Organizing the Unorganized – Employing IT to Empower the Under-privileged

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ABSTRACT

Various sectors in developing countries are typically dominated by the presence of a large number of small and micro-businesses that operate in an informal, unorganized manner. Many of these are single person run micro-businesses and cannot afford to buy and maintain their own IT infrastructure. For others, easy availability of cheap labour provides a convenient alternative even though it results in inefficiency, as little or no records are maintained, and only manual, paper-based processes are followed. This results in high response times for customers, no formal accountability and higher charges. For the businesses this translates to lower earnings and losses due to inefficiencies. In this paper, we look at few such micro-business segments and explore their current models of operation, while identifying existing inefficiencies and pain points. We build upon the findings and propose an approach for delivering benefits of IT solutions to such micro-business segments. Finally, we present technology that realizes the proposed approach in the specific context of two such segments.

Categories and Subject Descriptors

H.5.2 [**Information Systems**]: Information Interfaces and Presentation User Interfaces[Voice I/O, User-centered design]

General Terms

Human Factors, Design

Keywords

Developing regions, Voice applications, Virtual communities

1. INTRODUCTION

Different service sectors and market segments in developing countries like India are plagued with inefficiencies, low productivity and wastage of resources. A major factor contributing to this is the dominant presence of informal, unorganized businessmen who rely on manual processes and cheap human labour rather than automation through the use of Information and Communication Technologies (ICT). This is understandable since a significant percentage of population in developing countries lies near or at the bottom of

the pyramid [14], and cannot afford their own IT infrastructure. For instance, in India alone people in rural areas account for about 70% of the population which amounts to about 700 million [5]. Most large cities also have a sizable population consisting of people who have migrated from villages to earn a living. Such people are typically illiterate or semi-literate and earn around Rs. 60000/- per annum (approx USD 1500) or less.

We conducted a survey of 47 subjects in our target population across 10 cities and small towns in India to find out about their ICT awareness. The professions of the subjects varied from people in service industry such as house maids, milkmen, drivers, to very small businessmen such as shop-owners, vegetable and fruit vendors, to skilled micro-businessmen such as plumbers, carpenters, electricians, handloom weavers, to employed personnel such as security guards, cab drivers, etc. We asked them questions regarding the channels they used for obtaining information, the use of ICT in their professional and personal life, interaction with their clients, use of mobile and their financial status, lifestyle etc.

Only 23% of the people surveyed try to advertise themselves through some means such as personal contacts, government agencies, phone, or through a contractor. Only 40% people owned a phone out of which only 4% had a landline and rest had a mobile. 17% people used phone to communicate with their clients, while 4% used paper based communication mechanism, 2% communicated through government established channels, 2% communicated face to face, and 2% had no direct communication with their clients. Rest 73% of the subjects did not feel the need to communicate with their clients. For some professions it was understandable such as for auto-rickshaws which pick up passengers when hailed on the street but interestingly many shopkeepers also did not feel the need to have a channel of communication with their customers.

55% of the subjects surveyed had TV at home. However, only 32% used it to gather information. About 21% used newspapers, 2% used radio and 36% used word-of-mouth as their source of information. Rest did not feel the need for any formal channel to gather information.

In terms of their financial status, only 21% had a bank account in the family and only 4% accepted cheques (in addition to cash) as a mode of payment. None of them accepted credit cards or any other kind of plastic money. Only a little above 8% make a reservation before travelling by train.

The authors' own experiences, the survey results, and studies conducted by others [3, 6] indicate very little use of ICT by this user segment. This tends to make them very

informal in their business or profession and results in lot of disorganization. As a result, there are failed commitments, little or no accountability, and inefficiencies in markets leading to suboptimal behaviour [6]. This also enables many of these informal businesses to evade taxes since no formal accounting records are maintained [3].

However, with globalization and proliferation of new technologies these informal businesses are facing difficulties in keeping pace with new competition and increasing demands of their customers. Introduction of basic ICT such as mobiles, PC, Internet have helped improve various sectors such as the fishing industry [6]. There are other efforts such as aAqua [15] that go beyond the basic ICT plumbing, to offer useful services to this target population.

Paper Contribution: There are three key contributions of this paper. The first is to identify the pain-points of the mobile micro-businesses, from two angles. The first viewpoint is to look at micro-business from a service-provider's angle and the second is to seek the pain-points of customers of these micro-businesses. For this paper, we restrict mobile micro-business to household services that are provided by plumbers, carpenters, electricians, painters kind of skilled labourers. We also include auto-rickshaw service in our definition of micro-business. We use user interviews for this purpose. The second contribution of this paper is to propose organization of these micro-businesses as a solution approach the use of *virtual online communities* as a specific solution to the pain-points for this population segment. Finally, we validate the applicability and usability of the proposed solution through user-studies.

Paper Organization: The rest of the paper is organized as follows. In Section 2, we study two specific segments and inspect the operational models prevalent there. We summarise the pain points of these two segments of mobile micro-business. In Section 3 we propose a solution approach to overcome drawbacks of current models by proposing the concept of organizing micro-businesses into a virtual community. We also present detailed results of the user surveys with respect to the proposed community based solution. In Section 4, we present technology solutions for creating a virtual online community for the two micro-business segments. We also perform a user study to validate the usability of a prototype implementation and report the user evaluation results. Finally, we discuss the applicability of our approach in other segments in Section 5 and present some related work in Section 6 before concluding the paper.

2. APPLICATION SCENARIOS

In this section, we look at two specific unorganized sectors in India that can significantly benefit by leveraging IT.

2.1 Mobile Micro-businesses

Many people in the lower end of the pyramid especially those who migrate to cities from rural villages, pick up a small trade skill to earn a living. These include plumbing, gardening, driving, welding, carpentry, repairing of bicycles and motored vehicles among others.

The size of such unorganized workforce in India is about 370 million people [16]. This forms 93% of the total workforce in India. A significant fraction of this workforce is semi-literate, i.e. they have less than 5 years of elementary education. Skilled labourers such as plumbers, electricians, carpenters are a part of this workforce.

2.1.1 Surveys

We surveyed 26 skilled labourers in the Delhi region. The aim of this survey was to identify the pain points in their current operational model. We asked them the following questions and the results are summarized in table below.

- How much time in a week are you free while available for work?
- Are you willing to go to far off places due to lack of work in the neighbourhood?
- Are multiple conflicting requests that might result in loss of work, a problem?

Table 1: Summary of responses from skilled labourers

Questions	Yes	No
20%-60% Idle time?	75%	25%(< 20% idle)
Willing to travel to get work?	43%	57%
Conflicting requests a problem?	0%	100%

As is evident from the surveys, most often these labourers are idle while available for work. For some people, this idle time goes as high as 60%, i.e. they get work only on 12 days in a month. This was one of the most common pain points of this community. Secondly, since not everybody gets work in the nearby area, sometimes they have to accept assignments that are at far off places. Even though almost all travel outside their neighbourhood at times, 57% people do not find it covenient. The travel costs (sometimes paid by customer), problems in commuting through unreliable public transport, and fatigue due to cycling to far off distances are a deterrent.

Occasionally, a labourer may get multiple requests for the same time and day. In such cases, most labourers are able to convince the client for an alternate day and/or time. If a reschedule is not possible, the labourers refer the work to their colleagues. Overall, a conflicting request is not a pain point with this segment.

Even though there exists such a large workforce, clients often have trouble contacting them or finding information about their services and their contact information.

We interviewed 25 customers to understand how they currently engage the service of such micro-businesses and asked them the following questions with results summarized below.

- Do you face any difficulty in finding skilled labourers?
- Do you feel the need for a service to reach out to skilled labourers?
- Are you willing to pay a subscription for such a service?

Table 2: Summary of responses from customers

Questions	Yes	No
Difficulty in finding labourers?	44%	56%
Need a service?	91.4%	8.6%
Willing to pay subscription?	57%	43%

44% of the people said that finding these people is their biggest hurdle. 91.4% of the subjects expressed a desire/interest in a service that could connect them to the local micro businesses. They want it to be a one stop shop for all their needs. If it provides guarantee of service 57.1% were willing to pay a subscription fee.

2.1.2 Current Operational Models

Different operational models exist today, each with its own drawbacks. Many such micro-businessmen work on their own by visiting houses in a community to provide services. Their business depends on the information that the community has about them. As the number of people who know them increases, their clientele increases. The primary mode of advertising for these people is word-of-mouth references from their existing customers or their colleagues in other trades.

Yellow pages do not work in countries like India for multiple reasons. These people cannot afford the cost of such advertisements which are typically not updated frequently. Even people who have a small shop only occasionally advertise themselves through fliers that are cheaper to print and are distributed along with daily newspaper. For customers, it is tedious to search through printed yellow pages and online web based yellow page services such as Just-Dial [1] are only now beginning to emerge. However, the most important pain-point for the customers that emerged from these interviews was the lack of accountability and quality of service guarantees that exists in these unorganized sectors. Customers feel more confident to use services of a labourer referred through a known person rather than using an unknown one from yellow pages. Security concerns also come into play and a referred person instills more trust than a completely unknown one. Printed yellow pages do not provide any means to rely on the advertised labourer.

Customers rely instead on their social network of neighbours and hired labourers such as security guards, maid servants etc. to search for other micro-businessesmen. In most cases, they contact the local grocery store or utility store to contact these people. The utility stores charge a small fee for sending them the desired service men. But the choices are limited and customers usually stick to the same person even if he does a substandard job simply because the alternatives are not always available.

A few organized models also exist. In one such model, these skilled labourers get themselves employed at some establishment such as a local electrical goods store (in case of an electrician) or a local builder who constructs residential houses on contract. This gives them credibility and a steady stream or work. However, they get subjected to exploitation by the establishment and most often get underpaid. In another model, these workers get employed on an ad hoc basis by community housing organizations where their responsibility is to attend to repair needs of the housing complex. Here the monthly earnings are fixed, though this is usually lower than what they would earn in their own business. Such workers are contract employees and do not get health and insurance benefits. Some brick and mortar concierge services also exist today but their operating costs and overheads allow them to serve only high end customers.

2.2 Public Transportation

The second unorganized micro-business segment that we look at, lies in the transportation sector. Auto-rickshaws or simply 'autos', such as the one shown in Figure 1, are three-wheeled vehicles that operate like taxis and are a favourite mode of affordable public transportation in countries like India. However, they are either owned by the driver himself

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[1]http://www.justdial.com

or are rented by him and are operated autonomously. Such autos ply throughout various cities and towns of India.

Figure 1: An Auto-rickshaw

2.2.1 Surveys

We surveyed 30 auto drivers in three Tier-1 and Tier-2 cities of India — New Delhi, Bhopal and Jabalpur. The interview consisted of following questions about their work related pain points and findings are summarized in the table below.

- How much time do you spend on an average waiting for customers, per day?
- Do you own a mobile phone and use it for business?
- What is your daily expenditure?
- Do you face any harassment?

Table 3: Summary of responses from auto-drivers

Questions	Yes	No
High waiting time (7-8hrs)?	58%	42%
Use mobile for business?	33%	67%
High penalties?	82.6%	17.4%
Customer Harassment?	34%	66%

From the interviews we found that most auto drivers operate 12-14 hours a day. A surprising revelation was the fact that out of this, the waiting time accounted for upto 7-8 hours a day. 58% of the auto-drivers reported their daily waiting time to vary from 7-8 hours while 42% reported it to vary between 4-8 hours. This is the time when they are forced to simply idle around at road sides waiting for passengers to come by. Very few auto drivers are engaged in scheduled pick and drop arrangements. The primary reason for this is the lack of a channel for communication needed to achieve this. Of the drivers surveyed, about 58% owned a mobile phone, yet only 33% used it for their clients. The others used their mobiles as a family phone and therefore did not carry them all the time, making it unavailable for business use.

The drivers who have a mobile phone are able to accept prior appointments during morning hours typically for office or school drops. However, after that their location is governed by the passengers that they get and they cannot commit further pickups.

The daily expenditure including rent for the autos is typically between Rs 200 (≈USD 4.5)–Rs 250 (USD 5.5) per day, fuel and maintenance is another Rs 100 (USD 2 approx) per day. Additionally, they have to pay penalties to

the traffic policemen for road blocking[2] and other offences. These penalties account upto Rs 1500/- per month (USD 32 approx). Their average daily earnings (after the above expenditure) vary between Rs 100 to Rs 150 per day amounting to Rs 3000–Rs 5000 (approx USD 70 - USD 120) per month.

There were other characteristics that were revealed. Most of these auto drivers were willing to operate anywhere within city limits but going out of the limits either required paying extra taxes or was simply not allowed. However, towards the end of day they prefer to only take passengers travelling in the direction of their home location.

Some auto drivers also reported harassment by customers. Since most autos do not follow meters, many a times customers too go overboard and demand to be dropped for very low charges. At other times, customers demand to hire the auto even though it is not available for hire (such as parked in a stand waiting for the next shift driver or waiting daily checkup/repair). This is a negative side-effect of efforts by law enforcing authorities to control rude behaviour and unauthorised refusal by auto-drivers.

We surveyed the customers as well and asked them the following questions:

- How much time do you spend to get an auto? Specify Avg and Max. times.
- Would you want to do advance bookings?
- Biggest pain points of hiring an auto ?

We presented these questions to 33 auto-users and the result are summarized in the table below.

Table 4: Summary of responses from auto-customers

Questions	Yes	No
High waiting time (10-30min)?	57.5%	42.5%
Want advance bookings?	94%	6%
Harassment?	82%	18%
Service Dissatisfaction?	18%	82%

57.5% of them mentioned that they wait on an average 10 min to a maximum of 30 mins 94% of the people surveyed responded in positive to the second question. Among the pain points, 82% people complained of having been forced to pay more than the standard rates or drivers refusing to go the desired destination, and 18% professed their dissatisfaction with the impoliteness and rash driving of the drivers.

2.2.2　Current Operational Models

Unlike taxis which have their designated stands, autos are hailed from the street and they rarely have designated parking space while waiting for customers[3]. As can be seen from the surveys, there are several inefficiencies in this mode of operation. The long waiting times for the auto-drivers result in their urge to be dishonest and to charge more than what is fixed by the transport authority. For similar reason, auto-drivers often refuse to go to a place from where they may not get more customers easily. Moreover, often while waiting for customers on roadside or while picking up change for a customer or on other occasions they get fined by the

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[2]There are very few designated auto-stands and most autos commonly wait for customers in densely populated areas such as markets and popular joints.

[3]In Kolkata, however, the opposite situation applies.

traffic police as they are not authorized to park on road. All of these ultimately result in harassment to the drivers and the passengers.

Transport authorities have tried to create designated *prepaid auto stands* at different places for the convenience of passengers. Here autos queue up for passengers and pay some nominal fees to the stand operator and customers get readily available autos at charges fixed by the authorities plus a small premium. While customers are happy with the model as they do not need to negotiate and the autos are registered which adds to the safety factor, the auto-drivers complain of long waiting time and low fare charges for certain locations. For busy places like airports and railway station, auto-drivers are allowed to drop a passenger but either have to wait in a long queue to get next passenger or have to travel back to city empty.

These inefficiencies result from the fact that no central entity exists that can coordinate the operations of the autos much in the same way a taxi company operates by taking in customer requests and dispatching orders from a central location. The difference between the two lies in the ownership of the vehicles. In the former, taxi vehicles belonging to a single company or partners lie under single administrative control whereas in the latter case each auto-rickshaw is autonomous. It becomes apparent that organizing these auto operations while retaining the autonomy of these auto-rickshaws would provide significant benefits to both commuters are well auto-drivers and owners.

3.　ORGANIZATION THROUGH COMMUNITIES

Driven by the inputs from the surveys, we propose overlaying or imposing an organization over the unorganized sectors as a viable solution. Hopefully this can help in alleviating some of the inefficiencies and problems existing in current operational models. Specifically, we study the service providers in the two segments introduced above and explore whether they are willing to be organized with the goal of increasing productivity and reducing inefficiencies. Further we study the customer's view to explore the need and willingness from their perspective.

3.1　Mobile Micro-businesses

We surveyed 26 skilled labourers in the Delhi region. The aim of this survey was the following:

- to discuss with them and find out if organising them can help their business, and,
- to verify if their needs can be served by forming an organization for this section of the society.

We provided the survey subjects with an option of using a hypothetical organized community service through which subjects can get information about micro-business and can make appointments.

3.1.1　Survey Results – Mobile Micro-businessmen

Of the 26 people, 12 owned a mobile phone. Most of them were plumbers, electricians, painters, carpenters. Their current operating style involves flocking around near a hardware market. None of them advertise themselves through local yellow pages or through newspapers. They seem to have an impression that they are not a big company who can advertise.

Table 5: Mobile workforce survey responses.

Question	Yes	No
Need organization?	85%	15%
Community-based referrals?	92%	8%
Ready to pay commission	53%	47%
Use SMS	4%	96%

Table 6: Mobile workforce customer responses.

Question	Yes	No
Need an organization?	82%	18%
Ready to pay commission?	82%	18%
Need service guarantee?	92%	8%
Use SMS?	100%	0%

85% of the interviewed people felt that they need to organize their schedules. An overwhelming 92% said that they would want to register to a virtual community if it can help them in providing more work. 47% of them were not willing to pay a commission to this community. They wanted that the community should charge commission from the customers and not from them. However, the remaining 53% were fine with a commission of about 5% to 10%. None of them had problems with the fact that the community may call them back if the work is not good. However, some mentioned that the support will be provided only if it happens within a couple of weeks from completing the task. Almost all preferred to talk to the customer before signing up for work assignment on the virtual community.

Of the 12 people who had mobile phones, only one person was comfortable using SMS as a means of communication with the virtual community. Rest preferred voice.

Key Insights: *This survey clearly identifies that this segment does not get enough work volumes – they are capable of handling more. It also establishes the need for having a virtual community for these labourers. Moreover, this community should levy a very low commission (if any) from micro-businessmen and should be available over a voice interaction.*

3.1.2   Survey Results – Micro-business Customers

We interviewed 30 people who frequently use services from the micro-businesses such as plumbers and carpenters. About 75% of subjects mention that they do not get a plumber / electrician / carpenter when they need them. They are either late or unavailable. Reliability and overcharging is an issue with about 30% of the subjects. Perhaps owing to these pain-points, 82% of the subjects are willing to use an organization for their microbusiness needs. Of this, 68% (i.e. 82% of total surveyed) are willing to pay a nominal fees to use such a service. 70% of the subjects would prefer to use just Phone/SMS to contact such an organization, while the remaining are comfortable with the Web too. 92% of the subjects desire a service guarantee from the organization. 70% of the subscribers are willing to wait for a couple of hours before they get a confirmation for the service. For special long-term contractual services such as a maid or a driver, 15% subjects are willing to wait for a couple of days before being confirmed. A sample of the questions asked to these subjects are presented below:

- Do you get Plumbers/Electricians/Carpenters when you need them ?
- Would you rather deal with an organization for your needs ?
- Are you willing to pay a fee for this service ?
- How would you prefer to contact the organization ? (web, phone, SMS) ?

Key Insights: *It is clear that the customers who need the services of such mobile micro-businesses are willing to use and pay for the services provided by an organization. Since*

this segment of people are literate enough, they are fine with either voice or SMS as a mode of interaction.

3.2   Auto-scheduling

We created a service description, called *Dial-an-Auto* to explain the scope and limitation of the environment that the auto-drivers would be in with an overlaid organization. We presented Dial-an-Auto as an organization that would provide an effective matchmaking of needy customers to autos nearby. This is not possible today due to lack of a common communication channel.

3.2.1   Survey Results – Auto Drivers

We surveyed 32 auto drivers in New Delhi with the aim of determining whether they would be willing to sign up for Dial-an-Auto.

We asked the following questions:

- Would you be willing to use Dial-an-Auto service? This would mean registering with the service provider, calling in to update the current location whenever available for picking a customer or to find out if there was customer closer to them looking for an auto.

- Would you be willing to travel with charges fixed by the transport department while using this service?

- Would you be willing to accept advance bookings?

- How far would you be willing to travel to fetch a waiting passenger without charging anything extra?

Several drivers outrightly rejected the proposition — claiming it to be impossible. Further probing revealed couple of interesting insights. First, they felt that they would get customer requests from far off places and it would be a waste of time and money to pick them. We assured them that location based matching would solve this problem. Second, local rules enforce these auto-drivers to not refuse a passenger who has hailed them on the street. This was put in practice by the authorities to prevent errant drivers to refuse passengers that wanted to go to less profitable places or who wanted to pay as per charges fixed by the government. The drivers asked how they could refuse someone on the street if they have already been booked and are on their way to pick the passenger. We took this as an input to next refinement of sour design.

However, on presenting clarification most of them could immediately sense the benefits of such a service and many could relate it to the operation of radio taxis that are controlled from a central location.

We summarise some of the key responses. 100% of the surveyed auto-drivers wanted to use Dial-an-Auto. 53% of them were willing to charge as per the rates fixed by transport authority while the remaining 47% expressed their desire to negotiate with the customer. 100% of the people surveyed were keen on accepting advance bookings only in the mornings, since they cannot guarantee their location during day

Table 7: Summary of responses from auto drivers.

Questions	Yes	No
Want Dial-an-Auto?	100%	0%
Want to negotiate charges?	47%	53%
Advance Bookings?	100%	0%
Pick up to 1km without extra charges?	25%	75%

time. About 9.3% of auto-drivers surveyed were willing to go upto 0.5 km to fetch a customer without charging extra while 15.6% were willing to go upto 1 km without any extra charges. Remaining 75% were willing to go upto 5 km to pick up a customer as long the metering starts from the location where the call was received.

A few auto-drivers expressed concerns if they will have to pay commission for using this service. They were happy to know that no such charge will be levied to them. They were also concerned if this service would turn out similar to a pre-paid auto-stand described earlier. Long waiting times and trips to areas with low likelihood of returning customers make these stands not very popular among auto-drivers. Another reason is that they lose their autonomy in fixing up the charges. Even in the context of Dial-an-Auto, the drivers wanted to have the option to accept/reject a passenger, and the freedom to negotiate the price directly with the passenger.

Key Insights: *This survey helped us realise that the solution should be such that it retains the autonomy of individual auto drivers. It should also cater to passengers who do not have a mobile phone. The solution should be able to provide a mechanism for booked autos to refuse passengers. Since many drivers are not willing to drive with government approved rates, the solution should provide a mechanism for allowing negotiations.*

3.2.2   Survey Results – Auto Passengers

We interviewed 30 subjects who live in different regions in Delhi to find about their pain points with respect to getting an auto-rickshaw. About 80% of the subjects were willing to make a call to a Dial-an-Auto service to get an auto. Most subjects are willing to pay an additional 10% to use this service. 68% of the subjects are willing to do an advance booking for an auto. One subject had tried advance booking over phone with a know driver and he was satisfied with this mode of engaging an auto.

Table 8: Responses from auto passengers.

Questions	Yes	No
Will you call Dial-An-Auto?	80%	20%
Pay extra?	92%	8%
Advance Bookings?	68%	32%

Overall, most subjects showed their willingness to use the Dial-an-Auto service and they were positive that such a service can be helpful for commuters.

4.   THE TECHNOLOGY

The insights gathered through the interview process (as described in the previous section) establish a need for organizing the micro-business market through a community based system. As a solution, we propose the VOIAVATAR system, based on VOIGEN [9], that helps these labourers to *create* their *avatars* on the telephony network. The generated system is deployed in the network and accessible through a phone number that is assigned to it. For the auto-drivers, we have prototyped an auto-scheduling service called Dial-An-Auto. Both the applications are accessible by voice over the telephony channel. Thus these two applications provide a low-cost and low-literacy-requirement solutions to organize the micro-business. Next we describe the details of the two services.

4.1   Mobile Micro-business

The VOIAVATAR system can be used by micro-businessmen to create their own virtual avatars by making a phone call. The online *avatars* of these micro-businessmen can be accessed to get information about them and their work. Such information could include area of operation of the micro-businessman, service charges and work hours. Once many people create their *avatars*, this can evolve to a virtual online community of micro-businessmen and customers, where both can upload and access the information through a phone call. The customers could call in to community portal to specify their requirements and the portal would then search for relevant micro-businessman registered with it. Alternatively, the customer could browse through *avatars* of various micro-businessmen to select one for his job. The *avatar* also acts a proxy for the micro-businessman as the customer can interact with it if the micro-businessman himself is busy with a job or is unable to accept a phone call. This ensures that the user does not lose customers due to unavailability through the phone.

The VOIAVATAR system has been developed as a spoken language interaction system. A pre-defined template is provided for a particular type of business. The sample template shown in Figure 2 is for skilled laborers such as a plumber or carpenter. In this template for example, some of the information asked includes home location, working hours, service charge information and recommendations for this laborer. The laborer can also configure his *avatar* so that it can take appointments from his customers.

The VOIAVATAR system also allows multiple *avatars* to be linked together through a Hyperspeech Transfer Protocol (HSTP) that we have defined and prototyped [7]. This hyperlinking in voice enables creation of a networked ecosystem [10] of such *avatars*. Traversal of these links through a phone, involves transferring the phone call from one *avatar* to another along with the context of the application across the two *avatars*. Such a mechanism can enable customers to make online payments to a micro-business safely through a phone call. The businessman can later modify his *avatar* by calling the VOIAVATAR system.
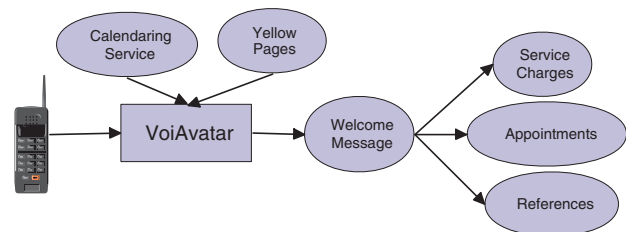
Figure 2: Creating the Voice Avatar

The system is not heavily dependent on the speech recognition accuracy since very few utterances of the end-user
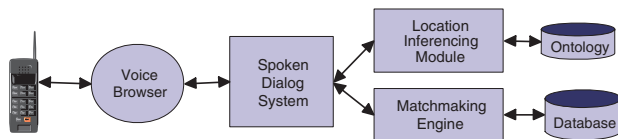
Figure 3: Dial-An-Auto System

are converted to text, most is recorded. Since the generated *avatar* of the micro-businessman is in his own voice, customers can easily relate the *avatar* to the actual person.

This service brings some organization into daily operations of these micro-businessmen. They become empowered with a means to advertise themselves, describe their service and corresponding charges and offer appointments. Later on, appropriate information logging at the server could help produce usage data and reports for a micro-business. Such data collection and analysis is missing for this user segment.

4.2 Dial-An-Auto

In order to organize the auto-driver operations, we propose a spoken dialog matchmaking system that will enable auto-drivers to find the closest passenger and vice versa at any time. The fare prices and decision to accept a passenger can still rest with the auto driver thus retaining the autonomy of the drivers. In this section we will describe the Dial-An-Auto system.

Figure 3 shows the architecture of the Dial-An-Auto. The system is accessed through the telecom network by making a phone call. The call is connected to the spoken dialog system via a Voice Browser. The spoken dialog system contains two call flows - one each for passenger and auto driver, and use a location inferencing module and a matchmaking module to serve incoming requests. We next describe these modules.

4.2.1 Location Inferencing Module

Well structured network of streets and highways in developed countries make it very easy to specify a precise location using location positioning systems. Applications like Google maps and Yahoo maps can be used in location based services to give directions or to guide someone to a particular location. The same is not true for countries like India where the roadways are highly unstructured, milestones or street identifications are missing at cross roads and there are multiple names for the same location. Locations are specified with the help of landmarks such as school, hospitals, market places as opposed to just the names of streets. For the Dial-An-Auto system, we developed the prototype of a voice based location inferencing system which makes use of an ontological model to narrow down to the exact location of the user. The details of the ontological model used is out of the scope of this paper.

4.2.2 Spoken Dialog System

This module presents a different call flow for passengers and auto-drivers. It guides the user by registering his call-information and request and transfers control to other modules to process the request. Figures 4 and 5 show separate call-flows that are designed for the Auto-driver and the passenger which can be accessed on different telephone lines.

Passenger Call Flow: Passengers can call the system to make two types of bookings: current or in advance. In case of current booking, the control is the transferred to the lo-
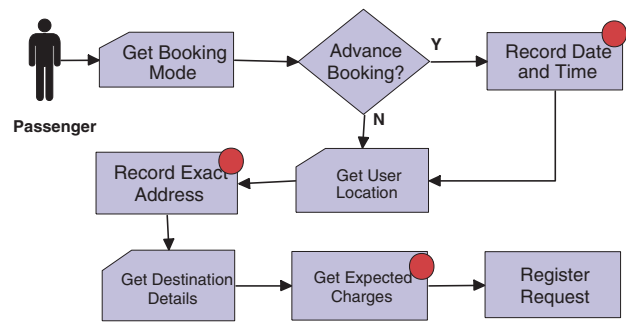

Figure 4: Passenger Call Flow

cation inferencing module which deduces the user's location by asking a series of questions. The location is deduced to the granularity level of a small area in the city. The exact location of the passenger is recorded later which is played to the auto-driver. The destination details are obtained in a similar fashion. Finally, the passenger is asked for an estimate of the fare he is willing to pay for the destination specified. This question is optional and can be removed for places where fixed fares are applicable in practice.

In case of an advance booking, the user is also asked to record the date and time as to when he will be needing the service.
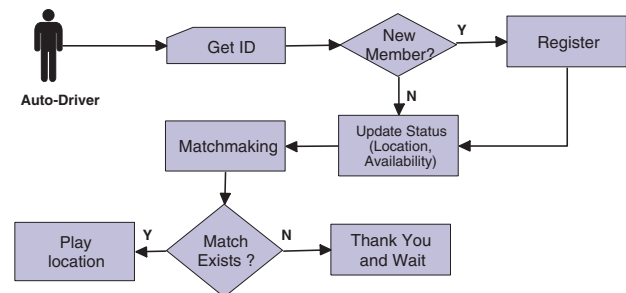

Figure 5: Auto Driver Call Flow

Auto-Driver Call Flow: When an auto-driver calls the system for the first time, he is asked to register his personal information: Working hours, home location, phone number etc. Some of this information is later used by the matchmaking engine to determine the best match for the auto-driver. For example, it takes into account whether the auto driver prefers passengers heading towards his home at the end of the day or how far he is willing to go to pick a passenger free of charge. Once the registration is complete, a 4-digit PIN is given to the auto-driver which serves as his identification. The system then asks the auto driver for his current location. The matchmaking algorithm determines the best match among all the registered passengers. In case a match exists, the passenger details along with the exact recorded location is played out to the driver. Otherwise the driver is asked to call back again after sometime. If the auto-driver has a cell phone, the system calls the auto driver as soon as a passenger becomes available.

We have implemented a matchmaking engine [8] that not only does traditional parametric matchmaking but also takes

into account real time updates such as location information of the auto-driver. The parametric matching is done on the preferences of the auto-driver specified at the time of registration.

4.3 User Feedback

Since the VOIAVATAR system is intended to be used by micro-businessmen, we invited some plumbers, electricians, carpenters etc (*subscribers*) to use VOIAVATAR. They created their own *avatars*. Secondly, we invited people who are typical *users* of such services and asked them to call the *avatars* that were generated by the *subscribers*. Thus we evaluated the entire process of generation of *avatars* (by *subscribers*) and then the use of these *avatars* (by *users*). In this section, we elaborate on the profile of the subjects who took part in the evaluations. Later we describe the evaluation process and conclude by providing the evaluation results and insights gained from user study.

4.3.1 Profile of Survey Subjects

The system was evaluated on two processes. The first process focused on the usability aspects of the VOIAVATAR system. The target population chosen for this task are the people who work as freelancers and have a specific region of operation (a few kilometers). They are typically skilled laborers (such as electricians, plumbers, carpenters) and charge on the basis of the amount of work that is required of them. We surveyed 12 subjects of which 3 were carpenters, 5 were plumbers, 3 were electricians and one was a drilling person.

The second process involves use of the *avatars* that are generated in the first process. These set of people, who we foresee would use these *avatars*, are from well-to-do families who need services to fix water taps, electricity problems, among other work items. This section of the population is relatively more exposed to IT services. Some of them have used interactive voice response systems and know about or use the Internet.

4.3.2 Survey Process

For the first process, we briefed the *subscribers* for about 10 minutes to motivate them of the use and advantages of *avatars* in their daily lives. Then we briefed them with the usage of the VOIAVATAR system for about 5 minutes. Then we asked subjects to make a telephone call to VOIAVATAR. Subjects were asked to interact with VOIAVATAR and respond to the commands and provide the relevant answers. Finally, we asked the subjects a set of questions to get an understanding of the usability of VOIAVATAR and of the potential of *avatars* for the masses. The questions asked were the following:

- Have you ever used an automated voice driven system?
- Was this method of generating the *avatar* easy to use?
- Are you interested in having your own *avatar*?
- Do you think your business will improve with the use of your *avatar*?

In addition, the following observations were made during their use of VOIAVATAR:

- Time required to describe the concept of *avatar*.
- Time spend by the *subscriber* in creating the *avatar* using VOIAVATAR.

For the second process, we explained the concept of providing services through telephony infrastructure to the prospective *users* of *avatars*. Then we asked them to make a phone call to the *avatars* that were generated as part of the first process. We asked the following questions to them after the phone call:

- Was this voice based system (i.e. *avatar*) informative?
- Do you normally have problems in getting touch with the plumber, electricians or such service providers?
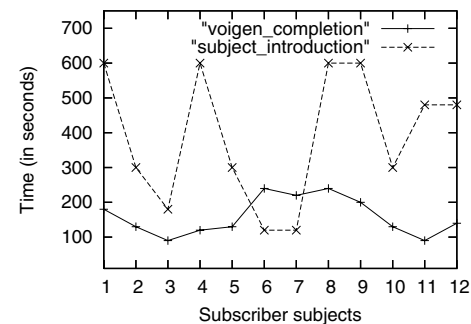

Figure 6: Time taken by each subscribers to understand the *avatar* concept and to build their *avatars*.

4.3.3 Survey Results

Out of the 12 subjects that were used to generate their *avatars*, 10 were able to successfully create the *avatars*. Figure 6 shows the time that was spent to build the *avatars* for the 12 subjects. Subject 1 and 7 were not able to create their *avatars*. As seen, most subjects were able to generate their own *avatars* within 4 minutes. A 4 minute phone call in India costs less than 5 rupees (10 cents). This is despite the fact that none of these subjects knew or had used a voice based conversational system before. Surprisingly most of them were comfortable with using the VOIAVATAR system. More importantly, all of them were able to identify the potential that having a *avatar* can have in increasing their business. However each such phone call had to be preceded by an introduction to the concept which took about 5 minutes for each subject, as is seen in Figure 6. All showed tremendous interest in the concept of *avatars* and the fact that their work can be advertised without them actually requiring to purchase any additional equipment.

About the usability of VOIAVATAR, 2 subjects felt that the system was not designed properly. They highlighted that it asks difficult questions rather than just asking for simple things such as name,occupation or area-of-work.

We also performed usability surveys on 12 subjects who were asked to make a call to the *avatar* that were generated by one of the carpenter. We asked them if the information provided on the *avatar* was useful to them. While most people found the information to be useful, 3 subjects mentioned that such a *avatar* will only be useful if they are able to make an appointment with the system. We also asked the subjects if it was an advantage to have the entire *avatar* in the voice of the actual carpenter, rather than it being a system voice. To our surprise, 66% of the subjects felt that they would prefer to hear to a standard voice that is clear and does not have a heavy accent. They mentioned that they were not

able to understand the voice of the carpenter in some of the prompts. However the remaining 33% were impressed with the fact that they could hear the carpenter's voice and mentioned that the voice would help them judge the carpenter. All the subjects used for this usability test were educated IT professionals. They were from different regions of India and not all of them had Hindi as their first language.

Summary: Overall, the concept of providing services over telephony infrastructure was found to be very important to the subscribers and they realized its potential. The concept of *avatar* was also found to be very easy to learn and use. Based on this survey study, we realize that since the access to *avatars* is through a telephone, it has a wider reach. Secondly, since voice interface is used to access the services, the learning required to use such services deployed on the telephony infrastructure is minimal. This is critical since our target population is not expected to be educated enough to learn the complex and non-natural interfaces such as keyboards. Finally, the model of *avatars* is such that it has minimal cost implications to the *subscribers* and *users*. The system evaluation through these user studies act as a proof point to the potential of VOIAVATAR in developing countries.

5. DISCUSSION

The approach proposed in this paper has been demonstrated to be applicable in two sectors. However, the approach is a generic one and is equally applicable in other sectors as well. Retail industry is one such sector where the problems faced by small and micro-retailers due to lack of organization has been recognized.

The Indian middle class represents a huge burgeoning market. This realization has led various retail giants such as WalMart [4] to enter Indian market. Several new players such as Subhiksha [2], FoodMart as well as local companies such as [1] have also ventured out into this space resulting into mushrooming of various shopping malls and retail stores across the country. This trend presents a challenge to survival of a huge number of small retailers that form an essential part of the country's economy.

It has been argued that the small retailers offer personalized service to their customers including free home delivery, attending to them at odd hours, remembering their preferences etc. and therefore they cater to a different segment than shopping malls [17]. Nonetheless, surveys indicate that such mom and pop grocery stores and retail shops are being hit hard since they are unable to match the reduced prices that big stores manage by ordering in bulk, sourcing directly from the producers and optimizing their supply chain.

Information Technology can again play a key role here in enabling these small retailers to organize themselves into virtual communities or cooperatives. This would give them bargaining power with suppliers, help them source products directly from producers and amortize transportation, warehouse and other cost across all members.

We believe that *organizing the unorganized* as an approach enabled through *virtual online communities* has the potential to impact several sectors.

6. RELATED WORK

An attempt has been made to make the process of hiring an auto simpler by an initiative launched in Bangalore by the city police and the transport authority, called *Easy Auto*[4]. The service has a call-centre based model. Customers must register with *Easy Auto* to receive door-to-door service. Non-registered customers can avail the service only at *Easy Auto* stands. The autos can be booked through the web, an Interactive Voice Response (IVR) system or by sending an SMS. Locations are specified using location codes that are provided in the passenger registration kit. Auto drivers need to register. However, they do not have the flexibility to choose their passengers. The fares are fixed by the transport authority. The control is more centralized and this model works like the regular cab service model. Comparatively, Dial-an-Auto strives to preserve the autonomy of the auto drivers while at the same time provides similar benefits to the passengers. The automatic matchmaking will also eliminate the call-center costs which account for a large part of the operational costs in *Easy Auto*. The *Easy Auto* is still in its initial phase of launching and not many auto drivers have registered for this scheme yet. One of the incentives for auto drivers to enroll is that they get insurance protection for their families.

In the micro business area there have been efforts to enable the organization of the micro businessmen to reach a larger clientele using web based solutions. The idea is to create virtual market places where micro businesses can directly sell their products. PEOPLink[5] allows artisans in developing countries to sell their products online by using a simple catalog generator software. Local catalogs are aggregated into online market places. The customers can order products through the web and the payments are made directly to the artisan. B2BPrice.com allows farmers in Philippines to trade their goods online.

Dilli Haat[6] is a central market place in Delhi, where artisans from all over the country are invited to exhibit and sell their products. It is a brick and mortar effort to organize the people in this segment. It is a government driven initiative to enable artisans from various parts of the country to reach out to a larger market. The market place simply provides a common venue for the artists and customers to interact. Another common model followed in India is where fruit and vegetable vendors gather at a common market place to sell their products. This is an example of a loose, informal organization of micro businesses where they still function like autonomous entities.

A recent effort is `babajob.com`, a social networking website for finding jobs with a difference. It enables people who have access to web (called mentors) to create and maintain online profiles of under-privileged people essentially incorporating them into an online social network. Since this is a new site, at the time of this writing, it is not known whether this service has been accepted by a lot of people or not. We believe that finding mentors will be a key challenge, as will be the updating of the social network links as time progresses. The use of voice-driven interfaces for our target population has also been suggested [18] and experimented with [11, 12].

Authors in [13] performed a user study to evaluate the acceptance of voice-driven application in rural India based on a sample speech-driven agriculture query system. The

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[4]http://www.easyauto.in

[5]http://www.peoplink.org

[6]http://www.delhitourism.com/dttdc/dilli-haat.html

study reveals that even illiterate users were able to navigate through the dialog system, though the number of errors for such users was higher than those with literate people.

VoiceGuide[7] is a system that allows fast and easy creation of IVRs. It offers an easy to use application development visual editing tool for IVR creation. While this may be convenient for application programmers, our target segment will be unable to use it. Our VOIGEN system [9] allows anyone to simply make a call to create their *VoiAvatar*, making the process all the more easier.

7. CONCLUSION

In this paper, we reported the insights gained from a survey of mobile micro-business service providers (and their consumers). These represent some of the 700 million unorganised workforce in India. Based on the collective painpoints of this community, we proposed the use of virtual online communities as a mechanism for organizing this workforce and hence improve their work efficiency and productivity. The surveys with the service providers and customers present the need for such a virtual community for the two verticals that we used for this purpose. *Thus we identified the problems, proposed a solution and validated the applicability of solution while constantly engaging the end-users.*

A key consideration as also observed from the surveys is that this approach has to be applied while retaining the autonomy of individual participants. Such efforts involving government results in participants losing their autonomy such as in Pre-paid taxi/auto stands and more recently in the *Easy Auto* service being piloted. Without the use of technology, similar practices have been successful in different forms in developing countries where people try to organize themselves to gain some business advantage. Examples include group organized auto-stands, semi-formal fruit and vegetable markets, etc. However, our belief is that technology can help scale such self/group-organization efforts and let private entities participate in enabling multiple such solutions under a sustainable business model.

In the future, we intend to pilot some of these services and explore the applicability of this approach in other vertical sectors as well.

8. ACKNOWLEDGMENTS

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