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Palm computers for spatially referenced social surveys in upgrading informal settlements

ABSTRACT

Conditions in informal settlements are complex, at times violent, and continually changing. Managing these settlements in a way that will result in a functional, healthy urban environment constitutes a major challenge. Effective upgrading strategies require accurate, up-to-date social, economic and spatial information. This is especially so when the information is used for adjudication and titling. Moreover the information should be regarded as legitimate by settlement residents themselves. Thus, residents participating in collecting data can contribute to an upgrade project succeeding. We describe two pilot studies where residents, with moderate levels of literacy, volunteered as field workers to collect data. They used a palm computer linked to a GPS and, using the Cybertracker system, collected socio-economic and spatial information. These studies were in an informal settlement in Cape Town, South Africa, and a rural land reform project close by. To simplify the process, icons were developed to represent questions or items of data to be recorded. After some initial difficulties, the field workers proved to be competent in using the hardware and software and the data that they collected were accurate. However, using icons to represent data items was found to be impractical. Instead, short text phrases were found to be appropriate and practical.

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1. INTRODUCTION

Land reform projects in developing world cities often involve intervening in complex situations. A major challenge for city managers is improving the quality of life for people who live in informal settlements, as they constitute a sizeable proportion of the world's population. For example, UNCHS (1996) estimates that between 30% and 80% of people live informally in developing world cities.

Accurate, up-to-date socio-economic and spatial information should form an important component of managing and governing these settlements. As the discussion below will show, maintaining accurate, current information is very difficult because of informal settlements' dynamic, conflictual nature. Experience in South Africa suggests that when a settlement is being upgraded, with adjudication and titling forming part of the process, information should be collected far more frequently than in many rural land reform projects. Preferably, information should be collected continually. And, residents themselves should view the information as legitimate (Barry 1999). It follows that getting residents to participate in collecting the data can contribute to an upgrade project's success.

Using appropriate technology and involving residents in collecting data can contribute significantly to the success or otherwise of housing and land reform projects. We present two pilot studies involving residents in an informal settlement and a rural land reform project using a palm computer to collect socio-economic and spatial information using the Cybertracker system.

The paper proceeds as follows. We first discuss relevant characteristics of informal settlements. Then we describe the Cybertracker system. Following that, the two studies in a rural land restitution project in the village of Algeria and the Imizamo Yethu informal settlement are discussed.

Informal Settlements

Informal settlements tend to be characterised by continual social change, high levels of conflict, solidarity and schism. Generally, solidarity occurs when a community acts against external agents, such as government agencies or private land owners. Many informal settlements are illegal, and so acting in concert becomes a crucial survival strategy. Strategies for confronting the State tend to be grounded on the bad publicity that might follow if the State acts against its poorest citizens. Tactics might include public protests and other forms of mass action. Schism occurs between individuals and between factions in a settlement as a result of internal power struggles. Different individuals and groups in a settlement compete for power and resources. In the process, opportunists may manipulate deals and agreements made with external agents to best suit their own ends. This opportunistic behaviour may be detrimental to the general community, and it is often illegal. In addition, individuals may change group allegiances continually in order to maximise their own opportunities. Unsurprisingly, violence is frequently a part of these social dynamics (Barry and Mayson 2000, Fourie 1993).

There are a number of reasons for the characteristics described above. One is that because most informal settlements start off as illegal occupation of land there is likely to be a history of hostile relations with authorities and surrounding residents. In this antagonistic environment, some factions do not respect internal rules formulated by the community themselves. Hence, agreements made with external agents may be manipulated or ignored (Barry 1999).

Another factor is pressure from new arrivals in a city who need a place to stay. Rural-urban migration is a common pattern throughout the developing world. Often, the first point of contact for a new arrival in a city is a family member or person from their village who lives in an informal settlement. Through this contact, a new arrival may have to pay a particular leader or faction for the right to stay in a settlement. This creates a market in occupation rights, which some powerful individuals may rely upon as a means of subsistence. If an agreement with external agents threatens their means of livelihood, it follows that these powerful individuals might not adhere to that agreement.

Community leaders' motivation in making an agreement with the authorities in the first place may be to ensure that they are not seen as obstructive. Alternatively, leaders may forge agreements in good faith, but lack the capacity to enforce them. The general quality of governance and the willingness of the police to be involved in enforcing these agreements is also a major factor.

The Marconi Beam case in Cape Town illustrates the need to collect information continually once a decision has been made to upgrade a settlement. In the early 1990s the authorities made an agreement with the elected settlement leadership that they would provide land and housing for the 450 households in the settlement. Part of this agreement was that no more shacks would be built in the settlement. Accordingly, a development for 750 houses was planned nearby, which included a sizeable allowance for contingencies. But, within two years of the agreement being struck, there were 1278 shacks in the informal settlement (Barry 1999).

For a variety of reasons, the authorities did not collect data reflecting this increase in population during the two year period. When this information did become available to a number of role players in the case, it was not communicated to the development team. They were faced with a major problem when the time came to clear the site (Barry 1999).

The reasons for the sequence of events are due to the informal settlement characteristics described above and the quality of governance and land administration at the time. The civil service was at the forefront of South Africa's social, political and economic transformation that occurred in the 1990s. As part of this change, local authority boundaries were being merged and then re-subdivided to form new institutions. Organisational structures were changing and some municipal personnel were being shifted into new positions. Others were being encouraged to take retrenchment packages with the object of making the civil service demographically representative of the country.

In the Marconi case, officials responsible for the area changed. In addition, roles and responsibilities of officials, private land owners and development project managers were not clearly defined. External stakeholders had not expected the influx of people into the settlement as there were agreements with the community representatives that this would not happen. Consequently, the situation was not monitored and an upgrade project proceeded on the basis of incorrect information.

A further characteristic of informal settlements is that transactions in land rights occur during the development cycle. In South Africa, a shack in an informal settlement can be very valuable. On the basis of owning a shack, under a government subsidy scheme the household may be granted a formal house if and when the settlement is upgraded.

Thus, the register of people who should

benefit from a housing project should be kept up to date. Transactions can take place for a number of reasons. These include sales to strangers, informal handing over of the right to a house to a relative, a faction evicting a potential recipient of a house from the settlement, incorrect adjudication of who should be granted a house, and the death of the shack owner (Barry 1999).

Increasing shack owner deaths is a manifestation of high HIV infection rates in informal settlements. Community structures are likely to reallocate the right to a house to the shack owner's spouse or children. In the latter case, there have been reports of orphans being neglected or abused. Orphans may be taken under the care of adult relatives from outside the settlement. There have been cases where the relative has manipulated the situation to gain ownership of a house. In addition, rent-a-child cases have been reported where the relative "lends" children to people in neighbouring informal settlements for a short period. This occurs because, as part of the government's housing programme, unmarried people can receive a housing subsidy if they have children.

Thus various items of information have to be kept up to date. The challenge is to be able to collect and manage this information cheaply using processes that settlement residents view as legitimate. Ideally, residents should be involved in collecting it. Their knowledge of the settlement should ensure that the information is reliable. Moreover, it provides employment for people in the settlement and also contributes to an environment of participatory development.

A proviso is that an institution outside a settlement should be responsible for managing the process of collecting and managing the data and ensuring that there are secure off-site back ups. And, the environment should be safe for settlement residents to collect data. Some factions may intimidate data collectors. For example, in the Marconi Beam case described above, some development project staff lived in the settlement. One of their functions was maintaining a set of records in an office in the settlement. However, towards the end of the development project, they were threatened by a particular faction and the office was forced to close. In another settlement, residents burned down the administration office in the settlement which housed the land records (Barry 1999).

2. THE CYBERTRACKER SYSTEM

The Cybertracker system is a Rolex Award winning project which was the brainchild of a biologist, Louis Liebenberg. It was developed in the mid 1990s to collect field data relating to animal behaviour in southern African game parks.

San (Bushmen) game trackers, who may not know how to read or write, become adept at learning to use a palm computer linked to a hand held GPS to collect animal behaviour data. Instead of using written questions, icons enable them to identify and record the animal type, the numbers of animals observed, sex, activities, and feeding habits. Expert game trackers have been involved in developing graphic icons, such as those in figure 1, to represent a specific animal behaviour (e.g. a species of antelope feeding) and the class of data (e.g. an actual sighting or tracks). A comprehensive set of these icons are stored in the palm computer. When a game tracker observes an animal performing a particular behaviour, the icon is accessed through a screen menu. By touching the icon on the screen, the time and location of the event is recorded in the palm computer. Upon returning from the field, the data can then be downloaded into commercial database or GIS (Cybertracker 2003).

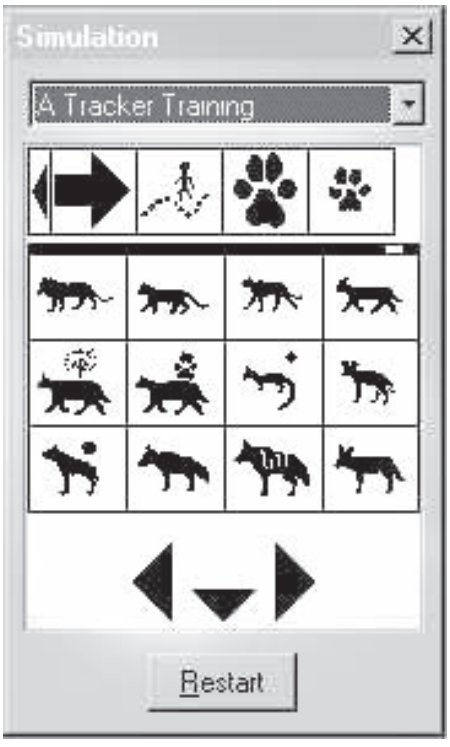

Figure 1 Cybertracker Sample Screen

The first applications of the Cybertracker system enabled improved coverage and reliability in spatial and temporal analysis of animal behaviour. Costs were also significantly lower. Instead of a skilled scientist visiting a game park to collect data in a series of intermittent field trips, game rangers with tracking skills could collect animal behaviour data as part of their daily duties. More important is that the sampling of data relating to a particular animal species was frequent and continual. This has improved the validity of research into animal behaviour. Previously, scientific theory was often developed by analysing the data from the scientists' intermittent trips, which may not have been truly representative of the general behaviour of a particular animal species (Liebenberg pers. com. 1998). Applications of Cybertracker have grown significantly, and the system is in use worldwide in a variety of applications (Cybertracker 2003).

Systems such as Cybertracker hold potential benefits for land reform project management, particularly projects involving informal settlements. If settlement residents can collect data continually using simple, low cost technology such as a palm computer, then some of the issues described above that might obstruct a project may not materialise. More realistically, the number of problems may be reduced. At least, decision makers will have accurate, current information and they can reformulate or update strategies to manage a settlement as a situation changes.

We adapted the Cybertracker data collection methods and system of hardware and software for collecting socio-economic data relating to land tenure. A Palm Pilot II

installed with Cybertracker software linked to a Garmin III GPS was used in the field.

The study areas

Two settlements were chosen where real data needed to be collected. Socio-economic, dwelling attributes, and spatial data were needed. Some of the data could be represented by icons, such as whether a house had a garden or running water. But, unlike the original Cybertracker application, some textual data were recorded. For example, the names of people living in a house and their status were required. Status implied whether they were immediate family members, extended family or lodgers. In contrast to Cybertracker, this work required field workers with some reading and writing ability.

The system was first prototyped with five people in Mitchells Plain, a suburb of Cape Town. They participated in the development of a set of questions for an electronic questionnaire and the palm pilot screen icons to match them.

The system was then used to collect socio-economic data for a land reform project in the rural village of Algeria. Algeria served as an ideal case to perform an initial test of using a palm computer with icons to represent census type questions in a real situation. The social and local political environment in the Algeria village is stable compared to most informal settlements. The beneficiaries of the land reform project had lived together as a community for a long time. Thus the possibility that a member of the community might be threatened or intimidated when collecting data was unlikely. The study could focus on the design of the questions and usage of the system of hardware and software, without many of the informal settlement dynamics that might impede the exercise.

Three Afrikaans speaking, middle aged women collected census-type data and data concerning attributes of the dwellings. They had attended school for seven or eight years and were reasonably literate. The data was used by the community's representatives, the

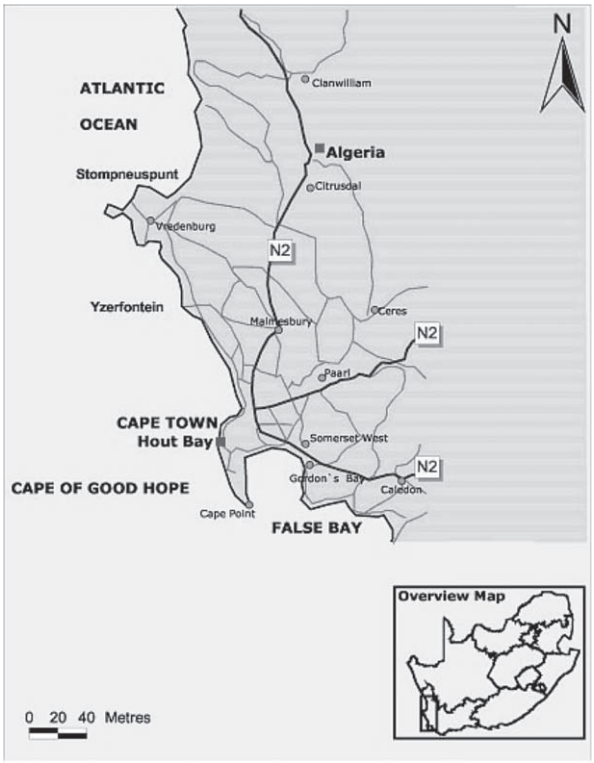

Figure 2: Locality of Algeria and Imizamo Yethu

Algeria Grond Komitee (*Algeria Land Committee – Afrikaans*), and a non-governmental agency, the Surplus People's Project (SPP), in planning and managing the reform project.

After the Algeria tests, the system was tested in the Imizamo Yethu *('through collective action' – Xhosa*) settlement, part of which is an informal settlement. In Imizamo Yethu, eight Xhosa speaking adults, five women and three men, collected data. This group had an average of eleven years of schooling.

The Village of Algeria

The village of Algeria is in the Cederberg Mountains, some 230 km north west of Cape Town (see figure 2). Most of the inhabitants are employees of the Department of Cape Nature Conservation. The community consists of 240 people who live in cottages owned by Cape Nature Conservation. A condition of tenure is that they are employed as nature conservation and forestry workers (Roux and Barry 2001).

With South Africa's transformation to democracy in the mid-1990s, the community initiated steps to gain ownership of the land on which they live as part of South Africa's land reform programme. A Communal Property Association (CPA) was chosen as the juristic person to hold ownership of the land (SPP / Algeria Grond Komitee 1997).

A Communal Property Association (CPA) is a legal entity through which communities can collectively acquire, hold and manage land. Ownership vests in the CPA. Individuals in the community are entitled to various occupation and land use rights in terms of the CPA's constitution and their class of membership in the CPA.

Imizamo Yethu

The second round of field tests were performed in the Imizamo Yethu settlement, which is part informal settlement and part site-and-service in Hout Bay, Cape Town. Parts of Imizamo Yethu consisted of serviced parcels, while others were occupied informally. It has a population of approximately 6000 people and has continued to grow since the early 1990s. Similar events to those described above in Marconi Beam occurred in Imizamo Yethu. Negotiation and conflict between the settlement residents, surrounding land owners and the municipality has occurred continually for the last 13 years. The social

LEGEND
1 - Garden
2 - Date of birth
3 - Employment status
4 - Divorced
5 - Brick house
6 - Outbuilding
7 - Electricity
8 - Running water
9 - House number
10 - Married
11 - Identity number
12 - Position in household
13 - Employment status
14 - Name and Surname
15 - Employment status
16 - Employment status

Figure 3 Sample of Icons Developed for Socio-Economic Surveys

dynamics are typical of those of informal settlements described above (Barry 1999, Swart 2002).

3. DATA COLLECTION

The field methods were designed according to principles established in the disciplines of semiotics, the study of signs and their meaning, and human computer interaction (HCI). HCI is the study of people, computer technology and the ways these influence each other (Chandler, 1994, Dix, Finlay, Abowd and Beale, 1993). The initial work involved constructing a relevant set of questions for the socio-economic surveys and developing suitable icons to match them. This was done with the group of five volunteers from Mitchells Plain. A set of questions and matching icons were work shopped, developed and refined with this group before the system was tested on real data.

A sample of the icons and the accompanying questions that they are meant to represent is included in figure 3. Most of the data are nominal. That is many of the questions relate to the mere existence of an observable fact, such as a person's name, personal identity number or marital status. And, many of the data are binary, of a TRUE/FALSE nature. For example, does electricity or running water exist in a house or not? Does a house have a garden or not?

As the study progressed, different icons were added to represent a particular mental concept of an observable fact being surveyed. For example there are three different icons to represent employment status in figure 3 above. These were derived from successive tests with different volunteers.

Volunteer field workers were given training in using the palm computer and GPS and in conducting the surveys. At the start of each training session researchers explained the objectives of the exercises and the nature of the data to be collected during the surveys. The field workers were then given a list of questions and a set of icons, including those in figure 3 above, and asked to associate the two. The aim was to evaluate how well they could match the icon and its associated mental concept. In the process, they critiqued the questions, the icons themselves, and the system as a whole. Alternative icons or refinements to the existing icons were then developed through this workshop process.

The next phase involved explaining the functionality and operation of the palm computer. This was done using paper mock-ups of the screen layouts. Then the field workers were given a sample of data to enter so they could practise operating the field computer and GPS.

The interpretive evaluation methodology was used to assess the feasibility of using the system, which incorporates qualitative rather than quantitative analysis (Preece 1994). In assessing the system, the volunteers were accompanied in the field and their ability to use the system and their attitude to the system were observed.

ICON IDENTIFICATION RESULTS

Algeria

In the initial tests, using an icon to represent a data item was not found to be useful. In Algeria, all three of the field workers struggled to make the association between the initial set of icons and the question assigned to them that the Mitchell's Plain group had designed. The Algeria group felt that the icons were not meaningful or informative. They felt that the details in some of the icons were misleading, ambiguous and caused them to misinterpret the image.

For example, the Mitchells Plain group intended the one icon in figure 4 to represent the number of rooms in a house. The Algeria group mistook it to mean the

Meaning	Picture
Number of rooms	
Garden	
Tap/Water	
Date of Birth/Birthday	

Figure 4 Icons and Intended Meanings

windows. Another was intended to indicate whether a dwelling had a garden or not. The Algeria volunteers could not attach a meaning to this icon. Rather than a picture of a gardener, they suggested using a carrot to represent the garden. The third icon in figure 4 was meant to indicate if a house had running water. The group did not find this intuitive either. This was the one icon that *a priori* the researchers considered to be one of the most easily interpreted.

A further problem was that the Palm Pilot II has low graphic resolution. For example, the icon chosen to represent the date of birth was a cake with candles. However, this could not be represented clearly on the palm computer.

In practical terms, the study showed that getting a group of people in one community to develop a set of icons representing a socio-economic survey questions to be used by people in another community is unlikely to work. In fact getting a group of people in the same community to agree on attaching the meaning of an icon to a particular question will not occur easily. However, these field workers could read and write. After the training, they all chose to use text phrases as per the legend in figure 3 to represent questions, rather than icons (Barodien 2002).

Imizamo Yethu

The Imizamo Yethu study yielded similar results to the Algeria village, even though the volunteer field workers were from a different ethnic and language group (Xhosa as opposed to Afrikaans). A generally interpretable set of icons could not be developed with this group either. The volunteers felt that most of the icons were not intuitive and they experienced difficulty associating them with a particular question. For example, one of the volunteers said that he came from a rural area and he felt the icons were more meaningful to city dwellers. Furthermore, to him a cake with candles did not represent a birthday in his culture. They have beer and a traditional meal instead (Barodien 2002).

As with Algeria, at the end of the training session, all eight volunteers chose to use text phrases to represent questions rather than icons when they went out to collect data.

DATA COLLECTION

A combination of Boolean (true/false) data, numeric and textual data was collected. The Boolean and numeric data were captured easily. The textual data had to be typed into the Palm Pilot manually, which requires some skill with a palm computer.

Other than spelling errors, and the textual data not being in a uniform format, the data were accurate.

USABILITY

The criteria used for evaluating a person's ability to use computer technology were learnability, throughput, attitude and flexibility. Learnability is the ease with which a user can learn to use a system. Throughput is the ease of use of the technology. Attitude is the positive or negative attitude created in the users by the system, and flexibility is the extent to which the system can accommodate changes to the tasks and environments beyond, those first specified (Preece 1994).

None of the volunteers in Imizamo Yethu or Algeria had used a computer, a palm computer or similar device before. All of them were sceptical, indeed some were fearful, about their being able to use the palm computer linked to a GPS in the field.

However, after some initial difficulties in learning to use the system, all the volunteers performed well in their ability to learn, their attitudes and flexibility. General problems involved the operation of the palm computer and the understanding the data collection sequence. In general, the field workers were enthusiastic and positive. Although some struggled to learn the system, once they overcame their initial fears, they became competent after a morning's training and some practical field work (Barodien 2002).

CONCLUDING COMMENTS

As with the Cybertracker project, field workers, who had no previous exposure to computers, used the technology competently. Moreover, residents of communities that were to benefit from land reform and housing projects were able to collect data about their communities. However, using icons to represent a question in collecting socio-economic data and data relating to dwelling attributes were found to be impractical.

In one-off surveys, using short phrases or single words to represent questions are more effective. Field workers who were moderately literate showed that they could use phrases instead of icons. However typing data into a palm computer in the field is cumbersome and may not be the best way to do an initial survey.

If necessary, perhaps icons can be used for monitoring work. For example, if unauthorised shacks are built in an informal settlement, then field workers can devise their own icon to represent this. The GPS will provide the location. Monitoring the list of residents or shack owners is also feasible. Textual information, such as the list of residents in settlement can be stored in the system and merely checked in the field. If a name on the list does not match the resident of the shack, then it is unlikely that the data collector would deal with the issue anyway. The issue would likely be referred to a project manager.

Finally, in informal settlement upgrades, the techniques tested in this study could form part of broader data collection, management and dissemination procedures. For example, the authors advised the Marconi Beam development team on a subsequent informal settlement upgrade project. A number of data collection techniques were used. In adjudicating who should be entitled to a house, photographs of beneficiaries, their shacks and their families were included in the relevant documents. Subsequent transactions in these rights were carefully documented, and a number of audits to

ensure informal transaction did not occur were carried out. Copies of certificates indicating a change of beneficiary were stuck on notice boards in the settlement whenever a transaction took place. The influx of people into the settlement was also carefully policed, using people from the community to monitor the situation.

This project encountered very few of the problems encountered in other informal settlement upgrade projects in Cape Town. This was in no small part due to the fact that relevant data were collected continually, relevant information was publicised and members of the community were involved in the process. Palm computers are an affordable, easy-to-use technology that enables settlement residents to do this continual data collection efficiently.

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