ISB CTO

Week 5: CTO as a Technology Architect

Video 1: Module Overview

Another important role and skill that makes a chief technology officer invaluable in today's digital economy context is their role as a technology architect. In this module, we will understand why is that function, or why is that role so indispensable today, and then we'll talk about what kind of frameworks, what kind of knowledge and skills you should cultivate to be effective in your role as a technology architect. So, let's start by talking about the strategic context today. In today's digital economy, firms must simultaneously implement strategies for customising products and services. For the customer experience, all the things we've talked about on enriching the customer interface, but do them simultaneously with synchronising operations. In other words, firms don't have the luxury of doing one or the other, customer or the operations, they have to do all of them which means that the scale is much larger. Firms must also balance open innovation with the ability to commercialise new product ideas. In other words, open innovation generates ideas, but then how do you sift and winnow those ideas? How do you build a robust platform to launch the good ideas, and how do you scale them up? Because remember, we said today the focus is on winner-take-all. If you remember from an earlier discussion of strategy catalyst, the new real rules of the game are scale, speed and scope. So, what kind of a technology platform do you need in order to commercialise the good ideas at scale and with speed? Third, firms must balance the ability to experiment with the ability to scale successful ideas. What kind of platforms do you build in order to support experimentation? One of the important metrics we said is not one or two experiments, but tens, maybe even 100 experiments in a year, or for some companies, 100 experiments every six months. So, what kind of a technology platform do you need in order to scale experiments and speed them up and at the same time learn from the successful ideas and bring them to market? So, what does that mean for the role of a Chief Technology Architect? Questions such as, what digital infrastructure do we need? How do we weave together different technologies? That they be ERP, data warehouse, mobility, smart, cloud, analytics and the list of technologies keeps growing, virtual reality, augmented reality, AI. So, how do we make sense of all these technologies and build the platform for our company? So, the role of a Chief Technology Officer as a technology architect is important to make sense of the technologies, to make sense of the business priorities and challenges and to marry them together. And that's what we mean by the technology architect role, translating business strategy into technology strategy and then leveraging technology strategy for new business strategy.

Video 2: Digital Economy: Business Imperatives

So, what are the business imperatives?

Imperative means pressure, need. What are the business imperatives in a digital economy that are influencing the need for technology and the role of a CTO as a technology architect? First, speed, speed, speed, in other words, faster time to market with new offerings is an absolute necessity. Second, seamless multichannel experiences. Blending the physical and the digital, so that customers can move effortlessly from one channel to the other, and put the customer as the centre of the choice in those decisions. Third, how firms can use big data and advanced analytics to better understand customer behaviour, that's a necessity today. And fourth, firms need to improve their capabilities to automate operations, to digitise business processes, so that they can have quicker response times to customers while at the same time cutting cost and waste and improving productivity. Gone are the days of saying we either reduce cost or improve our speed or enrich our customer offerings. Today the need is to do all of them, and how can you do them smartly through business processes, but importantly through technology? So, those are the challenges facing businesses today as drivers on the digital economy.

Video 3: Digital Economy: Technology Imperatives

Beyond the business imperatives, there are technology imperatives too. The IT industry, or the digital products and services industry over the last 20 plus years has been most dramatic in terms of the scale, the rapidity, and the frequency of innovation. Just think back about some of the products and services that are becoming household names like augmented reality, virtual reality. You see that on your smartphone. Five years ago, they were just concepts. So, 10 years ago, smartphones were just emerging, and today they have become very much a reality. So, the digital products and services industry continually expands, grows, and innovates at a rapid speed. That's the good news. The challenging news is for most firms, whether they are in retail, education, financial services, name the industry, which are the users of this technology, how do they stay on top of this growing list of technologies? How do they make sense of them? So, today, the list of technologies continues to grow and create challenges in understanding them.

So, what are some of the technology imperatives today for the digital economy? Enhanced web presence. Can you think of a business which doesn't have a web presence? It means mastering content management, mastering personalisation, and identity management, important elements of web presence. Add to that, the growing complexity of the app’s infrastructure. Where you need to build APIs, Application Program Interfaces, you need to provide integrated access to content. After all, an app is your identity. Who are you? Your services? What do you want? How you will procure the services, your payments, and your protection? Meaning that how do you protect security and privacy? Bundle all that. So, next time you look at an app, imagine how much complexity and richness goes into designing that app. And apps typically have a useful life of six months before they're replaced with a new app. So, just think about the scale and the speed of that world that companies have to venture into.

Then, of course, there is the backbone which is the ERP, Enterprise Resource Planning, CRM, Customer Relationship Management, Seller Relationship Management, Supply Chain Management. We call these the enterprise platform that are an important backend to the app's infrastructure. Later on, we'll talk about how do you build both these infrastructures simultaneously, which is a vastly new challenge.

Add to that, building and managing a data warehouse and an analytics platform. On top of that security platform, today security is a key issue, and the firms can be penalised for violating the security promise, the privacy promise.

The cloud platform. Cloud is the new technology and business infrastructure for business, so managing cloud platforms. And then, of course, digital marketing and Office collaboration tools. Every few days, Microsoft announces new innovations in teams, which one of the newest Office collaboration tools. How do you integrate that into your Office processes?

So, you can see the list of technologies continues to grow and those are the technology imperatives for a company. They rely upon the Chief Technology Officer to know what's new; how do we make sense of it, how do we marry them with what is existing, and then to predict what else is going to be happening in the future. Very important elements of the technology architect role that we will explore.

Video 4: Assembling the Digital Infrastructure

So, in thinking about the digital infrastructure, is there a way to identify the different components? Can we develop a framework so that we can systematically understand what does it mean to be a technology architect?

Some of the work done by professors at MIT, Jeanne Ross, Martin Mocker, and Cynthia Beath is helpful in this regard, where they've studied a lot of companies, and how do they build their digital infrastructure.

So, what are the five ways of assembling the digital infrastructure? The first area is the operational backbone. Typically, these are the integrated systems and processes that ensure operational efficiency, productivity, and reliability, particularly in how transactions are executed. Today, that means fundamentally re-engineering business processes and digitising them through enterprise systems. We'll talk more about that in detail later.

A second area of the digital infrastructure is shared customer insights. Remember, we said that in the digital reality is smart, mobility, analytics, cloud. So, lot of it is about generating insights, particularly customer insights and sharing them across the organisation. So, this layer of the infrastructure is: how do you generate organisational knowledge about what customers like, what will they pay, how much will they pay, and how digital technologies can be used to harvest those insights and put them to operational use.

A third area is the digital platform. This is a repository of business, technology, and data components. This is where a new trend called components-based architecture. In other words, components are modules of business processes, data, and technology woven

together. So, digital platform is a repository of these components which facilitates rapid innovation and growth, and particularly helps in creating new offerings in a rapid and a quick cycle time fashion.

The fourth area is the external developer platform. Remember we said, one of the key challenges today in a digital economy is, reimagine business around the customer. So, how do you provide external orientation toward the customer? And that's what an external developer platform is, particularly from an open innovation point of view. So, an external developer platform is a digital platform for an ecosystem of partners who contribute to innovation, different ideas.

And then the final piece is what we call a governance framework. How do you make decisions? We call that the accountability framework. Decision rights and decision rules about who will make specific decisions. So, these are the five components. And as a technology architect, this framework helps a CTO systematically address each of the five layers and assess whether they have been completely addressed or not.

Video 5: The Digital Infrastructure

Now, let's dig deeper into the components of the digital infrastructure. You will recall we said there are five key areas, so let's dig into each of these areas to understand what kind of decisions need to be made. So, let's start with the operational backbone. Think about this as the platform built around Enterprise Resource Systems, ERP, Supply Chain Management, CRM, a suite of technologies called enterprise systems and the data warehouse.

What's the objective of an operational backbone? It is to support seamless end-to-end transaction processing. It's also to provide visibility into the transactions, their timeliness, their reliability, how well they were done, were they done with security in mind? So, the quality of transaction execution is important. The goal is also to automate repetitive business processes so that they can be executed reliably and with speed. And the goal of the operational backbone is to provide a single source of truth, meaning data that you can trust, streamlining all the data and embedding that into a data warehouse.

So, once again as I said before, very much a focus on business processes and enterprise systems and data to provide the backbone for the organisation. The digital platform is the second dimension that complements the operational backbone. Think about this as the component-based architecture. What are components? Components are specific business processes designed with data and technology in mind. They have service rules, so for example a component could be, product pricing. So, it a business process with some rules of product pricing, data, and technology. So, this is how firms are building a modular set of products and applications on top of the enterprise backbone. The goal of the digital platform is to provide a repository of reusable technical components. Additionally, to provide a repository of reusable business components. So, product pricing is a business component whereas security, identity management, those are examples of technical components which can be reused in different ways.

The goal of a digital platform is also to provide data repositories and tools for analytics. It also provides linkages to core data and processes in the operational backbone. In other words, the operational backbone stores the data and then extracts of the data are drawn into the digital platform for particular uses. So, a customer relationship manager does not need to see the entire data, but depending on their rule and their decision responsibilities, they get to see a view of data that's relevant to them. So, that's what we mean by drawing data from the operational backbone into the digital platform. And then, of course, managing the continuous release of new components. So, there might be new components for redesigning customer segmentation, product positioning, channel management. So, every time there are changes they need to be, re-embedded into the digital platform. So, the operational backbone plus digital platform. The third one, and this is the new part of today's digital economy which is the external developer platform. In an open innovation manner, employees, customers, suppliers, all are sources of apps in an open innovation manner.

So, what's important is the external developer platform creates APIs or application program interfaces. These are hooks or these are rules which the firm publishes openly so that anybody can write an application and connect to the platform. So, APIs are a reality of today's world to provide flexibility, modularity, and open innovation. So, making the APIs available to external partners, what are the rules? How will you include external partners in your enterprise digital platform? Publishing a catalogue of services available in the digital platform so that outside developers can write code according to that. And the role of an external developer platform is to rapidly onboard new partners. Remember when we talked about strategy catalyst in Module 2, we said, open innovation, building new ecosystems, which means finding new partners and onboarding them rapidly. So, from a technology perspective, the quality of the external developer platform is the key to that success. The fourth dimension are the shared customer insights. Think about this as the investment in analytics, AI, and machine learning technologies, that's the layer that we call the shared customer insights.

What are some of the things we should know about this layer? Shared customer insights, they stem from a constant flow of experiments. Remember we said how many experiments do you do is a key to success in digital economy. So, the data generated from experiments that help identify what customers value. The shared customer insights are also based upon, experiments with new technologies such as wearables. They are guided by a vision that targets the customer value proposition, meaning, what is the customer value? so if it is product innovation, then this is how you keep testing new products.

The shared insights are enhanced by tightly integrated sales, service and product development processes. So, re-engineering them to make sure that they work together, something that's a challenge in traditional organisations. Shared insights are also developed through a co-creation process. We used that word before to say that the customer is not the end target, but the customer is a partner, co-creator in your product or offering. And then shared insights also have to build mechanisms for, sharing learning from every encounter, so capturing that knowledge. So, the key to success here is, are you capturing new insights, are you sharing them across the organisation

for reuse and deployment, and how well are you curating the accuracy and the authenticity of the knowledge? You will notice that as we move from the operational backbone to this, the kind of things you do start changing. That's what makes assembling the digital infrastructure so complex.

And then the final piece is the governance framework. Who has responsibility for the operational backbone? Who has responsibility for the digital platform? Who has responsibility for shared insights? Who has responsibility for the external developer platform? The mistake firms often make is not having clear rights and responsibilities and an accountability framework, so developing that is also important. Clear accountabilities enable a high degree of autonomy, but at the same time they build coordination across the decisions so that they are not incompatible with each other. An accountability framework also helps identify metrics of success which you can track. So, this involves decisions about what decisions will be made by the CTO, what decisions will be made by the CIO, and what decisions will be made by the business units? So, to summarise, the enterprise or the operational backbone, external developer platform, digital platform, shared customer insights, accountability framework; five different dimensions of how you systematically build a digital infrastructure.

Video 6: The Technology Strategy

The role of a CTO as a technology architect goes beyond developing the digital platform or the digital infrastructure to developing the technology strategy. The technology strategy is a blueprint of how will you translate the business strategy into a set of investments in technologies, and how will those technology investments support the business strategy. So, we call it synchronising business strategy and technology strategy. You will remember, when we talked about the business imperatives, we said, the challenge for companies today is to be both productive, efficient and reliable but at the same time open, flexible, innovative and customer-oriented. So, the challenge today is, how do you simultaneously embed flexibility and rigidity, openness and secrecy, modularity and reliability into the same technology infrastructure?

So, new ideas from Gartner, advocate for what we call a twin speed architecture and technology strategy. What does the twin speed mean? Simply put, it means that the backend moves slowly, it should, but as the frontend should move very fast. So, how do you take two gears, one moving at light speed on the customer side and the other one moving slowly and methodically on the operational side? So, a twin speed architecture recognises the need to simultaneously build foundational business processes and technology platforms where the goals are resiliency, security, integrity, quality and regulatory compliance, and, on the other hand, to build a different set of business processes, what we call the frontend processes and technology platforms for speed, flexibility and agility. So, another way of looking at the twin speed architecture is to describe this as a fast speed, customer-centric frontend running along with a slow speed, transaction-focused foundation. That's a challenge, but that's what is needed. The customer facing parts of the digital platform should be modular so that you can do quick deployment of new software by avoiding time-consuming integration work. Sometimes when you do this, you're making imperfect technology solutions, and we

call that you're incurring technical debt, meaning it's not perfect, but speed trumps perfection. And at the same time, the transactional core systems must be designed for stability, high-quality data management which means longer release cycle times. So, I hope you see the contradiction. At the frontend, quick deployment, whereas the backend, longer release cycle times. And both coexist in the technology strategy. And you do that both by leveraging partnerships with technology vendors and systems integrators, such as Accenture, Infosys, Wipro, TCS. On the other hand, you also leverage open-source development and APIs. So, the role of a CTO as a technology catalyst has become much more challenging and complex because in the old days, the focus mostly was on the backend, but now the backend is important but by itself is not sufficient. So, how do you build such a technology strategy? Here are some important dimensions of doing that.

First, focus on microservices. Microservices are small amounts of functionality, such as customer product pricing. It's a part of a bigger marketing function, but it's a discrete activity. So, build support for discrete activities, and we call them microservices. Similarly, enable, enabling digital payments by customers, that's only a part of the whole customer journey, but that's a specific microservice. You can build it fast, and you can deploy it fast. So, one approach is to define microservices with small amounts of functionality, such as looking up the next product a customer would most likely purchase. These functionalities can be deployed very quickly, often within a few hours. They also rely upon open access to outside programmers and multiple programming languages rather than being locked into a single development framework. So, that's one important element, build microservices.

A second criterion or a goal of technology strategy is zero downtime. In the digital economy, zero downtime is absolutely an imperative. So, upgrades of systems affecting consumer's experience should be seamless. They should not be able to notice that, that there's a disruption due to upgrades. The deployment of new software or service should be in parallel with the existing system and a gradual cutover to the new software or service. There must be fallback mechanisms in case things go wrong so that issues arising in one service do not harm the overall operations more than necessary. So, zero downtime, another critical priority.

A third element is real-time data analytics, the ability to analyse big data in real time and make analytics a part of the decision-making process. So, for example, the ability to analyse a customer's purchases automatically and deliver them a savings coupon for the next purchase they might make or the ability to recommend the next, important product or service, even as they're completing the current purchase. So, that's what we call analytics in real time. These are necessary today. And so, how quick and how accurate, how reliable are your analytics? That's a third dimension.

A fourth dimension is security. Cybersecurity must be an integral part of the overall infrastructure today. Not only do companies have more valuable data to protect and become more attractive to hackers, but the digital interface also opens up access to outside people like customers, suppliers and other partners. There's another important reason, which is regulatory compliance. Country after country are toughening up their

rules to punish companies for losing data or exposing customer data to outside hackers. So, secure architecture is another important dimension. So, to summarise: microservices, zero downtime, real-time data analytics and a secure architecture, four important ways in which you measure how good is your digital infrastructure. And you develop a technology strategy to assure high levels of performance on all these four dimensions.

Video 7: Developing a Two-Speed Architecture

What are some principles in developing a two-speed architecture?

One fundamental idea to grasp is for a very long time, we have focused upon the traditional systems development life cycle which is called the waterfall model. The waterfall model says build the systems deliberately through phases, which is plan, design, build and test, and don't go from one phase to the other until you're completely done with the specifications. So, take a retailer like Target. Using the waterfall approach, they will be reengineering their core business processes, such as, supply chain, merchandising, product placement, point of sale counters. So, these are examples of business processes and the waterfall model. The chief technology architect at, Target would essentially be very methodical and slow and deliberate, and the whole process might take, two years. The advantage of such an approach is it is systematic; it is disciplined, and it is comprehensive. The downside is it is slow and if the requirements are changing rapidly, then the work has already become obsolete even before it has been launched, and that's a particularly acute problem at the customer interface.

Remember we said, there is the external platform for customers and suppliers. So, where the waterfall model is built for six months, one-year, two-year development cycles, we need something that is fast, flexible, and that's the agile methodology. So, at the frontend at the customer facing, you have to marry the backend waterfall with the frontend agile methods. Going back to the same example of Target, as Target starts building apps, as it starts building web-based interface for customers, to find stores, to find products, to order products, enable, omnichannel experience, the development of new services have to be done in four weeks, not six months, not one year, not two years. So, that's where the agile methodology becomes important because the focus is on just do enough, build it, deliver it and then six months later build something new. So, in a two-speed architecture, if we stick with the example of Target, their goal has to be how do you apply the waterfall development methodology for the backend and at the same time learn how to do agile development at the frontend. So, what are some principles in this regard for developing a two-speed architecture? First, manage a hybrid target architecture. What does that mean? It means that in the old days, there was a single architecture, the operational backend, it was homogeneous. Now we have heterogeneous architectures, one is at slow speed and deliberative, other one is at fast speed and modular and open.

So, how do you develop your strategy or a target architecture where the transactional platforms are managed for scalability and resilience, and they coexist with systems optimised for customer experience? Same thing happens in financial services, a

backend in a bank, a backend infrastructure built for resilience, built for supporting ATM networks, built for supporting interbank transactions and built for high levels of security. But at the same time, in working with fintechs, the same banks have to focus on apps at the frontend using the agile development methodology. So, you get the picture of two different methodologies, a transactional platform optimised for scalability and resilience and the frontend platform optimised for customer experience. This two-speed strategy can only be sustained if there is a blueprint, a high-level target architecture, identifying what technologies and processes and who will have the responsibility for the frontend and similarly who will have responsibility for the backend and making sure that you're not missing. So, today's world, whether it be Target or whether it be a bank or a financial services or a hospital. Cybersecurity, so making sure that you're paying attention to security and you're describing it clearly from the beginning. One of the challenges is if you miss components in defining your architecture and you discover those gaps, you can get slowed down later. Second important element of the strategy is plan for ongoing software delivery with the blends of methodologies, again waterfall at the backend. So, sometimes there might not be the time because of urgency. If you remember in the last module we talked about, different ways in which you think about your innovation portfolio. Sometimes there are mandatory projects which have to be completed within a few weeks. So, there might not be time to apply the deliberative, methodical waterfall development model. So, the goal must be to develop software always by using a waterfall model, but sometimes moving with speed and coming back and correcting any technical deficiencies later. So, sometimes it's okay to do parts without worrying about the whole because urgency might be important, and you come back and do that. Again, using the Target example, if their competitor has introduced digital payments, then Target has to get that implemented in a week to two. So, it's a race to market, not waiting for perfection. But later on, they can come back and say, let's clean it up, let's build a better product while the customer still has something to work with. So, how do you blend the benefits of agile, which is iterative development, continuous delivery, into the waterfall model? So, that's an important element of blending both agile and waterfall development methods into your strategy. A third dimension is, developing the low-speed architecture, which is the backend. You might be tempted to think that we should simply focus on apps because that's where the value created and move on. But if you neglect the backend, then suddenly you will find that you built all these frontend apps which don't work with each other, and they're getting slowed down because they are searching for data and searching for speed. So, you have to periodically go back and re-engineer the backend, the low-speed architecture. It's important to recognise from the beginning that both models are necessary. You may not be able to develop them simultaneously, but it's important to make sure that you are also intermittently stopping and cleaning up and developing the backend infrastructure and not continuously only focusing on the agile methodology and the frontend infrastructure. Another important element is to build that change mindset. Technology development can be guilty of saying, let's get it perfect. But when technology becomes a key factor for a company's competitiveness, management attention must be more focused on viewing technology as a capital investment, and this is important. Even today, many firms make the mistake of treating technology as an annual expense. The same company is Target, when it invests in a store, it treats the investment in a store as a capital expenditure, whereas

if it looks at IT as an annual expense, then they're going to underinvest in technology. Technology is too strategic today to not elevate discussions about technology to the board level. So, while efficiency is important, IT for competitive advantage means, are you talking about that at the board level? Is the CEO paying attention to that? That means the chief technology officer must be a member of the board and if he or she is not a member of the board, they must have regular access to the board. They must be called in to periodically educate the board about the technology choices. And the outcome of all of this is not to be scared by the massive amounts of money that's often needed for technology investment. That's why taking the capital expenditure mentality, where you can write off that expenditure over multiple years rather than as an annual expense, that's an important element of a change mindset toward technology investment. You will recall I said, in an ideal world, the firms wish they have the time to be slow and methodical about building the operational backbone. Target would love to spend a lot of time redesigning their business processes, taking care of security, transaction speed and reliability. But in a fast-moving world, that's a luxury. So, think about managing change in three parallel streams. At the first level, speed and cycle time build applications and functionality that are rapidly needed for business with urgency. So, use the agile method and build those apps, then step back and optimise the solutions through development methods to integrate them with the cloud and with the data so that those, apps that you built are not standalone. This is called the medium-term approach, meaning that first move with speed in a few weeks, then come back and integrate those apps into your cloud and data platforms. Sometimes that might take maybe, a few months. Then come back and connect it with your infrastructure. Sometimes that might take one year, it's a longer-term investment. So, to manage the paradox of reliability and scalability with speed and modularity, in reality the chief technology officer can play the role of a technology architect by saying, I'm going to really manage change at three levels. At one level, I will be rapidly responsive to the market, but in the background I will continually make sure that we are cleaning up the technical debt. Technical debt is when you start building applications with speed without worrying about how connected they are to the cloud platform, to the security platform and to the database. Over time the app starts slowing down. So, running the change in three parallel levels is very important. So, to summarise, in thinking about the two-speed architecture, focus upon defining what is the target architecture, how will you blend agile and the waterfall method, what will be your backend architecture, how will you treat technology as a capital expenditure, not as an annual expense, and then how will you think about managing change in three parallel ways. Those are some important ways in which a chief technology officer can become invaluable to the senior leadership in an organisation.

Video 8: Action Plan for a CTO

So, now that we've talked about how do you build a technology architecture, we talked about the five different components, we talked about the process of a two-speed architecture and change management, what are some skills and qualities that a CTO must have as a technology architect?

First, they must have the expertise for developing a technology infrastructure strategy, articulating the two-speed architecture, defining the components, and researching the best knowledge and partnerships available so that you are not just learning from inside but also learning from outside. So, how do you develop a technology infrastructure strategy?

Second, element of the CTO as a technology architect is how do you orchestrate a technology ecosystem? Who are the technology vendors, who are the consultants? How do you bring them together? Both for the high-speed frontend and the low-speed backend, how do you learn about the best practices? As new technologies come up on the horizon, how do you learn what Accenture, what Infosys, what Wipro are doing in their labs, and how is that knowledge transferable into your organisation? How do you orchestrate app developers and encourage them to develop apps for your organisation? So, that's what we mean, orchestrate the technology ecosystem.

A third important dimension is how do you make the business case for infrastructure and technology investments? Organisations are comfortable viewing this from a financial investment lens, and then earlier I said, there the focus is, can we afford to make this investment? It's very rigorous, it's very conservative and very often it doesn't work well for technology investments, which are large in nature and the benefits are not easy to measure. So, the ability of the CTO to marry the financial case with the strategic case such as we need to do this because this is an investment in learning, we need to do this because this will be the source of competitive advantage, we need to do this because this is the new technology frontier. So, how does the CTO balance the financial case and the strategic business case to help the Board and the CEO understand the strategic importance of technology investments.

The fourth area of a CTO's responsibility is R&D. How does the CTO continually scan, read stories, read scientific reports, go to vendor conferences to learn about what are the new technologies that are emerging? What are the use cases for these technologies, and when should we experiment with these technologies? And the final element is how do you build the human capital infrastructure? Technology talent is scarce, it is expensive. So, hiring, retention, development, deployment, these are all important dimensions of the human capital infrastructure, and so managing the technical talent is also an important responsibility.

So, to summarise, developing the technology strategy, developing the technology ecosystem, developing the business case for investments, scanning about new technologies and developing R&D and insights, and building the human capital infrastructure, five important areas of responsibility that define the role of a CTO as a technology architect and as a key member of the top management team in most firms today.

Video 9: Module Summary

In reviewing the variety of concepts that we discussed in this module, in order to enhance your knowledge and insight about CTO as a technology architect, we, let's reflect upon the key lessons learned. They are as follows. First, business and technology imperatives challenge firms. Today, to develop a technology strategy that is both scalable, but amenable to experiments. Scalable for reliability, productivity and security. Experiments for fast cycle time and customer responsiveness, whether it be Target as a retailer or whether it be an automotive manufacturer like Maruti or it might be a bank, it might be a hospital, they all are finding it important to do both. Similarly, remaining open and flexible, but at the same time robust and protected. We talked about this a few times. And third agile, but deliberative. So, these are what we call traditional paradoxes, meaning that companies usually did this or that, but today, the challenge of a digital economy is simultaneously doing both.

So, how do you handle these paradoxes? We developed ideas about the two-speed architecture as a way to blend fast, flexible and open front end with deliberative, robust, scalable and secure back-end platforms. That's the challenge, but that's the role of a CTO as a technology, uh, architect. As a technology architect, the CTO must be in a unique position to synchronise the business strategy, the digital innovation sweet spots and the technology strategy. In a way, you can see the different concepts that we discussed across the various modules come together into the role of a CTO and that's what makes the role of a CTO exciting as a career choice as an area of growth in most organisations today.