# Prototyping Socio-Technical Systems for Banking Services for Rural India

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## Abstract
The discussion on ICT for developing countries often focuses on interface design to include marginalized users. However, this is only part of the challenge the development of ICT in such contexts face. Based on two past projects and an ongoing one, this position paper categorizes the diverse challenges the provision of financial infrastructures for rural and underserved societies encounter. Many of these aspects do not become visible in ICT development in Europe or North America. Reflecting the experiences of the Indian projects might not only inform future such projects but also help to uncover and reconsider 'working relations of technology production and use' (Suchman) that are often taken for granted.

## General Terms
ICT for Development, HCI, socio-technical development, mobile banking, business correspondent model, ATM, Rural.

## Introduction
This position paper is based on lessons learned from several socio-technical prototypes driven and coordinated by the TeNeT [1] Group at the Indian Institute of Technology in Madras (IIT-Madras) and the Rural Technology and Business Incubator (RTBI) [2]. The TeNeT

Group and RTBI are working towards the development of ICT based on mobile connectivity to strengthen capacity building, livelihood as well as products and services for rural India. One of the focus areas is the provisioning of banking services in small towns and villages.

Banking services are crucial for the development of rural India: Not only the provision of micro-financing [3] schemes is an important contribution, but also the ability to move from insecure cash to bank account based capital accumulation and mainstream financial service access is crucial. For e.g., the ability of the government to pay wages according the National Rural Employment Guarantee Act (NREGA) [4] directly to an account holder rather than via cash through (potentially leaky) local intermediaries is an important step to help include rural India into a developing economy.

The paper is based on a series of debriefing meetings between the authors on past and present activities at the RTBI. The debriefing meetings came about due to Yvonne Dittrich visiting the RTBI and the TeNeT Group for three months in Fall 2010. Lakshmi Vaidyanathan has been the RTBI project lead for the first two socio-technical prototypes, Ashok Jhunjhunwala and Timothy Gonsalves have been ideators, initiators and mentors of the whole initiative and have contributed with technical knowledge and research to the projects.

We use this short paper to structure the outcome of the debriefing with the intent to develop the position paper into a more comprehensive publication. The notion of 'socio-technical prototype' is already one of the analysis results: The experiences with deployment of technical prototypes in the intended settings, the importance to co-design of technology and its context of use beyond that what is currently discussed in the Participatory Design and HCI communities becomes visible. The discussion below indicates the extent to which the design and introduction of mobile ICT needs to take into account both the direct use context and the wider social, political and last but not least, the economic context.

The remainder of the paper is organized as follows. The next section introduces two past socio-technical prototypes and an ongoing initiative. For the sake of retaining a position paper size, we focus on one of the prototypes.

## Two socio-technical prototypes and one ongoing initiative

The notion of socio-technical prototype refers to the joined experimentation with innovative technology and the socio-technical environment in which the technology is deployed. We refer to the past two projects as such prototypes, as they have been temporarily deployed and are not active anymore. The technologies are partially used in context. The last example is an ongoing initiative partly based on the learnings through the first two projects. For the sake of space we are focusing on the second prototype in the present position paper.

*Banking at the local Internet Kiosk.*

The first, a Ministry of Rural Development (MoRD) and United Nations Developmental Projects (UNDP) sponsored project was an innovative pilot trial in four rural centres in the vicinity of Mayiladuthurai, a small town in the southern part of Tamil Nadu state. It addressed provisioning of rural banking via village based internet-enabled kiosks. [12] The idea was that trained opera-

tors manning these kiosks would act as business correspondents, i.e., agents of the designated bank. Via two-level biometrically authenticated access of both the agent and the account holder, secure debit and credit services to rural account holders, in particular NREGA beneficiaries (normally unlettered and unskilled manual labourers) could be provided. The project took place with local kiosk operators identified as potential business correspondents working with N-Logue a company providing wireless-last mile connectivity [11, 15] based on the CORDECT technology and back-end software/ accounting processes enabled by Legend Biometric application working integrated with the State Bank of India (SBI) core banking system. [16]

In rural India where the notion of privacy is not understood, PINs and passwords are often treated as the joint resource of an extended family or even community and do not serve as a means of secure personal identification. Biometrical identification is therefore crucial. Fingerprints biometrics at times fail in Indian rural population where heavy manual labour hardens the skin and erodes the whorls on fingers. [13] The trial showed up these experiences as well as the challenges of cost and business viability of rural banking access [14], an aspect still under test, with the mobile technology being evaluated as a possible low cost solution.

*The Grammateller Rural ATM*

The second pilot, also UNDP/MoRD sponsored, came about between the TeNeT Group and Vortex Engineering (P) Ltd. The idea was to develop a low-cost biometric ATM that worked in the physical and social environment in rural India. [12] A technical prototype was first deployed at the campus of the IIT Madras in cooperation with India's largest bank, the State Bank of India with network switch support from FSS. After initial debugging, it was deployed at four rural sites in the Cuddalore district of the state of Tamilnadu in India.

Indian Banking law required that ATMs need to be guarded while in operation. The Reserve Bank of India relaxed the regulation during the six-month project period. On completion of the pilot period, the closing to the ATMs at the pilot sites was heavily protested by the communities who had gotten used to having a neighbourhood cash dispensing facility.

Besides biometrics based identification and non-air conditioned environment support, additional challenges were uncovered. The disbursement of clean currency bills from the ATM was looked with distrust and fear of falsification among the rural people who felt that genuine currency notes must have passed through multiple hands. It was identified that further technology innovation was required to enable handling old notes, the lack of reliable power and dependence of network connectivity on unsecured power sources. The expenses in terms of rent, wages and network connectivity costs made the economic viability uncertain.

However, the ATM went through further iterations of design changes and tests and was subsequently commercialized under the brand name Grammateller by Vortex Engineering Ltd. As today, more than 400 ATMs are deployed across more than 20 states for more than 15 banks. [9, 10]

*Mobile Banking*

The experiences with the above two prototypes lead to a different line of thought regarding the possibility of

mobile based financial. In both the above pilots, infrastructure rentals, running costs network and salaries was an aspect leading to unviable business models. The ubiquity of the mobile and the fact that mobile based payment was already under experimentation in other parts of world like the Philippines showed a different option. The Mobile Payment Forum of India (MPFI) [5] was founded by the RTBI and the Institute for Research and Development in Banking Technology (IDRBT). IDRBT [6] is an RBI Institute with the mandate to do research in banking technology and to form standards for the Indian banking industry. The involvement of IDRBT was imperative due to the need for regulatory support especially for interoperability and deployability. The MPFI brings together governmental agencies, banks, telecommunication providers, technical experts in the coordination and development of services, protocols, applications and changes to regulations.

In 2009-10, MPFI developed interoperability standards to support person-person payments using mobile phones. [7, 8] Each person is identified only by his/her mobile phone number and a 7-digit Mobile Money ID (MMID). The MMID is essentially a mobile account number. The MMID is linked to a bank account, so that the payment is actually effected by a transfer between two bank accounts. Several banks including the State Bank of India have implemented the system and it is offered as a regular service to account holders. Further, with the option of voice biometrics and voice banking, payment even on low-end phones and for people who are only semi-literate has become easy.

## What does it take to make ICT work.

Already the brief presentation of the socio-technical prototypes above indicates that the factors influencing the usability and usefulness of the presented applications go beyond what normally is addressed as HCI issues. Below we start to categorize the issues encountered. We do so from the inside out: Presenting first the issues encountered in the concrete human computer interaction and moving out to the wider contexts that impacted the success of the prototypes. Due to space limitation we will only present the HCI aspects in detail and only point at the wider issues we see.

*Human Computer Interaction*

Human Computer Interaction and Interaction Design are developed in a European and Northern American context and thus rely on assumptions that are not necessarily valid in rural India. These culture, material environment and infrastructure related assumptions do only become visible once the ICT is deployed in a radically difference context.

One example for the invalidity of cultural assumptions in ICT design is the difference in notion of PINs and passwords, which, in turn, led to the need for biometrical identification. The need to dispense heavily used cash is a second example. Again the available mechanical cash disbursement ATM technology that worked with crisp new bills needed to be replaced by innovative alternative solution involving optics had to be designed.

As example for the material environment, the ATMs needed to withstand harsh climatic environments. Fingerprint biometrics for rural populace is not a dependable solution. Hence, the possibility of voice based biometrics and innovation around voice seemed like a more viable option.

Infrastructure related assumptions shows in the need to design solar based ATM power supply due to unreliable power supply in rural India. In the experiments it became clear that reliability was much more important than whether the dispenser took a few seconds more or less. As a result, the ATM energy standards required redesign and deviation from normal European standards. The current commercial ATMs take only 70 W average power compared to 300-700 W of others. Also they do not require air conditioning, further saving about 1000-1500 W. It even became necessary to look beyond the ATM at whole line of delivery such as the network, service providers as well as the bank to ensure reliability.

### Lessons learned

The experimentation with socio-technical prototypes has been a crucial part of the learning processes towards sustainable technology and banking services. Many of the issues discussed above would not have been discovered in a laboratory setting or when deploying the technology in an environment that is unlike the intended field site. E.g. the IIT Madras campus is very different from a village in the hinterland. The problem with prototyping on this scale though is that the pilot projects cannot always be continued in form of a permanent service. There is often substantial learning during the prototyping and new versions of the product are developed for commercial deployment. This is particularly true if some regulations are temporarily relaxed for the trial with the prototype. The risk of failure is an imperative stepping-stone to future success.

The experiences lead to the need to rethink and re-evaluate European optimization criteria. The trade-off between speed and energy consumption is an example here. Western technology will often be optimized according to different criteria. However, here the development for the underprivileged use context might result in technological innovations, which might, in turn, be beneficial even in more privileged environments: The amount of energy that could be saved by using the energy consumption optimized technology worldwide might contribute to slow the global warming.

The experiences with the socio-technical prototypes also resulted in experiences with user involvement and the gathering of user feedback. The social and technological inequalities in the underserved society groups and the high power distance in while working with rural communities makes it more difficult to communicate crucial feedback between the context of usage and the design and development context. In the presented prototypes social workers took on the role of the ‘project’s eyes and ears’. Social workers in India traditionally have the role of the people’s advocate and therefore the trust of the people. This also means that we need to look beyond traditional roles in software and systems engineering to address HCI issues.

*Beyond HCI in the narrow sense*

Already the short presentation of the socio-technical prototypes indicates that the issues at hand are not only regarding HCI in the narrow sense. Many other aspects influence the usability, the usefulness and sustainability of a service:

The ***deployment and service provision*** needs to be organized so that all involved actors – banks, telecommunication providers, business correspondents and users – have enough benefit to sustain use and provi-

sion. The development needs to address economic viability of the technology and service provision.

The deployment of services is highly dependent on ***infrastructures.*** The architecture and design of the services needs to take the whole infrastructure into account. Especially important are availability of power, communications and physical security.

In many cases the ***political and legal context*** needs to be addressed as well. The introduction of mobile payments required the involvement of national governmental agencies like the Reserve Bank of India. Leap frogging technical development has implications on the legal system as well.

As the development of such a service depends on the collaboration of the different actors, the ***development models*** have to adjust to cross-organizational development, which might include the development of economic models for usage and service provision as well as the legal system regulating the sector.

## Learnings for HCI and ICT development?

We are still in the process of exploring this question and will use the development of a journal article based on the current position paper to do so. Already now we can formulate some ideas:

Usability and usefulness depend on many circumstances that in the privileged contexts are normally not addressed explicitly as they are part of the assumptions underpinning methods and techniques. Also the trade off between different criteria might look differently. Experiences with ICT development in the context of radically different 'working relations of technology production and use' and the reflection on the experiences [17] will help to unpack these assumptions and challenge Western design and technology.

As has been pointed out by other researchers as well [18], new forms of participation and design need to be developed to fit with different socio-cultural contexts. The comparison of localized interpretations of methods and techniques can be expected to better understand how methods and techniques interact with the socio cultural environment.

The financial and legal viability and the sustainability of the service for all the actors involved is a central issue, which is normally not addressed in privileged contexts.

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