

## ISB CTO

### Week 5: CTO as Technology Architect

In today's digital economy, the role of a Chief Technology Officer (CTO) holds immense significance due to their expertise as a technology architect. This module aims to explore the crucial nature of this function in today's context and delve into the frameworks, knowledge, and skills required to excel as a technology architect. Let us commence by discussing the strategic context prevalent today.

#### Strategic Context in the Digital Economy

In the digital economy, companies are compelled to implement strategies that encompass both product and service customisation for an enhanced customer experience while simultaneously synchronising their operations. Unlike in the past, firms can no longer afford to prioritise one aspect over the other. Instead, they must effectively address both facets, which results in a significantly larger scale of operations. Additionally, firms must strike a delicate balance between open innovation and the ability to commercialise new product ideas.

#### The Challenge of Open Innovation

Open innovation serves as a source of generating ideas. However, the challenge lies in sifting through and identifying the valuable ideas. Subsequently, organisations must develop a robust platform to launch these ideas and effectively scale them. It is important to note that the contemporary business landscape revolves around the concept of "winner-take-all," as elucidated in our prior discussion on strategy catalysts. Thus, the focus lies on scale, speed, and scope. This prompts the question: What kind of technology platform is necessary to scale and commercialise promising ideas swiftly?

#### The Need for Experimentation and Scaling

Companies must maintain a balance between the ability to experiment and the capability to scale successful ideas. The goal is to establish platforms that support extensive experimentation, fostering the conduct of numerous experiments annually—potentially even reaching the scale of hundreds in a six-month period for some organisations. Consequently, a pertinent query arises: What type of technology platform is essential to scale experiments rapidly, learn from successful endeavours, and expedite their market introduction?

#### The Role of the Chief Technology Architect

Amidst these challenges, the role of a Chief Technology Architect becomes paramount. Their responsibilities encompass determining the requisite digital infrastructure, integrating various technologies such as ERP, data warehousing, mobility, smart systems, cloud services, and analytics. Moreover, the list of technologies continues to expand, encompassing virtual reality, augmented reality, and artificial intelligence. The Chief Technology Architect must navigate this landscape, comprehending the intricacies of these technologies, aligning them with the company's business priorities and challenges, and integrating them harmoniously.

The crux of the technology architect role lies in translating business strategy into technology strategy. By understanding the business landscape, the Chief Technology Architect can effectively leverage technology strategy to devise innovative business strategies that propel the company forward. This interplay between business and technology serves as the foundation of their role.

## **Digital Economy: Business Imperatives**

In the context of the digital economy, it is essential to understand the business imperatives that drive the need for technology and the role of a Chief Technology Officer (CTO) as a technology architect. The key imperatives shaping the business landscape today are:

- **Speed**  
One of the foremost imperatives in the digital economy is accelerate time to market along with continuous upgrades to offerings. Faster time to market with new offerings has become an absolute necessity. In this competitive landscape, companies must strive to bring their products and services to market swiftly in order to meet customer demands and stay ahead of the competition.
- **Seamless multichannel experiences**  
Companies must seamlessly integrate the physical and digital realms, allowing customers to transition effortlessly between different channels. Placing the customer at the centre of these choices is crucial, ensuring a cohesive and satisfying experience across various touchpoints.
- **Big data and advanced analytics**  
The effective use of big data and advanced analytics is now a necessity for businesses. By leveraging these tools, companies can gain deeper insights into customer behaviour and preferences. This knowledge enables personalised marketing strategies, better customer targeting, and improved decision-making.
- **Digitising capabilities to automate operations**  
By streamlining and digitising their operations, companies can achieve quicker response times to customer needs. This approach not only improves customer satisfaction but also reduces costs, minimises waste, and boosts overall productivity.

## **Digital Economy: Technology Imperatives**

In addition to the business imperatives, there are technology imperatives that businesses must address in the digital economy. The IT industry and the digital products and services sector have witnessed significant advancements in terms of scale, speed, and frequency of innovation over the past two decades. As technology continues to evolve rapidly, firms across industries face the challenge of staying abreast of these technological advancements and making sense of their implications.

- **Enhanced Web Presence**

One of the technology imperatives today is to establish an enhanced web presence. Virtually every business requires a web presence to remain competitive. This involves mastering content management, personalisation, and identity management, which are essential components of a strong online presence.

- **App Infrastructure**

The growing complexity of app infrastructure presents a considerable challenge. Building APIs (Application Programming Interfaces) and providing integrated access to content are crucial aspects of app development. Apps serve as a company's identity, encompassing its services, customer interactions, procurement processes, payments, and security and privacy measures. Designing and managing apps involves navigating significant complexity and continuously adapting to evolving user preferences.

- **Enterprise Platform**

The backbone of digital operations lies in enterprise platforms such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Supply Chain Management (SCM). These platforms serve as vital backends for the app infrastructure. Simultaneously building and managing these infrastructures pose significant challenges that companies must address.

- **Data Warehousing and Analytics Platform**

Effective management of data warehousing and analytics platforms is another imperative in the digital economy. Companies need to collect and analyse vast amounts of data to gain valuable insights and make informed business decisions.

- **Security Platform**

Additionally, companies ensure the security and privacy of data as it is of paramount importance.

- **Cloud Platforms**

Cloud technology has become a fundamental part of modern business infrastructure. Managing cloud platforms, including data storage, security, and accessibility, is essential for companies to leverage the benefits of cloud computing effectively.

- **Digital Marketing and Office Collaboration Tools**

Digital marketing and the integration of office collaboration tools are critical technology imperatives. Companies must leverage digital marketing strategies to reach their target audience effectively. Additionally, utilising collaboration tools like Microsoft Teams for seamless communication and workflow management within the organisation is crucial.

## The Digital Infrastructure

When considering digital infrastructure, it is crucial to identify its different components and develop a framework for a systematic understanding of the role of a technology architect. The research conducted by professors Jeanne Ross, Martin Mocker, and Cynthia Beath at MIT provides valuable insights into how companies build their digital infrastructure. Let us explore the five key components of digital infrastructure and their significance in the role of a Chief Technology Officer (CTO) as a technology architect.

Operational Backbone	<ul style="list-style-type: none"> <li>Comprises integrated systems and processes that ensure operational efficiency, productivity, and reliability, particularly in transaction execution</li> <li>In today's digital reality, re-engineering business processes and digitising them through enterprise systems are essential for optimising operational performance</li> </ul>
Shared Customer Insights	<ul style="list-style-type: none"> <li>Focuses on understanding customers' preferences, their willingness to pay, and how digital technologies can be utilised to harvest and operationalise these insights</li> <li>Smart technology, mobility, analytics, and cloud computing play a significant role in this aspect.</li> </ul>
Digital Platform	<ul style="list-style-type: none"> <li>Embraces a components-based architecture, where modules of business processes, data, and technology are woven together</li> <li>This approach facilitates rapid innovation, growth, and the creation of new offerings within shorter cycle times</li> </ul>
External Developer Platform	<ul style="list-style-type: none"> <li>Enables an external orientation by fostering open innovation</li> <li>It serves as a digital platform that engages an ecosystem of partners who contribute innovative ideas and collaborative efforts.</li> </ul>
Governance Framework	<ul style="list-style-type: none"> <li>Encompasses the accountability framework, which focuses on decision-making processes within the digital infrastructure</li> <li>Determining who will make specific decisions is crucial for effective governance and smooth functioning of the digital infrastructure.</li> </ul>

By developing a framework that addresses each component, a systematic understanding of the role of a technology architect can be achieved. Each dimension plays a crucial role in building an effective digital infrastructure.

- Operational Backbone**

The operational backbone encompasses integrated systems and processes, such as Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Customer Relationship Management (CRM), and data warehousing. The objective of the operational backbone is to support seamless end-to-end transaction processing, ensuring reliability, timeliness, and security. Automating repetitive business processes and providing a single source of trusted data are also key goals of the operational backbone.

- Digital Platform**

The digital platform complements the operational backbone and embraces a component-based architecture. Components are specific business processes designed with data and technology in mind. The digital platform serves as a repository of reusable technical and business components. It provides data repositories, tools for analytics, and linkages to the core data and processes of

the operational backbone. Managing continuous releases of new components is vital for adapting to changes and optimising the digital platform.

- **External Developer Platform**

The external developer platform focuses on open innovation and engagement with external partners, including employees, customers, and suppliers. APIs (Application Programming Interfaces) are crucial in this dimension, as they enable flexibility, modularity, and open innovation. By publishing APIs openly, external partners can write applications and connect to the platform. Rapidly onboarding new partners is a key aspect of the external developer platform, as it fosters the creation of new ecosystems and enhances innovation.

- **Shared Customer Insights**

Shared customer insights involve investments in analytics, artificial intelligence (AI), and machine learning technologies. These insights stem from a constant flow of experiments and data generated to identify customer preferences and values. Tightly integrated sales, service, and product development processes contribute to the development of shared customer insights. Co-creation with customers and capturing knowledge from every encounter are important elements in this dimension. Effective curation and sharing of accurate and authentic knowledge enhance the success of shared customer insights.

- **Governance Framework**

The governance framework establishes clear rights, responsibilities, and accountability within the digital infrastructure. It ensures coordinated decision-making across the operational backbone, digital platform, external developer platform, and shared customer insights. Clear accountabilities foster autonomy while facilitating coordination. The governance framework also helps identify metrics of success and defines decision-making responsibilities for the Chief Technology Officer (CTO), Chief Information Officer (CIO), and business units.

## **The Technology Strategy**

The role of a Chief Technology Officer (CTO) as a technology architect extends beyond developing the digital platform. It encompasses developing a comprehensive technology strategy that aligns with the business strategy.

The technology strategy serves as a blueprint for translating the business strategy into technology investments. Synchronising the two strategies is crucial to ensure that technology investments effectively support and enable the business objectives. This alignment helps address the challenges of simultaneously embedding flexibility and rigidity, openness and secrecy, and modularity and reliability into the technology infrastructure.

## **Twin Speed Architecture**

The twin speed architecture offers a solution to the paradoxical challenges faced by organisations.

- It involves maintaining a slow-moving, methodical backend while ensuring a fast, customer-centric frontend.
- The backend focuses on foundational business processes and technology platforms, emphasising resiliency, security, integrity, quality, and regulatory compliance.
- The frontend processes and technology platforms prioritise speed, flexibility, and agility.
- This approach allows for modular deployments of customer-facing components, enabling quick software updates and responsiveness.
- The transactional core systems, on the other hand, are designed for stability with longer release cycle times.

### Key Dimensions to Build a Technology Strategy

- **Microservices**  
Embracing microservices involves building support for discrete activities within the digital infrastructure. These microservices, such as customer product pricing or digital payments, can be developed and deployed quickly, enabling agility and modularity. Open access to outside programmers and multiple programming languages are key components of this approach.
- **Zero Downtime**  
In the digital economy, zero downtime is imperative. Upgrades and system changes should be seamlessly implemented without disrupting the customer experience. New software or services should be deployed in parallel with existing systems, gradually transitioning to the new components. Fallback mechanisms should be in place to mitigate risks and ensure minimal disruption.
- **Real-Time Data Analytics**  
The ability to analyse big data in real time and incorporate analytics into the decision-making process is crucial. Real-time data analytics enable personalised customer experiences, such as delivering savings coupons based on their purchase history or recommending relevant products or services during their current transactions.
- **Secure Architecture**  
Cybersecurity is an integral part of the digital infrastructure. Protecting valuable data from hackers is vital as organisations become more attractive targets. The digital interface also opens access to external parties, including customers, suppliers, and partners. Regulatory compliance further emphasises the need for secure architectures to prevent data breaches and maintain customer trust.

### Developing a Two-Speed Architecture

Developing a two-speed architecture requires careful consideration and a blend of methodologies to address the challenges of agility and reliability. This section explores



the principles involved in developing a two-speed architecture and highlights strategies for successful implementation.

### Hybrid Architecture

In the past, there was a single homogeneous architecture that focused on the operational backend. However, in a two-speed architecture, the goal is to manage a hybrid target architecture that accommodates both slow-speed transactional platforms and fast-speed frontend systems optimised for customer experience. This approach ensures scalability, resilience, and regulatory compliance in the backend while delivering flexibility and modularity in the frontend. The high-level target architecture should define the technologies, processes, and responsibilities for both the frontend and backend components.

### Software Delivery

A crucial aspect of a two-speed architecture is blending the benefits of agile and waterfall development methodologies. The waterfall model, traditionally used for backend development, emphasises a deliberate and systematic approach. However, at the frontend, agile methodologies enable rapid development and responsiveness to changing market demands. The key is to identify where each methodology is most suitable and ensure seamless integration. This allows for efficient and timely delivery of software while maintaining the necessary level of quality.

### Low-Speed Architecture

While the frontend may appear to be the primary focus due to its customer-facing nature, neglecting the backend can hinder overall performance. Periodically re-engineering the low-speed backend architecture is essential to ensure compatibility and efficient data retrieval for the frontend applications. Both the frontend and backend components are critical and should be developed intermittently to achieve a cohesive and effective two-speed architecture.

### Mindset Change

To drive competitive advantage through technology, it is important to view technology investments as capital expenditures rather than annual expenses. Elevating discussions about technology to the board level and involving the Chief Technology Officer (CTO) in strategic decision-making processes is crucial. The CTO's expertise and regular access to the board help ensure that technology choices align with the organisation's objectives. Adopting a capital expenditure mentality allows for long-term investment planning and avoids underinvestment in technology.

### Three Parallel Streams

Managing change in a two-speed architecture involves three parallel streams. Firstly, there is a need to rapidly develop applications and functionality with urgency to meet immediate business needs, employing agile methodologies. Secondly, optimising solutions through development methods to integrate them with cloud and data platforms, forming a medium-term approach. Finally, connecting the applications with

the infrastructure for long-term investment and scalability. By managing change at these three levels, technical debt can be minimised, and the architecture remains adaptable and robust.

## Action Plan for a CTO

Having discussed how to build a technology architecture and its components, it is important to explore the skills and qualities that a CTO must possess as a technology architect. This section will highlight five key areas of expertise and responsibility for a CTO in this role.

- **Technology Infrastructure Strategy**

A CTO must have the expertise to develop a technology infrastructure strategy. This involves articulating a two-speed architecture, defining the components of the infrastructure, and conducting research to identify the best knowledge and partnerships available. It is essential to leverage both internal and external sources to stay updated on emerging technologies and industry trends.

- **Technology Ecosystem**

The CTO plays a crucial role in orchestrating the technology ecosystem. This involves identifying and engaging with technology vendors, consultants, and app developers to bring together the necessary expertise for both the high-speed frontend and low-speed backend components. Learning from industry best practices and exploring partnerships with organisations at the forefront of technology innovation are key aspects of this responsibility.

- **Business Case for Investments**

The CTO needs to be proficient in making a compelling business case for infrastructure and technology investments. While organisations often view investments through a financial lens, the CTO must balance the financial case with the strategic business case. This involves demonstrating the long-term value and strategic importance of technology investments, such as gaining a competitive advantage or exploring new frontiers of technology.

- **Research and Development**

Continual learning and keeping up with emerging technologies are essential for a CTO. Actively scanning the industry landscape, reading scientific reports, attending vendor conferences, and staying informed about new technologies and their use cases are critical aspects of the role. This enables the CTO to identify opportunities for experimentation and innovation within the organisation.

- **Human Capital Infrastructure**

Building and managing the human capital infrastructure is another key responsibility for the CTO. Technology talent is scarce and valuable, so hiring, retention, development, and deployment of technical professionals are crucial. Effective management of the technical workforce ensures the organisation has



the necessary skills and expertise to drive technological advancements and successfully implement the technology strategy.

Having explored various concepts on the role of a Chief Technology Officer (CTO) as a technology architect, it is important to reflect on the key lessons learned.

- **Balance business and technology imperatives**

Today's firms face the challenge of developing a technology strategy that is scalable, reliable, and secure, while also being amenable to experiments for fast cycle times and customer responsiveness. The ability to balance these imperatives is crucial for success across industries, whether it's retail, automotive, banking, or healthcare. Embracing openness and flexibility while maintaining robustness and protection is essential in a digital economy.

- **Navigate the two-speed architecture**

Traditional paradoxes of doing either this or that are no longer sufficient in the digital era. Companies must find ways to handle and embrace paradoxes simultaneously. The concept of the two-speed architecture, combining fast, flexible, and open front-end platforms with deliberate, robust, scalable, and secure back-end platforms, provides a framework to address these paradoxes. The CTO as a technology architect plays a vital role in navigating and reconciling these conflicting aspects.

- **Synchronise business, digital innovation and technology strategies**

The CTO serves as a bridge between business strategy, digital innovation, and technology strategy. Their unique position allows them to synchronise these elements, ensuring that the organisation's goals and objectives align with digital capabilities and technological advancements. This integration is key to driving growth and success in modern organisations.