Smart facility location planning using GIS technology & facility provision standards for proactive planning of social facilities

Cheri Green
BRICS Smart Cites, Jaipur India
17-19 August 2016
Structure of presentation

- Key informants & objectives
- Linking Accessibility planning; Planning Support Systems and the Smart City concept
- Approach & provision principles
  - Accessibility analysis
  - Provision standards and guidelines
- Library case study
- Impact, value for capacity building & resource allocation
- Truth behind the successful application
Geertman (2015) two main discourses in smart city concept:

• Smart growth leading to environmental & financial sustainability

• How ICT can contribute to more efficient planning & management of cities
Context

Smart Cities emerge “when investments in human and social capital and traditional (transport) and modern (ICTs) communication infrastructure fuel sustainable economic growth and high quality of life, with a wise management of natural resources, through participatory governance”

Caragllui 2011

Planning Support Systems (PSS) can be defined as geo-information technology-based instruments that are dedicated to supporting those involved in planning in the performance of their specific planning tasks. .....provides an approach where ICT is combined with geo-spatial analysis capabilities to provide smart planning support solutions to inform and guide sustainable development and management of cities.

Geertman 2006/ 2015
Key informants

- Access to services is a basic right
- Need to eliminate service backlogs
- Plan for equity /fairness
- Support sustainable & efficient city growth
- Optimal resource allocation
- Standards used to inform decision making; and
- Provide benchmarks for monitoring
Inaccuracy of “Island” based planning

Unit area data ie. ward or local municipality indicators of service demand & available facilities per local area unit - Island approach

Inaccurate basis for assessing accessibility of facilities. Ignores distance & may ignore capacity, density and facilities just across border

Available services per local area

Potentially accessible “cross-border” services
Context and complexities

• Different density & settlement types within same management area.
• Need to constantly play catch-up.
• Young inexperienced planners versus developers & development pressures.
• Restricted budgets.
• Pressure for investment to have greatest impact on backlog reduction.
Solution?

To support capacity building through informed decisions

Use GIS (ICT) based accessibility analysis & apply provision standards

• Accessibility analysis provides good spatial evaluation tool which is a-political & empirical
• Standards enable measurement, benchmarking & target setting
Provision Standards & Guidelines

Main variables

• THRESHOLD CAPACITY
• DISTANCE

Available at:

Objective 1: Improvement of service accessibility and availability from the perspective of existing and potential customers

Objective 2: Attraction of the threshold volume of customers needed to cover overheads and make the service viable

Analyse Existing Service Accessibility and Availability

Explore & adjust facility locations & sizes in relation to planning considerations, e.g.
- spatial distribution of demand
- threshold targets
- other facilities/ clusters/ nodes

PROCESS

Service provider perspective

Citizen perspective
Accessibility analysis

• Analyse the service provision distribution & capacity in relation to demand

• Measured in terms of maximum distances people will travel - facility service capacity and minimum viable service thresholds within service catchments and BASED ON AGREED STANDARDS.

• Model access based on rational choice – to nearest facility.

• When access distance and facility size/capacity considered in combination over a wide area can show whether provision is both sufficient and equitable.

• Analysis of only distance or only capacity is not adequate.
Data layers used for accessibility analysis

- Road network used to calculate travel distance

- Facility locations with capacity - i.e. classroom/ staff or size

- Population distribution
  - disaggregated to hexagon layer
  - hexagon = 20ha
All three layers interact within set standards to determine:

- Which part of **population**;
- Will travel **how far**;
- To a **facility** with set capacity.
Libraries big and small

Objectives:
• fewer larger facilities of higher quality
greater focus
• slightly longer travel distances
• sharing, co-location and integration
• location – nodes & main travel network
• consolidation & rationalisation
Key Assumptions: Libraries

- The entire population = users of public library services.
- Larger facilities preferred: up to 120 000 threshold per facility.
- Distance limit: 5km maximum for Community 10km for Regional Libraries.
Population Demand

City of Cape Town: 2011 Population

Legend
- Major roads
- 2011 Population (Per hexagon)
  - 0 - 10 (Sparse)
  - 11 - 50
  - 51 - 150
  - 151 - 500
  - 501 - 1500
  - 1501 - 2500
  - 2501 - 4500
  - 4501 - 8553

3 664 445 People

City of Cape Town: 2032 Population

Legend
- Major roads
- 2032 Population (Per hexagon)
  - 1 - 10 (Sparse)
  - 11 - 50
  - 51 - 150
  - 151 - 500
  - 501 - 1500
  - 1501 - 2500
  - 2501 - 4500
  - 4501 - 12000

High growth areas

4 466 969 People (Projected)
Thank you

Community Libraries - Travel Distance Maps 2011 & 2032

Community Libraries: 2011 Travel Distance

Legend
- Community Libraries
- Major roads
- No population

Access to Community Libraries (Distance in km)
- 0 - 3
- 3 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20+

89% of population within 3km.
97% of population within 5km.

Community Libraries: 2032 Travel Distance

Legend
- Community Libraries
- Major roads
- No population

Access to Community Libraries (Distance in km)
- 0 - 3
- 3 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20+

85% of population within 3km.
95% of population within 5km.
Thank you

Community Libraries: 2011 Served Regions

Legend
- Community Libraries
- Major roads
- No population
Access to Community Libraries (Distance in km)
- Unserved
- 0 - 3
- 3 - 5

Prepared for:
CITY OF CAPE TOWN ISIKEKO SASEKAPA STAD KAAPSTAD
Making progress possible. Together.

Prepared by:
CSIR
Our future through science

76% Served = 2 803 219

Community Libraries: 2032 Served Regions

Legend
- Community Libraries
- Major roads
Access to Community Libraries (Distance in km)
- Unserved
- 0 - 3
- 3 - 5

Prepared for:
CITY OF CAPE TOWN ISIKEKO SASEKAPA STAD KAAPSTAD
Making progress possible. Together.

Prepared by:
CSIR
Our future through science

67% Served = 3 004 500
Community Libraries - Unserved Areas 2011 & 2032

Community Libraries: 2011 Unserved Regions

Legend
- Community Libraries
- Major roads
- No population
- Unserved population (Per hexagon)
  - Served
  - 1 - 10 (Sparse)
  - 11 - 50
  - 51 - 500
  - 501 - 1500
  - 1501 - 3000
  - 3001 - 5000
  - 5001 - 8553

Prepared for:
City of Cape Town
Isieke Sasekapa Stad Kaapstad
Making progress possible. Together.

Prepared by:
CSIR
www.csir.co.za

24% Unserved = 861 225

Community Libraries: 2032 Unserved Regions

Legend
- Community Libraries
- Major roads
- Unserved population (Per hexagon)
  - Served
  - 1 - 10 (Sparse)
  - 11 - 50
  - 51 - 500
  - 501 - 1500
  - 1501 - 3000
  - 3001 - 5000
  - 5001 - 10000

Prepared for:
City of Cape Town
Isieke Sasekapa Stad Kaapstad
Making progress possible. Together.

Prepared by:
CSIR
www.csir.co.za

33% Unserved = 1 462 468
## Community Libraries - Service Coverage

### Statistics per Planning District - 2011 & 2032

#### 2011 Community Libraries Served & Unserved

<table>
<thead>
<tr>
<th>Planning district</th>
<th>Unserved</th>
<th>Served</th>
<th>% served</th>
<th>Total pop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blaauwberg</td>
<td>55 215</td>
<td>190 758</td>
<td>77.55%</td>
<td>245 972</td>
</tr>
<tr>
<td>Cape Flats</td>
<td>177 450</td>
<td>400 197</td>
<td>69.28%</td>
<td>577 648</td>
</tr>
<tr>
<td>Helderberg</td>
<td>36 512</td>
<td>180 528</td>
<td>83.18%</td>
<td>217 039</td>
</tr>
<tr>
<td>Khayelitsha/Mitchells Plain</td>
<td>405 075</td>
<td>683 431</td>
<td>62.79%</td>
<td>1 088 506</td>
</tr>
<tr>
<td>Northern</td>
<td>102 422</td>
<td>228 642</td>
<td>69.06%</td>
<td>331 063</td>
</tr>
<tr>
<td>Southern</td>
<td>21 123</td>
<td>296 149</td>
<td>93.34%</td>
<td>317 272</td>
</tr>
<tr>
<td>Table Bay</td>
<td>7 947</td>
<td>160 801</td>
<td>95.29%</td>
<td>168 748</td>
</tr>
<tr>
<td>Tygerberg</td>
<td>55 482</td>
<td>662 714</td>
<td>92.27%</td>
<td>718 196</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td>861 225</td>
<td>2 803 219</td>
<td>76.50%</td>
<td>3 664 444</td>
</tr>
</tbody>
</table>

#### 2032 Community Libraries Served & Unserved

<table>
<thead>
<tr>
<th>Planning district</th>
<th>Unserved</th>
<th>Served</th>
<th>% served</th>
<th>Total pop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blaauwberg</td>
<td>145 881</td>
<td>235 565</td>
<td>61.76%</td>
<td>381 446</td>
</tr>
<tr>
<td>Cape Flats</td>
<td>286 873</td>
<td>412 741</td>
<td>59.00%</td>
<td>699 614</td>
</tr>
<tr>
<td>Helderberg</td>
<td>57 127</td>
<td>220 122</td>
<td>79.40%</td>
<td>277 249</td>
</tr>
<tr>
<td>Khayelitsha/Mitchells Plain</td>
<td>614 064</td>
<td>690 000</td>
<td>52.91%</td>
<td>1 304 064</td>
</tr>
<tr>
<td>Northern</td>
<td>204 257</td>
<td>252 640</td>
<td>55.29%</td>
<td>456 896</td>
</tr>
<tr>
<td>Southern</td>
<td>35 749</td>
<td>312 746</td>
<td>89.74%</td>
<td>348 495</td>
</tr>
<tr>
<td>Table Bay</td>
<td>10 623</td>
<td>178 555</td>
<td>94.38%</td>
<td>189 179</td>
</tr>
<tr>
<td>Tygerberg</td>
<td>107 894</td>
<td>702 132</td>
<td>86.68%</td>
<td>810 026</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td>1 462 468</td>
<td>3 004 500</td>
<td>67.26%</td>
<td>4 466 968</td>
</tr>
</tbody>
</table>
Community Libraries - What investment is required for 86% service level?

* New locations to be considered by 2022:
  - Location 6 @ 100 000 capacity (Regional + Community);
  - Location 7 @ 70 000 capacity;
  - Location 13 @ 25 000 capacity (Regional + Community); and,
  - Location 14 @ 20 000 capacity

* New locations to be considered by 2032:
  - Location 3 @ 100 000 capacity (Regional + Community);
  - Location 4 @ 100 000 capacity (Regional + Community);
  - Location 8 @ 70 000 capacity;
  - Location 9 @ 60 000 capacity (Regional + Community);
  - Location 11 @ 30 000 capacity; and,
  - Location 12 @ 30 000 capacity (Regional + Community)

Current Libraries to be considered for expansion by 2022
  - Crossroads Public Library to 100 000 (Regional + Community);
  - Delft Public Library to 100 000;
  - Guguletu Public Library to 70 000;
  - Lotus River Public Library to 40 000;
  - Lwandle (Hector Peterson Memorial Library) to 50 000; and,
  - Mfuleni Public Library to 100 000 (Regional + Community)

Current Libraries to be considered for expansion by 2032
  - Bishop Lavis Public Library to 100 000 (Regional + Community);
  - Brackenfell Public Library to 100 000; and,
  - Ottery Community Library to 60 000

Notes:
* See numbers on map to left.

All facilities shown in red text serve as both Community and Regional libraries.
Libraries – Key outcomes

• Most of City’s population have good access.
• More than sufficient Library capacity but not equally distributed.
• Used informed decision making based on empirical analysis to agree requirements with Regional Managers and District Level Workshops.

• Results

• 10 new Community Library locations needed by 2032; of which 6 should also function as Regional Libraries
  • 8 current Community Libraries – expansion required - good locations
  • 9 current Community Libraries have good locations to serve as Regional Libraries with capacities of 120 000.
Planning implications (1)

Shortfalls in most facilities – difficult to find suitable, well located land. Thus:

- Unconventional approaches required.
- Sharing, clustering and multi-storey developments with innovative **space saving designs**.
- Greater focus on re-use/ retrofitting of existing well located facilities.
- Rental within retail malls for libraries or clinics.
- Private Public partnerships.
- Sharing with other government sectors(cross sectoral management).
Planning implications (2)

• Need to reduce space standards & improve quality especially of land intensive facilities such as parks, sport fields & cemeteries.
• Reduce footprint of buildings.
• Operational budgets need to be aligned to capital investment to achieve goal.
Uses of accessibility analysis outputs

- Evaluating requests for new facilities
- Capital budget strategic planning
- Informing community participation process
- Evaluating impact of new development with respect to facility demand

Applications to date
- 4 metros 14 million people 28% SA Population
- National and provincial level applications for prioritisation of non-metro investment
Value of the research application

- Results are visual & spatial
- Technical competence builds trust in results
- Defendable, empirical, fair, A-POLITICAL
- Provides statistics for backlog monitoring
- Limits construction of white elephants
- Brings GIS/ICT into mainstream city infrastructure planning
- Provides technical support for planning
Conclusions

• Approach & tools provide empirical base for determining needs between areas.
• Together with the standards, analysis supports human capacity for informed planning.
• Integration between sectors is enhanced & multi-sector facilities can be planned for better resource allocation.
• Investment directed to areas of greatest backlogs for biggest impact and ROI.
HOWEVER ... It all depends on

- Having the right people, in the right place, at the right time.
- Political will, lack of ego and a clear vision to do what is right.
- Skills and desire to apply best available technical skills to the problem and apply standards without favour.
Contact:

Cheri Green – cgreen@csir.co.za