is a pipe and odds & ends that my son and I put together with a flower pot, so that you can look at the shadow that the sun actually casts on the ground and you can tell what time it is after you have calibrated it. So, that is the basic mechanism and people across ages have actually felt the need for measuring time and telling time very accurately. We do this to this day but it was also a practice aeon's ago, centuries ago, millennia ago, okay.

So, it is important to have a track on time. I am going to describe to you one of the ancient astronomers who was also very very interested in time and astronomical phenomena. He is a

mathematician by name Aryabhata, who lived in the 5th century AD in northern India, in a state called Bihar and he belonged to, he studied in a university called Nalanda University.

He was the top honcho of the university itself; he was the head of the university and he, his basic contribution, main contributions to mathematics have been enormous; very very impressive. He was, he is attributed to the invention of 0 which we take for granted. It is all around us, in financial systems, in mathematical systems, mathematics, 0 presence of 0 is always there. So, it was attributed to him, the invention of 0.

He was also the inventor of trigonometry. He came up with sin and cosine and how important it is, it has made a big difference in all our construction calculation. Also, another one that is important is the calculation of pi, the rational number pi which we use in circles and circular buildings and all that. So, that is important, he calculated to four places of decimal which is impressive considering that there were no advance machines, advance calculators, all with the power of his brain, okay.

So, back to astronomy. Astronomy, he, in, he said earth is not static, does not look, appear to be static for me, as was thought of the time. So, he said, here is the example that is going to convince you that maybe earth is not static. He said if you are in a lake in a boat and you see people on the shore, they seem to be moving with respect to you, although it is you who is moving. You assume that it is the people; you can assume that people on the shore are moving.

So, he said people on earth are exactly the same way. We are actually moving and we look at the stars and say that the stars are moving. Okay, it is the same phenomena that he proposed as a theory. In fact, he used that and calculated, he said earth is, one it is probably moving around itself and it also moving around something else, okay.

And, so he did not just say, oh this is an idea I have, he actually sat down and calculated using his own brain without any advance instruments. He calculated and was so close to the calculation of the duration of the day and also the duration of the year. He calculated within what, 3 minutes was the error that he had made with the calculation of a year.

So, he could also calculate many things using these calculations that he had come out with. He could do advance stuff in mathematics and he published it under a book called Bharat, I am

sorry, ‘Aryabhatiya’, that was the name of the book that he released, he published when he was 23 years old. So, it is one of the key books that has shaped the way humanity thinks about mathematics. It had been translated to many other languages including Persian and that made its way to Europe, is what the stories say.

Now, why am I discussing astronomy and an ancient astronomer in this course? So, this is a special day, as I said, we will come back to that. Okay, so why is today a special day and what has Aryabhata, the story of Aryabhata got to do with technology forecasting? So, why is today a special day? Today happens to be a solar eclipse, an annular solar eclipse. So, June 21st, 2020, today's date is June 21st 2020.

So, this is an annual solar eclipse, annular solar eclipse which is basically, says that we will see a ring of fire around the sun when the moon goes across it. So, Aryabhata calculated and he said that the reason for a solar eclipse is because the moon gets in between the sun and the earth and it blocks the sun like that and no other celestial phenomena like a mythical dragon or a mythical creature is eating it and spitting it out, none of that.

But it is actually a valid scientific phenomenon. And he tried his best to convey this to his audience throughout the world, to say that this is how the actual mechanism works. So, that people fear less of the solar eclipse and appreciate it, that it is a natural phenomenon that occurs and that one can actually calculate it to a very precise time and location as to what, when the solar eclipse is going to happen, how long is it going to last and where is it going to occur.

So, he actually established an astral observatory, a solar observatory near Nalanda University and used that because it was one of the best places to observe a solar eclipse. So, he was very active in this field of solar eclipse and also dispelling the myths and superstitions around solar eclipse. So, I thought I could use this as an opportunity to tell you this phenomenon on this particular day that we are recording it.

Another thing, so what is, now I have answered the first part - why is today a special day? But what about the second part? What has Aryabhata got to do with technology forecasting? So, as you probably have guessed it, he used data, he used observations, he used models, he used calculations. So, this is something that is going to be a repetitive phenomenon even in our

course. We are going to look for observations, we are going to look for calculations, we are going to look for models and then, finally, we are going to be able to predict.

So, the more you know about a particular model, particular phenomena, it is easier to, I mean you know where to gather data once you gather data, you can build your models. Once you know the models, you can actually calculate. So, that is something that you will see as a recurring pattern in the course and we will give you enough methods and tools for you to gather data. First of all, observe, gather data, plug it into a model, build the model itself, plug it into the model, run it and see if it works for you and then progress with that.

So, that is going to be the generic pattern and I thought this is a great opportunity for us to learn from the greats, we are going to stand on the shoulders of the giants like Aryabhata from the 5th century AD. So, hopefully you will appreciate lunar eclipse or a solar eclipse the next time it comes. Be safe, we are going to use a pinhole projector or a binocular inverted and we are going to look at the shadow on the ground and not look into the sun directly as it is unsafe to look into the sun, under eclipse or no eclipse, it is not advisable to look into the sun directly.

So, we are going to try and see if we can build such a projector and observe the natural phenomena. Okay, so this is me signing off and hopefully if our projector works, I will show you how it works. Thank you so much.