Opportunity Mapping: A conceptual Analysis and application to the Baltimore Metropolitan Area

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Abstract

With encouragement and assistance from the US Department of Housing and Urban Development many local governments and metropolitan coalitions are mapping opportunity to inform the development of regional sustainable communities plans. The notion that the neighborhood in which a person lives shapes their social and economic opportunities is not new, but how opportunity is to be measured, displayed, and used to guide policy decision making remains under examined. In this paper we conduct such an examination using data from the Baltimore metropolitan area. Specifically, we examine the conceptual foundations and standard analysis framework of opportunity mapping developed by the Kirwan Institute. We then present results from an opportunity mapping analysis conducted in the Baltimore region as part of a regional Sustainability Planning effort. We make numerous improvements on the Kirwan approach, such as including indicators drawn from substantial social network literature, incorporating advanced spatial analytical techniques, and going through the planning process to gain local input. We conclude with recommendations for how opportunity maps can be used to inform metropolitan sustainability plans.

I. Introduction

The Fair Housing Act was signed into law by Lyndon B. Johnson on April 11, 1968, just a week after the death of Martin Luther King Jr. Of all the legacies of Dr. King Jr., fair housing is among his most profound, because his assassination was the catalyst for long-overdue legislation that outlawed many kinds of private housing discrimination. Since 1968, the application of the law has expanded to preclude discrimination on the basis of race, gender, disability and sexual orientation. In recent years, however, its application has expanded beyond discrimination against individuals in the housing market to include local government policies that limit access by poor and minority residents to high opportunity communities and neighborhoods. In the 2006 Maryland District Court case, Thompson v. HUD, Judge Marvin Garbis held that the U.S. Department of Housing and Urban Development violated the Fair Housing Act by unfairly concentrating African-American public housing residents in the most impoverished, segregated areas of Baltimore City. The case set a new precedent in fair housing litigation, marking an important evolution in the way that scholars and policy analysts assess equitable housing conditions. The *Thompson* ruling was based on the premise that public housing residents deserve equal access to the same types of educational, economic, social and other opportunities found in other neighborhoods—and that it was HUD's responsibility to ensure such access.

In 2010, HUD launched its Sustainable Communities grant program and began encouraging local governments and metropolitan coalitions to conduct "opportunity mapping" exercises. These exercises

require grant recipients to measure and map differences in access to local opportunity structures for residents in different neighborhoods within the metropolitan area. The notion that the neighborhood in which a person lives shapes their social and economic opportunities is not new, but how opportunity is to be measured, displayed, and used to guide policy decision making remains under examined.

In this paper we conduct such an examination using data from the Baltimore metropolitan area. Specifically, we examine the conceptual foundations of opportunity mapping and discuss the challenges of presenting spatial variation in opportunity on maps. We review the history and evolution of opportunity mapping, the state of the practice of opportunity mapping, and current HUD proposed rule for recipients of the Fair Housing Act programs. Then, we discuss the ways in which opportunity mapping can be used most effectively, and identify situations in which its utility is limited. Finally, we propose recommendations for how opportunity mapping can be used to engage, evaluate and guide sustainable regional policy.

II. Literature Review

In recent years, regions and cities around the U.S have been conducting opportunity mapping exercises to better understand local socioeconomic dynamics and inform urban policy. In many cases, opportunity mapping, has led to effective engagement with local communities and thoughtful evaluation of current social programs. For instance, in many cases, opportunity mapping has been used to demonstrate that public housing is often located in the areas of lowest opportunity, and there is often a significant difference in access to opportunity between different ethnic and racial groups. These analyses often trace their ideological lineage to William Julius Wilson's classic book, *When Work Disappears*, in which he describes how the suburbanization of employment helps reinforce racialized poverty in inner cities. Indeed, Wilson is often credited among the first scholars to eloquently articulate the condition of spatial mismatch theory, and following his logic, many opportunity analyses have placed considerable emphasis on indictors such as employment growth and job accessibility. Recent research by Goetz and Chapple, however, suggests that concerns over spatial mismatch and lack of job accessibility within metropolitan regions have been vastly overstated (Goetz & Chapple, 2010). Instead, they argue, in addition to the job accessibility, school quality, safety, housing and neighborhood satisfaction, and social network all play an important role in providing benefits for the residents. Based on these findings, we provide a review of the state of the practice on how opportunity mapping has been applied and implemented in the current research.

1. The evolution of opportunity mapping

Opportunity Mapping is a relatively new technique, but its roots arguably begin in traditional and commonly used land-use planning methods. In the 1960s, well before Geographic Information Systems (GIS) became popular and widely accessible, celebrated landscape architect Ian McHarg devised an innovative method for identifying parcels of land most suitable for development. McHarg gathered data on land characteristics such as relief, soil type, and hydrology, and began to combine them, by laying transparent sheets on top of one another (Collins, 2001). As a result, McHarg produced a type of crude, visual index that he and his associates could use to make better, more informed land-use decisions. In doing so, McHarg laid the groundwork for a powerful decision-making tool that combined multiple, unrelated data into a single product used to solve a common problem.

As a landscape architect, McHarg was intimately concerned with the location of objects in space; his background gave him intuitive awareness of the value of maps and locational visualization. Over the years, this awareness has begun to saturate other areas of social science and urban studies as well. In recent decades, researchers focused on social outcomes have begun to critically examine the role that geography plays in the development of social systems. These researchers have contributed to a large body of literature that demonstrates the ways in which neighborhoods and other geographies are inextricably tied to important resources like high-quality education, access to healthy food, and crime-free environments. These researchers have shown—with convincing certainty—that these types of neighborhood structures contribute to the overall health and success of their residents.

Until the last decade, McHarg-style data visualization and urban social geography were two distinct concepts that were never formally wed, leaving social scientists and urban policy analysts without an important tool for understanding the ways that space influences social opportunity structures. Recently, however, amidst a wave of interest in social equity, place-based social policy, and residential mobility programs, researchers have begun to critically examine the ways in which geography impacts the life course, and the effect of federal and local policy upon equality of opportunity.

When federal housing policies came under fire in the 1990s, the stage was set for the confluence of these two concepts. During the landmark *Thompson v. HUD* case, six families living in public housing in the city of Baltimore brought a class action suit against the federal government, alleging that government policies intentionally concentrated public housing in the most segregated, impoverished and disadvantaged areas of Baltimore City. The litigation lasted a decade, during which numerous national policy experts were brought to bear testimony on whether HUD's actions were unlawful. Among the most influential of these opinions was that provided by John Powell, then Executive Director of the Kirwan Institute for the Study of Race and Ethnicity, who conducted an analysis of opportunity in the Baltimore Metropolitan region. His thesis was simple: where a person lives determines the quantity and quality of resources that impact his or her life outcome. In other words, the neighborhood in which you live determines the types of employment options available to you, the modes by which you can travel, and the quality of the schools your children attend. Because housing markets respond to valuable resources like good schools and accessible jobs, neighborhoods with strong opportunity structures are often marked by high housing costs, effectively eliminating lower-income and public housing residents. This pattern ultimately reinforces structural inequality and class privilege (Powell, 2006).

To illustrate his point, Powell created an opportunity index by taking various sets of data, and arranging them into the following categories:

- Economic Opportunity and Mobility
  - Number of estimated entry level and low skill employment
  - Ratio of entry level and low skill employment opportunities per 1,000 residents
  - Absolute change in employment from 1998 to 2002
  - Access to public transit
  - Median commute time
- Neighborhood Health
  - Population change from 1990 to 2000
  - Estimated crime rates in 2000
  - Poverty Rates for the general population in 2000
  - Vacant property rates in 2000

  - Median home value in 2000
- Educational Opportunity
  - Proportion of FARM students of elementary and middle school
  - Proportion of classes not taught by highly qualified teachers in 2004
  - Proportion of elementary students proficient in reading
  - Proportion of elementary students proficient in math
  -

He then combined the various pieces of data within each category to produce an opportunity index for each category, and then added the categories together to compute an overall opportunity index. Finally, he used the overall index to create a thematic map for the Baltimore region, and overlaid the locations of public housing (shown in Figure 1). It became immediately clear that the vast majority of Baltimore's public housing residents were occupying areas of very low opportunity.

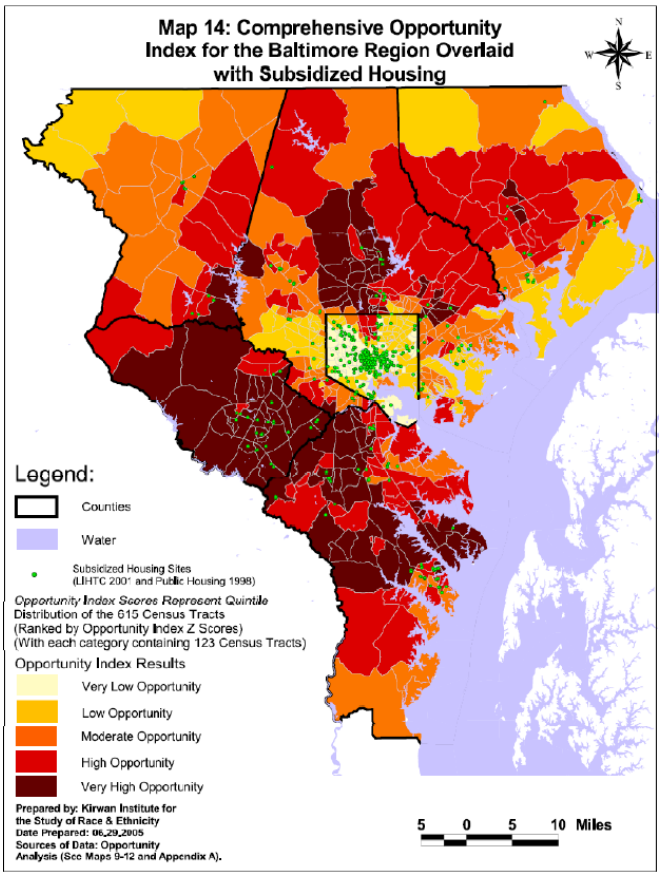


Figure 1 John Powell's Opportunity Mapping of Baltimore

2. *The State of the practice*

Powell's testimony represents one of the first documented uses of opportunity mapping to influence public policy, and since then, many other regions have undertaken similar studies. Most of these studies have followed the same framework as Powell's original analysis, including the following:

The Puget Sound Regional Council and the Kirwan Institute jointly developed "Growing Transit Communities," funded through an SCRPG grant. In this project, a steering committee worked with a

variety of stakeholders and advocates throughout the region to select a set of opportunity indicators representing five key elements of neighborhood opportunity: education, economic health, housing and neighborhood quality, mobility and transportation, and health and environment. The opportunity mapping tool has been a catalyst for community discussion and has led to many findings and policy implications, including: (1) the total population, disabled population, and the foreign-born population are more or less evenly distributed across the opportunity spectrum. (2) Subsidized housing can be a strategy to help disadvantaged population to access healthy food or high-performing schools. (3) About half of the people living in poverty are located in the areas of low or very low opportunity. (4) About one third of current and proposed light rail stations are in areas of low and very low opportunity.

The Central Texas Opportunity initiative was established by the Community Partnership for the Homeless and involved a steering committee representing a consortium of organizations in the Central Texas region. The committee worked with the Kirwan Institute to identify and gather data for indicators of opportunity in the region. Their categories of indicators include: education, economic, mobility and transportation, health and environment, and neighborhood quality. The results show that areas of high and low opportunities are not evenly distributed throughout the region. Specifically, higher opportunity areas in the region are primarily concentrated west of I-35, which is also the divider in education conditions. In terms of housing and neighborhood quality, public health and environment, they also found that neighborhoods west of I-35 performed better. Similar to the results in the Central Puget Sound Region, the findings in Austin demonstrated that subsidized housing sites are less likely to exist in high-opportunity areas.

The Denver SCRPG-funded initiative is focused on ensuring that the region's significant investment in new rail and bus service will provide greater access to opportunity and a higher quality of the life for all the residents, especially for the disadvantaged populations who benefit the most from transit service. The five categories of opportunity maps are: population and demographic characteristics, housing, job and economic development, education, health. The opportunity mapping results show that the region has a significant opportunity to increase transportation options through transit expansion. Many low-income and other economically disadvantaged populations, however, cannot currently take advantage of affordable transit choices. In addition, even though many of the region's affordable housing units are located near the current or proposed transit stations, the demand for housing near transit is expected to grow fast in the coming decades.

While each of these opportunity mapping exercises includes unique nuance and each effort was conducted in the context of specific challenges, constituencies and datasets in mind, their techniques are largely the same, and follow the basic framework instituted by Powell and the Kirwan Institute. Each opportunity indicator is assigned an equal weight and combined into a categorical index such as "Educational Opportunity," and a composite opportunity index is created by combining all indicators together. While this process is a sound foundation from which to analyze regional opportunity, it suffers from a number of drawbacks. For one, the lack of an explicit weighting system means that certain categories have implicitly greater impact on the composite index. In other words, if the Education category has more indicators than the Employment category, the composite index will be more sensitive to changes in educational scores, effectively placing a greater importance on education factors. For another, a lack of transparency during indicator selection process can lead to confusion and misrepresentation. Although social scientists have been studying the impact of neighborhood structures on economic achievement for decades, there is no

consensus on which structures offer the best route to social mobility. For this reason, many potential opportunity indicators often conflict, co-vary or defy operationalization. Finally, a large and growing body of sociological research suggests that many of the most important opportunity structures such as large, robust social networks are difficult, if not impossible, to measure in a spatial dimension because they are gained through particular types of institutions and specific socialization processes. For these reasons, we believe the basic opportunity mapping framework applied in most regions could be improved, and the increasing use of opportunity mapping as a policy framework gives urgency to do so

3. *Opportunity Mapping for the Baltimore RPSD*

In 2010, the Obama administration announced the formation of the Partnership for sustainability, a new federal body comprised of three federal agencies including the Department of Transportation (DOT), the Department of Housing and Urban Development (HUD), and the Environmental Protection Agency (EPA). This federal body would, for the first time in history, encourage regional planning through the disbursement of federal funds. To receive a grant from the HUD wing of the partnership, a team of regional applicants would be required to demonstrate a commitment to sustainability along each of the "Three E's:" economy, environment and equity, although a major focus would be placed on social equity.

To win one of these grants, the Baltimore Metropolitan Council, a body normally charged with crafting transportation plans for the Baltimore region, formed a coalition with powerful groups of stakeholders throughout the region, including the National Center for Smart Growth (NCSG), 1000 Friends of Maryland, the Maryland ACLU, and the Citizens Planning and Housing Association, to name only a few. This coalition, calling itself the Baltimore Opportunity Collaborative (BOC), was not only powerful, but also inclusive because it brought together a diverse group of stakeholders, some of whom had sat across the courtroom from one another only a few years prior during the Thompson v. HUD trial, but all of whom were committed to transforming the Baltimore region into a more socially sustainable place. Recognizing how valuable opportunity mapping had proven during the Thompson decision, the BOC promised in its grant application to perform a similar exercise to guide the planning effort. The application was approved, and HUD awarded a grant to the Opportunity Collaborative, on the condition that opportunity mapping would be an integral part of the process. In the following section, we describe the method by which most opportunity mapping exercises are applied, and we suggest improvements in a number of areas. Following, we present an application of our improvements by creating opportunity indices for the Baltimore region.

III. Method and Technical Issues

In July 2013, HUD proposed a new program rule for Sustainable Communities program grantees to affirmatively further the purposes and policies of the Fair Housing Act. For too many communities or people, housing choice can be constrained through housing discrimination, the operation of housing markets, the history and geography of the regions, and patterns of development and the built environment. HUD aims to apply this new proposed rule to improve the current regulatory structure by providing communities with robust data and a framework for assessment. HUD hopes that this proposed rule can help the communities to identify where fair housing challenges and opportunities exist. In the current version of the proposed rule, HUD includes the following indices: poverty index, school proficiency index, local market engagement/human capital index, job access index, health hazards exposure index, and transit access. HUD also hopes that a broader audience of civil rights advocates, affordable housing

developers, community development organizations, housing development agencies, and other members of the public interested in fair housing in their communities will provide input.

The new HUD rule requires opportunity mapping as a component of each regional Fair Housing Equity Analysis. The basic procedure for conducting an opportunity mapping analysis has become fairly standardized:

1) Indicator selection and identification
    a. Indicators are typically chosen based on justification from academic literature and data availability
    b. Indicators may be validated/qualified through community engagement processes
    c. Typical data sources include U.S. Decennial Census and American Community Survey, the Bureau of Labor Statistics, the Environmental Protection Agency
    d. When available, localized data (state or local level data) may supplement or replace federal data
2) Spatial representation
    a. Aggregation and/or spatial reallocation is performed to ensure consistency across geographic units (e.g census tract)
3) Normalization and aggregation
    a. Data are converted to Z-scores for comparison across multiple types
    b. indicators may be weighted according to importance before summation within categories
    c. Categories may be weighted to compute aggregate opportunity
4) Representation and Utilization
    a. Typically, the opportunity index is categorized into a set of five quintiles, with each category representing 20% of the geographic units within a region. These categories are generally presented in qualitative terms, where the quintile containing the lowest scores represents 'very low opportunity' areas, and quintile containing the highest scores represents 'very high opportunity'
    b. The most common use of opportunity maps has been to describe variation in access to opportunity by various demographic groups and to guide the placement of affordable housing.

Computing a spatial opportunity index relies on the combination of multiple, unrelated data, nearly all of which are measured along different scales and units. To overcome this issue, data must be collected according to a common geographical unit, and converted to a consistent measure. In nearly all cases, this involves collecting data by census tract. Census tracts are usually chosen as the geographic unit of analysis because they offer the finest geographic precision for which data are widely available[1]. This can present a challenge to for analysts, however, because data that are unavailable at the census tract level (such as point locations, or aggregates by zip-codes) require additional manipulation and Z-scores, statistical measurements that indicate how different a particular observation is from the sample average, are an effective way of standardizing and aggregating data into an opportunity index for two reasons. First,

[1] Although the US Census collects data at much smaller geographies such as blocks and block groups, many variables are unavailable at this scale due to confidentiality concerns

z-scores allow different types of data to be interpreted along a common scale; a Z-score of zero is equal to the mean for any given variable, whereas scores less than zero represent observations lower than the overall mean, and scores greater than zero indicate observations higher than the overall mean. Second, because z-scores are a relative measure, they are well suited for use in an opportunity index because access to regional opportunity is a relative concept.

Ensuring that data can be combined using consistent geographic units, however, presents a much larger problem, particularly for some indicators that are at a location level. The simplest way to deal with these types of point data, is to simply aggregate all the points within a single tract, and assume that locations with multiple locations have better access. This is an undesirable method, however, for a number of reasons. First, many tracts would not have a score at all simply because they did not contain any points. This is problematic because tracts could still have good access to one or more points even if those points do not fall within the tract itself. Second, this method fails to account for the difference in size between different tracts, and will provide a bias toward larger tracts.

In order to deal with this data aggregation issue, kernel density tools are applied for some variables in this study. Kernel density tools are provided with most common GIS software packages, and are commonly applied when studying crime and performing cluster analyses. These tools split a study region into a raster grid, then for each grid cell, search for any points that fall within a specified distance of the originating cell. Points within the search radius are then applied to a gravity equation so that nearby points have a larger effect than those further away. Kernel density tools produce heat-map style outputs, which can be used to estimate proximity or access to certain resources. Grid scores can be averaged for each census tract to provide an overall accessibility measure. While this method is better than simply aggregating points to tracts, it also suffers some drawbacks. For one, both the size of the grid cells and the search radius must be specified by the analyst, which requires some theoretical foundation for decision making. Second, although a kernel density calculation can be used to estimate access to a resource, it does so using a Euclidian distance measure that takes into account only distance, and ignores travel time or infrastructure connectivity. For these reasons, kernel density could be a good choice if no other method for estimating accessibility is available, but it is not ideal.

We also incorporate a large-scale transportation model to incorporate locational amenities. This is, perhaps, the best and most sophisticated option because it provides the most reliable measure of accessibility, by accounting for transportation infrastructure and commute times. This method also provides the benefit of disaggregating among modes of travel, for instance, to compute measures of accessibility by transit, which can add an additional layer of sophistication. We argue that this method should be chosen above others when there is an available travel model, though it is not without some disadvantages. One drawback worth noting is that travel models frequently rely on transportation analysis zones (TAZs) or other proprietary geographic units like statewide modeling zones (SMZs). Rarely do these types of models incorporate census tracts, so the conversion of model zones to census tracts can introduce error.

IV. Opportunity Mapping in Baltimore: Process and Results

Opportunity mapping is both an art and a science. It requires sophisticated and technical spatial analysis, but also careful decision making about which data sources are appropriate and which indicators should be

selected to represent neighborhood opportunity. Because of its technical expertise with GIS, the National Center for Smart Growth was contracted to undertake the opportunity analysis for the Baltimore region, though because selecting indicators can be a contentious process, an Opportunity Mapping Advisory Panel (OMAP) was formed to oversee the opportunity mapping process and provide feedback on indicators. The OMAP was formed to represent the multiple groups participating in the Baltimore RPSD effort and included a core group of local and regional planners, lawyers, policymakers and researchers from NCSG. The group also sought a rotating a group of technical experts who could provide feedback on various topics including public health, workforce development and education and others. The rotating group convened with the OMAP only when indicators in their respective substantive fields were discussed and members included public health officials from the city of Baltimore, researchers from Johns Hopkins University and education specialists from the Maryland State Department of Education, among others (the member participants are listed in the Appendix A).

The OMAP group met twice a month for seven months to discuss and select indicators. The meetings were organized by topic, with each month dedicated to a particular set of indicators such as "Public Health and Safety" or "Education & Training". In preparation for the first meeting, researchers from NCSG would conduct thorough reviews of academic literature to identify neighborhood variables that appear to impact achievement. They would then create maps for each indicator and present them to the meeting. There, the OMAP would be shown each map and have the opportunity to discuss whether they believed each indicator was useful and whether it was measured appropriately on the map. Often during this process, the subject matter experts would suggest new indicators that NCSG had not explored, and other members of OMAP would request that some indicators be removed or measured in another way. For the following meeting, NCSG researchers would attempt to track down the additional data suggested by the OMAP, and they would explore new methods of measuring indicators in response to comments they received. Finally, each map would be shown to the participants and they would engage in another discussion about the validity of each indicator. These conversations were often contentious with some members of the group strongly advocating for an indicator that another group member vehemently opposed. Very rarely did indicators receive unanimous support from all members, so very few could be ensured to survive the process.

Despite the heated conversations taking place during each meeting, there was no clear way to justify the inclusion of any particular indicator. Nearly every proposed indicator had at least one objector, most had partial support, and some indicators were so volatile that their support amongst the group would vary by day. To overcome this issue, the OMAP chose to institute a proportional voting system for selecting and weighting indicators according to the OMAP's collective will. At the conclusion of each month, each member of the group was given a worksheet to fill out. The worksheet had a line for each of the proposed indicators and asked two questions:

(1). "Is this an important indicator of opportunity?"

(2). "If yes, how would you rank its importance on a scale of 1-10?"

After each member had completed the worksheet the results were tabulated to form the group's overall recommendation. Any indicator that received "No" across the board for question one was dropped from the index. Each indicator that received at least one "Yes" for question one would be weighted according the average rank before it was added to the index. This system created a way for OMAP participants to

compromise on which indicators would be included, without the need to agree unanimously on every particular one. Because this was a very process-oriented way to generate decisions, the OMAP participants felt connected to the outcome, and that the exercise produced (at least partially) valid results.

By the end of the process, the OMAP reviewed approximately 165 maps and included 92 of those in the six composite category index maps including education, housing and neighborhood quality, social capital, public health and safety, employment and workforce, and transportation and mobility. Table 1a through Table 1f shows the indicators of each category. Each of the six composite category index maps is presented below.

Table 1a Education Indicator

Subcategory	Indicator Title	Weight
Elementary School	Student Performance (Elementary School)	10.4%
	3rd Grade Reading	6.6%
	3rd Grade Math	4.3%
	5th Grade Reading	5.1%
	5th Grade Math	4.3%
	Percent of Teachers Highly Qualified (Elementary School)	10.7%
Middle School	Student Performance (Middle School)	13.0%
	Percent of Teachers Highly Qualified (Middle School)	10.7%
High School	Student Performance (High School)	5.0%
	Advanced Placement Course Enrollment	2.1%
	Advanced Placement Exam Scores	2.6%
	SAT Scores	5.6%
	High School Dropout	3.9%
	Percent of Teachers Highly Qualified (High School)	4.5%
Adult Workforce Development	Access to Work Force Investment Area Training Programs	4.8%
	Proximity to Community Colleges	4.1%
	Proximity to Private Career Schools	2.4%

Table 1b Housing and neighborhood quality Indicators

Subcategory	Indicator Title	Weight
Housing Characteristics	Median Housing Value	15.0%
	Median Gross Rent	12.6%
	Percent Change of Total Housing Units (2000-2010)	1.8%
	Percent Change of Total Occupied Housing Units (2000-2010)	2.8%
	Percent Change of Owner-Occupied Housing Units (2000-2010)	5.1%
	Percent Change of Renter-Occupied Housing Units (2000-2010)	1.9%
	Percent of Single Family Housing Units (Attached)	2.9%
	Percent of Single Family Housing Units (Detached)	3.2%
	Percent of Multi-Family Housing Units	5.1%
Housing Burden/Affordability	Selected Monthly Owner Costs as Percentage of Income	2.5%
	Gross Rent as Percentage of Income	3.4%
	Ratio of Median Gross Rent to FMR	1.7%
	Cost Burden – Owner 35% Monthly Income	3.8%
	Cost Burden – Renter 35% Monthly Income	4.1%
	Cost Burden – Owner 50% Monthly Income	2.9%
	Cost Burden – Renter 50% Monthly Income	3.2%
	Housing Affordability Index	1.9%
	Housing + Transportation Index (local base)	3.7%
	Housing + Transportation Index (AMI base)	2.3%
	High Cost Loan Rate	3.8%
Housing Market	Foreclosure Rate	5.1%
	Vacant Units Abandoned	7.4%
Housing Policy	Housing Capacity per Acre	3.9%

Table 1c Social Capital Indicators

Subcategory	Indicator Title	Weight
N/A	Access to Combined Civic, Social, Community & Religious Organizations	8.8%
	Access to Public Institutions	7.2%
	Percent Population Aged 25 to 44	5.5%
	Racial Diversity Index	11.3%
	Percent Population Having High School Diploma or Greater	5.8%
	Percent Population Having Bachelor's Degree or Greater	10.2%
	Median Income	9.0%
	Percent of Households in Poverty	9.8%
	Labor Force Participation Rate - Ages 16-64	5.8%
	Percent of Labor Force Unemployed	7.4%
	Population Density	6.6%
	Percentage of Owner Occupied Housing Units	10.2%
	Percent Single Parent Households	2.6%

Table 1d Public Health and Safety Indicators

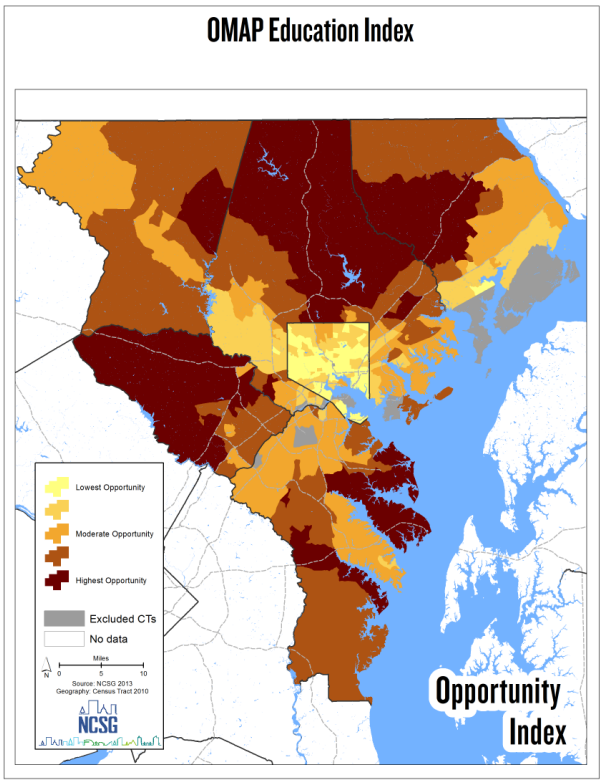
Subcategory	Indicator Title	Weight
Public Health	Cancer Risk	1.8%
	Neurological Disease Risk	2.4%
	Respiratory Disease Risk	5.3%
	Infant Mortality Rates	6.7%
	Teen Birth Rates	4.2%
	Percent of Births to Women Receiving Late or No Prenatal Care	2.6%
	Rate of Low Birth Weight	16.5%
	Access to Emergency Services	2.6%
	Emergency Services Coverage Areas	3.6%
	Access to Social Services	2.6%
	Access to Hospitals	2.9%
	Access to Freestanding Ambulatory Surgical and Emergency Centers	0.5%
	Access to All Other Outpatient Care Centers	2.4%
	Access to Food Swamps	6.5%
Environment	Percent of Watershed Fail in Nitrogen and/or Phosphorous	3.2%
	Access to Parks	11.1%
	Percent Park	5.1%
Crime	Crime Risk Index: Total Crime	20.0%

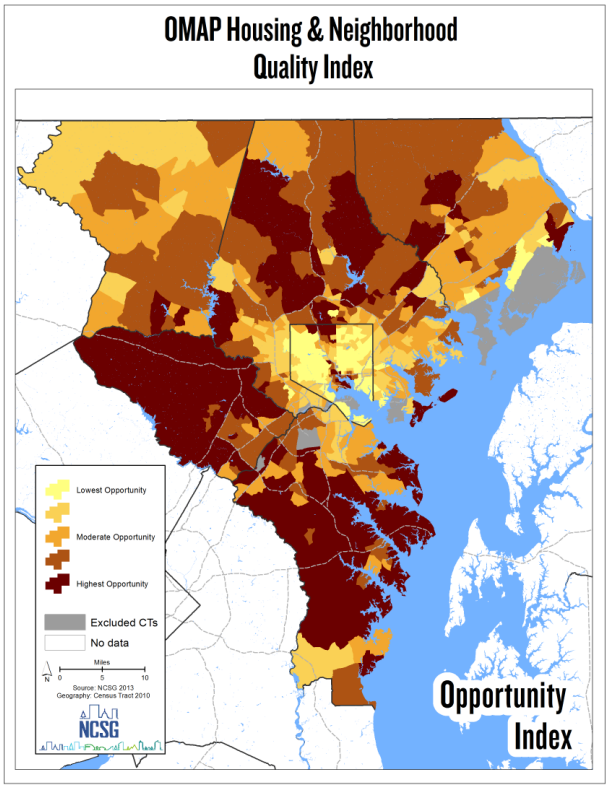
Table 1e Employment and Workforce Indicators

Subcategory	Indicator Title	Weight
Jobs	Total Job Density	10.0%
	Total Jobs Accessible by Auto	13.8%
	Total Jobs Accessible by Transit	16.3%
	Accessibility Gap between Transit and Auto	7.9%
	Percent Change in Total Jobs (2002-2010)	12.0%
Workforce	Low Skill Workers	3.0%
	Middle Skill Workers	3.0%
	High Skill Workers	3.0%
	Percent Low Skill Workers	7.6%
	Percent Middle Skill Workers	7.2%
	Percent High Skill Workers	6.7%
	Job Access Ratio	9.5%

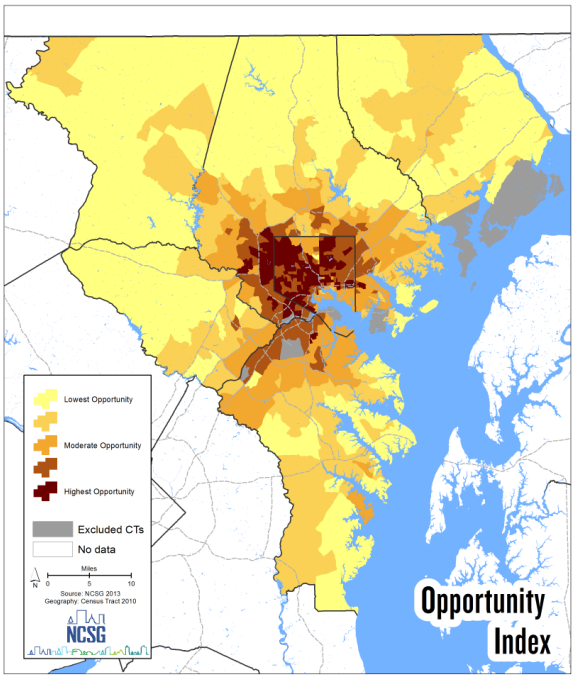
Table 1f Transportation and Mobility Indicators

Subcategory	Indicator Title	Weight
N/A	Travel Time Index	7.3%
	Driving Commuters: Percent Driving Less Than 30 Minutes	24.4%
	Commuters: Percent Taking Transit Less Than 45 Minutes	28.8%
	Transit Access (1/4 Buffer from Transit Stops)	10.7%
	Transit Connectivity Index	4.3%
	Walk Score	14.7%
	Transportation Trail Miles	1.3%
	Per Capita VMT for Home-Based Trips	0.9%
	Per Capita VHT for Home-Based Trips	7.7%

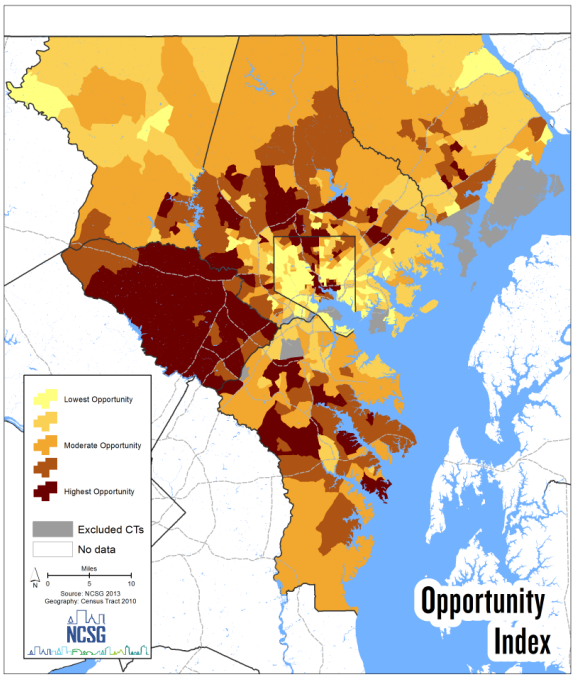

OMAP Education Index
Lowest Opportunity
Moderate Opportunity
Highest Opportunity
Excluded CTs
No data
Miles
0 5 10
Source: NCSG 2013
Geography: Census Tract 2010
NCSG
Opportunity Index


OMAP Housing & Neighborhood Quality Index
Lowest Opportunity
Moderate Opportunity
Highest Opportunity
Excluded CTs
No data
Miles
0 5 10
Source: NCSG 2013
Geography: Census Tract 2010
NCSG
Opportunity Index

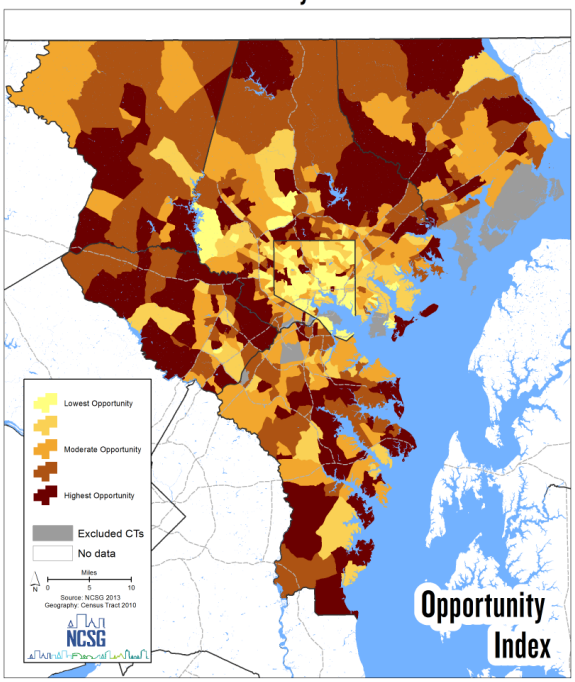
OMAP Employment & Workforce Index



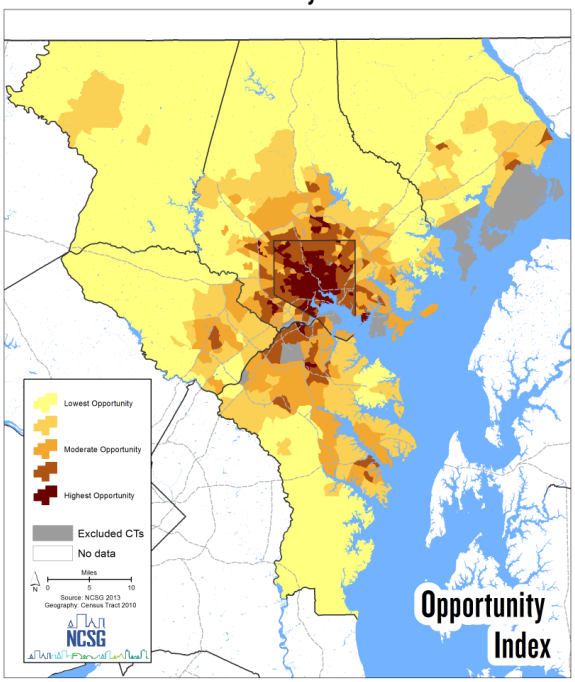
OMAP Social Capital Index



OMAP Public Health & Safety Index



OMAP Transportation & Mobility Index



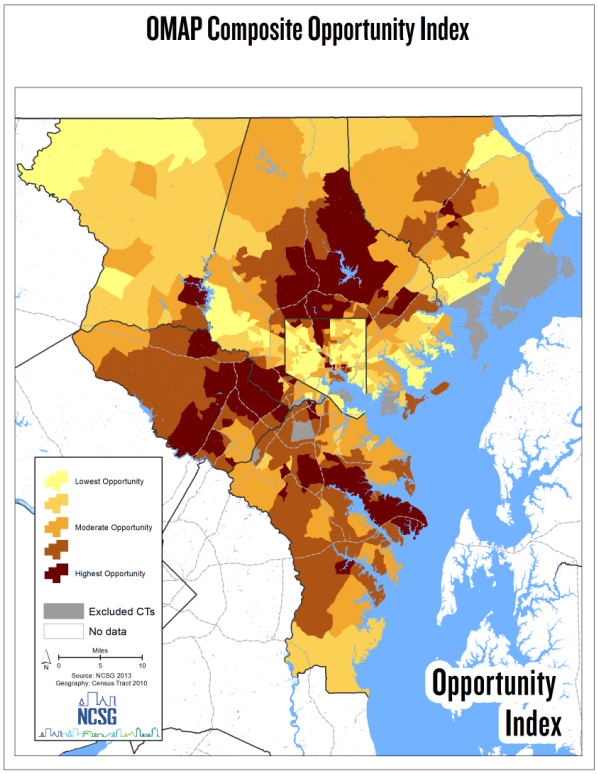


Figure 2a ---- Figure 2g OMAP Category maps and composite index map

Our analysis reveals that nearly 93 percent of Howard County's census tracts are classified as high or highest education opportunity, followed by Carroll, Anne Arundel, Harford, Baltimore, and Baltimore City. Placing the highest emphasis on home value, gross rent, and vacant abandoned units, the OMAP housing composite index, like the education index, results in the five counties all having an average tract percentile rank above 50 percent. Baltimore City's tracts rank the lowest whereas tracts in Howard County rank the highest. In the social capital category, the OMAP placed the highest weight on racial diversity, higher education levels and homeownership. As a result, there are higher opportunity tracts recognized in Baltimore than seen with education and housing. The OMAP placed the highest emphasis on crime, low birth weight and access to green space when constructing the public health and safety index. Therefore, the less urban Carroll County gets the highest rank tracts. The employment and workforce index created by the OMAP was heavily weight toward the supply and access to jobs. Job accessibility within a 45 minute transit commute, job accessibility within a 30 minutes auto commute, growth in jobs and total job density combined for over 52 percent of the index. Baltimore City is a stronghold of job opportunity and accessibility, which ranks the highest among all other counties. As regards for transportation and mobility index, the OMAP weighs heavily on transit and non-motorized mode. It includes measures of transit use, transit access, transit connectivity index, walk score, and transportation trail miles, which result in Baltimore City attaining the highest average tract score. Carroll County, with limited transit service, low walk scores, and longer commute times, ranks last at the 9th percentile. The final composite opportunity index map combines all the six category indices. This combination of 92 indicators across the six categories, has resulted in Howard County receiving the highest average score, followed by Anne Arundel, Baltimore, Harford, and Carroll Counties.

On September 3, 2013, BOC staff requested that we create a separate composite opportunity index map that would ideally incorporate about 30 indicators total from across the six categories of indicators. Drawing upon our knowledge of the determinants of opportunity, a review of what previous opportunity mapping efforts from across the country, and opinions and feedback we received through the OMAP process, we created an index that included 32 indicators. Table 2 below lists there indicators, which were all equally weight. The results of this index are similar to the composite index created by the OMAP (Figure 3).

Table 2 NCSG selected indicators

Category	Subcategory	Indicator Title
EDUCATION	Elementary School	Student Performance (Elementary School)
	Middle School	Student Performance (Middle School)
	High School	Student Performance (High School)
		High School Dropout
	Adult Workforce Development	Access to Work Force Investment Area Training Programs
HOUSING AND NEIGHBORHOOD QUALITY	Housing Burden/Affordability	High Cost Loan Rate
	Housing Market	Foreclosure Rate
		Vacant Units Abandoned
SOCIAL CAPITAL	N/A	Access to Combined Civic, Social, Community & Religious Organizations
		Percent Population Aged 25 to 44
		Racial Diversity Index
		Percent Population Having Bachelor's Degree or Greater
		Median Income
		Percent of Households in Poverty
		Percent of Labor Force Unemployed
		Population Density
		Percentage of Owner Occupied Housing Units
		Percent Single Parent Households
PUBLIC HEALTH AND SAFETY	Public Health	Infant Mortality Rates
		Teen Birth Rates
		Rate of Low Birth Weight
		Access to Hospitals
	Environment	Access to Parks
	Crime	Crime Risk Index: Total Crime
EMPLOYMENT AND WORKFORCE	Jobs	Total Jobs Accessible by Auto
		Total Jobs Accessible by Transit
		Accessibility Gap between Transit and Auto
		Change in Job Density (2002-2010)
	Workforce	Job Access Ratio
TRANSPORTATION AND MOBILITY	N/A	Transit Access (1/4 Buffer from Transit Stops)
		Transit Connectivity Index
		Walk Score

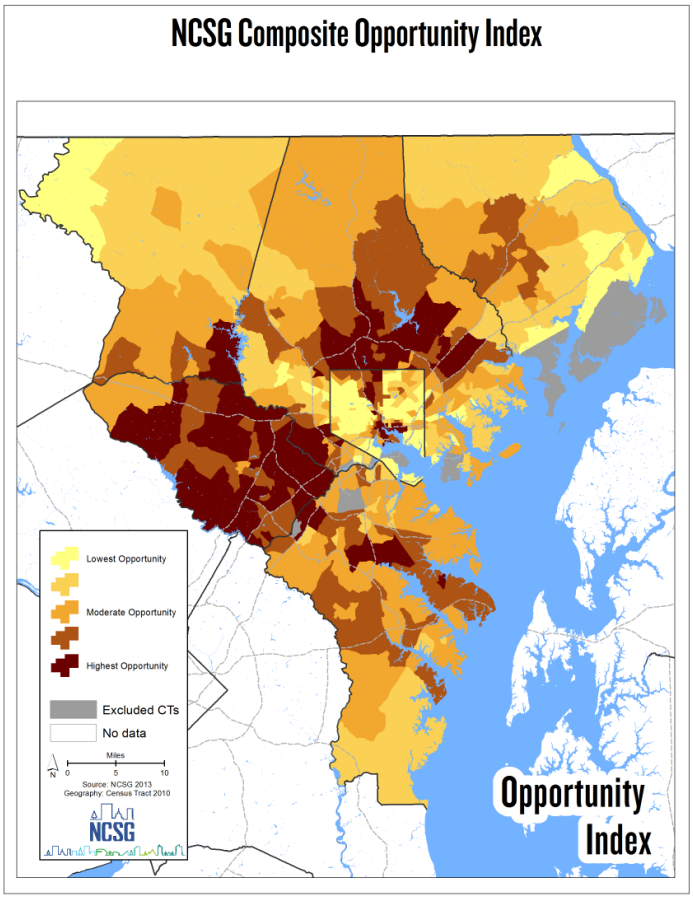


Figure 3 NCSG composite index map

V. Discussion on the Use and Misuse of Opportunity Mapping for Furthering Sustainable Communities

Opportunity mapping analyses can be used to significantly enhance regional sustainability planning efforts. Since its inception, the opportunity mapping has been used as a tool to promote equitable housing policies, and it remains an effective tool for doing so. Because the placement of affordable and public housing can be a contentious issue during the planning process, opportunity mapping can help ensure that such locational decisions are driven by data, and backed by research. Given the comprehensive nature of regional sustainability planning, though, it is important that opportunity mapping be understood as a tool to help guide additional policy instruments beyond housing. Certainly, understanding the regional opportunity disparities and the access to different opportunities is the crucial step to help BOC to connect housing, transportation, workforce development in the region.

In this paper, we examine the underlying concepts and common techniques employed by the Kirwan Institute Opportunity Mapping frameworks, identify areas for improvement and innovation, conduct an opportunity mapping analysis using advanced spatial analysis techniques and rich datasets and incorporate local input as a weighting approach to develop a composite opportunity index.

Over the course of developing the composite index of opportunity for the Baltimore region, we learn that this process requires the coordination and coalition of several diverse stakeholders with multiple interests, styles and agendas, all of whom must overcome individual differences to produce a successful outcome. Even though the opportunity mapping has been applied in many cases, this technique is still in adolescence, and requires serious forethought and considerable discussion when selecting the indictors of opportunity, how the indictors should be measured, what weights should be applied, and how the maps should be used.

Given the increasing policy relevance of opportunity mapping, we argue that several improvements should be urgently considered to assure opportunity mapping is used to its fullest potential.

The initial step in the process of opportunity mapping is indicator selection. An ideal indicator selection process begins with a series of engagements where local partners learn about opportunity mapping and its role in a strategy to effect community change. In our own experience, we found an advisory group of community stakeholders and subject exports was useful to create an iterative process where indicators could be refined, new indicators further identified, maps drafted and revised, and strategies for use crafted. Regardless of how indicators are selected, .openness and transparency about the reasons for their selection and weighting are paramount. Given the subjective nature of opportunity mapping and the vast number of decisions required to produce a composite index, the reasoning and justification behind each indicator should be We also found that opportunity indices often include multiple covariate indicators, effectively double – counting certain local factors. Initially, we decided to include all the selected indictors, and use the weights that were provided by the advisory group. However, based on the input of the advisory panel of OMAP, we found that in each category there were maps that nearly every OMAP member wanted to include in the composite map, but in every category there were also maps that only a few wanted to include. As a result, the recommend weights varied widely. The uneven weights obscure the specific indictors that contribute to a high or lows score of the composite indices. In addition, all the maps were displayed by using an “equal – count (quantile)” data classification scheme that classifies data into a certain number of categories with an equal number of units in each category. As the OMAP suggested, this approach is rather arbitrary since the data with extreme value skews the map display.

Another important part of the OMAP process is recognizing the limitations of the available datasets. Perfect data almost never exits at a neighborhood level for each county of a region. For example, we found that crime indicator is considered as one of the most important indicators for neighborhood safety. But after an extensive search of available data, given the time and cost of developing such datasets, we decided to use an imperfect crime data. Though care should be given to understanding caveats of the data, recognizing and accepting data shortcoming is part of the process of defining opportunity across the region.

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Appendix A OMAP Meeting Participants

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