Seamless Customer Journeys

An enterprise digital twin for CSPs

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IN BRIEF

While incurring huge infrastructure investments, communications service providers (CSPs) have to regularly offer new services and keep operations efficient. End-to-end enterprise visibility, operations automation, and dynamic data-driven decision-making become critical to achieve these. The business user needs to understand business - IT bottlenecks, what-if scenarios for products, services, and processes that may have to change. A purposive model of the enterprise environment which can be used for various customer journey simulation exercises will be invaluable to a CxO.

In this chapter, we outline how an Enterprise Digital Twin can help CSPs gain cross-functional visibility and insights to understand, design, and optimize customer engagements across the lifecycle.

A key success factor for CSP operations in this dynamic business environment is to ensure successful, first-time-right customer journeys

Communication service providers (CSPs) must be smiling: There are more mobile connections than people on this planet; the mobile has become a channel for hundreds of services. Technology is galloping in the area of communication.

Business must be booming? But CSPs are actually gasping. Technologies such as the Internet of Things (IoT) and 5G are introducing new complexities that are driving customers to expect a range of new services. Just offering operations support services at a personalized level for millions of customers is extremely complex. Advancements in technology are creating new business models but are also allowing plenty of free riders (such as over-the-top service providers) who seem to be getting more of the revenue pie, while using CSP networks. Investments in infrastructure are growing heavier and profit margins from traditional business lines are growing thinner for CSPs.

Limited Visibility

A key success factor for CSP operations in this dynamic business environment is to ensure successful, first-time-right customer journeys. A CSP tracks its customer's journey through five key stages: lead, order, activation, billing, and service assurance. At every stage, intervention from business groups, IT, and network operations—both human and automated resource groups—are required to orchestrate a seamless journey for the customer. However, in the current telecom landscape, there is limited visibility

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and correlation between enterprise divisions to do this. Organizational operating blocks are highly fragmented, working in silos without end-to-end visibility and awareness of their contributions towards customer journey outcomes. A customer journey deviation caused by performance bottlenecks of one operational block, if not identified and resolved, inevitably impacts the next block, thereby compounding the result of unresolved bottlenecks.

The Human Factor

While customer journeys are key to ensuring operational excellence, today's customers driven by retail expectations expect contextual and personalized engagements across their lifecycle. CSPs deal with petabytes of customer related data—purchase transactions, feedback, complaints, call detail records, tweets, and blog post records which can be used to construct a faithful representation of a customer's lifestyle.

As more and more customers make transactions in shopping, banking, healthcare, and travel through digital channels, CSPs have a great opportunity to understand each customer's lifestyle better at the n=1 level and therefore, customize its products and services to offer a "purposive" experience. That most CSPs are currently unable to do this is apparent from the deviation experienced from the ideal journey map charted: 25–40% of all customer journeys deviate from the "ideal" experience map, leading to lost business opportunities and low net promoter scores (NPS). On their part, customers struggle to access the support systems the CSPs have set up, such as self-service modules and constantly have to reach out to support executives to complete their tasks. This results in sub optimal outcomes for both CSPs and customers.

Models—Past and Present—to Parse Human Behavior

Various mathematical and statistical machine learning (ML) techniques were historically developed for "static problems" such as image processing and text recognition, since the 1970s. These techniques handled fairly stable signals/data in the past. Human behavior, however, is a different story. A traditional ML model trained to detect fallouts from customer connections and journeys may deteriorate in accuracy over time. It now requires constant monitoring and maintenance by a data scientist with continual infusion of new semantic knowledge into it. As customer behavior, markets, and competitors are subject to frequent (and constantly evolving) trends, constant retraining of the model, as well as frequent development of the new features to detect these trends (emergent behavior, complex behavioral properties that are not part of raw data) are required. These can only be done through the combined work of a semantics domain expert working alongside a data expert.

An Enterprise Digital Twin can help CSPs looking to gain cross-functional visibility and insights across their organization to understand, design, and optimize customer engagements across the lifecycle.

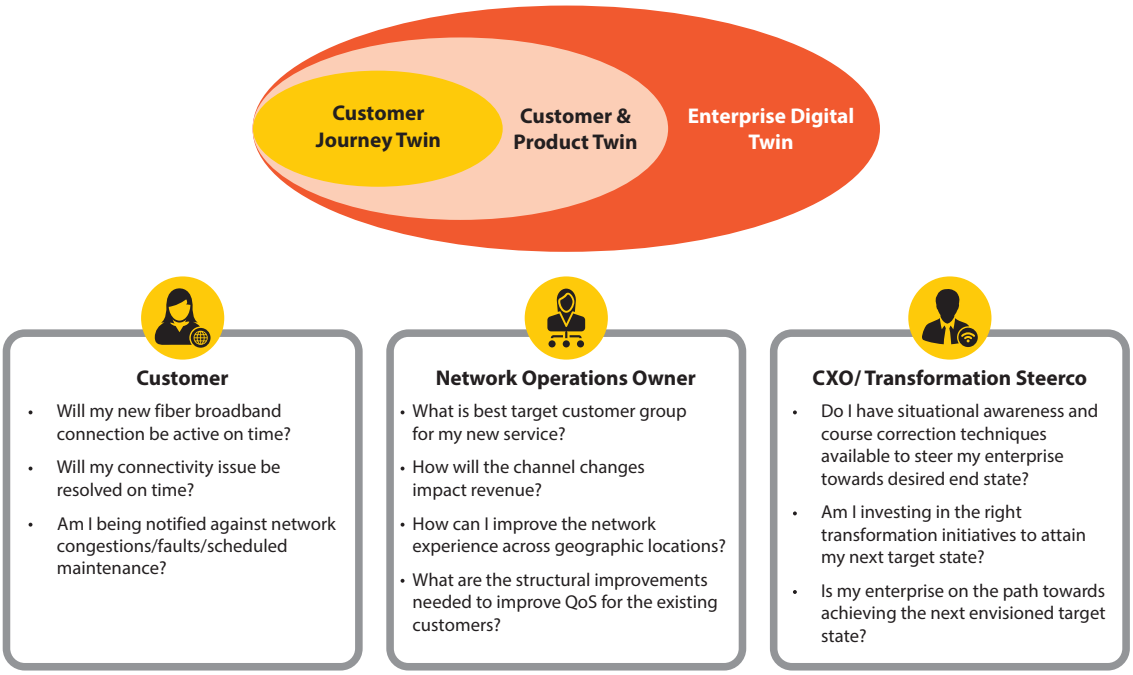


Figure 1: *Key Customer and Enterprise Issues for the CSPs*

Business and technical events are aggregated and ingested into the journey correlation engine for real-time correlation of customer journeys and creating a cross-functional single view across organizational blocks

In recent years, data scientists have started to employ "heavyweight" statistical methods and ML algorithms to try and cope with this complexity. These powerful tools, including new deep learning techniques, collect data and analyze its attributes in order to be able to classify behavioral patterns, detect anomalies, and predict future trends. However, even such tools (historically developed for "static problems" such as image processing and text recognition) cannot easily cope with human behavior data and complexities.

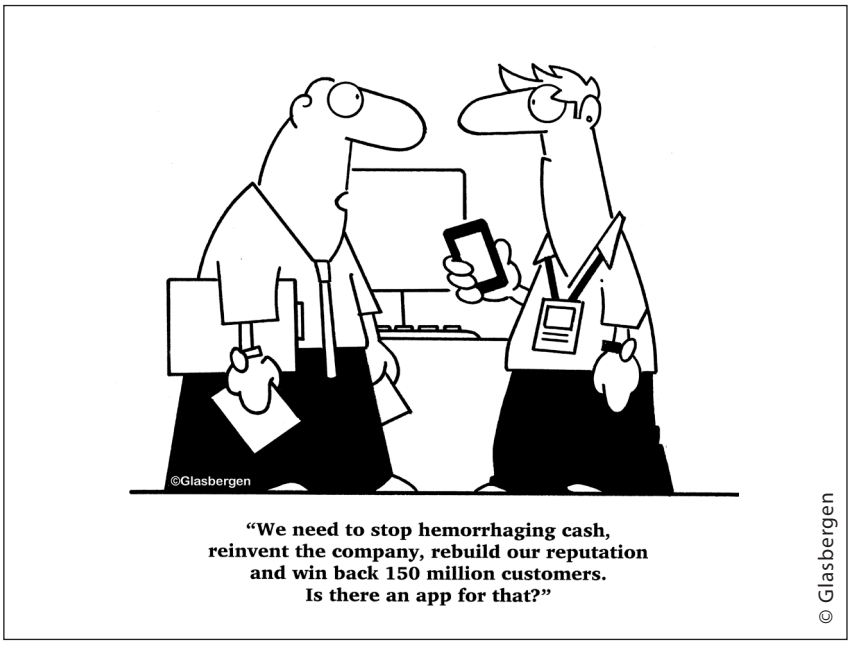
Actor Simulation Approach

The agent simulation approach works in a completely different way. Instead of deriving patterns from input data, it is based on the discovery of entities (in other words, actors) and their behavioral relationships "social behavioral laws" mathematical relationships that emerge in an enterprise when people, process, and systems operate in the same space. These laws govern the way various statistical properties of crowd behavior evolve over time. This happens regardless of the type of data, the demographics of the users who created it, or the data size. An engine integrates these laws into its data analytics component, which efficiently extracts the underlying social attributes of all people contained in the raw data being provided as input (e.g. phone calls, taxi rides, financial investments). It supports visualization of an enterprise along three aspects people, process and technology, with relationships across aspects as well as levels.

Building the Enterprise Digital Twin

We believe that organizational systems with all their chaos and silos can be faithfully represented in a digital format, which we call

the Enterprise Digital Twin. In this virtual environment, key entities such as customer, product, process, network, and resource are mapped and key strategic decisions (e.g. rolling out new products/channels of engagement) are tested before being piloted in the market. Through exhaustive enterprise simulation in this high-fidelity virtual representation of the enterprise, deviation risks can be identified and eliminated without disturbing any dependent entity in the real enterprise. Additionally, the digital twin of the enterprise also helps identify the optimized KPIs to align them with organizational goals and objectives.



An Enterprise Digital Twin can help CSPs looking to gain cross-functional visibility and insights across their organization to understand, design, and optimize customer engagements across the lifecycle. It envisions a simulated enterprise environment comprising three distinct blocks:

- Infrastructure (IT, networks, physical assets)
- IT application stack
- Business processes

Business and technical events are aggregated and ingested into the journey correlation engine for real-time correlation of customer journeys and creating a cross-functional single view across organizational blocks. Correlated customer journeys are further simulated and monitored using an artificial intelligence-based (AI-based) hybrid decision engine. Deviations are predicted, tracked, reported, and the next best actions are triggered towards corrective resolutions to minimize impact to the customer experience. Additionally, enterprise simulation enables simulating macro trends such as competitor actions, influence of emerging technologies, and micro factors such as inventory availability and resource performance, among others, and understanding whether these have an impact on current enterprise operations. Further, what-if and if-what analyses are supported powered by a self-learning controller which enables continuous optimization of the enterprise to address macro as well as micro trends, impacting customer journey outcomes.

A Hybrid Decision Engine

The AI and enterprise simulation-based hybrid decision engine is critical to the Enterprise Digital Twin solution, as it is responsible for the following tasks:

- Journey clustering
- Journey simulation
- Journey deviation prediction
- Dynamic deviation analysis and problem auto-discovery
- Enterprise simulation
- Next best action recommendation

The simulated environment, or the digital twin of the enterprise, is connected to the real enterprise through amorphous interfaces across the infrastructure, IT applications, and business operations blocks, enabling the recreation of an enterprise context and related customer journeys in real time as well as producing a simulation of ideal customer journeys.

From early implementations in industrial engineering, the digital twin technology is gaining momentum in other industries including telecommunications. The success of the digital twin depends on its core algorithm, data models, and the trainability of these models periodically, based on the insights gained.

TCS TwinX™ Mapping Journeys and Preventing Fraud

TCS' business insights platform, named TCS TwinX™, brings together AI and digital twin technologies. It simulates digital twins of:

- The customer: This is in accordance with their personas and archetypes to predict their behavior and guide them to behave in a desired manner.
- The customer journey: This is mapped at a process step level by gathering context across all layers that attribute to the occurrence of a process step in real time.
- The enterprise: This is done to preempt and allow for simulations of strategic decisions and predict their impact to the enterprise, detect deviations, and translate impacts respective to each enterprise function.

The platform ingests entity data from various data sources and is feature engineered using inputs from telecom process SMEs and algorithms such as time series, NLP and RNN, persona generation, and pattern association rule mining. Correlations are used to attribute the data to milestones and are compared with statistically derived ideal states for deviation detection and labeling via anomaly detection using Isolation Forest, Local Outlier Factor, and DNN Auto-encoders.

Aggregating the entities provides macro insights using clustering algorithms such as K-means, DB Scan, and Agglomerative. The architecture remains dynamic and adaptive using self-optimization capabilities enabled by traditional algorithms such as Decision Tree and Random Forest and advanced algorithms such as xgboost, Light GBM and catboost, and deep neural nets (DNN).

Coupling context from information gathered with machine learning capabilities enables the TCS platform to deliver actionable insights at both micro (individual entity) and macro (aggregated entities) levels. The insights could be informational or action recommendations.

The platform predicts deviations at future milestones and provides preventive or course correction recommendations. In addition to entity level insights, it can use accumulated knowledge from each journey to correlate it with other journeys and

form behavioral entity groupings, denoted by clusters and decision trees. Therefore, insights and action recommendations are shared for groups of entities with similar characteristics.

The TCS platform will also translate micro and macro insight derivations to predict KPI performance and offer intelligent decision aiding capabilities such as virtual simulations of business decisions. This helps to accurately predict outcomes considering the machine-learned state of current and future (predicted) affairs. The insights are presented on custom-built user interfaces and can also be shared across various notification channels. TCS TwinX™ also uses ingested data to predict the likelihood of occurrences like churn or fraud and shares prediction accuracy scores to external applications for informed decision-making. The TwinX platform for customer journey management was piloted for a South African telecom company in early 2019. The key business issues addressed were the entity fallout prediction in its customer acquisition/renewal/service assurance journeys along with fraud predictions in its SIM swap customer journey.

A SIM swap fraud (also known as SIM splitting and sim jacking) is a type of financial fraud that generally happens in two steps. A fraudster targets and cracks the two-factor authentication and two-step verification to change the SIM for the mobile number of the victim. Subsequently, mobile telephone usage fraud for international calls, data or bank transaction OTP is executed.

Benefits achieved were as follows:

- 12% reduction in average activation cycle time with 10% volume of data ingested. Activation times are expected to reduce by upto 30% as data increases
- A 4X increase in first-time-right (error free) orders
- Prediction accuracies between 80% and 90%
- Typically, 70% of SIM swap requests are fraudulent and the TCS TwinX™ platform has helped avert 62% of such requests
- Over 63,000 loyal customers have been protected from potential fraud with an average monthly customer fund protection of approximately $6M

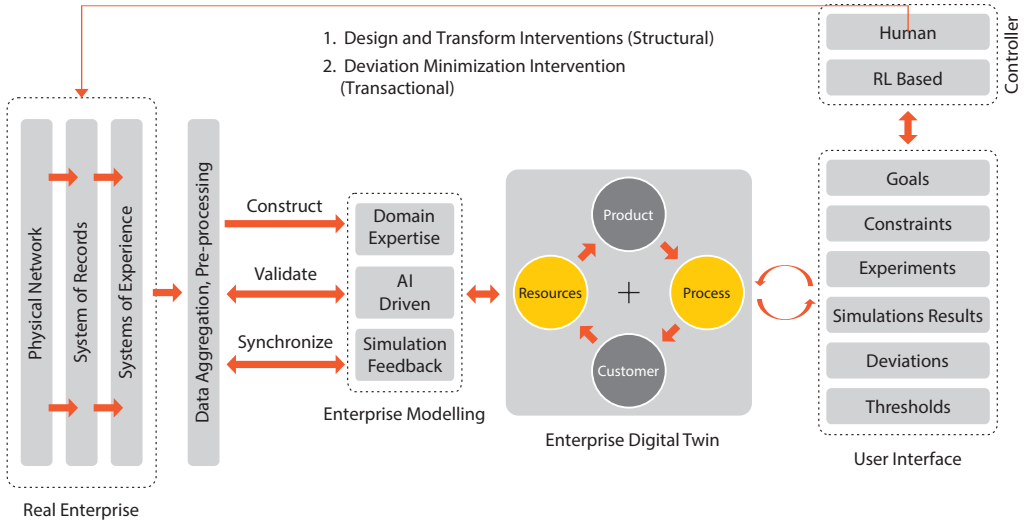


Figure 2: *TCS TwinX™ Solution*

Senthilvelan Natarajan

Senthilvelan Natarajan is the Global Head AI Platform Solutions of Communications, Media, and Information Services Business Unit. He has more than 22 years of experience in Global IT Services distributed across the US, Europe, South Africa, and APAC markets, notably in consulting and implementing transformative solutions. He works with TCS Corporate Research teams and the Industry Research teams in solving business problems with innovative technology solutions, particularly the portfolio of AI and intelligent automation solutions. He has filed patents in the area of digital twin and AI. Velan holds a bachelor's degree in engineering from the Government College of Technology, Coimbatore, India.

Kaustav Bhattacharya

Kaustav Bhattacharya is the Global Product Manager for TCS Enterprise Digital Twin. He is actively involved in TCS Research and Innovation programs for the development of new products and concepts and also conducts digital maturity assessment for Telcos across the world to help them realize real-time enterprise goals. His interest areas include intelligent automation, blockchain, and digital twin, and he brings a decade of rich consulting experience in this field. Kaustav holds a bachelor's degree in engineering from Manipal University, India and a master's degree in business administration from Cardiff School, UK.

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