Luther Case Study

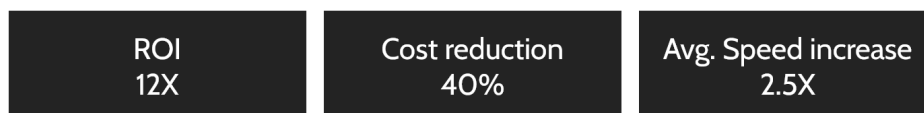# Cross-border Customer Onboarding and Global Profile

1. Executive Summary

Citigroup is a global investment bank with headquarters based in New York City, and is one of the largest banks by assets in the world[1]. Citigroup offer various services to their customers, including credit cards, wealth management, asset management, and have a focus on partnering with institutions that have cross-border needs[2]. Because of the global nature of their operations, Citigroup carries out business operations in nearly 180 countries, with on-the-ground representation in 95 of them[3],[4]. In 2023, Citigroup had nearly $2.5 trillion in total assets under their custody and administration, with almost 240,000 employees[5].

Citigroup operates various business lines to provide a variety of services, including corporate and investment banking, securities services, US Personal Banking, and private banking for high-net-worth individuals and families (referred to as wealth services). Wealth service customers will follow a localized customer onboarding process in which their details are given to the local Citigroup department to store, and accounts and services the customer wishes to use are opened for them. An effective customer onboarding process is vital to ensure that customer details are securely stored and the customer's needs are understood and met. Citigroup also offers a variety of customer account types to their customers to better meet their needs, and one example of these is the Citigold account, providing perks and benefits to individuals willing to store a combined minimum of $200,000 across Citigroup bank accounts and investments.

Due to Citigroup's nature as a global bank, many customers, especially high-net-worth customers, would like to access their services from multiple countries and regions. However, data regulations of certain nations mean the operational teams of Citigroup working in these countries can be unwilling to share data with other countries. Consequently, the issue of duplicate profiles arises, where one customer has two different profiles in two different countries and is unable to access their services. For example, a Citigold customer in Singapore cannot access their benefits and services in the US, where the database believes they are a Personal Banking customer, because the required minimum $200,000 dollars is housed in Singapore. This is a big problem, as outside of the US, Citigroup's individual customers are primarily high-net-worth individuals and families looking to use Citigroup wealth services, and this negatively impacts their customer experience.

The estimated commercial impact of implementing the Luther Platform for Citigroup are:

ROI 12X	Cost reduction 40%	Avg. Speed increase 2.5X

[1] https://www.spglobal.com/marketintelligence/en/news-insights/research/the-worlds-largest-banks-by-assets-2024
[2] https://www.citigroup.com/global/businesses
[3] https://www.citigroup.com/global/about-us/global-presence
[4] https://www.citigroup.com/global/businesses/banking-and-international
[5] https://www.citigroup.com/rcs/citigpa/storage/public/10k20231231.pdf

The process involves 6 teams and participants: i) the customer, ii) Citigroup's Account Management Team, iii) Citigroup's Verification Team, iv + v) Citigroup Data Management Teams from both countries the customer has an account in, and vi) Citigroup's Credit Risk Team. A full breakdown of teams and their roles can be found in section 2.4.

A key component of customer management is cross-border customer onboarding. The cross-border onboarding process involves several key steps: the customer initiates onboarding and fills out basic information fields. Citi verifies their identity and runs KYC checks, as well as analyzing their credit history. Citi approves the customer, generates their account and activates it. To reconcile the customer's information with their information in another country, the Citi team in one country contacts the team in the other country with a data request, which is then fulfilled. Once Citi has verified both sets of data against each other, the customer record is updated to reflect the customer's cross-border status and the customer is given a unified login point to access services from both countries. For a full breakdown of the process see section 2.5.

Citigroup onboard 22,000 cross-border customers annually, and each cross-border customer holds an average of $230,000 in assets with Citigroup. They also conduct 244,000 KYC checks on cross-border customers annually, for both new and existing customers.

Annual cross-border customers onboarded	Annual cross-border KYC checks	Average $ held by a cross-border customer
22,000	244,000	$230,000

Citigroup operates the cross-border customer onboarding process as part of the customer relations management value chain. This process operates across 6 teams & 18 software systems and it includes 203 tasks end-to-end.

Teams	Software systems	Tasks
6	18	203

To operate the process end-to-end, each team operates a number of functions. Each function performs the same Operations Cycle (series of steps); i) send data & info to the system, ii) receive response from system, iii) compute & validate response, iv) share & store execution of step, v) evaluate & initiate next step.

Operational Silos cause unreliable Process Operations

Citigroup operate the Process across 6 teams & 18 Software Systems

each team & system performs a function for the Process (perform checks, review docs, ...)

these teams & systems are siloed, they have separate ops, tech & governance

but the end-to-end process operates across them

For reliable operations, all teams & systems involved should operate the same end-to-end process. However, they often don't! This leads to operational & technical challenges, which make process operations unreliable. The opportunity is providing a platform to reliably operate the end-to-end process, across all teams & systems involved. Traditional solutions to end-to-end process operations are unreliable & expensive.

Enterprise Operations are generally function-first, which means they continue to focus on improving functions & systems, but processes are considered secondary. The thinking is that if we have great functions & systems, the business can operate any process! Traditionally enterprises use bespoke connectors & local operations scripts for process operations, which are fragmented, siloed, and change separately, and so are ineffective for reliable process operations.

Enterprises primarily focus on the operations of individual teams & systems, and continuously improve them

operations of the end-to-end process across 6 teams & 18 systems is of secondary focus, especially as the process evolves

This costs the enterprise millions in operational costs, and days in delays

For Citigroup's cross-border onboarding process, this leads to

Practical Problems in the onboarding process

Inefficient onboarding process for existing customers

Decreased confidence in Citigroup services

Less cross-border usage = lower operational revenue

Poor revenue opportunities due to ineffective global customer service

Fewer high-wealth cross-border customers with Citi

Increased risk of fraud

Increased risk of violating data regulations

To remedy this, enterprises use automation tools. However, they are ineffective at end-to-end process operations, due to their limited scope and scale, and stitching them together also doesn't solve the problem.

Luther's platform is designed process-first, & primarily focuses on end-to-end processes. Reliable end-to-end process operations include consistent operations, and great functions & systems.

Luther's platform takes a Process First Approach

focusing on reliable operations of the end-to-end process across all teams & systems,

instead of cobbling & stitching together the separate & siloed functions

of 6 teams & 18 software systems

The Luther Platform was used to develop the Global Onboarding Customer Profile application for Citi, an exemplary global customer data management product that creates a single source of truth for customer data by taking individual countries' customer data and creating a unique Global Customer Profile for each customer that acts as a directory of information. The application automatically checks their data for any errors and corrects them before encrypting the data. The Luther Platform notifies teams onboarding customers whether that customer is already a user in another country. From there, countries can contact teams in other countries to request the sharing of data of that customer.

Additionally, the Global Customer Profile updates in real time when changes are made to profiles, keeping all teams operating with the same information all the time. This provides a seamless user experience for cross border customers. This unique solution allows for the efficient operations of onboarding teams globally while still adhering to individual countries' data sharing policies. The Global Customer Profile will enable Citi to enhance the onboarding experience for existing clients in other countries, tailor their product offerings for cross-border customers better, and improve customer service for cross-border customers tremendously due to knowledge of their status in a different country.

The automated Cross-border Customer Onboarding Process, built on the Luther Platform, uses Deep Process Automation Technology to improve the automation of the onboarding of new and existing customers, and automatically store customer data in the new Citi Global Customer Profile application, developed by Luther in collaboration with Citigroup. The Luther Platform provides standard connectivity and a Common Operations Script shared by all participants. The platform reliably operates the end-to-end process across all teams and software systems from the common operations script.

Luther's unique value for reliable end-to-end Process Operations is providing i) standard connectivity & ii) a common operations script, across all teams & software systems.

Luther's unique value for reliable end-to-end Process Operations is providing

standard connectivity
a common operations script

across all teams and software systems.

Luther's platform vertically integrates i) distributed system technology ii) optimal resource allocation & management, iii) real time event ordering & streaming, iv) deterministic event processing & execution, for reliable end-to-end process operations.

Luther's platform vertically integrates

distributed system technology
optimal resource management
real time event streaming
deterministic event execution

To make reliable end-to-end process operations possible.

Luther's platform does this by i) connecting systems to standard platform nodes, rather than to each other, and ii) teams & systems can change the common operations script but all teams & systems have to know & agree to the change, so all teams & systems involved operate the same end-to-end Process all the time !

Finally the Luther Platform reliably operates the end-to-end Cross-border Customer Onboarding Process across 6 teams, 18 software systems & 203 tasks.
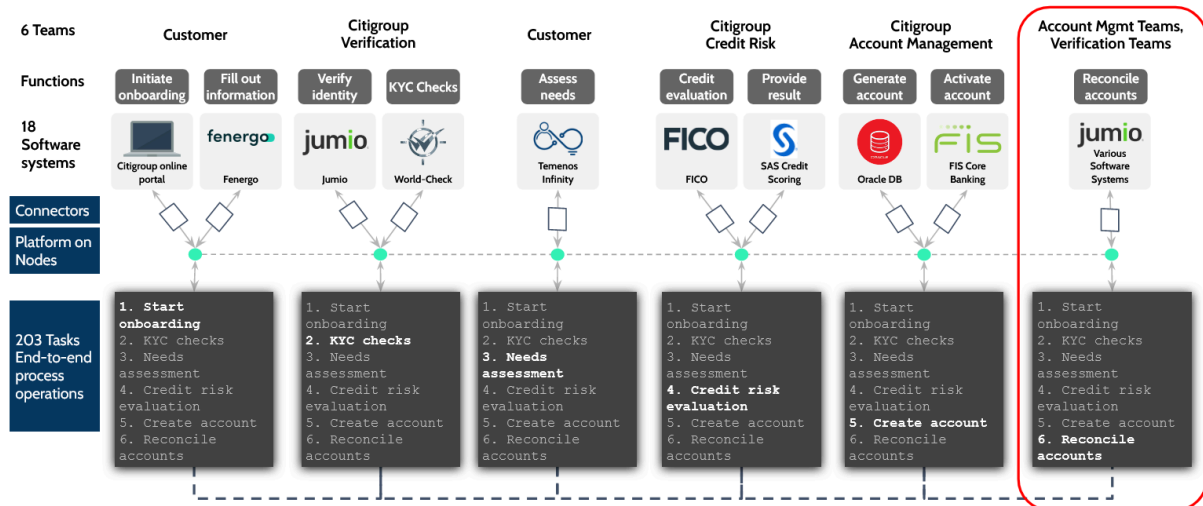

Fig 1. Cross-border customer onboarding process operations built on the Luther Platform

To implement the platform, i) Luther's team mapped the Process, ii) Identified teams & software systems in the process, iii) allocated nodes (servers) to teams, iv) connected nodes to systems, v) set up the Platform on the nodes. vi) Citigroup's team along with Luther's team developed the Common Operations Script (code) for Process Operations, vii) the process went Live.

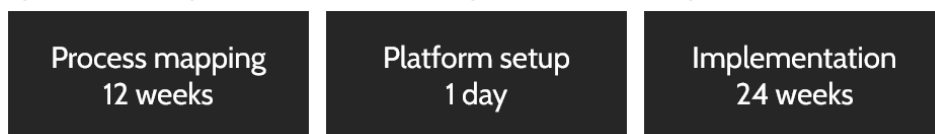| Process mapping 12 weeks	Platform setup 1 day	Implementation 24 weeks

Fig 2. Implementation timeline of the automated Cross-border Customer Onboarding Process.

The results have been highly impactful. Thanks to increases in efficiency and operations reliability, a process that traditionally took nearly 12 hours can now be completed in less than 5 hours and operational costs have been reduced by 40%. Beyond the commercial results, this led to operational benefits in production; i) reliable operations across the end-to-end process & over time, ii) 5X smaller Ops teams, iii) real-time monitoring, iv) enforced compliance checks, v) real-time and consistent updates across all teams, vi) reduction of reconciliation. Also, technical benefits during development; i) standard dev. process so developers can focus on operations, ii) 5X smaller Dev teams, iii) standard process connectors, iv) automated infrastructure and connectors setup, v) real-time and consistent updates with the rest of operations.

Operational benefits in production	Technical benefits during development
Consistent Ops: across the process	Standard development process
Consistent Ops: over time	Devs focus only on development of process Ops
5X smaller Ops teams	Eliminate DevOps teams, 5X smaller Dev teams
Real-time monitoring	Consistent, standard process connectors
Enforced compliance checks	Consistent process Ops scripts across teams
Real-time & consistent updates across teams	Standard infra., connectors, dev. env. setup
Reduction of reconciliation	Real-time & consistent updates across operations

Another key impact of the Global Customer Profile is the increased efficiency of the Cross-border Customer Onboarding Process. This process allows the onboarding systems to automatically query the Platform looking for existing Global Customer Profiles, eliminating the need to fully re-onboard customers, thanks to the enhanced visibility of customer status. Cross-border customers can access their services right away while reducing operating costs for Citigroup. The platform could be further expanded to include all countries that Citigroup operate in, and the Luther platform could also be utilized to further streamline other areas of Citigroup's operations, for example using automation to more effectively combine customer data across different business lines and value streams, to provide customers with an even more seamless user experience.
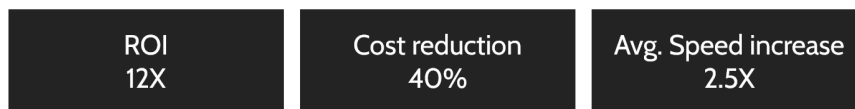
ROI 12X	Cost reduction 40%	Avg. Speed increase 2.5X

Fig 3. Estimated results of implementing the Platform for the Cross-border Customer Onboarding Process

2. The Process

2.1. Process Operations

Different teams have different operations, rules and governance and they also utilize and operate a variety of software systems in different ways. Each system operates a specific function for the process. To operate the process end-to-end, each function performs the same cycle of steps: i) **Send**: send data & information to the System, ii) **Receive:** receive response from the System, iii) **Validate:** compute & validate response, iv) **Store:** share & store execution of step, v) **Initiate:** evaluate & initiate next steps.
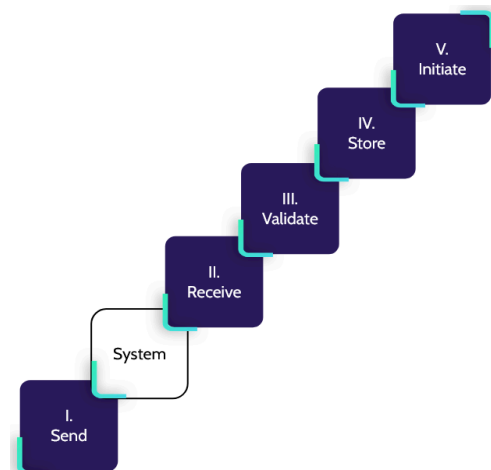

Fig 4. These are the requirements that repeat for all functions across the end-to-end Process Operations.

Enterprises operate a set of specific functions based on their objective. For example, an investment management company's functions help it to manage investment portfolios. While the functions and systems may change, the process remains the same. However, expecting processes to be efficient because of efficient individual tools simply does not work for enterprises. Luther empowers enterprises with a process-first approach.

Tasks are simple events that are localized to one team involving one or two software systems, for example retrieving data from a database. Workflows are more complex, involving 10-20 tasks between one to two teams, and two to three software systems. An example of a workflow is onboarding a new employee. Processes are complex, involving 50+ tasks, 3 or more teams and multiple software systems. Onboarding a customer end-to-end is a process.
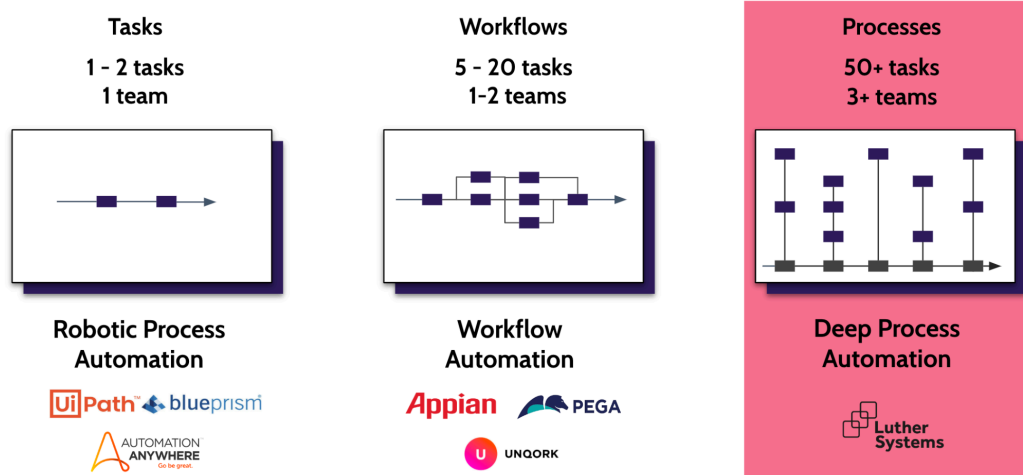

Fig 5. Different tools are used to automate different levels of complexity.

2.2. Function First Operations and its limitations

Generally, enterprise operations are function-driven. They have a large collection of software systems each operating a specific task. Tasks often have dedicated software systems and are operated by specific teams. By developing, purchasing and maintaining efficient systems, most enterprise tasks operate highly reliably.

Enterprise processes, however, operate across multiple teams and software systems, and involve many tasks. This means reliable end-to-end process operations require efficient teams and systems, as well as efficient connectivity and operations across these teams and systems.
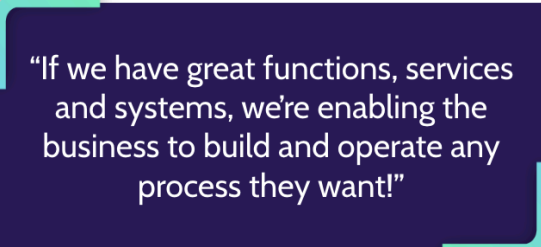
Enterprises generally take a "function-first" approach to process operations. Great individual teams and systems provide the required ingredients for great process operations, so they focus on enhancing and improving the performance and efficiency of individual teams and software systems. A good analogy of this approach is "if we have great ingredients, anyone can cook anything they want and it'll be of great quality!" Processes are considered secondary to functions and systems, as they are considered ever changing, and efficient functions and systems can enable any process that the business may envision. The problem is, efficient functions do not necessarily create an efficient process.

Efficient software systems and functions are not enough to reliably operate a process end-to-end

In practice, most enterprises have a defined charter and mission, particularly if they are in a regulated industry. They provide specific products and services which are generally enumerated and these rarely change. These form the basis of the value streams provided by an enterprise. For example, every major bank researches opportunities, develops services and products, manages investments, manages personal banking and provides benefits to its customers. The majority of "enterprise operations" are in operating these value streams. Each value stream has a set of processes, which are generally enumerated and these rarely change. The details might vary over time but the process functions remain the same. For example the customer relations management value stream includes these processes: customer onboarding, customer feedback collection, client reporting, customer inquiry processing, account maintenance and customer issue resolution. These are well known processes with well known functions, the details and data in these processes might change over time, however the functions of these processes remain the same.

The majority of processes and their functions (what each process does end-to-end) are enumerable for an enterprise. In fact a large deviation from these processes and venturing into new areas that are drastically different from the enumerated processes within an enterprise is a major event at an enterprise and is a multi-year plan. The vast majority of enterprise processes (what the process does) are enumerable and remain largely the same.

The prevailing view is if we build or purchase efficient teams and systems, then any process can be built on top of these great teams and systems. Processes are secondary to these functions and systems, as they are considered ever changing, and functions and systems are there to enable any process that the business may envision or desire to build!

"If we have great functions, services and systems, we're enabling the business to build and operate any process they want!"

Enterprises continue to optimize and improve, and incorporate better functions and systems. Example functions include contract signing, KYC checks, approving applications, finance, payments, settlement, fraud, compliance, reconciliation. Example software systems include databases, CRMs, RPA, Workflow tools, cloud services, microservices, data lakes, and others.

The problem is i) there are not that many processes, ii) efficient teams and systems are not enough to build efficient end-to-end processes.

For enterprise operations the process and its function (end-to-end operations) are equally as important as the individual teams and systems and their individual technology and functions (what they each do).

> Each enterprise generally operates a specific set of value chains and processes, in particular in regulated industries, as explicitly stated by their primary activities. An insurance company insures!
>
> For each enterprise most processes are already known and don't change.
> For most processes, the majority of the process operations are already known and don't change.
>
> **It's time to take a Process first approach in the enterprise!**

2.3. Process First Operations

Luther's platform is designed process-first. For efficient enterprise operations, effective end-to-end operations are as important as effective individual services and teams and systems, primarily since the enterprise's core value is delivering a specific set of processes and value streams, particularly in regulated industries, where most value streams & processes are explicitly enumerated!

> **Enterprise Operations are generally function-first.**
> They continue to improve functions & systems. Processes are considered secondary.
> If we have great functions and systems, the business can operate any process!
>
> **Luther's platform is designed process-first.**
> Primary focus on end-to-end processes.
> Reliable end-to-end process operations include consistent operations, & great functions & systems

The most important attributes of process first operations are i) standardized connectivity between all systems involved in the process, ii) Common Operations Script operating the end-to-end process.

> Luther's unique value for reliable end-to-end Process Operations is providing
>
> **standard connectivity**
> **a common operations script**
>
> across all teams and software systems.

2.4. Cross-border Customer Onboarding process in context

Citigroup has a number of general Value Streams involved in managing their wealth product lines. One such value stream is "customer relations management". This value stream includes multiple processes. Customer onboarding is a key process for Citigroup, serving to introduce users to their user base while providing an opportunity to make a good impression on new users and to maximize customer retention through ease of use. Its primary purpose is to easily integrate users into Citigroup's operations, perform identity and KYC checks on potential users, perform credit checks on potential users, safely collect and store customer data, provide new customers with the most relevant products and services right away, and onboard existing customers onto new services.
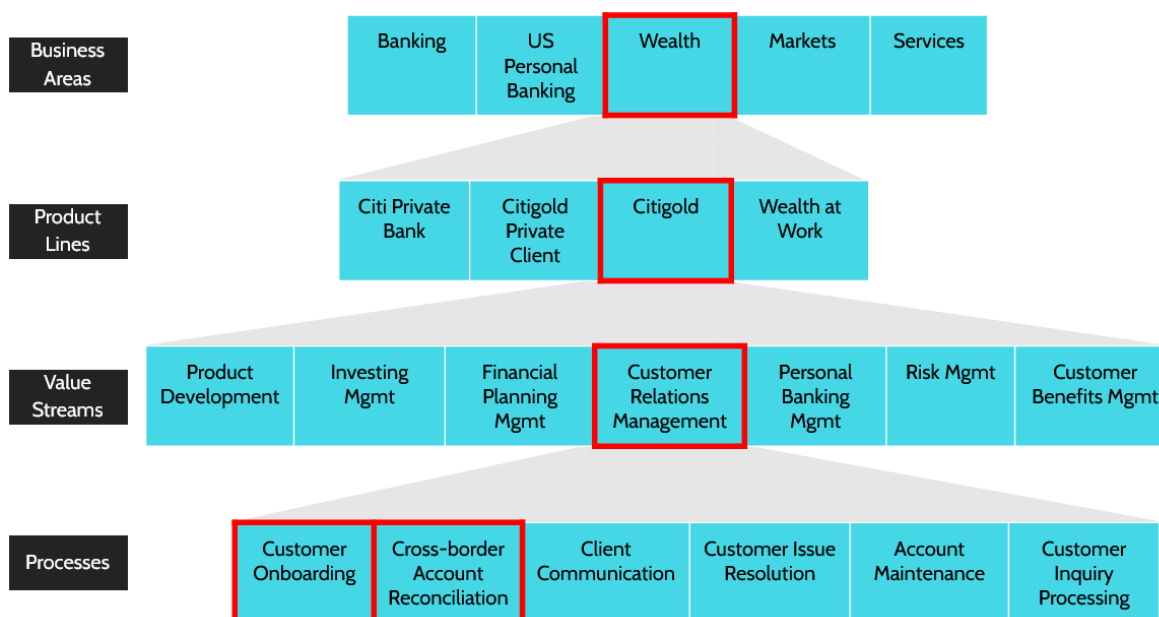
Fig 6. Citigroup operates many value streams as part of their wealth product lines. Each value stream contains many processes. Customer relations management is a value stream. It contains many processes, including customer onboarding.

Citigroup's customer onboarding process is key to managing both new and existing customers. In each country a customer wishes to use Citigroup's local services, such as a local credit card, they must be onboarded. This process requires collecting customer information, conducting a needs assessment for the customer, carrying out Know-Your-Customer (KYC) and identity verification checks to prevent fraud, carrying out credit risk assessments if required, and setting up the customer's account and services. An effective onboarding process is crucial for Citigroup's operations: a dissatisfactory, overly complex or erroneous onboarding process will create errors and delays which will need cost-intensive reconciliation and could result in the loss of customers.

In particular, wealth customers (high-net-worth individuals and families) are a core part of Citigroup. Across the US and internationally, these customers hold around $770 billion across investment assets and deposits[6], representing a significant primary source of funding for Citigroup. These include Citigold users and Citigold private clients, who bank at least $200,000 and $1 million dollars respectively, and also Citigroup Private Bank clients, 14,000 of the world's wealthiest individuals with an average net worth of over $100 million[7]. Due to the increased revenue opportunities provided by these customers and the wider variety of services they use, it is important to provide them with effective, efficient services to ensure customer retention. Due to the typical lifestyle and employment nature of wealthy customers, these users of Citigroup wealth services are far more likely to be cross-border customers, i.e. customers wishing to use Citigroup services in more than one country or region. Therefore, the cross-border customer onboarding process for these customers should result in Citigroup knowing that the profiles the customer has in two different countries are the same person.

| Annual cross-border customers onboarded 22,000	Annual cross-border KYC checks 244,000	Average $ held by a cross-border customer $230,000

It is important to Citigroup to maintain up-to-date customer profiles. Often, customers will start out as Citiblue customers, but will then pass the wealth threshold to qualify for Citigold status. Citi databases need to update to reflect this change, as the products and services available to this customer will change. Additionally, an accurate cross-border customer onboarding process that identifies customers already with Citigroup is vital for Citigroup compliance operations. Citigroup places limits on the amount of credit given to any one customer, however some individuals may attempt to defraud Citigroup by opening credit lines in multiple regions to circumvent this limit. All this shows that an accurate and flexible cross-border customer onboarding process and customer data management system are crucial for efficient customer relationship management.

To maintain up-to-date customer profiles, to comply with financial regulations, and to avoid fraud, Citigroup carry out regular KYC checks on all their customers. Generally, they carry out one check on each customer every year. However, high net worth individuals require 4 checks a year. The KYC process is more complicated for cross-border customers. All countries where the customer has an account will conduct KYC checks, and then reconcile the customers information and their eligibility status. Complex data sharing regulations mean that this reconciliation can be difficult as different teams must follow different regional regulations.

Here, we illustrate the 6 teams each operating a function for the end-to-end process operations:
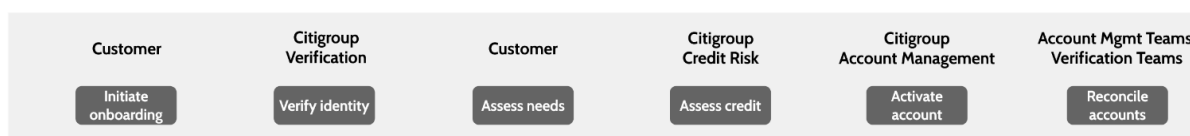
Each team has a number of software systems. These systems include:
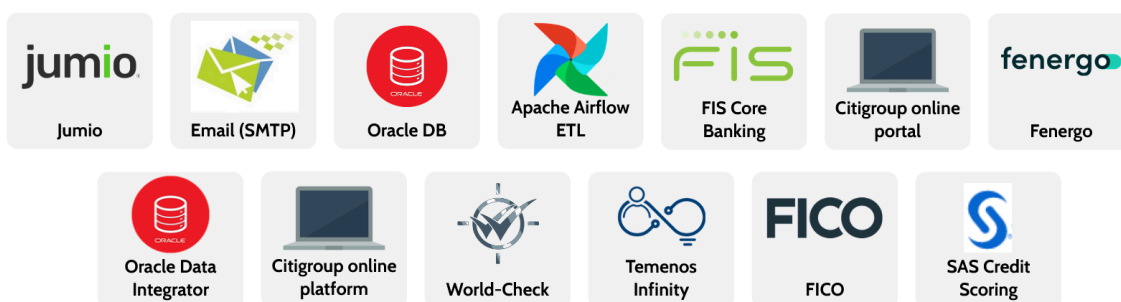
2.5. Cross-border Customer Onboarding Process before

This is the onboarding process for cross-border Citigroup customers. Customers initiate the cross-border onboarding process and go through a series of KYC checks, assessments and evaluations to open an account with Citigroup. In the final step of the process, which is a process in itself, Citigroup reconciles the account information of cross-border customers who have accounts in multiple countries. Additionally, the large majority of this process is used by Citigroup to conduct KYC checks on cross-border customers, which occurs yearly for most customers, and quarterly for the highest net-worth individuals. Certain steps are omitted for that use-case: the customer does not have to initiate the KYC check, and no new account is created for the customer during a KYC check. However, importantly, most of the process operates as normal.

1. The customer initiates the onboarding process through Citibank's website or mobile app or branch
2. The customer fills out basic personal information fields (name, DOB, SSN, address)
3. The Citigroup Verification Team verifies identity documents (e.g., passport, driver's license) against databases or through image recognition
4. The Citigroup Verification Team runs additional KYC checks including sanctions list and PEP screening
5. The Customer answers questions regarding their financial goals
6. The Citigroup Credit Risk Team pulls customer's credit history from credit bureaus for risk assessment and carry out a credit evaluation
7. The Citigroup Credit Risk Team provides creditworthiness feedback (approval, denial, request for documentation)
8. The Citigroup Account Management Team approves the customer and generates new account number and assigns services (savings, credit card)
9. The Citigroup Account Management Team activates the customer's account, enabling full functionality.
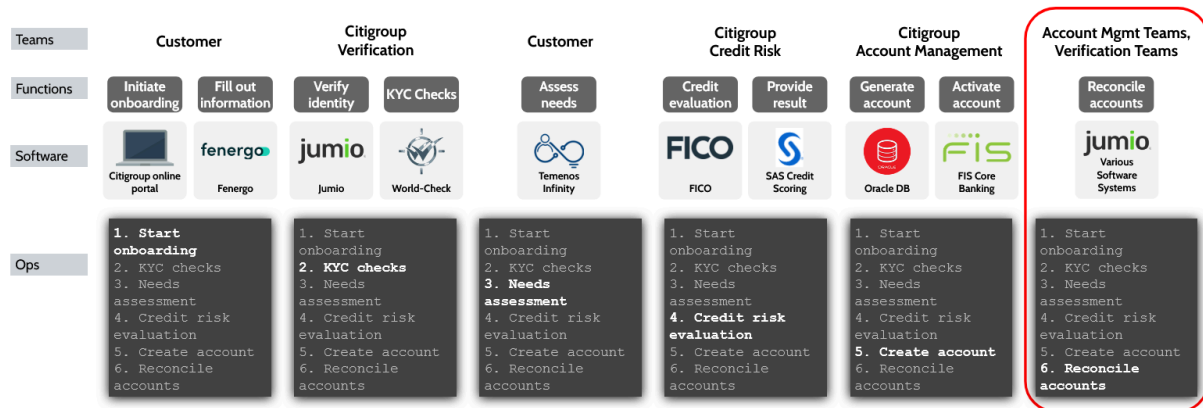

Fig 7. Illustrates the process of cross-border customer onboarding and the participants and systems involved.

The final step of the cross-border customer onboarding process is reconciliation of the multiple accounts of these customers across borders. This step is a process in its own right, illustrated below. While we represent it as just one step of the onboarding process above, it is important to understand that this is a highly important process with its own process operations.

Onboarding cross-border customers requires this additional process, where Citigroup must check if the customer has an account in a different country or region. This process also takes place whenever regular KYC checks are carried out for these customers, because both countries must complete these checks and consolidate the checks with each other. In regions with a CRM system, this process happens automatically when a cross-border customer is onboarded, as that customer's data is already stored in a regional system. For countries without a CRM system however, the customer must manually request account consolidation.

10.1. The Citigroup Account Management Team verify customer identification information

10.2. The Citigroup Account Management Team in one country contacts the team in the other country and requests customer data needed to verify Customer Identity

10.3. The Citigroup Data Management Team in the country the request has been made to retrieve the data from the database system

10.4. The Citigroup Data Management Team sends the data to the other Team

10.5. The Citigroup Verification Team verifies the customer's identity for each country to ensure they are the rightful owner of the accounts

10.6. The Citigroup Account Management Team checks that the separate accounts are eligible for the services the customer has access to (e.g., matching personal details, requirements are met, no conflicting ownership issues)

10.7. The Citigroup Account Management Team informs the customer whether their accounts are eligible for the services and if any additional steps or documentation are needed

10.8. Once verified, the Citibank Data Management Team initiates the update process by updating customer records across the relevant product databases

10.9. The Citibank Data Management Team creates or updates a unified login or access point for the customer to view and manage all their Citibank products in one place.
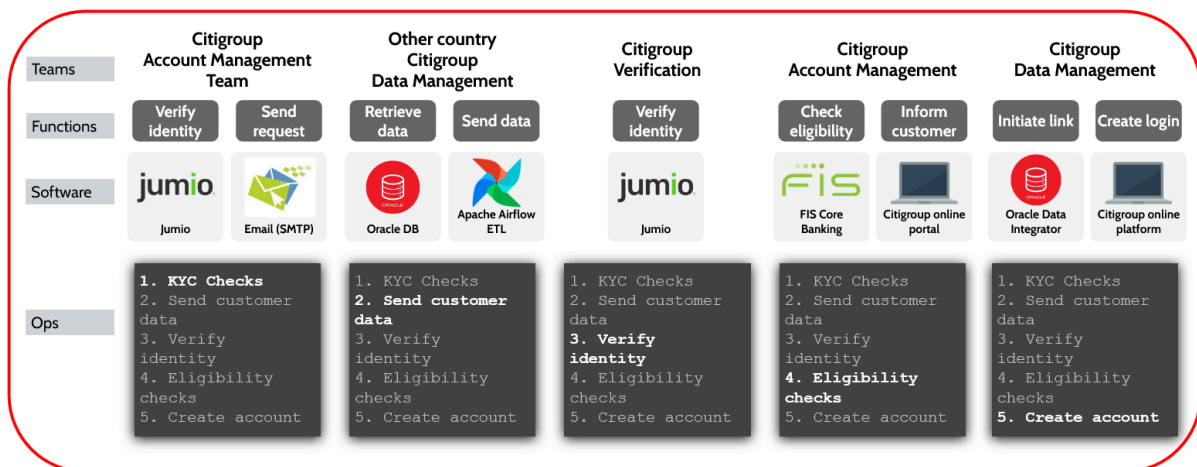

Fig 8. The steps that make up the cross-border account reconciliation process, treated as the final step of the cross-border onboarding process

3. Problem

3.1. Enterprise Process Operations Problems

Enterprises are complex organizations operating many processes. Enterprises operate processes across fragmented and siloed teams and software systems. This means that teams change their operations as functions and information change, but other teams operating the process are not made aware of that change. Consequently, other teams are operating on constantly changing and incorrect information, resulting in disjointed, inconsistent, inefficient end-to-end operations which lead to high costs, delays and errors. As a result, disjointed process operations require monitoring and reconciliation to correct errors, and this also increases operating costs.

Operational Silos cause unreliable Process Operations

Specifically, operating processes across fragmented and siloed teams and software systems affect process operations both i) technically during the development phase and ii) operationally once they go live in production.

On the technical side, for process changes, enterprises set up case-by-case projects, which includes large development and DevOps teams, and setup of non-standard case-by-case infrastructure and development environments, as well as bespoke connectors between different systems. Further, as the teams and systems change over time they deploy local updates which usually impact the end-to-end operations, requiring further updates and patching.

Technical hurdles in development

Inconsistent developer process
Dev teams focus on setup and maintenance
Large Dev & DevOps teams
Inconsistent and nonstandard process connectors
Inconsistent process Ops scripts across teams
Non-standard infra., connectors, dev. env. setup
Inconsistent updates & patches over time

Operational problems in production (live)

Nonstandard ops: across process steps
Nonstandard ops: over time
Inconsistent changes
Lack of execution status visibility
Need for execution reconciliation
Large Ops teams
Compliance fees & violations

Once the process is live, the fragmented and separated teams and systems result in non-standard operations across the process and over time as the teams, operations, and systems change. The fragmentation also results in a lack of execution visibility and operations monitoring. This further results in the execution requiring reconciliation, which is often lengthy and expensive. This could also result in compliance issues and violations. All of this requires large operations teams to run the processes and fix their recurring issues.

3.2. Problem Overview

For reliable process operations, all teams and systems involved should operate the same end-to-end Process.

They often don't!

Citigroup's cross-border customer onboarding process operates across teams in different countries that have poor visibility of operations, due to varying data standards and regulations on sharing data across borders, as well as non-standardized data entry. Teams are unable to view customer data from different countries and this has an adverse impact on customer relations, as users become frustrated with a lack of access to services they should have. This results in increased operational costs in handling customer complaints and providing them with service, as well as potential impacts on customer retention.

3.3. Cross-border Customer Onboarding Process Operations Problems

Citi does combine some countries it operates in into main regions, where each region comprises a number of geographically close countries. Some regions have a Customer Relationship Management system which combines customer profiles from various regions according to the system requirements and standards. However, some regions do not. Furthermore, when combining customer profiles into a regional Customer Relationship Management (CRM) system, there is the possibility of profile duplication when a customer has accounts in more than one country. If the duplication is not noticed and corrected, the customer will not be able to access their services from one country when in another, because the customer onboarding process was not aware the customer already had an account. As a result, cross-border customers must manually request the Citigroup onboarding team to contact the other countries team to confirm their status. This is a lengthy and time–consuming process.

Additionally, updates to customer profiles are not made in real time and across systems. For example, a cross-border Citiblue customer may now qualify for Citigold, but when this change is made the other country in which they access services is not informed, and now this Citigold customer is denied access to services they should have access to.
Citigroup also faces financial challenges from the lack of a global customer management system. Citigroup places limits on the amount of credit customers can use. However, fraudsters can open multiple accounts in different countries to circumvent this limit, potentially costing Citigroup millions annually if this were to be exploited by many people.

One reason no cross-border customer onboarding process has been implemented thus far is that different countries store different data fields for their customer profiles. As a result, it is difficult to create a global database that is consistent, with no errors or duplicate data. Also, global and regional data standards mean data must be encrypted before it crosses international borders, but different encryption methods and standards pose yet another challenge for a global customer database. Specific regions will have major data sharing restrictions with other specific regions, but not with others. Some specific countries will have major data sharing restrictions with other specific countries. Countries are often not allowed to share some or all data with each other. As a result, it is difficult to find a solution to the cross-border onboarding problem.

Citigroup employs large teams and uses advanced software systems and technology to operate the cross-border customer onboarding process and manage customer databases. However, owing to the complex data sharing and storage regulations involved in international data operations, onboarding teams are not aware of customer profiles in other countries and regions, or changes to these profiles. As a result, cross-border customers must manually request that onboarding teams verify their customer status, which must be done manually, delaying the customers' access to their services. This manual reconciliation process also increases operational costs for Citigroup. This shows that current methods have been ineffective at reliably onboarding cross-border customers.

All this makes the onboarding process frustrating for cross-border customers, who will often miss out on services they should have access to, or experience delays accessing those services. Additionally, duplicative onboarding increases processing and customer service costs for Citigroup.

Practical Problems in the onboarding process

- Inefficient onboarding process for existing customers
- Decreased confidence in Citigroup services
- Less cross-border usage = lower operational revenue
- Poor revenue opportunities due to ineffective global customer service
- Fewer high-wealth cross-border customers with Citi
- Increased risk of fraud
- Increased risk of violating data regulations

Operational Problems for Citigroup

- Nonstandard ops: across process steps
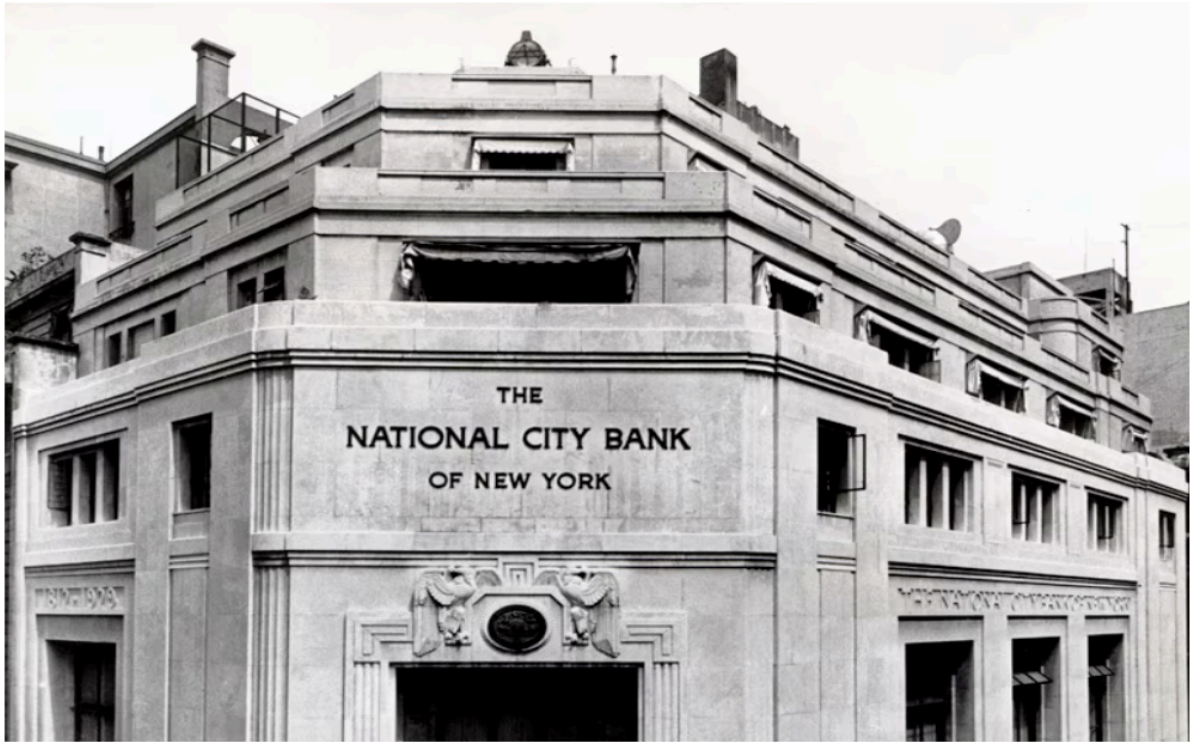- Nonstandard ops: over time
- Inconsistent changes
- Lack of execution status visibility
- Need for execution reconciliation
- Large Ops teams
- Compliance fees & violations

4. Traditional approaches to process operations and automation solutions don't work

4.1. Approach to Process Operations today

Enterprises typically establish dedicated projects and project teams to set up process operations. This involves mobilizing large development and DevOps teams, as well as large operations and support teams. They create custom, often non-standard project infrastructure, connectors, and development environments, which require dedicated ongoing maintenance once the process is live. The project team writes bespoke operations code to manage the end-to-end process, including code that links the operations of various software systems.

As the process moves into production, developers must continuously write custom local code to adapt to the evolving landscape of team operations, process rules, and software systems. Additionally, the project team or other development teams need to develop and integrate separate execution monitoring software and reconciliation software. These tools are essential for detecting errors and inconsistencies, determining root causes, and correcting the issues. Furthermore, they deploy multiple distinct application systems, such as compliance software systems, to support the overall operation.

This demonstrates the bespoke, fragmented nature of process operations development, in addition to multiple auxiliary systems required to keep the operations going. Most importantly, this approach cannot keep pace with the ever-changing process operations.

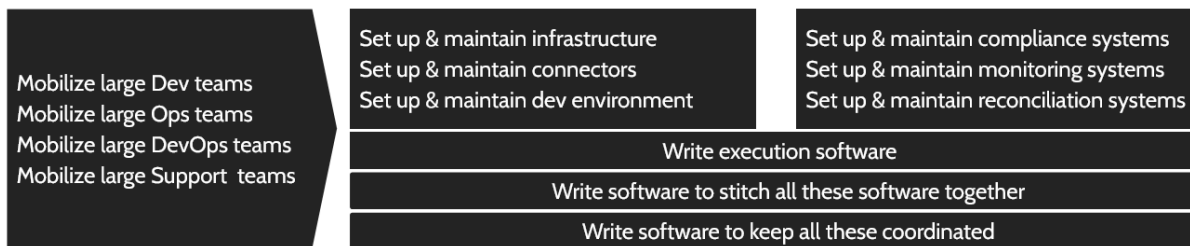Enterprise process operations are unreliable!

Fig 9. Enterprises generally carry out all of the above to run a process.

4.2. Bespoke Connectors & Operations Scripts & why they don't work

To manage the cross-border customer onboarding process, Citigroup typically; i) sets up local connectors between directly linked systems involved in the process, ii) Develops and updates local operations scripts to manage the process end-to-end. Both the bespoke connectors and operations scripts require regular updates and modifications as teams, process operations, and software systems evolve. These updates are reactive and localized, addressing immediate changes without fully considering the entire process.

The problem arises because these connectors and scripts are integral to the end-to-end process, where each step depends on others and assumes specific functions from other parts. Local changes alter the immediate local operations, but the rest of the process continues to rely on outdated assumptions about those functions. This results in a gradual drift and fragmentation between different parts of the process.

This drift and fragmentation requires further patches and updates, which will require further patches and updates in other parts of the process, and the cycle continues!
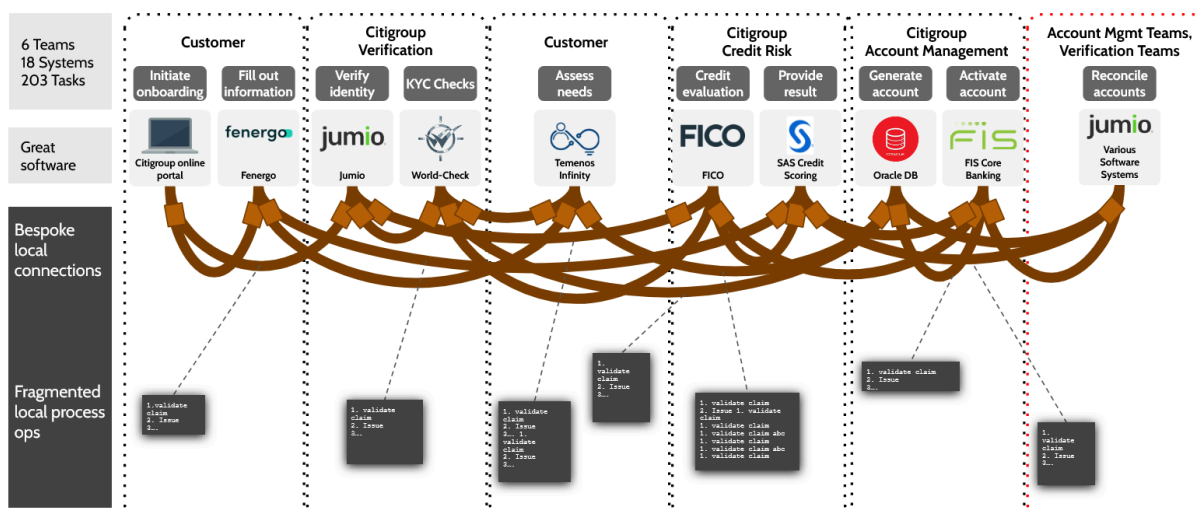

Fig 10. Bespoke local connections across the end-to-end process that are internally developed by the enterprise.

4.3. Local Automation (RPA, Workflow) tools & why stitching them together doesn't work
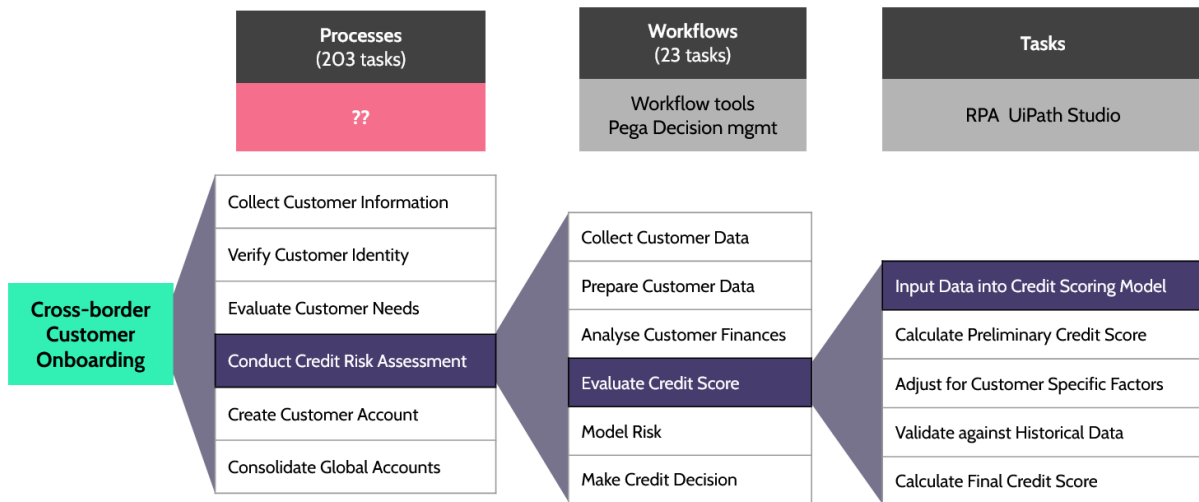

Fig 11. Today, there are no traditional tools which effectively automate processes.

Enterprise processes consist of numerous operations (tasks). Each process includes a collection of workflows, and each workflow is a collection of multiple tasks. Tasks are simple, localized events involving one team and one or two software systems. For example, inputting data into a model is a task. Workflows are more complex, comprising 10-20 tasks that span one to two teams and involve two to three software systems. For instance, evaluating a credit score is a workflow consisting of 17 tasks. Processes are complex, involving over 50 tasks, three or more teams, and multiple software systems. An example of a process is the onboarding of a cross-border customer, which includes 203 tasks.

Enterprises utilize Robotic Process Automation (RPA) tools to automate individual tasks. RPA tools have evolved into highly effective solutions for this purpose. However, for automating workflows (comprising 10-20 tasks), enterprises turn to Workflow Automation tools, as individual RPA bots are not scalable to handle such complexity. Workflow Automation tools have similarly advanced, becoming highly effective at automating entire workflows. These tools leverage a diverse array of technologies, including traditional ones like Workflow tools, ERPs, and BPMs, as well as modern innovations such as Hyper Automation, Intelligent Automation, and various developer tools.

> **RPA tools and Workflow tools do not scale to operate end-to-end processes**

To overcome the limitations of the traditional approach, enterprises deploy numerous RPA and Workflow tools across the end-to-end process, and then connect and orchestrate these tools to function reliably. This integration and coordination are typically developed internally by the enterprise.

Process orchestration approaches integrate combinations of RPA and workflow systems using point-to-point message passing techniques. These services often employ a batch scheduler or workflow system, which effectively coordinates tasks within a single team. However, this method falls short for processes involving multiple teams. Each team tends to create bespoke code for their tasks, leading to "script bloat" — the proliferation of numerous, often redundant, and poorly documented scripts. This complicates maintenance and scalability. Furthermore, there is a lack of transparency between participants in the process. This lack of coordination and integration results in inefficiencies and errors, causing delays and operational friction. For a full explanation of traditional process operations and Luther's solution, request access to the Deep Process Automation Primer.
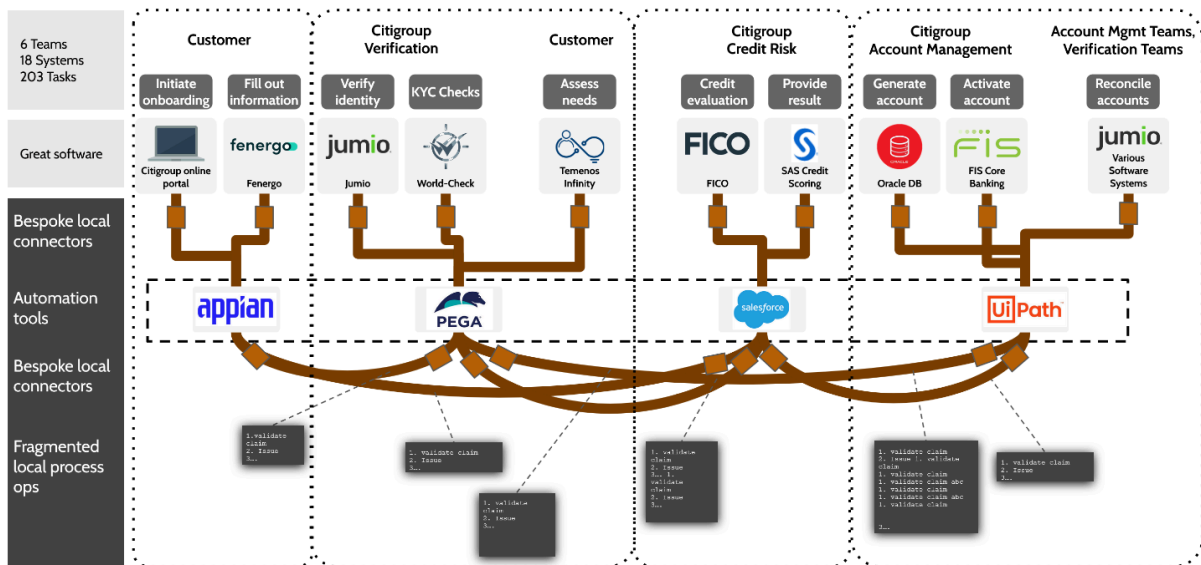

Fig 12. Stitching together local automation tools through local RPA and workflow tools is messy, localized and ultimately unreliable.

5. Solution

5.1. Luther Platform

Luther's Platform was used by Citigroup's development team to build a revolutionary Global Customer profile system that allows Citigroup to avoid duplicative onboarding and enhancing the user experience whilst providing a single source of truth for customer data that reduces errors. This required a system that could effectively handle the operations of multiple teams, software systems, numerous tasks and validations end-to-end, as well as taking into account different regulations and data standards across countries and regions.

Luther's solution automatically creates a unique Global Customer Profile for each unique Citi customer during the cross-border customer onboarding process and automatically updates their profile in response to any change, while preserving the data privacy of individual countries and complying with individual data sharing restrictions.

Luther's unique value for reliable end-to-end Process Operations is providing

standard connectivity
a common operations script

across all teams and software systems.

This is very difficult and costly with traditional automation tools and workflows. Automation of the cross-border customer onboarding process requires Luther's Deep Automation Platform. The automated Cross-border Customer Onboarding Process is the result of this work and is an end-to-end customer onboarding system that standardizes the process with exemplary local data encryption and storage, and global data matching protocols, while reducing onboarding costs and timescales, reducing the need for manual intervention to check for errors, and improving the customer experience.

5.2. How it works on the Luther Platform

After the Global Customer Profiles are created for all existing customers, each time a new customer is entered into the system from a given country, a query is sent to the Luther Platform (Second Floor) looking for a potential match with any of the existing Global Customer Profiles. A response is sent back to that country of the presence or absence of a Global Profile. If the new customer does not match any of the existing profiles a new Global Customer Profile is created for that customer. Also, everytime there is an update in the profile of any of the existing customers, a message is sent to the Platform (Second Floor) to update the Customers Global Profile. Additionally, countries (First Floor) can request data from other countries using the Platform at any time and receive it quickly. This "two floor" solution preserves data privacy for the individual countries, as no country can view other countries data, but provides a global data solution where the Platform can facilitate the sharing of data between individual countries' systems to effectively onboard existing cross-border customers.

Importantly, Luther does not place private data directly on the Platform (second floor). Instead, the second floor authorizes the request, and then disseminates the customer's private data point-to-point to only those allowed to receive it according to the second floor policies.

Additionally, the Global Customer Profile is used to streamline the continuing KYC checks of customers, saving many hours of work, especially for high-net-worth cross-border customers. Requests for identity verification from other countries can be sent directly to the platform and a response can be received in minutes. Once the customer has been reverified, the platform automatically updates with this information, allowing all other countries where that customer operates to verify the customer, removing the need for those countries to operate the verification process, resulting in savings in operational costs.

How it works on the Luther Platform:

1. The customer initiates the onboarding process through Citibank's website or mobile app or branch

2. The customer fills out basic personal information fields (name, DOB, SSN, address)

3. The Citigroup Verification Team verifies identity documents (e.g., passport, driver's license) against databases or through image recognition

4. The Citigroup Verification Team runs additional KYC checks including sanctions list and PEP screening

5. Based on the customer's information and verification checks, the Platform automatically informs the Account Management Team of the presence or absence of a matching profile, as well as supplying any public data fields

6. The Customer answers questions regarding their financial goals

7. The Citigroup Credit Risk Team pulls customer's credit history from credit bureaus for risk assessment and carry out a credit evaluation or evaluate the credit information provided to them by the Global Customer Profile

8. The Citigroup Data Management Team requests any private data fields that they require for the onboarding process from the other country, via the Platform.

9. The Citigroup Credit Risk Team provides creditworthiness feedback (approval, denial, request for documentation)

10. The Citigroup Account Management Team approves the customer and generates a new account number and assigns services (savings, credit card)

11. The Citigroup Account Management Team activates the customer's local account, enabling full functionality, as well as access to all their services

12. The Citigroup Account Management Team update the customers Global Customer Profile to reflect their cross-border status, as well as any new services they have access to, in both countries

13. The Citibank Data Management Team creates or updates a unified login or access point for the customer to view and manage all their Citibank products in one place.
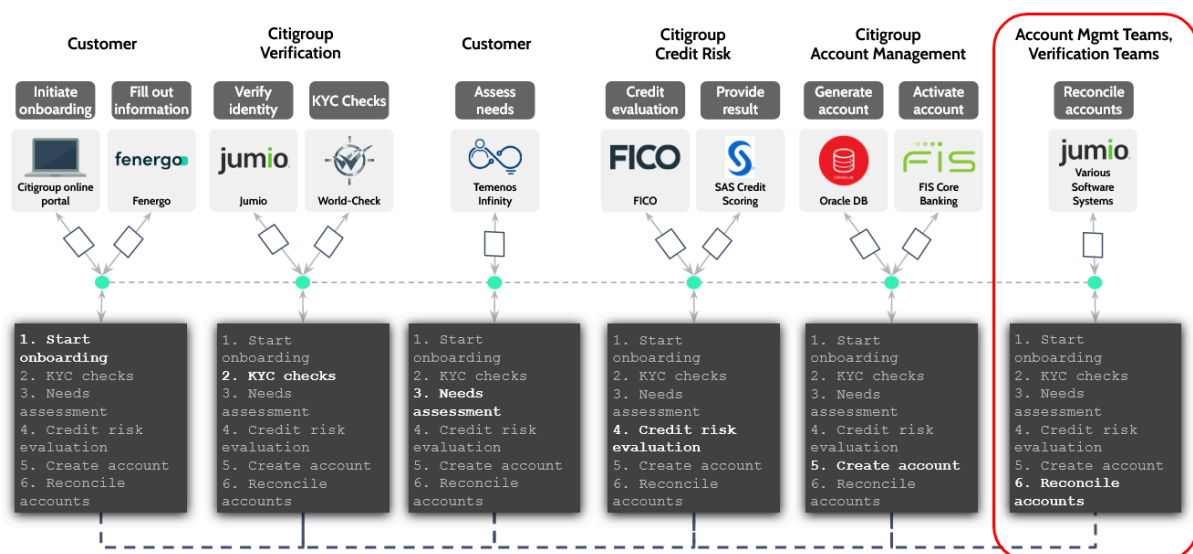

Fig 13. Overview of the Luther Platform automating the cross-border customer onboarding process.

For a more detailed view of the steps operating the Luther Platform, please view the appendix.

6. Implementation

Luther's team worked with the Citigroup team to implement the automated Cross-border Customer Onboarding Process on the platform.

First, Luther's team worked with the teams at Citigroup to map the process. View a process map here. Luther then identified all teams and all software systems involved in the operations of the process. Luther then allocated a node to each team, deployed the platform on all nodes, and connected the nodes to each of the software systems, through Luther's standard connectors. Then Luther's team worked with Citigroup developers to develop a robust common operations script for process operations. Then the application went live.

For more information please visit these links, for implementation steps, implementation in general, and sandbox.

Customer Team		Business Owner, Application Owner, Technical Lead	Day 1
Discover	Phase 1	Describe process operations	10 weeks
	Phase 2	Describe systems & technical requirements	
Process mapping		Map the process	2 weeks
Platform set-up		One-time platform set-up	1 day
Build application		Develop (code) application operations	24 weeks

Fig 14. Implementation timeline for the automated Cross-border Customer Onboarding Process.

To implement the cross-border customer onboarding process, Luther and Citigroup followed these steps:

6.1. Process mapping

Luther's team worked with multiple Citigroup teams to map the process operations. The process map includes i) functions, ii) data inputs and outputs at each step, and iii) rules and decisions at each step. Teams are operationally separate entities involved in the process. As part of process mapping, Luther identified the exact set of software systems and teams involved in operating the end-to-end process.

6.2. Identify teams and software systems

Luther's team identified the teams and participants involved in end-to-end process operations. The teams and participants are: Customer, Citigroup Verification, Citigroup Account Management, Citigroup Credit Risk, and both countries' Citigroup Data Management team.
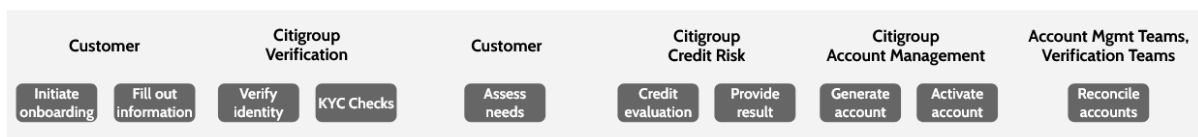
Fig 15. Luther's team worked with Citigroup to map the process including 6 teams involved in end-to-end operations.

Luther's team identified the software systems involved in end-to-end process operations. These systems are: Jumio, Email (SMTP), Oracle Database, Apache Airflow ETL, FIS Core Banking, Citigroup Online Portal, Oracle Data Integrator, Citigroup Online Platform, World-Check, Fenergo, Temenos Infinity, FICO, and SAS Credit Scoring.
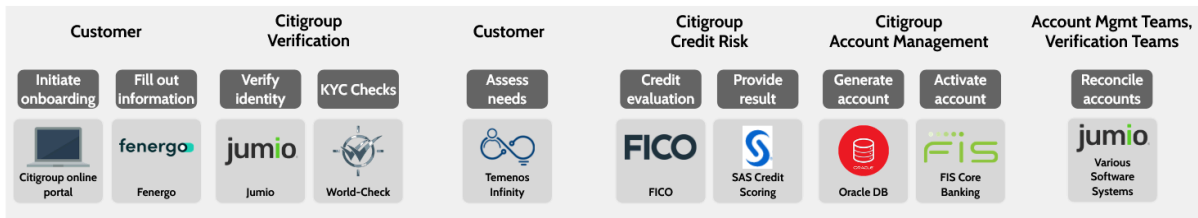
Fig 16. Luther's team identified the software systems involved in the end-to-end process operations.

6.3. Nodes and Connectivity through distributed system for end-to-end team connectivity

Luther's team assigned a dedicated node to each team involved in the process by allocating servers to their respective teams. These servers are cloud-native and can be deployed on either public or private clouds, depending on security requirements. All nodes are interconnected through a distributed system, which facilitates the sharing and validation of operational functions and data among all teams.

Fig 17. Nodes are connected via a distributed system on the Luther Platform.

6.4. Connectors to software systems
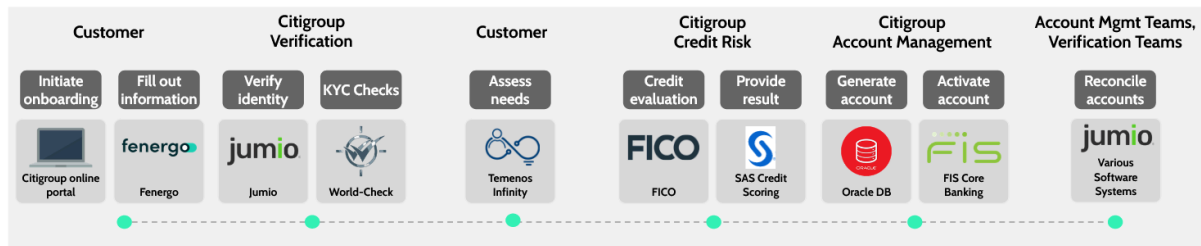
Each team has a number of software systems involved in its operations, as identified in the process map. For each team, Luther's platform connects its node to all software systems involved in its operations. Luther has a set of standard connectors across a wide range of enterprise systems, which the Luther platform deploys to rapidly connect to the systems involved in operating the process. This is done by determining the technology, type and system of the connector to connect to each system in the process.
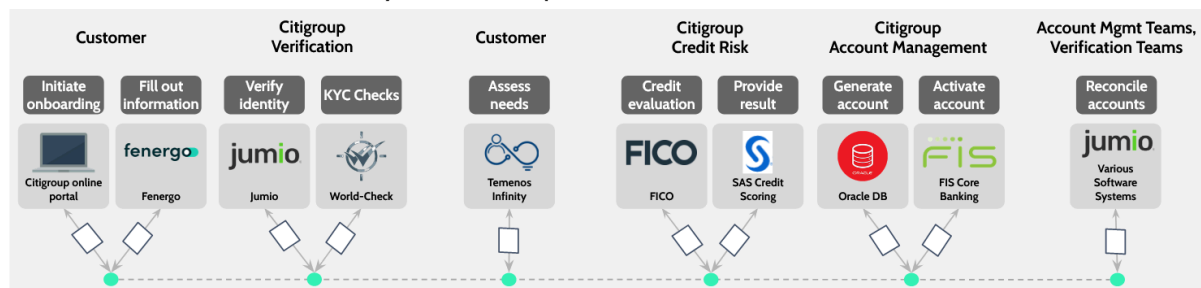
Fig 18. Luther's team set up connectors that link the processes together.

Luther, through numerous enterprise implementations has standard connectors to a majority of enterprise software systems across a range of processes and industries. For a full list of our connectors, please visit: *"Luther Platform Connectors"*.

6.5. Platform set-up

The Citigroup team selected a set of configurations for their platform specifications. This selection depends on i) the process complexity (number of tasks), ii) amount of data processed (KB) per process run, iii) number of participants, iv) reliability, availability and security requirements for the application. Based on these selections, Luther's team deployed the platform on all nodes. For more details on platform configuration specs please visit: *"Luther Platform Connectors"*.
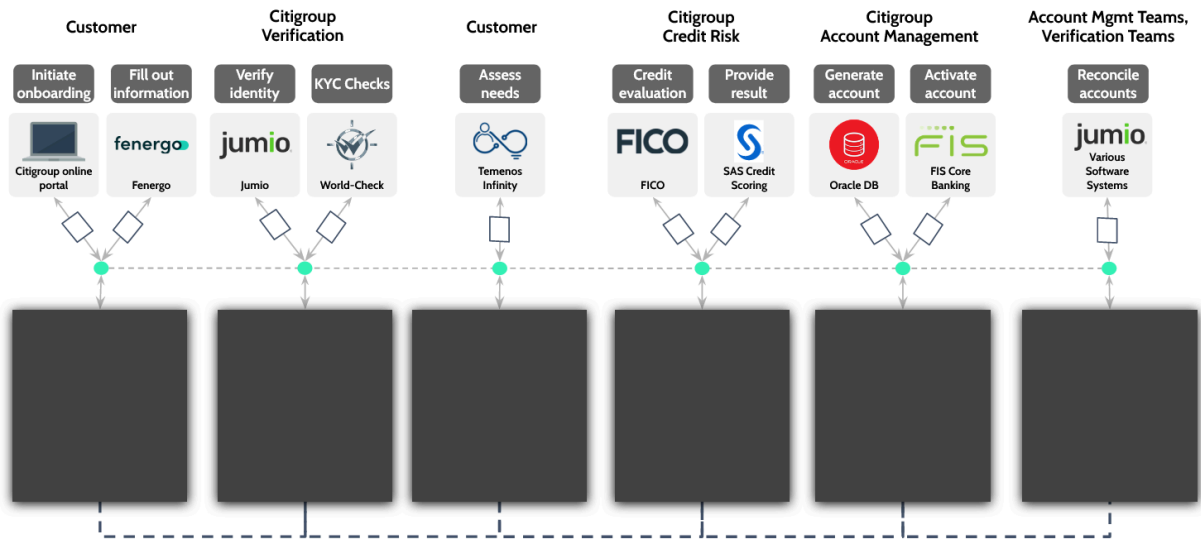
Fig 19. The platform is set up on each of the nodes, ready to reliably operate the end-to-end process at each step.

Luther's platform vertically integrates distributed system technology, optimal resource allocation and management, real-time event ordering and streaming (sharing), and deterministic event processing and execution, to provide a modern technology stack to reliably operate an end-to-end process across multiple software systems, at scale.

6.6. Common Operations Script for process operations

The platform is now fully set up and connected with all systems involved in the operation. The Citigroup development team, in collaboration with Luther, developed the Common Operations Script to manage the end-to-end process. Connectors translate data from local systems into a common data model utilized by the Common Operations Script. This script encapsulates the business logic, data, rules, and validations for each process step.

Luther's platform vertically integrates

distributed system technology
optimal resource management
real time event streaming
deterministic event execution

To make reliable end-to-end process operations possible.

The Common Operations Script effectively codes and operates the process map, executing the Operating Cycle for each system across the entire process. To operate the process end-to-end, each function performs the same cycle of steps: i) send data & information to the System, ii) receive response from the System, iii) compute & validate response, iv) share & store execution of step, v) evaluate & initiate next steps.
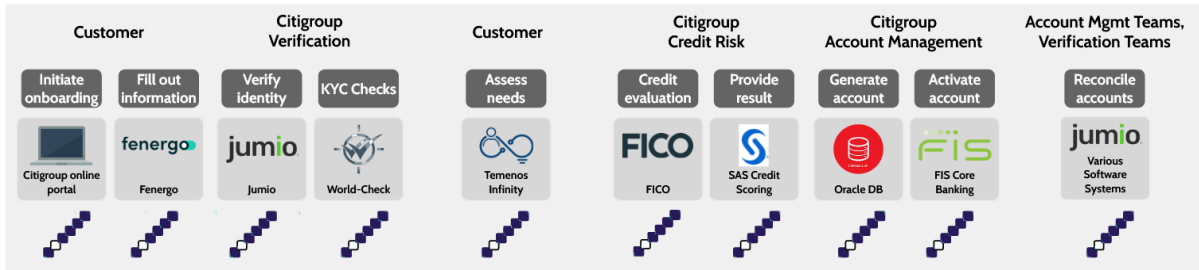
Fig 20. These requirements repeat for all functions across the end-to-end Process Operations.

For a more detailed description of how the Common Operations Script operates the Process please see the Appendix.

This script is shared by all participants and operates on the Luther Platform. Each participant can change the script through suggesting changes, once the changes to the script are approved by all participants the script is updated for all participants.

> **Teams & Systems can easily change the Common Operations Script**
>
> **They propose changes**
> **All other teams know and agree to the change upfront**
> **The Common Operations Script is updated for everyone**

The enterprise has full autonomy over the process operations to modify and change them, and it also ensures all participants are operating "the same process" at all times. When a team changes their operations, the operations for all participants are updated simultaneously. For a demo of the build process please visit our website.

> **All teams & systems involved operate the same end-to-end process all the time!**
> **The enterprise has full autonomy over its Operations & Operational changes**
>
> So, consistent changes are not an afterthought in a memo
> No need to call someone everytime you want to make a small change!

6.7. Go live (production)

Once the platform is set up and the Common Operations Script is coded, the application is ready to go live. Upon going live, it automates the operations of the end-to-end cross-border customer onboarding process by providing i) standardized connectivity between teams and systems, ii) the Common Operations Script, shared by all teams, ensures a consistent process operation at all times. For more information about Luther's platform please view this [video](#).
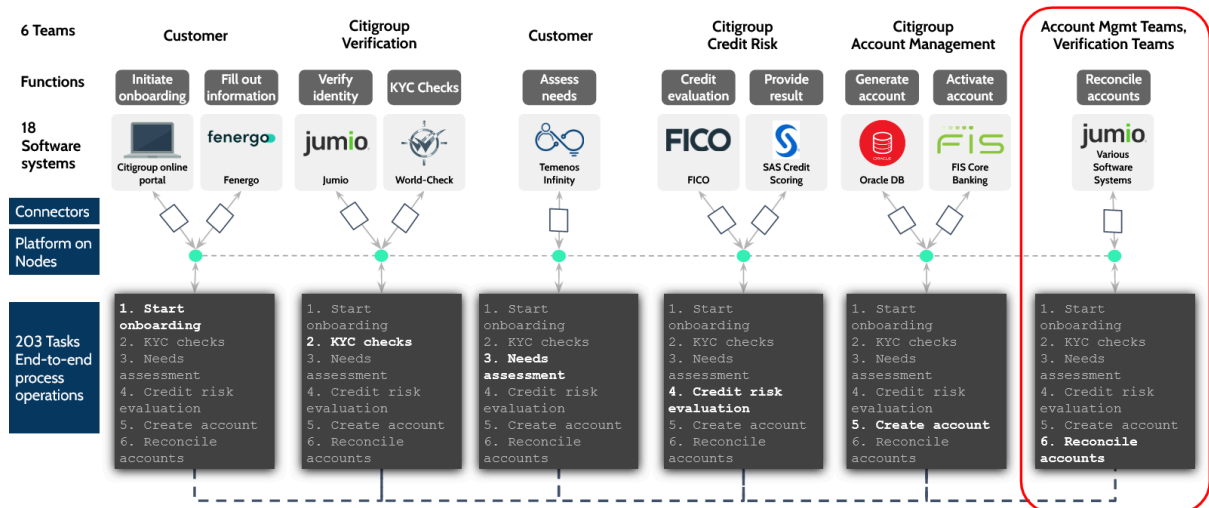
Fig 21. Luther and Citigroup developer teams work together to write the common operations script, converting tasks into an objective workflow that links every step in the process. The common operations script links independent systems into one cohesive process

7. Results

7.1. Commercial results

ROI: 12X

Cost Reduction: 40%

Average Processing Speed Increase: 2.5X

Using Luther's Deep Process Automation platform, implementing the automated Cross-border Customer Onboarding Process and the Global Customer Profile reduced the cost of the cross-border customer onboarding process by 40%. This is primarily due to FTE savings in both ops teams involved in process operations as well ops teams involved in correcting data errors, dealing with customer complaints and communicating with other Citigroup teams to solve customer data issues. Automating operations reduced errors associated with the process. The average total time for the cross-border customer onboarding process was reduced from 11.5 hours to just 4.5 hours, speeding up the average processing time by 2.5X. This results in a return on investment of 1200%.

Specific commercial advantages:

- Average total time for customer onboarding reduced from 11.5 hours to 4.5 hours
- fast processing times for customers, leading to better customer relations with cross-border customers
- Cost savings of 40%, reducing the operational costs from 131 million a year to just 80 million a year, resulting in an ROI of 1200%

Efficient onboarding process for existing customers
Increased confidence in Citigroup services
Higher cross-border usage
Decreased risk of fraud
Decreased risk of violating data regulations
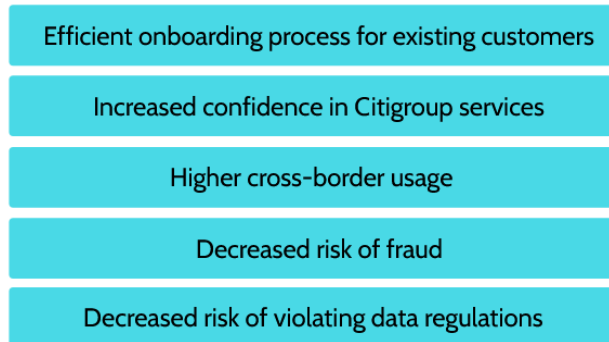
7.2. Operational benefits

Luther delivered a platform that standardizes customer onboarding, while reducing inefficiencies, improving process transparency, reducing the size of operations teams, and improving compliance, which could not have been achieved without Luther's Deep Process Automation Technology.

General operational advantages

The Luther Platform streamlines operations across enterprise processes, reducing process time and cost while maintaining transparency and flexibility.

Non-standard ops across process steps	Consistent reliable Ops across the process
Non-standard ops over time	Consistent reliable Ops over time
Lack of execution visibility: real-time status	Execution visibility: Monitor real-time status
Lack of execution visibility: need for reconciliation	Execution visibility: eliminates reconciliation
Large Ops teams	5X smaller Ops teams
Compliance violations & fees	Enforced compliance
Inconsistent and local updates	Real-time and consistent updates across all teams

Fig 22. General results from implementation of the Luther platform

Specific operational advantages

Implementing the Global Customer Profile and automated Cross-border Customer Onboarding Process has streamlined the operations of the cross-border customer onboarding process, making it more efficient, faster, and standardized all while requiring minimal manual reconciliation, and without sacrificing individual countries' data privacy. The platform is flexible and scalable to future changes to the process or data sharing/storage regulations.

Enhanced cross-border customer onboarding operations:
- Cross-border customers are more effectively onboarded by automatic customer status checks
- Countries' operational teams can make requests for data via the Luther platform more quickly and easily
- Increased process reliability and fewer processing errors eliminate costs associated with duplicate customer profiles

Enhanced customer service operations:
- Elimination of manual reconciliation means smaller operational customer service teams at Citigroup
- Standardization of the onboarding process, ensures faster timescales improving customer satisfaction and reducing operational costs for customer service teams

7.3. Technical benefits

General technical advantages

The Luther Platform makes process operations more consistent as well as standardizing the infrastructure used to operate the cross-border customer onboarding process. Real-time updates across the end-to-end process ensure less downtime in the process, improving efficiency. All this means that developer and developer operations teams can be reduced in size and that developers can focus on developing and improving process operations rather than focusing on handling inefficiencies in the process.

Inconsistent developer process	Standard developer process
Developer focus on setup and maintenance	Developers can focus exclusively on Ops
Large Dev & DevOps teams	Eliminate DevOps teams, 5X smaller Dev teams
Inconsistent and nonstandard process connectors	Standardized and consistent process connectors
Inconsistent process Ops scripts across teams	Common Operations Script across all teams
Non-standard infra., connectors, dev. env. setup	Automated infra., connectors, dev. env. setup
Inconsistent updates & patches over time	Real-time updates consistent with the rest of Ops

Fig 23. General technical results from implementation of the Luther platform.

Specific technical advantages

Improved operating efficiency:
- Automatically verifies execution to increase reliability and reduces processing errors
- Common execution visibility to all participants reduces troubleshooting effort
- Automatically supports Common Operations Script or Platform updates including new data regulations

Improved compliance and data storage:
- Single source of truth for data across organizational boundaries
- Full user control over access to data and data sharing

8. Expansion

This project demonstrates an application built on the Luther platform that introduces a Global Customer Profile for every Citigroup customer around the world, which helps to standardize and automate cross-border customer onboarding process operations. The Global Customer Profile provides a stable foundation for Citigroup operations globally, and could be used in a number of ways to streamline and automate Citigroup customer operations.

Potential areas of expansion to further automate Citigroup's operations on the Luther platform include:
- **Expand stored customer data:** Not every attribute Citigroup has about their customers were stored or shared with the Luther Platform. More attributes could be added to the database to provide a single source of truth for those attributes as well
- **Enhanced customer onboarding:** The Luther Platform for enhanced process operations could be used to further automate the customer onboarding process, taking advantage of the new Global Customer Profile

9. Luther Company & Offerings

9.1. What Luther does

Enterprises Operate Processes

A Process has multiple teams involved

Each team has a number of software systems involved

Each software system performs a function for the process

Operations for each System are:
send data & info to system: receive & validate response, share & store response, decide next step

Different teams and systems have different ways of operating

Different data formats & processing, doc handling, data validations, data storage & sharing

Different procedures, team structures, governance, compliance rules

However, the end-to-end process operates across all these teams & systems

Reliably
operating end-to-end processes across different & changing teams & systems is a big & expensive problem

There are no platforms for operating end-to-end Processes

Luther's platform operates end-to-end processes across all teams & systems and as they change over time Reliably
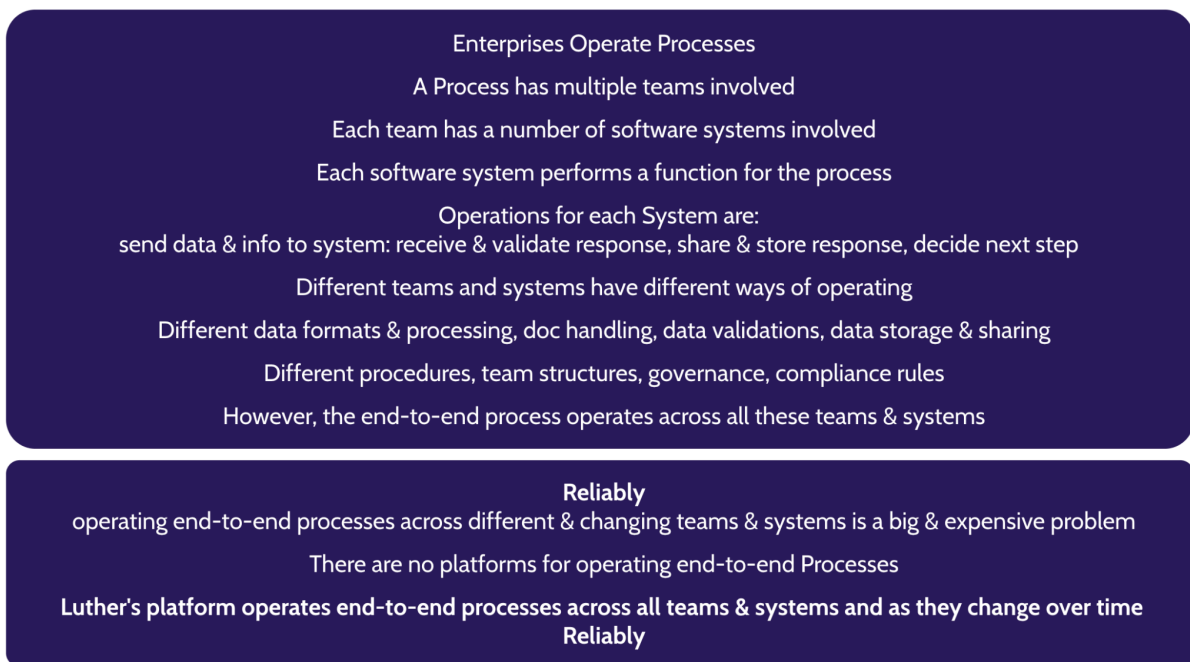
Fig 24. Luther's platform solves the complicated problem of end-to-end enterprise process operations.

For more information about Luther, please visit our [website](#).

9.2. "In a nutshell" - Luther's unique value

Luther's platform vertically integrates

distributed system technology
optimal resource allocation and management
real time event ordering and streaming (sharing)
deterministic event processing and execution

To make reliable end-to-end process operations possible.

Luther's unique value for reliable end-to-end Process Operations is providing

standard connectivity
a common operations script

across all teams and software systems.

Luther automates the operations of the end-to-end process
across multiple teams and systems

9.3. Platform implementation

To implement the Luther Platform, organizations work with Luther through an implementation process - laying out objectives and expectations for the project, then mapping the process and setting up infrastructure. After this, enterprise developers build code that will execute the agreed process.

Customer Team		Business Owner, Application Owner, Technical Lead	Day 1
Discover	Phase 1	Describe process operations	2-4 weeks
	Phase 2	Describe systems & technical requirements	
Process mapping		Map the process	1 week
Platform set-up		One-time platform set-up	1 day
Build application		Develop (code) application operations	4-8 weeks

Fig 25. Implementation timeline for an application operated on the Luther Platform..

Enterprises working with Luther fill in the details of all software systems and connectors for their processes. These documents are used to build the process map and subsequently, the application.

Item	Software System	Type	Category	Connector Technology
System 1	Oracle Database	Both	ETL	Oracle DB 21c
System 2	Oracle Data Integrator	Both	ETL	Oracle DB 21c
System 3	Jumio	Source	Identity Verification	Jumio REST API
System 4	Email (SMTP)	Both	Notifications	SMTP/IMAP
System 5	World-Check	Source	Identity Verification	LSEG WorldCheck REST API
System 6	Apache Airflow ETL	Both	ETL	Airflow Stable DAG API
System 7	FIS Core Banking	Sink	Industry Specific Connectors	FIS Code Connect
System 8	FICO	Source	Identity	Experian Connect API
System 9	SAS Credit Scoring	Source	Identity	SAS Analytics REST API
System 10	PEGA Customer Decision Hub	Source	Workflow	Google Pub/Sub
System 11	Citigroup online portal	Both	API Inputs	JSON API Gateway
System 12	Citigroup online platform	Sink	API Inputs	JSON API Gateway

Fig 26. The list of software systems involved in end-to-end Cross-border Customer Onboarding Process operations

Build Distributed Ledger

Item	Detail	Description	Input	Comments
Network	Number of organizations	These are separate IT teams that may be internal or external to one another.	6	Each participant belongs to a separate organisation.
Network	Number of peers per organisation	This determines the reliability of executing the process.	2	Each participant runs 2 peers for high availability.
Network	Number of peer cores	This is determined by the complexity of the process.	4	Each worker has 4 cores to process 10 profiles per second max throughput.
Orderer	Number of Orderers	Number of orderer service instances.	3	Spread orderers across 3 availability zones for high availability and practically 100% system uptime
Orderer	Number of orderer cores	Number of cores allotted for each orderer instance.	2	Allow enough cores to support 10 profiles per second max throughput.

Resource Management

Virtual Machines

Item	Description	Input	Comments
Number of Cores per Instance	Number of cores per instance in the cluster worker pool.	4	Ensure each peer has 2 cores for parallel event processing.
Ledger Size (GB)	Size of volumes used to store the ledger.	100	Provide enough storage for a years worth of transactions without resizing
Number of Worker Instances	Number of worker instances to utilize in the cloud region, distributed across availability zones.	6	One worker per participant

Cloud

Item	Description	Specifications	Comments
Cloud Provider Name	Cloud Service Provider that the platform is deployed into.	AWS	Deploy on AWS.
Cloud Service Account	What cloud service account will be used for deployment?	141812438321	Use existing AWS account.
AWS Role ID	Only necessary for AWS.	arn:aws:sts::343039485463:role/admin	Use role that requires MFA for InfoSec requirements
Cloud Provider Region	A cloud-specific string identifier for a geographic region.	us-east-2	Closest to customers
Cloud Provider Domain	A string identifier for a company domain	ford.luthersystemsapp.com	

Fig 27. A sample list of connectors and infrastructure, similar to one an enterprise building an application on the Luther Platform would fill out.

9.4. Results of the Luther platform for Process Operations Automation

At Luther, we recognize that enterprise processes of today are complex and challenging to automate. We provide a platform for successful process automation.

The results are incredible. Enterprises working with Luther see an average return of 10 times their investment. Time is saved everywhere, with development of process applications and automation technology sped up by 2.5 times, and processing times 7 times faster. Find out more about Luther's core platform features here.

2.5X faster development
10X less operational costs
7X faster processing time
10X ROI
1000s of compliance rules automated

9.5. Luther's platform architecture

Luther's platform vertically integrates

distributed system technology
optimal resource allocation and management
real time event ordering and streaming (sharing)
deterministic event processing and execution

To make reliable end-to-end process operations possible.

For a more detailed introduction on the Luther platform please request access to the "*Luther Deep Process Automation Primer*".
For a detailed introduction and documentation examples please see the Luther Platform site.
For more information about Luther's platform please visit luthersystems.com.

10. Appendix

10.1 How the platform operates an end-to-end process: Application walkthrough

Below is a more detailed walkthrough of the process operations, across the teams and software systems. Each step in the process follows the exact same 5 operational substeps which the Platform executes:

i) **Send:** Platform sends data & information to the System,
ii) **Receive:** Platform receives response from the System,
iii) **Validate:** Platform computes & validates the response,
iv) **Store:** Platform shares & stores execution of step,
v) **Evaluate:** Platform evaluates & initiates next steps.
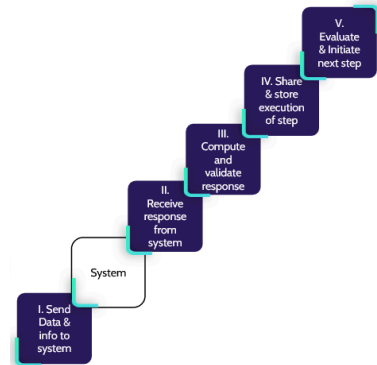
The Common Operations Script ensures that these operations cycle steps are carried out for all systems involved in the process to ensure reliable process operations.

The Platform operates the Process by standardizing the execution of each step in section 5.2. "How it Works on the Luther Platform"

The process involves 12 software systems, the systems' functions are as follows:

- Citigroup Online Portal: in Step 1 it initiates onboarding, in Step 16 it informs the customer of their linked account
- Fenergo: in Step 2 it collects and records the customers personal information
- Jumio: in Step 3 and 10 it verifies the customers' identity documents
- World-Check: in Step 4 it performs KYC checks on the customer
- Avoka Transact: in Step 5 it collects and records the customers needs and preferences
- FICO: in Step 6 it provides an initial credit assessment of the customer
- SAS Credit Scoring: in Step 7 it evaluates the initial assessment and provides a final assessment and report on the customer
- Oracle Database: in Step 8 it is used to generate a customer account, in Step 12 it is used to retrieve data from a customer database
- FIS Core Banking in Step 9 it is used to activate the customer's account
- Apache Airflow ETL: in Step 13 it is used to send customer data from one country's database to another
- Oracle Data Integrator: in Step 17 it is used to initiate the link between the customer's two accounts
- Citigroup online platform: in Step 18 it is used to create a unified login point for the cross-border customer

Step 1: Customer executes Initiate Onboarding, specifically Initiate Onboarding Process

    I.   Platform sends *onboarding initiation confirmation* (request) to Citigroup Online Portal

    II.   Platform receives *onboarding initiation confirmation* (response) from Citigroup Online Portal

    III.   Platform validates *onboarding initiation confirmation* based on predetermined rules in the Common Operations Script

    IV.   Platform shares & stores *onboarding initiation confirmation* from Citigroup Online Portal

   V.   Platform evaluates & initiates next step
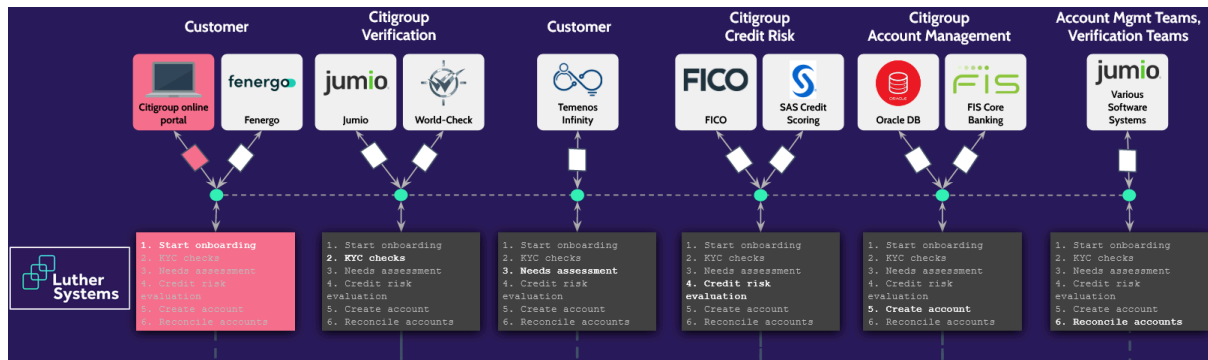
Step 2: Customer executes Initiate Onboarding, specifically Fill Out Information

    I.   Platform sends *confirm data fields* (request) to Citigroup Online Portal

    II.   Platform receives *data fields information* (response) from Citigroup Online Portal

    III.   Platform validates *data fields information* based on predetermined rules in the Common Operations Script

    IV.   Platform shares & stores *data fields information* from Citigroup Online Portal

    V.   Platform evaluates & initiates next step
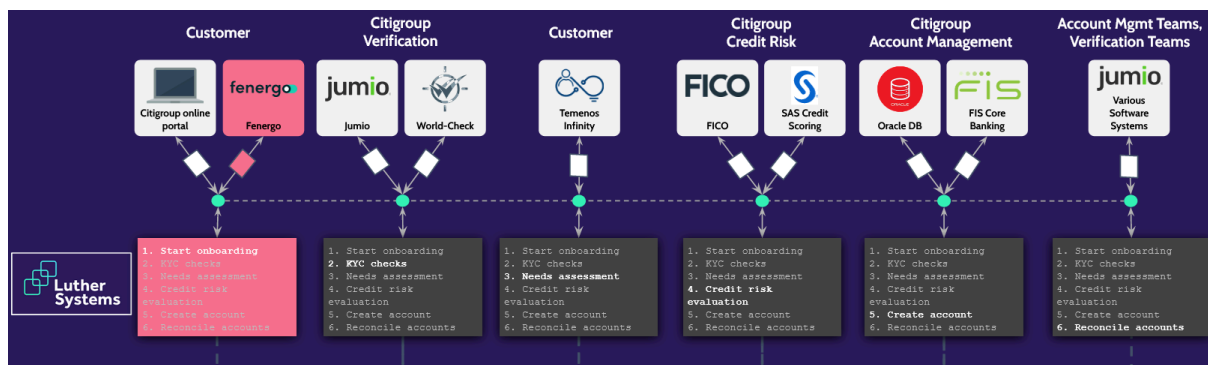
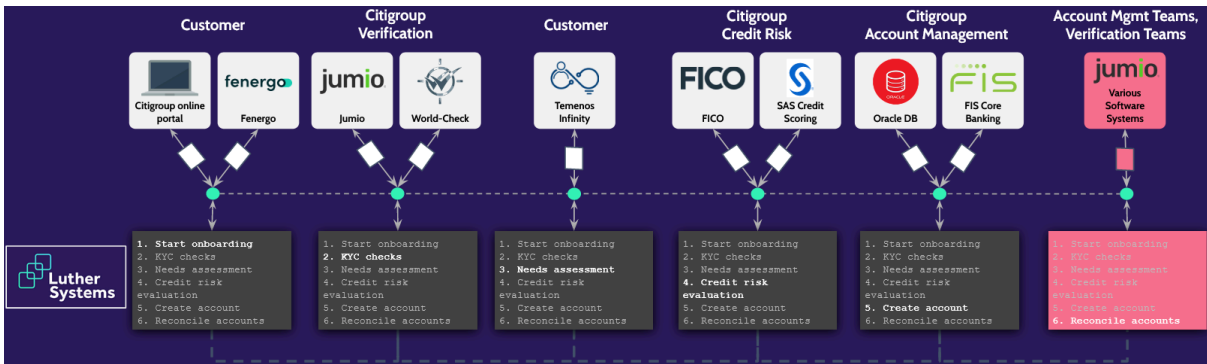Step 3: Citigroup Verification team executes Verify Identity, specifically Verify Customer Identity

    I.   Platform sends *identity verification* (request) to Jumio

    II.   Platform receives *identity verification* (response) from Jumio

    III.   Platform validates *identity verification* based on predetermined rules in the Common Operations Script

    IV.   Platform shares & stores *identity verification* from Jumio

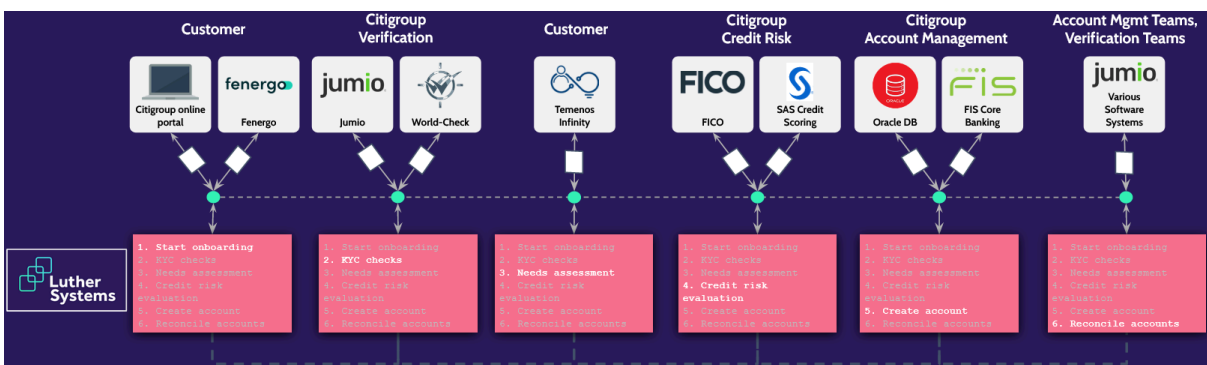   V.   Platform evaluates & initiates next step
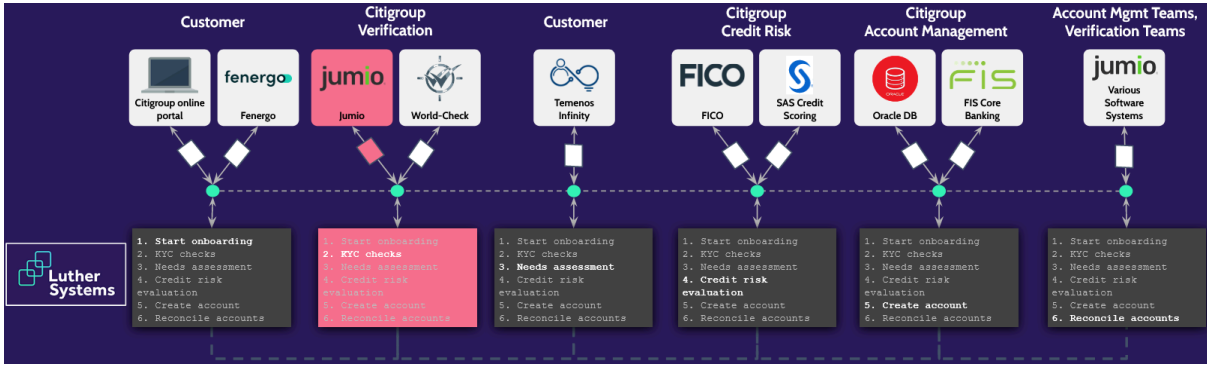
The steps operate in a similar manner until the final step is reached:

Step 10: Citigroup Data Management team executes Initiate Account Link, specifically Create Login

    I.   Platform sends *create login confirmation* (request) to Citigroup Online Platform

    II.   Platform receives *create login confirmation* (response) from Citigroup Online Platform

    III.   Platform validates *create login confirmation* based on predetermined rules in the Common Operations Script

    IV.   Platform shares & stores *create login confirmation* from Citigroup Online Platform

    V.   Platform evaluates & initiates next step

Final Step: The Platform completes the process:

43

10.2. Definitions

Term	Definition	Examples
Task	Simple events that are localized to one team involving one or two software systems	Copying data between systems, retrieving data from a database, making a payment
Workflow	A series of 10-20 tasks involving 1-2 software systems and 1-2 teams	Collecting related data from several systems, cross-checking data from different countries
Process	A series of 20+ tasks involving 3+ teams and multiple software systems	Onboarding a new customer
Value Stream	A collection of processes delivering a business critical value	Customer Relations Management
Participant	Operationally separate teams that have their own operations, governance and utilization of software systems and can make some autonomous decisions	The Customer, Citigroup Verification Team, Citigroup Account Management Team, Citigroup Credit Risk Team, Citigroup Data Management Teams for each country
Team	As broadly defined by enterprises, otherwise known as departments, groups, units, etc.	All employees in the verification team at Citigroup
Function	A unit of operations performed by a single team	Performing KYC checks
Process Operations	End-to-end completion of process operations across multiple teams and software systems, to deliver a specific business objective	The end-to-end customer onboarding process

10.3. Process Journey vs. User Journey

The Process Journey involves all the systems and teams including interactions with the users of the process, which usually interact with the process through UI systems and specifically designed Apps, with their own interfaces. However, process operations run through a much larger set of systems and teams, most of which are not visible to the user.

The User Journey is a small subset of the Process Journey. For an optimal User Journey, the whole process must operate reliably, not just the systems involved in the user journey! They must all operate correctly to operate the process end-to-end.
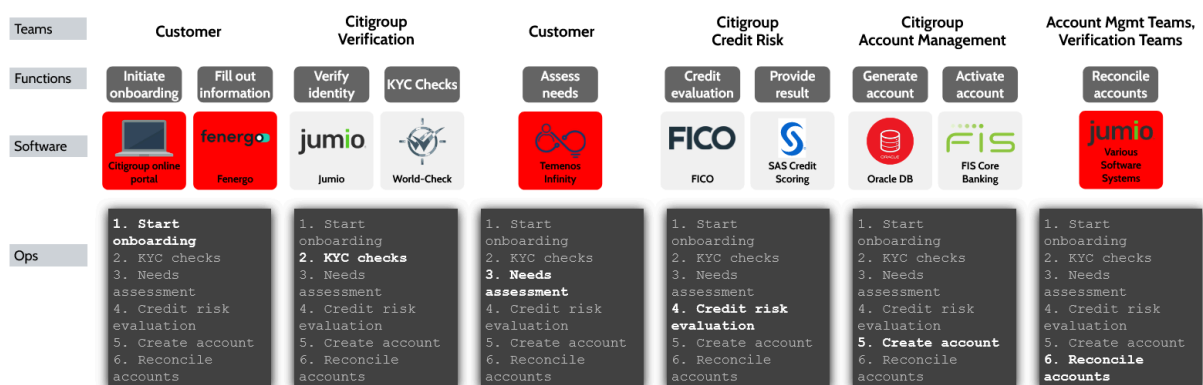

Fig 28. The process journey of the automated Customer Onboarding Process. Systems highlighted in red directly interact with or require direct interaction from the customer.

44

10.4. Plaintext Links

6. Implementation

For a walkthrough of the implementation process, view the Luther Systems Sandbox Setup:
https://app.platform.luthersystemsapp.com/sandboxSetup

For a full explanation of the implementation process, view the Full Luther Platform Setup:
http://app.platform.luthersystemsapp.com

For a more detailed description of the implementation steps please visit:
https://www.luthersystems.com/platform/platform-overview

Request access to an example of a more detailed timeline here:
https://docs.google.com/spreadsheets/d/1jHSeFRhaWVkUiEtQ_crxGoyGFJ82eGUZ3rxhnYi4cro/edit?gid=1722375828#gid=1722375828

9. Luther's Company and Offerings

For more information about Luther's platform please visit our website:
http://luthersystems.com

Find out more about Luther's core platform features here:
https://app.platform-test.luthersystemsapp.com/features

For a demo of the build process please visit our website:
https://app.platform-test.luthersystemsapp.com/build

For more information about Luther's platform please consult this video:
https://www.youtube.com/watch?v=78H5m1aZZoU

For a more detailed introduction on the Luther platform and a full explanation of traditional process operations and Luther's solution please request access to the Deep Automation Primer here:
https://docs.google.com/document/u/1/d/1O3KIQUDuwMVOe5CzjNFMYoYnq7g_7AoU_qIHLOza_Tw/edit

For a detailed introduction and documentation examples please see the Luther Platform site:
https://www.luthersystems.com/platform/platform-overview