Cost Realism in Deploying Technologies for Development

Aishwarya Lakshmi Ratan[1], Mahesh Gogineni

Microsoft Research India, May 2008

This paper was presented at the Conference on "Confronting the Challenge of Technology for Development: Experiences from the BRICS", Department of International Development, University of Oxford, 29-30 May 2008

Abstract

In this paper, we present a simple costing model supported by three case studies to demonstrate the ways in which a technology intervention's ability to deliver cost savings through efficiency gains is conditional on the local economic environment. Examining a set of information collection and processing transaction tasks that are part of a microfinance institution's workflow, we find that technology-enabled gains depend critically on the technology's impact on labour productivity and variable capital costs, in the context of the local wage rate for adequately skilled labour. In certain contexts, the per-transaction gains from using capital-intensive technologies are overwhelmed by the fixed and operating resources required to generate and sustain these gains.

Keywords: Transaction Cost Analysis, Economic Development, Technological Change, Financial Sustainability, Microfinance, India

[1] Corresponding author: Aishwarya Lakshmi Ratan, The Technology for Emerging Markets group, Microsoft Research India, aratan@microsoft.com

Cost Realism in Deploying Technologies for Development

I Introduction

The discussion around using information and communication technologies for development (ICTD) has increasingly become sensitive to the context in which technologies are deployed in developing world sites (Avgerou, 2001; Heeks, 1999; Warschauer, 2003). In this study, we deconstruct one particular dimension of context, namely the relation between the costs of various inputs in the environment where the technology for development project is undertaken. The domain we examine is that of the booming microfinance sector in India.

There has been an explosive interest over the past five years in promoting the potential of information and communication technology solutions to augment the delivery of microfinance[i] services to low-income clients. The key promise of such technologies is believed to lie in their potential to reduce transaction costs for the client and provider. Even the best performing microfinance institutions (MFIs), many of which are in India, have operating costs/asset ratios of >10%, compared to the 5% corresponding ratio for commercial banks (Ivatury, 2006). Any possibility of bringing this ratio down through greater efficiencies in delivery and operations is therefore very attractive to microfinance providers. At the same time, there is an underlying assumption that by lowering delivery costs, such interventions will result in lower interest rates[ii] and larger scale outreach of financial services to poor clients, thereby improving development outcomes.

In general, the potential of information and communication technologies (ICT) to be useful to the financial sector can be divided into three broad areas: *(A)* enabling the provider's back-end information system, *(B)* enabling the front-end information delivery channel from/to customers, and *(C)* enabling the currency in which financial transactions between customer and provider are made, i.e. allowing for electronic transfers of cash/value. When it comes to *A*, given the unambiguous benefit from the consolidation of customer data at the back-end for aggregated financial reporting and portfolio risk assessment, most MFIs already have or are looking to have back-end Management Information Systems (MIS), oftentimes as simple as a single PC set up at the Head Office for small MFIs, or a PC at each branch with a server at the Head Office for larger MFIs.

At the same time, *C*, i.e. removing cash from the cycle of microfinance payment transactions has significant benefits to offer and can be thought of as graduating poor microfinance customers to the self-service financial transaction channels that rich clients use on account of convenience to the customer and cost-savings to the provider (ATMs, internet banking, etc.). Most cash transfer channels in their current form require the customer to have a basic deposit account, which many of the poor do not own. An interesting set of offerings in this space have been made possible by the rapid growth of mobile phones across the developing world. With mobile phone penetration going deeper than banking penetration in several countries, there are efforts to understand whether in fact poor customers can access banking and money transfer services using their mobile phones (Donner, 2007; Ivatury and Pickens, 2006; Morawczynski, 2008; Porteous, 2007). The ability for the poor to make secure cash-in/cash-out and transfer transactions through authorized local agents, whose operations are enabled using ICTs, is another promising area.

While *A* and *C* are essential and rich areas of research and implementation both on the provider and customer side, we take an enterprise lens in this paper and examine tasks in area *B* from the perspective of the MFI. Whether it is mobile phones or PDAs, client-facing technologies for microfinance information collection and management have gained popularity in people's imagination of how ICTs can transform transactional capabilities in finance. Yet, those MFIs that have attempted to bring such technology to their front-end operations have invariably stopped at the end of pilot efforts and discontinued plans to scale up, or have significantly modified the nature of the technology intervention in an iterative process of approaching the optimal solution for microfinance information processing (Ganesan and Pichai, 2007; Parikh, 2006b; Regy and Mahajan, 2006).

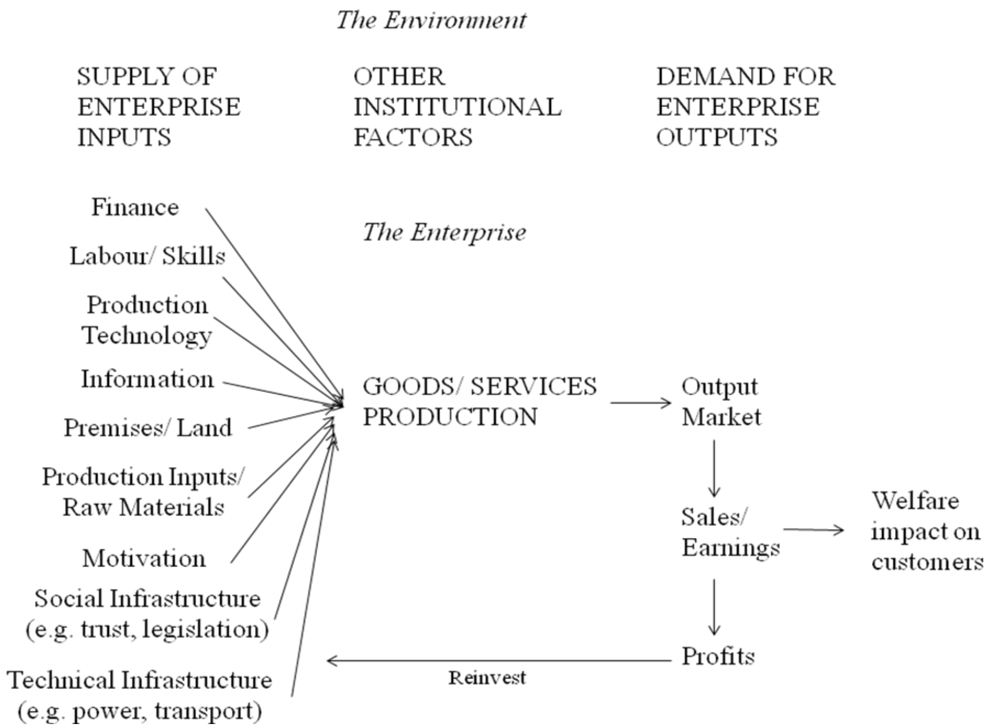
In this study, we look to see if there are systematic reasons related to cost that underlie these varied experiences that are relevant to the efforts of other MFIs planning technology deployments to achieve efficiency gains. This analysis is applicable not just to the microfinance sector in India, but to any organization thinking about cost-effective ways of information collection, processing, and management in developing country settings. More broadly, we emphasise an approach where technology is simply one of many input and process components that must together generate optimal outcomes in a given economic environment for a given task.

II Analytical Framework

Of the many inputs required for the functioning of the MFI as an enterprise (Figure 1), we examine the relation between labour, production technologies and information, specifically looking at the use and usefulness of information collection and processing technologies.

Figure 1: A Systemic View of the Microfinance Institution as an Enterprise

(Adapted from Heeks, 1999, pp.5)



For an MFI to accomplish a given transaction with a customer, there is a set of fixed and variable resources required. Fixed resources are more difficult to scale up or down in the short-term, while variable resources can easily be adjusted based on demand requirements. Capital inputs are likely to command fixed expenditures such as the purchase of devices, and variable expenses such as the maintenance or connectivity of those devices. Similarly, labour inputs are likely to command periodic expenses such as training costs and variable expenses such as wage payments. The proportions in which fixed and variable capital and labour resources are deployed to achieve a given production outcome depends on the joint productivity of these resources in delivering the most efficient outcome conditional on input costs.

One way of measuring efficiency is through input cost minimisation for a given level of output. In the case of an MFI, we can use the cost for a given transaction task τ as the relevant outcome variable, which can be described by the following function:

$C\ (V_l, V_k, O, L, F, N)$

Where

V_l= w (wage or labour cost per unit time) * A (inverse productivity indicator or no. of time units per transaction)

V_k = Variable capital cost per transaction τ

O = Operating costs per unit labour for transaction task τ

L = Total labour hired for transaction task τ

F = Fixed costs for transaction task τ

N = Number of transactions of task τ

Variable capital costs include per-transaction costs associated with paper forms, stationery, data transport, etc. Operating expenses include costs such as connectivity, maintenance, training that are incurred per-worker or per-device. The fixed costs involve up-front investments in hardware and software, especially for the HT channel.

In this study, we hope to assess not the absolute value of costs accrued per transaction task for an MFI, but instead the relative cost accrued per transaction for task τ under alternate technology arrangements. Let us say there are two alternate technology arrangements for transaction task τ: channel HT, referring to a high-technology option and channel LT, referring to a low-technology option. Let us also consider that the baseline state involves the low-technology channel (LT) being used, and that the intervention under question is the MFI shifting to the HT or high-technology channel. Since we expect the high-technology option to deliver cost savings (the primary reason to consider a technology change from an efficiency perspective), the transaction gains from using the HT option vs. LT for a given transaction of task τ can be simplistically characterized as the following linear combination:

$$G = (V_l + V_k)_{LT} - (V_l + V_k)_{HT} = ((w_{LT}*A_{LT}) + V_{k,LT}) - ((w_{HT}*A_{HT}) + V_{k,HT})$$

Should the wage rate per unit time be independent of the technology channel used, then we will have the following relation:

$$G = (w_{LT}*A_{LT}) - (w_{HT}*A_{HT}) + V_{k,LT} - V_{k,HT} = w\ (A_{LT} - A_{HT}) + V_{k,LT} - V_{k,HT}$$

These per-transaction gains need to be aggregated across all transactions for task τ:

$$TG = G*N$$

At the same time, the operating expenses required to maintain technology options HT and LT differ and will either add to or temper the transaction gains TG. The differential in total operating expenses is included as:

$$OG = (O_{LT}*L_{LT}) - (O_{HT}*L_{HT})$$

Where the number of units of labour hired is independent of the technology channel, we have the following relation:

$$OG = L\ (O_{LT} - O_{HT})$$

The total profit from cost savings due to the introduction of the technology option H is therefore:

$$\pi = TG+OG$$

This profit would need to be assessed against the differential in fixed investments needed for either technology option to function, in order to evaluate the overall return on investment. Therefore:

$$RoI = \pi \ / \ |F_{LT} - F_{HT}|$$

This return, however, will not sustain indefinitely. At a certain point in time, the fixed capital investments will need to be replaced. We therefore need to include a financial sustainability measure, i.e. at the time when the fixed investments have depreciated and need replacement, will the channel have generated sufficient profit through cost savings to allow for the renewed fixed investments to be made (Kumar, 2004). Given that we are concerned about information and technology products, we measure sustainability with the NPV of the net profits generated through the HT technology option over a six-year timeframe, when devices such as mobile phones usually need replacement. The financial sustainability metric would involve:

$$\mathbf{NPV} = \sum_{t=1}^{6} \frac{(\pi_t (1+\varrho))}{(1+\delta)^t} \quad - |F_{LT} - F_{HT}|$$

Where ρ is the inflation rate and δ is the measure of the opportunity cost of the capital had it been invested in an alternate venue. An NPV>0 would therefore ascertain the High technology channel's ability to generate sufficient cash flows through cost savings, and financially sustain its operations over time.

This description of costs leaves us with a set of hypotheses around the relationship between various input costs and the potential efficiency gains from a High technology channel vs. a Low technology one for a given transaction task τ in the MFI's workflow:

Hypothesis 1: The cost savings from a High technology intervention are maximized when TG is maximized. This would require a high wage rate (w), a high differential in the labour productivities of the LT and HT technology channels for transaction task τ (a high positive measure for A_{LT} - A_{HT} in our model), a high positive differential in the variable capital cost per transaction ($V_{k,LT}$ - $V_{k,HT}$), and/or a high differential in the number of transactions of task τ per unit time.

Hypothesis 2: The cost savings from a High technology intervention are also maximized when OG is maximised. Since O_{HT} will typically be higher than O_{LT}, this would require the operating cost differential between LT and HT channels (O_{LT} - O_{HT}) to be small in magnitude.

Hypothesis 3: Given a certain level of net profit via cost savings through the new technology channel, the larger the amount of fixed costs required to establish the HT channel ($|F_{LT} – F_{HT}|$), the lower the likely financial sustainability of the HT channel, for a given level of inflation and depreciation.

Using data from a set of microfinance institutions in India, we now verify the validity of these hypotheses in predicting when High technology interventions deliver value in the form of cost savings to the MFI and when they may ironically reduce efficiency. For the sake of simplicity in the empirical assessment, we take w, N and L to be given and constant across either technology channel at a certain point in time for an MFI. Clearly, the differences in labour productivity across channels assessed in the model will affect subsequent values of these variables, especially N and L. A dynamic model that endogenises these variables would be a logical extension to the simple static view presented here. We describe the cases of three MFIs in Section III, and dissect the cases in the context of the analytical framework in Section IV.

III Case studies

India abounds in microfinance activity (over 30 million customers of microfinance services at present[iii]), with a huge array of provider types all the way from the very local and small serving a few hundreds, to the large national players who work closely with formal financial institutions and serve hundreds of thousands of clients. The data for these case studies were collected from three MFIs with operations in southern India, chosen for (a) the spread they offered as small, medium and large organizations, (b) their choice of varying microfinance operating models (Joint Liability Groups vs. Self-Help Groups), and (c) their experimentation with ICTs in client-facing information collection and processing tasks. Over extended field visits, primary data was collected from management, field staff and customers through successive interviews and observation of operations. This was complemented with aggregate financial data from the organizations' annual reports and publications. All figures have been checked and approved by the respective organizations before inclusion here.

The costing methodology used here draws from the financial sustainability modules presented in Kumar (2004) with respect to rural PC kiosks being integrated into agricultural supply chains. Based on the MFI's choice of transaction task to streamline, we began case each study with a detailed understanding of MFI workflow for the transaction task in question. We then enlisted the various cost components and levels for that specific transaction task, under a baseline Low-technology channel (using a PC-based database at the back-end and paper-based information collection at the front-end) and under a proposed/piloted High-technology channel (using a PC-based database at the back-end and electronic device-based information collection at the front-end).

The per-transaction cost differentials aggregated over the scale of transactions were then combined with the operating cost differentials between LT and HT channels, to calculate the net transactional cost savings from the use of the HT channel. These were then compared against the fixed investments required for each channel to calculate the return on investment in the HT channel. Finally, given that technologies such as mobile phones have a short half-life, their depreciation needed to be kept in mind while choosing to invest in such systems. So the NPV of the cost savings from the channel over six years (the expected period for capital replacement) was calculated to assess the financial sustainability of the HT channel.

We examine two kinds of information collection and management tasks involved in routine microfinance operations: (a) Loan Customer Acquisition, and (2) Loan Installment Processing. These are examined strictly in relation to their information collection and processing components. These transaction tasks in some cases are accompanied by others such as cash disbursement or collection. However, since the cash-related transaction costs are equivalent across the HT and LT channels being compared, we do not include those costs here. Similarly, since the existence of a back-end PC-based database for the storage of customer records is the same across the HT and LT channels for the MFIs examined, we do not include those costs here.

III.I Loan Customer Acquisition in urban microfinance

Of the key challenges facing a young and rapidly expanding MFI (NBFC[iv]) serving the urban poor in Bangalore, south India, the top three involved “increasing the efficiency of the customer acquisition process, providing Customer Relationship Staff with access to all relevant information, and eliminating paper to the extent possible from the process" (Srikrishna K.R., 2007). The MFI had achieved an outreach of 24000 clients in less than two years, served through 13 branches across the city, with each branch employing eight Customer Relationship Staff (field officers), a Branch Manager and an Accountant. With aggressive targets of growing outreach three-fold and growing revenues four-fold over the next financial year, the MFI was concerned about its customer acquisition process and was considering ways in which technology-enabled investments might augment the efficiency of this task.

The MFI had a core banking software solution in place at the back-end, along with an in-house data centre at the Head Office, which lent itself to a centralized processing workflow structure. The original workflow of the customer acquisition process involved the MFI's field officers filling out a detailed profile form per potential customer during the initiation process (at or near the customer's house), which included data on her household's characteristics, occupational affiliation, earnings, expenditures, outstanding financial obligations, housing, well-being measures, etc. along with collecting supplementary material like a copy of her ration card and a photograph. All profile forms for new customers were then collected at each branch office and couriered to the MFI's headquarters, where back-office staff then manually re-entered the data from the paper form into the server database using a PC. Each field officer was able to process ~25 new customers per month following this procedure. The workflow had resulted in costs associated with double data entry, error correction, data transport, stationery (~5% of annual revenues in first year), and back-office data entry staff (~15% of annual revenues in first year) (Gogineni and Ratan, 2007).

In a pilot effort, the MFI considered replacing the paper-based customer acquisition process with a mobile phone-based channel. The field officer would directly enter customer profile information into a mobile phone-based software application at the point of customer interaction. The data would be transferred using one of two communication channels, SMS or GPRS. In the SMS-based system, data sent via SMS from the field officer's phone would be received by another smart phone at the Head Office, which would act as a gateway that translated the incoming SMS data into updates in the server database. In the GPRS-based system, the field officer would directly access a web-based customer profile creation application, input the data, and have it uploaded via the phone's GPRS connection to the MFI's central server. Either of these channels would eliminate the role for back-office staff to re-enter the customer's profile data, and do away with the ferrying of paper forms back and forth. The approval process would be quickened as a result.

Through the course of the initial development of the phone-based application and workflow, there were a number of issues around cost effectiveness that were raised. The phone-based channel was indeed successful in lowering the per-account Loan Customer Acquisition transaction cost from Rs.19 to Rs.8.25 in the case of the SMS-channel and to Rs.9.20 in the case of the GPRS-channel, lowering variable costs by over 50% mainly through the elimination of labour needed for the second round of data entry at the back-end. However, the efficiency with which field staff could enter data in the field using the new channel remained the same. Further, when the heavy fixed and operating costs associated with the establishment and maintenance of the new phone-based channel were included, the investment netted a 9% overall return on investment, but only half of the upfront fixed investments could be recovered over six years' cost savings, resulting in a negative NPV for the overall investment (Gogineni and Ratan, 2007). Since the intervention was driven by the need for cost reduction and sustained efficiency gains, development of the phone-based channel was discontinued.

III. II Loan Installment Processing in rural microfinance I

An MFI (NGO) in Tamil Nadu supporting the microfinance accounts of over 8000 rural customers, organized into 1000 Self-Help Groups (SHGs) across six Federations, found itself spending a considerable amount of resources on coordinating the monthly financial data collection and management tasks around Loan Installment Processing. The NGO employed a set of staff to conduct the monthly book-keeping for the SHGs, with each field officer responsible for 15-25 groups, 7-8 of which formed a Federation.

Initially the records were maintained locally by each SHG on regular notebooks and aggregated on loose paper forms stored at the Federation office. Having the aggregation done manually resulted in numerous errors and poor quality records. This inspired the establishment of a PC-based back-end Management Information System (MIS) in each Federation office for data storage and aggregation. The NGO then looked to ways in which Loan Installment Processing transaction data could be entered into the MIS and processed cost-effectively and efficiently every month for every group. They explored two alternate channels. The first involved the field officer recording loan repayment data using a mobile phone in the field and sending it via SMS to the MIS. The second involved the standard procedure of the field officer entering repayment data into the MIS using the PC at the Federation office.

In this instance, the emphasis was on ease of field officer usability, due to which the paper-based data entry forms were maintained at source while having the electronic data entry occur as an interaction between the device and the paper forms. For instance, the mobile phone-based channel initially involved scanning specially-designed paper receipts/vouchers (with barcodes) that had each members' data recorded by hand, and having the data captured either through the mobile phone's built-in camera or through the punching in of data using the mobile phone's keypad (for details see Parikh, Javid, et al, 2006a).

On analyzing the cost structure of the new channels, we found that the ongoing transaction costs per customer per month under the phone-based channel being piloted turned out to be marginally lower than the PC-based system used. Between the two channels of electronic data collection and report generation, the field officers' efficiency in using the mobile-phone-based system was slightly higher than the PC-based data entry channel. Yet, the phone-based channel did not involve the elimination of paper at the front-end, with the 'SHG MIS barcode vouchers' being used across the PC and phone-based channels. So the new system did not present itself as a significant transactional cost-saving intervention.

In addition, the mobility of the phone-based channel turned out to be of little value since connectivity limitations in their rural locations forced the field officers to upload their entered data via SMS only at or around the Federation office where there was sufficient network connectivity. As a result, while quality gains from both channels were similar, the fixed costs associated with the voucher and mobile-phone-based channel were thrice that of the voucher and PC-based channel, in which a single device was being used for data entry, storage and processing across field officers. A paper-based client-facing Loan Installment Processing channel linked to a back-end general purpose PC running the MIS application was therefore sufficient as a cost-effective yet quality-enhancing investment, compared to both the original fully paper-based system and the mobile phone + PC arrangement.

III.III Loan Installment Processing in rural microfinance II

A large established MFI (NBFC) serving over 500,000 customers through operations in rural and urban Andhra Pradesh, Rajasthan and other Indian states, has continually experimented with various methods of using technologies to streamline its Loan Installment Processing workflow. The baseline process involved an office-based staff member compiling a master list of customers and installment dues from the MIS software at the branch each month, which the field officer then carries as he visits customer groups at their homes. He collects repayments per customer as per the data in the list, records the transaction on a paper receipt and in the customer's passbook. The data is then manually re-entered into the back-end MIS at the MFI's branch by the office-based data entry staff (Gogineni, 2007).

A recent pilot intervention involved the introduction of a handheld point-of-transaction device that would allow field officers to record repayment data electronically at source during their interaction with customers. A copy of each customer's loan record is stored locally on the device. After each update, the device allows for a receipt to be printed for each customer, a signed copy of which is retained with the field officer as verification for the cash transaction. The loan officer carries the device from one customer location to the next, and finally brings it back to the branch. The updated data is collectively uploaded by the back-office staff from the field officer's handheld device to the PC-based MIS at the branch via a USB connection, and all customer records are synchronized automatically.

The handheld device-based channel succeeded in achieving a nearly 73% reduction in variable costs primarily due to the substantial reduction in time taken to enter each customer's repayment information on the receipt by having it pre-filled in the handheld device and ready to print, as well as the nearly twenty-fold reduction in time taken to integrate the updated data on the device with the back-end MIS. Further, given the large number of Loan Installment Processing transactions conducted per field officer each month, the cost savings allowed for the up-front device investments to be recovered in less than 18 months, allowing for a positive NPV and substantial efficiency gains.

IV Discussion

We now present summary figures on each task-related cost component for the cases described in the previous section in Table 1 below, based on the analytical framework presented in Section II.

Table 1: Comparison of cost components and efficiency gains for the technology interventions of three Indian MFIs

	Case 1[+]	Case 2	Case 3
Labour component 1(front-end)			
w_1 (per month, Rs.)*	4500	800	4500
$A_{1,LT}$ - $A_{1,HT}$ (Productivity gain in minutes)	19-19 = 0	2-2 = 0	3.46 - 0.81= 2.65
Productivity gain 1 (share of baseline)	0	0	**0.76**
Labour component 2 (back-end)			
w_2 (per month, Rs.)*	4000	800	6000
$A_{2,LT}$ - $A_{2,HT}$ (Productivity gain in minutes)	14-0 = 14	2-1.75 = 0.25	0.6 - 0.033 = 0.57

Productivity gain 2 (share of baseline)	**1**	0.125	**0.95**
$V_{k,LT}$ - $V_{k,HT}$ (Rs.)	5.65-0.05 = 5.6	0	0.78 - 0.33 = 0.45
Variable capital cost reduction (share of baseline)	**0.99**	0	**0.58**
G (Rs.)	10.97	0.019	1.92
N (number of task τ transactions per yr per branch)	2400	22,992^	64,800
TG (per yr per branch, Rs.)	*+26,304*	*+437*	*+124,416*
$O_{LT} – O_{HT}$ (per L, Rs.)	-2030	-1680	**-970**
L (per branch)	8	8	12
OG (per yr per branch, Rs.)	*-16,240*	*-13,440*	*-11,640*
π (cost savings, Rs.)	*+10,064*	*-13,003*	*+112,776*
F_{LT} - F_{HT} (per branch, Rs.)	*-98,462*	*-68,000*	*-138,000*
NPV of π over 6 years^^	<0	<0	>0
*(PV of π over 6 years) / $\lvert F_{LT} - F_{HT}\rvert$ ^^*	*0.5*	*<0*	*3*

Note: All values in 2007 Indian Rupees; US$ 1~ Rs. 40; All costs aggregated at the individual branch level. Positive values indicate cost savings, and negative values indicate added expenditures in HT vs. LT
[+] Cost comparison with the SMS-based channel included here (for the GPRS channel, please see Gogineni and Ratan, 2007)
*MFI employees are paid for a 40 hour work-week and 4 weeks paid leave each year (365/12/7 = 4.345 weeks of work per month on average). So total no .of working minutes per month =4.3453*40*60. This figure is used to evaluate the monetary cost of each minute of a worker's time.
^1916 members in the SHG Federation (September 2006)
^^ Assuming ρ = 5.5% and δ = 10% p.a.

Examining the differential values of various components and outcomes listed above, in reference to the hypotheses presented in Section II, we are able to draw a number of relevant insights around the achievement of efficiency gains and cost savings through the introduction of information technologies in particular microfinance workflows in particular economic environments:

1. *The higher the labour productivity gains from the HT channel, the greater the transaction cost savings.* Looking across both components of labour used in the MFI tasks examined (front-end and back-end), the MFI that achieved the greatest gains in having the HT channel reduce labour time requirements/ improve labour productivity, both at the back-end and the front-end, was the one that was successful in having a High technology intervention deliver substantial efficiency gains (Case 3).
2. *The higher the local wage for the task, the higher the productivity-linked transaction cost savings.* Where local wage rates are high, there are substantial cost savings to be gained from the reduced use of labour through High technology-enabled productivity improvements. However, the labour market contexts of MFIs in developing countries are dominated by the availability of low wage labour at particular skill levels, as we see in Case 2. Where the productivity of labour is sufficiently high to begin with, while also being associated with low wages due to labour market conditions, it is difficult to introduce a High technology channel that can bring in efficiency gains through transaction cost reduction.
3. *The higher the variable capital cost reduction, the greater the transaction cost savings*. Both cases 1 and 3 achieved substantial reductions in their use of paper and other variable overheads when they used the High technology channel, which boosted their transaction cost savings. In case 2, the decision to retain the paper-based front-end vouchers while also investing in the mobile-phone-based channel for electronic data entry, did not allow for any variable capital costs to be eliminated, which adversely affected cost savings from the intervention.
4. Over a given period of time, *a larger number of transactions per unit of labour/per device greatly multiplies the power of productivity gains per transaction from the use of the HT channel.* While in Case 1, the transactional cost savings were significant, the scope of the task and consequently device usage per unit of labour was very limited (only 25 new customers recruited per field officer each month). On the other hand, while the baseline transaction cost faced by the MFI in case 3 was low in

absolute terms to begin with, the volumes processed per loan officer each month were large, allowing for transactional gains per unit of additional fixed investment in the HT channel, to be substantial.

5. *The larger the operating costs required to run the HT channel, the lower the gains from overall cost reduction*. Though gains from improvements in transactional efficiency were positive in Cases 1 and 2, the MFI had to pay out substantial amounts as operating expenses to maintain the HT channel, most significantly through the monthly mobile phone connectivity charges. In Case 3, on the other hand, the MFI did not invest in any ongoing remote connectivity channels (SMS/ GPRS), instead choosing to conduct data uploads at the times when the device was physically present at the branch office and could be plugged into the PC. Their operating costs were contained as a result (limited to maintenance and training fees), again boosting the efficiency gains from the intervention.
6. *The higher the fixed capital investments called for in the HT channel, the more substantial the requirements for high transactional cost savings and low operating cost differentials to ensure the HT channel's financial sustainability*. In Case 1, the net gains from transactional cost reductions through HT, despite heavy operating expenses, were high. Yet, the substantial fixed investments in suitable devices (smart phones with graphical user interfaces and sufficient memory) to enable the HT electronic channel's effective usage in the field for the given task, prevented the channel's cost savings from translating to financial sustainability over a reasonable timeframe.

Of the three cases examined, the only MFI that achieved substantial and sustainable cost savings from the introduction of the High technology channel for a given task, was the one that satisfied the hypothesized conditions in the costing model, i.e. it operated in an environment of high wages, achieved high improvements in labour productivity through use of the HT channel, achieved high variable capital cost reductions through use of the HT channel, and minimised operating costs in the HT channel. Further, were the fixed investments for the High technology channel to be any lower, as might be expected with the reduction in device costs each year for the same functionality, the financial viability of the channel can only be expected to improve. The MFI's positive outcome stems from maximising labour productivity gains and minimizing variable and operating capital cost differentials, in relation to a given level of fixed capital investment, for the HT channel.

Conversely, having access to relatively low-cost devices *does not* necessarily translate to achieving efficient outcomes from their introduction into existing MFI task-flows. This is a critical message for those development practitioners who see the introduction of any and all information and communication technologies as fundamentally efficiency–enhancing in developing country contexts, conditional on minor implementation challenges. Case 2 illustrates the fact that for the Loan Installment Processing task being targeted, the fixed investments in the mobile phone devices might have been easy to recover in another context. The greater barriers in this case were posed by the fact that the field agent's productivity in using the mobile phone for data entry was nearly equivalent to her corresponding productivity manually inputting the data on the PC at the Federation office. Moreover, saving a few minutes of the field officer's time through the use of the High technology channel hardly translated to cost savings, given the low wage rate in the rural environment where the MFI's operations were conducted, and came at a high operating cost of maintaining the phone's connectivity. In cost contexts such as these, therefore, a paper-based, marginally more labour-intensive front-end channel complemented with manual input of data directly into the database at the back-end using a shared PC, may easily be the more efficient, cost-minimising option (Ratan, 2007).

V Conclusion

In a recent Forbes poll of microfinance providers worldwide (2007)[v], the MFI Bandhan in India was listed second. This must have come as a surprise to technology evangelists, given that Bandhan has minimal investments in technology and maintains a very strong emphasis on streamlining its decentralized processes, focusing on the strength and empowerment of its field staff who use predominantly paper-based processes to run their operations. We consider approaches such as Bandhan's to display remarkable cost realism in their understanding of the most cost-effective ways to conduct a certain business transaction or achieve a desired business outcome at a given quality in a certain environment.

This paper's contribution to the discussion on deploying technologies for development is to direct both academic and practitioner attention to the importance of the economic context in which developing country enterprises like MFIs operate. There is no older economic concept than the relation between the costs and productivities of capital and labour and their judicious combination using technology. Yet, numerous ICTD interventions are implemented with the naïve view that though capital-intensive, electronic information and communication technologies, with their speed and accuracy, will automatically trump labour-intensive paper-based ways of fulfilling the same functionalities. This view is seen not just in deploying technologies for microfinance, but also in PDA-based data collection for healthcare, telecentres for accessing lean data, individual computers for education, etc.

Our study has shown how the relevance and effectiveness of a High or Low technology channel can only be assessed in relation to its interaction with labour productivity and variable capital costs, its need for operating expenses, and its draw on resources for fixed investments, in the context of the local wage cost for adequately skilled labour. In certain environments, the per- transaction accuracy and time gains from using various ICTs may get overwhelmed by the fixed and operating capital costs required to generate and sustain the gains.

The model presented here has many limitations. It adopts a static comparative transactional task-based view, to assess the relative value of one technology channel versus another. It does not specify a functional form that will allow precise estimations of productive or allocative efficiency in microfinance operations under various technology channels, which also prevents a serious assessment of returns to scale. Differential bundling of tasks through a High versus Low technology option is not addressed. The empirical evidence used has been case-based, limiting the size and variability of data points. Extensions to this study will therefore involve modeling that adds complexity and dynamism with the inclusion of costs across transaction tasks per customer, as well as the endogenisation of variables such as number of transactions per unit labour and number of units of labour per task under a given technology channel. It would also be valuable to incorporate gains in data quality from differential accuracy in data entry and varying error correction costs across channels. In addition, using a larger sample of empirical data points from within and across MFIs will contribute to improving the model's accuracy and predictability.

Acknowledgements

Thanks to Kentaro Toyama for his feedback on an earlier draft of this paper. Many thanks to the microfinance institutions that allowed us to examine and learn from their experiments with information and communication technologies.

References

Avgerou, C. 2001. The significance of context in information systems and organizational change. *Information Systems Journal*, 11 (1), pp. 43-63.

Bailur, S. and Ali, M. 2007. Re-thinking Sustainability in 'ICT for Development', in the *Proceedings of the 9th International Conference on Social Implications of Computers in Developing Countries,* São Paulo, Brazil, May 2007.

Donner, J. 2007. M-Banking and M-Payments Services in the Developing World: Complements or Substitutes for Trust and Social Capital? Paper presented at the Preconference on Mobile Communication at the *57th Annual Conference of the International Communication Association*, San Francisco, May 23-24, 2007, San Francisco.

Heeks, R. 1999. Information and Communication Technologies, Poverty and Development. Development Informatics Working Paper series, University of Manchester.

Ganesan, S. and Pichai, H. 2006. Study of Delivery of Financial Services in Rural Areas through ICT. CCS Report, Indian Institute of Management, Bangalore.

Gogineni, M. 2007. Preliminary assessment of a pilot intervention run by BASIX involving the use of handheld devices to record microcredit repayments. Microsoft Research India Case Study.

Gogineni, M. and Ratan, A.L. 2007. Evaluating the viability of a mobile phone-based, SMS/GPRS-enabled, client data collection channel for urban microfinance. Microsoft Research India Case Study.

Ivatury, G. 2006. Using Technology to Build Inclusive Financial Systems. Focus Note No. 32, Consultative Group to Assist the Poor (CGAP), Washington D.C.

Ivatury, G. and Pickens, M. 2006. Mobile Phone Banking and Low-Income Customers: Evidence from South Africa. Focus Note, Consultative Group to Assist the Poor (CGAP), Washington D.C.

Kumar, R. 2004. E-Choupals: A Study on the Financial Sustainability of Village Internet Centers in Rural Madhya Pradesh. *Information Technologies and International Development*, 2 (1), pp 45-73.

Morawczynski, O. 2008. Surviving in the 'dual system': How M-PESA is fostering urban-to-rural remittances in a Kenyan Slum. Working Paper, Social Studies Unit, University of Edinburgh.

Orlikowski, W. and Robey, D. 1991. Information Technology and the Structuring of Organizations. *Information Systems Research*, 2 (2), 143-169.

Parikh, T., Javid, P., Sasikumar, K. and Ghosh, K. 2006a. Mobile Phones and Paper Documents: Evaluating a New Approach for Capturing Microfinance Data in Rural India, in *Proceedings of CHI*, Montreal, Canada, 22-27 April, 2006, pp. 551-560.

Parikh, T.S. 2006b. Rural Microfinance Service Delivery: Gaps, Inefficiencies and Emerging Solutions, in *Proceedings of the International Conference on ICT and Development*, Berkeley, May 25-26, 2006.

Porteous, D. 2007. Just How Transformational is M-Banking? FinMark Trust, South Africa.

Ratan, A. L. 2007. An assessment of Pradan's 'Computer Munshi' intervention to improve microfinance accounting operations. Microsoft Research India Case Study.

Regy, P. V. and Mahajan, V. 2006. IT@BASIX Successes and failures: a retrospective. *Information for Development (i4D)* magazine, pp. 8-10.

Srikrishna, K.R. 2007. Operational Challenges: Our Experience with Technology. Presentation at the Workshop on Microfinance and Technology, Microsoft Research India, May 2007.

Veeraraghavan, R., Yasodhar, N. and Toyama, K. 2007. Warana Unwired: Mobile Phones replacing PCs in a rural sugarcane cooperative. *Second IEEE/ACM International Conference on Information and Communication Technologies and Development*, Bangalore, Dec 15-16, 2007.

Warschauer, M. 2003. *Technology and social inclusion: Rethinking the digital divide*. Cambridge, MA: MIT Press.

---

[i] Microfinance is used here to describe financial products and services that are sold in small-denominations to low-income clients (usually organized in groups), most often without physical collateral or surety, whose good behaviour (i.e. on-time repayment in the case of microcredit) is ensured by relying on social networks and sanctions to prevent delinquency and fraud. The provision of 'microfinance' has been driven and promoted by a variety of institutions ranging from NGOs, cooperatives, social entrepreneurs, government agencies, multilateral donors, all the way to large commercial banks.

[ii] Standard MFI interest rates range between 24% and 36% APR. Informal private financier/moneylender rates often exceed 60% APR.

[iii] There are 33 million customers of microfinance Self-Help Groups (SHG), source: http://nabard.org/pdf/stmt1.pdf . This does not include customers served by Joint Liability Group-style microfinance.

[iv] Non-Banking Finance Company

[v] Swibel, Matthew. "The 50 Top Microfinance Institutions." Forbes, Dec 20, 2007. url: http://www.forbes.com/2007/12/20/microfinance-philanthropy-credit-biz-cz_ms_1220microfinance_table.html