



Decentralized Business Identity and Lending Platform

Sabhi is a business identity management and lending platform. Sabhi allows both traditional and digital asset lenders to serve the millions of Micro, Small and Medium Enterprises (MSMEs) that do not have access to finance. Sabhi assesses the financial viability of MSMEs through attestation-based identity management and the creation of a decentralized peer-to-peer and organizational vouching (“reputation staking”) network.

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Abstract

Background

Over 65 Million (40%) of Micro, Small and Medium Enterprises (MSMEs) in emerging markets do not have access to finance and allied services due to the lack of an economic identity. This accounts for a total financing gap of \$5.9 Trillion. [1]

Economic identity consists of verifiable credentials that define an entity's proof of existence, creditworthiness and position in an economic value-chain. The few proofs of economic identity that do exist in these markets are physical and do not translate easily to the digital realm. This lack of a unified identity solution locks out billions of dollars in unrealized economic value from the economy. [2]

Overview

In this whitepaper, we introduce Sabhi - a global business identity management system, combined with a protocol to assess financial viability. Sabhi addresses existing limitations in MSME financing in emerging markets, by allowing MSMEs to prove their identities in low trust environments, and linking those identities to bonafide viability records on the blockchain.

Sabhi is a standardized, programmable mobile-first ecosystem to facilitate on-demand, and secure access to credit services for MSMEs. Sabhi presents a novel approach to the viability assessment of MSMEs for investment, allowing both traditional fiat lenders and digital asset lenders to issue compliant loans. This increases competition, lowers fees and improves borrower experience, while exposing lenders and venture capitalist to a larger more viable customer base.

The Sabhi protocol presents solutions to the following problems:

1. **Inability of Emerging Market MSMEs to Prove their Business Identity:** MSMEs in developing countries lack the proper documentation and records to prove the existence and viability of their businesses. This severely curtails their access to finance from the formal sector.
 2. **Lenders Have Limited Ability to Assess MSME viability:** Borrowers in markets with less developed financial infrastructure and limited public data struggle to access credit as lenders have limited identity and business data to facilitate credit decisions.
 3. **Backward-Looking Creditworthiness Assessment:** Credit systems rely on historical debt repayment information and therefore cannot easily accommodate users who are new to credit. This is especially true for minorities, the underbanked, and the youth[3].
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Sabhi Protocol Components

There are three main systems which comprise the Sabhi protocol:

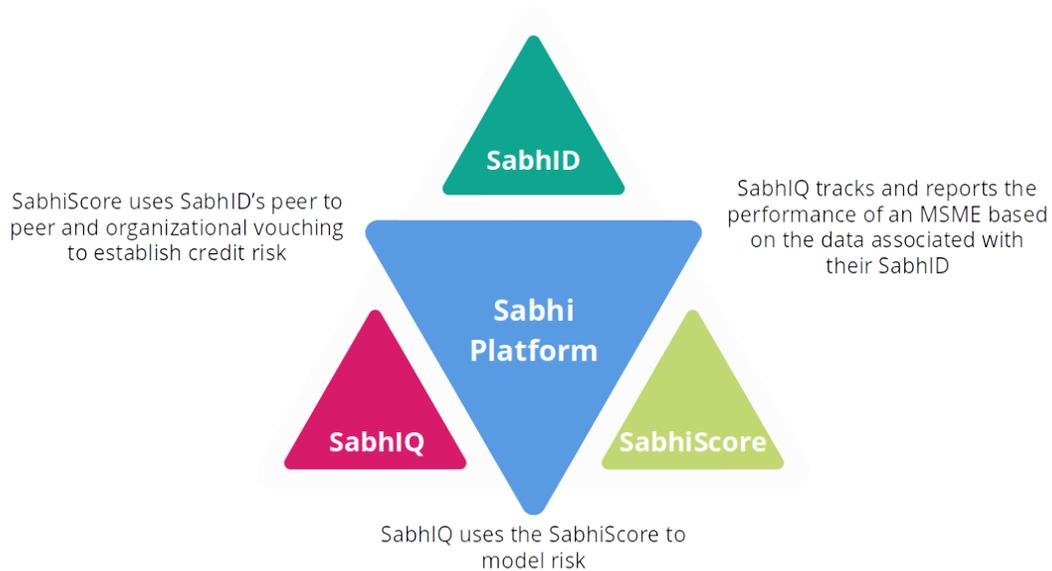
1. **SabhID (Identity Framework):** SabhID creates a global secure identity. MSME owners can publish claims about their business to this identity, and have them verified by others. Data associated with SabhIDs is controlled by the business owner and can be selectively presented to relying parties. SabhID allows lenders to receive the necessary information without forcing borrowers to expose personal information, or risk identity theft.
2. **SabhiScore (Reliability Score):** The SabhiScore is a metric of an MSMEs viability and creditworthiness. This decentralized score is based on an MSME's business network and operations.
3. **SabhIQ (Viability Oracle):** SabhIQ is a system for reporting and tracking MSME viability by combining data tied to SabhIDs with off-chain market data and analytics.

The Sabhi protocol improves the current MSME investment ecosystem by creating an inclusive MSME profile and reducing opaqueness to the formal financial sector. Sabhi's viability algorithm is also better suited for MSMEs in markets with little to no public data. This means both traditional lenders and digital asset lenders will be able to securely serve the 65 Million financially constrained MSMEs in emerging markets.

1. Sabhi Protocol Overview

Sabhi protocol facilitates broadening the efficient operation of credit markets by allowing lenders to extend credit to businesses operating in markets with underdeveloped or immature identity and credit infrastructures.

There are three components of the Sabhi protocol:



SabhID - Self-Sovereign Economic Identity

SabhID lets users establish a global identity by allowing independent third parties to publicly vouch for a user's identity information, legal status and creditworthiness. These third parties can be

- a. friends, family, vendors, business associates, or other peers who vouches for a business's identity and/or creditworthiness ("peer-to-peer staking"), or
- b. organizations who earn revenue by evaluating a user's credentials ("organizational staking").

Organizational stakers act as the main trust anchor in the Sabhi ecosystem. Organizational Stakers can either inherit their high trust from their existing reputation (existing credit bureaus, identity companies, Financial Institutions etc) or by establishing a track record of successful identity attestations on the network.

SabhiScore - Business Reliability and Credit Score

SabhiScore is a dynamic indicator of an MSMEs reliability and credit worthiness. The SabhiScore takes into account a number of factors, including the business relationships and previous credit history (or lack thereof). A detailed breakdown of the scoring mechanism is included in later sections.

By splitting the scoring mechanism into multiple phases that each take into account different data points with varying weights, SabhiScore can produce a score that is conducive to building credit from the ground up while helping creditors differentiate the credit risk of consumers in markets and communities with sparse data.

SabhiScore initially relies on peer-to-peer and organizational credit stakes as a means of bootstrapping trust and eventually transitions to primarily using a business' spending habits and credit activity as a proxy for creditworthiness. Organizational stakers with an established presence can vouch for users with strong credit under the current system allowing them to transition their existing history with these organization to the network. An important example of organizational stakers for the Sabhi network are Microfinance Institutions (MFI) who can vouch for their existing or former customers.

SabhiQ - A Viability Oracle for Reporting and Tracking MSME Performance

SabhiQ is a system for reporting and tracking the health and attractiveness for financing of businesses on the Sabhi Platform.

SabhiQ helps lenders and investors answer important questions about the MSMEs performance by combining data associated with SabhiIDs and the SabhiScore with off-chain market data and machine learning models.

It is important to note that, SabhiQ's tracking mechanism puts the user in control, requiring each instance of data release to a 3rd party to be authorized by the user. The primary goal of SabhiQ is to provide a reporting mechanism to lenders while keeping the MSME in control of their data.

2. SabhiID - Self-Sovereign Economic Identity

The foundational building block of Sabhi is a securely established and verified identity. In order for Sabhi to be the go-to platform for MSME lending each participant's identity must be adequately established.

SabhiID is the Sabhi protocol's method of both establishing a reliable identity for MSMEs as well as forming the basis of all other services for users entering the Sabhi network. Technically, SabhiIDs are a type of Decentralized Identifier (DID) that are now supported by all leading blockchain platforms.

SabhID allows organizations to attest to the identity of a Sabhi user and upload the details of the verification transaction on the blockchain for future re-use.

A user's business associates and customer can also provide attestation, while noting their relationship to the SabhID owner. This allows the Sabhi network to get a sense of the users place in a financial value-chain. In addition friends, family and peers can help an individual bootstrap creditworthiness by vouching for their ability to act responsibly with credit.

During this vouching process, a user's peers can attest to various identifying traits such as the nature of business and business address to help secure the network and provide further proof of the business identity for the user.

Organizational Identity Attestation

Private companies, like microfinance institutions, banks and telecommunication providers, currently hold the majority of identity data in emerging markets. These organizations play a critical role in helping onboard businesses onto the Sabhi system by attesting to the authenticity of SabhID holder data.

The first step in establishing a SabhID is to identify the person that has created the SabhID. In most countries this is easily accomplished by using telecommunication providers to verify the owner of the SIM of the mobile device the SabhID was generated on. This connects the SIM owner to a SabhID, which the SIM owner can then curate for their business.

All participants in the Sabhi ecosystem are identified by their unique SabhID, which is linked to their cryptographic keys. All records of a SabhID are signed by a public-private key pair, making it cryptographically secure and instantly identifiable. To curate a business profile a SabhID owner must get their basic business information verified by trust anchors on the network.

In the Sabhi ecosystem lenders can either nominate specific identity attesters whom they trust, or use the platforms web-of-trust metrics to gauge the quality of existing trust-anchors on the platform. Trust-anchors, such as MFIs, sign data with their cryptographically secure public-private key pair, making the identity of both the user and the attester instantly verifiable.

Reusable Identity Verification

By publishing all identity transactions on a blockchain registry, organizations can help take part in building a reusable identity that builds up trust over time rather than having to be re-evaluated for every transaction with a new lender. This not only saves money across the network of lenders, but it also significantly reduces on-boarding time by reducing duplicate work by anti-fraud and compliance teams across lending organizations.

Sample Organizational Identity Attestations

There are many kinds of identity attestations that can be supported by SabhID. Below is a non-exhaustive list of potential attestation types:

1. **Electronic ID Verification:** Verification of an identity data by cross-checking supplied information with a multitude of public records, private records and government records. E.g. Telecom Provider verifying a SabhID owners Name and National ID number from a governmental electronic registry.
2. **Documentary Evidence:** Verification of a document like a cash receipt or a bill of payments addressed to the user. E.g. Microfinance Bank verifying the sale of assets by a SabhID holder

Peer-to-Peer Attestation and Vouching

In the Sabhi protocol, “peer-to-peer staking” is a mechanism for representing real-world relationships between businesses with the goal of establishing both an indicator of creditworthiness and authenticity of identity. Evidence suggests that a business's creditworthiness can be reliably determined by the people and other businesses who would vouch for their creditworthiness [4]. This concept of vouching would not be a specific statement about a credit event such as “Robin’s Wedding planner vouches that Erum’s Flower Co. is likely to repay a \$10,000 loan”, but rather a general statement that Robin trusts Erum’s ability as a business woman, and her ability to be a responsible borrower.

Enabling users to vouch for (“stake”) other people they personally and professionally know, and whom they expect to be financially responsible has several benefits:

1. Facilitates access to credit for new users, that do not have formally established credit ratings.
2. Allows the Sabhi network to determine a business’s location in a value-chain network. Research suggests that a participants creditworthiness is related to their place in a value-chain. [5]
3. Increases permanence in credit scoring and ensures appropriate weighting of long-term and short-term relationships and payment habits in a business/personal network.
4. Enhances resilience to fraud by making SabhID holders responsible for who they vouch for.

Revealing Business Viability Through Relationships

By establishing bilateral stakes with trusted customers, vendors, friends and family, users reveal the type of financial network they are a part of. If a user does not have a rich credit

history of their own, the financial history of their peers can be used as a heuristic for what patterns their own repayment behavior can reasonably be expected to follow [6].

For example, if Erum stakes 2 of her vendors and 2 of her clients who have a consistent history of debt payment, then a lender can take more of a risk on Erum because she is likely to be in a healthy business value chain and behave similarly to her peers. Likewise, if Farhad stakes several business associates when he joins the Sabhi network and these associates end up making late payments and/or defaulting on loans, then a lender can mitigate their risk in dealing with Farhad by requiring a higher interest rate or requesting collateral.

In staking associates who ultimately fail to meet obligations towards their creditors, Farhad has compromised his own creditworthiness. Similarly, Farhad's associates have imposed a cost on him by failing to adequately meet their financial obligations. The network effect created by this system extends beyond enhancing accountability between creditors and debtors, but adds an additional element of accountability amongst real-world business and social networks.

If Farhad realizes that most of his peers are unlikely to behave financially responsibly, he might be more conservative with the number of peer-to-peer stakes he establishes. Staking a small number of peers might be done to deliberately hide the fact that the user does not know many people who are financially responsible, but this reduced participation in the peer-to-peer staking network will be factored into the assessment of Farhad's own creditworthiness.

These varying behaviors that produce a different number of stakes can be used as a heuristic for creditworthiness. A user who is part of a network of financially responsible participants should be able to quickly accrue bilateral stakes. Each of the users they stake is also likely to have more stakes of their own that have been acquired quickly. The expectation is that members of a riskier business grouping are more likely to add stakes slowly and be in a more sparsely connected network.

The Sabhi network combines this intuitive understanding of business relations with formal network analysis methods to determine the viability of businesses.

Managing Multiple Businesses

Many people own multiple businesses that have varying degrees of success. The Sabhi ecosystem does not disincentivize this entrepreneurial spirit. Business owner may create separate SabhIDs for the different businesses they own.

This allows users to manage and curate the Sabhi business identity for their businesses separately. Users may choose to only expose individual business SabhIDs relying parties. If lenders require more information, they can ask users to expose their personal SabhID to see the number of businesses that are connected to it.

PaymentID

Mobile payments are one of the most popular form of digital payment in emerging markets. The Sabhi network allows users to connect their mobile payment wallets with their SabhiIDs, tagging their business and personal transactions separately. This allows users to upload pre-verified cash flow information onto the Sabhi network.

Sabhi AssetID (Future)

MSMEs often lack fixed collateral that is necessary to secure financing from the formal sector. Providing structures through which movable assets in emerging markets can be effectively used as collateral will significantly improve access to finance for MSMEs. [7] One of the long term goals of Sabhi is to implement a decentralized Secured Asset and Transaction Registry, to allow MSMEs to use their movable assets as collateral.

Note: Sabhi AssetID is underdevelopment, and not part of the Sabhi Network at the moment.

Securing the Sabhi Network

In an extreme situation, a group of attackers could create SabhiIDs and have these accounts all stake each other. The attackers could then set up their own fake loan organizations and have the accounts pretend to take out and pay off loans. This process could effectively produce SabhiIDs that appear authentic with good financial history that the attackers could then use to defraud real loan originators.

This attack is prevented by allowing new organizations to only lend if they have been verified by existing trust anchors. These trust anchors are organizations and entities that will be on-boarded onto the platform during the initial pilot phase, and would effectively be the trust seed that bootstraps all following loan originators. Thus unless the attackers are willing to create and maintain a real loan company for an extended period, they are unlikely to be successful.

In addition to the practical difficulty of creating and maintaining such a company, Sabhi is also equipped with network analysis algorithms that monitor the network for suspicious activity. For example, networks of real users should contain participants from across the Sabhi ecosystem. The attackers' network will seem unusually disconnected from the rest of the network. If the attackers are successfully engaged in a loan scam it will taint the scores of many users in the attacker's network. An unusually disconnected network of users with financially responsible users that suddenly start scamming loan companies will be identifiable quickly before it can cause a meaningful amount of damage to the network.

3. SabhiScore - MSME Reliability and Credit Score

The goal of the Sabhi network is to securely expose information about financial networks and historical payments so both lenders and borrowers benefit. To this end the Sabhi network computes a SabhiScore for each business to evaluate their viability.

We can think of a user on Sabhi as being in one of three phases of account maturity as she enters the Sabhi network:

1. The user has just recently signed up and has only staked other users and businesses, none of whom are yet financially active on the network
2. The user's peers are financially active
3. The user has taken out loans or otherwise has made business and financial information available on the Sabhi network

Each successive phase corresponds to more knowledge about an MSME and raises the ceiling for how high the user's credit score can be before the user ascends to the next phase.

Note: The current version of the SabhiScore computes a score based on peer-vouching, debt obligations and payment history. We believe that as the network grows, more information will become available about the value of different types of value chain networks and will lead to a more sophisticated scoring mechanism. The wider Sabhi community, including lenders and attesting organizations will be encouraged to provide feedback to help develop the subsequent versions of the scoring mechanism.

Reliability Score

The reliability score is a creditworthiness metric strictly based on the users lending and payment behaviour. The reliability score predicts a user's likeliness to pay back a future loan. Sabhi will start with a reliability score that takes into account:

- Total amount paid vs. total amount owed
- Longest repayment history on file
- Average payment total per month
- Number of past loans
- Total amount paid across all reported information

In the initial pilot phase of the Sabhi score these factors will be combined in a simple multivariate logistic regression. It is important to note that the weights for each parameter in the reliability score will be continuously updated as more data enters the network.

Scoring Phase 1 - Brand New User with no active peers

All new SabhiIDs start with a score of 10. Users who have not staked any users with financial activity will be scored on the number of stakes they have established and how long it took them to establish those stakes. Individuals from more financially lucrative and responsible networks should be able to find more people they can stake, so they should have a higher number of stakes, and should have their initial score bootstrapped fairly quickly

New users should be able to quickly get to a score of 20 if they add eight or more stakes in two week or less. Fewer numbers or longer time to acquire stakes should reduce the number the user can reach.

Scoring Phase 2 - User with financially active peers

The peer score for a user will be the average SabhiScore of each peer the user has staked, capped at a maximum of 50. In the equation below, s is the number of peers the user has stake, and $SS(u_i)$ is the SabhiScore score of peer i

$$\min(50, \sum_{i=0}^s \frac{SS(u_i)}{s})$$

Scoring Phase 3

In the final phase of account maturity, the user has her own financial activity as well as financially active peers. Their SabhiScore is now uncapped. To maintain a SabhiScore that is granular and represents individual payments the weight of each payment a user makes is weighted equally to the SabhiScore of one of their stakes.

In the equation P and T correspond to “paid” and “total owed”. Individual payments are accounted for by the amount owed over a payment cycle. For example P_2 means the second payment the user has ever paid, on the amount T_2 owed on the payment due date.

$$\sum_{i=0}^s \frac{SS(u_i)}{s} + \sum_{j=0}^n \frac{P_j/T_j}{s+n}$$

4. SabhiIQ - Viability Oracle

SabhiIQ is the Sabhi networks reporting and tracking system. SabhiIQ functions as a decentralized oracle, that combines data associated with SabhiIDs with off-chain market data and machine learning models to present a comprehensive view of an MSME. SabhiIQ is designed to bring the wealth of pre-existing and comprehensive credit history to the blockchain while maintaining privacy for the user by introducing a user approval-based system of information dissemination.

Data about an individual's ability to pay past debts remains an important part of determining credit risk. SabhIQ combines this data with information about a user's place in her value network and the expected worth of the value chain from off-chain resources to present a holistic view of the MSME. Combining the traditional credit data metrics with data about the MSME's value chain is important in emerging markets, that often do not have well developed credit reporting systems. SabhIQ allows lenders to get insight into an MSME's business context and allows venture capital to flow into the market.

SabhIQ Algorithm

The SabhIQ machine learning model that combines on-chain and off-chain data is underdevelopment. This section will be updated in subsequent drafts.

Fair Reporting by Default

Sabhi's self-sovereign identity model puts loan recipients at the center of all transactions involving their private information and credit history. Users can review the information before sharing it with the company performing the verification. In the event that information is incorrect, the user can work with the original data vendor to amend records. This workflow promotes proactive correction of information before it impacts a user's SabhiScore. Sharing data with lenders through SabhIQ authorizes the network to update the user's reliability score. Unlike traditional credit systems, users can catch mistakes before they impact their creditworthiness.

When a loan has matured, the loan provider is expected to consolidate any off-chain loan payment data and publish it to the blockchain encrypted to the recipient's SabhID.

5. Loan Cycle Example

Putting these concepts together, below is a simplified example of the risk assessment and lending lifecycle. The required attestors and credit stakers could be customized to fit the location and demographic that is being evaluated.

Erum's Flower Co. Loan Process

Erum is a successful business woman running a flower decoration business. She is an existing user on the platform and is now looking to apply for a loan to expand her business. Her business's identity and operations have already been attested by a reputable Microfinance Institution that issued her a loan when she was starting her business. She also has bilateral stakings with a number of her business associates on the network.

Step 1: MSME applies for a loan, exposing the basic information to Loan providers.

Erum submits a request for a loan on the network, authorizing the lenders to have access to her basic SabhiID information. The lenders can immediately see Erum's:

1. SabhiScore: a metric representing her current standing on the platform
2. Reliability score: a metric gauging her credit repayment history.
3. Peer score: a metric to determine the average reliability score of her peers.
4. Business Information: the type of business, business name and location.
5. Number of loans taken out in the past, both those that were taken on the network as well as off-network loans whose data has been attested by the MFI and uploaded.

Data that the lenders cannot see with basic access:

1. Erum's past loan information (total loaned, payment amounts, etc)
2. Her peer's transaction history
3. The approximate value of her value chain.

If Erum has enough past loans and still has a very high SabhiScore lenders may opt to issue the loan without further checks.

Step 2: Loan originator creates contract detailing the amount of the loan, the repayment schedule, and the specifics of any additional information requirements for the risk assessment

If a loan provider wants more information than that provided by the basic access, they can send Erum a request detailing the information needed.

The zero-knowledge design of the Sabhi network allows for the lender to check if the information needed, like cash-flow records, are attached to her SabhiID, without seeing the actual data.

In the case that data is not currently associated with SabhiID, the loan provider can ask Erum to upload that information and get it attested by an organization of their choosing ("Verification Co.").

Step 3: User reviews and agrees to the contract and disclosure of additional information.

If the requested data is associated with Erum's SabhiID, she can immediately decide to expose that information to the lender.

If the data is currently not part of the network, Erum needs to get the desired information attested by the Verification Co.

Step 4: External information attester (Verification Co.) agrees to verify based on loan originator's requirements, and details their fee to the user.

Erum can then follow the normal attestation procedure to have the data verified and attested. In some cases, a third party ("Data Co"), such as a utility company, might control this information, and Erum will have to request this party to release the data which she can then have verified by the Verification Co.

Erum has final say over all requests. If she chooses not to disclose the information her loan request with the specific provider will be terminated without cost to any parties involved.

Step 5: The verifier, checks and uploads the data to the users SabhID

Erum now has new verified data associated with their SabhID and can expose it to the Loan Originator.

Step 6: The SabhIQ recalculates the users scores and exposes all the new information to the loan originator.

Erum exposes the new data to the Loan Originator through the SabhIQ. SabhIQ recalculates the user's scores and exposes the new score and information.

Step 7: If the loan originator thinks all requirements are met, borrower can withdraw credited funds

Note: the role of the Verification Co. can be replaced by a Risk Attester. Risk Attesters function like guarantors on the network. They can vouch for the borrower, and receive a certain percentage fee of the loan. In cases where the borrower may default, the Risk Attester must pay the loan originator an amount equivalent to their stake.

6. Sabhi Tools

Mobile App

The Sabhi mobile app is the main MSME facing part of the Sabhi Platform. The Sabhi App allows users to

- Manage their Identity
 - Create and store their identity credentials
 - Send and Receive Credentials
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- Create SabhIDs for their businesses
 - Manage their Profile
 - Send and Receive Stakes
 - Monitor their SabhiScore
 - Manage their password and login details
 - Connect External Data Sources such as Telecom Wallets, Utility Bills etc.
 - Monitor and Manage loans.
 - Review Terms
 - Get payment details

Web Dashboard

The Sabhi Dashboard is a secure web dashboard for organizational verifiers

The Web Dashboard allows Verifiers to:

- Manage the verification process
 - Receive Verification Requests
 - Verify Credentials
 - Connect with existing data management systems
 - Connect to external data sources
- Manage Verification accounts
 - Create new delegate verifiers
 - Manage Passwords and Login details
 - Revoke delegate privileges

Protocol

The Sabhi network is being built on the open-source verifiable credentials specifications. The Sabhi protocol will specify the data format for credential exchange. Participants on the network will be able to define their own templates for different credential types.

In the long run, we foresee the development of lending marketplaces. Intermediate Verifiers (IVs), such as market lenders will set up services, where they curate profiles of MSMEs in

different verticals. IVs will compensate MSMEs for providing credentials, and in turn lending parties would pay IVs for access to curated profiles. We see IVs becoming the developers of templates, enabled by the basic Sabhi protocol.

7. Roadmap

Phase 1: Development of a socio-economically relevant mobile app

In Phase 1 we will be developing a user facing mobile application in collaboration with Microfinance Institutions. The objective of Phase 1 is to make the app fit in the workflow and lives of MFI customers.

Phase 2: Sabhi Pilot

Phase 2 will be the Pilot program run in conjunction with microfinance institutions in Pakistan. We will be targeting current and former customers of the MFIs. Users will be able to use the Sabhi app to leverage their identity to secure financing. Financial Institutions that already have relationships with MFIs will be used as the loan originators. In this phase, organizational vouching will be by MFIs and their partners.

One of the objectives of Phase 2 is to obtain real world data to fine tune the SabhiQ algorithms.

Phase 3: Launch Sabhi Invite Only Beta

In this phase Sabhi will be launched as a closed Beta for both organizations as well as users. The users from the Pilot will be allowed to invite a certain number of peers to join the network. Organizations will be invited by existing trust anchors, and by the Sabhi Management team.

Phase 4: Launch Sabhi

Phase 4 is the public launch of Sabhi, with active marketing. Anyone with a smartphone will be able to join Sabhi and become part of the borrowing and lending cycle.

Phase 5: Launch of Sabhi API

One of the long term goals of Sabhi is to become the go to identity platform for MSMEs around the world. In Phase 5, the Sabhi API will be released, that allows developers to onboard businesses onto their digital platforms using SabhiIDs.

Phase 6: Decentralized Autonomous Infrastructure

As the network grows and matures the one size fits all approach will not work in every location. In Phase 6 stakeholders will be able to propose different scoring mechanisms and protocols,

that the wider community can then use. The objective is to allow Sabhi to function as the go to platform for different types of fundraising and venture capital activities.

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