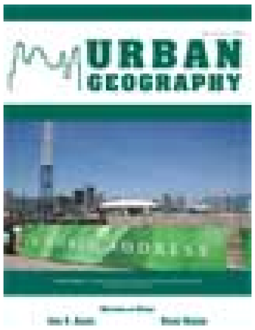

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Using suitability analysis to prioritize demolitions in a legacy city

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ABSTRACT

Abandoned properties are a significant problem facing legacy cities. Given historic and ongoing population losses, many legacy cities turn to demolitions as one solution to their surplus property problems. Unfortunately, cities lack the resources needed to demolish all of the buildings that should arguably come down. Determining which properties should receive highest priority is a difficult task. Therefore, this paper presents an empirical method, based on basic suitability analysis, for prioritizing demolitions city-wide. Using Youngstown, Ohio as an example, every vacant property in the city was assigned a demolition score based on four factors: property characteristics, vacancy, neighborhood potential, and crime. Properties with higher scores were deemed stronger candidates for timely demolition. In addition to prioritizing demolitions, the proposed method can facilitate the creation of hotspot maps of proposed demolitions, and a per se strategic demolition plan.

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Introduction

Legacy cities have experienced substantial job and population losses due to economic forces like deindustrialization (Mallach & Brachman, 2013; Schilling & Mallach, 2012). As a result, these cities face complex challenges (such as crime, high unemployment, and physical decay), that are exacerbated by decreased tax revenues and increased demand for services (Galster, 2012; Mallach & Brachman, 2013). Many vacant structures have fallen into various stages of disrepair in these cities, contributing to widespread urban blight.[1] Almost a quarter of the residential structures in Detroit are vacant for example (Detroit Works, 2012), and Detroit is not alone. The Legacy City Design Initiative (2015) identified 39 other legacy cities with vacancy rates of at least 10%. Given the scale of these challenges, some legacy cities, like Detroit and Flint, Michigan, have framework plans that identify low-demand neighborhoods for de-densification and naturalization (Detroit Works Project Steering Committee, 2012; Houseal Lavigne, 2013). The question is how to determine which properties to demolish, and in what order, given that the need for demolition exceeds available resources.

Demolitions are often necessary in legacy cities because of the sheer number of vacancies (Galster, 2012; Haase, Lautenbach, & Seppelt, 2010). While preservation and

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rehabilitation are certainly desirable, they are not feasible or even appropriate in every neighborhood, especially not in weak-market cities where vacant properties number in the thousands or tens of thousands (Mallach, 2012). Instead, preservation, rehabilitation, and demolition need to be targeted to specific neighborhoods or areas of the city based on sound planning principles. For example, a study of demolitions in Cleveland, Ohio from 2009 to 2013 found that demolitions increase real estate equity hedge, exceeding the cost of demolition. This increase was greatest in high and moderately functioning market areas (Griswold, Calnin, Schramm, Anselin, & Boehnlein, 2013). The same study found that demolitions decrease mortgage-foreclosure rates and may be a preventive measure for future mortgage foreclosures. Considering these potential benefits, deciding which properties to demolish should be carefully calculated.

Few American cities have derived empirical methods for determining which structures to demolish. To the author's knowledge, no study has compared the outcomes of different demolition approaches. As Johnson, Hollander, and Hallulli (2014) note:

> There are no clear principles in the literature on managing municipal decline regarding decision rules for implementing strategies, such as those that might specify most-desirable geographies within which growth should be concentrated, preferred alternative land uses, or thresholds of density below which alternative land uses should be considered (p.152).

While Johnson et al. (2014) made strides in this area, their study did not focus on demolition specifically. Instead, it focused on identifying neighborhoods for either smart growth or smart decline, with either strategy possibly involving demolition.

Because demolition is a tool that legacy cities are aggressively using (Mallach, 2012), the lack of studies on demolition decision-making represents a serious gap in the literature. If land use is within the purview of urban planners and demolition is necessary to bring about new land uses in legacy cities, then planners need to be concerned with the both the decision-making methods and outcomes of demolition. As legacy cities lack the resources to demolish all derelict structures contributing to blight, policy makers are forced to decide which structures to demolish now and which to demolish later—in some cases, years or decades later—depending on unknown future funding sources (Cohen, 2001; Mallach, 2012). Unfortunately, these decisions tend to be based on property-level conditions or political pressures alone (such as vocal neighbors or community groups) and not on city-wide planning principles or strategy (Cohen, 2001; Kidd, 2013; Skolnick, 2013; Van Allsburg, 1974).[2] The *ad hoc* approaches to demolition may be due to the aforementioned lack of research on strategic decision-making as applied to demolitions, or to a historic lack of demolition funding.

Notably, discussions about what to demolish are futile when no funding is present; but given that some cities have seen significant increases in demolition funding in recent years due to initiatives like the Neighborhood Stabilization Program (Joice, 2011) and Hardest Hit funds (Mallach, 2014), how to use demolition resources has become a more pressing concern. In fiscal year 2011 alone, a total of $74 million in Community Development Block Grant funds were spent on demolitions nationwide (Mallach, 2012). Given these large investments (and an even larger need), it is critical for funds to be used wisely. Therefore, to address gaps in the planning literature about what to demolish and why, this study demonstrates a method for prioritizing demolitions using data from Youngstown, Ohio.

Youngstown is one of America's fastest shrinking cities (Posey, 2013). The city's current population is about 65,000, down from a peak of 170,000 in 1930 (Posey, 2013; U.S. Census Bureau, 2013). This precipitous decline was largely due to the collapse of the city's steel industry and the movement of white, middle class families to the surrounding suburbs (Akpadock, 2012; Kidd, 2013; Swope, 2006). Accompanying this population loss are problems that commonly plague legacy cities, such as crime, concentrated poverty, an insufficient tax base, and physical decay (Galster, 2012; Oswalt, 2006; Schilling, 2002). Youngstown currently has about 4,500 vacant structures and 20,000 vacant, unimproved lots, making around 40% of the city vacant in some form (Kidd, 2013; Tavernise, 2010). In an aptly titled article, "Demolitions in Youngstown lacking one thing: Strategery," Kidd (2013) observes that Youngstown's approach to demolition is scattershot, complaint-driven, and arbitrary at best. The city would therefore benefit from a more strategic approach, both in terms of justifying decisions to residents, and (likely) in terms of actual outcomes.

While many legacy cities could have been selected for this paper, Youngstown holds a special place in the American city planning literature. The city became famous in planning circles when it created its "Youngstown 2010" comprehensive plan in the early 2000s (City of Youngstown, 2005). The Youngstown plan was the first American city plan to acknowledge decline, strategize with population loss in mind, and reconsider growth-based strategies meant to return the city to its heyday (Schilling & Logan, 2008; Swope, 2006). This plan contributed to a paradigm shift amongst planning practitioners and some academics, whereby we, as a profession, began to think about how to plan for (or in the face of) population loss, rather than always pursuing growth. Given its notoriety and classic legacy-city characteristics, Youngstown offered a good test-case for demonstrating a strategic demolition model.

ArcGIS10.2 was used to create a model that assigns every vacant property in the city a demolition score between 0 and 1000. The model was based on basic suitability analysis from the field of geography, with the goal being to identify the properties most suitable for demolition. [For a historical overview of suitability analysis, see Malczewski (2004), or Collins, Steiner, and Rushman (2001)]. Each variable or factor (which appears as a layer or overlay in ArcGIS) was assigned a score and weighted based on importance. At the end of the analysis, the scores for each factor were summed, with higher overall scores indicating stronger candidates for timely demolition. The scores in this paper were based on four factors: vacancy, property characteristics, neighborhood potential, and crime. The factors were assigned equal weights of 0.25 (25% of the final score); however, measures within each factor were assigned varying weights based upon their importance in the existing literature. The model is described in greater detail in the next section "Model and factors," which explains the theory behind the factors, their measures, and their weights. Table 1 summarizes these details and associated equations.

Model and factors

Vacancy

Given the large number of vacant properties in legacy cities, vacancy at both the house and neighborhood levels are important considerations when deciding which properties

Table 1. Factors and variables included in the demolition priority model.

Factor	Variable	Description	Measure	Weight
Vacancy	Parcel-level vacancy	Whether a property is vacant	Occupied properties = 0	*Not applicable*. Properties that are not vacant were removed.
Vacancy	Neighborhood-level vacancy	A relative measure of concentrations of vacancy (both land and structures) at the neighborhood level	[Number of vacant properties within 1320 feet/the highest number of vacant properties (within 1320 feet of a property) that occurs in the dataset] × 1000	0.25
Property characteristics	Property conditions	Whether a property was in poor condition as of 2010	Poor condition = 1000 All others = 0	0.20
Property characteristics	Visibility	Whether a property is located along a major corridor	Visible = 1000 Not visible = 0	0.05
Neighborhood potential	Civic assets	Distance from a civic asset	(Distance from nearest asset up to 1320 feet/1320 feet) × 1000	0.10
Neighborhood potential	Neighborhood associations	Distance from the centroid of a neighborhood association	(Distance from centroid of association's boundaries up to 1320 feet/1320 feet) × 1000	0.05
Neighborhood potential	Neighborhood Property conditions	A relative measure of nearby property conditions as of 2010	[Number of properties in poor condition within 1320 feet/the highest number of properties in poor condition (within 1320 feet of a property) that occurs in the dataset] × 1000	0.05
Neighborhood potential	External funding	A relative measure of external investment in the neighborhood from 2009 to 2014	(Number of programs funded in the census tract/the highest number of programs funded that occurs in the dataset) × 1000	0.05
Crime	Property and personal crimes in 2014	A relative measure of criminal activity in the neighborhood for the year 2014	[Number of crimes within 1320 feet/the highest number of crimes (within 1320 feet of a property) that occurs in the dataset] × 1000	0.15
Crime	Property and personal crimes in 2013	A relative measure of criminal activity in the neighborhood for the year 2013	[Number of crimes within 1320 feet/the highest number of crimes (within 1320 feet of a property) that occurs in the dataset] × 1000	0.07
Crime	Property and personal crimes in 2012	A relative measure of criminal activity in the neighborhood for the year 2012	[Number of crimes within 1320 feet/the highest number of crimes (within 1320 feet of a property) that occurs in the dataset] × 1000	0.03

to demolish. While some studies have pointed to the importance of market conditions (Mallach, 2012; Morckel, 2013), this model prioritizes vacancy over market conditions for two reasons. First, there is little variation in market conditions in the city of Youngstown; it is a weak-market city located in a weak-market region (Mallach, 2012b). Second, the vacancy status of neighborhoods is already an indicator of market conditions. If there was sufficient housing demand, there would be far less vacancy. For legacy cities with greater variation in market conditions, especially those with high demand or gentrifying neighborhoods, it would be prudent to include additional market indicators in the model.

Unfortunately, good information on vacancy is difficult to obtain. Morckel (2014a) discusses various operational definitions of housing abandonment (i.e., extended or permanent vacancy) and concludes that it is best to collect this information by foot- or windshield-survey if the intent is to identify properties that are "eyesores" in the community. The most recent foot survey for Youngstown was conducted in 2012; therefore, the 2012 vacancy dataset was updated by adding 2014 vacancies identified by the United States Postal Service (USPS) and removing those properties that were demolished from 2012 through 2014. Although the USPS data could have been used independently, both datasets were considered since there are variations in the reporting of "no stat"' addresses in the USPS database, including properties that are severely dilapidated (Institute for Housing Studies, 2013).

Occupied properties were assigned scores of zero in this model. Prioritizing occupied properties for demolition makes little sense when there are thousands of vacant ones to choose from, not to mention that acquisition through processes like eminent domain can be arduous, expensive, and politically unsettling (Hollander & Nemeth, 2011). While there may be situations where a legacy city wants to demolish an occupied property—say, if the property is the only one standing for blocks or miles around—the author believes that these cases are relatively rare and warrant a different set of decision-making criteria than the one outlined in this paper.

Vacancy at the neighborhood level is included in the model by considering the number of vacant, unoccupied structures and vacant, unimproved lots located within a neighborhood. In this case—and throughout the paper unless otherwise noted—a neighborhood is operationally defined as a quarter-mile radius around a property of interest, since a quarter-mile (1320 feet) is commonly used to describe a walkable neighborhood from center to edge (Duany & Plater-Zyberk, 1994). To obtain neighborhood vacancy information, three datasets were combined: the aforementioned vacant property dataset; a dataset on demolitions completed since 2005 (because demolitions typically result in long-term vacant lots); and a parcel database that contains land use codes for vacant land.

Once the number of vacant properties has been determined, the neighborhood vacancy subscore is assigned. (This is the score on the neighborhood vacancy measure from 0–1000, which is weighted at 0.25 in the model.) The subscore indicates how a neighborhood of interest performs relative to other neighborhoods in the city. Given the large number of vacant properties in Youngstown compared with its small size (over 24,000 vacant or unimproved properties across 34 square miles), it is not reasonable to use a straight-line distance measure such as "feet from the nearest vacant property," since there would be little variability in the resulting scores. Considering the number of vacant properties within a set radius allows the model to account for concentrations of vacancy, which would not be possible using straight-line distance.

In this model, properties located in low vacancy neighborhoods are assigned low demolition scores, while properties located in high vacancy neighborhoods are assigned high demolition scores. The theory is that structures should be preserved in neighborhoods that are mostly physically intact and occupied. These structures may be suitable for rehabilitation or mothballing rather than demolition, for demolition has the potential to give a neighborhood a "snaggletooth" appearance, which compromises the neighborhood's character and texture (Cohen, 2001; Mallach, 2012). Conversely, in high vacancy neighborhoods with a history of demolition, additional demolition has the potential to create contiguous green spaces that allow for "right-sizing" efforts. In a report that offered a policy framework for addressing vacancy in the Youngstown region, Kildee, Logan, Mallach, and Schilling (2009) stated that

> …right-sizing means developing a holistic and equitable process for stabilizing the most dysfunctional markets and distressed neighborhoods by adjusting the amount of land available for development; this process more closely aligns the built environment of a city with the needs of its existing and foreseeable future population (p. 7).

Examples of right-sizing strategies include de-annexing surplus land to adjacent municipalities, reorganizing or eliminating some city services in selected areas to provide better services to more populated areas, and establishing policies that discourage new development in sparsely populated parts of the city (Johnson et al., 2014; Popper & Popper, 2002; Rybcznski & Linneman, 1999; Schilling & Logan, 2008). Ecological and economic benefits from right-sizing may include new active or passive green space, the restoration of wetlands and other natural habitats, the emergence of urban agriculture and land-intensive green industries, and "green collar jobs" involving the deconstruction and recycling of materials from abandoned buildings (Houseal Lavigne Associates. City of Flint, Michigan, 2013; Schilling, 2008; Schilling & Logan, 2008; Swope, 2006). Cities that are losing population are changing in physical density as properties are demolished and vacant lots slowly return to nature. Rather than view this process of ecological succession negatively, it can be positive if it results in urban wildness and opportunities for restructuring the city (Desimini, 2014).

The City of Philadelphia adopted a policy that aligns with the aforementioned theory by focusing the resources of its Neighborhood Transformation Initiative (including demolition funding) on their most distressed neighborhoods (Beauregard, 2013). The opposite approach is being used in Detroit, where demolitions are targeted for intact neighborhoods in order to reduce the negative spillover effects that abandoned properties have on neighborhoods (Nassauer & Raskin, 2014; Wilkinson, 2015). While there is little doubt that vacant properties have spillover effects, the factors that influence abandonment in intact, stable neighborhoods may not be the same factors that influence abandonment in distressed neighborhoods. In a study of Columbus, Ohio, Morckel (2015) found that the predictors of abandonment in stable neighborhoods have more to do with the characteristics of a given house than with the characteristics of the surrounding neighborhood. The opposite was true in more distressed neighborhoods. Assuming these findings are generalizable, demolishing properties in intact neighborhoods may do little to prevent other property owners in the neighborhood from abandoning since the decision to abandon is not primarily about the neighborhood. In the present paper and in Morckel (2015), terms like "distressed" and "high vacancy" are not operationally defined since scores are relative to one another. What constitutes high vacancy in one neighborhood or city might not be considered high vacancy in another. Even so, there is not enough research to date to determine which approach is most effective (i.e., the author's or Detroit's). Perhaps the relationship between neighborhood vacancy and demolition prioritization should be modeled by combining the two theories—resulting in a U-shaped relationship where demolitions are prioritized in areas of very high and very low vacancy, over all other areas.

Property characteristics

This study includes two property characteristics: property conditions and visibility. Property conditions are weighted heavily in the model, representing 0.20, or 20%, of the overall demolition score. If a property is in poor condition, the cost to rehabilitate it —or to just bring it up to code—may very well exceed its worth (Ford et al., 2013). After all, the median price per square foot for homes in the city of Youngstown was only $23 as of January 2015 (Zillow.com). With little likelihood of return on investment, few people will be willing to acquire and improve these properties (Ford et al., 2013). Consequently, demolition may be the only viable option, as these properties are likely to remain vacant for the foreseeable future. Blighted structures that pose health and safety hazards are often automatically targeted for demolition through a city's code enforcement procedures (Schilling, 2009). By removing these and other derelict structures, the quality of neighborhoods presumably improves.

Data on Youngstown property conditions were obtained from a 2010 property survey conducted by the Mahoning Valley Organizing Collaborative. In 2010, all properties in the city were rated on a scale from A-F, with A indicating good condition and F dilapidation. Because this dataset was old, the author chose to dichotomize the data rather than assign separate values for each rating. Thus, every property was assigned a value of 1000 (poor condition, rated D or F in 2010) or a value of 0 (all others), under the assumption that if a property was in poor condition in 2010, it is probably still in poor condition today given the lack of investment and housing demand in the city. With updated data, a more nuanced approach should be used, with different values assigned for different conditions (e.g., a value of 0 for A, 250 for B, 500 for C, and so forth). More detailed measures of property conditions could be included if the data were available. For example, scores could be assigned based upon whether a property's roof is in poor condition or foundation is unstable. Scores could also be assigned based upon missing features like windows, plumbing, wiring, and water heaters, which indicate criminal activity. Community organizations (such as churches and block watch groups) could be recruited to assist with property surveying efforts, provided that the conditions of interest are measurable from the sidewalk or other public space. Code enforcement officials could also conduct inspections—and have more legal backing to be physically present on vacant properties than community groups—although legacy cities' code enforcement offices tend to have limited capacity due to budgetary constraints (Schilling, 2009).

Even if external subsidies or grants supported rehabilitation, rehabilitating derelict houses may perpetuate vacancy by keeping the supply of houses higher than demand. If few outside residents move into the city, investment in rehabilitation may only serve to shift existing residents—and the vacancy problem—from one house or neighborhood to another, rather than prevent overall vacancy. This is not to say that no structures should be rehabilitated or newly built in legacy cities, for certainly residents deserve quality housing. However, the decision on whether to renovate or demolish must be carefully considered from a spatial perspective. Policy makers need to recognize that the people who move into newly rehabilitated homes came from somewhere—often another neighborhood in the city where the vacancy problem has presumably gotten worse. There is a natural flow of residents from bad housing to good, as older structures fall into disrepair and are unable to compete with newer homes. This idea is consistent with neighborhood life-cycle theory (Metzger, 2000) and the theory of housing filtering (Bier, 2001).

The second property characteristic included in the model is visibility, which was weighted at 0.05. In theory, highly visible vacant structures are a greater detriment to a city's image than less visible vacant structures (Morrison & Dewar, 2012). If thousands of people, particularly non-residents, drive by vacant properties on their way to work or to school, for example, these highly visible properties likely damage the city's image more so than similar properties hidden within residential neighborhoods. Thus, it makes sense to prioritize demolition of vacant properties that large numbers of people see on a daily basis. These strategic demolitions should bolster a city's image, change visitors' perceptions, and improve peoples' general sense of safety. To prioritize highly visible vacancies, Morrison and Dewar (2012) suggest that planners borrow site selection techniques from billboard companies (e.g., traffic counts). In the current study, a visible property was operationally defined as a property located along a primary or secondary road, defined by the census bureau in its TIGER/Line files. Vacant properties within 50 feet of these roads were assigned a value of 1000, while all other properties were assigned a value of 0. Again, a more nuanced approach would be possible with better data. For example, demolishing a structure along a major traffic corridor may reveal vacant properties in the residential neighborhood located beyond. This possibility was not addressed by the model used in this present study. Although only two property characteristics were considered in this study (property condition and visibility), additional variables like age, historic character, and land use could be included. Age was not considered here because the author believes that property conditions are more important than age. Older structures may be in good condition because they were well built and then well maintained over the years; whereas newer structures, especially those mass-produced, may be in poor condition due to cheap construction and poor maintenance. Regarding the historic character of vacant structures, this type of information was not included in the current study because it was not readily available. With additional resources, cities like Youngstown could rate every property for historic architectural features and include this information in the prioritization model. Practically speaking, these efforts could focus on select areas of the city since many houses in post-industrial cities were quickly built for factory-workers in the early twentieth century and, therefore, do not possess distinguished architectural characteristics (Morrison & Dewar, 2012). Finally, land use could also be included in a prioritization model, where demolition of vacant, commercial, or industrial structures could be prioritized over other uses. The present model does not assign different scores for different land uses, since it is not clear from the literature how various uses should be prioritized. There are very few studies of abandonment that consider uses other than housing (Park & von Rabenau, 2015).

Neighborhood potential

Neighborhood potential is the third factor included in the current model. It has four measures: civic assets, community associations, neighborhood property conditions, and external funding. Population change, another indicator of neighborhood potential, was not included as a separate measure because vacancy and population change strongly correlate. Neighborhood potential is included here to improve upon current demolition approaches which, as Hackworth (working paper, 2015) notes, do not determine which neighborhoods can be saved with investment, but instead function to exterminate "already-mortally-wounded neighborhoods" (p. 23).

Civic assets

Since the mid-2000s, community development has shifted from a needs-based approach that emphasized deficiencies, to an assets-based approach that emphasizes existing assets to promote economic development and a better quality of life for residents (Mathie & Cunningham, 2003). Given their former wealth and populations, legacy cities often house significant assets not typically found in newer cities of comparable size. Although Youngstown only has a population of 65,000 (U.S. Census Bureau, Population Division, 2013), it is home to a major university, regional hospitals, a symphony orchestra, and historic performance venues. These assets, and others, can be leveraged to create positive community change (Center for Community Progress, 2013; Mallach & Brachman, 2013). Anchor institutions like universities and medical centers are particularly noteworthy since they represent "sticky capital" and have a stabilizing effect on their surroundings, especially as they invest in the community and physically expand (Center for Community Progress: Turning Vacant Spaces into Vibrant Places, 2013). These institutions predictably draw people from the surrounding region and represent assets that can be capitalized upon (Morrison & Dewar, 2012).

The current model focuses on physical, institutional, and economic assets, since social assets are more mobile and difficult to measure. Assets were operationally defined by the Youngstown State University Center for Urban and Regional Studies, which was the source of the asset data for this study. These assets include cultural points of interest, schools, government buildings, hospitals, museums, shopping centers, and universities. While some of these assets are probably more important to community development than others, the present model does not delineate amongst them. A more detailed analysis could provide different weights for each type of asset based on size, location, taxable value, ability to attract visitors, or any other variable deemed important by local policy makers. Nonetheless, given the strong evidence that these types of assets increase a neighborhood's stability and potential to rebound (The American Assembly, 2011), this measure was assigned a weight of 0.10, with higher demolition scores assigned to properties located farther from these assets.

Neighborhood associations

Another measure of neighborhood potential was the distance from the centroid of a neighborhood association, including block watch groups. Scheller (2015) characterized neighborhood associations as voluntary, grassroots efforts that provide services like social functions, beautification efforts, limited city services, and code enforcement. The presence of a neighborhood association is an indicator that residents care about and are invested in their neighborhoods—enough so to organize to reduce physical manifestations of disorder and to improve social conditions (Perkins, Florin, Rich, Wandersman, & Chavis, 1990). Hur and Bollinger (2015) found that neighborhood associations impact overall neighborhood satisfaction by improving four factors: sense of community, communication and activity, physical environmental character, and crime/racial/homeownership character (a grouped measure of residents' perceptions of subjective ratings of neighborhood crime, racial, and owner-to-renter characteristics). Bennett, Holloway, and Farrington (2006) conducted a meta-analysis of neighborhood block watch studies and found that the majority of studies (15 out of 18) provided evidence that neighborhood watches reduce crime. Therefore, community associations are included as a measure of neighborhood potential since neighborhoods with associations are more likely to stabilize and attract future residents than neighborhoods without. This item was weighted at 0.05 and adjusted based on distance from the centroid to reflect the fact that properties located near the center of an association's geographic scope stand to benefit from the association more so than properties located on the fringe. This method is better than dichotomizing the data (assigning a score of 0 if a property is within an association's boundary and a score of 1000 if a property is not) because neighborhood associations may have positive spillover effects beyond their formal boundaries. Additionally, accounting for distance allows for greater variability in the scores, which is necessary for prioritization.

Neighborhood property conditions

The third measure of neighborhood potential is *neighborhood* property conditions, which is distinguished from *individual, property-level* conditions (a characteristic previously discussed) as it is a measure of nearby property conditions. It is important to consider both scales (individual and surrounding area) because predictors of abandonment have different effects at different scales (Morckel, 2015). Practically speaking, even if a vacant property is in good condition, if it is surrounded by properties that are in poor condition and located in a low or no demand neighborhood, demolition may be the best strategy based on right-sizing as well as potential—since it would take tremendous investment to stabilize the neighborhood as a whole. As Van Allsburg (1974) recognized forty years ago, "…some neighborhoods have little future and should not be preserved. There is no social utility to allocating scarce investment resources to neighborhoods filled with shoddy housing" (p. 877). Therefore, the current model ranks properties based upon the number of poor condition properties located within a quarter-mile radius. This item was weighted at 0.05.

External funding

External funding is the final measure of neighborhood potential used in the model. Neighborhoods that receive more external support have greater potential to rebound

(Morckel, 2014b). The Youngstown Neighborhood Development Corporation provided information on census tracts that received federal funds in 2014 and local grants between 2009 and 2014. In all, these funds spanned 17 different programs. Ideally, demolition subscores would be based on the dollar amounts allocated to each tract. However, because this information was not available, scores were based on the number of programs that had been funded in each tract. Beauregard (2013) supports this notion: "…as a neighborhood devolves, the complexity of its problems demand more programs, not just programs of a particular size… The city government must match the complexity of the problem with an equally complex array of interventions" (p. 231). The model implies that neighborhoods already receiving support through multiple programs should receive additional priority for demolitions to support existing revitalization efforts. However, one could conversely argue that these neighborhoods should be targeted for rehabilitation instead of demolition, due to their aforementioned potential. The direction of the variable (whether neighborhoods experiencing investment should be prioritized or not) could be determined by residents who live in the neighborhood of interest. If residents prefer rehabilitation over demolition and the market dynamics make rehabilitation feasible, then that strategy can be used. If the effectiveness of the various programs were known, it would be possible to weight census tracts based on the type of program, as well. Here, all programs were aggregated since determining the relative effectiveness of 17 programs was beyond the scope of this study. Like the last two measures, this item was weighted at 0.05.

Crime

The final factor considered in the model is crime because vacant buildings can encourage, harbor, and facilitate crime (Cui & Walsh, 2015; Schilling, 2008; Spelman, 1993; Van Allsburg, 1974). The broken windows theory by Wilson and Kelling (1982) posits that unmaintained or vandalized properties—such as properties with broken windows—signal that no-one cares, thereby encouraging unlawful behavior. In a more recent study, Keizer, Lindenberg, and Steg (2008) found that "…when people observe that others violated a certain social norm or legitimate rule, they are more likely to violate other norms or rules, which causes disorder to spread" (p. 1681). With these concerns in mind, residents and public administrators advocate for demolition as a means of eliminating or preventing crime (Adomaitis, 2015; Nassauer & Raskin, 2014), since demolitions eliminate the visual cues of disorder, particularly if the resulting vacant lots are greened and well-maintained (Branas et al., 2011). However, despite the correlation between vacancy and criminal activity, it is not entirely clear whether demolition eliminates or prevents crime, or merely serves to shift it. In a study of the effects of Buffalo's 5 in 5 demolition plan, Frazier, Bagchi-Sen, and Knight (2013) found that demolitions lowered crime in target neighborhoods but did not lower crime city-wide. Instead, crime was displaced to other areas. However, Frazier et al. only examined three types of crime—assault, drug arrests, and prostitution—so it is unclear whether their results would hold for other types of crimes, particularly property crimes. Despite the findings of Frazier et al. (2013), criminal activity was still included in the current model since many municipalities continue to use demolition as a tool to either eliminate or prevent crime. If additional studies confirm and expand upon Frazier et al. (2013), then a different approach may be warranted.

From a measurement perspective, the current model included the number of crimes occurring within a quarter-mile radius of each property of interest for the years 2012 through 2014. To account for the possibility that criminal activity may relocate over time, recent crimes were weighted more heavily than older crimes, with 2014 crimes weighted at 0.15, year 2013 crimes at 0.07, and year 2012 crimes at 0.03. Similar to the method for weighting neighborhood vacancy, the number of crimes occurring within a set radius of the subject property was used to capture potential concentrations of criminal activity occurring around—or perhaps because of—the problem property. Here, criminal activity is broadly defined to include all crimes for which data was available: arson of structures and cars, littering/dumping, stripping of a house (typically removing aluminum siding or copper wiring), narcotics arrests, trespassing, red flags (i.e., properties flagged for unsuitable living conditions), breaking and entering, burglary, car arsons, robbery, attempted robbery, theft, assault, kidnapping or abduction, homicide, prowling (if arrested), and rape. With additional research on the relationship between demolition and crime, different weights could be assigned to different types of crime.

Table 1 provides a summary of the factors and variables presented in this section. It also includes the equations that were used to derive the demolition subscores and overall score. Each subscore (a value between 0 and 1000) was multiplied by the respective weight; all weighted subscores were then summed to achieve the overall demolition priority score between 0 and 1000.

Results and applications

The suggested model generates a prioritized list of vacant structures recommended for demolition. The model should be rerun regularly, preferably annually, since most of the calculations that comprise the model compare properties relative to one another, and new vacancies are likely to continue to come online into the foreseeable future. To uphold the fidelity of the model, cities must maintain current data that can be used to update the list of vacant structures.

To illustrate the results of using the model, Table 2 highlights the characteristics of the first 10 properties the model selected for the city of Youngstown. The table shows that all of the properties are in poor condition, more than a quarter-mile from a civic asset, and far from the centroid of a neighborhood association. All of the properties are located in neighborhoods with moderate levels of vacancy, poor property conditions, and crime. Figure 1 shows the locations of the priority properties. All ten are located on the south side of the city, two along a major corridor (Market Street), and seven along Hillman Street. It is not surprising to see the properties in close proximity to one another, given that the model accounts heavily for neighborhood factors and distance. The model has utility beyond creating a prioritized list. All of the demolition priority scores can be mapped to indicate areas where demolition need is greatest. Moreover, a hot spot analysis can be conducted to detect statistically significant concentrations of potential demolitions. To demonstrate this point, a global Moran's *I* statistic was run on the Youngstown dataset to determine whether spatial dependence existed in the

Table 2. Top 10 priority demolitions for Youngstown, Ohio.

Address	Property type	Neighborhood-level vacancy [0.25]	Property conditions [0.20]	Visibility [0.05]	Civic assets [0.10]	Neighborhood associations [0.05]	Neighborhood property conditions [0.05]	External funding [0.05]	Crime 2012 [0.03]	Crime 2013 [0.07]	Crime 2014	Demo score
Points possible for subscore		***250***	***200***	***50***	***100***	***50***	***50***	***50***	***30***	***70***	***150***	***1000***
3324 Hillman St.	1-family dwelling	62.58	200	0	100	50	33.34	44.44	14.37	49.02	65.98	619.73
3517 Market St.	Dwelling used as an office	61.55	200	50	100	50	30.84	11.11	13.89	38.73	61.38	617.50
3410 Hillman St.	1-family dwelling	63.63	200	0	100	50	30.41	44.44	14.13	48.41	65.60	616.62
3505 Hillman St.	Small retain structure	61.73	200	0	100	50	28.75	44.44	13.5	42.77	64.83	606.02
3304 Hillman St.	1-family dwelling	64.15	200	0	100	48.71	36.25	44.44	12.47	44.78	52.56	603.36
3224 Hillman St.	2-family dwelling	64.65	200	0	100	48.22	37.09	44.44	12.63	44.58	50.26	601.87
3502 Hillman St.	Small retail structure	59.3	200	0	100	50	26.66	44.44	12.87	41.56	64.83	599.66
3031 Market St.	Medical office	71.9	200	50	100	50	39.16	11.11	9.55	30.26	33.38	595.36
3317 Idlewood Ave.	1-family dwelling	63.28	200	0	100	43.11	33.75	44.44	12.16	43.78	53.71	594.23
3120 Hillman St.	1-family dwelling	62.58	200	0	100	48.41	38.34	44.44	12.63	39.74	46.42	592.56

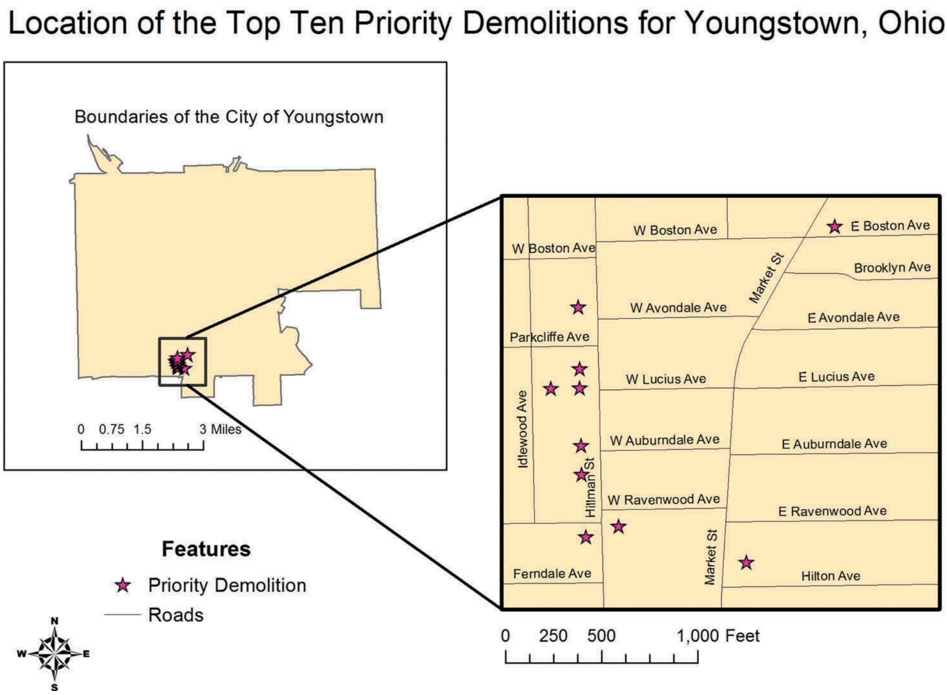

Figure 1. Location of the top ten priority demolitions for Youngstown, Ohio.

demolition priority scores.[3] A global Moran's *I* statistic measures the average correlation of an observation with its neighbors (Ward & Gleditsch, 2008). Here, Moran's $I = 0.079$ ($p < 0.001$), indicating that (i) similar demolition scores are located near one another, and (ii) this spatial distribution is unlikely to be due to chance.

Moran's *I* is a global statistic that captures the *extent* of overall clustering in a dataset. If policy makers want to know the *locations* of specific clusters of potential demolitions within their community, a local statistic must be used. In this case, the author used a local indicator of spatial autocorrelation (i.e., the Getis-Ord Gi* statistic within ArcGIS10.2). Given a set of weighted data points, this statistic processes every feature within the context of its neighborhood features to determine whether or not it is part of a statistically significant spatial cluster. The output is a *z* score for each feature, which represents the statistical significance of clustering or dispersion for a specified distance (ESRI, 2009). Here, a distance of one quarter-mile was used because this distance was adopted throughout the model creation process. For additional information about spatial statistical methods, see Getis (2010) or Ward and Gleditsch (2008).

The results of the Getis-Ord Gi* statistic are shown in Figure 2 below. Based on Figure 2 results, any future initiatives that provide demolition funding but restrict that funding to select Youngstown neighborhoods should focus on the neighborhoods shown in red (i.e., neighborhoods in the south central and north central parts of the city). Using this approach, property-level data can inform neighborhood selection, which then determines which properties are to be demolished.

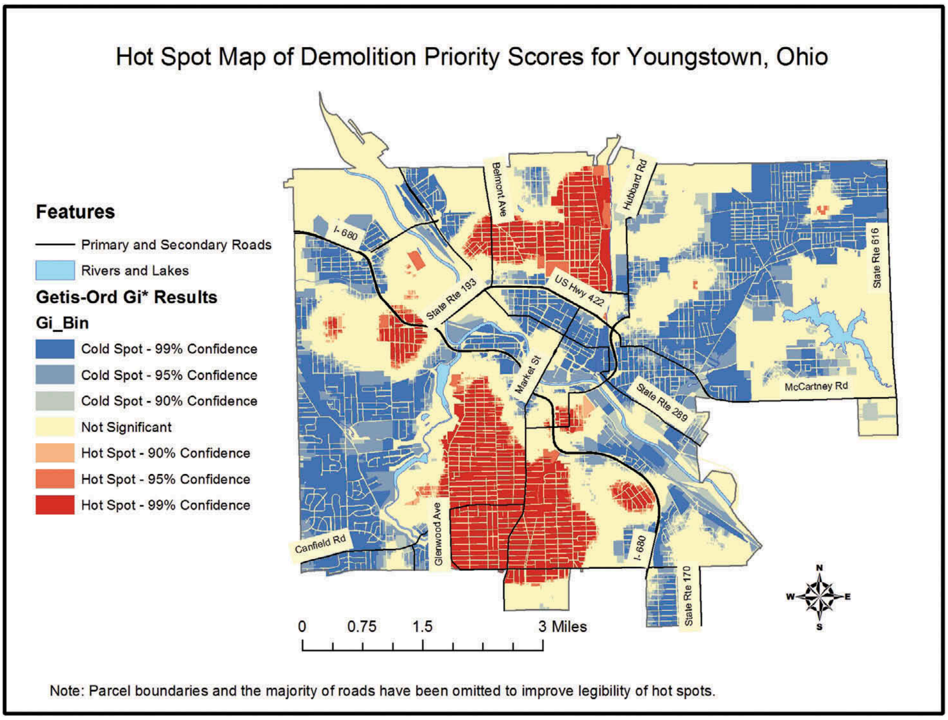

Figure 2. Hot spot map of demolition priority scores for Youngstown, Ohio.

Another potential outcome of using a formal strategy to prioritize demolitions is the opportunity to create a *per se* strategic demolition plan. It is not unusual to find city plans dedicated to specific issues (e.g., transportation plans, parks and open space plans, historic preservation plans). Since vacancy is a critical issue facing legacy cities, it is logical and necessary for these cities to create vacant property action plans or strategic demolition plans (Mallach, 2012; Schilling, 2009). Creating these plans can mirror traditional planning processes. Suggested steps are outlined in Table 3. The reader should note that the proposed process emphasizes data-driven decision making, significant public participation, and frequent updates to the plan. Although these components represent good planning principles in general, they are especially important in the demolition planning process. To alleviate concerns about a possible return to urban renewal, policy makers can emphasize that the proposed model does not prioritize neighborhoods based upon racial makeup, nor does it consider occupied properties for demolition.

Discussion

Ideally, demolitions would be scheduled in the order in which they appear on the priority list. However, this may not always be feasible. Demolition funding may be limited to certain geographic areas based on conditions established by the funding source. In such cases, the properties on the list that are eligible under a particular program can be selected in the order in which they appear. Moreover, the model does

Table 3. Ten basic steps to a strategic demolition plan.

1	Define the problem. Gather recent data on vacancy, demolitions, funding, and other relevant variables
2	Host public forums to present the data, discuss the problem, and brainstorm potential solutions
3	With additional public input, create a vision, goals, and objectives for the demolition program
4	With the objectives in mind, determine a method for prioritizing which properties to demolish. In other words, finalize the input variables and weights to be used in a model like the one presented in this paper
5	Present the model for public feedback. When necessary, revise the model, incorporating the feedback
6	Discuss implementation possibilities with city staff and other, relevant stakeholders (This step could also be conducted at the data gathering stage)
7	Draft the demolition plan. The plan should include the vision, goals, and objectives; a discussion of the public participation process; the demolition model itself (variables and weights); an implementation schedule; and a section that discusses the process for plan revisions, updates, and exceptions. The prioritized list can be an appendix to the plan that is updated annually
8	Present the draft plan for public comment and input. If significant concerns arise, rewrite the appropriate section (s) of the plan and/or create additional public forums to explain the plan
9	Codify the plan. Seek the approval of city council, the planning commission, and/or other relevant parties
10	Revisit the plan at the specified time. Gather new data to assess the extent of implementation. Determine which objectives were and were not met and why. With this information in mind, conduct plan revisions and updates, following the steps above

not account for emergency demolitions (i.e., health and safety hazards that must come down immediately). The model assumes that a city's demolition funds are sufficient to allow for more than just emergency demolition. Where that is not the case, it will be difficult to use demolitions as a strategic tool for planning.

It is also worth noting that, when possible, cities should look beyond the somewhat narrow issue of vacancy to the broader issue of blight-elimination. Communities can start with a demolition plan to address vacancy, and scale up to address other challenges related to vacancy. For example, in February 2015, the legacy city of Flint, Michigan, adopted a blight-elimination framework that addresses not only demolition of vacant properties, but related issues like waste removal, board-ups, code violations, and mowing (Pruett, 2015). Unlike the model presented here which prioritizes demolitions parcel by parcel city-wide, the Flint framework prioritizes demolitions based only on 11 place types and the occupancy of blocks. As a result, thousands of parcels could be given equal priority, which could prove problematic for the city of Flint going forward.

To reiterate, the author does not mean to imply that every vacant structure in legacy cities should be demolished. If sufficient resources were available, communities would need to decide how many properties on the prioritized list to demolish. In the Youngstown example, perhaps the first 4,000 homes on the list should be demolished, and the last 500 should be preserved. This paper does not consider where to place the cutoff point since communities are not currently faced with this question. The more pressing question is how to obtain the resources necessary to demolish structures that are beyond repair. Nonetheless, the model can be thought of not simply as a way to create a demolition list, but also as a continuum of demolition and prioritization efforts. Properties that receive the lowest scores in the model could be targeted for mothballing or rehabilitation, for example. Demolition needs to be planned as part of a broader strategy for community revitalization, even beyond blight-elimination (Mallach, 2012). Demolition is not a panacea for distressed neighborhoods or cities. Although demolition can ameliorate some of the negative effects of decline, it does little to address the root causes of vacancy and population loss.

Words of caution

Empirical models, like the one proposed, must be used with caution. In the wrong hands, the model could be manipulated to achieve the users' predetermined objectives that may not be in public's best interest—which further points to the importance of a robust public participation process. Because the model is technical, uses quantitative data, and produces numeric values, there may be a tendency for community members to view it as a neutral device. But as Kitchin, Lauriault, and McArdle (2015) note:

> Indicator, benchmarking and dashboard initiatives express a normative notion about what should be measured, for what reasons, and what they should tell us, and are full of values and judgements shaped by a range of views and contexts. There is a politics to indicator and benchmark selection, their communication and visualization, they deployment, and their use" (p. 18).

Consequently, all components of the model (e.g., data, weights, equations, geographic scales, assumptions) should be readily available and accessible to the public. Increasing transparency will help to ameliorate the so called "black-box" effect, whereby data are entered into a system and a solution pops out—a solution that appears neutral and scientific on the surface, but in reality reflects the values and opinions of its creators (Waddell, 2002). Additionally, by making the model's components transparent and by having a robust public participation process, it should become clear to stakeholders that any demolition strategy involves trade-offs and compromises between mutually desirable goals and competing interests.

One must also consider whether the model serves to identify poor and minority neighborhoods for clearance. Because poor housing conditions and abandonment correlate strongly with income and race (Bassett, Schweitzer, & Panken, 2006; Massey & Denton, 1993; Morckel, 2013), it is probable that demolitions will be concentrated in neighborhoods with disenfranchised populations. Because of the history of urban renewal, some scholars have serious reservations about demolition activities that seem to target poor or minority neighborhoods (such as Gratz, 2010)—and rightfully so. But so long as residents desire demolitions, the property selection process is transparent, and the demolitions are not being used to remove residents, then this author does not have serious reservations. Even though planners and others have used demolitions for questionable purposes in the past (Gratz, 2011), this does not mean that demolitions cannot be used for good.

Conclusion

Overall, this study demonstrates that empirical models can be developed to prioritize vacant structures for demolition. If legacy cities had sufficient funding for demolitions, there would be less need for prioritization models. However, even with additional funding, it would take a long time to clear existing blight. For example, sustaining a pace of 200 demolitions *per week*, it would still take the city of Detroit at least 5 years to eliminate its current abandoned housing inventory (Gallagher, 2015). The reality is that sufficient funding is unlikely to materialize in the foreseeable future; therefore, how best to prioritize demolitions will remain a salient question. The proposed method improves upon scattershot approaches in that it adds vision, strategy, and transparency to the demolition decision-making process. The question remains whether it can be implemented. Although the model provides a technical solution, it will take political will to use it in practice. Even with the soundest method, planners will need to contend with residents who feel their neighborhoods should have received demolition, or other, resources.

Lastly, the proposed model creates additional possibilities for evaluating demolition strategies and activities. Many research questions flow from the work herein; the first question is whether using the model results in better outcomes than an unplanned approach. While the answer may seem clear, it would be interesting to do a comparative study of cities that use different approaches to prioritizing demolitions (especially different variables and weights) and evaluate the outcomes. It is also critical to define what is meant by an effective demolition. Is an effective demolition one that eliminates blight, reduces crime, and/or allows for possibilities of creative reuse or property aggregation? The answer to this question can become the dependent variable in a regression model that seeks to examine which independent variables or weights lead to specific results. Further, because the question of which properties to demolish is a multi-objective one, more sophisticated decision modeling techniques from the field of operations research (like the one used in Johnson, Hollander, & Whiteman, 2015), could be explored—particularly as we, as a research community, learn more about the specific, *measurable* effects of demolitions (e.g., a demolition decreases crime by X% within an X mile radius under X condition). Finally, the strategy and structure of the demolition model might differ depending upon the outcome(s) a community seeks. It may be the case that there is no "correct" way to weigh the variables in a demolition prioritization model. Rather, the choice of weights could—and arguably should—depend upon the priorities and objectives of the respective community.

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Notes

1. "Blight" in this paper is defined as "unwanted property conditions that stem from the presence of vacant properties." This definition comes from the city of Flint, Michigan's blight elimination framework (Pruett, 2015, p.11). Using this definition, blight includes, "…the presence of tall grass, accumulated waste, and the continuous challenges associated with dilapidated and vacant houses and buildings" (Pruett, 2015, p.11).
2. For a historical overview of demolition activities, see Hackworth (working paper).

3. In most cases, Moran's *I* should be statistically significant. By considering a set radius from each property for several of the input variables, the construction of the model creates some degree of spatial autocorrelation amongst the scores. Spatial autocorrelation in the demolition priority scores is desirable because it means that demolitions are more likely to be concentrated, which results in better outcomes.

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