GOOD SYSTEMS
A UT Grand Challenge

Good Systems Year 2 Funding Proposal: Tier III

Tier III
Up to $200,000 Up to 12 months
Creation of City of Austin-centered research proposals to advance research in one or more of the Good Systems research areas. Tier III Project awards, up to $200,000 per award, will go to well-established and mobilized groups that include at least one current Good Systems Network member and a City of Austin stakeholder partner.

Project Title	Smart Cities Should Be Good Cities: AI, Equity, and Homelessness
Proposal Contact	Sherri Greenberg, LBJ School of Public Affairs, srgreenberg@austin.utexas.edu
Research Area(s) (select one or more from the list at right)	x **DEFINE**: What does it mean for a system that uses AI technology to be good? x **EVALUATE**: How do we decide if it is good (or not)? x **BUILD**: How can we best build good systems?
Total funding requested	$194,680

Project Team:

Table 1: Project Team

Full Name	**Title**	**Department**	**Email**
Sherri R. Greenberg	Professor of Practice	LBJ School of Public Affairs	srgreenberg@austin.utexas.edu
Min Kyung Lee	Assistant Professor	School of Information	minkyung.lee@austin.utexas.edu
Stephen C. Slota	Postdoctoral Fellow	School of Information	steveslota@gmail.com
Kenneth R. Fleischmann	Professor	School of Information	kfleisch@ischool.utexas.edu
James Snow	Assistant Director	City of Austin Public Works Department	james.snow@austintexas.gov
Khalil Bholat	Division Manager, Information Technology	City of Austin Public Works Department	khalil.bholat@austintexas.gov
Divya Rathanlal	IT Manager	City of Austin: Communications and Technology Management	divya.rathanlal@austintexas.gov
Jonathan Tomko	Business Process Consultant	City of Austin: Neighborhood Housing and Community Development	jonathan.tomko@austintexas.gov

Sherri researches housing instability, healthcare, and digital inclusion[1], works on the Austin Affordable Housing Data and Search Tools, serves on the Housing Investment Review Committee, and serves as Chair of Central Health. Min has done research on using AI techniques to assist underserved populations such as food-insecure or homeless populations[2,3,4]. Steve researches knowledge infrastructure and its

dynamics in science, policy and society[5,6] as well as values and IT design. Ken has done research on use of social media by individuals experiencing homelessness[7,8,9] and received the 2019 Civic Futures Award for Designing for the 100%. James's military, private, and public sector leadership experience focuses on providing systems and solutions that create community-focused, and outcome-driven cultures of operational excellence. Khalil leverages strategic planning, solution development, change management, iterative development, and infrastructure enhancement to lead private and public-sector organizations in digital transformation efforts such as the Homeless Encampment Right of Way app. Divya leads the emerging technology initiative under the Office of the Chief Technology Officer championing programs such as the Austin Affordable Housing Data and Search Tools as well as the Homelessness Dashboard. Jonathan collaborated on developing the Austin Affordable Housing Data and Search Tools as well as the Affordable Housing Inventory.

Together, our team spans technical, social scientific, and humanistic expertise. Sherri holds degrees in Government, and Public Administration and Policy. Min holds degrees in Industrial Design, Interaction Design, and Human-Computer Interaction. Steve holds degrees in Creative Writing, Library and Information Science, and Informatics. Ken holds degrees in Computer Science, Anthropology, and Science and Technology Studies. The project team will include GRAs from LBJ and the iSchool and three undergraduate students from both humanities and social science programs in COLA (recruited in part from Fleischmann's Good Systems Signature Course).

Our UT-Austin team members will collaborate closely with our City of Austin team members, along with partners in organizations including Austin Ending Community Homelessness Coalition, Central Health, Travis County, Integral Care, and Housing Authority of the City of Austin. The components of the research project will be led by cross-organization teams that will meet weekly via Zoom, and all UT-Austin and City of Austin team members, as well as periodically invited members from other organizations, will meet every two weeks to share progress and plan next steps, ensuring the convergence and coherence of the interdisciplinary research and the adoption of the findings by City of Austin.

Rationale:

Public health messaging during the COVID-19 pandemic emphasizes "shelter-in-place," "stay-at-home," and "safer at home." This messaging assumes that everyone has a safe place to shelter, a home. Unfortunately, many Austinites, as well as many Texans, Americans, and people worldwide, are experiencing homelessness. During this crisis, we must consider our most vulnerable populations, including the homeless -- not just due to the threat of infection, but also the resulting food insecurity and societal instability. As Austin becomes a smart city, we must also ensure it is a good city. We will leverage AI to benefit individuals experiencing homelessness, both directly by empowering them with information about available services and by helping those who help them.

Advancements in technology can reduce global inequalities, or they can exacerbate existing inequalities, or create new ones[10]. Ensuring that technology achieves societal goals requires us to consider the values of all stakeholders and how to leverage technology to serve everyone in society[11], with a particular emphasis on doing the greatest good for those who are most disadvantaged[12]. The goal of the proposed research is to leverage AI to benefit society, starting locally within the City of Austin, with a particular

focus on helping the most one of our most vulnerable communities, Austin residents who are experiencing homelessness.

Homelessness is a 'wicked problem'[13,14,15] characterized by its complexity, sociality, and heterogeneity of stakeholders and interested parties across governments and nonprofits. Homelessness is experienced as a complex and multi-dimensional continuum, ranging from 1) housing instability to reintegration from incarceration, 2) couch-surfing to street homelessness, and 3) from episodic to chronic homelessness, wherein individuals move to, from, and across dynamically[7].

The goal of this project is to study how to better provide wrap-around services to individuals on the homelessness continuum in the City of Austin, as well as how to assist local governments and nonprofits seeking to serve those individuals. Part of the solution lies in consolidating all of the existing data stored in various databases, formats, etc., while another part lies in making sure that all stakeholders' voices are heard. As a wicked problem, addressing current gaps in policy and services relevant to homelessness requires an interdisciplinary approach that is both predictive and summative, qualitative and quantitative. These improvements can help the City of Austin achieve its strategic outcome of Government that Works for All.

Novelty/Innovation:

AI has the potential to transform cities into smart cities through innovations such as smart homes and autonomous vehicles. Less research has focused on how to leverage AI to benefit vulnerable populations such as individuals on the homelessness continuum. Even fewer studies have had a noticeable impact on improving equity in communities, due to typical disconnects between academia and government. The novelty of this project derives from the interdisciplinary, cross-institution collaboration between the City of Austin and UT-Austin. Our innovative research will transform services for those experiencing homelessness in Austin, using AI to make Austin a good city.

Project Description:

Research Questions:

RQ1. What information and service needs do individuals experiencing homelessness have?
RQ2. What information do agencies serving these individuals need to identify gaps in messaging and services?
RQ3. How can we leverage AI to assist agencies to serve, inform, and empower individuals experiencing homelessness?

Research Aims:

Aim 1: We will conduct field research to understand the information and service needs of individuals on the homelessness continuum. First, we will analyze the dataset generated by The City of Austin Bloomberg iTeam, which conducted field research with individuals on the homelessness continuum, including identifying data useful for this project and gaps in relation to this project. Then, we will augment this dataset with a new set of interviews with individuals across the homelessness continuum focusing on their information needs. Finally, we will use thematic analysis to identify gaps in the services explored in Aim 2 and insights that can be leveraged as features for AI in Aim 3.

Aim 2: We will use field data collection to understand information needs of agencies serving individuals on the homelessness continuum. First, we will analyze the websites and reports from governmental and nonprofit providers. Based on our analysis we will conduct interviews with staff of government and nonprofit service providers. Finally, we will use thematic analysis to compare service providers' perspectives with those of users in Aim 1 and feed into identifying gaps in existing information resources that will be filled through AI in Aim 3.

Aim 3: We will apply AI to empower individuals experiencing homelessness and assist agencies. We will leverage datasets listed under City of Austin Data/Resources. Applying time-series and clustering modeling and other general predictive modeling techniques, we will analyze data to understand factors contributing to homelessness, and identify gaps in social services that, when filled, can improve individuals' lives across the homelessness continuum, and decrease the likelihood that individuals would find themselves on this continuum and empower people on this continuum to improve their situations. In this process, we will investigate how qualitative insights from Aims 1&2 can improve analytics, employing features and needs identified in Aim 1 and exploring the gaps identified in Aim 2. Our AI research will lead to refinements to user-facing and social service provider-facing systems. We also will compare where social services are provided and where they are most needed. The resulting AI-based tools will help decision-makers to identify where services are most needed and how to deploy those services, and offer personalized recommendations to individuals on the homelessness continuum.

Collaboration Plan:
Each Aim will be led by an interdisciplinary, cross-organization subteam. Aim 1 will be led by Steve (critical infrastructure studies), Ken (social media use by individuals across the homelessness continuum), and Jonathan (affordable housing). Aim 2 will be led by Sherri (public policy on homelessness) and James (public works management), who will leverage their established relationships with local governments and nonprofits to coordinate outreach and engagement with these organizations. Aim 3 will be led by Min (AI and crowdsourcing-based research on information needs of individuals across the homelessness continuum), Khalil (homeless encampment cleanup app), and Divya (digital transformation).

Our research will incorporate a collaborative feedback loop, whereby the three Aims concurrently interact to determine and align the needs and wants of government and nonprofit staff and end users, and develop AI-based interventions. Collaboration between Aims 1&2 will focus on exploring the relationships among social service providers and those whom they serve, identifying mismatches in information, services, and expectations. Collaboration between Aims 1&3 will involve the development of a recommender system to connect individuals across the homelessness continuum with needed information and services. Collaboration between Aims 2&3 will apply predictive modeling techniques to identify where social services are most needed and useful.

All three Aims will be integrated and inform each other, through full team meetings. This project is feasible because the research team includes key stakeholders across the City of Austin, and the project will directly build upon the Austin Affordable Housing Data and Search Tools, which have been developed by a team including Jonathan, Sherri, and Divya, thus creating a through-line across all three aims. Hence, our research has significant potential for both scholarly and societal impact.

Table 2: Schedule of Proposed Activities

			Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Aim 1	**Homelessness Continuum**	Identification and analysis of existing datasets												
		Design of interview instrument												
		Conduct interviews												
		Analyzing data												
		Focus group to share and evaluate results												
		Compare results with Aim 2												
		Feed data into Aim 3												
		Focus group to evaluate resulting tool												
Aim 2	**Social Service Providers**	Identification and analysis of existing datasets												
		Design of interview instrument												
		Conduct interviews												
		Analyzing data												
		Collaborative design workshop #1												
		Compare results with Aim 1												
		Feed data into Aim 3												
		Collaborative design workshop #2												
Aim 3	**AI application**	Identification & classification of existing datasets												
		Dataset anonymization & integration												
		Data analysis & modeling												
		System development												
		UX design & delivery of predictive model												
		UX design & delivery of recommender system												
		Share tools with Aims 1&2												
		Incorporate feedback from Aims 1&2												

Dissemination Plan:

We will share research outcomes with our scholarly communities through conferences such as CSCW, CHI, AIES, ASIS&T, ASPA, and NASPA (including travel support for the postdoc and students). We will publish in data science, information science, and policy journals, including *AI and Society*, *JASIST*, and *American Review of Public Administration*. We will publish reports and papers documenting the study's findings and share our datasets through the Austin Open Data Portal and our codebases through GitHub.

To ensure that this research addresses a real societal need, we will disseminate this study's findings to social service providers who can leverage our research. A crucial part of dissemination will be incorporating our results into tools developed by the City of Austin such as the Austin Affordable Housing Data and Search Tools, leveraging AI to better serve individuals across the homelessness continuum and those at risk of entering and having recently exited the continuum. Our interdisciplinary, cross-organization team will directly influence government policy, leading to improvements in the lives of individuals across and beyond the homelessness continuum.

We also seek to make an impact beyond Austin. Hence, we will present at professional conferences such as the International City Manager Association and the US Conference of Mayors and publicize our reports broadly, so that social service providers in other cities can apply our findings in their communities, and so researchers at other universities can leverage the strategies we develop through this project for promoting mutually beneficial collaboration across universities, governments, and nonprofits.

Anticipated Opportunities for External Funding:

Our research team is keen to pursue external funding for this research. Sherri and Ken currently are funded by Cisco Research Center for a very different project on the ethical, legal, and policy dimensions of AI broadly, but given the emphasis that Cisco places on Smart Cities, we will leverage our existing connections and record of performance, plus preliminary data through this project, to seek new funding on this topic from Cisco Research Center.

Min and Ken have collaborative proposals currently under review at JP Morgan Chase (with Joydeep Ghosh) and NSF (with Bo Xie). While the topics of these proposals are also quite different, we note that one of the other funding opportunities provided by JP Morgan Chase is the $500 million *Advancing Cities* initiative, which focuses on partnerships between nonprofits, academia, and government; this project would provide a compelling proof of concept of the collaborative relationship that exists across these organizations that could result in future transformative research at a much larger scale.

The NSF Smart and Connected Communities (S&CC) program is also promising; Min, Steve, and Ken have separate proposals currently under review at S&CC, but the preliminary research that would be enabled through this project would allow us to submit a much stronger proposal. We will also pursue funding from federal agencies such as HUD, DOT, and DOE; State of Texas funding; funding from foundations

such as Ford, Living Cities, Arnold, Kresge, Bloomberg, and Calvert; and funding from additional social impact investors including Goldman Sachs, and Morgan Stanley Dean Witter.

Requested resources:

City of Austin Data/Resources

City datasets are dynamic and growing. We will remain proactive in seeking access to novel datasets from municipal partners throughout Central Texas, such as City of Austin Departments that provide social and medical services, provide storage solutions, and provide utility services such as site cleaning and debris collection, and nonprofit partners that provide wrap around services. The research team will have access to interview staff who span the horizontal and vertical of organizations across the service spectrum. Data, reports, and conclusions drawn from prior research conducted by the City of Austin Bloomberg iTeam will inform our field research.

Resources that we intend to use will include data drawn from the Affordable Housing Data and Search Tools, which contains a listing of all rental income-restricted affordable housing within the City of Austin. This includes income-restricted units from governmental agencies (Housing Authority City of Austin, Neighborhood Housing and Community Development, Housing Authority of Travis County, and the Texas Department of Housing and Community Affairs) and some market-rate properties that accept a large number of Housing Choice Vouchers. The Search Tool will show housing units that match the prospective tenants' household income and household size according to the Department of Housing and Urban Development. Each property also has detailed information that helps prospective tenants find housing that best meets their needs.

We also will access data collected through the Affordable Housing Inventory (AHI), which includes locations and contact information for affordable housing, the types and income restrictions required for certain units, and the different City programs under which the projects were funded. The Open Data Portal also offers a digital map version of the inventory to get a spatial relationship of what units are available or where.

Finally, we will make use of the Homeless Encampment Cleanup Geospatial Application, which includes locations, frequency of reported observances, and living conditions of sites reported and visited throughout Austin. The data portal offers a digital map of the data collected with a spatial relationship of frequency of reporting by citizens as well as a picture of conditions before and after site cleanup.

In addition to data drawn from the above resources, we will make use of the following publicly available datasets:

Table 3: Publicly Available Datasets

Database Name	**Responsible Agency or Department**	**Contents of the Database**
Annual Sheltered HMIS Count[16]	Ending Community Homelessness Coalition (ECHO)	Information on individuals experiencing sheltered homelessness in the Austin/Travis County Continuum of Care (CoC) in a given fiscal year.
Number of Individuals and Families who are Homeless in Austin Travis County Emergency Medical Services (ATCEMS)[17]	U.S. Housing and Urban Development (HUD)	Point in Time Count from 2007 to 2019 broken down by Families and Individuals and intersecting with Sheltered and Unsheltered categories.
Number of persons who successfully exit from homelessness[18]	ECHO	Number of persons who successfully exit from homelessness in a given fiscal year in the Austin/Travis County Continuum of Care (CoC).
Pop Up Resource Clinics Services[19]	City of Austin (COA) & Austin/ Travis County Emergency Medical Services	Number and type of services delivered to people experiencing homelessness through Austin/Travis County Emergency Medical Services' Pop Up Resource Clinics. From November 2017 to the present.
Comprehensive Affordable Housing Directory[20]	COA/ Neighborhood Housing and Community Development	All income-restricted housing within the Austin Full Purpose and into the 5-mile Extra Territorial Jurisdiction. This includes properties funded by the City of Austin along with the Housing Authority City of Austin, Housing Authority of Travis County, and Texas Department of Housing and Community Affairs
Comprehensive Affordable Housing Inventory[21]	COA /Neighborhood Housing and Community Development	The City of Austin Affordable Housing Inventory (AHI) includes all income-restricted affordable units in developments funded through the Housing Development Assistance Programs and incentivized through Development Incentive Programs that are currently affordable.

Requested budget overview (totals only):

Table 4: Budget Overview

Category	Budget
Personnel	$159,713
Tuition	$24,733
Equipment & Supplies	$3,645
Events/Workshops	$1,700
Travel	$4,200
Total funding request	$194,680

References:

1. Greenberg, Sherri. “Housing+ Social and Economic Mobility.” report prepared through the Lyndon B. Johnson School of Public Affairs, University of Texas at Austin, (July 27, 2018).
2. Kahng, Anson, Min Kyung Lee, Ritesh Noothigattu, Ariel Procaccia, and Christos-Alexandros Psomas. "Statistical Foundations of Virtual Democracy." In *International Conference on Machine Learning*, (2019): 3173-3182.
3. Lee, Min Kyung, Daniel Kusbit, Anson Kahng, Ji Tae Kim, Xinran Yuan, Allissa Chan, Daniel See et al. "WeBuildAI: Participatory framework for algorithmic governance." *Proceedings of the ACM: Human-Computer Interaction*, no. 3 CSCW (2019): 1-35.
4. Tsai, Huey-Ru, Yasser Shoukry, Min Kyung Lee, and Vasumathi Raman. "Towards a socially responsible smart city: dynamic resource allocation for smarter community service." In *Proceedings of the 4th ACM International Conference on Systems for Energy-Efficient Built Environments* (2017): 1-4.
5. Slota, Stephen C., and Geoffrey C. Bowker. "How infrastructures matter." In Ed. Clark A. Miller, Laurel Smith-Doerr, Ulrike Felt. *The handbook of science and technology studies* (London, UK: MIT Press, 2017): 529-554.
6. Slota, Steve, and Geoffrey C. Bowker. "On the value of "useless data": Infrastructures, biodiversity, and policy." *iConference 2015 Proceedings* (2015).
7. Koepfler, J.A. & Fleischmann, K.R. “Studying the Values of Hard-to-Reach Populations: Content Analysis of Tweets by the 21st Century Homeless.” *Proceedings of the 7th Annual iConference, Toronto, Canada* (2012).
8. Koepfler, J.A., Shilton, K., & Fleischmann, K.R. 2013. “A Stake in the Issue of Homelessness: Identifying Values of Interest for Design in Online Communities.” *Proceedings of the 6th International Conference on Communities and Technologies*, *Munich, Germany* (2013).
9. Koepfler, J A., Templeton, T.C., & Fleischmann, K.R. “Exploration of Values and Frames in Social Media Texts Related to the Homeless Hotspots Debate.” *Proceedings of the 75th Annual Meeting of the American Society for Information Science and Technology, Baltimore*, MD (2012).
10. Jaumotte, Florence, Subir Lall, and Chris Papageorgiou. "Rising income inequality: technology, or trade and financial globalization?." *IMF Economic Review* 61, no. 2 (2013): 271-309.
11. Fleischmann, Kenneth R. "Information and human values." *Synthesis Lectures on Information Concepts, Retrieval, and Services* 5, no. 5 (2013): 1-99.
12. Rawls, J. *A theory of justice*. (Cambridge, MA: Harvard University Press, 1971).
13. Buchanan, Richard. "Wicked problems in design thinking." *Design issues* 8, no. 2 (1992): 5-21.
14. Head, Brian W. "Wicked problems in public policy." *Public policy* 3, no. 2 (2008): 101.

15. Churchman, C. West. “Wicked Problems." *Management Science* 14, no. 4 (1967): 141-2.
16. https://catalog.data.gov/dataset/strategic-measure-number-of-persons-experiencing-homelessness-annual-sheltered-hmis-count
17. https://data.austintexas.gov/dataset/Number-of-Individuals-and-Families-that-are-Homele/x77n-2tsw
18. https://data.austintexas.gov/Health-and-Community-Services/Strategic-Measure_Number-of-persons-who-successful/3yhd-8eiv
19. https://data.austintexas.gov/dataset/Pop-Up-Resource-Clinics-Services/czzw-4f5n
20. https://data.austintexas.gov/Housing-and-Real-Estate/Comprehensive-Affordable-Housing-Directory/4syj-z4ky/data
21. https://data.austintexas.gov/Housing-and-Real-Estate/City-of-Austin-Affordable-Housing-Inventory-AHI-/x5p7-qyuv/data