1

INTRODUCTION: COMMUNITY-BASED ORGANIZATIONS, NEIGHBORHOOD-LEVEL DEVELOPMENT, AND DECISION MODELING

1.1 CHALLENGES AND OPPORTUNITIES FOR HOUSING AND COMMUNITY DEVELOPMENT IN THE US

Community development in the United States is a complex process that has historically centered on meeting the diverse needs of low-income, low-wealth, and otherwise disadvantaged people and places for improved shelter, education, employment, and health. By doing so, community development professionals support social and economic integration and the alignment of capital with justice (Pinsky, 2012). This book represents an attempt to apply current knowledge in decision science, particularly an emerging area called community-based operations research (CBOR); to develop new analytic models, mostly quantitative and prescriptive; and to support the work of community-based organizations (CBOs) whose activities are intended to enable economic prosperity and social justice.

There are many successful examples of community development. The Dudley Street Neighborhood Initiative in the Roxbury neighborhood of Boston, founded in 1984, generated a network of local developers and

Decision Science for Housing and Community Development: Localized and Evidence-Based Responses to Distressed Housing and Blighted Communities, First Edition. Michael P. Johnson, Jeffrey M. Keisler, Senay Solak, David A. Turcotte, Armagan Bayram and Rachel Bogardus Drew.

community organizations to perform large-scale housing redevelopment. It has since branched out to address issues such as public safety, community planning, and environmental justice through the lens of community economic development, leadership development and collaboration, and youth opportunities and development (Dudley Street Neighborhood Initiative, 2014). DSNI's success has served as a model for comprehensive community development initiatives across the United States (von Hoffman, 2012). The Purpose Built Communities program in Atlanta's East Lake neighborhood provides affordable housing development, community engagement, and education and early learning programs (East Lake Foundation, 2014). PBC's efforts in East Lake from 1995 to the present have been associated with dramatic declines in violent crime, improvements in housing quality, and improvements in educational outcomes and have been replicated in eight communities across the country (Belsky and Fauth, 2012).

Since 1997, the Harlem Children's Zone (HCZ) in New York City has put the needs of children at the center of its efforts to provide comprehensive services to families. These services include educational resources (charter schools, parenting workshops, college readiness programs), family and community programs (family support services and one-stop-shop connections to government resources, legal services, and tax preparation) and health improvement programs (nutrition education and facility-based recreation, fitness, and nutrition resources) (Harlem Children's Zone, 2014). HCZ's social outcomes, though limited in various ways and expensive to produce, serve as a model for high-impact social investments (Belsky and Fauth, 2012). Community development initiatives such as the three presented here embody principles of success including local initiative, support from diverse financial and governmental sources, and a focus on tangible results that can be scaled up and replicated (Grogan, 2012).

However, the environment within which community development works is one of high social inequality and substantial barriers to social advancement. Two prominent areas of challenges are income and economic opportunity and affordable housing. Recent figures from the U.S. Census show that while 9.8% of non-Hispanic whites live in poverty, 25.6% of Hispanics and 27.2% of blacks live in poverty; similar disparities are seen for persons whose income is 50% or less than the poverty rate. Moreover, while children are 23.7% of the total U.S. population, they make up 34.6% of persons in poverty and 35% of Americans living in deep poverty (NCLEJ, 2013). Accounting for household taxes and cash transfers, the relative poverty rate in the United States of 17% is exceeded only by OECD countries Mexico, Israel, and Chile (Krueger, 2012). According to a measure of equality called the Gini coefficient, the United States has the fourth most unequal distribution of disposable income among

countries in the Organization for Economic Cooperation and Development; only Chile, Mexico, and Turkey score higher on this scale (Denk et al., 2013). The United States has low levels of social mobility: a measure of the likelihood that poor persons stay poor (intergenerational earnings elasticity) of about 0.47 is exceeded in developed countries only by Italy and the United Kingdom (Krueger, 2012).

Housing, a foundation of the U.S. economy and a source of family stability, community engagement, and wealth accumulation, shows similar signs of inequality and barriers to opportunity. Nearly 41 million American households in 2012 are cost-burdened (pay more than 30% of their income on housing), an increase of 9 million from a decade earlier. Three-quarters of households whose income corresponds to the full-time federal minimum wage are cost-burdened, and two-thirds are severely cost-burdened (pay more than 50% of their income on housing). Such families are more likely to spend less on food and health care and live in inadequate housing located in higher-crime and blighted communities, than more affluent families (JCHS, 2014).

These structural barriers make it difficult for nonprofit organizations, especially smaller, resource-constrained, locally focused CBOs, to design, fund, implement, and evaluate projects that can make a difference in the lives of people whom they serve. Seidman (2012)'s review of efforts in community development to respond to important social problems emphasizes the importance of community actors to use data and analytics for decision making that enables funds to be used on programs that are most effective and discontinuing programs that aren't. Seidman also encourages community development organizations to become more nimble, entrepreneurial, and attuned to program development based on return on investment, not simply best use of subsidies.

CBOs must address a wide range of challenges to improve the lives of their constituents (Stokey and Zeckhauser, 1978; Levy, 2003; Johnson, 2011). CBOs must leverage their expertise in designing programs and policies to assess the ways in which these programs and policies will have a demonstrable positive impact on families and communities. They need to identify alternative courses of action, including the one that they may be otherwise predisposed to pursue, as well as suitable metrics that can capture progress toward goals and help choose between competing alternatives. CBOs must then choose a most preferred alternative course of action, often accounting for uncertainty in knowledge about data, or the future social and economic environment that may affect the feasibility of a program or outcomes of program participants. The likely impacts of pursuing a path defined by a most preferred program or policy must be communicated to diverse stakeholders

in easy-to-understand ways. Finally, professionals who implement programs and engage with community members must have a clear grasp of the problem and the rationale for new policies and programs. We believe that decision sciences, or analytics, can assist CBO practitioners in designing policies and programs that improve individual and community outcomes.

Notwithstanding the success stories in community development presented at the start of this chapter, Erickson, Galloway, and Cytron (2012) argue that community development needs a new approach to solve the core problem that motivated the creation of the sector, reducing the number of people in poverty. Recognizing the central role of CBOs in this effort, and the traditional importance of affordable housing in meeting basic needs of low- and moderate-income residents in urban neighborhoods, the authors advocate for a new community-level actor that can bring together multiple programs, resources, and actors using actionable data to design novel local interventions.

This book is inspired by the many community development innovators listed earlier in this section, as well as an awareness of social, economic, and organizational barriers to achieving the goals of community development. We focus particularly on community-based responses to residential foreclosures. We ask the following: how can CBOs make better decisions regarding acquisition and redevelopment of residential housing at various stages of foreclosure? Our analyses and findings represent an effort to adapt the principles of successful urban community development to provide a range of models and methods, rooted in analytics and implemented with information technology, that can provide CBOs with the means to develop evidence-based and flexible strategies for local action. The organizations that can benefit from this book may serve communities that are diverse according to race, ethnicity, income, housing composition, and many other criteria. They may be located in cities, suburbs, or rural areas. They may have missions that encompass housing, economic development, arts and culture, and community engagement, among many others. Through engagement with experts in decision sciences, these organizations are likely to demonstrate an increased awareness of localized problems whose solution exceeds their expertise and resources; a deeper understanding of the ways that data can enable them to identify objectives for action that are best aligned with their missions and measure their progress in achieving these objectives; and an increased ability to formulate and solve decision problems that allow them to choose between alternative courses of action while making best use of limited resources.

We recognize that the scope of the foreclosed housing crisis, and the lack of sufficient affordable, good-quality housing to meet the needs of all who desire it, greatly exceeds the resources and capabilities of CBOs alone. Clearly, state- and federal-level policy design and political action to

support policy and enable successful implementation is essential to specific, substantive improvements in community residents' lives; the continuing saga of the Affordable Care Act (Patient Protection and Affordable Care Act of 2010, Public Law 111–148) provides ample evidence of this. Yet even the Affordable Care Act would not have enjoyed the success it has generated, for example, in increased health insurance coverage without the work of "navigators," persons working with nonprofits and CBOs to provide important health insurance information to consumers (Centers for Medicare and Medicaid Services, n.d.).

The impetus for the research effort that is the basis for this book is the foreclosed housing crisis of the late 2000s, which, while showing evidence of moderation recently (JCHS, 2014), continues to have severe impacts on families across the country. Between 2007 and 2012, 12.5 million homes have gone into foreclosure, and the number of owners with mortgages fell by 2.7 million. Homeowners have lost a total of $7 trillion in housing equity associated with the housing market downturn and the foreclosure crisis, of which $2.2 trillion in equity losses were borne by neighbors of properties in foreclosure (JCHS, 2014; Center for Responsible Lending, 2013). Foreclosures have resulted a variety of negative social impacts, and these impacts have been especially severe for racial and ethnic minorities, and residents of lower-income, postindustrial "gateway cities" (Teasdale, Clark and Hinkle, 2012; Lindblad, Manturuk and Quercia, 2013; Immergluck and Smith, 2005; Anil, Jordan and Zahirovic-Herbert, 2011; Wallace, Hedberg and Katz, 2012; Center for Responsible Lending, 2010, 2013; JCHS, 2014; Gateway Cities Innovation Institute, 2011).

CBOs provide many responses to housing foreclosures. These include: homeowner counseling; community organizing and advocacy regarding the causes and impacts of foreclosures and against actors seen as complicit in specific foreclosure actions; refinancing mortgages to enable vulnerable families remain in their homes; and acquisition, rehabilitation, and resale or rerental of residential units in various stages of the foreclosure process (Foreclosure-response.org, 2013). Foreclosed housing acquisition and redevelopment is particularly challenging, in terms of strategy design and daily operations. Indeed, property acquisition and redevelopment embodies many of the core challenges of community development: large-scale physical and social problems, limited understanding of the potential impacts of various policy and planning responses, and a challenging funding and housing development environment. Our first-hand observations of community development corporations (CDCs) engaged in foreclosure response have led us to recognize that management science and operations research can provide a variety of models and methods, not currently used by CBOs, that could improve the quality, timeliness, and impact of their work.

Research into ways to better address challenges associated with foreclosed housing acquisition and redevelopment generates knowledge that can be applied to related domains such as vacant property management and transit-oriented development. This work is intended to enable researchers to devise novel tools by which CBOs can devise flexible responses to foreclosures and distressed housing. It is also intended to enable practitioners to apply methods of analytics and decision science directly, without specialized training, to improve the quality of life in their neighborhoods.

1.2 COMMUNITY DEVELOPMENT IN THE UNITED STATES

History: Community development has its roots in the social welfare and settlement house movements of the late 19th century, when activists and professionals, mostly in the urban North and Midwest, sought to address severe urban problems of poverty, overcrowding, crime, and youth delinquency that were especially prevalent in slums occupied by the working poor and indigents, many of them first-generation immigrants from Europe and African-American migrants from the South.[1] These reform movements embodied the contradiction of direct action to alleviate poverty and the social impacts of poverty with a top-down, elite-driven approach to social welfare that was to bedevil initiatives well into the 20th century. President Franklin Delano Roosevelt's 1930s era New Deal programs – urban public housing, rural electrification, public works projects, and many others – provided a model for federally funded, locally implemented social welfare programs for many years afterward.

In the wake of controversial efforts to address urban poverty via urban renewal and increased investments in public housing in the early 1950s, and increased visibility of urban and rural poverty in the late 1950s, a combination of academics, foundations, and practitioners sought to develop locally driven solutions to urban poverty via nonprofit organizations engaged in comprehensive development that were run on business principles. These innovations were institutionalized in the Lyndon Johnson Administration's War on Poverty, with an emphasis on comprehensive community action programs and local control of program funding. This chapter of community development saw a tension between community-based advocacy, diverse localized antipoverty experiments, and resistance from municipal politicians eager to preserve their influence on neighborhoods.

Urban riots of the mid and late 1960s and the destruction that followed spurred stakeholders to refocus on root causes of urban poverty. A new

[1]This paragraph and the four that follow are based on von Hoffman (2012).

emphasis on private sector investments in urban communities, academic efforts to devise "scientific" solutions to urban problems, federal funding for entities that became community development corporations, and economic development initiatives directed by minority communities themselves evolved into a multilevel enterprise for community development. Institutions that supported this work included national-level technical support and financial intermediaries like the Local Initiatives Support Corporation (LISC), traditional municipal-level offices and agencies for neighborhood and economic development, and locally based CDCs and community action agencies.

From the 1970s through the present day, the community development movement has seen many successes in communities across the United States. The community development movement has also contributed to large-scale redevelopment through public housing demolition and redevelopment via the HOPE VI program (Goetz, 2003). In the wake of the Great Recession of 2007, which saw unemployment rates and long-term unemployment at or near record highs in the post-World War II era, resulting decreases in median incomes, household wealth and homeownership rates, and a recovery at a rate lower than other postwar recessions (Center for Budget and Policy Priorities, 2014), the Obama administration has responded with a mix of policies. Federal-level investments include the American Reinvestment and Recovery Act and the Neighborhood Stabilization Program (NSP) (the first phase of NSP originated in the George W. Bush administration). In addition, Choice Neighborhoods and Promise Neighborhoods represent locally driven, federally funded programs. These successes, however, are tempered by changing demographics and market dynamics, such as the suburbanization of poverty (Kneebone and Garr, 2010), continued high levels of minority segregation, and an increase in majority–minority cities (Frey, 2011) and increasing gentrification in some central cities (Hartley, 2013).

Process and Design: Community development is challenging. It is expensive, time consuming, and often frustrating. Years of successes may be undone by changes in the macro economy. It requires expertise in diverse areas, including marketing, housing development, human services provision, economic development, finance, and public safety. It requires individuals, organizations, business, and government to negotiate, advocate, organize, and at times oppose the efforts of other actors.

Community development faces a tension between "physical capital development" and "human capital development" (Erickson, Galloway and Cytron, 2012) that parallels the long debate between people- versus place-based initiatives (Belsky and Fauth, 2012). Physical capital development is focused on improving the places where low-income people live. Initiatives in this area include connections between the interactions between affordable housing,

schools, and grocery stores; community health clinics that treat the entire neighborhood as the "patient"; transit-oriented development to improve access to employment opportunities; and creative reuse of vacant properties in blighted neighborhoods where conventional housing and economic development strategies are insufficient. Human capital development, in contrast, seeks to improve individual lives through interventions that connect people to specific services, such as early childhood interventions, youth and community development, community engagement, and human and social services. Many of these interventions can be provided together and can jointly address the concerns of economic, political, and social conditions that comprise social determinants of health.

Human capital development and physical capital development both rely on the availability of affordable, high-quality housing that can provide a stable and experience-rich environment for children and adults. Residents of such housing require local amenities, financial and social benefits of housing, and healthy choices to reduce disparities in health, education, and labor market access.

Community development is comprised of many actions, as well as actors who may not recognize the local impact of their choices. A household may move from an expensive, high-amenity neighborhood to a less expensive neighborhood with fewer amenities in order to have more space for a growing family. An entrepreneur may buy a vacant, dilapidated property with hopes of renovating and then "flipping" it to make a profit. Neighbors may meet informally to start a block club by which local news can be shared and new relationships formed. A real estate developer may propose a subdivision of new housing in a blighted neighborhood that she thinks will be attractive when a mass transit stop comes online. A CBO may introduce a business incubator with for-profit and nonprofit enterprises as an "anchor" in a struggling community.

Which of these actions may be influenced by community development practitioners? What notion of "community" is salient for these actions? Are certain actions more appropriately classified as human capital or physical capital enhancing? Which of these actions may serve as the basis for directed replication by other similar actors in similar neighborhoods? Which of these actions should qualify for technical support from local nonprofit organizations, funding from foundations or subsidies from government? What community development actions can be regarded as successful? How can these actions be replicated in ways that reflect differences across neighborhoods?

The answers to these questions motivate the goal of this book: the design of analytic, prescriptive models that enable community actors to implement initiatives that use limited funds to optimize social impact. This book's theory,

analysis, and findings are the result of seven years of research. This work is focused on a particular geography, administrative, and programmatic focus of community development: CDCs in urbanized communities in central cities and economically distressed smaller "satellite" or "gateway" cities who face the challenges of stabilization and revitalization of housing stock in the wake of the foreclosure crisis. The question that is at the center of this book – how can CDCs make decisions regarding acquisition and redevelopment of residential housing at various stages of foreclosure? – is one whose answers can help CDCs intervene more effectively in local housing markets and improve the lives of the residents they serve. It is a question that harkens to the classical goals of community development, that is, provision of decent, affordable housing to low- and moderate-income residents of urban neighborhoods. This question is also one that can provide CBOs, including CDCs, the ability to design responses to diverse challenges in local development. These include improved program design in traditional categories of human services, education, and health, as well as novel ways to integrate multiple interventions to more broadly. More comprehensive responses to local distress have the potential to connect needy and at-risk communities to social and economic opportunity, both in the places where families live and work now, as well as other places of opportunity across metropolitan areas.

1.3 BIG DATA, ANALYTICS AND COMMUNITY DEVELOPMENT

In recent years, increased attention has been paid to trends in business practice and research focused on the collection, analysis and sharing of large collections of data derived from enterprises of varying types. "Big data" is the term used to characterize the exponential growth and availability of data. In 2015, it has been estimated that there is enough data created by 3 billion Internet users worldwide to fill the Library of Congress 1.8 million times over (Tableau Software, 2013).

The availability of data, by itself, need not be transformative. Instead, the value of big data comes from the uses to which it is put. These include *descriptive analysis*, that is, tabulations, statistical analyses, and visualizations that provide improved insight into current and past organizational processes and outcomes; *predictive analysis*, that is, models and methods to estimate the future state of an organization's activities or the environment within which it works; and *prescriptive analysis*, that is, models and methods intended to generate policies, rules, and insights regarding individual and organizational decisions (Liberatore and Luo, 2010).

This expansive notion of "data analytics" – often shortened to "analytics" – gains increased significance in the size of datasets with which these tasks are

performed. Larger and more comprehensive datasets enable more accurate pictures of an organization's activities and higher-quality statistical inference regarding relationships between current and past inputs, processes, and outcomes. They provide deeper and more accurate understanding of future environments within which goods and services are produced and consumed and potential levels and impacts of future business decisions. They may be input to more detailed visual representations of an organization's clients and activities, past, present, and future. Finally, they can help organizations design more robust processes to guide strategy development and operations implementation.

Private sector firms commonly use data analytics to make critical decisions. American companies that used data-guided management processes improved productivity by up to 6% (Tableau Software, 2013). Big data, and the analytic methods that make them useful, not only makes companies more productive, it helps them create new opportunities and find new markets. Much of the literature on big data reflects the perspective of the corporate private sector, since it not only understands the potential of big data, but it has the capital to pursuit the latest data analytics tools (McAfee and Brynjolfsson, 2012).

The impacts and benefits of the big data and analytics movements are not as clear-cut for the mission-driven CBOs that are the focus of this book, however. Many nonprofit organizations are bounded by the demands set forth by their funders (Stoecker, 2007). Funders are often reluctant to grant organizations the right to use funds for increasing technological capacities (Al-Kodmany, 2012). The literature on nonprofits and data stresses that data is not solely in the domain of the private sector. By understanding how to utilize data, organizations can improve their outcomes and create greater impacts (Boyd and Crawford, 2011). According to Patrick Ball, head of the Human Rights Data Analysis Group,

> If you're looking at poverty or trafficking or homicide, we don't have all the data, and we're not going to … That's why these amazing techniques that the industry people have are great in industry, but they don't actually generalize to our space very well. (Wallace, 2014)

In contrast to corporate firms which may place primary interest on a fairly small set of metrics that are straightforward to quantify and collect (e.g., sales, market size, product quantity), CBOs are often interested in a larger set of metrics related to individual and community health and capacity and economic and social progress. However, limited technical and organizational resources may make it difficult for a CBO to develop information technology (IT) applications that may allow the analysis and sharing of data they desire

(Wallace, 2014; Boyd and Crawford, 2011; Stone and Cutcher-Gershenfeld, 2002).

Confronting these barriers through improved data-analytic capabilities is a primary motivation for this book. By doing so, CBOs will better fulfill their missions in four important ways. First, they will gain a deeper understanding of neighborhood and community characteristics through quantitative and qualitative data. Second, they will be able to organize data into information by identifying and quantifying key values, outcomes, and impacts. Third, they will be able to share data and information within the organization and across stakeholder groups to set goals and measure progress. Last, they will be able to better design novel and adaptive policies and practices within their service areas, such as program evaluation, project selection, resource allocation, and collaborations. Such policies and practices are likely to result in larger and more significant impacts upon their constituencies (Johnson, 2015; Stoecker, 2007).

1.4 THE FORECLOSURE CRISIS: PROBLEM, IMPACTS, AND RESPONSES

The dramatic increase in residential foreclosures, which began in 2007, is another key motivation for this book. This phenomenon, which we discuss in detail in Chapter 2, has its origin in a number of trends. After steady increases in home ownership rates in the post-World War II years, homeownership rates began to decline in the 1980s, decreasing from 65.2% in 1980 to 64.0% in 1994, due in part to lower rates of first-time home buying by younger households (Schwartz, 2010; Gabriel, 1996). The 1980s also saw deregulation of mortgage lenders and other financial service providers to encourage more lending (Green and Malpezzi, 2003). Tax reform in 1986 exempted mortgage interest, local real estate taxes, and capital gains from real estate sales from federal income taxes (Carliner, 1998; Glaeser and Gyourko, 2008). Government-sponsored enterprises Fannie Mae (Federal National Mortgage Association) and Freddie Mac (Federal Home Loan Mortgage Corporation) introduced affordable lending goals that increased homeownership opportunities for low-income and minority households (Carliner, 1998; Glaeser and Gyourko, 2008). At the same time, there was an increase in nontraditional loans offered by mortgage brokers not subject to the same safety and soundness provisions as deposit-taking banks (Schwartz, 2010). Finally, mortgage securitization emerged as a way to offset the risk of nontraditional loans (Cannato, 2010; Schwartz, 2010).

The result of these related events was an increase in the homeownership rate from 64% in 1994 to 69% in 2004, with especially large gains observed

among low-income and minority households (Herbert et al., 2005), increases in housing values, and increases in new housing construction (Belsky and Duda, 2002; Di, Belsky and Liu, 2007). These beneficial housing market impacts were accompanied by less desirable trends in speculative purchasing and renovation, increased fraud in home mortgage originations, and racial segmentation and discrimination in the provision of mortgage products (Immergluck, 2009).

An important outcome of these trends was a crisis in the housing market in the mid-to-late 2000s. A slowing housing market led to increased efforts to lock in profits via sales, leading to leveling off and sometimes decreases in housing prices (Schwartz, 2010). Some homeowners, facing lower-than-expected asking prices, couldn't sell their homes. Poor performance on some loans exposed flaws in underlying elements of housing mortgage portfolios, leading to reduced demand for mortgage-backed securities. A sell-off in mortgage-backed securities fed a decline in housing prices, which led to increased foreclosures and crisis in wider economy. The resulting collapse of the housing market proved to be the catalyst to the deepest economic recession since the Great Depression (Schwartz, 2010; Couch, 2013). The impacts on families and neighborhoods, both direct (foreclosed mortgages, evictions, lost equity) and indirect (increases in crime, family instability, decreases in property value, reduced child education outcomes), have been devastating and especially severe for minority and low-income communities.

The federal government responded to this crisis in a number of ways. The Troubled Asset Relief Program (TARP), known popularly as the bank "bailout," enabled purchase by the government of mortgage-backed securities that had dramatically declined in value, ensuring the survival of many mortgage sellers and financial institutions. The federal government enacted a full takeover of Fannie Mae and Freddie Mac and initiated mortgage refinancing and foreclosure prevention programs such as the Making Home Affordable Program, HOPE NOW, and loss mitigation and early delinquency interventions provided by the Federal Housing Administration (U.S. Department of Housing and Urban Development and U.S. Department of the Treasury, 2014). The government also developed the Neighborhood Stabilization Program, which provided funds to state and local governments and nonprofit organizations to acquire and redevelop foreclosed units in three phases: $3.92 billion in Phase 1, starting 2009; $1.93 billion in Phase 2, starting 2010; and $1 billion in Phase 3, starting 2011 (Shelterforce, 2010; Nickerson, 2010). The Dodd–Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act, 2010) introduced new restrictions on mortgage marketing activities intended to reduce the incidence of fraud and reckless lending to sometimes unqualified home buyers (Couch, 2013).

The private market, state and local governments, and nonprofit organizations have also responded to the foreclosure crisis. Private firms have purchased properties at various stages of foreclosure for renovation and resale or rental. States have increased regulation of the lending industry and provided additional consumer protections to mortgage purchasers. Municipalities have engaged in large-scale demolitions and land banking, as well as negotiations with financial institutions that own foreclosed properties to acquire units for redevelopment. CDCs have provided counseling for first-time homebuyers and homeowners at risk of foreclosure and made smaller-scale acquisitions and demolitions. Other nonprofit organizations have pursued policy advocacy and direct action on behalf of residents of foreclosed housing and neighborhoods affected by foreclosures. Specific initiatives include programs to refinance owned units at risk for foreclosure to ensure that families can stay in their homes.

Addressing the foreclosed housing crisis and the extensive damage done to individuals and neighborhoods in the wake of the crisis is the responsibility of many different private, public, and nonprofit actors. These responses take place at multiple geographic levels and take many different programmatic forms and are intended to support different components of the housing market. The focus of this book is on one of these actors (nonprofit CBOs, primarily CDCs), one residential type (urbanized areas), and one geographic level (smaller cities and neighborhoods within larger cities). However, our framing of the problem we address in this book, and the models and methods we will discuss, can be generalized to other geographies, community development activities, and community development actors.

1.5 COMMUNITY-BASED OPERATIONS RESEARCH: A NOVEL APPROACH TO SUPPORT LOCAL DEVELOPMENT

For over 30 years, housing and community development has been a subject of inquiry by researchers in the decision sciences. Surveys of work in this area (Johnson, 2012, 2011) demonstrate a wide range of *descriptive models*, which identify evidence regarding policy initiatives; *prescriptive models*, which generate policy alternatives that balance multiple social objectives; and *decision support systems* to automate the process of policy analysis and recommendations. Examples of this work include cost–benefit analysis of housing mobility programs (Johnson, Ladd and Ludwig, 2002), long-term policy modeling for housing mobility (Caulkins et al., 2005), multiobjective optimization for affordable and subsidized housing location (Johnson, 2006, 2007) and housing mobility planning (Johnson, 2003), and decision support for individual housing search (Johnson, 2005). Johnson (2011) concludes, however, that much of the work in this area is disconnected, lacks evidence of real-world

implementation, and is not grounded in a theory of housing and community development that is generalizable to diverse regions and housing types.

As we discuss in detail in Chapter 4, decision modeling for housing and community development is situated in a long-standing literature of public sector operations research (Pollock, Rothkopf and Barnett, 1994) which has applied operations research/management science methods to different sectors at the national, regional, and local levels. This work, spanning application areas such as police, fire, and emergency management services, urban and air transportation, energy policy, health-care delivery, natural resources management, and hazardous and undesirable facility location, has tended to focus on theory building and algorithm development for stylized mathematical representations of the real world. A classic text by Larson and Odoni (2007), originally published in 1981, focused on urban operations and logistics issues using methods from queuing theory and facility location models.

A more recent stream of public sector operations research, referred to as policy modeling (Grass et al., 2010; Kaplan, 2008), uses stylized models from OR/MS, optimal control, and other areas to estimate impacts of policy changes that incorporate time, uncertainty, and systems dynamics. Another stream of public sector OR, humanitarian logistics, addresses the design and implementation of decision models to address the flow of goods and materials to address preparation, response to and recovery from natural and man-made disasters, as well as long-term development (Çelik et al., 2012). Recent extensions to humanitarian logistics address decision models to improve service delivery to disadvantaged populations that face entrenched barriers to basic needs such as food security (Lien, Iravani and Smilowitz, 2014; Davis et al., 2014). Another recent extension of public sector OR uses economics-based systems modeling (in the spirit of policy modeling) to solve resource allocation problems that provide guidance to real-world managers (in the spirit of humanitarian logistics) (Ashlagi and Shi, 2014). Finally, nonprofit operations management addresses the problems of supply (fundraising, income earning), production (achieving defined objectives, centralization and collaboration, and means by which goods and services are made), and demand (consumer-side competition and performance measurement and evaluation) that distinguish nonprofit organizations from for-profit organizations and government entities (Privett, 2011).

This work in public sector OR, which Johnson (2012b) classified as "US-style OR," tends to center on government and large nonprofit organizations as decision makers; uses prescriptive decision models that rely on stylized, mathematical representations of complex systems and phenomena; and focuses on issues of efficiency and robustness of solution methods. Such

models are detailed, address needs of real-world providers, and to some extent address the equity and social impacts of resource allocation decisions. However, rooted as they are in a logistics and supply chain view of public service delivery, they are not designed to reflect a more fundamental concern with the role of power, class, and community in defining problems amenable to OR/MS models and methods, as well as the stakeholders who are affected by the problems and play a role in solving them. Neither are they intended to address social processes or the role of social policy in alleviating the concerns, such as poverty, inequality, and the human capital/physical capital conflict that motivate this work.

An alternative view on public sector OR emphasizes a broader understanding of "problems," the social and political aspects of problem identification and solution, the role of stakeholders who are affected by problems and can play a role in formulating and solving them, and the use of mixed methods that draw from urban planning and community development as well as operations research. These approaches, which encompass community operational research (Midgley and Ochoa-Arias, 2004), soft OR and soft systems methodologies (Checkland, 1981; Churchman, 1979), and problem structuring methods (PSMs) (Rosenhead and Mingers, 2001), represent a more qualitative, critical, and community-oriented kind of inquiry into public sector decision modeling and decision making. They have been primarily the province of researchers in the United Kingdom and are classified by Johnson (2012b) as "UK-style OR." In the face of disagreements regarding the type of OR methodological approaches that ought to be represented in the most prestigious journals in the field (Johnson, 2012b), researchers reflecting this alternative view of public sector OR have made increased efforts to popularize soft OR and related methods among US audiences (Mingers, 2009, 2011a).

CBOR has been devised as a way to bridge the gap between "US-style OR" and "UK-style OR." This approach, described in Johnson (2012b) and Johnson and Smilowitz (2007), is defined as the collection of "OR/MS applications that address provision of goods and services, or prescribe social policy actions, for which stakeholders are defined, in a spatial or social sense, as localized, or who are considered disadvantaged or underserved, or for which issues of equity or social influence are important considerations" (Johnson, 2012b, pp. 4–5). This definition makes no specific mention of preferred methodologies, analytic methods, or application areas, instead focusing on the nature of the services provided or phenomenon modeled and characteristics of the stakeholders and their locations in physical and/or social space.

We discuss in more detail in Chapter 4 our rationale for choosing CBOR as the unifying theoretical approach for this book. We believe that progress in

community development includes a variety of opportunities for applications of decision sciences. However, purely technical approaches are insufficient. Innovative decision-modeling approaches must be based on best and most current social science evidence; recognize the centrality of lived experiences and social, racial, and class barriers to opportunity; and critically examine previous efforts in community development. This approach is also consistent with a recent movement, community-engaged research, that puts special emphasis on developing and maintaining long-term, mutually beneficial relationships with community partners and generates insights useful for practice and research oriented toward capacity building and social change (Van de Ven, 2007; Saltmarsh, et al., 2009). We describe now the ways in which CBOR can meet these goals.

CBOR is conceived as a collection of four analytical steps. The first, *problem identification*, recognizes that determining the nature of a problem to be solved is an opportunity for application of problem structuring and values clarification methods such as value-focused thinking (Keeney, 1992), soft systems methodology (Checkland, 1981), and facilitated modeling (Franco and Montibeller, 2010). Application of these methods recognizes that place and neighborhood, with their connections to race, class, and ethnicity; formal and informal institutions and organizations; social and economic mobility; and neighborhood change, provide a basis for a critical perspective of the problem at hand and the nature of analytic methods to be applied. This approach, described in detail by Mingers (2000a,b, 2011b), addresses critical thinking, critiques of traditional norms and processes, critiques of authority, and critiques of objectivity.

The second step of CBOR, *problem formulation*, comprises stakeholder analysis and a collaborative approach. It recognizes the fact that stakeholders, who may not be trained in operations research/management science, understand their social and cultural environment, neighborhood, and community development context very well. This process should be evidence-based and should recognize that conventional optimization goals such as increased system efficiency (e.g., reduced delivery time or distance-weighted demand) are not necessarily closely associated with improved social welfare (e.g., improved health or increased education performance or labor market participation). This process should also incorporate concerns with equity, fairness, and ethics and, following Mingers (2011a), engage multiple stakeholders in discussions on potential solutions and solution methods. The outcome of this step is a qualitative statement of a problem to be solved, even if it appears to exceed the scope of traditional OR/MS.

The next step of CBOR, *problem solution*, recognizes that there may be multiple solutions to a defined problem; they may be derived from quantitative analytic methods such as optimization or simulation or mixed-methods

approaches such as problem structuring and collaborative learning. These solutions can be derived through research frameworks such as mathematical modeling (Winston and Venkataramanan, 2003; Winston, 2004), case studies (Yin, 2013), and action research (Burns, 2007). Mathematical modeling solution methods, applied in the context of CBOR, should account for a community or an organization's available expertise, technology, and resources and may yield optimal algorithms, heuristics, or perhaps an entirely qualitative presentation of decision problems and solutions that may provide substantial insight for CBOs. Case studies use multiple sources of evidence and rely on theoretical propositions to guide inquiry rather than explicit hypotheses (Yin, 2013). They are an important way to provide crucial social and organizational context to primarily quantitative analytic decision models. Action research, a means by which "communities and organisations can adapt and respond purposefully to their constantly changing environments" (Burns, 2007, p. 1), supports strategy development that acknowledges the complexity of practice and the inability of conventional models to "understand, explain or predict reality" (Burns, 2007, p. 2). It provides support for the notion in CBOR of iterative solution design that build community capacity to solve progressively more challenging problems or problems of a recurring nature (Johnson, 2012b).

The last step of CBOR is *implementation*. The translation of problem solutions into practice can encompass increased understanding of the problem, agreement on goals and metrics associated with solving a problem, and generalized insights on existing processes and strategies, to problem-specific policies and prescriptions. These alternative understandings of implementation reflect a fundamental concern with community change for the public good, which comprises theory building, capacity building, and social change.

These four steps of CBOR are illustrated in Figure 1.1.

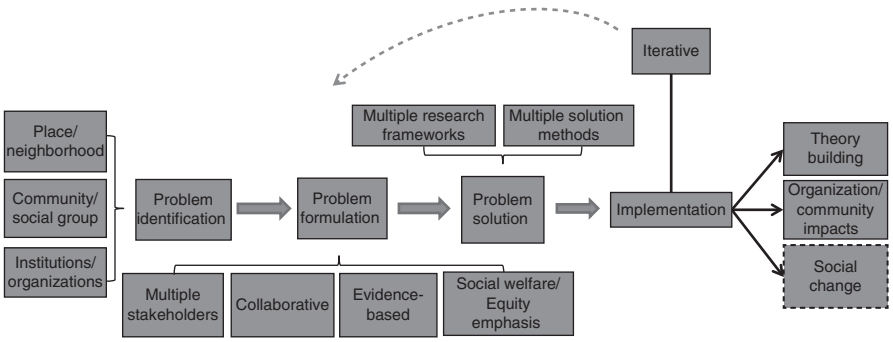

Figure 1.1 The process of community-based operations research. *Source:* Johnson (2005).

We now present research questions inspired by the goal of this book and whose answers will help CDCs to make better decisions regarding acquisition and redevelopment of residential housing at various stages of foreclosure. *First*, which model-building method, or combination of methods, is most appropriate to the context of urban foreclosed housing acquisition and redevelopment, especially by resource-limited CBOs serving economically disadvantaged neighborhoods? *Second*, what combination of math modeling, case study, and action research methods will yield greatest insight into neighborhood stabilization and revitalization through foreclosed housing acquisition and redevelopment? *Third*, what approximations of impacts of foreclosed housing on individuals and communities might best reflect current and best practices in community-level operations and planning for foreclosed housing development? *Fourth*, what representations of outputs of the models will provide most value to community-based housing development practitioners? *Fifth*, what combination of analytic decision models are best suited for different aspects of foreclosed housing acquisition and redevelopment? *Sixth*, what use context, or combination of use contexts, that is, real-time decision making, expert support, or auditing and evaluation, is most salient for this project? *Finally*, how can the impacts of our models upon the operations of CBOs as well as the neighborhoods they serve be best measured in order to assess the overall utility of our research project?

The answers to these questions are rooted in the nature of CBOs engaged in foreclosure response. These characteristics, illustrated in Figure 1.2, can be summarized along the dimensions of mission type, size of data used for analysis, nature of technologies available for problem-solving, and capacity to apply theory to practice. As shown by Johnson (2015), CBOs – including the CDCs that are the focus of this book – represent a unique combination of social change mission, limited access to data for daily practice (though the set of available data is quite large), need for technologies appropriate to resource-limited organizations, and relatively limited capacity to apply theory to practice, as compared to large nonprofits and government, as well as for-profit organizations.

Based on interviews with Boston-based practitioners, Johnson (2015) identifies a contradiction between the availability of large, detailed datasets and analytic technologies that CBOs may use to achieve their goals and low actual usage of these resources. There even appears to be resistance by CBOs to basic use of information systems to assist in program management (Philip Clay, personal correspondence, July 30, 2014). Locally based, CBO-driven foreclosure response, in particular acquisition and redevelopment of residential housing at various stages of foreclosure, is technically demanding, resource intensive, time sensitive, and closely integrated with

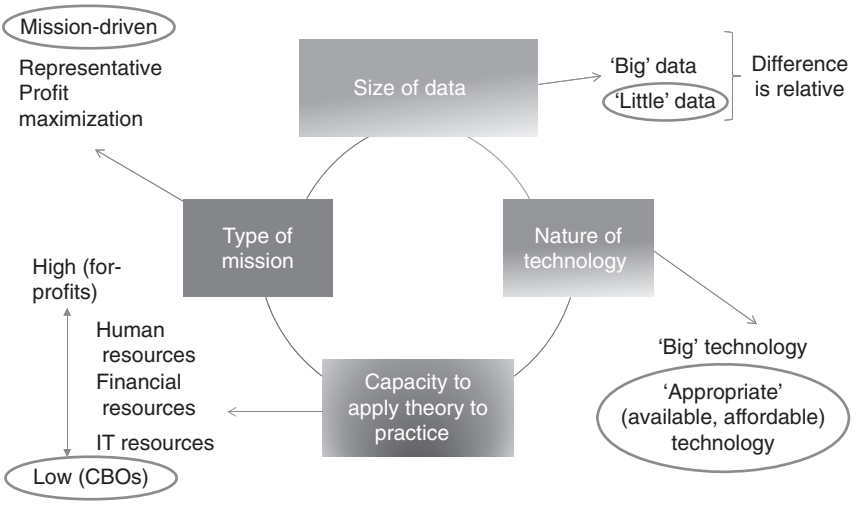

Figure 1.2 Characteristics of community-based organizations. *Source:* Johnson (2015).

larger community development goals. There need not be one problem statement, or one solution to that problem, that, by itself, is likely to improve the ability of a CBO to support neighborhood change. In this book, we take care to ensure that our analysis is sensitive to the resource needs and limitations of CBOs and that our work is applicable to community development generally, not only foreclosure response. The empirical chapters in this book, Chapters 2–10, as described in Section 1.7, represent multidimensional views of housing and community development, in particular the problem of localized foreclosure response, through the analytical lens of CBOR. What we do in this book, then, is to show what CBOR can do for foreclosure response, and community development generally, in a variety of ways that may correspond to conventionally understood notions of operations research and others that may represent novel or less standard applications of OR/MS principles.

1.6 WHY THIS BOOK NOW?

This book has its origins in a realization by the first author around 2008 that the best opportunity for high-impact decision-modeling research in housing and community development no longer lay in models for subsidized and affordable housing location (Johnson, 2006, 2007), allocation over space (Johnson, 2003), or housing mobility counseling systems design (Johnson, 2005) intended for use by large agencies or housing authorities.

This understanding arose from the observation that long-term stagnation in federal support for housing for low- and moderate-income families (JCHS, 2014) meant that government agencies and nonprofit organizations devoted to subsidized and affordable housing were unlikely to acquire the analytic capacity or programmatic flexibility to apply decision modeling to support their core missions.

Instead, the growing impact of the foreclosure crisis and federal, regional, and local responses to it, as well as a new understanding of the potential impact of OR models rooted in notions of community engagement and social change, introduced an awareness of the potential benefits of decision models to assist CBOs in extending their traditional strengths in property development. This enterprise, rooted in identification of residential investment opportunities; purchase of land and/or properties; development, in the form of new construction or rehabilitation; and subsequent marketing of units whose quality reflected a social mission rather than profit maximization, appeared to be well suited to decision modeling.

Two of us (Johnson and Turcotte), along with a doctoral student at University of Massachusetts Boston, developed a multiobjective integer optimization model for acquisition and redevelopment of foreclosed multifamily rental housing (Johnson, Turcotte and Sullivan, 2010). A social welfare objective maximized aggregate utility of acquired units, where utility, consistent with principles of spatial interaction models, increased proximity to high-amenity neighborhoods. An equity objective minimized the maximum disparity between the fraction of all foreclosed units acquired in a given neighborhood and the fraction of total foreclosed units available in that neighborhood. An efficiency objective captured scale economies in housing development by minimizing total distance between housing units acquired. We implemented this model with data from Lowell, MA, though without contact with an actual client partner.

This research provided the basis for a small grant that supported a pilot project to better understand the attributes of foreclosed housing development actually of interest to CBOs and to identify ways to broaden our decision model in terms of size of problem instances and scope of applications. Through this grant (Johnson, Turcotte and Sullivan, 2009), we worked with two CDCs in the metropolitan Boston area to learn more about social objectives and programmatic and resource concerns that influence foreclosed housing development.

We were then able to conceive of a new research program that would address multiple and mixed analytic methods, an explicitly community-oriented method of inquiry, and model-building perspectives that would address short-term (“tactical”) and longer-term (“strategic”) concerns. Our

pilot project then yielded a larger federal grant (Johnson et al., 2010a) that allowed us to address multiple fundamental questions in foreclosed housing acquisition and redevelopment. This project integrated disciplinary perspectives of management science, operations management, housing policy, urban planning and community development, and modeling concerns such as decision making under uncertainty, multicriteria decision models, and single-period versus multiperiod decision modeling (Johnson et al., 2014).

Encompassing and extending the work that has come before, this book's purpose is to enlarge the theory and practice space within which decision modeling in housing and community development can support the diverse missions of urban CBOs. We do so in two ways. First, we demonstrate the ways in which CBOR can serve as a unifying theme for decision-modeling efforts that reflect the antecedent sub-disciplines of community operational research (Midgley and Ochoa-Arias, 2004), PSMs (Rosenhead and Mingers, 2001) and value-focused thinking (Keeney, 1992), and urban operations research (Larson and Odoni, 2007). Second, we develop a collection of related and reinforcing decision-modeling methods while remaining rooted in the imperatives of community development theory and practice to support access to social stability, economic opportunity, and healthy neighborhoods (Andrews and Erickson, 2012).

We are a diverse team of researchers, and this diversity enriches our inquiry. Our educations span operations research, operations management, decision theory, public policy, and community development. This multidisciplinary preparation, and comfort with multiple- and mixed-methods approaches to problem-solving in the not-for-profit sector, provides a cornerstone for the analysis in this book.

1.7 BOOK DESCRIPTION

This book consists of three sections. The first section, "Policy and practice in foreclosed housing and community development," serves two purposes. First, it provides a motivation for the book rooted in public policy and planning and decision sciences. Second, it introduces the reader to the environment in which our study is situated: neighborhoods, CBOs that serve them, and the impact of the foreclosure crisis and recession on residents and groups in these neighborhoods. Chapter 2, "Foreclosed housing crisis and policy and planning responses," describes the foreclosed housing crisis in the United States and responses to the crisis by federal, state, and local governments, nonprofits and for-profits, with special emphasis on foreclosure responses directed by CBOs. It proposes that decision models may complement traditional tools

of planning and policy used by CBOs and other nonprofit actors. Chapter 3, "Community partners and neighborhood characteristics," introduces our partner organizations across the Boston metropolitan area in a quasi-case study framework and provides details of organization design, service area, technical capacity, and willingness/ability to participate in our study. Chapter 4, "Analytic approaches to foreclosure decision modeling," develops a theoretical and evidence-based framework for decision-modeling approaches to housing and community development, with a focus on foreclosed housing acquisition and redevelopment. In this chapter we address three fundamental questions that motivate the choice of analytic methods in housing and community development: Under what conditions are community development best practices sufficient to address physical blight and resident distress associated with housing foreclosures? When are methods from the decision sciences appropriate for housing foreclosure responses? What decision-modeling approaches are most appropriate for housing foreclosure response?

The second section, "Values, metrics and impacts for decision modeling," provides a basis for the prescriptive decision models that are at the core of the book. We introduce decision model components such as values and attributes, and decision variables and decision alternatives, and the objectives and constraints that can be constructed from them. Chapter 5, "Value-focused thinking: Defining, structuring and using CDC objectives in decision making," introduces a flexible, mixed-methods approach to defining objectives for decisions that is well suited to CBO decision making. We introduce the basics of value-focused thinking, illustrate its use in three cases, and analyze and explain the relevance of those cases to decision makers seeking to craft localized strategies for foreclosed housing acquisition and redevelopment.

Chapter 6, "Characteristics of acquisition opportunities: Strategic value," is inspired by a community partner's desire to develop programs, policies, and interventions that are consistent with a strategic plan, i.e. that are "strategic." We develop a formal mathematical model that is based on the insight that proximity to local amenities, and distance from local disamenities, determines the strategic value of a candidate housing acquisition by CBO. Using data from one of our community partners, we demonstrate that computed measures of strategic value vary in ways consistent with stakeholder's understanding of amenities and disamenities. We also demonstrate the potential social gains associated with the use of our model as compared to conventional practice. Chapter 7, "Characteristics of acquisition opportunities: Property value," is inspired by a community partner's expectation that its acquisition decisions maximize property value impact within its service area. We develop a procedure based on Markov chains and cost–benefit analysis to estimate

the aggregate impact on property values of nearby properties of a particular acquisition candidate in a given stage of the foreclosure process. As in the previous chapter, we demonstrate the potential for social gains associated with the use of this model as compared to current practice.

The third section, "Prescriptive Analysis and Findings," uses results from the previous three chapters to formulate and solve prescriptive quantitative decision models for foreclosed housing acquisition and redevelopment. Chapter 8, "Social benefits of decision modeling for foreclosed redevelopment," uses estimated strategic value and property value data computed in Chapters 6 and 7 to solve a simple mathematical program for foreclosed property acquisition. By applying various assumptions regarding strategic value and property value computations, we generate results which show policy-relevant variation in objective space and decision space. We also generate a range of estimates of social gains associated with a model-defined property acquisition strategy as compared to a baseline defined by acquisitions actually made by the community partner.

Chapter 9, "Acquiring and managing a portfolio of properties," introduces a more realistic decision-modeling framework for foreclosed housing acquisition and redevelopment. We address this question: Given the limitations in the amount of accessible funds and the uncertainty on the impacts of the foreclosure crisis, what are socially optimal acquisition policies that a CDC should implement while considering foreclosed properties for potential acquisition? By describing the choices and challenges a typical CDC faces when making bidding and acquisition decisions for candidate foreclosed housing units, we develop a stochastic and dynamic mathematical model of the foreclosed housing acquisition process. We apply this model to data from a community partner and derive numerical results for specific policies that can be used when making bidding or acquisition decisions on foreclosed properties.

Chapter 10, "Strategic acquisition investments across neighborhoods," focuses on a strategic problem faced by many CDCs: How should an organization design an investment strategy across multiple diverse neighborhoods to support efficient and equitable housing acquisitions? We develop a stochastic integer programming model to determine optimal resource allocations based on specific acquisition decisions, accounting for the inherent uncertainty in community development. We demonstrate the trade-offs between efficiency and equity associated with specific alternative acquisition strategies. Chapters 8, 9 and 10 constitute a collection of prescriptive decision models for foreclosed housing acquisition and redevelopment that reflect considerations of actual organizations and address various aspects of strategy design and operations practice. Solutions to these models provide specific

policy insights and guidance for practice that benefit professionals as well as scholars.

The concluding chapter, titled "Findings and opportunities in decision analytics for foreclosure response and community development," identifies specific findings, common themes and insights for theory and practice, and policy recommendations across all previous chapters. It concludes with a research agenda for CBOR that is inspired by our findings in local foreclosure response.

1.8 CONCLUSION

Over the last half-century, community development professionals have worked to apply insights from human capital development and physical capital development to improve the quality of life for residents and the physical quality of our neighborhoods. The frontiers of human capital development include the means by which early childhood interventions, improvements in the determinants of individual and community health, community schools, and local economic development can improve life outcomes for low- and moderate-income residents in cities, suburbs, and rural areas. As stated by Dr. Douglas Jutte, director of the Center for Community Development and Health:

> Where we live, work, learn and play dramatically affects the health of all Americans for better or for worse. The sometimes toxic relationship between how we live our lives and the economic, social and physical environments that surround us has resulted in some of America's most persistent health problems. At the same time, improving conditions in our homes, schools, workplaces and communities can help create greater opportunities for healthy lives. (Erickson, Galloway and Cytron, 2012, p. 388)

In the wake of the Great Recession, and the foreclosed housing crisis that precipitated the recession, it is essential for CBOs to make creative use of data to diagnose community conditions and design local investment strategies that are flexible and evidence-based. Through the lens of foreclosed housing acquisition and redevelopment, this book offers a way for multiple stakeholders to transform data into information, to design and implement investment strategies that reflect best available research and practice, and to evaluate and improve these strategies as local conditions change. We believe that

the models and methods discussed in this book represent a step toward the promise of the decision sciences to make tangible improvements in the lives of residents and in the ability of the local organizations to deploy human, technical, and financial resources to support the diverse needs of local residents. In so doing, researchers and professionals may generate innovations in policy, planning, and practice that balance the classical concerns of efficiency, effectiveness, and equity in service of sustainability and social justice.