September 11, 2018

Community Operational Research: A Survey of the Discipline

Michael P Johnson, Jr.
Gerald Midgley
Jason D Wright
George Chichirau, *University of Massachusetts Boston*

Community operational research: A survey of the discipline

Michael P. Johnson, PhD*[†]

George Midgley, PhD**[‡]

Jason Wright*

George Chichirau*

*University of Massachusetts Boston, USA
**University of Hull, UK
[†]michael.johnson@umb.edu
[‡]G.R.Midgley@hull.ac.uk

The Operational Research Society OR60 Annual Conference
Lancaster University, September 11, 2018

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

UMASS BOSTON

Agenda

- Introduction
- COR and its position in the discipline
- The EJOR special issue
- Emerging trends and new frontiers in COR
- Applications and extensions of COR
- Reflections and next steps

Acknowledgements

Funding:
- University of Hull
- National Science Foundation Faculty Early Career Development (CAREER) Program, "CAREER: Public-Sector Decision Modeling for Facility Location and Service Delivery"

Collaborators, supporters, thought leaders, sources of inspiration:
- Institute for Operations Research and the Management Sciences
  - Brian Denton, Past President
  - Melissa Moore, Executive Director
  - David Hunt, Chair, Pro Bono Analytics
  - Committee on Diversity, Equity and Inclusion
- Deborah Elizabeth Finn, Tech Networks of Boston
- Monica Lamboy, University of Massachusetts Boston
- Mark Daskin, University of Michigan
- Mark Warren, University of Massachusetts Boston
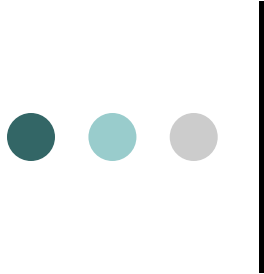- Jeffrey Keisler, University of Massachusetts Boston

High levels of social problems across developed world…

Measure	US	UK	OECD
Persons less than 50% of median income, 2014	17.4%	10.4%	11.4%
Change in median disposable income, 2007 – 2013	-0.4% (Median) 1.5% (Top 10%) -0.6% (Bottom 10%)	-0.8% (Median) -1.3% (Top 10%) 0.8% (Bottom 10%)	-0.03% (Median) -0.15% (Top 10%) -0.77% (Bottom 10%)
Gini inequality coefficient, 2014	0.394	0.358	0.317
Prison population, per 100,000, 2016	698	146	147
Public social spending, % of GDP, 2016	19.32	21.49	21.0
Life expectancy, 2014	78.8	81.4	80.6

Source: OECD (2016), *Society at a Glance 2016: OECD Social Indicators*

- US often worse off than UK, OECD

- Effects of Great Recession persist

- Impacts especially severe for youth ages 15 - 29

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON
UMASS BOSTON

Although decision sciences may provide an avenue for response…

- Addressing these problems requires focus on
  - Underrepresented/isolated/vulnerable populations
  - Localized as well as national-level responses
  - Recipients of social services and interventions as well as systems or physical infrastructure
  - Understanding of political economy and cultural and social context
- Traditional OR approach limited by technocratic, top-down, consultancy model
- A new approach should place value on needs of community members to identify, structure, model and solve problems and implement solutions
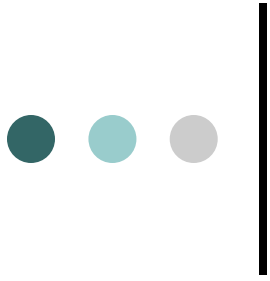
Research questions

How can OR/MS/analytics provide theory, models and applications that can improve lives of individuals and communities?

Can solution approaches balance rigor and generality with specificity and impact?

Is OR/MS/analytics as taught and practiced compatible with social change and social justice?

Community operational research can address social problems in an inclusive, scientific and transformational way

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

UMASS BOSTON

What is COR? How is it situated in the discipline?

Public-focused OR can add value to society…

- When individuals or organizations seeking better ways to deliver goods or services define value in ways not limited to 'profit'
  - Reduction in food insecurity
  - Preservation of biodiversity
  - Maximization of property values
- When the goods or services delivered are not primarily traded in 'markets'
  - Public safety
  - Human security
  - Environmental quality
- When beneficiaries of goods and services provision lack political or social influence to set policy priorities
  - Racial and ethnic minorities
  - Low- and moderate-income individuals
  - Residents of socially- or geographically-isolated communities

An OR application for public impact is distinguished by…

- Multiple stakeholders
  - Client/partner organization
  - Individuals and groups that experience externalities
  - Future generations
- Multiple objectives
  - Efficiency
  - Effectiveness
  - Equity
- Substantive engagement
  - Problem definition with, not just for, clients and stakeholders
  - Validation that solutions can generate improved social outcomes, not only improved process measures

Public-sector OR has had many successes…

- Design of policies for drug distribution to anticipate epidemic and pandemics
- Emergency management vehicle dispatch and scheduling
- Preservation of public safety against threats of terrorism
- Distribution of donated food to communities facing food insecurity
- Air transport management
- Hazardous materials distribution and storage
- Reserve management design

(and many others, see Pollock, Rothkopf and Barnett 1994, Larson and Odoni 2007, Kaplan 2016)

But many important public problems are not as well-understood

○ What measures of 'resiliency' are important to the well-being of vulnerable communities?

○ How can low-income communities choose redevelopment strategies that balance opportunity and protection?

○ What mix of energy development options are affordable to a wide range of populations?

○ How can a school district design a lottery system for public schools that balances desires for local access and academic excellence?

Problems that are hard to define (see e.g. Rosenhead and Mingers 2001), that require a deep understanding of local needs, and whose solutions depend on active community participation can be addressed using *community operational research*
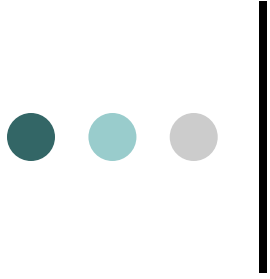
McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON
UMASS BOSTON

Characteristics of COR

Defining feature: *meaningful engagement of communities*

Key principles:

- Requires *intervention*, i.e. "purposeful by an agent to create change" (Midgley 2000)
- Local engagement and impact
- Concern for disadvantaged, underrepresented and underserved populations
- Focuses on problem-solving processes as well as outcomes
- Embodies a critical approach and a concern for ethics
- Methodological preference for qualitative and mixed methods approaches to problem-solving
- Prefer interventions that result in community empowerment and social change

COR can productively address many problems of social concern, including those outside areas traditionally associated with OR
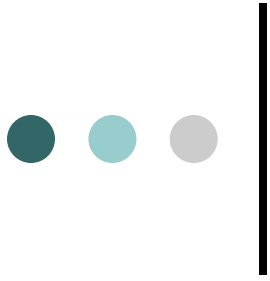
Designing and implementing effective COR responses is difficult…

Challenges:

- Ordinary citizens may lack analytic and problem-solving skills
- Requires broad and ongoing participation by multiple stakeholders
- Knowledge produced by COR supports learning for decision-making rather than model-generated prescriptions
- Lacks high-profile solutions and innovations associated with metaphors of logistics and business operations

Opportunities:

- Increased interest in OR for public good
- Distrust of government institutions provides space to reconcile technology and management with real-world understandings and problems
- Identify specific application areas where COR may generate insights, strategies and operational recommendations
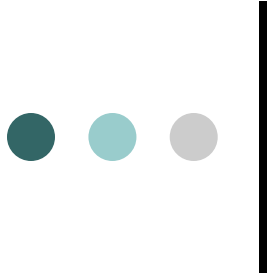
EJOR Special Issue on COR

We pursued this initiative because…

- We perceived differing traditions in OR between US and UK:
  - Acceptance of 'soft OR', 'problem structuring methods' and COR in UK but not US
  - 'Public-sector OR' in US tends not to distinguish between government, non-profit and civic associations
  - 'Community-based operations research' (CBOR) places less emphasis on participatory methods, co-creation, systems science and critical perspectives than COR
- Some time had passed since comprehensive publications in COR and related fields:
  - Midgley and Ochoa-Arias, 2004
  - Johnson, 2012
- Wanted to document trends in internationalization and representation of non-dominant groups in the discipline

EJOR Special issue

- Title: "Community Operational Research: Innovations, Internationalization and Agenda-Setting Applications" (August 2018)

- 31 papers plus editorial

- Resources:
  - Overview: https://umb.libguides.com/community operationalresearch/home
  - Elsevier main page: https://www.sciencedirect.com/journal /european-journal-of-operational-research/vol/268/issue/

- Paper categories:
  - (Re) Defining COR
  - Theoretical and methodological contributions
  - Prevention is better than cure: Working with youth
  - Working with indigenous people
  - Urban and community development and planning
  - Rural development
  - Interfaces with other practices and disciplines

Papers reflect substantial diversity

Methodology	Number of papers	Percentage
Mixed methods	6	19%
Qualitative	23	74%
Quantitative	2	6%

Analytics orientation	Number of papers	Percentage
Descriptive	22	71%
Prescriptive	9	29%

Author Gender	Number of papers	Percentage
Female	14	45%
Male	17	56%

Author racial/ethnic origin	Number of papers	Percentage
Asian	1	3%
Black/African	6	19%
Latino/South American	2	6%
White	22	71%

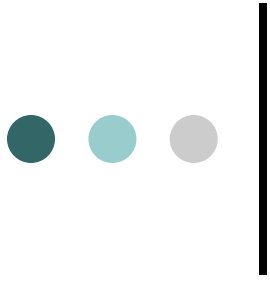| Geographical focus of paper	Number of papers	Percentage
Africa	3	10%
Asia	4	13%
Australasia	2	6%
Europe	13	42%
North America	4	13%
South America	2	6%
All countries	3	10%

Variety of approaches illustrate breadth of COR

Title	Developing a business analytics methodology: A case study in the foodbank sector	Co-designing the solution space for rural regeneration in a new World Heritage site: A Choice Experiments approach	Teaching Decision-Making and Building Resilience in Youth: A Case Study to Reduce the Supply of Vulnerable Youth to Sex Traffickers in Atlanta, Georgia
Purpose	Develop a multidimensional view of business practice for social impact that maximizes value-added	Design and evaluate alternatives for the redevelopment of properties in the vineyard region of northern Italy	Engage vulnerable populations to improve their capacity for personal decision-making to better resist the temptations of sex work
Methods	Rich picture diagramming, business model mapping, activity model design, business model canvas, spatial data analysis	Facilitated modeling, stakeholders analysis, spatial SWOT analysis, choice-based conjoint analysis	Interactive planning problem structuring method, value-focused thinking; individual decision-making based on resilience framework
Findings	Business analytics is an emergent mix of top-down analysis and bottom-up action and can be practiced as a collective and community endeavour.	Experiment results provide guidance about solution strategies for specific parcels, and communicate to leaders the importance of capacity-building for localized planning expertise	Illustrates contrast between perceived and actual development of decision-making skills in youth and provides an empirical assessment of value-focused decision-making in a peer mentoring setting

Community engagement, mixed methods and capacity-building are central to the research goals of these papers

What has the special issue taught us?

- Meaningful engagement of communities and concerned citizens can occur via government, nonprofits *and* business

- Methodological focus is diverse and inclusive:
  - Qualitative methods rooted in systems science, soft OR, problem structuring methods, critical analysis, participatory action research
  - Mixed-methods and quantitative methods rooted in analytics and decision modeling

- The US/non-US conflict between methodological perspective is not as strong as one might assume

- Primary conceptual emphasis is on nature of engagement and theory-building rather than data and analytics

Emerging trends and new frontiers in COR

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

UMASS
BOSTON

Emerging trends in OR subfields

- ○ Humanitarian logistics
  - ● Adaptation of logistics principles for planning for and responding to natural and man-made crises (Çelik et al. 2014)
  - ● Usually concerned with systems-level understanding and quantitative modeling and solutions
  - ● Community OR can integrate stakeholder experiences to address on-the-ground difficulties in disaster response (Munday 2015)

Emerging trends in OR subfields

- Analytics
  - Composed of descriptive analytics, predictive analytics and prescriptive analytics (Liberatore and Luo 2010)
  - Often seen as a 'superset' of OR
  - Linked with explosion of data, business redesign and IT/Web innovations
  - Community OR can emphasize qualitative data and methods, utility of data for individuals and communities, and role of communities in defining their own problems

New frontiers in domains outside of OR

○ Urban planning and community development

- Goal is to make homes, neighborhoods and cities better places to live for all

- Available tools include land use management, community organizing, design of products and services to meet needs of urban neighborhoods (Hall and Tewdwr-Jones 2010; Levy 2017)

- COR can connect theory and methods of planning and development with decision science principles of problem identification, formulation and solution that emphasize process learning and stakeholder impact (Johnson et al. 2016)

New frontiers in domains outside of OR

○ Information systems and information technology

- IS/IT is a well-studied field for design, development and evaluation of computerized tools and systems that crosses many disciplines

- However, IS/IT places less emphasis on community-engaged problem solving, and community OR has placed less emphasis on IS/IT for community interventions

- Participatory information systems, online community creation and engagement, localized applications addressing marginalized communities can be fruitful areas for community OR

New frontiers in domains outside of OR

- Big and difficult data

  - Public-sector applications of big data often reflect technocratic, consumer-focused, surveillance and enforcement concerns

  - Growing evidence of community participation in large-scale data analysis (Calvard 2016), community curation of datasets (Bertot et al. 2014) and community-driven understanding of data meaning (Couldry and Powell 2014)

  - 'Small' data can tax resources of community-based organizations (Johnson 2015)

  - Community OR can support development of locally-generated datasets and metrics, and data-driven decision models that embrace mixed methods

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

New frontiers in domains outside of OR

- ○ Smart cities
  - Common understanding emphasizes use of large datasets to improve operations and management of government and services through advanced technologies (Caragliu et al. 2009)
  - Many applications reflect centralized, expert-driven tools and applications and centrality of surveillance state (White and Trump 2016), though recent work (Batty et al. 2012) acknowledge potential of 'citizen science'
  - Community OR could influence design and implementation of smart city initiatives to reflect governance, digital divides and community concerns rather than technology and customer-facing applications

New frontiers in domains outside of OR

- Diversity and inclusion
  - *Diversity* addresses recognition of differences, both valued and stigmatized, that affect individual and group social outcomes; *Inclusion* reflects policies that enable organizations to better reflect community diversity
  - Many D&I problems are amenable to quantitative, model-driven solutions (Shi 2015; Chen and Kesten 2016), but complex problems confront political and social barriers
  - Community OR is well-positioned to contribute to diversity and inclusion, but more can be done to generate policies and prescriptions for organization design and service delivery

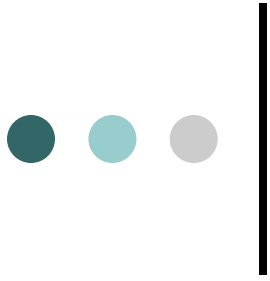# New frontiers in domains outside of OR

○ Indigenous people's issues

- 'First nations' populations struggle to achieve economic stability, cultural preservation and political empowerment in the face of cultural imperialism and exploitation by researchers (Smith 1999)

- COR has increasingly recognized issues of identity and indigenous problem-solving methods but struggled with conflicts between cultural norms (Midgley et al. 2007; Bishop 1996) that can inhibit Western-style research

- Community OR can deepen understanding of co-creation of problems and solutions and support development of culture-specific theories, methodologies and practices

New frontiers for practice

- Consultancies for third-sector (nonprofit) organizations
  - The Operational Research Society and INFORMS have recognized that mission-driven, resource-constrained not-for-profit organizations have special needs for analytics support
  - 'Pro Bono' initiatives are common in other disciplines: medicine, engineering, statistics
  - Community OR can enable organizations that provide essential services but which may be vulnerable to funding cuts to achieve individual and community impact and to advocate for social change

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

Applications and extensions of Community Operational Research

Pro Bono initiatives

Concerns of nonprofit/third-sector/charitable organizations:

- We have lots of different options for the future – which can we choose in such uncertain times?
- How can we make emotionally charged decisions with objectivity and rigor?
- How can we show that our programs change lives and improve communities?
- Should we start, expand, contract, terminate programs?
- Our funders want evidence of impact. How can we go beyond individual stories and case studies?
- Our staff are highly-trained and committed, but are distrustful of 'efficiency experts'. What can 'analytics' and 'OR' do for us?

Response:

- The Operational Research Society: Pro Bono OR (http://www.theorsociety.com/Pages/Probono/Probono.aspx)
- The Institute for Operations Research and the Management Sciences: Pro Bono Analytics (www.probonoanalytics.org)

COR is well-suited to assist nonprofits

- Engage clients and community members, not just organization staff
- Help understand the real problems to be solved
- Tell stories with qualitative and quantitative data
- Build capacity within the organization and in the community

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

UMASS
BOSTON

Examples of volunteer projects

Pro Bono Analytics

American Music Therapy Association
- Advances public awareness of the benefits of music therapy
- Decision analysis approach to assessing a proposed change in the credentialing of certified music therapists

Global Urban Observatory / UN Habitat
- Collects data and published "State of the World's Cities" report
- Developed Excel-based human vulnerability index, which added a missing dimension to the report

On the Rise Women & Children Shelter
- Daytime space provides safety and basic tangible needs, while building long-term relationships
- Tableau-based system to better evaluate services and communicate program effectiveness

Pro Bono OR

Disability Law Service
- Provides legal service to disabled people and their families/careers
- Used SWOT exercise and facilitated workshop to develop a sustainable set of priorities in the face of funding cuts

Kaleidoscope Enterprise, Ltd
- Provides services and advocacy to black and minority communities in Welwyn/Hatfield areas
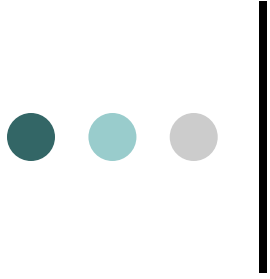- Workshop with all stakeholders produced action plan and mentoring opportunity for the manager

Reach – matching volunteers to charities
- Focus groups, interviews and document analysis produced ideas for process improvements
- Recommendations included short-term efficiency improvements and new service delivery model
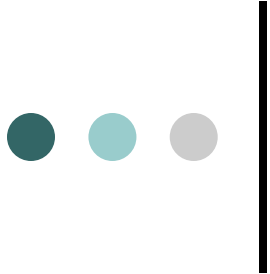
Pro Bono initiatives face challenges in integrating a COR approach

- Engaging community members, not just organization staff, is time-intensive and logistically difficult
- COR allows for ambiguity, iterative approaches and critical perspective – but organizations have problems to solve now!
- Nonprofit managers may have little exposure to analytics and OR

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

UMASS BOSTON

Diversity, equity and inclusion and COR

- Diversity initiatives can remedy past and current discrimination and structural barriers to opportunity
- They can help organizations reflect and respond to diverse stakeholders characteristics
- Successful initiatives require collaboration between affected groups and allies
- COR's focus on engagement and lived experience make it a promising approach

Contrasting conceptions and worldviews in diversity & inclusion modeling

- **Why we do it**: optimize organization efficiency vs. address structural social inequalities

- **What we know**: Positivist vs. interpretivist conception of data and modeling

- **Relationship type**: Client-consultant vs. community partner-engaged researcher

- **How we solve the problem**: Quantitative data and analytic methods vs. mixed-methods

- **How we design the intervention**: Technocratic/managerial vs. democratic/community-focused

> Who are we developing diversity and inclusion-focused decision models for (and with)?
> To what purpose will (should) these models be put?

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON
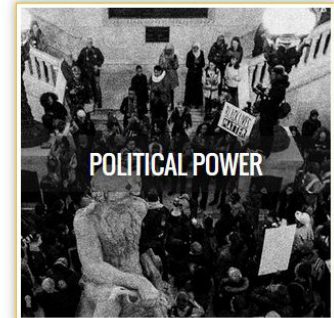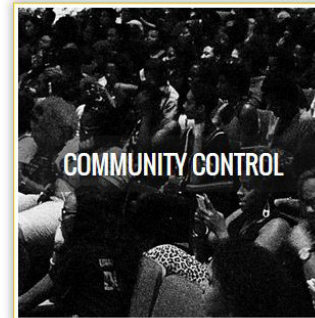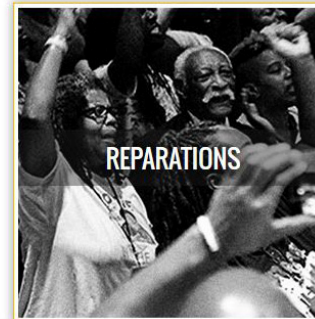
UMASS BOSTON

Opportunities for COR

- Systems thinking can emphasize outcomes (vs. outputs) and decision alternatives (vs. defined tasks)

- Problem-structuring methods such as value-focused thinking helps generate structures by which core values, goals, objectives, constraints, attributes and alternatives can be identified

- Social science-based research methods can document social inequities and benefits of diversity

- Challenging questions: Who is (not) at the table? Who vets the model? What framework is best?

Potential application: The Movement for Black Lives

Principles:

- Elevating the experiences and leadership of the most marginalized Black people
- Achieve a complete transformation of the current systems, which place profit over people
- Balance vision of a fundamentally different world with policies that address the immediate suffering of Black people

Movement for Black Lives policy platform
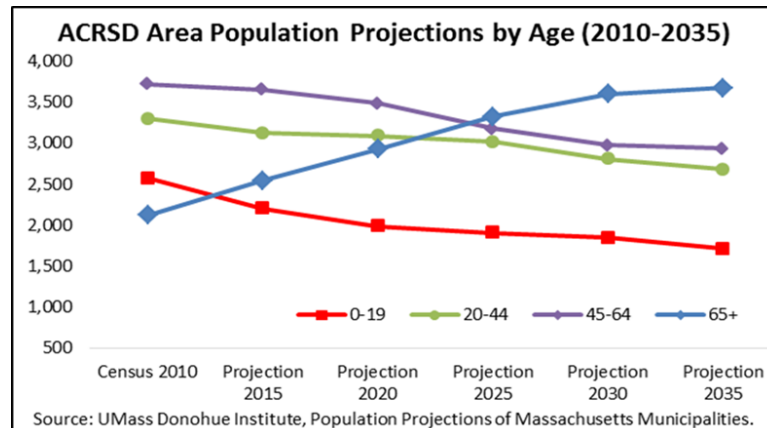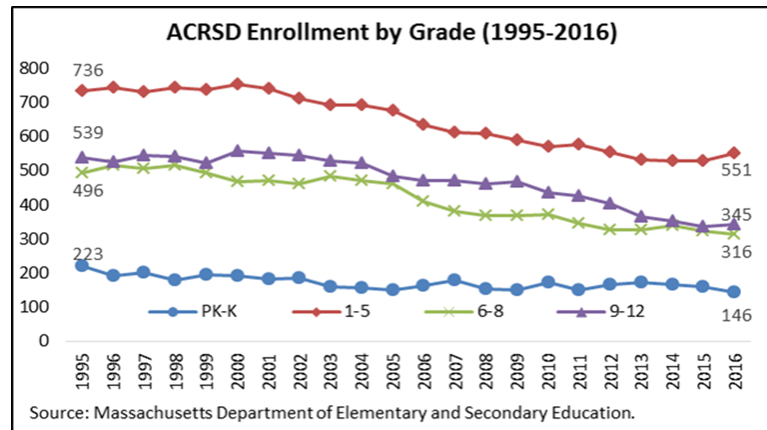(https://policy.m4bl.org/platform/)

Shrinking schools and declining regions

- Many cities and regions in the U.S. and in other countries face sustained declines in population, housing and economic activity in the wake of deindustrialization and the Great Recession

- School districts across the country face declining enrollments, aging infrastructure and low performance

- Results of shrinking districts include school closings, consolidations and cutbacks (National Center for Education Statistics 2010)

- Effects of school closings and student reassignments on student outcomes is ambiguous (Engberg, et al. 2012), but impacts on rural communities could be negative (Tyson 2005)

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON
UMASS BOSTON

Application: School consolidation in western MA, USA

ACRSD Enrollment by Grade (1995-2016)
Source: Massachusetts Department of Elementary and Secondary Education.

ACRSD Area Population Projections by Age (2010-2035)
Source: UMass Donohue Institute, Population Projections of Massachusetts Municipalities.

- Two school districts in face declining enrollments but resist the conventional response of school closures

- Usual OR-based approaches: planning models, efficiency and performance measurement models, and routing and scheduling models

- How can COR help stakeholders 'think different' about a controversial issue?

Community engagement helped build trust and generate new ideas

"Given the fact that hard decisions will have to be made, what do we Value? How might those values guide us?"

"What Creative Ideas do we have to strengthen the District financially and help students get a great education?"

Values analysis generated broad range of principles

'Core' Fundamental Value Maximize contribution of ACRSD to community sustainability	'Core' Fundamental Value Maximize student preparedness for the next phase of life
General Community Values • Strengthen local community • Improve educational outcomes • Increase district financial sustainability • Improve in-school experience • Increase system enrollment • Improve district administration and operations • Improve community image	**Student Values** • Strengthen community connections and values • Improve educational outcomes • Improve district financial sustainability • Improve in-school experience • Maximize community impacts
Community Performance Metrics • Student safety • Level of satisfaction with curriculum and programming • Educational quality • Level of engagement with the district • Level of satisfaction with the community • Perceived community quality • Building usage • Alternative sources of revenue • Budget surplus • Alternative district configurations • Level of employer-community engagement • Attractiveness of district for employer relocation/expansion	**Student-generated Performance Metrics** • Educational outcomes • Student satisfaction with classes and activities • Community cohesion • Town population levels • Level of student involvement with the community • Educational quality • Class sizes • Breadth of offerings • Savings from school consolidation • Funding levels

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON
UMASS BOSTON

Values analysis supported specific recommendations

Adams-Cheshire alternatives analysis: Best Practices & School Configurations								
	Associated objectives/values from public discussions			Associated metric/attribute from public discussions			Constraints/limitations/concerns from analyst discussions		
Alternatives	Value 1	Value 2	Value 3	Metric 1	Metric 2	Metric 3	Constraint 1	Constraint 2	Constraint 3
1. Transfer health benefits for current employees and retirees from the Berkshire Health Group to the Massachusetts Group Insurance Commission (GIC)	Increase district financial sustainability	Improve district administration and operations		Budget surplus	Funding levels		Hardships for low-income employees	Town/district reluctance to cede authority	
2. Transfer pension system assets from the Town of Adams' retirement system to a system with a better rate of return such as the State's Pension Reserves Investment Trust (PRIT)	Increase district financial sustainability	Improve district administration and operations		Budget surplus	Funding levels		Town/district reluctance to cede authority		
3. Undertake steps to reduce special education enrollment and costs to approach the state average	Improve in-school experience	Improve district financial sustainability		Educational quality	Funding levels		Limited staff for new SPED chair and committee	Limited resources to improve SPED data collection and analysis	Parent and teacher opposition
4. Increase enrollment in the high school by increasing offerings and incenting students/parents to choose HVHS	Improve educational outcomes	Improve community image		Educational quality	Level of satisfaction with the community	Attractiveness of district for employer relocation/ expansion	Administrative time and costs to build and manage partnerships		
5. Increase District-wide funding for professional learning to support District goals	Improve educational outcomes	Improve in-school experience		Educational quality	Student satisfaction with classes and activities	[Community] satisfaction with curriculum and programming	Need metrics to assess effectiveness	Increased professional support costs must be offset	
6. Reduce teacher absenteeism and provide funding for teacher substitutes as needed	Improve educational outcomes	Improve in-school experience		Educational quality	Student satisfaction with classes and activities	[Community] satisfaction with curriculum and programming	Teacher opposition	Increased costs of hiring substitutes must be offest	
7. Control/moderate fiscal impact of future teachers' cost of living and annual step increases on the budget	Increase district financial sustainability	Improve district administration and operations	Improve community image	Budget surplus	Funding levels		District may be less attractive to current and potential teachers		

Reflections on COR and related fields

- "Community-engaged OR" can describe OR models, interventions and theory to be performed in, with and on behalf of communities, especially those that are disadvantaged and/or lacking voice: COR, CBOR, others..?

- COR is distinguished by interventions in communities using direct collaborations with community members

- COR demonstrates a commitment to social justice and local impact that is consistent with disciplinary traditions of evidence, rigor and model-based analysis

- COR welcomes multiple methodological and analytical approaches: 'hard OR' as well as 'soft OR'

- Principles of diversity, inclusion, equity and critical approaches within COR can be a model for OR, STEM and society at large
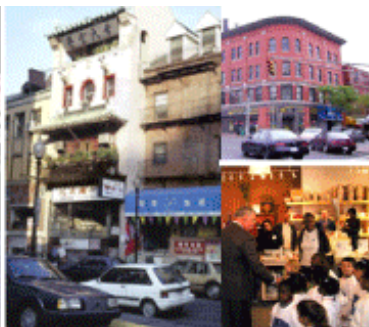
McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

UMASS BOSTON

Next steps

- Publish more COR in OR/MS outlets that have traditionally favored quantitative research

- …as well as scholarly outlets less-commonly used in OR/MS
  - Urban, community and regional planning
  - Policy and urban studies
  - Race, ethnicity and gender studies

- Deepen the theoretical understanding of COR
  - Costs and benefits of COR as compared to other approaches
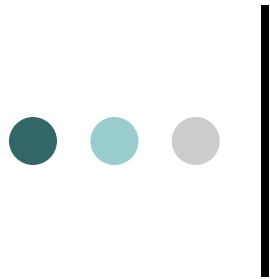 - Increased use and justification of multi-methods

McCORMACK GRADUATE SCHOOL OF POLICY STUDIES
UNIVERSITY OF MASSACHUSETTS BOSTON

UMASS
BOSTON

Thank you!

Questions?

Selected references

Johnson, M.P. (Ed.) 2012. *Community-Based Operations Research: Decision Modeling for Local Impact and Diverse Populations*. New York: Springer.

Johnson, M.P., Midgley, G. and G. Chichirau. 2018. Emerging Trends and New Frontiers in Community Operational Research. *European Journal of Operational Research: Special Issue: Community Operational Research: Innovations, Internationalization and Agenda-Setting Applications* **268**(3): 1178 - 1191.

Kaplan, E. H. 2008. Adventures in policy modeling! Operations research in the community and beyond. *Omega* **36**(1): 1 – 9.

Midgley, G., Johnson, M.P. and G. Chichirau. 2018. What is Community Operational Research? *European Journal of Operational Research: Special Issue: Community Operational Research: Innovations, Internationalization and Agenda-Setting Applications* **268**(3): 771 – 783.

Midgley, G. and A. Ochoa-Arias (Eds.) 2004. *Community Operational Research: OR and Systems Thinking for Community Development*. New York: Kluwer Academic/Plenum Publishers.

Pollock, S.M., Rothkopf, M.H. and A. Barnett (Eds.) 1994. *Handbooks in Operations Research and Management Science, Vol. 6: Operations Research and the Public Sector*. Amsterdam: North-Holland.

Rosenhead, J. and J. Mingers (Eds.) 2001. *Rational Analysis for a Problematic World Revisited: Problem Structuring Methods for Complexity, Uncertainty and Conflict, Second Ed*. Chichester, UK: John Wiley & Sons, Ltd.