The role of Environmental Audit tools in the measurement of physical characteristics of Streets

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***Abstract*— Researchers in Spatial Planning and Design often encounter with the problem of measurement of complex and dynamic physical settings with changing actors. Many types of environmental audit tools are developed for different contexts. The use of such tools for environment behavior studies in urban settings, especially streets is discussed in this paper.**

Keywords*— *Environmental Audit Tools, Streets, Environment Behavior Studies

I. INTRODUCTION

Physical environments of various scales such as buildings, landscapes, streets, plazas and entire cities may need to be measured qualitatively and quantitatively for various reasons. The basic characteristics like length, breadth, height, volume, colour, temperature, and noise level can be measured objectively. But these attributes do not make an exclusive list of attributes for physical settings, especially for the more complex ones. In many decision making processes empirical measurements of these attributes and user's or viewer's opinions about them are required.

Environmental audit tools are checklists, inventories and/ or subjective and objective measures of physical and social attributes of physical environments, like street segments, playgrounds, courtyards, railway stations etc. They have been widely used in environment behaviour studies and active living research (Project for public spaces, 2008; Clifton et al. 2008).

These checklists are used in research in order to measure, rate and compare physical settings so that they can be assessed empirically. Such quantification is useful in answering questions like

Which street segment is best suited for walking?

Which school design supports physical activity of children?

Which park design encourages participation?

Which apartment design supports community activities?

Which parts of the city are likely to be safe?

Checklists and inventories are in the form of comprehensive listing of physical and social elements such as presence and type of footpath, presence of trees, openings in buildings, number of people, their activities, aesthetic qualities, accessibility etc. These can be recorded in checklists or coding lists. Objective measures can be environmental measures like street width, sidewalk width, number of trees in the stretch, duration of activities etc. Subjective measures can be opinions of observers recorded in various kinds of rating scales.

Most of these tools require direct observation of the street segments/ area under study. They are accompanied by detailed protocols of classifications and ratings to reduce inter "rater" variability. Many such audit tools are developed and used by researchers over the past decade. Following is a detailed discussion of some of the environmental audit tools.

Pedestrian Environment Data Scan (PEDS): Developed by *Dr. Kelly Clifton* of University of Maryland, this tool measures-

- environment (Landuse, slope, intersection),
- pedestrian facilities (Type of footpath, sidewalk width, surface material, maintenance, obstructions, connectivity, continuity etc),
- road attributes (Condition of road, number of lanes, posted speed limit, parking, traffic control, crosswalks, crossing aids, bicycle facilities etc.)
- walking/ cycling environment (lighting, amenities, signage, trees, degree of enclosure, power lines, cleanliness, building articulation)
- subjective assessment of attractiveness of the street (www.activelivigresearch.org).

Zhu and Lee (2008) have used this tool to assess street level walkability in a study of walkability and safety around elementary schools in Austin.

A. *Irvine Minnesota Inventory* is a measurement tool for objective and perceived measures of the environment that may be linked to active living (www.activelivigresearch.org) It comprises 160 items in 4 domains: accessibility, pleasurability, perceived safety from traffic and perceived safety from crime. Brown et al (2007) used this tool to assess walkability of selected routes in a study of walkable route perceptions and physical features.

B. *Audit tool analytic version* (developed by St. Louis University School of Public Health) is a long checklist for collecting information on various street scale environmental aspects related to recreational and transportation based physical activity. Data can be collected by observation on foot

or on automobile. It combines inventory data and ratings by observer. It collects data under following major heads:

Landuse, Transportation, Facilities, Aesthetics, Signage and Social Environment (www.activelivigresearch.org)

C. *Path Environment Audit Tool (PEAT)* is a computer based instrument to assess physical characteristics of community trails and paths (www.activelivigresearch.org).

D. *Systematic Pedestrian and cycling Environmental Scan (SPACES)* Instrument is a comprehensive instrument to measure the physical environmental factors that may influence walking and cycling in local neighbourhoods (www.activelivigresearch.org).

E. *Dementia Therapeutic Garden Audit Tool:* This tool helps to rate Therapeutic gardens in terms of accessibility, orientation, sustainability, safety, and the ability of the garden to evoke memories, sensory stimulation, and to generate meaningful activities

F. *Residential Aged care Services Audit tool:* This tool measures the suitability of Aged care Services both outdoors and indoors.

Coding sheets are used for recording the inventories and for rating qualities and attributes of spaces. Coding sheets are usually accompanied by detailed protocols for auditing. Protocols will describe the auditing practice in detail and ensures uniformity in rating and auditing.

Reliability of audit tools: Audit tools will be reliable only when they provide the same results when audited by different persons. Detailed coding protocols are to be developed along with audit tools. Such audit tools along with coding protocols may be tested for reliability before putting into practice.

The coding process may require a lot of observations of the environment under consideration. In order to ease the coding job the physical setting may be photographed or video graphed.

II. MEASUREMENT OF PHYSICAL CHARACTERISTICS OF STREETS

Streets and public spaces are owned by many and are in continuous use. Measurement of urban spaces and streets is challenging since one has to measure a range of complex ever changing spaces. Such measurement is required when street segments or similar urban settings are to be quantitatively assessed. Such assessment can aid in answering the following types of questions.

Which street characteristics promote/discourage certain activities?

Which streets are good for walking?

Which are the environmental improvements required for aiding the intended activities?

Which are the components of streets which make them attractive?

A quantitative assessment of street characteristics is possible with a suitable audit tool. An audit tool was developed for Indian conditions for an environment behaviour study. Following is a description of the audit tool.

Unit of Analysis for the auditing can vary according to the need of the study. The following are some of the examples

- Street segments of specific length (every 10meters),
- A street from one junction to the next,
- Street bound by one continuous stretch of built form on the side,
- A setting for a social activity

It may be convenient to audit both sides of the street separately, since in many cases they function as separate spaces divided by the traffic. In such cases the characteristics across the street also may be recorded

The following are the variables measured in the audit tool Right of way of the street

- Width of the carriageway
- Average width of the footpath if it is present Presence/absence of a curb
- Average width of clear space available for pedestrians
- Surface of pedestrian space
- Presence of vegetation, potholes, litter, and water puddles, on the side
- Prominent land use on the each side (e.g. residential, commercial, vacant)
- Specific land use (residential only, residence with shops, residence with office etc.)
- Background at ground floor
- Height of adjacent structure
- Age, Colour, Character of adjacent structure
  Presence of street furniture, street hardware
  Presence of signage at different levels
- Activity spill over (Shop keepers putting merchandise outside their shop, residential use spill over)
- Canopy characteristics
- Shade characteristics

Presence of the following on adjacent facade

- Balconies
- Windows Doors
- Projecting buttresses

Presence of the following in the public space

- Low walls, curbs which can be used for sitting
- Electric posts, transformers Trees, shrubs
- Tree guard Fencing
  Garbage box
- Chairs, benches etc. Provided by adjacent land users
- Drinking water pandals
  Landscape elements Art work
- Telephone kiosks Stalls
- Street vendors with/ without carts Parked vehicles

Presence of people in different types of activities can also be recorded using the code sheet. Number of people, different categories of people etc. also can be recorded

Detailed coding protocols have to be developed for each of the variables so that different observers will record the same data for the same unit of analysis and iner-rater variability is reduced.

Most of the variables discussed above are categorical variables. Many statistical analyses are possible with these data. Association between physical variables and activities can be analysed. Many physical characteristics can be found to be associated with participation of people. Many types of cross tabulations can be used. Logistic Regression analysis is possible with binary variables (in this case presence or absence). Such analysis will indicate the significant associations.

Environmental audit tools like these provide empirical measurement of complex physical settings. Empirical findings of associations between physical characteristics and different types of participation by people in streets and other public spaces provide valuable input into how public spaces are to be planned and maintained. It can also aid us to decide how existing public spaces can be modified to support participation by people in general; and different categories of users like the aged, women, children, the poor and people with special needs in particular. Thus it saves planners and designers from arbitrary decisions and helps them to plan inclusive public places.

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