Building an Adaptive System for Multiple Policy Goals in Cities

Alfred Ho, Ph.D., Elaina J. Sutley, Ph.D., Alexandra Kondyli, Ph.D., Bonnie Johnson, Ph.D.

City Management as an Adaptive System

Cities are dynamic clusters of economic activities, social interactions, cultural assets, and meanings [2]. Between day and night times, between weekdays and weekends, and during different events and seasons, the flows of people, goods, and capital in and out of a metropolitan area fluctuate dramatically. The dynamics of city life and the exchange of information as a complex system are the driving forces that propel creative activities and economic vitality [3,6].

At the same time, the surge and decline of people and traffic, the wide distribution of income and economic opportunities, and the varying expectations of the diverse population can create significant challenges for city leaders. These problems create a lot of uncertainty and system stress in the planning and day-to-day operations of governmental services.

To address these challenges, decision-makers in "smart cities" try to understand the economic and social dynamics of city activities, use relevant and reliable data and information to make responsive decisions, engage their stakeholders proactively, and align resource allocation and program activities with community values and goals [4,7]. In this process, multi-sectoral partnership, shared knowledge, and intelligent coordination among actors are emphasized [1].

Implication for Kansas City, Missouri

In recent years, Kansas City has experienced downtown revitalization and new opportunities for economic growth. For example, the availability of Google Fiber network has created new buzz for the city and stimulates entrepreneurial activities related to high-tech development. The introduction of Street Car has also led to new excitement for business, tourist and residential development in the downtown area.

At the same time, like many urban areas, Kansas City struggles with crime problems. During the summer, the downtown entertainment districts also have to deal with unruly behavior and congregating youth problems. The east side of the city is a hotbed for crime and social problems. Inequality in development can endanger the long-term progress and economic potential of the city.

To manage these urban challenges, we propose to think about urban management of Kansas City as a multi-objective optimization problem in a complex system. In general, city leaders have the following policy objectives: (1) to ensure public safety; (2) to enhance public satisfaction with quality of life and amenities; (3) to ensure the cost-efficiency of public programs; 4) to enhance customer services for visitors, businesses, and local residents and keep them informed about where and how to get the services they need; 5) to ensure equitable access to public services and equal opportunities for all to be heard in the decision-making process. In a complex system, these objectives are not separable and can be mutually reinforcing. For example, better public safety will lead to greater satisfaction with quality of life, but this relies on the cost-efficiency and effectiveness of the police, good customer service of city programs, strong public support and trust in city government, and equitable access to essential public services by the needy population.

Using data from city and county departments in the metropolitan area and quarterly citizen survey results of Kansas City, the relationship between public service outcomes, public safety conditions, economic opportunities, and public satisfaction can be analyzed as a system to understand how factors are significantly related to each other and what geographical areas need more policy attention. This data-driven approach puts evidence into community dialogues and can foster multi-

departmental actions and regional collaboration among government agencies and community organizations.

In this data-driven approach to policymaking, tools like multi-objective optimization algorithms can be used to identify optimal solutions based on decision maker preferences and policy objectives discussed above [5]. A realistic multi-objective optimization algorithm (MOOA) can be formulated using various city and county data. Additional data can also be collected through crowd-sourcing and by city sensors placed in different locations.

For example, a MOOA can be used to analyze the optimal deployment of police officers in the Street Car Corridor to balance public safety concerns of visitors, local residents, and business owners, public expectation to have fun in the area, the expected level of responsiveness by the police, the concern of traffic flows, and the perception of police presence by different racial groups. Machine learning and instant update of the algorithm results can be done to assist public safety decision-making, and if necessary, inform the public to foster more effective crowd control. MOOAs can help transportation planning and neighborhood development. Data from sensors and smartphones can be used to analyze traffic patterns. The data can be joined with neighborhood data, analysis of social and/or economic segregation, and the location of economic opportunities to understand how economic development and tax incentive policies should be re-formulated to help the needy population more. Finally, MOOAs can be used to rethink community resilience and disaster management. Data about traffic flows, economic activities, housing patterns, location of vulnerable facilities and population, and capacity of health care facilities and community shelters can be analyzed to track preparedness and optimize emergency response actions. Community involvement and public education can be then planned more effectively to help local residents understand their vulnerability and what they should do more.

Summary

Many urban policy challenges can be viewed as a complex system. Data analytics, such as multi-objective optimization algorithms, can be used to help policymakers address them proactively and responsively. Effective use of these tools, however, require a smart governance structure that encourages evidence-based policymaking, organizational learning, and multi-departmental and sectoral partnership. Technical analysis by itself does not guarantee smartness and outcomes of policy execution.

References

1. Batty, M., Axhausen, K. Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., and Portugali, Y. "Smart cities of the future." European Physical Journal, 214: 481-518.
2. Castells, M. The Rise of the Network Society. Malden, MA: Blackwell (1996).
3. Comunian, Roberta (2011). "Rethinking the creative city: The role of complexity, networks and interactions in the urban creative economy." Urban Studies, vol. 48, no. 6 (2011): 1157-1179.
4. Goldsmith, Stephen, and Crawford, Susan. The Responsive City: Engaging Communities through Data-Smart Governance. San Francisco, CA: Jossey-Bass (2014).
5. Jennings, E. "A Multi-Objective Community-Level Seismic Retrofit Optimization Combining Social Vulnerability with an Engineering Framework for Community Resiliency." Dissertation. Dept. of Civil and Env. Eng. Colorado State University, 2015.
6. Stock, Wolfgang G. "Informational cities: Analysis and construction of cities in the knowledge society." Journal of the American Society for Information Science and Technology, vol. 62, no. 5(2011): 963-986.
7. Yin, ChuanTao, Zhang Xiong, Hui Chen, Jingyuan Wang, and Daven Cooper. "A literature survey on smart cities." Science China: Information Sciences, vol. 58, no. 10 (2015): 1-18.

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