Towards Digitization of Collaborative Savings Among Low-Income Groups

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Rotating Savings and Credit Association (ROSCA) is a mechanism of informal collaborative savings that is widely used across the globe. Despite its popularity and prevalence, it is not well-studied from HCI and CSCW perspectives. The global increase in mobile penetration has created opportunities to serve the unbanked using mobile-based Digital Financial Services (DFS) for greater financial inclusion but there have not been any DFS-based interventions around ROSCAs. In this paper, we report a qualitative study involving 80 individuals to understand the dynamics of ROSCAs and opportunities for their digitization in the Pakistani context. We also present a smartphone-based Digital ROSCA platform designed on top of a simulated mobile money system. The platform was designed to be inclusive towards low-literate users. We present qualitative findings of its evaluation with 15 users (3 individual ROSCA groups). We find that digitization has the potential to support and strengthen traditional ROSCAs by mitigating issues like record-keeping, delayed payments, collection, distribution, and safety of money. It also allows the creation of payment history for individuals that can be used to score their financial credibility.

CCS Concepts: • **Human-centered computing** → **Empirical studies in collaborative and social computing**; *Empirical studies in HCI.*

Additional Key Words and Phrases: ROSCAs; Collaborative Finance; Informal Savings; Financial HCI; Digital Financial Services; Pakistan; HCI4D

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1 INTRODUCTION

In recent years, there has been an increased interest in the HCI and CSCW communities towards digital financial services, with a particular focus on the challenges of design and uptake of the new financial systems [39] [42] [62]. The workshop titled "CHIMoney: Financial Interactions, Digital Cash, Capital Exchange and Mobile Money" at CHI 2014 [37] and "Collaboration and Social Computing in Emerging Financial Services" [48] at CSCW 2015 highlighted the role of technology and social interactions towards greater uptake and usage of financial services. Our work contributes to this growing body of research on the intersection of financial services and HCI referred to as Financial HCI. We present a study around the digitization of a globally popular informal, collaborative saving practice known as *Rotating Savings and Credit Association* (ROSCA).

According to the 2017 global Findex report, there are 1.7 billion unbanked people in the world who primarily reside in developing countries [7]. Such exclusion of this population from the formal economy is due to factors including the lack of access to banks, lack of sufficient finances to deal with formal financial institutions, and a perceived lack of need. Financially-excluded individuals and businesses often rely on informal channels to meet their financial needs of savings, credit, and insurance [11]. These informal practices often help them achieve their financial goals but at the same time also give rise to new problems like unreliability, lack of privacy and transparency [15].

After the digital revolution of the 21st century, the digital transformation of every aspect of human life started and Information and Communication Technologies (ICTs) played a major role in this digitization. Recent penetration of low-cost technologies, especially mobile phones in the developing countries have initiated a new pathway of digitization of various health, education and agriculture services for the poor. Over a few years, these digital interventions have made a great impact in the developing world. These include the m-health interventions that made a significant impact on communicable diseases in developing countries [1, 16] by supporting health workers in providing their clinical duties in areas where no formal health facility is available [57]. ICT-enabled agriculture services have been able to disseminate information among farmers in developing countries. One project in particular called Digital Green (participatory video-based agriculture extension) was able to convince farmers to adopt new agricultural practices and resulted in an increase in adoption by 85% among farmers [24]. Similarly, e-Sagu, a web-based personalized agro-advisory system, reported increasing the income of low-income farmers by INR. 3075 (63 USD) per hectare annually and also reduced the pesticide usage [6].

Collaborative finance refers to financial transactions between individuals without the involvement of a financial institution. The rise in technology-facilitated community collaborations and social networks have given birth to collaborative economies which promote utilization of resources by sharing rather than increasing possession. ROSCAs enable such utilization by allowing its members to create a pool of their surplus savings at regular intervals (e.g. every month). Members then take turns to utilize these savings. Although increased digitization has enabled new forms of collaborative financial practices such as peer-to-peer lending and crowd-funding, ROSCAs have yet to benefit from it. Due to the informal nature of collaborative saving groups like ROSCAs and their independence from formal approvals and regulatory restrictions, many different variations of group-savings have evolved over the years to fulfill the diverse needs of its participants. [15] Some of these variations are more prominent than others in certain geographies. Research around the study and digitization of informal saving groups, therefore, has implications beyond ROSCAs to Accumulating Savings Associations, Saving Up Clubs and Self-Help Saving Groups. Following are the objectives of this research:

- To understand the functioning of ROSCAs in the Pakistani context, the role of social capital, and any problems faced by ROSCA members;

- To explore the opportunities for digitization and building of a Digital ROSCA platform;
- To evaluate the platform and explore its potential of value-addition to traditional ROSCAs

We conducted a 3-phase study following the Human-Centered Design (HCD) cycle. The first phase presents a qualitative research study with 80 individuals (including ROSCA users and non-users) to understand how ROSCAs work, what is the role of social capital in their functioning, what are the challenges in current ROSCAs and the opportunities for their digitization. In the second phase, we showcase our Digital ROSCA artifact built using iterative design process based on our findings from the field. The last phase is the evaluation of the Digital ROSCA artifact with 15 individuals (3 ROSCA groups) to explore its usefulness.

2 BACKGROUND

ROSCA is a financial saving mechanism employed in markets with low financial inclusion ratios as well in well-developed financial markets [38]. Little is known about the origins of ROSCAs, however, they are widely used in many parts of the world under various names. For instance they are referred to as "committees" in Pakistan [35], "equbs" in Ethiopia, "kuris and chit funds" in India, "hui" in China, "partners system" in Jamaica, "njangi" in Cameroon and "ke socities" in North Korea [34]. According to a 2015 study, the worldwide value of ROSCAs was around USD 480 billion [60]. According to Financial Inclusion Insights (FII) data by Intermedia [31], 36% of people in Pakistan save money and out of these only 4% save money with a formal financial institution. The majority of them (63%) save cash in hiding places while 33% save money through ROSCAs.

The process from the conception of a ROSCA group to its conclusion is termed as a *ROSCA cycle*. A typical ROSCA cycle starts with the formation of the ROSCA group. This involves social processes through which individuals who are interested in participation find out about a ROSCA group, and organizers (individuals who take up the responsibility of managing a ROSCA group) approve of and recruit ROSCA members usually based on strong social capital involving personal links or reliable referrals [55]. The group is formalized through a set of rules to administer it. ROSCA members contribute a fixed sum of money (termed as *ROSCA Pot*) to a collective fund from which every member receives the full sum at least once during the ROSCA cycle [5, 18]. Since ROSCAs thrive on social capital, member-recruitment criteria are crucial to their success. Multiple variables impact the member recruitment criteria which may include income level, locality, gender, ROSCA size and financial goals [2]. *Group size* (no. of people in a ROSCA group) and *cycle length* (duration of ROSCA) are dependent on the preferences of the participants. People with low-income levels prefer relatively smaller group sizes varying from 10 to 20 members whereas people with higher income levels prefer group sizes greater than 30 members to raise reasonable amounts to meet their financial goals [2, 55].

Common types of ROSCAs, based on *turn allocation*, include *random* ROSCAs and *bidding* ROSCAs. In a random ROSCA, all members have an equal opportunity to win a turn through a lucky draw whereas in bidding ROSCAs, the member with the highest bid gets the turn [8]. *Exchanging Turns* (swapping turns between members) is also a common practice in ROSCAs. It allows flexibility to members with respect to their turn in a group through the consent of the organizer and the member who holds the current turn. Individuals who receive an earlier turn can be considered net borrowers and those with later turns can be thought of as net savers [35]. ROSCAs facilitate both the savings and credit aspects. The credit aspect is advantageous for members who require funds at an earlier stage than if they had saved by themselves. The savings aspect can be useful as a commitment device, forced financial discipline, or a tool to cope with the social pressure of lending within their social circle. People who are prone to procrastination often use ROSCA as a commitment device [3]. People with lower income levels use ROSCAs to purchase

durable goods whereas people with higher income levels use them as a platform for insurance and savings [2]. Since ROSCAs are based on social collateral, people use them as a channel to build their reputation and enhance social status [35] [18]. ROSCAs are also employed to save money for medical emergencies and major ceremonies [2].

Pot Collection (collection of pot amount from members) and pot disbursement (giving a cumulative amount to the member whose turn is due) are also vital components of the ROSCA cycle. The organizer is responsible for these tasks. ROSCAs are also vulnerable to problems like the frauds committed by organizers or members, record-keeping issues, delays in payments, privacy and safety concerns, and member disagreements. Figure 1 summarizes a typical ROSCA cycle.
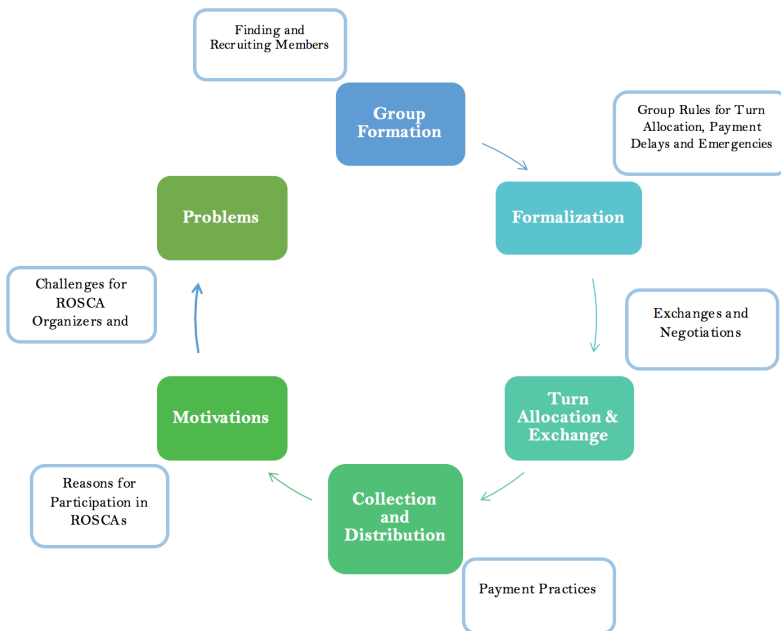

Fig. 1. A typical ROSCA Cyle

3 RELATED WORK

3.1 Social Capital and ROSCAs

Social capital is defined as the trust, information or benefits that people gain from their social networks [54]. Common sources of social capital are membership in friend groups, family and work [26]. Putnam [54] has referred to bonding and bridging as two types of social capital. *Bonding* is defined as strong social links for example links among close friends and family groups. *Bridging* is associated with weaker social links, for example, the links among distant friends or colleagues. That is why some researches suggest that when ties are to be exploited i.e when someone needs others to vouch for them and put their reputation on the line, strong ties are of more value [36]. Trust is another key factor in social capital and it is argued that the effect of trust is stronger among people with lower literacy [23]. Trust enables people to do business together and business creates wealth which eventually leads to economic mobility in low-income communities [28]. Social capital

also tends to be a significant factor in acquiring human capital e.g economic mobility that leads to development in low-income communities [9].

Informal saving practices around the world operate on social capital, particularly in low-income settings in developing countries where formal financial products are not available [32]. Ito [33] claims that social capital is integral to the success of micro-finance. In the absence of legal binding, social connectedness is employed to minimize defaults. The risk of losing reputation in society and peer-pressure minimize defaults [8]. ROSCAs are also deeply embedded in the structures of social capital and Raccanello [55] argues that social acceptance and support are the factors that augment social capital in ROSCAs. Social capital is premised on trust and the members of a ROSCA group use trust to empower themselves to achieve their financial goals [53]. Researchers also claim that ICTs have the potential to increase social capital by encouraging civic engagement but it is a concern that it will only increase the social capital in those communities who are already rich in social capital [4, 9]. A recent HCI study examined the impact of social capital on social media users and argued that the users who already have social capital are more likely to take advantage of social media effectively to find employment after losing a job [10]. Given the fact that social capital plays an important role in the working of informal saving groups, our study aims to deeply understand how social capital is associated with ROSCAs among different demographics in Pakistan.

3.2 Formalization vs Digitization of ROSCAs

There is a fine line between *formalization* and *digitization*. Formalization is defined as offering financial services through a regulated and formal financial channel like banks without relying on any social capital and placing all the financial liability and risk on the institution [63]. Digitization does not necessarily imply formalization and only implies facilitating existing social and informal practices using technology. It does not necessarily involve any formal financial institutions.

Different studies for the formalization of ROSCAs have been conducted but there is little published work on the digitization part. A model for modernizing and formalizing traditional ROSCAs through Islamic banks has been introduced, termed as FROSCA (Formal ROSCA) [63]. Under this model, members should have saving or current personal accounts in the bank as well as a SACA (Savings and Credit Account). Members have to sign a standing order form to authorize the bank to deduct a fixed amount every month from their account and transfer it to SACA. At the end of the month, one of the members gets the amount collected in SACA and this cycle keeps going until all members receive their collective amount. Another study [58] presents the formalization of ROSCAs in Argentina by car dealers where an automobile serves as collateral against the debt to the ROSCA. All the payments are made through a bank and the bank makes the necessary risk assessment against the member who wins the pot. In case the winner doesn't fulfill the bank's requirements, their turn is forfeited and they have to wait until the end of the ROSCA cycle to get the car or an equivalent amount. A major concern associated with formal ROSCAs is the exclusion of the poor, as the formalization of ROSCAs can give rise to administrative charges and government taxes and may require steady income and some collateral which may be unacceptable or impossible for them [58] [38].

In terms of technological interventions to facilitate the traditional social structure of ROSCAs, we do not find published research but only scattered attempts by fintech startups. These include ChamaPesa and Chama Soft [14] in Kenya, FinLok [21] in India and Tanda by Yahoo in the USA. Chama Pesa [13] is an interest-based ROSCA model that works on the mutual social capital of its members. It uses blockchain models where the Chama Pesa application creates a microblockchain for each ROSCA and manages membership, bookkeeping, share issuance, payments, and loans between members. Tanda [52] works on an open-community model where anyone can join to save money. The application handles payouts in such a way that the first two people to receive their

money pay a fee, but the last payout position receives a 2% cash bonus. As a user participates in Tanda by making contributions, their 'Tanda score' is created and with higher-scores, the user gains access to higher-value saving-circles and earlier payout positions and if someone drops out, Tanda can step in to cover their positions. Most of these systems were specifically designed for particular local contexts and societies that have no problems with interest-based transactions. Most of them target literate users. As interest is deemed unlawful in Islam, interest-based models are not a good fit for Pakistan's Muslim-majority population.

3.3 Designing for the Low-Literate

As our work focuses on low-literate and tech-naive populations, it is imperative that we design inclusive technological solutions. Ibtasam et. al. [29] show that mere access to mobile applications is not enough for inclusion and propose to make mobile applications more learnable to increase their adoption and uptake. Grossman [27] argues that financial service providers currently do not design services catering to the specific needs of their user-base and adopt a one-size-fits-all approach. There is extensive literature on human-centered design, user interfaces, usability and learnability in the context of low-literate users. Medhi et al [44] [43] recommend text-free interface design over text-based designs to make the interfaces easier to use for low-literate and illiterate users. Video Kheti [17] employed audio and graphical guidance for low-literate users in smartphone interfaces. Similarly, Prayana used visual cues, reduced the textual entries and scrolling to make their financial management system usable for people with mixed literacies [47][46]. Researchers have also employed Interactive Voice Response Systems (IVRs) to make mobile services easier for users with literacy issues [56, 59]. Studies also suggest that the need for human mediation in using mobile applications could be reduced by providing side-by-side audio, video and textual help in the application [45].

4 METHODOLOGY

A typical ROSCA group consists of several members and one organizer who manages all the activities of the group. To understand the dynamics of ROSCAs and to explore the opportunities for their digitization, we conducted a qualitative research study with 80 participants including organizers, members, and non-members. We only focused on ROSCAs based on random-turn allocation as bidding ROSCAs are illegal according to Pakistani law. Bidding ROSCAs also involve interest, which is forbidden in Islam and as a result, these ROSCAs are not prevalent in the population, the majority of whom are Muslims. This study was conducted between early to mid 2018 after getting an approval from our Institutional Review Board.

4.1 Participant Recruitment and Study Details

We conducted one-on-one semi-structured interviews with 29 organizers, 41 members and 10 non-members. The sample was varied across gender, geographical location and ROSCA size[1] following the statistics provided by Financial Inclusion Insights Survey Data by Intermedia. FII's nationally representative data states that females constitute 66.66% of the total ROSCA participants. In terms of locations, 66.66% of the ROSCA activity occurs in urban regions, and 33.33% occurs in rural areas[31]. Participants were recruited using convenience and snowball sampling through our personal contacts and our partner micro-finance organizations. Survey participants included shopkeepers, housewives, office boys, male and female janitorial staff and working women. On the

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[1]ROSCA size is the amount being contributed by each member of ROSCA every month and it was classified into three categories small, medium and large. In small ROSCAs, each member contributes upto PKR 5000 (almost 30 USD) monthly, medium ROSCA members contribute PKR 5000 to PKR 10,000 (almost 60 USD) whereas the members contributing more than PKR 10,000 were categorized into large ROSCAs

basis of convenience in finding interview respondents and to ensure representation from across the Punjab province, we conducted interviews in three different districts of Punjab including Lahore, Multan and Rawalpindi. Table 1 provides a summary of our respondents and their responses.

The interviews were conducted by a team of 2 researchers. While one was conducting the interview the other was responsible for taking notes. Respondents were asked to talk in their preferred language (Urdu and Punjabi) and the interview audios were recorded with the respondent's consent. The interviews ranged from 25-45 minutes depending on the amount of details in participant responses and were conducted at the participant's preferred location (including their homes, offices, shops, other work places, and micro-finance offices).

4.2 Interview Design

We designed a semi-structured interview guide based on our information from the literature review and followup team brainstorming sessions. As we were to talk to people about their financial matters and saving behaviors, we framed our questions to be discrete and respectful so that the respondents do not feel pressurized to reveal information that they were not comfortable sharing. We designed our interview guide based on both the known and unknown points from existing literature. The purpose of including known findings was to verify them in the Pakistani context. Following are the key themes of our interview guide.

- Exploration of existing ROSCA dynamics
  - Formation and working
  - Role of Social Capital
  - Associated problems
  - Perceptions of ROSCA users of alternate saving mechanisms
- Use of technology and comfort-level with various modalities
  - Access and use of mobile phones and internet
  - Familiarity with mobile money and banking services

4.3 Data Analysis

All interview audios were transcribed in Urdu, to avoid the possibility of misinterpretation of data due to translation. We recruited male and female undergraduate students from our institution and trained them on how to transcribe the data. Sample audio was shared with all the students and they were asked to transcribe it following a set of guidelines provided to them. The lead researchers evaluated all the sample transcripts and shortlisted five students including 3 male and 2 female students for transcribing all 80 interview audios. The students were paid at the rate of PKR 100 (71 cents) for every 4 minutes of transcription.

We subjected our data to thematic analysis and the two lead researchers randomly picked the interview transcripts and started assigning codes. After assigning codes to a few transcripts, the researchers conducted discussion sessions to identify common codes and kept iterating accordingly. Unique names were assigned to the codes that were identified by both researchers but had different names. Once both researchers had agreed upon a standard coding framework, we started coding all the transcripts using the agreed-upon framework. QSR Nvivo was used for the data analysis and all the code assignments were made in QSR Nvivo.

5 FINDINGS

In this section, we present an analysis of the findings from our interviews. We show quantified themes of the responses and analyze commonalities and differences in behaviors, preferences, concerns and opportunities of members and organizers in ROSCA groups.

Category	Organizer	Member	Non-Member
Sample Size	29	40	11
Gender	Male: 10 Female: 19	Male: 18 Female: 22	Male: 4 Female: 7
Locality	Rural: 9 Urban: 20	Rural: 11 Urban: 29	Rural: 4 Urban: 7
Age Group	20-30:2 30-40:11 >40:16	20-30: 14 30-40: 18 >40: 8	20-30: 6 30-40: 4 >40: 1
ROSCA Size*	Small: 5 Medium: 16 Large: 8	Small: 21 Medium: 14 Large: 5	Not Applicable
Phone Ownership	Feature:10 Smart:18 Both:1 None:0	Feature: 13 Smart: 21 Both: 3 None: 3	Feature: 3 Smart: 7 Both:0 None:1
Previous OTC** Usage	Yes:8 No:21	Yes: 22 No: 18	Yes: 1 No: 10
Internet Usage	Yes:18 No:11	Yes:15 No:25	Yes:8 No:3
Mobile Wallet Ownership	Yes:6 No:23	Yes:5 No:35	Yes:0 No:11
Bank Account Ownership	Yes:15 No:14	Yes:25 No:15	Yes:7 No:4

Table 1. Participant's Profiles (*Small: up to PKR 5,000 per month, Medium: Between PKR 5,000 and 10,000, Large: greater than PKR 10,000, ** Over The Counter transactions through a mobile agent)

5.1 Formation of ROSCA Groups Social Capital

5.1.1 Existence of Strong Social Capital. Investigation of the role of social capital in ROSCAs was one of the primary goals of this research as the existing literature places great emphasis on it. There are two types of interactions where social capital was studied. The interaction between organizer and member, and interactions among the members. We observed that **social capital is a strong component in organizer-member interactions, whereas members do not necessarily know each other.** Interestingly, none of the ROSCA members reported knowing all other members of the group. Given the strong social ties between individual members and the organizer, the group meetings rarely take place. The face to face interaction remains only between the individual members and the organizer and they just pass by to submit or collect ROSCA money and there is no fixed time or frequency for these meetings. Knowing and trusting the ROSCA organizer is of immense significance to all members who were interviewed, as they trust the organizer with their finances. We observed that the members were mainly interested in the surety of their payments. Organizers exercise the discretion to add members to the group, who might be strangers to other members. Members do not have any problems with this, as long as the organizer ensures regular payments from each member and timely pot disbursements. A respondent said:

> "As we have to deal with money so I prefer keeping ROSCA with a person whom I know and trust very well. He [the organizer] ensures that I will get my money even if some other member of the group defaults."

On the other hand, organizers also reported recruiting members based on social capital. There were a few instances where organizers did not know the members directly and asked for a guarantor to testify to the trustworthiness of new individuals for them to be admitted to ROSCA groups. In case if the new member defaults, the guarantor bears the financial liability and this guarantee is mostly ensured by verbal agreements because of guarantors' strong social capital with the organizer.

5.1.2 Physical Proximity in ROSCA Group Formation. Physical proximity was seen as a key determinant of ROSCA group formation. Majority of the ROSCA groups engage relatives (who live nearby), neighbors or office colleagues. Members reported that when looking for a ROSCA group, they inquire among relatives, friends, neighbors or colleagues, who are known to participate in ROSCAs, to refer them to an existing group and usually they are able to find a group to join. In case a person cannot find a ROSCA group, they try to put together a new group and attempt to recruit members from within their friends, colleagues and family members. Henceforth, either the person takes the responsibility of being an organizer or asks someone else from the group to become one.

Members and organizers both prefer participating in ROSCAs with individuals they trust and know very well, as they think that financial dealings should only be conducted with people they trust. Factors that are deemed vital by both members and organizers to consider an individual trustworthy contribute directly to reducing the risk of fraud and include long-term relationships (before participation in ROSCAs), ownership of personal property or business in the locality (house or shop), and their reputation among community members. One way to reduce the risk of a member or organizer running away with funds is to look for people who own personal property in the area. Other ways of reducing the risk of fraud and default include reluctance in engaging individuals who live in rented spaces, are relatively new to the neighborhood or have a fluctuating income. A participant said:

> "A major point is that they live in your neighborhood for a long time and you know them quite well, there are no complaints about them in the community and they are known as good neighbors."

5.1.3 Preferred ROSCA Size and Duration. Group sizes are determined based on efforts to reduce financial risks although at the cost of increasing administrative burdens. The number of members in a ROSCA cycle are mostly decided solely by the organizers and in some cases through consultations between organizers and the members. Respondents reported between 10 to 30 members in their current groups with an average of around 16 members per group. Participants indicated a preference for ROSCAs that last for less than two years, and have 15-20 members. Participants shared general hesitation in engaging with ROSCAs that last longer than two years due to various uncertainties. Respondents expressed that with longer ROSCAs it is more probable that some members may pass away, move or lose their financial viability. Two respondents also indicated that the value of their money will decrease if they keep waiting for their ROSCA amount for a long time. Members think that long ROSCA cycles increase the administrative burden on organizers, and create delays in payments. A participant said:

> "Having more members in the ROSCA group increases the length of the ROSCA cycle. Life is unexpected and in my opinion, financial matters should not be extended over a long time. ROSCA is like a loan and it should be returned as soon as possible."

A few respondents expressed their preferences towards ROSCA groups with more than 20 members, but their motivation was primarily general-purpose saving and did not have any planned expenditures. Their justification is that pot-sizes get bigger as the number of participants increases.

5.2 Motivations to Join ROSCAs

Motivations for participation in ROSCAs are important as they can affect the flexibility of a member with respect to their turn in a group. This includes flexibility towards exchanging turns and the opportunities for us to design products associated with ROSCAs. Our findings on motivations towards taking part in ROSCAs confirmed existing literature. Figure 2 shows a summary of the motivations of people towards taking part in ROSCAs.

Forced or commitment-driven savings were reported as the primary reason for participation in ROSCAs. People think that they will not be able to save at home or bank where cash is readily accessible and can be spent easily. 37.5% of the respondents shared the lack of discipline in their saving habits as the primary reason for participating in ROSCAs. With ROSCAs, paying a set amount every month becomes a responsibility and the cumulative amount is only available at a decided time, thus decreasing its liquidity and chances of being spent. A participant said:

> *It is very difficult for a person like me to save money in daily life. If I will have some money in my bank account or pocket, I will spend it somewhere. ROSCA payment is like an obligation for me because I have to pay it every month. When I get my salary, the first thing I do is to make the ROSCA payment and eventually I get the cumulative amount on my turn."*

Purchasing durable goods was reported by 24 out of 80 (30%) respondents as a motivation towards participation in ROSCAs. Durable goods include household items like refrigerator, television, air conditioner as well as car or motorcycle. A participant said:

> *"I bought furniture with my ROSCA money and my mother also bought many things like a fridge, microwave oven, and stove by participating in ROSCAs. We always take part in ROSCAs with a motivation that we will buy some household item with this money."*

Another reason to take part in ROSCAs is to raise capital for starting a new business or expanding an existing business. An earlier pot constitutes net borrowing (without the cost of capital) that business owners can invest in their business, and is considered better than acquiring an interest-based loan. Participants with this motivation have a preference for an earlier turn as they comprehend the time value of money and are also in control of how the return will be generated. 27.5% respondents reported building a house or buying property as their motivation to participate in ROSCAs. A participant said:

> *"One of the major benefits of ROSCAs is that you can raise some capital that can be used for a purpose that needs plenty of money like buying a piece of land or building a house fully or partially."*

ROSCA pots are also utilized to cover the complete or partial expenses of children's wedding (dowry or wedding party) or education. As the time of the wedding and school dues are often predetermined or known in advance, the turns are requested to coincide with these expected expenditures. When ROSCA participation is linked to payment obligations with certain due dates, it becomes time-sensitive. Lastly, 17.5% of the respondents reported ROSCAs as a means to fulfill religious obligations such as a full or short pilgrimage to Mecca for themselves or their parents, or for buying an animal to sacrifice on the Eid-ul-Adha.

5.3 Turn Assignment in ROSCAs

Turn assignment is defined as the allocation of monthly pots to the members of the ROSCA. Existing literature suggests that lucky draw and need-based assignment are the two ways of assigning pots
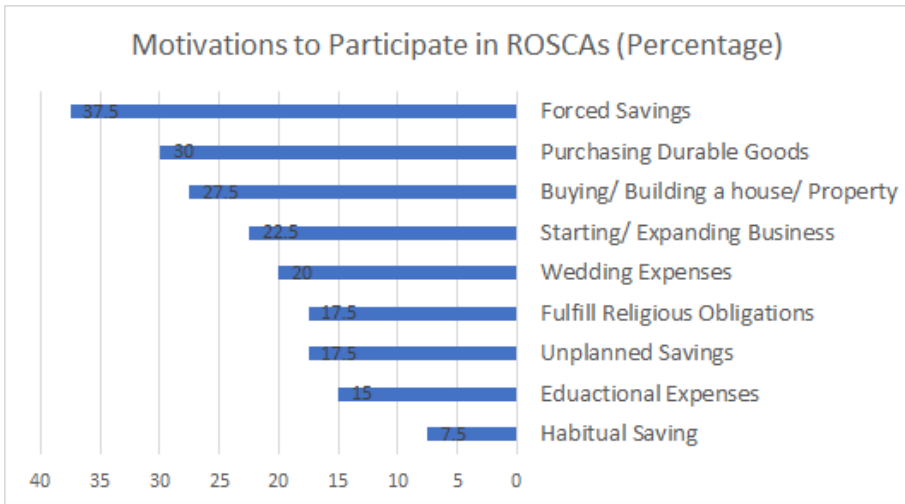
Fig. 2. Motivations for Participation in ROSCAs

but we identified a third method, *priority-based assignment* during our field research but it was not very common.

5.3.1 Lucky Draw. **The most common method of assigning turns is through lucky-draws as 58% of the respondents reported using this method.** To conduct a lucky draw, the names of the members are written on small pieces of paper, folded, shuffled and then drawn out randomly. The person whose name is picked out first gets the first turn, and so on. Furthermore, there are two ways of conducting a lucky draw; either it is conducted once at the start of the ROSCA cycle where all the turns are decided at once, or it is conducted every month and the winner for that particular month is decided. In the following months, the names of the members who have already received their pot are excluded from the lucky draw. Regardless of the timing of the lucky-draw, in almost all groups organizer takes the first pot as a reward for managing the ROSCA group. Participants preferred the lucky draw to be at the beginning of the ROSCA cycle as knowing in advance about the month in which they will get paid helps plan their expenses accordingly.

5.3.2 Need-based Assignment. The need-based assignment involves determining turns based on financial need, or whoever is the first to request pot in a particular month. Lucky draws are not conducted as pot months are assigned to members based on their need. If more than one members require the pot in any particular month, the organizer subjectively decides on whose need is more crucial and deserves to be prioritized, or the organizer and members mutually decide and reach an agreement. It is interesting to see that need-based assignments were more common among large ROSCA groups as 35% of the respondents reported using need-based assignment method and out of this 70% were from larger value groups.

5.3.3 Priority-based Assignment. In this method, a person with more shares in the ROSCA group gets a priority. For example, a person having four shares in one group will be given two shares at the very beginning, one in the middle and the remaining one at the end of the cycle. This pot assignment method is not very popular as only 7% of our respondents reported ever using this.

5.4 Exchanging ROSCA Turns: A Popular Approach in ROSCAs

Exchange of turns can be defined as swapping ROSCA turns between two members of the group with their mutual consent. It was seen as a common pattern in ROSCA groups regardless of the gender or locality, as **80% of our respondents mentioned the trend of exchanging turns in their groups.** If a member is in urgent need of money but their turn is scheduled for later, they can request the group for an exchange of turn. The member requesting exchange contacts the organizer to exchange turns, who then talks to the relevant member who holds the current turn. They may also contact the relevant member directly if they know them personally. People also exchange turns with unknown members through the organizer's recommendation. In some ROSCAs, where turns are decided through monthly lucky draw if a person has an urgent need and majority of the members agree with giving them the turn, no lucky draw is conducted for that month. Members reported exchanging their turns with other members if they (themselves) do not have an urgent need. Some needs which are considered most important include the wedding of a member's daughter or sister, death of a close relative or a medical emergency. Often the qualification for turn-exchange in case of above-mentioned needs is an agreed-upon group rule that members must comply with. A participant said:

> "In our group, there are only two conditions in which an exchange is possible. First, if a person has some medical emergency or death in their family and second if there is the marriage of some group member's daughter or sister. In both cases, the turn is exchanged without any arguments."

5.5 Management of Money in ROSCAs

5.5.1 Pot Collection and Distribution. Management of money in ROSCA groups includes the collection of the monthly contribution of payments from individual members and the disbursement of the pot to the relevant member whose pot is due in a particular month. **The collection and distribution of money is solely the responsibility of an organizer and it is one of the core functions of a ROSCA.** ROSCAs follow two types of collection models i.e a monthly collection model where the members are supposed to submit their amount by a due-date once a month whereas in the daily collection model, the monthly amount is divided on days and the organizer collects the amount on daily basis. In the monthly collection model, members have to pay their contributions between the 5th to 10th of every month. However, this deadline is not observed rigidly. In most cases, the organizer has to visit the members to collect the payment whereas few members pay a visit to the organizer to submit their payment. Members also reported sending their cash payments to the organizer via a trusted individual. Such personal transactions are common in low-income groups as they are considered safe and there are no extra charges associated with them. Organizers reported pot collection as one of the most time-consuming tasks during the ROSCA cycle. 6.25% organizers even mentioned pot collection as the most difficult part of the ROSCA management. Since female organizers face mobility challenges due to women's mobility issues in Pakistan [30], they tend to be accompanied by their male counterpart in the family for this collection and distribution exercise. We also inquired from the organizers about the mode of payment prevalent in their groups, the associated reasons for the stated modes, and their preferred mode. Below, we report the variations that we found in the pot collection methods among groups of different sizes.

5.5.2 Modes of ROSCA Payments. Our data indicates cash-based transactions to be highly prevalent in ROSCA groups as 65% of the respondents report paying their contributions as cash. Preference for cash is driven by the source of income particularly among low-income members who do not possess formal bank accounts and receive their salaries as cash. For groups constituting housewives,

respondents shared that they receive money from their husbands as cash and therefore prefer paying their ROSCA contribution from their household budget as cash as well. Cash-based transactions have certain problems associated with them but people still prefer them. A female respondent reported receiving counterfeit currency notes from a member. Because payment trail is easily lost in cash, she could not recall who paid those particular currency notes and therefore incurred a loss. However, she still preferred conducting cash transactions because majority of the members pay in cash and she is quite aged and can't travel back and forth to access her bank account.

We came across ROSCA groups that had members living across different cities or living within the same city but at a great distance from other group members. Such members are part of the group either due to their strong ties with the organizer (as a relative or a close friend) or because they were part of the group before relocation. Hence, these members are left with two options either to send money through someone they know or transfer pot amount via online transaction. For example, a respondent mentioned that a member transfers the pot amount to her bank account. She said:

> "One of my ROSCA members lives in another city so she transfers the ROSCA amount to my account via online banking."

36% organizers received pot payments via a combination of different methods including cheques, online transfer, mobile money to facilitate members despite physical proximity. This trend was observed in high-income groups and these groups had large ROSCAs (greater than PKR 10000). Some respondents who had access to mobile wallets reported not using these wallets for ROSCA transaction because of the associated transaction charges. One respondent stated that online transaction is so convenient that the members who transfer pot amount via online transaction are often the first ones to submit their pot every month.

5.6 Record Keeping and Rules in ROSCAs

5.6.1 Record Keeping: A Major Task in ROSCAs. Keeping records for ROSCA involves a written record of ROSCA payments, dates and pot allocations. Our data shows that 65% of the members do not maintain a written record of their ROSCA payments and only make mental notes, whereas 35% members reported keeping a record of their ROSCA payments on their notebooks. A major reason for not keeping records was the trust on the organizer. A respondent said:

> "I have never kept any record with me. The organizer is a good friend of mine, so I trust him and rely on his record."

14 participants mentioned keeping a record of their ROSCA transactions and, interestingly, 11 of these were females. No payment receipts are given to the members by the organizers and they just rely on verbal agreements, whereas 3 members reported using cards (each ROSCA transaction is recorded on these cards and organizer signature validates it) for ROSCA record-keeping and all of these were females. The cards are used as records as well as receipts and are made for individual members. They get them signed by the organizer after submitting the amount.

We observed that the organizers maintained their record in one of the two formats: manual and digital. 81% respondents kept a manual record on notebooks, ledgers, etc., while 5% respondents stated that they have made digital records using spreadsheets whereas 14% maintained no record. Figure 3 (left) shows the copy of an organizer with records of ROSCA payments. Some respondents stated that they don't maintain records because they can remember everything. Respondents also mentioned that they regularly update the records, which also increases the chances of errors. Low-literate respondents reported seeking assistance from someone in their family to maintain records as they could not do it on their own. This assistance in record maintaining also left the transaction
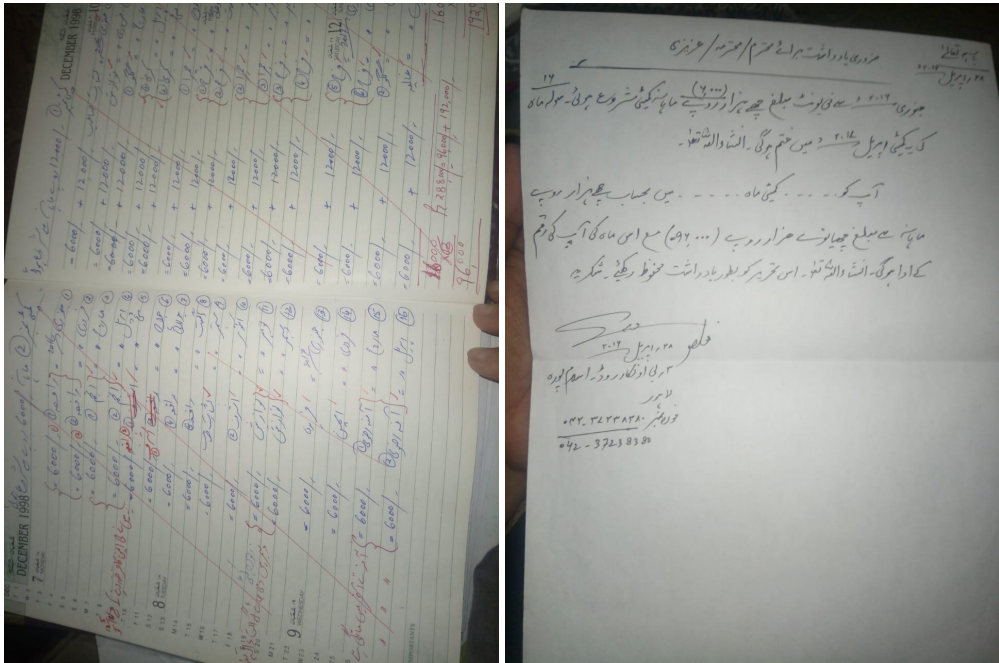
Fig. 3. Copy of a ROSCA organizer's record book (left), written agreement used by an organizer (right)

history of the members vulnerable in front of a non-member of the group, hence compromising privacy.

5.6.2   Rules and Legal Bindings. Rules are created to define the functioning of the group, especially aspects which could lead to disagreements. These rules differ across ROSCA groups. It was seen that the majority of the ROSCA groups have very basic rules, which include the deadline to pay the amount, methods of pot assignment and exchange policies. These ROSCA groups are regulated by verbal rules and written rules are not considered necessary because of the social capital among members and organizers. However, the rules are made to maintain discipline in the group depending upon the demographics like large ROSCA groups have the rule to have collateral in the form of legal documents. Figure 3 (right) shows the copy of the agreement used by a ROSCA organizer. On the contrary small/medium ROSCA groups don't have such rules because of the trust among members and organizers. A participant said:

> "We tell the group rules to the members like they have to pay the amount by a set date and they might be penalized in case of delay in payment. Also, we tell them that if you will follow the rules strictly, we will cooperate with you in case of turn exchange."

5.7   Problems Associated with ROSCAs

5.7.1   Fraud: Denial of Payment after Receiving Pot Amount. One form of ROSCA fraud reported in the literature is when a person refuses to pay the ROSCA amount after receiving their pot amount. Literature indicates fraud as one of the main concerns in ROSCAs, therefore, we included it in the scope of our exploration. **Interestingly, none of our respondents had experienced any fraud in ROSCAs but a majority had heard of it from others.** Further, only 5 respondents reported

the stories of fraud that happened with someone whom they knew personally, the rest were based on hearsay. Despite having heard of instances of frauds in ROSCAs, respondents were not concerned about the possibility of fraud in their group. This owed to the strong trust in organizers, as the individuals who are selected for the role are trustworthy and close acquaintances of members, which reduces the risk of frauds. This trust was further strengthened by promises from the organizers to take full responsibility in case of default or late payments by other members. We even came across cases where the organizers used their personal funds to make payments after a member defaulted. A participant said:

> "We take part in ROSCA because of the reliability and authenticity of the ROSCA organizer and being a reliable person the organizer takes the responsibility, if any person commits fraud, and pays the amount from their own pocket"

5.7.2 Delayed Payments: A common Issue in ROSCAs. Delay in payments was found to be quite common in ROSCAs as over half of the respondents reported having delayed their ROSCA payment at some point of time, but these delays were not habitual, they were rather triggered by unexpected situations. Reasons for delay in payments include delay in salary, some emergency financial need, being out of town, etc.

Members reported that they inform the organizer beforehand about the expected delay in payment and request them to accommodate them for the particular month. Organizers act as a buffer and utilize their personal funds to contribute towards the pot to ensure timely pot allocation while they wait for the member to make the actual payment. A participant said:

> "In case my salary is delayed or there is some other financial issue, I borrow the money from some friend or colleague and pay the ROSCA pot on time so that there is no issue in the smooth functioning of the ROSCA."

We see organizers using various kinds of penalties to discourage late payments. One of them is to impose some fine after the due date but only 27% of the member respondents reported having to pay these fines. **As ROSCAs work in close social circles so it is considered inappropriate to impose a fine or penalty on people they have known for years as friends or colleagues.**. Organizers, therefore, reported resorting to non-monetary penalties. As reported by a member, to penalize delayed payments organizers either exclude the member who delayed payment from that particular month's lucky draw or they are given the pot later than their decided turn (if the turns were decided earlier).

Once payment has been delayed, the organizer bridges the gap by personally paying the installment and collecting the amount from the member later on. Therefore, organizers need to keep funds available to bridge the gap caused by delayed payments. If a member delays payments frequently, it affects their reputation. We observed that delays are often inevitable, and can be either habitual or isolated and not entirely in control of the members. The habitual members can be easily spotted and it affects their chances of being recruited again in the next cycle.

Our findings reveal that the organizer-member social capital plays an important role in the smooth functioning of the ROSCAs and the organizer is the most influential person in the entire ROSCA group. The motivations of people towards participation in ROSCAs in our study were very similar to those reported by research conducted in other parts of the globe. Organizer being the key stakeholder in a ROSCA group has to take all the major responsibilities like recruitment of members, turn allocation, record-keeping, collection and distribution of money, and conflict management. Organizers reported record-keeping and money collection and distribution as quite difficult tasks and these tasks become more complex if the organizer has literacy issues. Existing literature reports frauds as a common issue in ROSCAs but none of our study participants reported

facing them. Delayed payments were reported as a common issue in ROSCAs and this issue arises because of the informal nature of ROSCA and strong social ties between the members and the organizer.

6 DESIGN AND DEVELOPMENT OF DIGITAL ROSCA

During the field research, we found few limitations in the conventional ROSCA groups including the lack of record-keeping and transparency among members, proximity issues for females in collection and distribution and limited involvement of members in groups. Most of the activities in ROSCA groups are organizer-dependent therefore, member's role is limited to submitting their monthly contribution and receiving the total pot amount when it is their turn. As 62% of the interviewed organizers owned a smartphone, we decided to start with the design of a smartphone-based Digital ROSCA solution to facilitate both the organizers and members in managing their ROSCA. Other important aspects that played a role in the selection of platform for design of the Digital ROSCA are the breadth of uses cases (e.g. group creation, pot allocation, turn exchange etc.) and the complexity associated with entering and managing of information of about 10 to 24 group members in any one group for 12 to 24 month cycles. Smartphones are the only platforms with the requisite physical real estate available to present and manage this information. Although, such design excludes non-smartphone ROSCA participants for now, future work can include accommodating the organizer and member flows on IVR or USSD to the extent possible. Following the iterative design process, we designed and developed a fully functional prototype for the Digital ROSCA on Android platform. The Digital ROSCA application supports all major functions of ROSCA including group creation, pot assignment and exchange, cash flow management and record keeping. The Digital ROSCA application has two modules, one for ROSCA organizers and the other for members. Details of the design and development of the application are explained in this section.

6.1 Designing for Low-Literate Users

Considering that the main audience of this research comprises low-literate and low-income communities, the application interface was designed to be usable and learnable for low-literate users.

6.1.1 Icon Design Process. The icons of the application were designed through an iterative design process and tested with 5 respondents including 3 males and 2 females. We came up with multiple designs for the same icons and employed the in-context and out-of-context icons testing methods for their testing. [22] During the out-of-context testing, users were shown the icons in isolation and asked for their interpretation of the icons whereas during the in-context testing, icons were shown as part of the actual interface and user feedback was collected. For icons not easily comprehended by the users, we sought user suggestions on what would be a more suitable icon for the given functionality and redesigned icons accordingly. Figures 4 and 5 show how the icon designs emerged after incorporating user feedback.

6.1.2 Audio Help Option. Multiple techniques have been employed by HCI researchers to make the interfaces usable and learnable for low-literate users including text-free interfaces, audio, and video help methods [29, 44, 45]. We used the audio help technique for each interface item, as a similar technique has already been used by Ibtasam et al. [29] where they argue that such help technique makes the interfaces learnable for the respondents who have issues with literacy. Figures 4 and 5 show how this audio help technique was used in each interface item. The audio cues were recorded in Urdu (Pakistan's national language) and the audio was played when users tap on the speaker button briefly explaining the interface item.

Fig. 4. The users were unable to relate the initial icon (left) with pot collection and so the later designs emerged from discussions with users

Fig. 5. The initial two icons (left) were difficult to understand and the users reported them as the icons for some game, so we redesigned them

6.2 Social Model and Group Creation in Digital ROSCA

Digital ROSCA aims to have the features translated from traditional ROSCAs so we designed it around the existing social model. All the use cases for Digital ROSCA application were designed based on our findings from the field research. The testing of the initial designs was iteratively carried out in the lab and evaluation with the actual users was done during the User Testing phase. The Digital ROSCA application facilitates the creation of ROSCA groups through social ties between organizers and members. Similarly, as it is evident from our findings that the organizer is the most influential person in the ROSCA group and has to perform all the major duties of the ROSCA group; the Digital ROSCA model is, therefore, designed mainly to facilitate the organizer while catering to members as well. There are two modules of the application, one for the organizer and the other for the member. While a user can be organizer of a group as well as be member in other groups using the application, the organizer's module has more features associated with it. Similar to the traditional ROSCA model, the organizer takes the initiative of starting a new ROSCA group using their social links.

Digital ROSCA application facilitates the group creation process digitally where the organizer takes the lead in creating a group by adding all the details of ROSCA like "name", "amount", "number of months", "due dates for payment" and "group rules" and then sends the invites to the members by selecting their phone numbers from his/her phone-book. The invitations are sent to members via SMS and members can accept or reject these invitations by logging-in to the member module of Digital ROSCA application. Figure 6 shows the group creation process on the organizer's end.
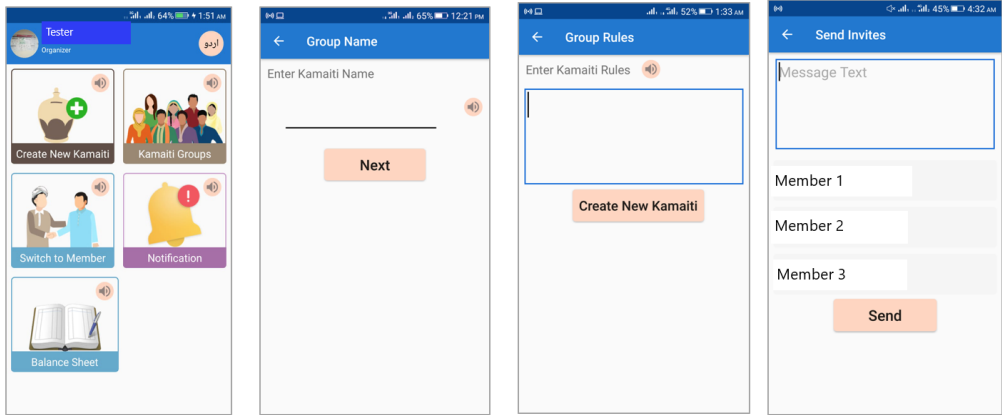
Fig. 6. The process of ROSCA group creation by the organizer using Digital ROSCA application

6.3 Facilitating Turn Assignment and Exchange

During the field research, we identified that lucky-draw and need-based assignment were the most commonly used pot assignment methods in traditional ROSCAs. Building on top of that, we introduced the digital lucky-draw method in Digital ROSCA application. Once all the members have responded to the invitation requests, the organizer can start the ROSCA group and conduct the pot assignment through lucky-draw. The system generates a random list of ROSCA members and assigns them to months in the ROSCA cycle. The organizer and members can both see this pot allocation through the application where the organizer has no control over these allocations. The system follows this pot allocation list for disbursing the payments.

On the other hand, turn allocation orders could be changed by following the pot exchange process similar to traditional ROSCAs. The Digital ROSCA application facilitates the entire turn exchange process where the member has an option in the application to initiate a turn exchange request. This turn exchange request lands on the organizer's application where the organizer has the discretion to accept or reject this request. In case the organizer accepts this request, it is forwarded to the concerned member, who holds the current, turn for their approval. The turn allocation list is updated if the member accepts this request and the turns of the two members are swapped with each other. Figure 7 shows the turn exchange process.

6.4 Money Management in Digital ROSCA

As discussed earlier in the findings section, the majority of the traditional ROSCAs deal with physical cash for pot collection and disbursement. Collecting, managing and disbursing the physical cash increases the complexity of work for the organizer in many cases. While we were thinking of money management option for Digital ROSCA application, one option was to replace the physical cash with digital cash by linking the application with branchless banking wallets/accounts. During the brainstorming sessions, we came across a risk that replacing physical cash entirely with the digital one might exclude many people as the majority of low-literate and low-income people do not have the access to bank accounts or mobile wallets. To overcome this issue, we decided to facilitate both physical and digital payment methods. The ROSCA application requires an organizer to have a mobile wallet for managing a ROSCA but it is optional for the members to have a mobile wallet.
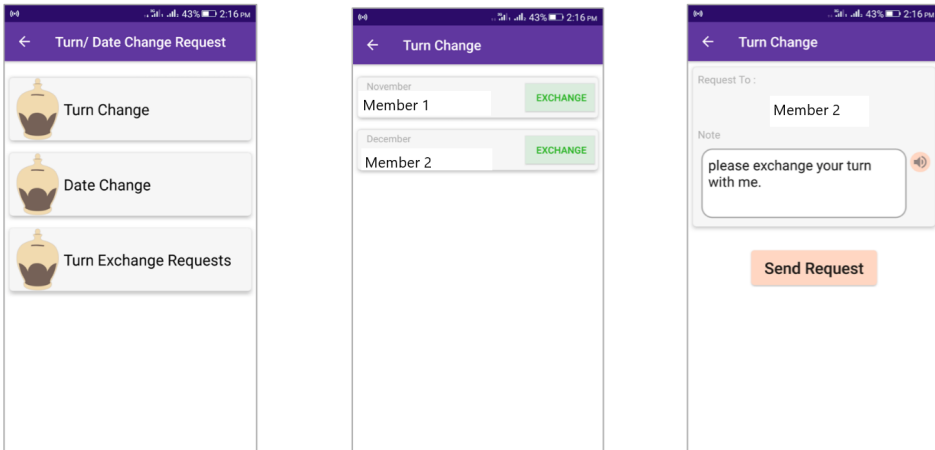
Fig. 7. The process of turn exchange where a member can initiate a request to exchange the pot with any other ROSCA member by organizer mediation

To support digital payments in the ROSCA app, we built a simulated mobile money environment called UW-Pesa. We designed UW-Pesa as a small-scale research prototype, mimicking real-world mobile money systems. UW-Pesa supports basic common mobile-money operations like opening an account, viewing the balance, making a transaction to another UW-Pesa user, and depositing or withdrawing money through a UW-Pesa agent. We also added ROSCA-specific APIs to UW-Pesa to enable seamless integration between UW-Pesa and our application Digital ROSCA. The integration provides automatic account creation (when a new user creates an account on the ROSCA app, UW-Pesa account is automatically created for the user) and ability to make ROSCA payments digitally through the UW-Pesa account.

When the ROSCA members have to pay, they can choose to pay with cash or digitally through their UW-Pesa account. If a member pays with UW-Pesa, the amount is transferred to the ROSCA organizer's UW-Pesa account and is automatically logged in the Digital ROSCA app; thus, the organizer does not need to verify the Digital ROSCA payments. If the member makes the payment using cash, the payment is logged in the ROSCA app, but with a pending status, which means that the organizer needs to check the payment and confirm that they have received the payment. The organizer can also disburse the pot to the relevant member using the member's preferred method (either cash or UW-Pesa). Figure 8 shows the money management aspect of Digital ROSCA application.

6.5 Design for Convenient Record Keeping

As discussed earlier, record-keeping is one of the major responsibilities of an organizer of the ROSCA groups. Record-keeping in traditional ROSCAs is quite resource-intensive in terms of an organizer's time and it becomes even more challenging when the organizers are low-literate. We also observed that few literate organizers were using spreadsheets for digital record-keeping but when it comes to repeated and frequent updates of this record, it again becomes difficult. Digital ROSCA application facilitates the entire-record keeping process for both the organizers and members. All of the ROSCA-related data is stored digitally and updated automatically in case of any change. The records are visible to both the organizer and member in their respective interfaces.
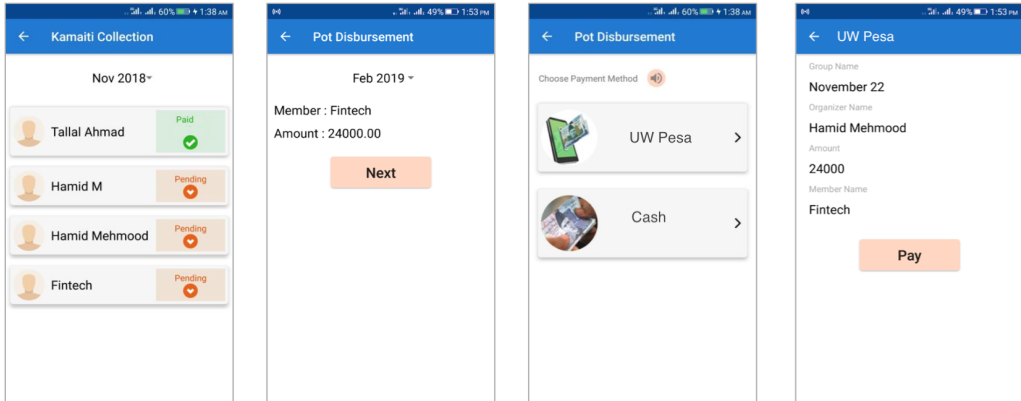
Fig. 8. Money management in Digital ROSCA along with payment methods for pot submission and disbursement

The members can see their ROSCA turn, payment history, and upcoming payments whereas the organizers can see the details of the entire group. Record keeping in Digital ROSCA application also eliminates the need for using paper and pen methods.

6.6 Rules and Legal Bindings

As the ROSCA groups are based on social relationships, most of the times they are administered through verbal rules and guidelines while a few groups have written rules and agreements. Digital ROSCA application has the option of adding group rules by organizer at the time of group creation. These rules can be manually added by the organizer and the invitation acceptance on member's end implies that the member has also agreed to these rules. During the field research, delayed payments were reported as a major concern but there were no strict rules to overcome this issue and strong social capital was reported as a reason for not penalizing the members on delayed payments. Digital ROSCA application is currently not imposing any penalties on delayed payments but instead, a record of all the payments is being maintained. Every payment from the ROSCA members is tagged as on-time or delayed and we aim to use this record for credit-rating of ROSCA users in the future versions of the Digital ROSCA. These credit ratings may increase access to formal borrowing for individuals. Alternatively, those who default would risk receiving a poor credit rating, which may restrict them from future ROSCA participation.

6.7 Alternative Designs for Digital ROSCAs

Before designing a Digital ROSCA stand-alone application, other alternatives which were carefully considered and critically evaluated include platforms with wider penetration like messenger apps and e-wallets. We provide an assessment of the features that cannot be facilitated in Digital ROSCA through Whatsapp and the limitations of mobile money wallets. We considered the various features that would be difficult to achieve in Whatsapp and have been developed in the Digital ROSCA app. For managing a ROSCA group on Whatsapp, the organizer will need to create and maintain a single group window and N private windows where N is the number of group members and ranges from 12 to 24 in our observations. Secondly, for group creation, the organizer has an option to invite members to the ROSCA-group which can also be achieved through Whatsapp by creating a group and inviting members. But Digital ROSCA app has the advanced functionality where an

organizer can define the due dates for payment, start and end dates and group rules. Once all the members review and accept the invitations, all ROSCA related functions are displayed on the home screen and only then a ROSCA cycle can start. Thirdly, the group topology of Whatsapp implies that all members of the group know each other or are comfortable sharing information whereas in ROSCAs, all people do not know each other and a common group window is not suited as it hinders privacy of group members. The sharing stream features of social media apps prove to be a nuisance for users in case of financial transactions as they compromise privacy [12] required by users in ROSCAs, especially women, wanting to keep their savings hidden from others. Fourthly, money management and record-keeping are simplified and less error-prone in Digital ROSCA application which allows for recording of both cash and digital payments as they happen while also displaying the payment history of each group along with dates indicating people who have paid and have yet to pay. It also allows sending reminders from the same screen to those who have not yet paid for the current cycle. Whereas in Whatsapp, each member will individually communicate about their payment within a group or in individual threads. The organizer will have to carry out the tedious navigation of a long chat history where information is heterogeneous and chronologically arranged. Payments, exchange, and records of every transaction will need to be manually maintained which is again prone to errors in noting and completion. And last but not the least, reminders for payments need to be sent by the organizer. The Digital ROSCA app creates a barrier where it pretends that the app is sending the reminders but Whatsapp does not afford this barrier. One aspect where we find Whatsapp and Digital ROSCA app to be comparable is pot allocation. For pot allocation within a Whatsapp group, the organizer will have to make a video of paper lucky draw and send to the group whereas Digital ROSCA application algorithmically conducts the pot allocation and it is displayed to all members in the group.

Similarly, e-wallets of branchless banking players have certain limitations associated by design such as being a wallet subscriber is a prerequisite to using these applications and they have a rather cumbersome cash transaction process of Over-The-Counter transactions through an agent rather than in-person between the organizer and member. Currently, no e-wallet applications offer Digital ROSCAs in Pakistan. Even if the e-wallets were to offer Digital ROSCA modules within their applications, only users subscribing to the particular e-wallet offering Digital ROSCA can participate in the use of such an application which then excludes other members of the group who are not likely to be users of the same wallet application or any e-wallet at all. A standalone Digital ROSCA application is payment method agnostic while offering customized features essential to the operation of ROSCAs.

7 EVALUATION OF DIGITAL ROSCA

The evaluation of the Digital ROSCA application was carried out to test the usability and functionality of the application as well as to get an understanding of what value Digital ROSCA application brings as compared to the traditional ROSCAs.

7.1 Testing Methodology

User testing was carried out with 3 ROSCA groups consisting of 5 members per group, where the groups were recruited based on the following criteria.

- Gender (2 groups consisted of all men as members, whereas 1 consisted of all women as members)
- Education (Primary (up to 5th grade) to Graduation (12th grade))
- Age (20 to 45 years)

- Smartphone ownership (since the Digital ROSCA is a smartphone-based application, we only recruited people who were smartphone users)
- Familiarity with ROSCAs

Testing was carried out in two phases, the first phase included a face-to-face session with the participants where participants were given a verbal overview of the application and were asked to complete the sign-up task of the application to gauge usability. During the second phase, we left the application with the participants along with a list of tasks to complete at their leisure time. We replicated the complete ROSCA cycle in this phase but tweaked it to fit within the testing duration since we couldn't run the testing cycle for several months. Phase 2 lasted a few days in which a whole ROSCA cycle was completed, equating each day with a month of normal ROSCA cycle.

7.1.1   Phase-1: One-on-One Testing. At the start of the session, a verbal demo of the application was presented to the participants by the researchers to introduce them to the basic features of Digital ROSCA. Participants were informed about the availability of the audio help feature throughout the interface to help them understand the purpose of a particular interface item. A pre-usability interview was conducted to establish the profiles of the participants by collecting information like basic demographics, technology usage and ROSCA participation. Digital ROSCA application was installed on participants' phones, and they were asked to create their accounts on the application. Once the participants had successfully created their accounts, they were asked to complete the following activities:

- Organizers were asked to create a new ROSCA group by filling all the information fields required for group creation. The members of the group were either the organizer's acquaintances or were recruited by the researchers and the contact information was provided to the organizers.
- After creating the group, organizers were asked to send invites to the members who had agreed to participate in the testing. Phone numbers of the concerned members were provided to the organizer to send the invitations .
- After sending the invites, the organizers were assigned a list of tasks (discussed below) and they were required to complete a short ROSCA cycle for 5 days by completing those tasks.
- Members were asked to check for any invitations received from the organizer and accept these invites. After accepting the invites, members were provided with a list of tasks and were required to complete a short ROSCA cycle for 5 days by completing those tasks.

7.1.2   Phase-2: Completion of a ROSCA Cycle. A typical ROSCA cycle spans several months, usually the number of months being equal to the number of members in the group. Our testing aimed at completing an entire ROSCA cycle. As we had 5 members in the ROSCA group, we decided to consider one day as one month and completed the ROSCA cycle in 5 days. As explained above, after installing the application on the participants' phones and initiating a ROSCA group, we left the app with the participants and asked them to complete a 5-day ROSCA cycle.

Following is the list of tasks that the organizers were required to complete over the period of 5 days.

- Approve the members who have accepted the invitations to join the ROSCA group and start the ROSCA cycle;
- Generate pot allocation list;
- Collect the pot amount each day and send reminders;
- Review the pot exchange requests initiated by members and respond to these requests;
- Disburse ROSCA payment to the concerned member on daily basis.

Once the members receive the notification from the organizer that the ROSCA has started, they will be required to complete the following tasks.

- View the pot allocation list generated by the application to check their turn to collect the pot amount
- Submit the pot amount to the organizer for each month on daily basis
- Initiate a turn exchange request in any month, write a note (the reason for requesting exchange of turn) and send it

7.2 Findings based on User Testing

The findings from the testing phase of Digital ROSCA are categorized as follows:

7.2.1 Icons and Audio Help are Usable for Low-Literate Users. Textual terms, icons and audio help included in the application were found to be user-friendly and were understood by the participants. We were monitoring each user's navigation through the application both during one-on-one sessions and remote testing. We found that navigation through the application was easy as participants were able to complete the required tasks. 5 out of 15 participants were educated and used the application in English whereas others browsed through both English and Urdu language interfaces. Participants with literacy issues reported successfully navigating both English and Urdu interfaces with the help of self-explanatory icons and audio cues.

7.2.2 Preference of Cash Payments Over Simulated Mobile Money. During testing, the majority of the participants used the cash payment option to make their ROSCA payments instead of using UW-Pesa. Although they were briefed about UW-Pesa being a payment option at the beginning of the testing session, only 4 out of 15 participants used it. The 4 participants who paid through UW-Pesa for their pot submission, only made two payments through it and made the rest of the payments in cash. Few participants who paid cash were curious about simulated mobile money system and inquired about it. During the post-usability interview, we asked participants the reasons for switching from UW-Pesa to cash payments. They reported that they found paying in cash and UW-Pesa the same so they randomly chose one of them. Few participants also reported unfamiliarity with UW-Pesa option and how it works so they preferred the known option - cash.

7.2.3 Technology Assisting in Handling Delayed Payments. The Digital ROSCA platform sends push notification and SMS-based alerts to participants for all activities. All participants mentioned SMS alerts as a useful feature of the application. The organizers found it particularly convenient as it reduced their effort of communicating with members through phone calls or via in-person visits. Organizers preferred the push notifications and SMS reminders for late payments because they could avoid the social embarrassment of reminding people personally for payments. Organizers reported that it is embarrassing for them to repeatedly ask people in their close social circle for payments. Sending the reminders through the application makes it appear as if the alerts are being generated by the system without any involvement of the organizer. We can relate this behavior with the concept of "Blame it on Technology", where people initiate a certain action on their own but report it to others as having being initiated by the system. Interestingly, 2 members also asked us during the post-testing interview whether the payment reminder messages were being sent by the organizers or the system. Their perception was that these are system-generated messages. One of these members reported that he was busy and wanted to submit his ROSCA amount later but frequent payment messages convinced him to take out the time and make the payment to avoid further messages.

7.2.4 Facilitation for Female Organizers. A female organizer was very appreciative of the pot collection feature of the Digital ROSCA application. She reported that pot collection is a difficult task for female organizers in traditional ROSCAs because of mobility issues. Chasing members to make timely payments becomes very difficult as they cannot visit them frequently, and therefore, rely on male members of their family to accompany them for payment collection, decreasing the privacy of payments and members. They reported that the push notifications and SMS reminders, along with digital pot collection will help female organizers overcome the above-mentioned issues.

7.2.5 Record Keeping. Digital ROSCA was designed to facilitate record-keeping for ROSCA organizers and members. Hence, we sought feedback on this feature from the participants during the post-testing interviews. All the participants, members and, organizers, appreciated the record-keeping feature of the application. The organizers, in particular, mentioned it as a vital function of the application. An organizer mentioned that during traditional ROSCA cycles, she has to maintain all the record on a notebook and has to update it as the ROSCA cycle moves forward. She also reported making receipts for ROSCA payments and having them signed by the members, but with Digital ROSCA she can manage everything on her mobile phone without the hassle of making manual records and updating them. The records for both members and organizers increase the transparency in ROSCA groups according to members as they can see their payment history. It also reduces the workload of organizers of handing out receipts every month to all members. Transparency and reduced workload were reported as an added benefit of Digital ROSCA over traditional ROSCA.

7.3 Challenges Faced During Testing

During participant recruitment for testing, we faced two major challenges. The first was finding women who own smartphones and the second was lack of permission for women to participate in the research by their family members. Initially, women agreed to participate but later they refused to be the part of the study because their family did not allow them. Since there is already low phone ownership among women in Pakistan, it was quite challenging for us to find women who are low-literate, own a smartphone and are also allowed by their families to participate in research.

8 DISCUSSION

This research aimed to explore the working of traditional ROSCAs in Pakistan and identify design opportunities for Digital ROSCAs while keeping the affordances of traditional ROSCAs intact. We followed the Human-Centered Design approach and conducted a qualitative study with 80 individuals including ROSCA organizers, members and, non-members to understand the working of ROSCAs, the role of social capital and the associated problems. Based on our findings from the qualitative field research, we designed a smartphone-based Digital ROSCA application to strengthen the implementation of traditional ROSCAs and overcome the associated issues. The Digital ROSCA application was designed to be inclusive towards the low-literate users. The Digital ROSCA application has two modules, one for the ROSCA organizer and the other for the members. Some low-hanging fruits of Digital ROSCA include ease in group creation, record keeping, reminders for delayed payments, and collection and distribution of money. To support the digital payment in Digital ROSCA, we built a simulated mobile money environment called "UW-Pesa". The Digital ROSCA application was tested with 15 users (3 ROSCA groups with 5 members each) in a 5-day ROSCA cycle simulation where the users were given Digital ROSCA application with a list of tasks to complete at their convenience. We find that digitization has the potential to support and strengthen traditional ROSCAs by mitigating issues like record-keeping, delayed payments,

collection, distribution, and safety of money. It also allows the creation of payment history for individuals that can later be used to score their financial credibility.

In the upcoming sections, we provide the insights derived from our work about the design of Digital ROSCA in Pakistan. We first discuss the possible negative implications associated with Digital ROSCAs. We then comment on the retention of digital records. Finally, we discuss how the system can be tailored to cater for non-smartphone group members.

8.1 Implications of digitizing ROSCA

Traditionally, the social aspect of ROSCAs comprises of social capital and social element. Social element refers to the in-person meetings of the ROSCA group members while social capital refers to the benefits, trust, and information gained from one's social network. Social elements contribute to social capital and it is important to consider the implications of digitization on these social aspects of traditional ROSCAs. For ROSCAs in Pakistan, we find that the social capital exists only between the organizer and individual group members and is absent among members of a group as they are often unacquainted with each other. Although social element or meeting is uncommon among ROSCA groups, it is not non-existent as the groups meet to conduct lucky draws and organizers and members have personal interactions every month for the collection of payments. Literature [20] indicates that interactions around financial payments support individuals in building connections to their communities and Tiwana et al. [19] demonstrate that technology strengthens the existing social capital. But fintech interventions can have negative implications on the social elements of traditional ROSCAs if personal interaction is not incorporated in the design of such interventions and is reduced as a result [41]. Therefore, the incorporation of social aspects of traditional ROSCAs in the design of Digital ROSCA is recommended and the details of the social interactions remain to be explored in more detail.

ROSCAs are common across all income groups in Pakistan. The digitization of ROSCA records can provide a view into the financial capacity and behavior of the financially excluded groups and serve as a means for credit rating - which can qualify them for access to other sources of finance including formal lending. We suggest that the organizer maintains this transaction history as the organizer is the *"human intermediary"* [49] who has insights into the underlying causes of the delays and can differentiate between delays caused by real constraints such as late salaries or illness as opposed to habitual delays. Such personal insights are important for low-income groups whose personal lives are uncertain and have fluctuating finances [15]. We observe slight flexibility displayed by the organizers around payment schedules that is lacking in the formal banking systems which have a rigid payment schedule. Organizers personally know their members and therefore offer grace periods or make payments on behalf of the infrequently late members. Organizers also negotiate on behalf of the members for turn exchange in cases of emergency. We, therefore, recommend a design for credit rating through a payment tagging system where timely and delayed payments can be tagged by the organizer based on their personal insight into delays and their underlying causes. A credit rating system, where the organizer has the flexibility to offer a grace period to the members and can, therefore, decide when and which payment should be considered as delayed is meant to amplify the element of insight and empathy afforded by the organizers and minimize the rigidity associated with a traditional banking system. The tagging of payments by the organizer in a Digital ROSCA will result in the amplification of the authority of an organizer who is currently involved in the credit rating process, although informally, when s/he utilizes the historical information on member's past behavior before recruiting them for their ROSCA group. Since the organizer and members have a social as well as a financial connection, such a system also has the chances of being abused by the organizer by providing a good rating for members whose social behaviors are endorsed by the organizers.

With regards to frauds, we did not come across any instances of fraud in ROSCAs owing to the social capital between members and organizers but literature indicates the possibility of exploitation of ICTs and Digital Financial Services (DFS) platforms to perpetrate socially engineered frauds. Therefore, the possibility of such exploitation of Digital ROSCA is not out of the question[51].

8.2 Digital Record Keeping and Mixed Ownership Groups

When designing digital record-keeping systems, Ghosh et al. [25] suggest that the affordances offered by paper are to be retained in digital design whereas Panjwani [50] demonstrates that the users of digital systems can revert to paper-based records of transaction because of the fragility of the digital systems and lack of reliability needed in a financial transaction record. It is therefore imperative to consider the key features sought by the intended users of such records when designing digital financial systems. In the case of ROSCAs in Pakistan, findings reveal that while the organizers are the main creators and users of records, some members keep records too. In the absence of a digital medium, paper-based records dominate. Organizers use these records at different times during the ROSCA cycle - within a particular month and after the ROSCA cycle is complete. The organizers need these records to keep a log of the timely collection of payment from their members as successful payments to pot winner depends on the timely collection. Record enables them to remind members to pay before deadlines and also make a note of the extent and frequency of delayed payments and inquire of the underlying causes for delay. Once a full ROSCA cycle has been completed, the organizers need to recruit a new group of members. The payments records then help the organizers to determine who are the best members (in terms of payment behavior) and convince them to join the next cycle as well. Records are normally not requested or viewed by the members but are nevertheless available on demand. The members are primarily concerned with making sure that they make their monthly contribution and recalling the month when they should expect the pot to be allocated to them. However, for the organizer, maintaining records is important for the efficient functioning of the group. The key features sought by the organizers in records are accuracy and efficiency which are difficult to achieve in paper-based records as they are difficult to maintain and prone to errors due to frequent requests for turn exchange. Our design, therefore, enables the efficiency and accuracy sought by the organizers. Other affordances available to the ROSCA participants through paper-based records and the uptake and continued use of digital records remains to be explored. Our design also addresses the fragility of the Digital ROSCA system (due to the lack of network or internet access) by allowing offline record entry and updates on the availability of internet connection.

Designing for mixed ownership group. The current smartphone based design of records can be made more inclusive by addressing the *"design-actuality gap"* [25] and designing for organizers and members with feature phones. This is especially true for women in Pakistan who are more likely to participate in ROSCAs but less likely to have smartphones [30]. A purely smartphone-based design would then amplify the exclusion (rather than inclusion) of women from such systems [61]. While we started out with developing one modality i.e. smartphone, we offer some recommendations on the incorporation of feature phones into Digital ROSCA.

For interaction in a mixed ownership group, we plan to implement SMS templates or IVRs for non-smartphone members seeking different types of information or making requests. Most of the interaction in Digital ROSCA is from the organizer sharing information with its members, therefore, the templates about payment receipts, group creation, group updates, and allocations can be utilized effectively. In a mixed ownership group, for creation of group the organizer can send invite to a non-smartphone user who receives it either as an SMS or an IVR call informing the invitee of the terms and conditions. The member upon receiving the call or message, replies with a certain button press or character response to accept the invite and is included in the group. A

welcome SMS can share the group ID and SMS templates that the non-smartphone member can use to interact with the group. For turn allocation, the list generated by the system can be sent to the non-smartphone members in an SMS. For turn exchange, if the requesting member has a smartphone while approving member has a feature phone, request can be initiated on the app and replied through the feature phone with a predefined set of options for accepting or rejecting. If requesting member has feature phone, s/he could send an SMS (based on the predefined template) to request turn exchange. There can also be templates to record payments. An SMS can be initiated by the member in case of collection and by the organizer in case of allocation, informing the other party about the transaction and seeking confirmation. For confirmation, the recipient will send a reply message which will send a confirmation receipt to the initiator.

The design-actuality gap has been carefully considered in payments for Digital ROSCAs by taking into account the dominance of cash transactions in Pakistani ROSCAs and blanket digitization of payments has been avoided by allowing users to pay in cash or digitally.

9 LIMITATIONS

In this section, we discuss the limitations of our study. The Digital ROSCA system works on a simulated mobile money environment which does not require cash-in and cash-out transactions or impose transaction limits and charges like real-world mobile money systems. Users may react differently when faced with such transaction limits in the eventual roll-out of Digital ROSCA. The testing was carried out with 3 ROSCA groups including one women-only group. Certain questions like "if the low literate ROSCA users will trust the random allocation of pot money by the system rather than a person" and "how seriously the users will take the payment reminders" can only be answered after long term deployment and use of Digital ROSCA application. Testing Digital ROSCA on a larger scale for a longer duration may help understand the longer-term outcomes of the system at scale. Seeding of Digital ROSCA among women also presents challenges of phone ownership and usage. Even with smartphone ownership, socio-cultural constraints may hinder seeding and usage among females. This requires a thorough follow up study.

10 CONCLUSION AND FUTURE WORK

ROSCAs are a popular informal collaborative saving mechanism around the globe. In this research, we present a qualitative study of 80 individuals to understand the dynamics of ROSCAs and identify the opportunities for their digitization. We built a smartphone-based Digital ROSCA application to facilitate the working of ROSCAs, make them more inclusive, and overcome the issues associated with them. The Digital ROSCA application was tested with 15 users (3 individual ROSCA groups) and our findings reveal that digitization of this collaborative saving practice mitigates the issues like record-keeping, delayed payments, collection, distribution, and safety.

In the future, we plan to test the Digital ROSCA application with a larger user-base and for a longer duration. We also plan to replace the simulated mobile money back-end with real-world mobile money systems. Currently, our service only facilitates smartphone users. We plan to cater to other modalities such as SMS, USSD, IVR in the future, as explained Section 8.2. To preserve social capital between organizers and members, the Digital ROSCA application currently does not impose penalties on delayed payments. However, support for various (optional) monetary and non-monetary penalties can be provided in future versions. Digital ROSCA have the potential for encouraging digital payments by extending liquidity farming [40] in two ways, by creating groups with people outside of an individual's social circle, and by qualifying for credit from a service-provider based on Digital ROSCA transaction history. This requires the creation of a combination of social and credit rating mechanisms, which replace social trust with quantified behavior in ROSCA groups. Digital ROSCAs also present opportunities for extending customer engagement beyond

simple savings in groups to investments by providing advisory for the investment of unplanned savings, and collaborations with e-commerce platforms for allowing the purchase of durable goods.

11 ACKNOWLEDGEMENTS

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