An Introduction to Development Engineering: Fintech for Rural Markets in sub-Saharan Africa

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Development Challenge

Since the 1990s, cash transfer programs have been an important part of social protection policies in developing countries. As of 2020, approximately 159 countries have 700 types of social protection programs in place, over 200 of which are cash-based measures (Gentilini et al 2020). The key issue, though, is distribution: Globally, 1.7 billion adults remain unbanked, without an account at a financial institution or through a mobile money provider (Findex 2017). This lack of access to financial services not only increases the logistical challenges associated with implementing cash transfer programs, but potentially creates substantial direct and indirect costs to program recipients. This is especially the case in sub-Saharan Africa, where money transfer costs are among the highest in the world (World Bank 2017, 2019). In such an environment, then, how can cash transfers or salaries be distributed more efficiently using digital technologies? In addition to efficiency, can digital transfer mechanisms improve the welfare of program recipients along other dimensions? Could it disadvantage particular sub-groups? And could public investments in transfer infrastructure lead to spillovers for person-to-person (P2P) transfers, especially in an area of the world where remittances represent 2.5% of GDP? (World Bank 2018).

These questions are at the heart of this case study on Niger, a landlocked country in West Africa and one of the poorest countries in the world. In 2009/2010, Niger experienced both drought and harvest failures, with 2.7 million people classified as vulnerable to extreme food insecurity (FEWS NET 2010). Such crises are not uncommon, as droughts happen with increasing frequency in Niger and the Sahelian region more broadly (CSAO/OECD 2015). In response to this crisis, governmental and non-governmental organizations implemented a series of food aid and cash transfer interventions. While seemingly simple, the context was not: Niger was one of the poorest countries in the world, with one bank for every 100,000 people (Findex 2017), few paved roads and insecurity along the Niger-Mali and Niger-Nigeria border. As a result, at the time, the government and NGOs would distribute such transfers in cash, counting the transfer in small denominations, into individual envelopes, and transporting it (with armed security forces) into remote rural areas (Aker et al 2018).

In January 2010, a relatively new technology at the time – mobile money – was introduced into the country by one mobile network operator (MNO). Known as "Zap", the mobile money product allowed households to transfer money via a text-based system on their phone and pick up their cash at a local agent. The technology therefore offered a unique opportunity: Rather than physically distribute cash to thousands of beneficiaries, NGOs and the government could send that cash electronically via the mobile money system. This led to three hypotheses: 1) mobile money would reduce the transfer costs for the implementing agency and program recipients, as well as allow the agency to reach areas affected by conflict; 2) these cost reductions would lead to other improvements in well-being; and 3) introducing mobile money would allow households to use the system for remittances, especially in a context where at least 50% of households have at least one migrant (Aker et al 2020, Jack and Suri 2014). The researchers collaborated closely with a non-governmental organization to design and implement a randomized control trial (RCT) across 96 villages in one region of Niger, with the primary goal of assessing the feasibility, cost and impact of using mobile money for cash transfer programs.

In the ten years since this study took place, many of the country statistics for Niger have not changed, and insecurity has intensified. Mobile money still exists, although it has not taken off as predicted. Despite mobile

ownership rates of over 80% (Aker et al 2020), m-money adoption in 2017 was estimated at 9% (Findex 2017), with relatively lower rates in rural areas. These rates are mirrored in the West Africa region: Whereas mobile phone adoption is 67% and there are 59 mobile money deployments, there is marked heterogeneity in adoption within and across countries (GSMA 2019). As a result, mobile money has not yet become the transformative technology that it was hoped in countries such as Niger, nor in its neighbors, despite high money transfer costs, substantial migration and demand for the service.   This challenge was all too evident in 2018, during a second cash transfer program across 110 villages in the east of the country.

Implementation Context

Niger is one of the largest countries in Africa, with relatively limited access to roads, financial infrastructure or electricity. The first mobile money system, "Zap" was introduced in January 2010. Known as "Zap", the product was developed by one of the MNOs, Zain (later Bhartia Airtel). Like most mobile money systems, Zap allowed users to store value in the mobile money account, convert cash in and out of the account and make transfers by using a set of text messages personal identification numbers (PINs) (Aker and Mbiti 2010). The cost of making a $USD45 transfer using Zap cost USD$3 at the time. Unsurprisingly, then, initial coverage, usage and growth of Zap was limited and geographically focused in the capital city (Niamey) and regional capitals. The cost of making a $USD45 transfer using Zap cost USD$3 during this period.

Given the context, there were a number of challenges to designing, implementing and evaluating a mobile money cash transfer program. The first of these was **mobile phone ownership**: While mobile phone coverage was initially introduced in Niger in 2000, and had grown substantially between 2000-2010, adoption rates were at 30% at the time of the study. Although individuals within households often shared one mobile phone, and households shared mobile phones, the targeting nature of the cash transfer program – which targeted vulnerable households within villages, as well as women within the household – meant that mobile phone ownership was a potential issue.

Beyond the issue of mobile phone ownership, few households in Niger – and specifically in the study region – **knew about (or had used) mobile money**. Since mobile money had only been introduced in January 2010, and the first transfer was scheduled to take place in May 2010, adoption in remote rural areas was less than 1%. This not only meant that households were not registered for mobile money (which required identification), but they also did not have the special SIM required to read the program.

Third, the initial mobile money systems were (and in some cases still are) heavily text- and number-based: In this specific case, the program recipient received a text notifying her of the transfer (with the amount); in order to pick up the transfer from the agent, the program recipient needed to have a four-digit PIN. And this was the fourth challenge: **Niger has some of the lowest literacy rates in the world**, less than 30%, with marked heterogeneity by gender. In the study area, 58% of women had attended some school, but literacy rates were less than 15%. This led to challenges in manipulating the mobile phones, as well as recalling PIN codes.

The final challenge at the time in the area of **mobile money agent density**: As a new mobile money program, there were few agents located outside of the capital city, and no agents in the targeted area. Thus, while the mobile money program had the potential to reduce the costs associated with distributing the cash transfer for the NGO, it also had the potential to increase the costs to the program recipients, essentially shifting the risk to the private sector: the MNOs and the agents.

To design the innovation and intervention, implement the program and conduct the evaluation, this therefore took close consultation with six sets of stakeholders: 1) the **NGO**, Concern Worldwide, who was the implementing agency; 2) the 116 villages who were part of the cash transfer program, and were responsible for identifying vulnerable households within the community; 3) **Zain**, the MNO, who was the only mobile money operator at the time; 4) **local cereal traders and retailers, who were the primary mobile money agents in the region;** 5) the local data collection firm, **Sahel Consulting**, and **Tufts University**, who were responsible for designing the research and data collection during the evaluation; and 6) the **Ministry of Social Protection**, who was responsible for overseeing cash transfer interventions during the food crisis of 2009-2010.
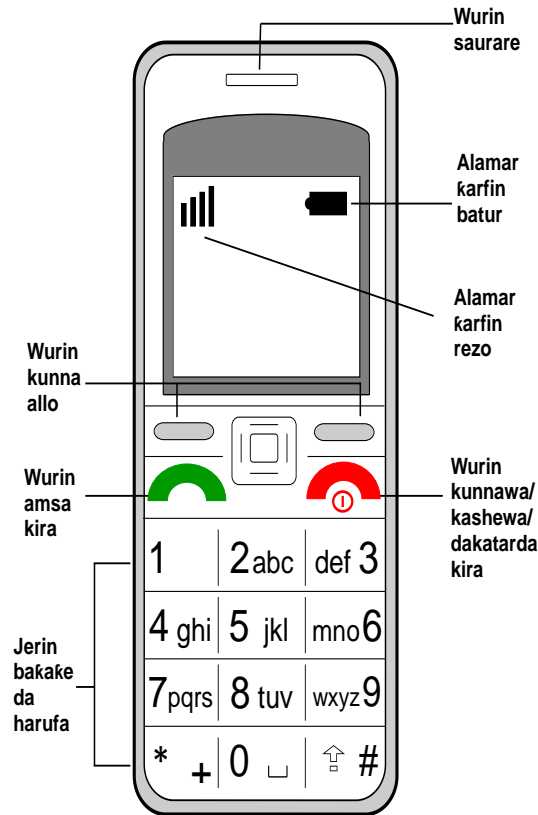
Overcoming these challenges required close collaboration between the researchers and the implementing partners, as well as between the key implementing partner (Concern Worldwide) and the MNO. For the issue of mobile phone adoption, this required purchasing mobile phones for the beneficiaries, as well as discussion between the researchers and Concern Worldwide about how this purchase would affect the interpretation of the results, and the addition of an additional intervention arm.

For the challenges related to **knowledge of mobile money and low literacy levels**, this required close collaboration between Concern Worldwide and the MNO, as well as the researchers and the NGO, along two dimensions. First, MNO provided Zap-enabled mobile phones, as well as registration for these SIM cards, for program recipients; and second, researchers and NGO worked carefully on a series of picture books and training manuals, as well as trainings on how to use mobile money in a low-literate environment. Similar to work done by the researcher on a mobile phone literacy project, the NGO adopted the use of a mobile phone poster, which allowed program recipients to find their PIN code on the handset, as well as memorize the number.

Finally, **for challenges related to the agent network**, Concern Worldwide worked closely with the MNO to identify potential agents in the region. While this did not involve identifying specific sites for agents, it did involve letting the MNO know where the intervention villages would be, so that it could attempt to identify suitable agents in those areas. In addition, Concern notified the MNOs (and the agents) of the timing of the cash transfers, so that they would have sufficient liquidity for program recipients to cash out.

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Innovate, Implement, Evaluate

Innovation

In light of the high costs involved in distributing cash transfers in Niger, the introduction of mobile money offered a new mechanism for distributing cash transfers to food insecure households. The starting point for the intervention, then, was to use two existing models of cash transfers – in-person and mobile money – and adapt this to the particular context to distribute the cash transfer.

The cash transfer intervention in this context was relatively simple: a monthly transfer of US$45 per month over a five-month period, for a total of US$225. The transfer was provided via the hungry season (from May until September), in the hopes that this would reduce the likelihood of food insecurity, malnutrition and asset sales until the following harvest. While a total of 116 villages received cash transfers, 20 villages were removed from the evaluation sample, as they either did not have mobile phone coverage (and hence were not eligible for cash transfers via mobile money) or were in highly insecure areas (and hence were not eligible for cash transfers in person). All targeted households in targeted villages (96) were scheduled to receive the same amount, at about the same time, each month.

Villages were assigned to one of three innovation models:

1. **Manual cash**, whereby program recipients in a given village received the cash transfer in the village or via a nearby village, using the standard model of cash delivery. This entailed having program recipients having a beneficiary card, traveling to the cash delivery point, waiting in line, being verified and receiving their cash in individual envelopes.
2. **Manual cash with a Zap-enabled mobile phone,** whereby the program recipients received their cash in a similar mechanism as above, but also received a Zap-enabled mobile phone, worth approximately $US5. The mobile phone had a Zain SIM, and program recipients could use mobile money if they wished, but they did not receive their transfer.
3. **Zap transfer,** whereby program recipients received the Zap-enabled mobile phone (as was the case in the second model), but received their transfer via the mobile phone. This involved not only distributing the phone to households (with the Zain SIM), but also conducting an interactive training with households to explain how mobile money worked, and what they could expect. The process also involved intense interaction with Zain to create a web-based, password-protected interface with program recipients' phone numbers, transferring money to a bank account connected to the Zap account, identifying and verifying program recipients, uploading an encrypted file onto Zain's system (so that they would not have program recipients' personal identifying information, and sending the cash transfer via SMS to program recipients' Zap accounts.

Amongst these three, the primary innovation of interest was the third one, the provision of the cash transfer via mobile money. While there were numerous channels in the theory of change – in other words, linking the innovation to the outcomes of interest – the primary one was related to a reduction of the transfer costs. By providing the cash transfer via mobile money, this would reduce the program recipients' costs in obtaining it, both in terms of transport costs and waiting time. It was hypothesized that the reduction in costs would not only allow program recipients to invest time in other productive activities at a particularly busy time of year, but also potentially change the timing and location of purchases, particularly if program recipients were able to purchase food and non-food items at local retailers, who were also agents, using mobile money. In the short- to longer-term, the introduction of mobile money to program recipients for the public transfer program could also allow them to use it for P2P transfers, therefore potentially increasing the amount of remittances available from migrants, as well as allowing remittances to arrive when they were needed most (Jack and Suri 2014). Beyond a reduction in transfer costs, the privacy of the mobile money cash transfer – program recipients only received a discreet "beep" letting them know that the transfer had arrived – could have allowed households to have more control over the resources, either within the household or between households

Implementation

The design and implementation of the above interventions were developed collaboratively between Concern Worldwide and the researchers, and was an iterative process. Initially, the implementing agency wanted to have two interventions: the manual cash group and the mobile money transfer group. When it was realized that mobile phone ownership was only 30% amongst the target population, and that mobile money adoption was essentially zero, the teams quickly realized that improving program recipients access to mobile phone technology (by providing mobile phones), as well as the mobile money technology (by facilitating registration, SIM cards and trainings) were needed.

The provision of Zap-enabled mobile phones to the mobile money cash transfer recipients required one primary modification to the interventions. The first was the addition of the "cash transfer plus mobile phone" intervention group. Since the Zap program recipients would receive the mobile phone plus the cash transfer via the mobile phone, there were two differences with the manual cash transfer approach: the mobile phone and the use of mobile money. By comparing the manual cash group with the manual cash plus mobile phone group, we were able to answer the question, "Conditional on receiving a manual cash transfer, what is the additional impact of the mobile phone?" Then, by comparing the second intervention group with the third, we were able answer the question, "What is the additional impact of receiving cash via mobile money"? The addition of the second intervention group created numerous discussions, as this required additional resources (cash to purchase the mobile phones) and trainings. The researchers and Concern Worldwide decided, in consultation, that the primary objective of the research was to measure the impact of the new mobile money transfer technology, and that the impact of the mobile phone needed to be netted out.

The second modification was related to the availability of agents in the targeted region. Despite intense work with the MNO to encourage them to register agents in the region, the MNO was unable to register a sufficient number of agents by the time of the first cash transfer, which essentially meant that one agent was distributing cash to 32 mobile money villages for the first transfer. After additional discussions with and pressure on the MNO, the MNO worked to register agents in the region, although not specific in the targeted mobile money villages, in order to avoid selection bias. This was verified during the evaluation stage; the number and density of Zap agents was similar across all groups, without a statistically significant difference.

Evaluation

In order to measure the impact of the mobile money cash transfer innovation on outcomes of interest, a RCT at the village level was used. After removing 20 villages without mobile phone coverage or in highly insecure zones, 96 villages were stratified by administrative division and randomly assigned to one of the three cash transfer innovations, with 32 villages in each group. The primary outcomes measured were those in the theory of change: 1) data on transfer costs, both for the implementing agency and program recipients, including when, where and how they obtained their cash; 2) data on uses of the cash transfer, including the different categories; 3) impacts on welfare measures associated with the cash transfer, including food security, diet diversity and nutritional outcomes; and 4) data on the mechanisms behind specific effects, in particular related to access to remittances, as well as intra- and inter-household sharing of transfers.

The evaluation collected a wealth of data, including the baseline (May 2010), the midline soon after the transfers (December 2010) and a final round one year later (May 2011). The data were a panel dataset, with the primary program recipient as the survey respondent. For each survey found, intensive survey piloting was done; the survey was first written, with the team trained, and then piloted in the field at least three times before being deployed. In addition, before the midline and final survey rounds, qualitative data (via focus groups) were also collected before the quantitative surveys, in order to gain insights into impacts that were not initially expected in the initial theory of change. This led to some useful insights about the observability of the transfer within the household (as women wore the mobile phones around their necks, and reported that only they knew of its arrival), and a module on intra-household decision-making. In the current context of using Pre-Analysis Plans (PAPs) for rigorous evaluations, these findings may not have been fully integrated into the study, or made it into the final paper.

Overall, the evaluation had four key findings:

- The **marginal costs of the mobile money cash transfer were lower than the costs of distributing the cash transfer manually,** but the fixed costs were higher, primarily due to the purchase of the mobile phones
- **Mobile money program recipients traveled shorter distances to obtain their transfer** as compared with their manual cash counterparts, equivalent to a savings of 2.5 days
- **Mobile money cash transfer recipients used their cash transfer to buy more diverse types of goods, were more likely to purchase protein and energy-rich foods and had higher diet diversity**
- **These results can be partially explained by less time spent on obtaining the transfer**, as well as increased bargaining power for women.

While these results were initially promising, they also had some caveats. First, they suggested that distributing cash transfers via mobile may not lead to improved financial inclusion for all households in all contexts, as proponents might suggest. As is evident from the statistics in Sahelian West Africa, mobile money registration and usage has not grown as quickly in other parts of sub-Saharan Africa, including Niger. In addition, while program recipient households in our study used mobile money to receive their transfer, they did not use it to receive remittances or to save, two important aspects of financial inclusion. This is potentially related to the limited m-money agent network in the country, a common issue in other West African countries.

There are several limits to the generalizability of these results. First, our case study studied the impact of different transfer mechanisms during a food crisis, when the marginal utility of income can be high. And second, since Niger is one of the poorest countries in the world, with low rates of literacy, financial inclusion and mobile money adoption, the context might be different from other countries where governments are considering mobile money payments. Yet Niger's educational, financial and mobile money indicators are not vastly different from other countries in West Africa, suggesting that these results might be informative for those contexts (GSMA 2019, Findex 2017). This is particularly the case in other areas of West Africa, such as Burkina Faso, Mali and northern Ghana, which have similar education and mobile money indicators.

Adaptation

In 2018, the question of distributing cash transfers arose in the context of another project, one which studied the impact of training and cash transfers on the adoption of an environmental technology (Aker and Jack, 2020). The study was taking place in 180 villages, 110 of which were assigned to receive either conditional or unconditional cash transfers. The program took place in Zinder, in the far east of the country, and in areas relatively close to the Nigerian border. These villages had relatively high rates of migration (and hence sent and received money), as well as relatively high rates of mobile phone ownership: Over 60%. The project was in collaboration with our data collection partner, as well as the Ministry of Environment, neither of whom had the capacity to distribute cash transfers manually.

An assessment of the mobile money adoption and usage in the region during 2017 had found that fewer than 3% of households had used mobile money (Aker et al 2020), and that there were only four mobile money agents in the entire region. Yet the program required transferring $20 to approximately 1750 program recipients across 110 villages. In discussing this with the team, we thought of four solutions: 1) manual cash transfers initiated by the data collection firm, Sahel Consulting; 2) using local money transfer providers; 3) sending the money as airtime credit, which households could then convert into cash; or 4) using mobile money, but with a modification (called "envoie-code").

Options #1 and #2 were quickly rejected by the partner, the first for being too risky, and the second because the location of the agents was similar to those of the mobile money agents. As a result, the discussion focused on #3 and #4, each of which had advantages and disadvantages. The researchers and data collection team disagreed on the relative merits of each one, and so used a technique called "Analytical Hierarchical Process" (AHP) to discuss the options and make a decision. In essence, this approach involves stating the goal of the exercise (finding the best cash transfer mechanism) and the criteria as to how this decision would be made (namely, the costs to the program recipients, the number of agents, the knowledge of the technology and the risks to the implementing agency). Each individual of the team then assesses each option along each criteria, and uses this to come up with a ranking. The rankings are all compared across each team member.

Based upon this exercise, Option #4 was used. In essence, this involved sending the money via the mobile money application to a mobile phone number, whose recipient did not need to have a mobile money account. The recipient then received a code, and could take this code to the nearest mobile money agent to pick up the money. If the program recipient did not have a mobile phone, then they were asked to provide the number of someone whom they trusted. This modification did not require providing mobile phones, nor registering program recipients on the mobile money platform. With some additional monitoring – namely, by calling program recipients and the village chief, and working closely with the MNO – over 98% of program recipients received their cash transfer, and received the full amount.

Results/Lessons Learned

Overall, this case study showed how the introduction of a new technology could be harnessed to quickly respond and adapt to the distribution of cash transfers in a slow-onset emergency, and are particularly relevant in light of the COVID-19 crisis. However, using digital technology in such contexts requires significant start-up costs and logistics, as well as significant interaction with the private sector. In the ten years since this study has taken place, there have been a number of other studies using digital platforms to provide cash transfers (Muralidharan et al 2016, Blumenstock et al 2015, Hausofer and Shapiro 2016), yet, to our knowledge, are unable to disentangle the impacts of the technology from that of the transfer mechanism. Second, while mobile money adoption and usage has increased quite substantially worldwide, including West Africa, there is substantial heterogeneity in adoption and active usage. This is, in part, due to the limited agent network infrastructure in these areas.

Summary & Interpretive Text Boxes

Gender
The cash transfer program targeted women within the household. The potential assumption of implementing partners was that this targeting criteria might increase women's bargaining power within the household, yet did not consider cultural differences across different ethnic groups in terms of women's access to markets. As a result, a number of proxy measures for intra-household decision-making were developed.

Responsible Research

The clear ethical responsibility in this context was the principle of Do No Harm; recipient households were extremely vulnerable and in the midst of a food crisis. Hence, it was decided from the outset that no pure control group would be included in the experiment; in other words, every intervention village received a cash transfer. In addition, this also meant that every effort was made to limit the time burden of surveys on recipient households. These modifications meant that the research could not answer the question "What is the impact of the cash transfer program?", but rather, what is the impact of this cash transfer mechanism? In addition, the research could not answer questions related to expenditures and consumption, as these data were not collected. This principle was agreed upon at the outset by all involved.

Failure

A clear implicit criteria for failure for the mobile money technology is whether households used the technology beyond the immediate need to "cash out" – ie, either by saving cash on their mobile phone or by using mobile money for P2P transfers. None of these occurred in this context, and mobile money adoption was not sustained in the longer-term, nor was the presence of mobile money agents.

Discussion Questions

- Did you think that the current model of distributing cash was a problem in Niger prior to the program? If so, why? If not, why not?
- Do you think that providing mobile phones was necessary in this context?
- What other factors might have been taken into consideration to increase the sustainability of the adoption and usage of mobile money in the medium and long-term?
- Should the identification and registration of mobile money agents be left solely to the responsibility of the MNO, or in collaboration with the public sector? What is the best way to ensure collaboration?