Day Labour Mobile Electronic Data Capture and Browsing System

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ABSTRACT
In this paper, a day-labour Mobile Electronic Data Capture and Browsing (MEDCB) system is presented. In building and evaluating this system, the primary aim was to evaluate the possibility of applying mobile data capture and browsing to the day-labour market with a view to improving data capture and verification accuracy and efficiency. The MEDCB system consists of a mobile client application and a web interface. The system was evaluated with non-profit organizations working for day labour semiliterate job seekers. Results showed that data capture, processing and browsing is a possibility in day labour market. Improvement in accuracy and efficiency was also seen with the use of MEDCB. We describe the design process, present initial findings and discuss the results.

Categories and Subject Descriptors
H.3.2 [**Information Systems**]: Information storage

H.3.3 [**Information Systems**]: Information search and retrieval

General Terms
Design, verification

Keywords
Day labourer, worker collection point, MEDCB

1. INTRODUCTION
Mobile Electronic Data Capture and Browsing systems (MEDCB) are electronic data capture and browsing systems which use mobile phones as client applications. They have been used in different sectors and have been found to be relatively accurate and efficient [1]. While many such applications are unidirectional, from client to server or vice versa, some are interactive. MEDCBs' data transmitted to the server is consumed either by data capture systems or other users. A widely applied area of MEDCB is in health care. Examples include work done by Morak *et al.* [2] who developed an electronic data capture system platform for clinical use. Kogure *et al.* in [3] described a system used to monitor information of multiple patients in intensive care unit/critical care unit (ICU/CCU) via 3G mobile phones. Mobile data capture systems have also been used in research; for instance in [1], where Mourão and Okada described a phone based solution for field data collection that included a web based module for real time data analysis.

In other application areas, Hulkko *et al.* [4], used a digital user study tool called Mobile Probes as a self-documenting tool for studying peoples' actions in mobile contexts; White et al [5] describes work done to design an enterprise application, using mobile phones, that connects employees on the go; [6] where a tool was implemented for data collection in a coffee cooperative and in [7] where data from the field is captured using a field computer by expert animal trackers.

Though it has been widely used, mobile electronic data capture and browsing has not seen much application in informal sector settings such as day-labour job search. Examples include work by Eagle [8]. He developed an Unstructured Supplementary Services Data (USSD) system that enables people to earn small amounts of money by completing simple tasks on their mobile phones. Workers would work for corporations who pay them in either airtime or *MPESA* (Mobile electronic money transfer operated by mobile service provider *Safaricom* Kenya [24]). In another work Ho *et al.* [9], described the design and implementation of a mobile and web based system for processing claim forms for reimbursing health service providers for treatment of patients with sexually transmitted infections in Uganda.

In this paper, we describe the application of MEDCB to the day-labour market, a kind of open-air labour market exchange (OALME). In building and evaluating this system, the objective was to determine the possibility of applying mobile data capture and browsing to the day-labour market with a view to improving data capture and verification accuracy and efficiency.

The remaining part of this paper is organized as follows: In section 1.1, our case study is described. The problem is defined in section 1.2 while section 1.3 describes the design approach. In section 2, we describe our data gathering and design approach. Section 3 describes the MEDCB system. Section 4.1 presents the results which are discussed in section 4.2. The conclusion is presented in section 5.

1.1 Our case study
Day labourers are workers whose work contracts are on a daily basis. They are often said to be either unskilled or semi-skilled with low levels of literacy. However, in some developing countries, a majority of day labour workers are either skilled or semi-skilled and with high literacy levels. The majority of day labour workers do work in urban suburbs, mainly inhabited by the society's rich. A typical day labour worker lives in an informal urban settlement (or slums). These settlements are usually about 10 to 25 Kilometres from the urban suburbs where they work. The types of work done by day labourers are as diverse as their skills. They range from less specialized jobs like moving and packaging to more technical jobs like pool cleaning and plastering [23].

A large percentage of day labourers are faced with extreme poverty, on average surviving on less than two USD per day.

Apart from food, a good percentage of their resources, money and time, go to searching for jobs [23]. They are found in many cities of the world, both in developed and developing countries. In Nairobi, Kenya, Johannesburg and Cape Town, South Africa, for example, day labourers have designated places where they congregate every day. Their primary target is to secure a job, even if it is for half a day. Locations where labourers congregate are referred to as *worker collection points* [10, 12], street corners or just corners [11]. These places are strategic to workers, not only for job seeking but for other social factors that necessitates the need to congregate.

Worker collection points are either run by organizations — referred to as intermediary organizations — or by workers themselves. These organizations employ people who accompany workers to their respective collection points with the intention of helping them easily secure jobs. These intermediary organizations employees are called field officers.

Information obtained by interviewing job seekers and field officers indicated that worker collection points either have historical attachments or are close to areas frequented by potential employers. We observed that such areas include factory vicinities, bus parking, building material shops and even popular places with known or unknown historical importance to the workers.

The collection points are known to potential employers and to a large extend to the members of the public. The employers are individuals and companies who deal with building and construction. In an ideal situation, employers drive to known worker collection points to pick up workers with specific skills and good character. As important as it is for a worker to have a well paying job, it is important for an employer to get a suitable worker for their job, both in skills and character.

The structure, leadership and control of worker collection points are widely diverse. In our field studies from Nairobi, for example, we found out that many collection points are run by the workers themselves and draw on leadership from within. We have named such collection points *self-organized*. Some other collection points are run and controlled by not-for-profit organizations whose objective is mainly to present workers in an organized manner to employers.

For example in Cape Town, South Africa, Men on the Side of the Road [12] is a non-profit organization involved in among other things, matching day labourers with employers, seeking jobs on behalf of workers and sometimes offering training opportunities. Among other forms of support, Men on the Side of the Road (MSR) has a system where trained field officers accompany day labourers to collection points. Workers are helped by field officers to seek jobs and negotiate for better pay with potential employers. Field officers also register new worker members of the organization. MSR is an example of an *intermediary organization*, coming in between job seekers and employers. Such worker congregation sites, as those run by MSR, are defined as *intermediary organized worker collection points*.

The third form of worker collection point structure is the *unorganized*. This is run neither by an intermediary organization nor by workers themselves. Every worker is for him/herself and such collection points could be at a collection point adjacent to organized ones.

1.2   The problem
Many day labour job seekers use a substantial amount of their income and time looking for jobs. Our fieldwork results from Cape Town, South Africa and Nairobi, Kenya, show that job seekers spent up to 10% of their daily income in job related expenses. This is roughly between USD 12.5 to around USD 35 per month. The spending mainly goes to commuting costs to and from their collection points. There are always those worst cases, for example days when labourers borrow money for fare to travel to congregation points and miss getting placed. It is common to hear stories of job seekers who are out of work 'eating' into their savings, if they are lucky to have had any. Job seekers also suffer a great deal when they find themselves in situations where they are forced to wait at collection points during harsh weather conditions.

On the other hand, potential employers use time and money in looking for the right workers. They drive through heavy traffic congestion common in many developing world cities. Sometimes, employers may pick up workers with the wrong skills or an undesirable character. This is often because there are either no ways of verifying skills and/or personality, or that existing ways are wanting. According to the interviewed field officers, there can be more serious cases, such as job seekers having criminal records and hence end up jeopardizing employer's security and consequently tarnishing the reputation of worker collection points. The officers emphasized the fact that the worker collection point's reputation is key to workers being trusted by potential employers and members of the public.

Intermediary organizations use a substantial amount of their resources in looking for jobs on behalf of the day labourers. This happens by way of trying to show a good image to the society. They do this by having field officers accompany job seekers. These organizations are sometimes forced to fund expensive marketing initiatives during low job seasons. For the few jobs an intermediary organization is able to find, allocation to workers is sometimes perceived to be unfair and in some cases can create acrimony among job seekers.

1.3   Our Approach
The prototype design presented in this work is a reaction to the above-mentioned challenges. In our Information and Communication Technology (ICT) intervention in the situation, we first carried out an extensive fieldwork study to find out what kind of system designs can best suit the open-air labour market exchange community. The outcome was a comprehensive understanding of the context and system design architecture. Next, a set of mobile and web-based software applications were designed and implemented. The designs were informed by the need to help alleviate some of the challenges encountered by employers, workers and intermediary organizations. The motivation for taking the mobile phone approach is the pervasiveness of mobile phones and lower cost of data bundles provided by mobile service providers [21]. The context was another motivation. The day labour market is field based, distributed and mobile in nature. This prescribes a condition that if an ICT-based, or any other form of solution, has to help, it must conform to the context, i.e., it needs to be mobile and distributed. The other reason was that mobile phones have been shown to be useful to the poor, especially in developing countries, in many ways. For example [13] [14] [15][16] and [17] describes various situations where mobile phones have helped alleviate the poor's problems. Findings from our field study shows that day labourers can be classified as being poor as they live below the poverty line. The average earnings on a successful day are USD 10 in Kenya and USD 20 in South Africa. Successful days are on average fewer than ten days per month.

Although day labourers were our target intervention group, we deliberately chose not to focus directly on them. This was because of a number of challenges we identified in the field. These challenges were identified by carrying out structured and in-depth interviews among the day labour workers both from Cape Town, South Africa and Nairobi, Kenya. The challenges include low literacy levels, low rate of mobile phone ownership in some regions and access to low end phones in general. This makes it very challenging to intervene directly with the workers in the first instance. Dealing with low skilled, semiliterate workers is challenging in itself [18][19]. We therefore focused on a mediating organization. We focused on designing systems that would be used by those who help the day labourers. Prior studies, for example [20], have shown that an intermediation approach works for such arenas.

2. DESIGN METHODOLOGY

We started by doing an *in situ* contextual inquiry in Nairobi's Moi Avenue collection point to understand how day labourers operate. The Nairobi fieldwork consisted of unstructured interviews and contextual inquiry and was carried out for one month. In a quest to get more insight into how day labourers engage, we embarked on a similar study for six consecutive months in Cape Town. In this second round of study, we were in partnership with a non-governmental organization (NGO), Men on the Side of the Road [12].

A comparison of findings from Nairobi and Cape Town showed that the two groups operate in different ways with a few characteristics in common. Based on these findings, it was prudent to design interventions that are specific to each group. The prototype application being described here is an attempt to intervene specifically for the *open-air labour market exchange communities with an intermediary organization*, the case of MSR in South Africa.

The fieldwork study involved face-to-face interviews with all our stakeholders. The outcomes were user requirement guidelines covering current working systems and work challenges. Those studied included day labour workers (30 were interviewed), field officers, who were followed around in the field (4 — all the ones based in Cape Town) and six office-based MSR employees. Apart from a scientific literature review on similar research, we also carried out an extensive document ethnography covering, for example, MSR operations manual, worker attendance and daily job allocation forms from the field. Further, we critically analysed MSR's current web based database system, which has about 19,523 day labour worker records.

One might expect that after such an extensive contextual inquiry, involving long-term observations and interviews, it would be easy to derive clear requirements and hence straight forwardly derive a design. This was, however, not the case in our study. At first, even with all the knowledge on how the day labour community worked, it was difficult to identify the kind of systems that could deal with their challenges. At some point it looked like the more we understood the structure, the more complex it became. This needed a new approach. We chose prototyping [22] as a method within the action research umbrella.

We now describe the first prototype system and in the next section show how it is affecting its users.

3. DAY LABOUR MDCB SYSTEM

In this section, the system, which is currently under evaluation, is described. After briefly showing how the design was derived,

a description of the two main modules and their user interfaces follow.

Our first design concept was based on the understanding that the three major stakeholders of MSR are its employees (both office and field based), day labourers and day labour employers. Their key information needs were mainly around job search, the right job skills and character. Consequently, the version 0 prototype had three client mobile application modules: (1) Employer module, for employer registration, worker request and rating; (2) Worker module with registration and job search functionalities and (3) Employee module with job allocation, worker rating and worker issues update. Figure 1 shows screen shots of employee (field officer) and employer modules.

Fig1 (a): Intermediary organization employee mobile client module for registering and managing the worker details

Fig1 (b): mobile based client employer module for registration and worker search use.

After initial testing and discussions with our partner organization on the prototypes, it emerged that a concurrent introduction of the three modules would not be practical. MSR field officers, the lead users, and the designer agreed to prototype the design incrementally. The MSR employee module, the subject of this paper, was the first to be deployed. It has two main sub modules:

(a) Data capturing and information search mobile phone based client application (see figure 3) and

(b) A web based interface for data validation and upload to both the payment system and to the working database (see figure 4).

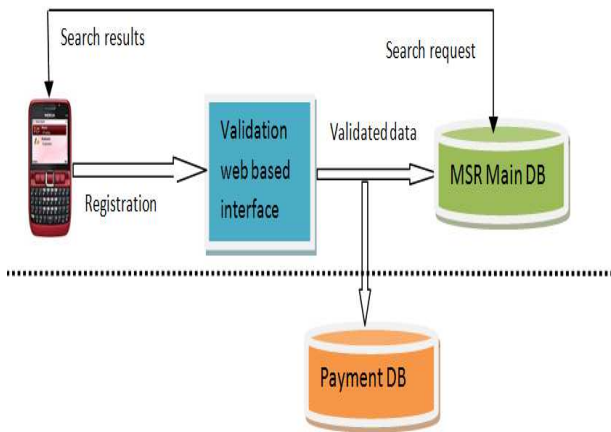Figure two shows the interoperation between the two modules.

Fig 2: The overall System architecture of the MEDCB

The mobile-based client application is for capturing and sending data from the field to a temporary storage location in the MSR database. Data captured include new worker and employer registrations details. In the old system manual data capture was used. Field officers would fill pre-designed forms which they latter returned to the office for re-capturing.

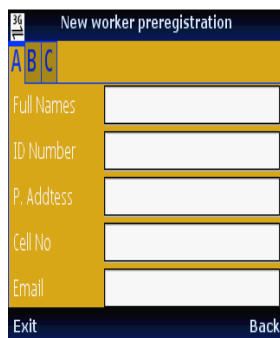**Fig. 3(a) mobile based client main user interface main menu**

Fig. 3(b): mobile based client application for worker Registration

Fig. 3(c): Mobile based client Employer Registration user interface

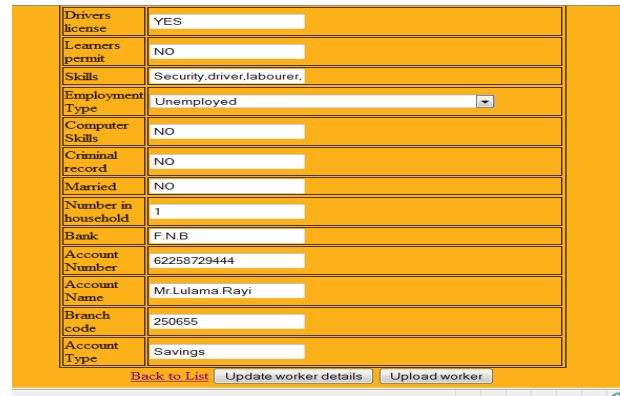**3(d): Mobile based client Worker Confirmation user interface**

Fig. 4(a): Worker details verification user interface

The data capturing and information search sub-module also allows MSR field officers to search and confirm worker skills claims and ratings remotely. Previously this involved making phone calls to the office. This method was quite burdensome; for example, confirmation of any sort needed an MSR employee dedicated to answering phone calls and was only possible during office hours. The cost of calling by field officers was also seen to be high, given the exorbitant mobile phone call rates compared to data bundles in South Africa [21].

A web-based validation module allows office-based workers to validate and upload data. Before, all field officers from different stations all over South Africa would capture data using pre-designed paper based forms. Data entry to the main database was then done by various MSR employees without any verification. As a result, MSR has 19,523 members in their database. According to the MSR general director, about 10,000 of the records have erroneous data with incomplete cell phone numbers, wrong member location, dates of birth, or wrong skills captured. He blamed the errors on lack of a verification system. This necessitated the need to have central verification of data before being uploaded.
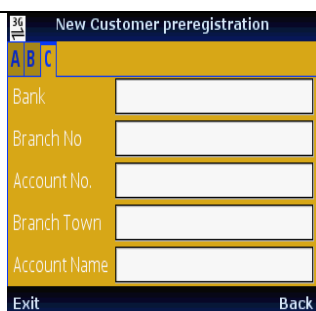
4

Approve Worker
Disaprove Worker
Generate Worker List
Approve Employer
Disaprove Employer
Generate Employer List

MSR Login
About this work
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Select the workers to verify their details: make sure you are sure about the details

#	Select	ID	Names	Date of Birth	Gender	Cell No.	Address	MSR Office	By
64		C0480222	Prudenece Mpunsa Kabey	2032-05-02	M	0731771993	420 Grand Central Main Rd Wynberg 7800	Cape Town	Leigh-anne
65		8609125754085	Lulama Rayi	2018-05-03	Male	0786079486	L618.Mkhushulwa.Site b.Khayelisha.7784	Cape Town	Leigh-anne
66		CTR00058205	Junior Yenga Mbala	2030-05-03	Male	0838668985	51 Devon st.Woodstock 7925	Cape Town	Leigh-anne
67		CTRZWE012801009	Martin Shutu	2009-05-02	Male	0730373237	42 Francis str,Woodstock	Cape Town	Leigh-anne
69		8009260835080	Ntsaphokazi Cynthia Tunce	2032-05-11	female	0738758838	1766.Kwepile str.Phillipi Nyanga East.7785	Cape Town	Leigh-anne
71		6309150872082	Eleanor Bobby Christine Spadone	2021-05-02	Male	0767479387	13 Zwartkop rd,Manenberg,7764	Cape Town	Leigh-anne
73		8106061258088	Thoble Hlazo	2011-11-07	Male	0827428521/0829732045	1837 Kwepile Str,Philippi 7785	Cape Town	Leigh-anne
78		87121011850b2	Nowzi Abigirl Mayeye	1987-12-10	Male	0721167348	8778 Road 6 Vietnam Drive Phillipi	Cape Town	Leigh-anne

Approve worker details | Work References

Fig. 4(b): Web based interface showing workers' information registered using the mobile application

4.   RESULTS AND DISCUSSION

Prototype evaluations are being carried out in Cape Town with MSR field officers. Over 100 registrations were completed between 22nd October and 22nd December 2010, with most of these being done from the field. We ran the new system in parallel with the old paper based system, and so the mobile interface was used together with the paper based forms.

We report on our findings observed during the evaluation period done for two weeks. The observation was done during the training and usage period. Six field officers were trained and observed using the system. To supplement the observations, we interviewed the field officers before and after the system use. Further, we also analyzed a usage log which was built in to the system.

4.1   Results

We observed the use of our system in terms of six mission areas. They were: (i) Accuracy of data captured; (ii) Data entry time; (iii) Office visit frequency; (iv) Number of calls by field officers to the office; (v) Ease of use and (vi) The cost of using the system. We report on each one of them and an unexpected observation, where over 90% of the dates of birth entries were wrongly entered.

On data accuracy, there were early indications of a reduced error rate on worker and employer registration. This was according to the MSR director and four office based employees interviewed. They reported that the verification module reduced the amount of erroneous data being captured. Evaluating accuracy of data by soliciting comments from users may not be rigorous. However, it was the only viable option for us during the test period. In the next deployment, the records captured using the system will be compared to paper based records to establish their accuracy.

From our observation of six field officers, employer and worker registration carried out through the mobile phone based application took a field officer the same amount of time as filling out the paper form. Taking the average of 100 registration entries, we found that it took on average four and half minutes to register an employer or a worker

Prior to deployment and use of MDCB, a typical week for a field officer would see them go to the office for a minimum of two and a maximum of five days in the six days of a week. Findings from interviewing field officers and observing six of them use the system showed that the office visit frequency had reduced to a minimum of one to a maximum of two days a week. The observation was done for two weeks.

Worker details confirmation is a common activity of a field officer. With the new system, a confirmation took less than a minute. Compared to the old way of confirming worker details, where phone calls would be made, the worker confirmation module was found to be the most accepted and valuable module of the system. This is according to the opinions of the six field officers and what was observed as they used the system. The observation and in-depth interviews were also done for two weeks after the system launch. The six field officers also said it was the cheapest way of doing the confirmation. It was possible to confirm worker details with as little as USD 0.014 using the search module, compared to a phone call that would need at least USD 0.333. This is over 90% reduction in the cost of confirming worker details.

When asked for any use challenges of the system, the users reported no serious usage challenges. Close observation of three field officers while they were using the system also revealed no major usage challenges. However field officers found it impossible to enter the correct date of birth field by selecting from a date picker. Over 90% of the entries were wrong.

The cost of using the system was a major concern to users. A confirmation that the cost of using it was minimal and a few trials eliminated the doubt. Finally on the findings, the mobile phone application system use was challenging for those who were using Nokia E63 for the first time. They had difficulties keying in data mainly because they were not used to QWERTY keyboards on mobile phones. This was true for two field officers and one office employee who were issued with E63 phones specifically for this trial. The challenge of using the QWERTY keyboard did not raise any alarm as there are studies

such as [25], which have shown that typing speed is not largely determined by the keyboard layout. Some studies, such as [26], have reported results showing that thumb keyboard is the fastest text entry method after the standard QWERTY keyboard.

4.2 Discussion

We consider the implications of initial results for both our target group and our own next round of design. These discussions follow from the results, taking cognizance that the results are only from first round of field test that lasted only two months and observed for two weeks.

Before the advent of our system, MSR had a web-based data capturing interface available to all employees from all over South Africa. Data captured through the web-based interface updated the main database directly without any verification. As a result, the MSR database has more than half of its registered members with incorrect details. This challenge was addressed by introducing a data capture client application, running on a mobile phone, which allows field officers submit data to a temporary storage location awaiting verification by office based employees. This was reported to have reduced the error rate during worker and employer registration. Further study is required to get rigorous statistical proof for this.

Initially, paper-based data capturing was in use by the field officers. Data captured on paper would then be physically carried to the office where office workers entered into MSR web based database. With the new system, field officers capture data using the mobile phone client application. As soon as data is transmitted to the central database, officers in the head office can, on a real-time basis, verify and update the data before uploading it to the "live" database. Since it takes the same time to register a worker as paper based, the reduction in data capture time brought about by the mobile based system is as a result of elimination of office visits by field officers.

With our new system, visits to the office were reduced to one or two days a week for staff meetings. This saves field officers a considerable amount of time. The time saved could be used to market MSR leading to more jobs and sometimes donations hence boosting their morale. We anticipate that this will be true for the other regions in South Africa and Nairobi Kenya, when we roll out the system in those locations.

The search module was seen as the most important contribution by the field officers. They claimed that it will save them time and money. One of the field officers reported that they were seen by workers as knowing what they were doing. The old method of confirming workers' details sometimes took time before being substantiated. This is costly to field officers and labourers who sometimes used their airtime to call. We found a greater than 90% reduction in the cost of confirming worker details when compared with phone call costs. Overall cost reduction may, however, be lower given that phone calls were not being made as frequently as the new confirmation system is being used.

The cost of using the system was at first a concern for everyone during the prototype period. We had not understood the reason until one of the field officers asked. This was however sorted out by explaining that it was costing less than USD0.03 to use the system for over ten minutes. After using it for some time, one field officer exclaimed that "you don't need to have credit to use the system". She said she could use it even with less than ZAR. 20 cents.

At first, the date of birth field was always entered incorrectly. The initial form of capturing the date of birth was by way of selection using a J2ME date picker. It failed miserably with over 90% of the cases capturing wrong dates. The second version has three different combo boxes with a list of days, months and years to select from. We are yet to see how this will perform. Finally, with the dates, it was interesting to note that people scrolled up when looking for old values. For example the list would work better if you placed it backwards as "1984, 1983, 1982, 1981, 1980" as opposed to forwards as "1980, 1981, 1982, 1983,1984". The reasons for this were not clear immediately and we intend to investigate further in future deployments.

Few of the benefits listed above accrue directly to day labourers, however, implicit benefits exist. For example, MSR had three data entry employees who used to capture data from the field. With the new system, they can afford to use one person to verify and upload field data, freeing the other two for marketing and hence more jobs for day labourers. In cases where workers needed to be confirmed for placement, delay from the office sometimes caused them to miss the placement. This is now minimized by the newly introduced mobile based search module.

5. CONCLUSION

We have described MEDCB system as applied to day-labour market. A description of the design process was given with emphasis of how prototyping was chosen as a design method of choice after rigorous field studies. These methods were used within Action Research methodology.

In our field study findings, it was found that different day labour communities are unique and hence require unique solutions. MEDCB evaluation was done with the employees of an intermediary organization working for day labourers. The outcome showed that application of MEDCB in day-labour market is viable. Results showed that data capture and verification accuracy and efficiency improved with the use of MEDCB.

The work presented in this paper is part of an Action Research process aimed at building suitable ICT systems for day-labour market. It is our first cycle of the process and will inform our next cycle which will include building various prototypes for the self organized day labourers in Nairobi, Kenya. Lessons from this work will be applied.

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