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Blockchain For Trustful Collaborations Between Immigrants, Citizens And Governments

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BLOCKCHAIN FOR TRUSTFUL COLLABORATIONS BETWEEN

IMMIGRANTS, CITIZENS AND GOVERNMENTS

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Thesis submitted to the LANE DEPARTMENT OF COMPUTER SCIENCE AND ELECTRICAL

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in

Computer Science

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LANE DEPARTMENT OF COMPUTER SCIENCE AND ELECTRICAL ENGINEERING

Morgantown, West Virginia

2018

Abstract

Blockchain for Trustful Collaborations between Immigrants, citizens and Governments

by Chun-Wei Chiang

Immigrants usually are pro-social towards their hometowns and try to improve them. However, the lack of trust in their government can drive immigrants to work individually. As a result, their pro-social activities are usually limited in impact and scope. Although blockchain technology have the potential to solve the trust issue, people are not familiar with the technology and they have no idea why it is trustworthy. Previous research showed that the adopting user interface properly can increase people's trust in technology.

This paper studies the interface factors that ease collaborations between immigrants and their home governments. We specifically focus on Mexican immigrants in the US who want to improve their rural communities. We identify that for Mexican immigrants having clear workflows of how their money flows and a sense of control over this workflow is important for collaborating with their government. Based on these findings, we create a blockchain based system for building trust between governments and immigrants by: (1) decentralizing the power of the government and giving more agency to citizens; (2) fighting corruption; and (3) enhancing fiscal transparency in community development projects. We finish by discussing design implications of our work and future directions.

To my parents

Acknowledgments

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Introduction

Immigrants are people who leave their hometown and settle down in another country to pursue better lives [1]. One of the largest corridors of human immigration is between Mexico and the US. Before 2013, at least 13 million Mexican immigrants had moved to the US [2]. Immigrants send money back home in the form of remittances, not only to assist their families but also to sponsor community development in their mother countries [3]. For decades, Mexican immigrants contributed their knowledge [4] or wealth [5], [6] and constructed various projects that benefited their native communities. These donations from Mexican immigrants are especially meaningful to small towns, as their total value can amount to seven times the local government's budget [4].

Despite their good intentions, most of these efforts usually have low impact and are executed on a small scale [4]. The main reason for this result is: immigrants are averse to collaboration with the government; preferring to supervise and complete projects independently [7]. Without the help of well-established institutions, it becomes much harder for citizens to lift an effort off the ground and create large-scale change.

Previous research explored how open models fought corruption within government structures and increased citizens' trust in these institutions [8], [9]. The idea behind these transparent governments is: their honesty will (in the long run) encourage partnerships between citizens and the state. Open government models focus on: presenting how the underlying administrative procedures of the government work to citizens, provide complaint mechanisms [10] , and allow citizens to maintain and review public records without interference from corrupt officials [9]. Some open government models also leverage social media to supervise officials [11].

These models depend heavily on strong audit entities [10] because adopting open governments also means increasing the workload of watchdog groups [10], which is not always viable. These approaches also assume the auditors employed are not corrupt, and citizens trust them. To promote collaborations between governments and citizens, it is important to consider solutions that do not necessitate heavy personnel overhead, or assume trust in human auditors.

In this thesis, we introduce **C**itizen and **I**mmigrants **V**erifiable **I**ncorruptible **C**ollaborative platform with **Go**vernments, or CivicGov for short. CivicGov is a decentralized platform that uses blockchain technology to assist immigrants, local citizens, and governments cooperate; without requiring individual, human managers. CivicGov integrates blockchain technology to systematically help fight corruption by enhancing fiscal transparency. Increasing accountability of all government financial transactions builds citizens' trust in these institutions. CivicGov blockchain technology algorithmically enforces the agreements between governments and citizens. This helps citizens by removing the necessity for faith in human officials' audit abilities or motives. It also lessens the burden on internal accounting departments that would otherwise need to invest resources to supervise projects. Being decentralized also reduces the power that governments have at any point in time by distributing the influence over projects. This strengthens the citizen-government alliance, as citizens feel empowered through participation.

Although the blockchain technology have the potential to solve the trust issue between citizens and government, whether citizens trust with technology is still an issue have to be solved before building the system. In this thesis, we investigate the interface factors, especially those that are known to be important in Latin America [12], that can motivate or hinder Mexican immigrants to contribute their finances and collaborate with the Mexican government to aid their hometowns.

We then use the findings of our study to design CivicGov a system that helps immigrants, NGOs, and local governments to cooperate with each other for community prosperity, by: giving citizens more agency over the finances they donate; fighting corruption; and enhancing fiscal transparency in community development projects. We finish by discussing design implication of our research.

Related Work

Blockchain and Smart Contract

Each online trading requires a mediator to guarantee both seller and buyer cannot cheat, but the mediator could also not be trustworthy. To solve the problem, Satoshi Nakamoto [13] proposed blockchain as a peer to peer electronic cash system that allows everyone on the blockchain, called node, network verity the transactions between people. To implement the system, blockchain technology allows each nodes have its own record of the whole blockchain network [14]. When a new transaction (block) created, each node has to compare whether the transaction data from the sender is same as their own record.

However, it produced another problem about double spending. Double spending would cause a same single digital token can be spent more than once. To avoid double spending, each block has the cryptographic hash code of previous block. The verified processes, called mining, in different blockchain are different. Yet, there would create "uncle block" when two miners verified the same transaction at the same time. To avoid the "uncle block" problem, the miners have to solve a difficult math problem after they verified transaction. Only if they solve the math problem, they can broadcast the verify result to the whole blockchain network. Researcher can create a decentralize database system through blockchain technology.

User Adoption to Mobile Money

Mobile money is a service (e.g., Bitcoin [13], PayPal [15], M-Pesa [16], Venmo) that allows users to access and transfer funds via mobile devices. There is a large body of research that has investigated how people adopt e-banking. Much of this paper concludes that security, user-

friendliness, convenience, [17]–[19] and trust [20], [21] affect user adoption of e-banking. However, the customers of mobile cash system are considerably different from the customers of E-banking services. E-banking services are viewed as an add-on that banks provide as an alternative channel for existing bank customers, while mobile money normally focuses on people who are not bank customers per se. Mobile money gives financial inclusion for the lower segment who cannot afford banks or have been excluded by banks because of their bad credit score or other reasons.

There has also been research covering how social networks affect user adoption of mobile money [22]–[25]. This research reveals that social networks can greatly enhance the user experience in mobile money tools. For example, if a person's friends also use mobile money, the person is likely to also adopt such services. However, such studies have not researched how integrating an online social network into the design of the mobile money application actively changes the adoption of the system. This paper helps provide a more detailed understanding about how integrating social networks into a mobile money application affects the adoption of such technology.

Investigating Interface Factors for Facilitating Government-Immigrant Collaboration

Here we investigate how technology could ease collaborations between immigrants and governments. We consider that immigrants have access to mobile phones, and could potentially use these devices to collaborate with their governments to help their hometowns. Previous work showed that individuals trust can be affected by the user interface [26]. We believe that such collaborations could especially be enabled with mobile interfaces that facilitated trust building. We focused first on defining the design space for mobile money, and then investigated how people in Latin America perceive the different mobile money designs within this design space. We examined how different interface factors influence people's acceptance of mobile money applications, i.e., interfaces that allow immigrants to transfer their wealth via mobile devices to their hometown. For this purpose, we allow people to use different mobile money applications, and we then interview and survey their perceptions of such applications. We especially investigate the mobile money interface factors that facilitate trust-building.

Identifying Interface Features of Mobile Money Apps

We inspected 27 mobile money applications - Abra, Android Pay, Apple Pay, Azimo, Bank of America, Bitpesa, Bitsparks, Mobi, CirclePay, Coinapult, Coinbase, coins.ph, Facebook Messenger payment, MoneyGram, Paypal, Transferwise, Venmo, Western Union, Xoom, Zelle, Popmoney, Snapcash, Squarecash, Payfriendz, Nooch, Payza, and Gmail payment (on Google play or iTunes Store). We studied the different features of each of these mobile money applications and categorized them manually into three (3) main clusters which define our design space. In the following, we present and discuss the main features we found differentiated each mobile money application.

Feature I: Connection to Users' Social Networks

One of the main features that differentiated mobile money applications was whether they connected to social media content or social content stored on mobile devices (e.g., friend lists). Connecting to social media includes being able to sign up with particular social media platforms, such as Facebook or Twitter, and interact with the friend lists from these social media services. Mobile money applications with connections to social media usually have users create their accounts using data from different social media services. The social media service provides basic information to the mobile money application such as the user's name, phone number, and email address, reducing the time that the user has to invest in signing up. In this case, the mobile money application can also access its users' phone contacts and friends lists on different social media platforms. This interface feature allows users to send money directly to their friends; users no longer have to write down complex details about their contacts before sending them money. This type of feature also lets people visualize how their friends and family make use of the mobile money application. In our examination, we studied how viewing the mobile money transactions of friends from different social media platforms and being able to interact with them on the system directly correlates with the trust a person has for the mobile money application.

Feature II: Instant messaging service

Instant messaging service is a real-time exchange of text, images, video, and voice over an online chat service [27]. In the case of mobile money applications, the integration of an instant messaging service enables people to chat in real-time with other users of the application, especially their contacts. Such feature might help people in maintaining and developing relationships within the mobile money application [28].

Feature III: In-app sharing

In-app sharing is about enabling people to share their experience with the mobile money application with other users of the system. Usually, the sharing can be published to all the other users in the application or just specific users. Underwood, Robert, et al. [29] commented that sharing experiences among customers can help build brand identity and elicit strong, effective ties to the firm. In this case, we studied how this feature can help people in Latin America to develop more trust for mobile money applications.

Feature IV: Friend-inviting program

To attract new customers, some mobile money applications have a referral system. Previous research also found that the friend and social network would affect the intention of using mobile money [24]. Friend inviting or referral is a program that allows people to get digital rewards as they interact with other individuals on the platform; this can include inviting new people onto the application. For instance, PayPal users can get \$5 when they invite a friend who has never used PayPal before.

Design Space of Mobile Money Apps (Clusters)

Based on these different features, we clustered mobile money applications into three primary interface models: individual interfaces, contacts-based interfaces, and social-networked interfaces. Table 1 provides an overview of each cluster with the interface features associated with each one.

Table 1. Overview of each cluster and the features they present. Columns represent the features (I: connection to Users' Social Networks, II: Instant Messaging Service, III: In-app Sharing, IV: Friend-Inviting Program). Row is the cluster. ✓ means the cluster has that particular feature.

	I (Social Networking)	II (Messaging)	III (In-app Sharing)	IV (Friend-Invitation)
Cluster A: Individual Interface				
Cluster B: Friends-based Interface	✓			✓
Cluster C: Chat-based interface	✓	✓	✓	✓
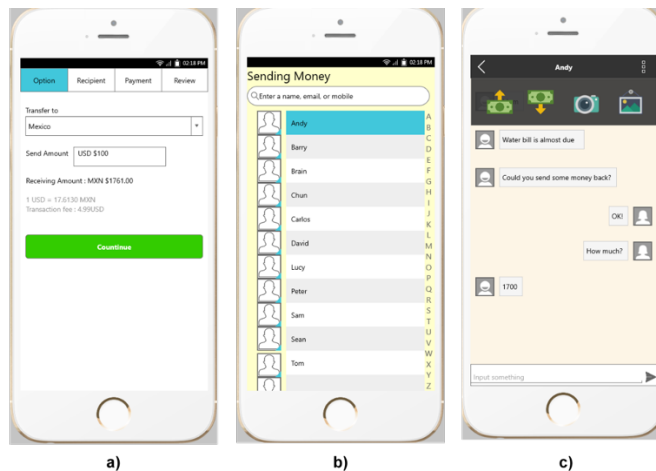
Figure 1. Overview of the different interface probes we presented to participants. Each of the interfaces represents designs from one of

the clusters we identified previously. Figure a) the Individual
Interface Model; b) the Friend-based Interface Mode

Cluster A: Individual interface

Individual interface applications are the basic type of mobile money applications

(Figure1a). They do not connect to the social network of the user; however, they provide the

simplest user interface and present the workflow clearly (i.e., they showcase how money is being

transferred from one point to the next). The user, in this case, needs to provide the basic

information of the recipient, including name, bank account, and phone number (depending on

whether they want the person to be notified of the money transaction). Individual interface models

show less concern about the relationship between the sender and the recipient. Notice, however,

that this does not mean that the mobile money application does not care about their users; they

build their brand identity and customer loyalty in other ways.

Cluster B: Friends-based Interfaces

Friends-based (Figure1b) interface employs the friend's list on a social-network service,

such as Facebook or Google, or the phone contacts on sender's mobile phone to get the necessary

information of the recipient, but does not include any instant messaging function. When users sign

up, they can choose to sign up directly or with a social media service. The interface can store the

user's friends and contacts list. If the user sends money to his or her friends, but the friends have

not signed up for the application, the application will send the money to a pseudo-account and ask

their friends to sign up to get the money. There are several advantages to this type of interface.

First, it can reduce human error, such as typing errors or spelling mistakes, as the mobile money

application gets the basic information directly from the contacts or friend list. Second, it invites

people who have never used the application. Baker, et al. [30] observed that user would be more active and stay longer in a network when they are invited by people with the same social identity. We assumed applications that adopt friends-based interface may produce more high-loyalty users.

Cluster C: Chat-based interfaces

The main characteristic of chat-based interfaces (Figure1c) is that they give the user the ability to send instant messages to others users on the platform. There are two types of chat-based interface applications. The first one bootstramps on existing social media platforms to allow people to easily send messages to their social media contacts, such is the case of Snapcash in Snapchat. The other type of applications also connects to social media, but they create their own virtual communities. For example, Venmo allows its users to communicate with each other and even share their mobile money transaction as public messages. WeChat payment [31], has had a great success in China. However, we lack an understanding of how these chat-based interfaces interplay in developing countries. Previous work has shown that sharing messages about one's experiences using the mobile money application may inspire other users to utilize the application more [32]. The chat-based interface also provides other benefits. After senders remit the money to the recipients, they can check the transaction correctness on the application without another channel. For instance, a farmer in the United State can remit $200 to his family in Mexico. He can directly ask his family to send him an instant message once they receive the money. The family therefore does not need to call him back or use a Short-Message-Service, which might be missed, to inform him.

Evaluation

We investigated the perceptions that people from Latin America had about each of these different interfaces via interviews and a survey.

Participants

We recruited a stratified sample based on their habit of using online banking (14% of Mexicans use traditional banking service and 78% of Mexican use online banking or both traditional and online banking service [33]) from a street-intercept survey done during large scale events in Latin America. These events gathered people from all over Latin America (Mexico, Argentina, Brazil, Colombia, among other countries). The total sample size is 88 mobile phone users, with 16 of them not having experience on operating remittance service on the internet and 62 of them having experience on online banking system. Their age ranged between 18 and 40 years (M = 24.13, SD = 4.80, Median = 22.92); 29.5% of the participants were female and 70.5% were male. 38.6% of participants have more than 6 years of experience in using mobile phones, 46.6% of participants had between 4-6 years of experience in using mobile phones, and 14.8% of participants reported to have less than three experience using mobile phones.

Our participants had varying degrees of experience with using mobile money and international remittance services. We questioned them about international remittance services, as this is one of the main uses that people in Latin America have for mobile money. Our participants presented 3 types of experiences with mobile money: (1) those that never used mobile financial services or international remittances (Newcomers of the Payment Market), (2) those that never used mobile financial services but used international remittance services (International Remittance

Savvy), and (3) those with experience using mobile financial services (Mobile Financial Services Experts). 13 of our subjects were in the first category, 41 were in the second, and 33 were in the third.

Survey and Interviews

Our survey had two main parts: (1) questioning people about their experiences with different mobile money applications and their perceptions of different features of mobile money applications, and (2) having people directly use different types of mobile money applications based on our clusters and questioning people about their perceptions of such interfaces. We interviewed people about their perceptions and impressions of each interface.

The first part of our survey was about collecting information about participants' background knowledge of mobile money. The survey asked a series of questions related to their experience, such as how frequently they send money or received money from abroad, and the frequency with which they utilized mobile applications to transfer money to other individuals. The survey also questioned participants about their habits of transferring money and how much they trusted each money transfer channel. Lastly, we asked participants several sequential questions about their thoughts on different interface features.

In the second part of the survey we had participants use 3 different mobile money applications (one from each of the clusters). After participants used the interfaces we asked them to compare the three interfaces and evaluate which model gave them more confidence and which interface they felt they would use the most. We counterbalanced the order in which we showcased each interface to participants. After participants finished the survey, we interviewed them. The

interview questions dug deeper into how people perceived and trusted each mobile money application. Notice that for all interfaces we asked participants about specific interface factors that previous work had identified were important for user adoption of the money application [26], [34], [35]. We were interested in studying how such factors played out in people's perceptions in Latin America.

All the opinions that measure the user adoption were reported on a five-point Likert scale, where 5 is very important and 1 is not important. We view Likert scale data as ordinal data because the value assigned to a Likert item has no objective numerical basis. Therefore, we collected the responses into the bar chart and analyze the data with the mode and the frequency participants chose.

Result

In this section, we present what our survey disclosed about the Latin Americans' experiences with mobile money and the interface features that affected their adoption of mobile money applications. In the subsequent section, we discuss what we learned about Latin American's mobile money habits and their confidence in remittance channels.

Overall, 43% of the mobile phone users in our sample transferred money through online financial service, while 39% of our participants transferred money through brick and mortar financial service despite having the experience of operating online financial service. 29.7% of the people who have access to their bank's online financial services instead use services provided by other financial institutions or bitcoin.

Mobile phone users in our sample have confidence in bank employees (mode = 5, median = 4); however, our participants reported less confidence (mode = 3, median = 3) in other financial services employees, such as Western Union and PayPal. Yet, we saw that in general people in Latin America did not trust technology to interact with their finances. In our survey, the participants have less confidence in online financial service, both bank (mode = 4, median = 4) and other financial institutions (mode = 3, median = 3, and 42% participants distrust it) than in human employees. The preferred mode of interaction to access their finances was with humans who could ensure them that everything was in order and rapidly respond to all their questions. For people in Latin America it was extremely important to have a sense of control and be able to understand how their finances were moving.
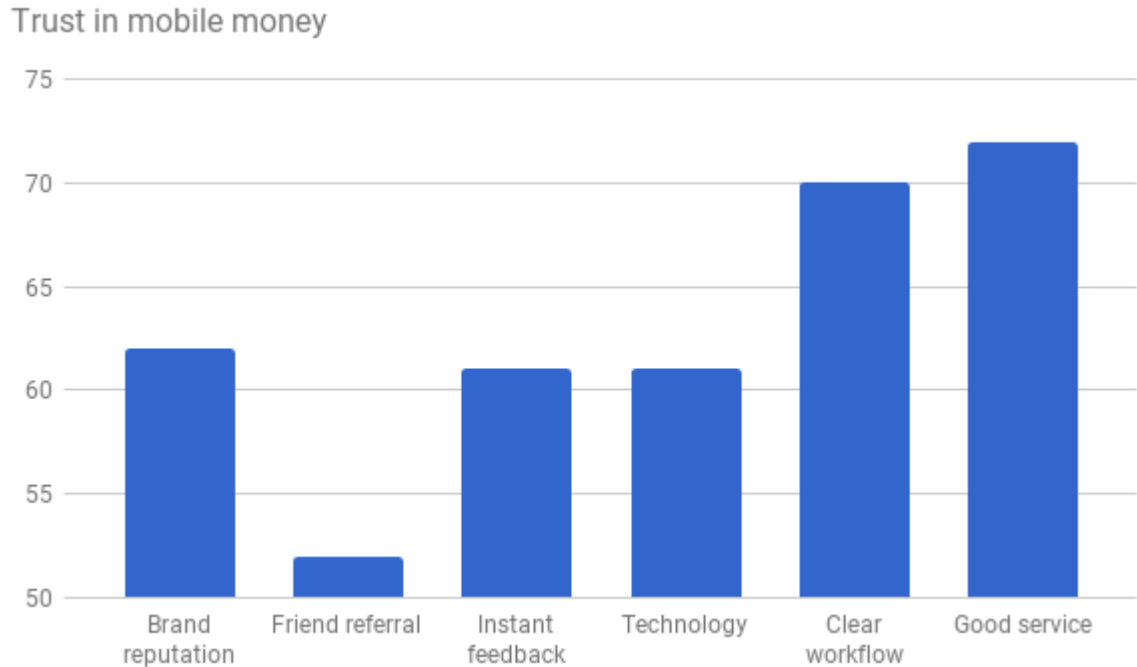
Figure 2. Overview of the factors that participants consider important and most important when deciding whether they trust a mobile money application in Latin America. Good service and clear workflows were the factors that influenced people's trust in mobile money applications the most.

Our study (see Figure2) also revealed that good service (82%) and clear work flow (80%) are the most important factors that could enhance people's adoption of mobile money. Figure3 shows that security (90%) and transaction speed (82%) are essential features when users choose remittance channels. Over 60% users in the sample trust and want to use the individual interface model more than the other two models which involve social connections. It seems for Latin Americans it is most important to have a clear work flow that allows them to understand how money is moving in the system. This is more important than having social connections available.

Our finding also showcased that security and transaction speed are the most important factors to choose remittance channel.

Reason for remittance channel
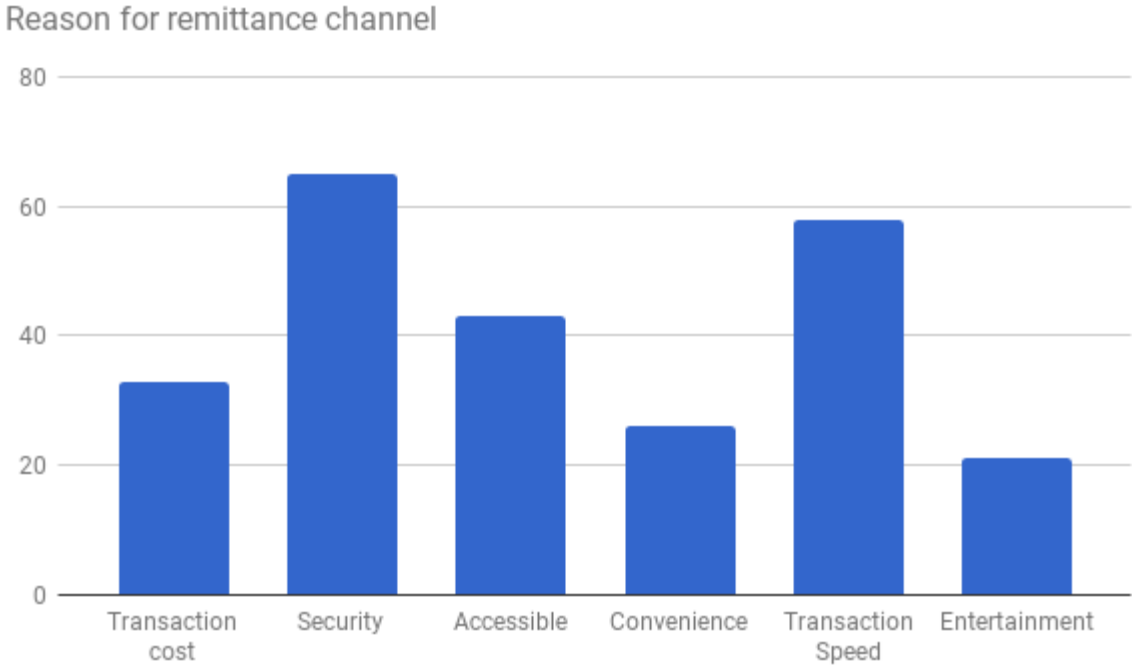
Figure 3. Overview of the factors that participants consider most important when choosing a remittance channel (service through which they will send their money). Most of our participants indicated that security and transaction speed are the key issues in the selection of their remittance channel.

Our study also showcases how people's experiences with mobile financial services and international remittances interplay with people's acceptance and usage to mobile money, see Figures 4 and 5. Based on their experiences, we classified and clustered participants of our study into 3 types. In the following we present the differences between each type of user.

Analyze the factors by group in trust in mobile money
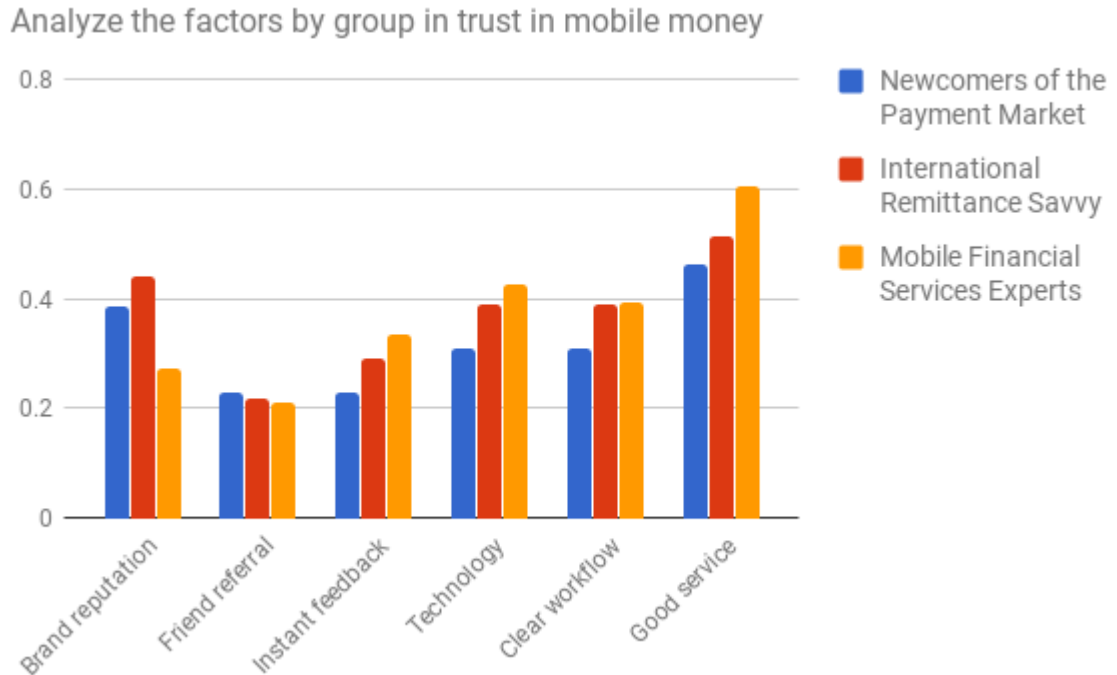
Figure 4. Overview of the ratio of people in each group who consider that particular factors are important for trusting mobile money applications. Besides the clear workflow and good service, brand reputation plays an important role in trusting mobile money applications. This is especially true for people who are "International Remittance Savvy".

Newcomers of the Payment Market (14.8%)

The users who belong to this group never used mobile financial services or international remittance and rarely had any experiences with transferring money to others. Compared to the other types of users, these individuals do not have the high confidence in banks and financial institutions (mode = 4, median = 4, but mode = 5 in other two groups). For these individuals what was most important within the interface was security. Therefore, it seems that to involve these individuals into mobile money applications, so companies may need to showcase that users can indeed trust and have security over their digital financial transactions. It might also help to have

mobile money applications that are not linked to well-established banking institutes but rather more independent or distributed banking groups (given their distrust for institutions). It was also interesting to observe that these individuals are the ones who are most accepting of social networking features, as well as chat-based features. These individuals seemed opened to new technological innovation.

Ratio of each group consider the factor is most important in remittance channel
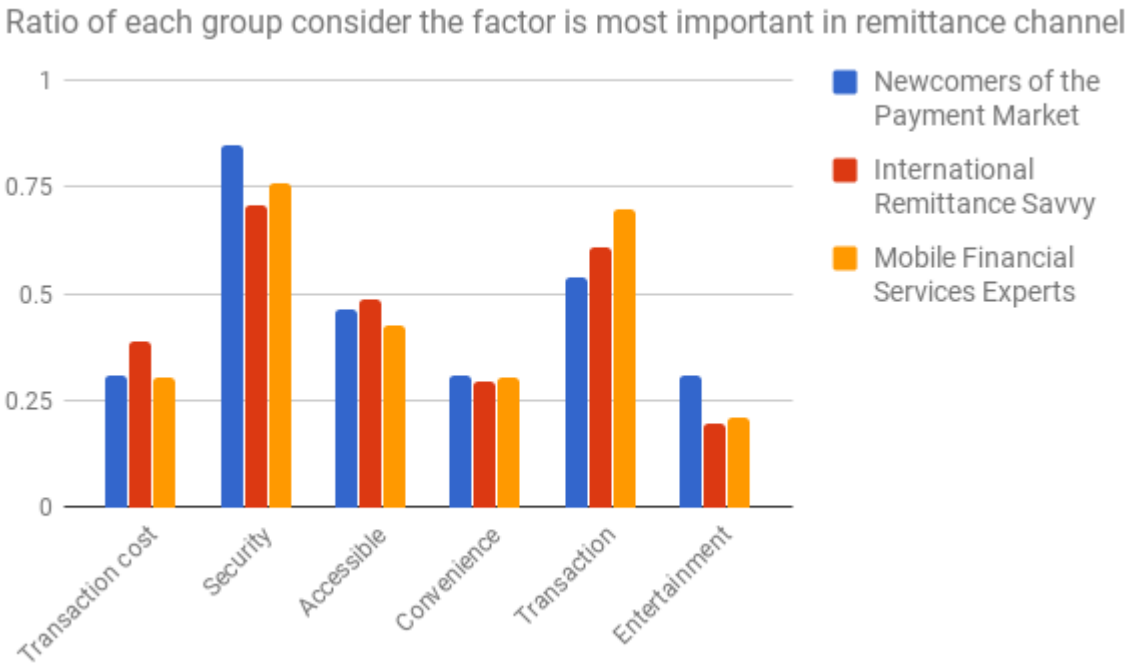
Figure 5. Overview of the ratio of people in each group who consider that particular factors are important for deciding what remittance channel to use. Security in general was a crucial factor when selecting the remittance channel, especially for newcomers. "Mobile Financial Services Experts" consider that efficient transactions are equally as important as security.

International Remittance Savvy (46.6 %)

This group had plenty of experience with money transfers but very little with mobile money applications. These individuals have the highest confidence in the bank and financial institutions than any other group. Our survey shows that people experienced with international remittance paid more attention not only to good service and clear workflow but also on brand reputation when they first used the financial service. The integration of social network data seemed to have the least acceptance in this group. This feature simply did not seem to be important for these users.

Mobile Financial Services Experts (38.6%)

People in this group had the longest (4-6 years) experience using mobile phones, and this likely lead them to adopt mobile financial services. This group also does not trust banking systems, but they do have a high acceptance of its related technology, which facilitates their adoption of mobile money applications. This group also seems to appreciate having clear workflows, especially as they distrust the financial banking institutes.

CivicGov

From our study, we identified that Mexican immigrants had trust issues with technology and institutions (even more so with non-traditional institutions). Mexican immigrants thus seemed to value transparency in their mobile money interfaces. They especially wanted to clearly visualize the flow of their finances (i.e., how their money moved). We use our findings as a design probe to create systems that lead to trust building and ease collaborations between immigrants and governments.

Openness is one of the primary ways trust is built between citizens and institutions [8], [9]. The Open Government Partnership (OGP) is a multi-national organization consisting of 70 countries promoting open government. It declared: to have an open government it was necessary to follow three principles: transparency, civic participation, accountability [36].

We integrated the principles set forth by the OGP into community development projects in order to stimulate collaborations between immigrants and governments by building trust. We explore these ideas in our system CivicGov, a decentralized collaborative platform for immigrants, governments, and other institutions, such as non-government organisations (NGOs). Our system helps immigrants work with rural governments to endow and construct suitable projects that benefit their native communities. Our tool provides real-time monitoring of all transactions, assures that donations are spent on the community, and regulates the purpose of the donations.

To achieve decentralization and transparency, \sys employs blockchain based technology [13], specifically smart contracts [36] that manage the cash flow of the community development projects. Blockchain technology provides a public ledger (public database), that is stored on a distributed network; which is hosted on all the computers on the network. Therefore, data on the

blockchain is accessible to everyone on the network [13]. Smart contracts are user-defined contracts that enumerate rules, controlling transactions and are stored on the blockchain [36]. While normal contracts outline a relationship and enforce the relationship via laws and authorities, smart contracts enforce the established relationship using code. Theoretically, smart contracts can be considered special, "trustworthy third parties", which are publicly maintained. In our system we use smart contracts to ensure that all the donations and expenditures of the community development projects can be accessed through the public domain. Everyone can therefore see how the money is being used, and also have some safety that the money is used in the way it was established.
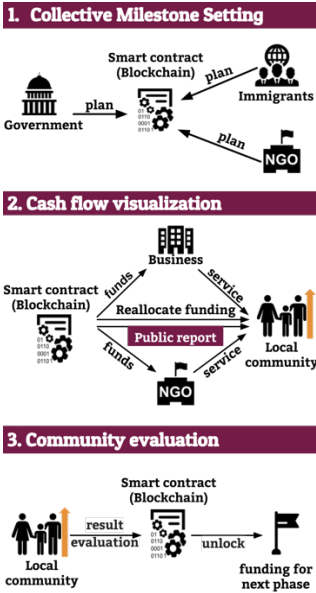
Figure 6. Overview of CivicGov, which has three stages: 1) United Milestone
Setting 2) Cash Flow Visualization 3) Community Evaluation.

Based on the principles of open government, CivicGov (presented in figure 6), consists of 3 main parts: 1) Collective Milestone Setting, 2) Cash Flow Visualization, 3) Community Evaluation.

1. Collective Milestone Setting

The aim of this step is to help immigrants, locals from rural communities, governments, and NGOs: (1) discover what improvements the community needs; (2) establish a suitable plan to address the community needs; and (3) fundraise and execute the established plan. To enable more open collaboration and build trust, CivicGov redistributes the responsibilities and power of the government. The completion of the community project is divided into stages with milestones, which are collectively established by the stakeholders (donors, governments, NGOs, rural citizens). This reduces misappropriation of funds from the community development projects or practicing any type of corruption. No stage is given access to all of the funding (reducing the chances of illegal transactions, and the likelihood of embezzlement the funds.) In its execution stage CivicGov records the milestones and the funding distribution, which were negotiated collectively by immigrants, local rural citizens, NGOs, and governments previously and established in the smart contract. Through the smart contracts, attention to the project execution is possible -- due to the pre-determined milestones -- without requiring any human supervisors. A smart contract holds the funds in escrow, which are disbursed according to a prescribed distribution and the pool of money is overseen by the "miners" on the network [36]. Notice how this work-flow reduces the workload and the dependence on the government audit officials, as the audit is now done automatically.

2. Cash Flow Visualization

In the interest of transparency, CivicGov records all money transactions -- starting from the donations to the expenditures -- on the public blockchain. Through the completion of the project, all information about the transactions and reallocations, such as the purpose, amount, recipient, sender, and timestamp, are recorded on the blockchain network. This enables the public to scrutinize whether the funds were used appropriately. Notice, that while the public can examine the records on the blockchain, it is hard for non-experts to recognize meaningful information without specific visualization tools. CivicGov incorporates data visualizations techniques to help the public easily check how the different actors are using the funding of the development projects.

3. Community Evaluation

Although blockchain make all the cash flow records publicly accessible, this technology cannot evaluate the quality of the goods or services that are produced in each stage of the execution plan. Bribery, one common form of government corruption, occurs when businesses provide gifts or incentives to officials to ensure that governments will buy their products or offer preferential treatment; however, these products or services are normally inferior in quality [37]. To guarantee that the funding is not siphoned for bribes, \sys requests public inspections periodically throughout the execution of a project. Once the funding for a specific stage is spent, CivicGov automatically triggers the evaluation.

Discussion

Mobile money, like Bitcoin, provides an opportunity to improve financial transparency and trust building in Latin America; nonetheless, user adoption of mobile money has been particularly slow in this region. Our paper suggests what features are discouraging user adoption of mobile money in Latin America and provides a model which helps the promotion of mobile money within this region.

Through our analysis, we identified that for Mexican immigrants transparent workflows of how their funds moved was important for trust building. This result matches the recent findings of the Open Government Partnership, which identified that for trust building it was important to offer supervision and accountability [36].

Our results also suggest that mobile money providers need to embrace new strategies for people with international remittance experience. Given that these individuals are accustomed to the current financial system, the process of using mobile money should not be significantly different than transferring money through talking to banking staff. It might therefore be important to consider crowd-powered interfaces that could allow people to send money and receive real-time human assistance as the money is transferred, similar to when someone visits and completes the transactions within a bank.

In sum, our results suggest that people in Latin America have trust issues with financial institutions and government, particularly in countries like Mexico that have had bank collapses in recent times [7]. This distrust also seems to be present in how they adopt and use mobile money services. Having clear and transparent workflows of how their money is transferred therefore

becomes crucial for people in Latin America, as this enables them to be able to be vigilant if they want to and understand how their money is flowing.

However, how much a person values clear workflows and transparency seems to depend on the individual's background and experience. In particular, those who do not have experience with mobile financial services and traditional money transfer channels had a higher acceptance to novel interfaces than other groups. The reason might be that they are not limited by the process of the current system and they have more imagination about what mobile money can be.

Our finding also showcased that security and transaction speed are the most important decisive factors when Latin Americans chose a remittance channel. However, the security of mobile money depends on the service provider and technology itself. The problem of security includes malware attacks, identity theft, phishing schemes, account fraud [18] and inside jobs. Given that current technology already offers sufficient solutions to the first four attack methods, establishing transparency is the fundamental issue for alleviating security concerns because inside jobs and other risks can be avoided or mollified when the customers can easily check each transaction they have had.

One of the most important revelations of our paper is that for the Latin America trust building it is crucial to showcase how the workflow functions. In Latin America straight-forward workflows are valued greatly by all types of users. This feature is valued much more than any social interface. This result is surprising when we consider that in other developing countries, e.g., in the Asian market, the chat-based interface model helped mobile money become extremely popular. However, it seems that such interface model cannot be duplicated in Latin America because the culture and the background are different than in Asia. People in Latin America appear

to have more distrust for the financial institutions and as a result they value more transparent and clear cash flow interface.

We took these findings and designed CivicGov: a decentralized system that facilitates collaborations among immigrants, citizens, NGOs, and governments. CivicGov pushes a more democratic power balance between governments, rural citizens and immigrants, as it allows decentralized collaborations where all stakeholders can establish a plan, view all transactions and supervise the execution. Figures 7-8 show an example of how governments, social companies, and immigrants have started to use our system to collaborate. While researchers have started using blockchain technology to solve existing difficulties in financial and governmental institutions [38], we still lack an understanding of how blockchain could address trust issue between governments and citizens. Our work helps to start investigating this gap.

Figure 7. Example of resulting collaborations between immigrants and governments that our system facilitated. Here citizens are completing one of the stages of the community project: they are building stoves in a particular rural community.

Figure 8. Example of resulting collaborations between immigrants and governments that our system facilitated. Here citizens are completing one of the stages of the community project: they are building stoves in a particular rural community.

Design Implications for Blockchain Developers

One of the features of blockchain is that it is "trustful", which means that all the transactions (records) on the blockchain cannot be deleted or falsified. However, this does not guarantee that what is inputted into the blockchain is truthful. It could be that a corrupt official colluded with a company to increase the price of the company's products to keep the extra fees. Designers should consider this problem and think about how to overcome it to design truly trustful technology. more easily flag and break corrupt transactions. Blockchain designers should also consider that the value of cryptocurrencies, i.e., the currency units that are used in the blockchain fluctuate greatly and cryptocurrency is also hard to treat as a medium of exchange in the real world. Therefore, it might not be convenient to store the actual funds of the community project on the blockchain. To conquer the fluctuation problem, CivicGov only used blockchain technology for record keeping rather than for trade. All of the funding for the community development projects are deposited in banks (this is also important given that immigrants trusted banks more).

However, this design also creates a new middleman problem, which blockchain technology promised to eliminate [13]. We are currently exploring the resolution of this problem through crowdsourcing. Designers also have to analyze people's adoption and use of blockchain technology. For the public, blockchain is still in its initial stages and most do not understand it. In CivicGov we hid the blockchain aspect of the system and simply presented people with a mobile interface to manipulate.

In CivicGov we decide to incorporate a milestone-setting phase where immigrants and governments brainstorm their plan and budget, and an evaluation phase where the immigrants can lock the funding when the finances of the project are unclear or the quality of the work is low-grade. This helps citizens to feel more confident about collaborating with the government, as they can

Design Implications for Civic Platform Developers

Prior work had identified that in Latin America there is a general distrust for the government [4]. Consequently, transparent technology might not be enough. We believe that to build trust it is important to also push campaigns that present to citizens how corruption is currently being fought. This could help change citizens' mindset that "corruption is systematic in the country and no technological advancements will transform that reality." Such campaigns could e.g., focus on highlighting cases where important public figures were prosecuted for corruption. Another aspect for designers to consider is that there might be certain policies or even laws that impede the government from being completely open. Civic platform designers should think about how to effectively communicate these restrictions to end-users as it could also lead to misunderstandings and the belief that the government continues to be corrupt, hindering

collaborations. It could also be helpful for civic platform designers to develop mechanisms to help governments be more open about their work dynamics. The lack of such practices can generate unnecessary doubts and affect collaborations. Finally, when developing technology for rural areas, it could also help civic developers to consider theories of alternative development [39]. Alternative development focuses on improving the economic development of an area by targeting the root causes of their problems and giving residents the agency to address the problems, e.g., address that rural citizens might be involved in illicit activities[40] and therefore provide tools to brainstorm and solve that problem.

Limitations

Some of the limitations of our study is that we only surveyed and interviewed the people who have mobile phones. However, in Latin America there is a relatively small number of people who do not have access to mobile phones (usually less than 14%) [41]. Therefore, our study might still be significantly representative of the population of Latin America and benefit the population by promoting mobile money in Latin America.

In addition, the features we studied may not include all features present in mobile money applications, however, we tried to ensure that we considered the ones that the literature has identified as the most salient.

Conclusion

This paper investigates the different features that can enhance user adoption of new mobile financial service interface. We identified that a clear and straight-forward workflow and good service are the most important factors to encourage potential Latin American consumers of mobile money tools; moreover, transaction speed and security are also fundamental factors that affect what channel the user will choose for remittances. The chat-based model, which integrates a social network and mobile money, does not seem to be that helpful in improving the user adoption of mobile money in Latin America, despite the fact that the same model has been successful in other countries. There are also widespread trust issues with the Mexican financial system which indirectly affects user adoption of electronic platforms for money transfers.

Our paper provides an overview of how having transparent and clear workflows could facilitate the adoption of mobile money in Latin America, especially as people in these regions do not trust the government and financial system. Moreover, we use the finding to create a decentralized system to empower the citizens and provide mobile interface to track all the cash flow in the community development project.

We will evaluate our proposed model by helping the Mexican government to install our system for community development projects in rural communities. A critical aspect of CivicGov is that it helps to combat corruption with blockchain technology. This should facilitate immigrant, rural citizen and government collaboration towards benefiting rural communities. Moreover, by providing transparent reports and promoting the participation of rural citizens in the development projects (by requesting they help verify the transactions) we anticipate that trust will start to be built among citizens, immigrants, NGOs, locals, and governments. We will use direct observation,

interviews to study CivicGov from five different angles: a) user adoption, b) how CivicGov changes immigrants' perceptions, their trust and willingness to collaborate with their home governments and institutions; c) corruption reduction; d) project completion rates; and e) community transformations through the projects completed.

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Appendix

Survey Questionnaire

Questionnaire

Section 1: Tus hábitos de remesa

Queremos saber cómo transfieres dinero a otras personas para crear nuevas y mejores Interfaces que mejoren Mexico!

1) **¿Que tan frecuentemente envías dinero al extranjero?**

   ( ) Una vez por semana

   ( ) Más de una vez al mes

   ( ) Una vez al mes

   ( ) Cada 2 ~ 3 meses

   ( ) Cada 6 meses

   ( ) Una vez al año

   ( ) Nunca

2) **¿Que tan frecuentemente envías dinero a otros de modo digital?**

   ( ) Una vez por semana

   ( ) Más de una vez al mes

   ( ) Una vez al mes

   ( ) Cada 2 ~ 3 meses

   ( ) Cada 6 meses

( ) Una vez al año

( ) Nunca

3) ¿Con qué frecuencia envía dinero a otros?

( ) Una vez por semana

( ) Más de una vez al mes

( ) Una vez al mes

( ) Cada 2 ~ 3 meses

( ) Cada 6 meses

( ) Una vez al año

( ) Nunca

4) ¿Qué canal usas para enviar dinero a otros?

( ) Ir al banco y tratar con personal bancario

( ) Banco (cajero automático)

( ) Banco (en línea)

( ) Servicios financieros (oficina) (tales como Western Union, MoneyGram)

( ) Servicios financieros (teléfono móvil) (tales como Western Union, MoneyGram)

( ) Amigos o familiars

( ) ninguno

5) **¿Podría evaluar que tanto confías en los siguientes canales para enviar dinero a otros?**

	Muy desconfiado	desconfiado	Neutral	Confianza	Muy confiado
Ir al banco y tratar con personal bancario					
Banco (ATM)					
Banco (en línea)					
Servicios financieros (oficina) (tales como Western Union, MoneyGram)					
Servicios financieros (teléfono móvil) (tales como Western Union, MoneyGram)					
Amigos o familiares					
ninguno					

6) ¿Qué tan importantes son los siguientes puntos para que confíes en una aplicación digital para enviar dinero?

	No importante	Ligeramente importante	moderadamente importante	Importante	Muy importante
Reputación de la marca					
Referencia de Amigo					
Retroalimentación instantánea					
Tecnología					
flujo de trabajo claro					
Buen servicio					

7) ¿Qué tan importantes son los siguientes factores para influir en el canal de remesas que usa?

	No importante	Ligeramente importante	moderadamente importante	Importante	Muy importante
Costo de la transacción					
Seguridad					
Accesibilidad					
Conveniencia					
Velocidad de transferencia					
Entretenimiento					

Section 2: Aceptación de diferentes interfaces de usuario

Ofrecemos tres tipos de interfaz para las aplicaciones de remesas. Por favor vea los siguientes videos

"Interfaz individual" sólo le permite enviar el dinero al receptor. Tienes que escribir la cuenta bancaria del receptor y otra información relacionada. https://youtu.be/-dBhYOVVsfM

La "interfaz basada en amigos" te permite enviar el dinero a los amigos de tus contactos telefónicos o redes sociales, y no tienes que escribir la cuenta bancaria y otra información del receptor. https://youtu.be/6gXjheX0Xqs

"Interfaz basada en chat" te permite enviar el dinero cuando hablas con tus amigos, al igual que adjuntar fotos a tus amigos. Usted no tiene que escribir la cuenta bancaria y otra información del receptor. https://youtu.be/yYyfcbZFzCw

1) ¿Qué interfaz le da más confianza ?

( ) Interfaz individual

( ) Interfaz basada en amigos

( ) Interfaz basada en chat

2) ¿Qué interfaz cree que usaría más?

( ) Interfaz individual

( ) Interfaz basada en amigos

( ) Interfaz basada en chat

Section 3: Información Personal

1) **¿Cuál es su género?**

( ) Mujer

( ) Hombre

( ) Prefiero no decirlo

2) **¿Cuántos años tienes?**

( ) 18 o menos

( ) 18-24

( ) 25-30

( ) 31-40

( ) 40 +

( ) Prefiero no decirlo

3) ¿Hace cuánto envía dinero usando tecnología digital?

( ) Menos de un año

( ) 1 ~ 3 años

( ) 4 ~ 6 años

( ) Más de 6 años

( ) Ninguno

4) ¿Cuánto tiempo ha utilizado smartphone?

( ) Menos de un año

( ) 1 ~ 3 años

( ) 4 ~ 6 años

( ) Más de 6 años

( ) Ninguno