ISB CTO

Week 12: Digitisation of the Value Chain

Video 1: Introduction to Business Analytics

So, before talking about supply chain and value chain, and how data is playing an important role on how we make decisions, lets first try to understand and put business analytics in perspective, and then we will get deeper into how supply chain plays an important role, and how analytics plays an important role in supply chain and vice versa.

So, business analytics when we think about, we first have to deal with data and the data analytics part contains lot of different steps, and we have to first get the raw data, we have to clean the data. But where the real focus is right now especially in supply chain and value chain is on how to understand the meaning out of the data, and then create business value out of it. So, first piece is that we try to do lot of visualisation with supply chain data, and that is covered in exploratory data analysis.

For example, if you are looking at inventory data, we will try to see that how this inventory is being located in different warehouses, what kind of assortment is in different warehouses. When we look at supply chain demand data, we may want to see that how the demand is different across different states, different countries. So, we do lot of visualisation to make ourselves familiar with what the data tells us, and then in supply chain and value chain, we talk a lot about confirmatory data analysis right now. So, we, for example, we have a belief that this supply chain partner is not performing well. Now, how can we confirm that? That is where we can go, we can collect right data, and we can do all the analytics around that. But the future lies on lot of data related to unstructured part where we look at images, videos, text.

Now, we are very good in dealing with numbers, but when we come to the images, videos or text, we are still emerging. We are in very good shape with text analytics, which is a lot of data comes from reviews, from social media and even sometimes these internal nodes that we try to analyse in supply chain domain. But we are also getting now lot of facial recognition data, lot of data related to how customers are reacting in supply chain and those are the videos. We are going to see a lot of that coming in supply chain domain as we are moving more towards newer technologies like blockchain and putting cameras everywhere around. And that's where the analytics is going to change the shape of a supply chain.

Now, once we understand all these data analytics, then we have to think about how to convert them into business decisions.

Video 2: Supply Chain Vs Value Chain

Now when we think of a supply chain, supply chain essentially deals with lot of different processes. We have to think of input, which is a raw material, and there is an output, which is our goods and services. But in between, we have both resources, which helps in transforming, and then they are connected with some kind of processes. Now inputs are something which goes with the product. So, they are very important for the supply

chain, but we cannot discount all the resources they are part of it, because the whole cost of supply chain or where the data can help us can be in all different aspects, all three aspects of supply chain, which is input, resources and output. And in supply chain management, we deal with managing all of that, especially using lot of analytics which is on the data side, as well as optimisation side.

And we have taken this to a different level in last five to 10 years with the emergence of lot of new data. And then when we look at this, if we take a value chain perspective of all of those things, then we have to understand that each process should add some value to the preceding activities, and if we have any unnecessary cost or unnecessary step, we need to eliminate that. And data can tell us that what is important here. This is also very important to understand that how supply chain and value chain are different from each other. On the supply chain, we start with our procurement of raw material, then we go to our logistics, we go to assembly of those products, we go to production, sales and marketing, distribution, delivery and then we go to customer support.

And this will be valid across lot of tangible supply chains. We think of car manufacturers, and it will be valid through a lot of service supply chain as well. When we think of airline industry or even, we are sitting talking about the different way the universities teach courses, all of these are value chain, or even we go for haircut, that's a service supply chain and we have to think about there as well. Now the service supply chain is not very different from traditional supply chain in many aspect of using data. But the biggest part which is different in service supply chain is we have lot more variability in the process. Now if we take a value chain approach or value chain view, in value chain, we always start with customer part. So, we try to see the customer demand comes,

now how we can do innovation, planning, development, training and even after-sales services and sales and marketing, they all are part of value chain. Now supply chain and value chain are very closely linked to each other. Even though they are not the same thing, the approach is different, they are very closely linked with each other. So, when we think of digital component, I think we have to think from the holistic view of how we can improve our processes from both supply chain and value chain perspective. And the fundamental difference here is that supply chain management usually start with the side of how we can make our operations better. So, lot of data goes into that using this data to improve our operations, whereas when we think from the value chain perspective, that's where lot of data essentially goes into how to improve our business processes, how we can improve our customer service.

So, when we think of different supply chain management and value chain management example, it is very important to understand they always sit in the centre of any businesses. Now you think of companies like Amazon and all where the supply chain and value chain play an important role. It's very easy to see that they are very closely connected with all different parts of businesses, for example, marketing, information systems, finance, accounting, human resources and so on. But even for traditional companies like Honda, like General Motors, for them also the supply chain and value chain play a very important role. So, irrespective of the industry, we have to now start looking at this from holistic view.

Video 3: Examples of Supply Chain

One of the problems we have seen over decades in the supply chain management is that we try to look at it in silos. We try to improve different small components of supply chain rather than improving it holistically. And supply chain is not just about one player, it is about many players. We have to deal with our suppliers, we have to deal with suppliers of suppliers, and many times we have to deal with our customers and customers of customers. So, what are the different drivers? It is important to see the different pieces and see how data can help us. And that is the approach we all need to take as supply chain managers.

Now when we think of examples of supply chain, so let's think about example of, let's say, Dell supply chain. Now when we think of Dell supply chain, how Dell started, Dell started by using a pull method, which is basically whenever the demand comes, we will pull different pieces. Now, in order to run this kind of supply chain, we really need to have very good understanding of how much inventory I need for different parts, and that is where we started seeing lots of push on data analytics, and even the collection of lot of different types of data and use of newer concepts like AI and machine learning.

Now it is very easy to see in the case of Dell that what will be our input and output and resources. For example, their output will be laptops as one example, their input will be all the parts which goes inside the laptop, and the resources could be all the assembly line, all the people involved in the assembly.

So, when we think of the more traditional company, the definition of supply chain is lot more clear. And when you think of car manufacturers, things like Toyota, for example, they are very clear and defined supply chain. We can see that the parts coming like our nuts, bolts, tires, even different pieces that goes into the brain of car these days, they all are part of input, and we have all the machines, heavy machines, which makes help us in producing cars. Again, it is quite obvious that what are the input and all. But when we start moving towards more intangible domain, then that's where challenge comes, and that's where the whole process of managing data becomes more critical.

So, let's take example of Delta Airlines. Now in Delta Airlines, what is our output here? What are we trying to create? So, we are not creating a physical product here. We are creating service. So, Delta Airlines is taking care of the service, moving people from one place to another place. So, what are the kind of inputs we are talking here that goes inside the process, right? We can always think about all the human resources that goes here, but they are mostly resources. So, this becomes, start becoming very complicated. And the food that we supply is input. This is input because that gets consumed by the consumers, but the seat we provide, that is also consumed by customer, at least for that flight. But the line becomes blurrier between your input and resources, and that makes the utilisation of all the analytics also challenging. Let us make it little bit more complicated.

How about Google? When we think of Google as a company and their supply chain, what is their real output, right? Now, for Google supply chain, the output depends on who you think customer is. Where do Google really makes money, even though Google

has users like coming from the people who are really using their search results, and let's first focus on Google's core business, how they started with their search results. Now, Google is also getting into lot of hardware and other things which makes them more like many of the other examples in traditional industry, let's focus on their core business. So, when we think of their core business, their customers are, one may think, are the people who are using their results, right? But at the same time, one can argue that those are not the people who are paying them money. So, users of the search results essentially becomes indirect customer.

So, where is the money coming from? Now the money is coming from the advertisers. Advertisers are really paying them money. So, advertisers are their true customers, but they get those customers only because there are users on the platform. Now that is another piece that comes into puzzle now. Now let's think about that what are the resources, what goes into the input? Now they make their money by showing ad on their page. The biggest real state space in their supply chain is the space where ads are placed. Now those are the critical thing, because if you put the wrong ad in those place then that is wasted. And when I say this is the critical part of the supply chain is that space is generated for every user. So, that is different for different users. So, what we need to understand, what kind of data we need to even get, understanding of that is to understand about every individual users and what is the value of that space. So, in this supply chain, we have to now worry about getting data at the individual level. And for each individual now, I have to find out which ads will go and how the search results would look like, and that's where Page Rank algorithm came into place.

So, when we think of Google as a company, even though we look at it as a search result and advertising, they are basically algorithm company, that's their key resource that makes this happen. So, to manage this kind of supply chain, the data requirements will be more severe. So, when we move towards more intangible and service supply chain, the data requirements are more severe, more critical for the operations of the company than any other place.

One more thing that is important to understand is that when we are moving towards more intangible supply chain or service supply chain, the process variability is very high, which means I need more data to reduce my variability, because variability kills us in any business. How can we now think from a broader perspective to get this data and analyse this data, especially in the supply chain context? And for that, it's important to understand what company has, what different companies in different industries have done to analyse this data.

Now this is where I want you to little bit think. Take a pause here and think about the education at ISB. Is it a supply chain? If it is a supply chain, what is the output here? What is the input here? What are the resources here? Now this is not very straightforward. So, when you think deeply on this, you will realise that, that all the lines are getting blurred between even input and output and resources. So, here we are talking about that the brain the students get out with after the education, that is essentially the output. But then brain the participants come with, that is the input. So, the participants or the students, they are both input and output but in different form. And

that is where the value chain piece comes into picture because we have to create value in the process, and that value is generated through many different resources. And those resources could be faculty, they are not really any different from what we talked about all the machines in Toyota or General Motors. And then other resources will be all the facilities, the staff involved in that.

So, now we need a very different kind of data, but once we get the data on all these different kind of supply chain, the key drivers are not very different. That makes our life little easier on how to manage this. But lot of this is about changing our perspective and culture as well. When we deal with non-tangible supply chain, we can think like how we were working in the supply chain, especially from the data perspective.

Video 4: Logistic View of Supply Chain

Now, if you think of a logistic view of a supply chain. It is even the simplest supply chain where you have one supplier, one wholesaler, one distributor and one retailer. The supply chain would be quite complex because you know, it requires to move items from one place to other place which may require different mode of transportation and lot of information transfer from one place to another place. Then how to deal with that?

That is the biggest question right now, to be ready for future supply chain and to make ourselves agile and competitive. We all need to understand the nuances involved, how we can avoid the blind spots, how we can create value. And that is the focus here. And we all should have that mindset first. So, changing that mindset to start thinking in that direction and how we can do. And it is also important to see and analyse what people have done right, what people have done wrong because that understanding essentially tells us what to do.

So, here we will use now a classic example of Boeing 787 Dreamliner. Now, Boeing 787 Dreamliner has always been a point of discussion and we all understand that they handle their supply chain very differently. So, this was the very first time. Then Boeing decided that they will diversify their supply chain to many different players in many different countries, break it by different pieces. Now, in a supply chain, we always talk about that to be a successful supply chain, we need to have information symmetry. All the supply chain player should be able to see the data from different players, but that is not always feasible. And if you think of Boeing, Boeing has a big challenge. When I am working with so many suppliers, I have to be very careful, what kind of data I am sharing because there could be lot of problem with IP. There are some industries like airplane manufacturing industry. We can also think of all the Pharmaceutical industry there, a lot of money and resources go into research and development part, right?

So, if a Boeing decide to share data with their supply chain partners it is possible that some of this data can be misused. So, Boeing was very careful on sharing only parts of data. Now, when you see that and when you are working with many different players. For example, Boeing worked with the suppliers in ten different countries with thousands of engineers for one airplane and they had 13 Tier 1 suppliers and partners across the globe. They really had to be very careful on what data is transferred. But since they shared only part of the data, that created another set of problem. And the problem was

that now, our supply chain is not the most efficient supply chain. That is why when we hear about all the story of, they going over budget, having lot of safety issues because all the different supply chain partners are working differently.

Now, you know, means Boeing is a very interesting example on many ways because you know, the way they assemble plane is a fantastic process, you know, they do it very efficiently. In a few days, they assemble whole plane and if you see their supply chain, they are like doors from where the parts come and the plane is actually moving in the middle on a rail and the parts snap like those Lego blocks. You know, they literally look like Lego blocks, and you expect everything to work because they all have got design specification. But there was a limit in data shared with each of them to make sure that we do not lose strategically and that led to lot of safety issues.

So, you know the ultimate goal is if we can find a way where we can share all these data with supply chain partners who can use all these data to make their decisions without losing our strategic power. That is the best situation and how we can achieve that, that is all we need to understand and talk about. Without that, we cannot create efficient supply chains. One of the reasons why we talk a lot about analytics, use of analytics and disruptions in supply chain is about the cost involved. If you look at the logistics cost in the US right now, the logistics cost itself is around 8% of country's GDP. Now, that is a lot of money we are talking about. So, if we can do anything using data and analytics, this can change the view. That is why the view, the digital view of the supply chain and value chain is critical, not just for individual companies but for the society in general. Once, if we do not do that this 8% that we are taking can be much larger and it can go on the path of destruction and these numbers are not the same across countries.

So, it is also important to understand what we can learn across countries. Now, it has been hovers around the logistic cost hovers around 7 to 9% of GDP in US and for a country like India, it is around 13 to 14%. So, there is a big question here that why do we see this difference? Is this 7 to 9% to 13 to 14% in India? Is it because of different environment? Is it because of different infrastructure? Or is it because of the lack of efficiency or not using data very well and not using analytics very well?

Now, this is a good time to think about it, right? But if we all think carefully, you will see that it is a combination of all three. And partly, we can touch first and second point which is about the type of product being sold or infrastructure, the biggest dent can be made in impacting the efficiency part. And if we can do that and I can tell you, these are the low-hanging fruits we have right now. If we can develop a system on creating a supply chain where which essentially can reduce all this wastage or improve efficiency, I think that itself will be a phenomenal service to the society and it will be a good money-making business.

That always raises the question that why we do not see enough in this domain, right? It is not that we do not see enough. Sometimes, we do not hear a lot about it, but there is always some hesitancy because of many factors. Number one, this is not as attractive as some of the other fields. I can see it is not considered very high-tech domain. But the second piece is that also the understanding. You know, not many people really

understand deeply what is going on in there and many times, there is a lack of data. So, if we can make that happen along with dealing with different bureaucracy, I think this is a fantastic time to delve deeper into all these supply chain and value chain analytics. And if we can, hopefully, we can discuss about how we can overcome these challenges and how we can make the value out of it, right?

Video 5: Drivers of Supply Chain Performance

Whenever we think of a supply chain from the perspective of either a manufacturing company or very service -oriented company such as General Motors or Google, there is always physical flow in one direction, which could be cars, or which could be just search results and the cash flow always in the reverse direction. The information flow need to be in both directions and how to make that happen is very, very critical for the success of our future supply chain. So, in order to now take the perspective of really understanding it nicely, we all need to look at what is really going on right now in this industry.

Now before jumping into some of the examples, let's first understand what are the key drivers of a supply chain. So, it can be divided in many different ways because of very broad thing. But the key drivers especially where the data really make a big impact or that is transportation, for example. And transportation is a big portion of our logistic cost. So, transportation is always very important and here we can make really big difference using data. Then comes inventory. We spend lot of money on either keeping an extra bunch of inventory or running out of inventory and both are problems, both are a big cost to supply chain. And then comes facilities that we have different warehouses or any kind of facility. And sometimes these facilities don't even have to be physical facility, they could be virtual facilities where we are storing data on cloud or something like that.

And then along with these three drivers which is facilities, inventory and transportation, we also have information. Now information is something that ties everything together and all of these drivers essentially rely heavily now on analytics. And some of the non - modern supply chains, we see that they do not use enough data. Those are the ones who are struggling right now because you have to deal with Amazons of the world where data is used at a different level or even think of Walmart.

Walmart is using data from very different perspective. When you are dealing with these kind of companies. And then in the service sector, we have Google. We have companies supplying different kind of services to the customers, cloud services and software as a service. All of those things are run by companies who are very good with data and can manage their supply chain lot better. So, how to understand and apply, is critical for any executive right now. We cannot think of executives running businesses, without getting a good perspective on that. And when we think of these drivers, we also need to think about what are these drivers really trying to achieve?

So, facilities, inventory, transportation and information, together they all impact our efficiency and responsiveness. What is the efficiency here? Efficiency mainly talks about how to reduce cost. So, we can think of many examples in the supply chain world.

For example, I want to look at my data and realise how to keep optimal level of inventory to reduce my inventory, reduce my cost.

Now this is not very simple. Like seasonal product is a very good example. Summer products need to be sold during summer otherwise they don't get sold. This has been a pain problem for any retailers going from Walmart to Zara or any fashion clothing. They all struggle with the problem of deciding summer clothing. We have similar problem in flu vaccine. We have to first decide well in advance how many vaccines are needed because this whole vaccine process manufacturing takes several months and then whatever is leftover might not be used all the time, right? So, for these kind of supply chains, reducing cost may not always be the ultimate goal.

So, we look at the cost part using data analytics, but we also need to look at the responsiveness which deals with how good we are responding to the demand of the customer, how fast we can respond and how many we can respond. So, any supply chain is always in this dilemma of how to manage the cost and responsiveness. And lot of COVID-19 failures in supply chain that we saw was mainly because of mismanaged of these two-part or not proper utilisation of data. For example, over time because of all the competitive factors and so on, we have become very cost -centric. We want to reduce cost on every possible thing but that means we are not keeping in a buffer which hurts our responsibility. So, that is basically sets the stage for all this trade -off that is involved in the process right.

Now how to achieve this balance between efficiency and responsiveness, that is a good question to ask. So, if you think about even though the primary goal of efficiency is reducing cost and primary goal of responsiveness is the quick response, it goes into every aspect of value chain. So, we have to think about how to begin with product design. If I keep a product design which can be easily flexible, then I can be very responsive. But that whole process may be more costly.

One of the classic and the most recent example is, what went out of the shelf in the U.S. when COVID started. The very first thing that suffered the supply chain problem was toilet papers. And then many more after that, of course. So, here let's take a pause and think about what could be the possible reasons that toilet papers went out of sale. And I will give you some hint. Yes, we will think about hoarding. People are keeping more. But that was true with many other products, not just toilet paper, right? And second, toilet paper is one of the product which was almost completely built within the United States. So, they could not go out and blame any other country for the disruption, be it China or India. This is not possible because it is all coming, most of the product is coming from there.

So, let us think that what could be the reason that they went out of self and how we can avoid this kind of problems going forward. So, for the toilet paper, the supply chain is very inefficient and there is a reason behind it. It is a very stable product. People always use the toilet papers, so there was not enough push to improve the transparency in the supply chain and improve efficiency in the supply chain. For some of these products, actually the time it is bought at the retailer, the time it reaches to the manufacturer that information that the retailer has bought could be 50 days or so. And more so these kind

of things are closer to this high numbers in the toilet paper segment because the demand is very stable, I don't need to worry about doing lot of analytics to understand it. But there was a one big challenge which defines the trade-off between efficiency and responsiveness, which is our product design was not modular. What do you mean by modular? That means that we did not have enough substitutability.

So, there are mainly created the household toilet papers and commercial toilet papers. Household toilet papers are sold to individual household where the commercial one goes to offices. So, when COVID came, we saw certain surge in the demand for household toilet papers and sudden drop in the demand of commercial toilet paper. It was not possible to quickly switch from one type to the other because they require different papers, different type of roles, different types of machines, different type of capabilities. So, we could not switch. So, we had lot of machines sitting idle which could create commercial toilet papers and we had lot of machines which we were not able to make household toilet papers. How could we solve this problem and how could we use data for that?

Think about it. So, the first piece, first kind of data we could use is that transfer the information much quicker from retailer to manufacture or create more transparency in the supply chain. But that itself will not solve the problem. We have to take the holistic view of supply chain. Now, we have to think how I can change my design to more modular so that I can easily switch around. Now even though the cost of doing this may seem like high at a given point, the supply chain benefits are much longer and that's where data can tell us all the ROI and so on. But unless we start thinking about it, we will not be able to fix these problems in the long run. We may not have another pandemic, but lot of other disruptions keep coming And if we believe all the recent reports and even some medical journal papers, they are all alluding to, we may even have a major disruption of COVID kind in coming years, which may not be necessarily pandemic but something which can disturb, right? So, supply chains have to be viewed from very different angle and how data can be viewed from very different angle.

Video 6: Supply Chain Analytics

Being more responsive makes our supply chains more agile and efficiency is always important. In fact, data can help us in reducing in improving on both dimension which means that improving efficiency or reducing cost and improving responsiveness. Now the whole discussion on this is of course need to go deep deeper into each of these things. But first need to understand that why did we start talking so much about data in analysis. One of the key reasons have been that we started collecting lot of data.

So, in late 90 and early 2000, series of things happened that changed the whole supply chain analytics or digital supply chain. First of all, in 90s we got our worldwide web, which just kept exploding over time. So, we kept getting more and more data. In fact, if you really think carefully that the way people thought in the early days of worldwide web was very different. So, suddenly we started seeing the explosion of data in supply chain. Then to make things even more interesting, there was a big push in late 90s and early 2000s on using enterprise resource planning system or ERP systems, right. So, those ERP system generated volume of data and finally we have started using sensors for

everything. Now go back to think about different examples that comes in your mind about the supply chain.

787 Dreamliner. That has a millions of RFID tags in there. Now how do this RFID tags help with supply chain? So, RFID tags are different from barcodes where you don't have to scan each item, it can transmit information right? It can just transmit data and the reader can catch it. Now this RFID tag started making very popular in retail industry in warehouses because you know people like one of the engineers at Procter and Gamble, Kevin Ashton who essentially popularised the term Internet of Things later, he started using lot of RFID tags in lipstick product which are always getting displaced and unable to find in the system. But many such things started coming and we started getting lot of data from these sensors. When we think about the world of blockchain in supply chain, we are talking about tons and tons of data right. Now that data made our supply chain lot richer than earlier, and we started seeing lot of applications around that and so it made people make lot of better decisions.

If we breakdown this supply chain analytics, we have descriptive analytics which talks about lot of visualisation, lot of images, and lot of this descriptive analysis data come from GPS system, RFID chips which gives us lot of data visualisation. But the descriptive analytics, which try to say that now we have got the visualisation, now we have to describe the data and get the meaningful value out of data. This where we started using lot of real time information.

So, when RFID started becoming very popular, Walmart went and told all their Tier 1 suppliers or mandated them to use RFID chips right. They told that if you cannot put RFID chips you cannot supply. And many other suppliers followed the suite, the same path, using Boeing and others where they pushed their suppliers to put RFID and all and trucks like UPS trucks and others. They started putting lot of RFID chips into trucks. Now you can monitor the whole path. You can see how things are going, where the truck is moving and so on. And several examples of the great uses of analytics emerged because of the availability of this data and the mindset.

And the predictive analytics comes mostly into demand forecasting and demand forecasting can be done at any level. It could be done at the store level; it could be done at broader level. But all of these required many things in terms of network design, capacity planning, production planning and we need to understand all of them to get the real view. But the ultimate truth of all this analytics in supply chain has been on prescriptive analytics where we focus on finding the business decision similar to decision analytics where essentially our goal is how I can take all the meaning of the data and make business value out of it. And this is where I strongly believe that we need to do more as a society because supply chain analytics in the prescriptive part should have taken much bigger leap, than what it has done right now. We are seeing lot of interesting things but still it is not perfect.

Video 7: Supply Chain Analytics: Examples

So, prescriptive analytics can drive lot of real time analysis and so on that is where we are mostly using, right. So, if you think about you know what could be different

techniques and models that we can use from the supply chain mapping side, we have to monitor different kind of factors like moving average and so on. And here we use lot of time series method, time series method simply is that we take data overtime to do that. They can in the prescriptive or decision analytic side we have lot of applications like mixed integer program as well as lot of clustering theory, game theory. Game theory is picking up a lot because game theory takes us to a different level.

So, now let us think about some example. I think unless we look at the examples, we will never be able to really visualise the value of it, right. So, one of the thing HP did, HP have used lot of supply chain analytics and you know I have worked very closely with them on many of the supply chain projects in when I was at Texas A&M, and I was dealing with their company in Houston. But one of the application that I find fantastic is that how they did product rationalisation using data. So, they had to decide which product to focus on, should it be the most profitable product or some combination by looking at the whole supply chain not just from the profit perspective. So, it is fantastic work. I think that example itself tells us that how analytics can totally change the same.

Coca-Cola, they have used for the fleet planning, lot of nice analytics, how do they, how do they manage, how do they plan about their fleet. Then comes Procter and Gamble. And Procter and Gamble has been one of the forefront of many of the applications that we see right now in supply chain. For example, one of them, they manage their multi echelon inventory management.

So, what is a multi-echelon inventory management. When we think of inventory management, we have different pieces, different partners and sometimes many partners at one place like supplier, distributor and so on. So, how can we manage that? That is not an easy task and sometimes it requires very different not only algorithms but very different thinking process. So, great example to look at.

Similarly Waste Management Inc which is one of the largest waste management company in the U.S. They have, they have started using lot of data analytics on vehicle routing because they have to take their vehicles to some place and then either one side it is very packed and the other side it is empty. So, how I can combine these two pieces and make sure that both side we utilise?

A lot of push on supply chain analytics and value chain right now is regarding reverse supply chain because that is the big part of the total supply chain cost and there, we cannot do much without data. You know data becomes very critical even sharing cross partner And another very classic example is that which was always titled in media that left is not right, right? So, this was for UPS. So, UPS looked at the RFID data. They kind of derived from there that it is not always good to take the left turn. So, sometimes left is not your right turn, you have to take U-turn from somewhere else or take somewhere else another path. Now they have taken analytics to a different level by looking at all these data and try to create all these different kind of rules and regulations. So, Amazon is kind of monitoring the data at as a 30 second levels of their trucks and they can instruct them what to do. So, fantastic you know fantastic applications and these applications can give us lot of understanding on where supply chain analytics is going.

But one of my one of my most favourite example is Harrah's Entertainment. Now Harrah's Entertainment is one of the largest casinos in the world and in 90s, they did something very interesting. They had this guy named Gary Loveman as a Chief Operating Officer who was who was a faculty at the Harvard Business School. And what Gary did was that he basically told that, "Let us find our pain point, even predict our pain point and see how we can use data to customise everything." You know, in the most recent world we talk about Web 3.0 which talks about mass customisation, where we basically treat each individual as individual person, and we customise that. Actually, Harrah's Entertainment tried to do a lot of that through analytics. So, they even found out that well, not everybody like free drinks, so how we can serve them and so on and then which marketing initiative to serve, move through which channels and so on. So, lot of lot of fantastic application. There are several case studies written about them. It is very easy to find about how they really used analytics on that, but very good use cases around that.