Grassroots GIS: Digital outdoor designing where the streets have no name

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1 Mega-urban reality

This paper documents the quest of the authors to find potential social impact factors of digital modelling and visualization, related to landscape architectural design projects in the context of urban informal settlements. It focuses the application and development of digital tools, but it is embedded into a heavy mega-urban topic. Central aim of the described research is to contribute to the extrication of urban slums and slum-upgrading projects from non-consideration and invisibility. Secondary aim is to create reliable geographical data for directed design interventions in these environments. The mentioned design process is no subject matter in the article, because the described project is not finished yet. A very first glimpse of the nature of the intended – but inchoate – design interventions can be found in the rear section of the paper (Fig. 5).

In 2001, virtually one billion people lived in urban slums. It is projected that in 2030 the global number of slum dwellers will increase to about 2 billion, if no significant changes are taking place (UN HABITAT, 2003). The worldwide doxology of city life detracts from the shady side of the urbanisation process. Asia dominates the global picture of this shady side with 60 per cent of the world’s total slum dwellers (Ibid.). Megacities, with populations in excess of 8 million, and hypercities with more than 20 million inhabitants (DAVIS, 2007) are contemporary epicentres of urban poverty. The urban poor in such megacities are mainly living in informal settlements or slums. According to the operational definition of UN HABITAT, a slum is an area that combines the following five characteristics: 1) Inadequate access to safe water; 2) Inadequate access to sanitation and other infrastructure; 3) Poor structural quality of housing; 4) Overcrowding; and 5) Insecure residential status (UN HABITAT, 2007). Slums are vast, challenging and fascinating urban worlds, but almost fully eschewed by the architectural design disciplines – definitely landscape architecture is a foreign word there. On the one hand the common avoidance of slum areas is an understandable thing. On the other hand the sheer number of slum dwellers and their unacceptable living conditions are an unmistakable indication of the importance of urban slums as a work task for designers. The here introduced fieldwork-based approach of Grass Roots GIS had been first-time applied in Metro Manila, Philippines, one of the icons of Asian megacities in developing country context, with a population of more than 16 million people. Metro Manila contains the city of Manila, national capital of the Philippines, as well as sixteen surrounding cities and municipalities. Metro Manila is a rapidly growing endless city (BURDETT & SUDJIC, 2007) with all imaginable characteristics of urban affluence as well as of bitter urban poverty. Vast parts of Metro Manila – an estimated 40% portion – have to be attributed to urban informal settlements or slums.
2 Grassroots Approaches

2.2 Bottom-up

Slums are extremely densely populated and highly socially controlled neighbourhoods. Slum upgrading initiatives only can be successful, if they are entrenched in the participation of the resident dwellers and the engagement of groups of volunteers, in conjunction with intensive links to the local government and administration. Sensitive slum upgrading is an interminable, dusty and malodorous working field. It means dirty work (BEARDSLEY & WERTHMANN, 2008), embedded in a crossfire of bottom-up activities and building stones, instead of top-down master plans and pre-establishments. Grassroots engagement is predicated on big numbers of people, but as a rule it faces small or diminutive budgets. In terms of design efforts, expensive and sophisticated methods and tools have to be replaced by pragmatic, simple and effective instruments that allow basic fieldwork and in situ design.

2.3 Low cost

Landscape architectural design in slum areas is facing a categorical scarcity of space. Therefore large projects as parks or other representative big outdoor spaces are out of place. It is the small, unimposing micro-plot that counts in a slum and there are uncounted possibilities of designing essentials as a landscape architect. Microgardens can help to increase the quality of life in a slum to a significant extent and additionally can deliver precious food for the table. Microdesigns necessitate meticulous analysis and design, and every grassroots approach requires comprehensible, simple and low cost solutions. Grassroots landscape architecture must be realistic looking, proposed materials must be on hand and affordable. Chosen vegetation must be recognisable by laymen. We have to point out that the emphasis of this paper doesn’t lie on the attainable design results. The paper focuses the core fieldwork steps, the post-processing workflow, and lessons learned allowing progress in the course of further fieldtrips and projects.

3 Grassroots GIS

3.1 The concept of Grassroots GIS

Grassroots GIS relies on the bottom-up principle, aims on outdoor design inclusive planting design, and integrates 2D and 3D geospatial data and tools for the purpose of landscape design activities. By and by we tend to develop a toolbox and user-generated geospatial content process that supports mapping, storing, interactive design, disseminating, and interactive visualizing of landscape architectural interventions in the context of urban informal settlements. Meeting the requirements and the spirit of donation-based or volunteered projects implies easy and free access to applied tools, geodata and georeferenced design data. This premise calls attention to open source, open standard and cost-free or low-cost tools and data storage possibilities. The concept Grass Roots GIS is developed in the context of the MLA Design Studio 2010 “Needle in a Haystack Gardens – Manila”, National University of Singapore. The studio project is related to and organised in cooperation with the Philippine grassroots movement Gawad Kalinga. The mission of
Gawad Kalinga – meaning *to give care* – reads as follows: “Building Communities to End Poverty”. The method is boldly: “Land for the Landless. Homes for the Homeless. Food for the Hungry” (GK, 2010). Beneficiaries work hand-in-hand in *bayanihan* (Filipino term for teamwork and cooperation) with GK volunteers in building the infrastructure and structures of the community. The *kapitbahayan* (association of GK homeowners) composed of the beneficiaries themselves, take on multiple roles and undergo various leadership trainings. The beneficiaries learn to take ownership of their community and are empowered to help themselves and help others (Ibid.).

We are working on two project sites. One is a GK slum-upgrading project area, denoted as *villages*, in the context of a notorious slum called *Baseco*, situated at the estuary of Pasig River and the most central harbour front area of Manila City. Second site is the GK slum-upgrading area *Espiritu Santo*, surrounded by a vast slum area with the euphemistic name *Sitio Pajo* in Quezon City (Metro Manila). In this studio, Grassroots GIS has been operated with the help of simplest fieldwork tools (Fig. 1). The only technical equipment is represented by a low cost GPS device and an ordinary digital compact camera. All secondary information is put down on paper maps and pocketbooks, before being processed back in the studio.

![Fig. 1: Simplest fieldwork tools incl. low cost GPS device and ordinary digital camera.](image)

4 Fieldwork iterations and data manufacturing

4.1 Arriving where the streets have no name

It’s safe to say that slum areas are the most unsurveyed and thus most untraceable parts of megacities. They constitute white spots on official maps and planning materials. As a form of illegal land use, slums are blinded out from the radar of governmental cartographers, planners and public relation officers. The majority of urban slums – worldwide – shows no
street names and no formal addresses. Design professionals and students who intend to work in these neighbourhoods are downright dependent on taxi drivers familiar with the place, drivers of other adventurous wheelers, local organisations and local guides to bring them there. This circumstance is relevant, because finding the area of operation – in situ – forms the first step of Grassroots GIS in slum areas. In Manila we faced the situation that Espiritu Santo only could be found after several indications given by local dwellers on the street – even though we had an extremely experienced driver and a member of the GK organisation with us, who regularly goes to the site. We also had a GPS device, but no basic maps are available so far, showing any street of the searched slum area. No wonder that informal settlers extensively live in non-consideration. One major aim of Grassroots GIS is to breach this isolation and addresslessness by starting to publish the neighbourhoods of these people via online maps at the public platform OpenStreetMap (OSM).

4.2 GPS tracking, data editing and web-map upload

Second step of Grassroots GIS is to pace off all accessible streets, lanes and pathways of the project area with a GPS device, we used a low cost Garmin product. In the totally unmapped slum areas, this tracking act truly forms a way of volunteered geography (GOODCHILD, 2007), exploring untrodden paths of urban public realm (Fig. 2) and contributing to the growing global patchwork of self-generated, amateur geographic information.

Back in the studio, the fieldwork data were edited by dint of the open source Java OpenStreetMap Editor (JOSM), which allows processing of raw data and file preparation for web-based publication on OpenStreetMap (openstreetmap.org). The edited and uploaded geo data for the GK slum-upgrading project at Baseco, Manila, published on OpenStreetMap, lift these hitherto undocumented and invisible city neighbourhoods onto a worldwide accessible and visible public map (Fig. 3).

We regard this unspectacular action as a first successful step for the slum dwellers respectively ex-slum dwellers away from addresslessness and untraceability, towards a collective urban identity and territorial consciousness.
4.3 Handmade Street View surrogate

Designing in slums means highly detailed, small-scale work. It is impossible to remember all relevant details after the fieldtrip, without having an area-wide and building-sharp photo documentation of the project site. For this purpose Google Street View would be the state-of-the-art tool, but for a city like Manila – and all other large cities of developing countries – it is not available. For that reason also the "luxury" of an automatically generated Google SketchUp/Google Street View 3D model of selected city streets is not applicable. A sufficiently detailed working model has to be built by hand. In the field we used our standard digital camera to photograph all relevant facades, front gardens, public spaces and streets. Main advantage of this simple freehand tool was the speed of work and the flexibility of the photographer. Many situations in the narrow lanes required acrobatic climbing to allow overlapping image shots – the precision of the attained image material is accordingly limited. Back in the studio we began to drape these photos on a basic Google SketchUp 7.1 model. It gives an effectual overview of the spatial situation and depicts all design-relevant outdoor realities (Fig. 4). This handmade Street View surrogate serves as practicable sandbox model for the landscape architectural design process (Fig. 5).

Fig. 3: Baseco at OSM before (left) and after (right) our fieldwork in Manila 2010.

Fig. 4+5: Handmade sandbox model (l.) for the outdoor design process in Baseco, Manila. Inchoate example of a design approach (r.): "Trojan horse" concept to create garden space, where is no space but narrow streets and small houses (design sketch by Yue Zi En).
4.4 Micro designs visualized on the digital globe

Final step, after map generation, model building and design activity, is the project visualisation on the digital globe *Biosphere3D* (Fig. 6). The design intervention shown in the example is a placeholder for demonstration purposes only. *Biosphere3D* is a free and open source real-time landscape visualisation system (*PAAR & CLASEN*, 2007). It is laid out for interactive placement and rendering of complex landscape scenarios and landscape elements in geospatial context. The software system enables zooming from various scales up to 1:1 scale, being relevant for the micro designs of ‘Needle in a Haystack Gardens’ in the informal city context of Manila. In *Biosphere3D* especially 3D vegetation can be visualized in an interactive and photo-realistic way, an important function for landscape architects (*REKITTKE & PAAR*, 2006), which is not yet available on the popular archetype *Google Earth*. Placing the design proposals and project areas on a digital globe, adds geographical and spatial identity and comprehensiveness to the otherwise untraceable informal worlds in the haystack of the megacity. The possibility to fly to new addresses and entries on the digital globe, sharpens the sense of orientation and spatial sense.

*Fig. 6:* ‘Foreshadowed’ inchoate design visualisation (Baseco) on the digital globe of *Biosphere3D* (open source real-time landscape visualisation system).
The depicted example (Fig. 6) just represents the described working step in a schematic and symbolic way. Visualized designs in the informal urban context, finally should not look soulless but epitomise a form of dirty imagery (Rekittke & Paar, 2009), being in line with the rough and unadorned face of urban reality.

5 Lessons learned

Working in the field of informal urban settlements and slum upgrading projects offers a multitude of opportunities for landscape architects to go back to some essential contents of the profession. It sometimes resembles the exciting fact-finding tour of a discoverer, setting sail into the unknown. This is not meant to sound bumptious, it just shall indicate the overwhelming and fascinating potential of information gathering and design generation in a universe next door, which is as yet nearly untouched by the landscape architectural discipline. The comfortable, luxurious side of the urbanized planet seems to be buried under all thinkable sorts of institutional and technical layers of information, navigation and visualisation, the other, uncomfortable side of the coin seems to remain a blind spot in the global consciousness. After the fieldwork in Manila, the chosen approach of Grassroots GIS and the chosen simple fieldwork tools can be found adequate. Every elaborate analysis method and every expensive technical toolbox would seem absurd in the urban neighbourhoods of the poorest of the poor. The simpleness of the fieldwork action leaves room for identification and appreciation of the homemade details in the tinkered worlds of informal settlements. This ability is crucial for the development of context and user related designs – we are not coming as geographers and not as helpers. We are coming as outdoor designers.

Our positive general valuation of the presented fieldwork session in Manila shall not hide the fact that a multitude of things can be made better next time. We would like to single out the most relevant points concerning improved future fieldwork and post-processing methods and tools, that we can identify so far:

- During site inspection with a GPS device, all relevant detail information should be recorded and tagged by dint of the technical device – in situ. We decided to limit the GPS application to primary geographical information like streets, lanes, pathways etc. and recorded secondary information on a paper map. This is long-winded and gives away much of the great data gathering potential of a handheld GPS.
- The use of a combined camera and GPS device with additional mapping and tracking applications would be utile. The integrated functions of an Apple iPhone for example, allow a sophisticated combination of geographical and visual data. The sinking price and growing market share of such high-end tools seems to allow their future subsumption under the grassroots category.
- The photo shooting process on site has to be further systematised and improved. Freehand photographing without tripod, is fast, flexible and adequate in narrow and congested slum environments. But the gained material is difficult to process because of irregular picture intervals and shooting angles. “Quality, not quantity” should be motto next time. Instead of covering an entire slum upgrading area – Baseco has a dimension of several hectare – selected parts should be documented more systematically. Tripod
positions have to be calibrated, shooting angles have to be fixed and picture intervals have to be unitised.

- By dint of an improved photo shooting process, the subsequent picture processing workflow can be essentially optimised. True grassroots approach always will necessitate handwork, but the successful use of photo stitching software, photo matching tools, and 3D model generation from photos will facilitate the model building for further design action.
- The very small housing lots of GK slum upgrading projects (18 m²) would require a bigger zoom scale of the OSM map renderer (Mapnik). Over the time we would like to add more and more details to the OSM platform, but as yet closely located Points of Interest are hardly distinguishable and being labelled visibly.
- Building footprints from existing SketchUp models have to be georeferenced and added to OSM. This will provide the opportunity to GK village dwellers to add house numbers etc.

We regard the chosen path of Grassroots GIS as an initial attempt to work in a neglected field of urban public space. It is an effort towards geo-referenced landscape design for the real world (PAPANEK, 1985/2000), which seems definitely callow enough to be pursued.

6 References

Gawad Kalinga, 2010. Building Communities to End Poverty. URL: http://www.gk1world.com