

# Customer Banking Relationship in 5 Dimensions

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# Introduction

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**A customer's relationship with their bank** is anything but simple. This relationship evolves over time within an economic ecosystem that includes many other people. The goal of the "Customer Banking Relationship in 5 Dimensions" is to accurately represent the true complexity, and the possibilities, of this relationship.

Banks need to expand from the traditional bank system-of-record-based profile data to a true 360-degree view of the customer relationship. For the first time, neural architectures allow banks to develop models that can fully make use of the multidimensional nature of this relationship.

The financial planning challenges that consumer households face is daunting. John Y. Campbell, Harvard economics professor, said it best: "Households must plan over long but finite horizons; they have important nontraded assets, notably their human capital; they hold illiquid assets, notably housing; they face constraints on their ability to borrow; and they are subject to complex taxation."<sup>1</sup>

To address these challenges, consumers engage with financial services providers like banks. A bank's ability to respond to these challenges is increasingly related to the bank's ability to holistically understand the customer relationship.

## Background

Until the adoption of computer systems in the 1960s, banks managed customer relationships through ledger books containing the chart of accounts. To open a checking account, a consumer had to visit a bank branch, meet with a bank officer, and fill out a signature card. Only then could they make the initial deposit with "good funds"—currency or a cashier's check. Any subsequent deposit or withdrawal was manually posted to the individual deposit account in a ledger. Well into the 1970s, a customer had to visit a branch so that accumulated monthly interest could be "proofed" into their physical "passbook."

The advent of timesharing on computer mainframes motivated companies like IBM to create software to automate these paper-ledger-based accounting systems, known as systems of record, for demand deposits, credit cards, and mortgage loans.

The legacy of account-based management control systems persists to this day, as enterprise customers were not enumerated from day one but rather derived from the account holder detail within systems of record; this promotes a fractional view of the bank's relationship with individual people.

Many banks are moving beyond this purely account-driven view of the customer relationship and embracing the multifaceted relationship revealed through interactions and communications with customers.

There are five key customer dimensions that banks need to address:

**Product:** The bundle of services and capabilities provided by the bank to address a customer's financial need

**Channel:** How the bank delivers products to customers

**Payment:** The movement of money to facilitate economic activity

**Network:** People as economic actors in banking activity and the roles that they play as employees, suppliers, etc.

**Time:** The evolution of customers' financial needs and relationships with the focal bank.

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1. Alex Pentland, *Social physics: how good ideas spread--the lessons from a new science*, New York: Penguin Press, 2014.

The focal bank, or the institution of our primary focus, must expand from the limited dimensions of the traditional customer profile, derived from account information within systems of record, to a true multidimensional view of the customer.

This holistic view is oriented toward gauging the customer’s financial needs and the extent to which the focal bank meets these needs with diagnostics such as:

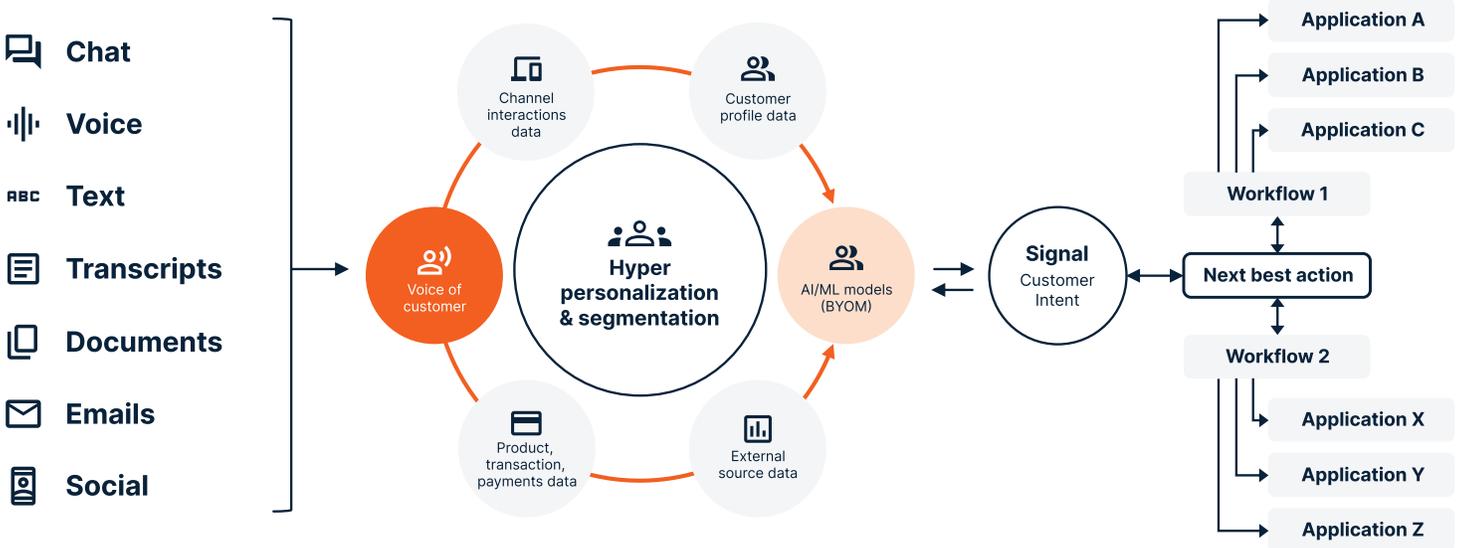
- **“Share of wallet”** (what portion of the customer’s current financial products does the focal bank have?)
- **“Share of spending”** (what percentage of total customer expenditures are facilitated by the focal bank?)
- **“Share of borrowing capacity”** (what portion of the customer’s total creditworthiness is provided by the focal bank?)

Banks need to assess how the customer engages in economic activity to identify the best financial services product to promote. For example, they can consider such questions as: Are they part of a household? Whom do they work for? Do other people work for them? Do they own real property?

Modeling human economic behavior is extremely complex across manifold dimensions—individually, socially, temporally, and spatially. Sandy Pentland, MIT professor and co-creator of the Media Lab, is the progenitor of “social physics,” which he describes as a “quantitative social science that describes reliable, mathematical connections between information, idea flow, and people’s behavior” in social networks so that “people can make reliably better decisions and become more productive.”

The goal of a bank is to help its customers meet their financial goals by providing specialized knowledge and dedicated services across a broad array of financial products. At the heart of the financial network are information flows between actors –generally monetary transactions within an economic network. Banks must organize data to form a holistic view of their relationship with a customer to help the customer make financial decisions that will promote their well-being.

### Multi-Dimensional Customer View



# Customer

**Customer is defined** by the relationship between the bank and a natural person (“Joe Smith”) or a legal person (“Joe’s Bar & Grill, LLP”), as articulated in the account holder agreement.

A valuable conceptual model of a bank and its customers is the “party/identity model,” where the party is a natural person and the nature of their relationship to an account is their identity. For example, Joe Smith’s identity could be the managing partner of Joe’s Bar & Grill, LLP, which gives Joe the contractual ability to transact against the account. Jane Smith, the bookkeeper for Joe’s Bar & Grill, LLP, would only be given the identity of a “delegated user,” allowing her the ability to monitor activity but not initiate transactions.

A complication of this process is the familial relationship between natural persons, which banks have attempted to resolve by “householding” accounts by common mailing address or by examining the crossholding of distinct deposit accounts by the same person.

The party/identity relationship of natural persons to the bank can be very complex and even intentionally obscured in domains such as commercial real estate, where each individual building can be owned by a limited partnership, with many individual members.

As almost all banks were built through a cascading series of mergers and systems conversions, the customer relationship must be derived from that of the account holder. Banks seek to augment account ownership data and disentangle the complex relationship between natural and legal person via sophisticated entity resolution and knowledge graphs. There are excellent analytical tools available in Teradata ClearScape Analytics™ that can help to untangle these interrelationships.

Ultimately, a bank seeks to label each natural person with a numeric identifier, often called an “enterprise customer number” derived from the superset of account ownership records. A common practice in the U.S. is to leverage the taxpayer identifier numbers of account holders, which are both exogenous to the bank and carefully maintained, to synthesize an endogenous “enterprise customer number.”

Teradata can help banks fully materialize the party/identity model of the customer relationship within the Teradata banking reference architecture. The model of the customer relationship is a critical component of the enterprise data warehouse and a cornerstone of the “feature store,” or inventory of curated enterprise data, required for the development and deployment of predictive models, which ClearScape Analytics can support.

It’s critical to recall that it is always a human being and not a legal entity that makes decisions and interacts with the bank—often tacitly in concert with other people. As financial decision-making is complex and banks design processes to minimize risk, customers often fail to accomplish their immediate “banking task.” Banks need to identify these unresolved in-flight customer journey issues to determine the “next best action” to help the customer achieve their financial goals.

## Financial intermediation

At their core, banks are designed to support financial intermediation between savers and investors, payors and payees, and borrowers and lenders. Financial intermediation exists in multiple dimensions:

- **Cross-sectional:** Helping one group of customers lend funds in deposit accounts to another group of customers who wish to buy now and repay later
- **Temporal:** Providing instruments for a customer to invest their excess savings today to accumulate increased funds for use in a future period, as articulated by Milton Friedman’s household lifecycle consumption theory
- **Spatial:** Facilitating transnational payments by converting funds delivered by the payor in one currency to another currency required by the payee

Product is what banks have come to call accounts, many of which are quite similar, that address customer financial need through a bundle of banking services. Banks often use subtle differences in product features to allow price discrimination, a practice that leads to a proliferation of accounts subject to periodic product simplification.

### Product classification

The proliferation of product types within a bank may lead to redundancy. It's important to rationalize the product types into a more concise set of fundamental banking needs. One approach is to categorize the many account types and subaccount types using a taxonomy built up from first principles of financial contracts, considering key attributes of the account: Is the term fixed or intermediate? Is the interest rate fixed or variable? Is the account FDIC insured? For example, the taxonomy-driven product classification reveals that there are only subtle differences in the economic function of a money market mutual fund versus an interest-bearing money market bank account.

The type of financial products a given customer requires is driven primarily by the age and number of their dependents, including themselves if they are the primary wage-earner. A type of Maslov's hierarchy exists in the household financial portfolio, building from daily activity to long-term retirement planning:

- **Deposit accounts:** A safe store of value and a vehicle to facilitate payments
- **Consumer credit:** Using funds today for a purchase and paying back the money tomorrow
- **Investments:** Acting today to provide future period income tomorrow
- **Insurance:** Protection against financial loss due to a hazard, such as a fire, theft, or the premature death of a wage-earner

This financial hierarchy of needs drives the products that a customer requires. The "completeness theorem of household portfolios" identifies the outer limit of the product cross-sell opportunity for the focal bank. However, the focal bank can compare product adoption across the totality of its customer base to better understand the unmet needs of an individual customer.

The product classification exercise produces a product catalog that is an integral component of the feature store required for the development and deployment of predictive models in ClearScape Analytics.

### Data external to the focal bank

From the perspective of the focal bank, information about any customer is fragmentary. Banks need to work harder to collect information about their customer's financial relationships beyond those that the focal bank can directly observe through its own account records.

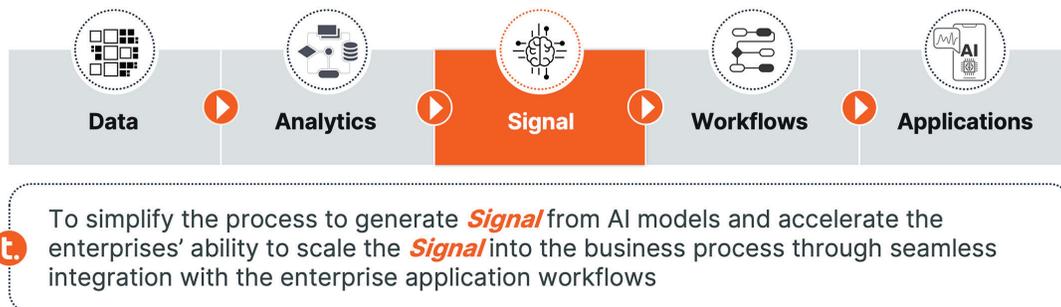
A great illustration of the benefit of collecting relevant external information are credit bureaus, which consolidate outstanding consumer credit and repayment histories across multiple lenders. The development of credit scores based on credit bureau histories revolutionized direct consumer lending in the 1960s; the application of information technology allowed banks to better manage credit risk, which directly led to the extension of credit to a wider audience.

While consumers are inclined to diversify their accounts across multiple banks, some consumers want to consolidate transaction information from these diverse accounts to gain a holistic perspective on their own spending. In the early days of internet banking, third parties such as Yodlee supported information consolidation via "screen scraping" for consumers who delegated authority for account access.

This practice, stimulated by consumer protection legislation for "open banking," has evolved into leveraging application programming interfaces (APIs), which is a much more scalable and efficient approach to information dissemination. Banks should internalize the deployment of APIs to deliver important signals of customer intent to downstream workflow applications. For example, when a bank identifies a potentially fraudulent transaction, it could deliver it as a signal to the customer-centric knowledge management applications used by phone bankers, branch bankers, or even the enterprise marketing function.

Banks find that "open banking" can be both a blessing and a curse: a blessing, as APIs are brutally efficient for sharing data without the security risk of customers delegating their online banking sign-on credentials to a third party; a curse, as open data transfers reduce information asymmetries between the focal bank and potential competitors and erode the "switching costs" that impede customers defecting to another bank.

### Teradata point of view: Signal-as-a-Service



# Channel

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**Channel is how banks facilitate** the usage of the products held by their customers. Historically, due to the tangible nature of currency and checks, channels were physical bank branch locations that customers were required to visit to conduct transactions, even at the ATM. Channels are communication media controlled by the bank. Innovation in banking doesn't occur in product design but rather in the way that the product is delivered.

The introduction of around-the-clock phone support in the late 1980s and the emergence of internet banking in the late 1990s allowed banks to deliver product through multiple channels and compete with "temporal convenience" in addition to "spatial convenience" of their branch network. The evolution of e-commerce and prevalence of mobile smartphones contributed to rapid consumer adoption of digital payments, which has resulted in a steep decline in the usage of currency and paper checks.

It's important to note that bank channels not only facilitate transactions but are also a critical customer communication mechanism that the bank directly controls. The reduction in branch foot traffic has materially impacted the bank's ability to directly communicate with customers. Banks can mitigate the drop in direct customer communication with direct response marketing, which Teradata partner ActionIQ and the composable customer data platform can help deliver.

Customers often use multiple channels to resolve a banking task, which can generate friction and customer dissatisfaction. The "nPath" algorithm available in ClearScape Analytics can sequence diverse channel interactions by timestamp by customer, in support of customer journey analytics.

Customer journey analytics can identify customers struggling to resolve a banking task and generate a customer intent signal within ActionIQ. The bank can then monitor the customer's progress within the customer journey.

## Simulation

The adoption and usage of digital banking channels is influenced both by the bank's ability to deliver high-order functionality in the digital channels and by the appetite of the customer to manage their account through a digital channel.

Essentially, the migration of customer service activities to digital channels from physical channels is an act of cocreation generated by the bank's application maturity and the customer's appetite and technological savviness, a process called "customer efficiency." A large U.S. bank created "customer efficiency" segments via a cross-tabulation of physical channel versus digital channel usage. We used a hidden Markov model to simulate customer transitions across these segments over time and to generate a corresponding forecast of activity by channel by geography.

For a deeper discussion of the nature and importance of channel delivery in banking, please see the companion [Customer Journey Analytics in Banking](#) whitepaper.

The evolution of e-commerce and prevalence of mobile smartphones contributed to rapid consumer adoption of digital payments

# Payments and transfers

**Payments are the movement of money** from one person to another (interparty) from one bank to another (interbank) to facilitate economic activity.

## Payments topology:

	Intraparty	Inter-party
Intrabank	Transfer	Payment on us
Interbank	Payment nominal	Payment

Movements of funds that are intrabank and interbank are defined as “transfers” rather than payments, as transfers are essentially riskless to the bank. Payment nominals are sometimes misnamed “transfers”; these funds flow through interbank payment instruments and, although the payer and payee are the same person, this may not be visible to the bank that originated the payment.

## Payment instruments

Payments always involve some degree of risk, and banks evolved to manage these risks, including counterparty, settlement, liquidity, or stability of value (currency depreciation due to hyperinflation). Payment networks evolve payment instruments, which are contracts designed to negotiate the sharing of these risks between payor and payee in what economists call a “two-sided market.”

Payment instruments are a standardized mechanism to move funds among banks and are, in most countries, the exclusive province of the regulated banking system. Payment instruments in the U.S. include currency (coins and notes); check drafts; ACH (scheduled interbank clearings); wires (generally intercountry and interbank); debit card; and credit card.

## Payment networks

Generally, a third party stands between the banks serving the two counterparties, such as a bank clearinghouse (ACH Clearinghouse Association) or a card network payments platform (Visa, Mastercard) with a large degree of standardization.

A card network payments platform can be either “closed loop,” where the network issues the card to consumers and signs up a merchant to take the card, or “open loop,” where member banks in the network specialize as either card issuers or merchant acquirers. Closed-loop card networks evolved independently of the traditional banking system, including Discover, which grew out of the Diners Club and the Sears store credit card, and American Express, with roots in corporate travel and expense accounts.

Open-loop card networks evolved when commercial banks, such as Bank of America (Visa) and Bank of New York (Mastercard), decided to expand by separating the two sides of a payment platform and licensing platform participation to other banks.

Novel risks associated with e-commerce promoted the entry into the payment system of “money transfer services” (PayPal, Venmo, and Zelle) as well as facilitating payment convenience via the mobile phone wallet modality (ApplePay). Essentially, money transfer services are a modality that allows a party to use a payment instrument.

## Payments behavioral insights

Banks face an increasing challenge regarding access to their customers’ payment behaviors as card networks and money transfer services process and retain important data about the nature of the payment transaction and the relationship between the payee and payor.

The positive spillover value of detailed card payment instrument data is profound. Bloomberg Second Measure maintains a proprietary dataset of U.S. consumer credit card transactions that it aggregates and delivers as detailed company and industry sales performance data to investors. Bloomberg Second Measure “deciphers payment descriptors and tags them to corresponding merchants” as well as “inferring location” and “online versus in-store purchases.”

Banks can pursue similar competitive insights by aggregating payment instrument data by customer. ClearScape Analytics can support the use of natural language processing to identify a “global payee,” such as Verizon, and to facilitate their mapping to expenditure categories. This mapping allows banks to make valuable inferences about their customers, including the source and stability of income as well as deep behavioral insights from expenditures—notably payee descriptors.

As identified by economist Douglas Diamond, the economic rationale for commercial banks dominating business lending is the exploitation of the information asymmetry they enjoy in credit risk assessment via the “delegated monitoring” of the inflow and outflows of funds in the business checking account. The concept of “delegated monitoring” can be extended beyond the dollar volume of funds inflow and outflow, to the specific nature of the counterparties to income and expenditures—information that is incremental to any repayment history in a credit bureau.

On-us payments are a rich source of customer insights, as they reveal a lot about the relationship between the payer and payee. Payment instrument data in the focal bank can provide unique insights into customers’ comfort with digital technology. For example, customers who purchase Netflix are much more likely to be highly engaged in digital banking than customers who patronize Redbox rental kiosks at grocery stores.

Moreover, a deep understanding of consumer expenditures, as revealed through payee data, addresses key questions about the customer, notably the “share of payments” and “share of wallet” revealed by payments to competitor banks. Understanding detailed consumer expenditures, especially against public reference data like the U.S. Bureau of Labor Statistics Survey of Consumer Expenditures, allows a more consistent and authoritative assignment of lifestyle and life stage segments. A large U.S. bank developed a family of data products to socialize the insights from payments data by standardizing the “global payee” and revealing the detailed source of income inflows and the nature of expenditure outflows.

## Social networks

The economy is, by definition, a nexus of individuals, households, governments, and businesses where needs are expressed and met through marketplace transactions. The social network influences how people make decisions, notably regarding credit and investments. The proliferation of electronic communications networks, including payment systems, allows these social networks to be revealed and modeled as never before.

More sophisticated financial services products require relationship-selling to customers via conversations with premier bankers or wealth managers. There is an enormous opportunity to reveal the social networks of the bank’s customers by the careful analysis of account linkages (as discussed in the customer section above), which can accelerate these relationship selling efforts.

A large U.S. bank leveraged the standardized global payee (identified by entity resolution algorithms from Teradata) to review the payments flows from one focal bank customer to another. These flows were instantiated in a “payments network graph” that revealed tremendous insights into the social networks of business customers, notably supplier networks.

To promote the adoption of the bank’s person-to-person payment platform, the payment network graph was exploited to identify customers who routinely made payments to other customers with the latter earmarked as potential clients for expansion of the person-to-person payment product. Novel direct response marketing applications of payment network graphs can be enhanced with Teradata partner ActionIQ.

Fraud in financial services is, of course, a major challenge. Fraud mitigation and intervention requires the ability to identify social networks of these bad actors through techniques such as “link analysis” and “network graph analysis.”

# Time series data

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**Consumers' financial needs evolve** over time as they grow their families and near retirement. Small business banking needs grow with payroll size and number of locations.

It can be helpful to envision the bank's relationship with the customer as a dynamic process that evolves with the maturity of the customer and the engagement and trust with the bank. ClearScape Analytics features several algorithms that interrogate time series data with precision.

## Customer dynamics

One large bank in the U.S. developed a family of interrelated "customer dynamics" behavioral predictive models to assess current and future engagement with the customer to maximize value. Banks can use these models for multiple applications: descriptive (what has happened?), predictive (what will happen?), and prescriptive (what should happen?). Although models are abstractions of reality, they are great tools to identify and manage strategies to influence human behavior.

Customer dynamics models address key dimensions of the customer relationship:

- Customer churn, or the likelihood of relationship retention, which is driven by the breadth of product holding and depth of product usage, with additional consideration of payments intensity and channel usage
- Deposit balance growth, or the likelihood of material average deposit balance growth
- Product expansion, or customer propensity to expand product holding with the focal bank; many of the attributes that contribute to "stickiness" also correlate with the likelihood of product cross-sell.

Fortunately, ClearScape Analytics provides econometric models, such as logistic regression, and tree-based methods, such as gradient-boosted decision trees, to develop these models.

## Customer profitability and customer lifetime value

Customer profitability is the net revenue of current products less the direct cost of product usage. In banking, revenue is largely net interest margin and fees. Direct cost is primarily driven by the ability to understand the marginal cost of channel usage via access (branch assigned) and activity (duration of channel interaction times direct cost).

Retail banking is a 90-10 business where 10% of customers account for 90% of profits. Most customers hover around zero profit; subtle differences in behavior, notably the breadth and depth of digital channel usage, materially impact customer profitability.

Customer lifetime value (CLV) is a discounted cash-flow analysis of current profitability cast over the customers' expected future life discounted at the bank's target return on equity. Robust measures of CLV carefully assess the likelihood of future period product expansion, as well as a potential increase in the intensity of usage of current products. CLV calculation can be validated through the careful analysis of small bank acquisitions, divestitures, and branch acquisitions.

## Marketing applications

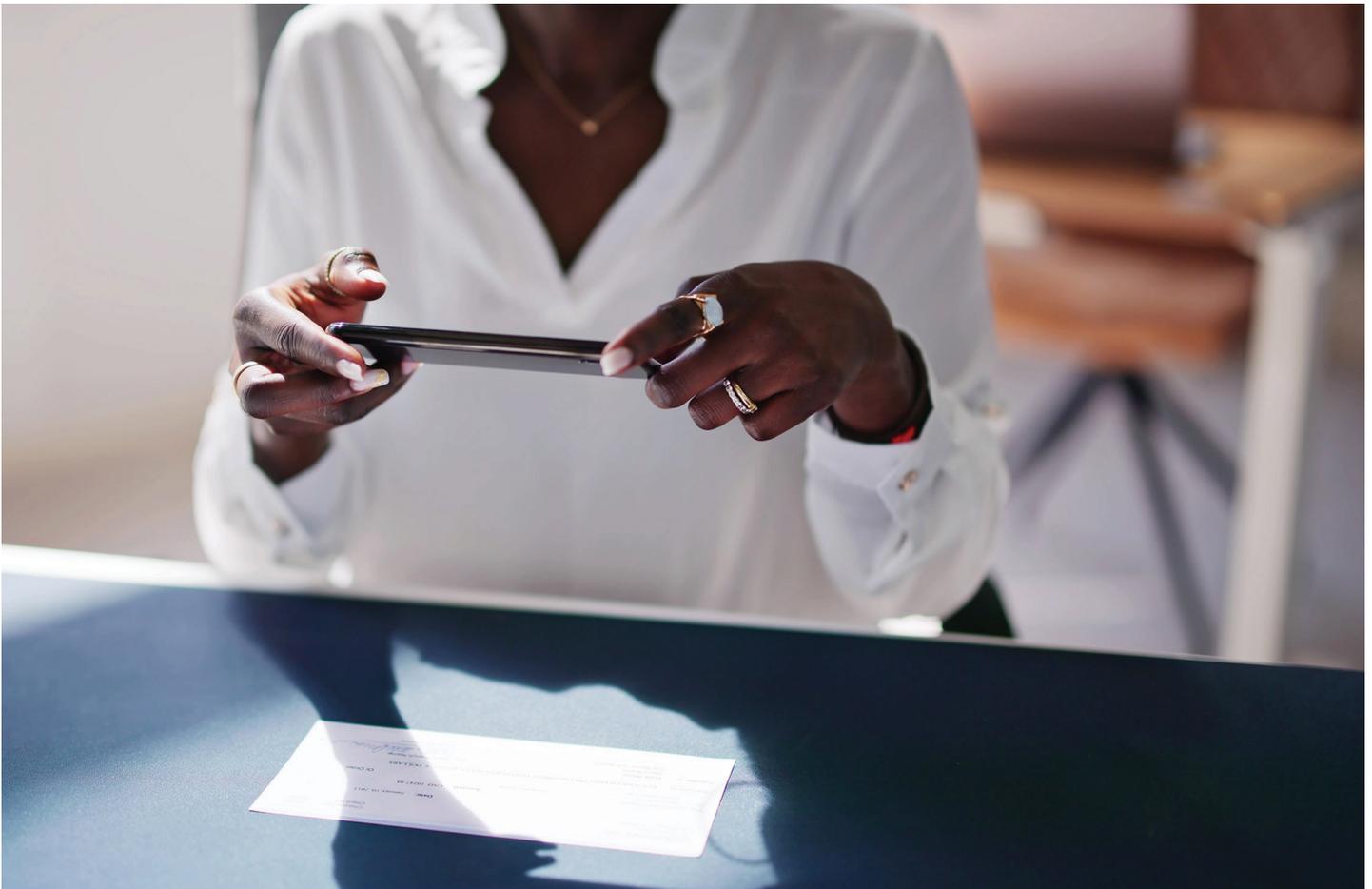
Leveraging a wealth of behavioral data, the focal bank can identify the propensity to purchase for each of the family of products and even the logical product purchase sequence. Explicitly assessing the propensity of purchase for each bank product for a customer can inform the primacy of direct marketing campaigns and minimize "offer contention."

A predicate assessment of product purchase propensity allows banks to identify the strength of the purchase signal resulting from "hand-raising" behaviors, such as initiating an online product application, which can then invoke a direct marketing response enabled by Teradata partner ActionIQ.

## Primary bank

Many customers have a relatively low level of engagement with the focal bank. Therefore, it's important to assess the extent to which the focal bank is the customer's primary bank. Fundamentally, this is the question posed to the customer of "what's your bank?" While some consumers respond with the bank that facilitated their residential mortgage, most customers will identify the bank that facilitates most of their daily transactions via a checking account, a credit card, or both as their primary bank.

The degree to which a bank is primary can be readily ascertained via the evaluation of deposit inflows and payments behavior. This can help identify the frequency and monetary amount cutoff points where customer retention is materially increased.



# Strategic segments

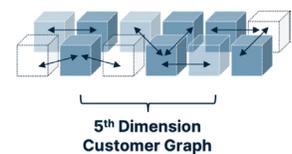
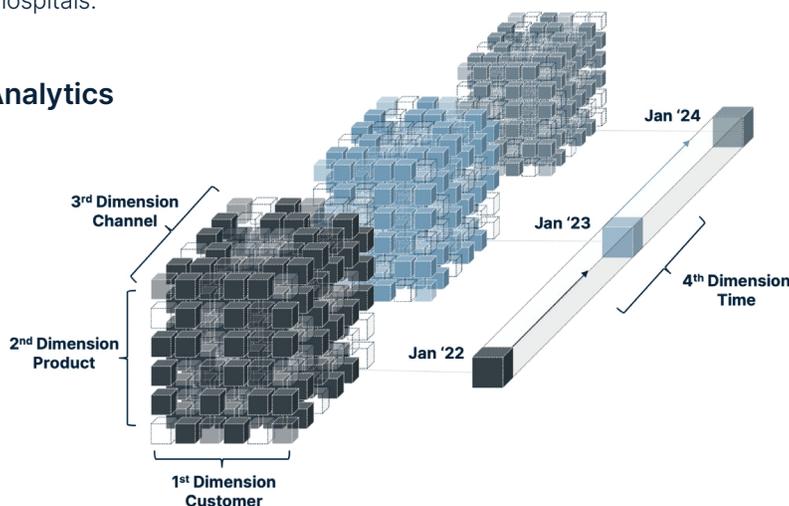
With the scale and complexity of a bank's customer base, the creation of robust strategic segments can be a useful tool to prioritize resource allocation and product design efforts. The identification and assignment of these strategic segments rely on both art and science and fall into the domain of unsupervised models, such as K-means clustering, an algorithm available in ClearScope Analytics.

A common approach to strategic segments is "life-stage segments" that aggregate customers by their age, number of dependents, affluence, and employment situation. These life-stage segments align with household financial milestones, such as opening a first bank account, first career job, accumulating financial assets, purchasing a house, saving for retirement, and decumulating assets in retirement.

Life-stage segments can be a convenient methodology to organize the portfolio of customers into subgroups that have similar needs or may be responsive to the same messaging and, with help from third-party data providers, also be used to identify prospects for the focal bank's products. Banks that accumulate detailed records of how their customer relationships evolve over time can organize customers by birth year or bank tenure to create synthetic cohorts or segments.

Economic geography is an often overlooked but very effective method to target customers in life-stage segments by exploiting the "assimilative sorting" of economic geography. Banks often use this intelligence to identify locations for bank branches and ATMs, as "birds of a feather shop together". For example, a large U.S. bank targeted "emerging affluent" households by locating focal-bank-branded ATM machines on the campus of graduate business schools and university-affiliated teaching hospitals.

## Customer 5D Analytics



## Summary:

Banks need to address the five dimensions of the customer:

- **Product:** The bundle of services and capabilities provided by the bank to address a customer's financial need
- **Channel:** How products are delivered by the bank to customers
- **Payment:** The movement of money to facilitate economic activity
- **Network:** People as economic actors in banking activity and the role that they play, as employees, suppliers, etc.
- **Time:** The evolution of the customer's financial needs and the customer's relationship with the focal bank.

Modeling human economic behavior is extremely complex across manifold dimensions—individually, socially, temporally, and spatially. This holistic view is oriented toward gauging customer financial needs and the extent to which the focal bank satisfies these needs.

For the first time, neural architectures allow the development of models that can truly exploit the multidimensional nature of the customer relationships with banks. Teradata is uniquely positioned to address these challenges via ClearScope Analytics and the open analytics platform supporting "Bring Your Own Model" functionality.

# How Teradata can help

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**Teradata partners with businesses** in financial services and many other industries to create impactful customer experiences through artificial intelligence and machine learning (AI/ML) and advanced analytics. Using customer journey analytics, we help banks evaluate and improve their service delivery processes by expediting issue resolution and eliminating channel friction to radically increase customer satisfaction and engagement.

We empower banks' customer journey analytics through:

- **Complete data harmonization:** Integrate data and accelerate data preparation with the most resource-efficient cloud platform and advanced in-database analytics
- **Rapid AI innovation:** Use preferred model training tools and technologies via our open and connected ecosystem
- **Cost-effective performance:** Operationalize and scale Trusted AI through robust governance, automated lifecycle management, and massively parallel processing

Teradata provides the flexible, proven solutions banks need to innovate faster, enrich customer experiences, and deliver value—all with the transparency and security of Trusted AI.

To learn more about how Teradata can help enhance every step of the customer journey and accelerate customer acquisition and adoption, visit [teradata.com/industries/financial-services](https://teradata.com/industries/financial-services). You can also see firsthand how ClearScape Analytics works with [a test drive](#).