Smart Cities in Application

Stan McClellan
Editor

Smart Cities in Application

Healthcare, Policy, and Innovation

Springer

Editor
Stan McClellan
Ingram School of Engineering
Texas State University
San Marcos, TX, USA

ISBN 978-3-030-19395-9 ISBN 978-3-030-19396-6 (eBook)
https://doi.org/10.1007/978-3-030-19396-6

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword to "Smart Cities in Application"

"Please Text, Don't Drive"

As funny as that sounds, it was the statement I made at the Regional Transportation Council, the independent transportation policy body of the North Texas Metropolitan Planning Organization. We had just received an update on autonomous vehicles from the National Highway Traffic Safety Administration (NHTSA). I was partly trying to be funny, but also serious at the same time. When we reach full "level six automation", the consensus is that will actually be safer to text while you drive than driving your vehicle yourself! So what is our future really going to bring?

As the Former Mayor of Frisco, Texas, a board member for Collin College Educational Foundation, a commissioner for the State of Texas Red River Boundary Commission, and a CEO of the Prosper Economic Development Corporation, it has been an honor and privilege to serve my local community during complex transitions and astounding growth. I have witnessed the implementation of many incredibly valuable technologies, applications, and concepts which revolutionize the management of municipal facilities and assist the educators, public safety officials, and city management in improving the lives of the citizens and neighbors. In my current role as a Principal at Ryan, LLC, I advise cities, counties, and states on best practices, and I represent companies as they look for sites in this thriving new frontier of "Smart Cities."

You will see a focus on Smart Cities in this book, but what does that really mean? While I won't presume to define it for you, I can tell you that my definition includes thinking outside the box of what we consider "norms." A truly Smart City uses innovation to provide critical services to the residents in a cost-effective manner. Issues such as public policy; equitable treatment for citizens; effective technologies for hospitals, police, and fire; and other public safety concerns are paramount. Intelligent transportation systems which are integrated with command/control will be critical assets for traffic optimization, event management, and orchestration of high-priority travelers, such as first responders. Internet-of-Things (IoT) architectures, cross-domain enterprise integration of devices, and software and management

systems will enable new solutions to common problems. Smart home, smart building, smart grid, and smart water solutions will optimize limited resources and provide equitable, inclusive environments for the residents.

Frisco, Texas

As the Mayor of Frisco, Texas, from 2008 to 2017, I was privileged to be able to experience firsthand some of the policy issues and incredible innovations that lead to a "Smart City." It was also exciting to be on the front end of the amazing opportunities that exist in this space. Frisco has experienced incredible growth in the last 25 years, from just over 6000 residents in 1990 to almost 180,000 in 2017. Managing this "hyper-growth" required a lot of innovation, an attention to detail, and a vision of the future.

As a case in point, the city of Frisco is in Texas, where water resources are limited. We addressed this problem in 2001 by being the first city in the United States to adopt Energy Star standards for new homes. The innovative "Smart Controller" program was implemented in 2007, so that each new home is connected to a weather station to predict weather conditions. As a result, grass, plants, and other household items use water only when needed. Innovation, through careful management of resources, bold leadership, and matching technologies to requirements, was the key to achieve a level of "smartness" that helps everyone.

Innovation Is Key

In a "Smart City," innovation will be critical in deploying and optimizing municipal services. This certainly includes new technologies and systems which support public safety. The Frisco Independent School District, which grew from 6 schools in 1996 to 72 schools in 2018, had the opportunity to partner with the city and security providers to create a system that gives first responders an access to maps and live data feeds on calls to schools and an up-to-date access to school building information—all in real-time. These smarter and safer communities will continue to create an atmosphere for families and corporations to achieve success.

In a "Smart City," innovation will be critical in developing new approaches to healthcare. Do we continue just treating the symptoms or use innovative practices? Do we use an app to summon a health practitioner to our home to treat the typical ear infection within a short period, or do we continue routine doctor's office visits? With an innovative approach, the doctor may use augmented/virtual reality (AR/VR) to treat patients remotely, and the first responders may have access to novel training and situational awareness tools which improve their performance. Technology deployed in appropriate contexts can help ensure the safety of the first responders as well as the safety of those in their care. With appropriate innovation

in healthcare, patients will experience completely personalized care, and the result will include better patient outcomes and commitment to quality and safety.

When Jerry Jones and I were sitting in the Cowboys bus at the grand opening of The Star sports fields in Frisco, the subject of innovation and the future of sports medicine and research on how to prevent sport injuries were the topics we were exploring. Jump forward a few short years and now, The Star in Frisco integrates healthcare into the recreation facility. In one place, you have an amateur, club, semi-pro, and professional sports and the opportunity to marry innovative research in injuries, medicine, rehab, nutrition, and many other concepts. This is an example of innovation which results in better training, personalized healthcare, and improvements in equitable treatment for all citizens of the community.

Enabling all of these innovations presupposes a minimum level of universal coverage, an ability to ensure commonality of understanding, and a means of providing a trusted service. Implementing a vision of this nature will set apart the truly "Smart City" from the ranks of conventional municipalities. Innovations, such as block chain technology, may be important in the authentication of transactions in the next-generation power distribution. It may also be critical in ridesharing markets enabled by autonomous vehicles. How will cities manage these digital transactions? New technology deployments, including fifth-generation telecommunications or "5G," will provide a baseline of connectivity to support high-priority, low-latency, and mission-critical municipal services as well as entertainment and social interaction for citizens, businesses, and agencies. How will cities manage the public/private partnerships and leverage of municipal assets to ensure "fairness" across citizen groups?

Challenges and Constraints

All of these technologies will create opportunities for automation of complex processes (e.g., driving, delivery, response) as well as issues of digital trust and security (e.g., encryption, authentication) and policy-based rationale for centralized management as well as distributed intelligence. The chapters in this book outline approaches and recommendations for architecture/implementation, technology choices/constraints, and considerations for this new paradigm which will drive significant changes across all aspects of society and vertical segments in the "Smart City." Along this evolutionary—and revolutionary—path, the ability to evaluate new ideas, optimize innovation, forecast skill sets, and prioritize markets will be the key areas of innovation in the Smart City space.

Smart Cities and innovation also bring a host of challenges that society must help answer. No one can argue that sending a drone automatically over an area where a 911 call was received helps the first responders become more situationally aware prior to arrive at the scene. However, what about our expectation of privacy? With automated traffic lights that capture video, who will have access to that data? The

one answer that is clear is that innovation will continue its break-neck speed and we must all learn to work and function in this new world!

Looking Forward

By the time you read this book, the National Soccer Hall of Fame museum at Toyota Stadium in Frisco will be open. With state-of-the art technology and facial recognition by the NEC, you can join your favorite team on the field and visit with your favorite legends. How we enjoy entertainment is changing just as rapidly. A few years ago, no one had heard of eSports. Now, almost every professional sports team is involved. Twitch, OpTic Gaming, NRG, complexity Gaming, and Overwatch League are names you may have never heard. Over the next few years, they will become more recognizable. The US Conference of Mayors has asked me to help the Mayors from around the country understand what a public/private partnership looks like in eSports. The first thing I told them is that no one really knows where it is going, but everyone wants a foot in the door. So, you are getting your foot in the door with this book!

I hope that you will enjoy the unique perspectives on Smart Cities that this book provides. It is a continued perspective on Smart Cities, which builds on the companion book *Smart Cities: Applications, Technologies, Standards, and Driving Factors* (2018). This top-down exploration of the Smart City phenomenon is targeted toward the practitioners, and the conversational nature of the book will appeal to anyone interested in learning more about key issues in this important new space.

Maher Maso, Principal – Credits and Incentives, Ryan, LLC
CEO—Prosper Economic Development Corporation (2017–2018)
Commissioner—State of Texas Red River Boundary Commission (2013–present)
Board Member—Collin College Educational Foundation (2006–present)
Mayor—Frisco Texas (2008–2017)

Preface

This book provides a continued perspective on the Smart City phenomenon, which builds on the companion book *Smart Cities: Applications, Technologies, Standards, and Driving Factors*.

The top-down exploration of the Smart City phenomenon continues in this volume with a focus on topical areas of "smart healthcare," "public safety and policy issues," and "science, technology, and innovation." The contributors with direct and substantive experience with the important aspects of Smart Cities discuss issues with technologies and applications, roadblocks to implementation, innovations which create new opportunities, and other factors relevant to emerging Smart City infrastructures.

The continued exploration of Smart City issues, via a sequence of editions in topical areas, is unique in the marketplace and is targeted toward the practitioners in various fields. Additionally, the practical and "conversational" nature of the coverage is appealing to the readers interested in learning more about Smart City issues and technologies.

San Marcos, TX, USA — Stan McClellan

Contents

About the Authors

Michelle Alvarado is an Assistant Professor in the Department of Industrial and Systems Engineering at the University of Florida, where her research develops theory, models, algorithms, and practical tools to improve the operation of complex healthcare systems under uncertainty.

Alvarado's methodological expertise is in simulation and stochastic programming. Her current research interests include hybrid simulation modeling for healthcare operations, remote health monitoring of chronic diseases, and optimal design of health policy models. She is the Co-founder and Co-director of the HEALTH-Engine Laboratory at the University of Florida. She received her MS and PhD degrees in Industrial Engineering from Texas A&M University (TAMU), in 2012 and 2014. Her research has been published in *Health Care Management Science*, *Journal of Medical Internet Research*, and *IISE Transactions on Healthcare Systems Engineering*, *IEEE Transactions on Automatic Science and Engineering*, and *Simulation*. She is a Member of IISE, INFORMS, and ASEE.

Achamkulamgara Arun is a Connected Products Director for Cognizant Technology Solutions (CTSH), a $14B company headquartered in New Jersey, NJ, with over 100+ delivery centers around the world. He serves as Chief Architect for Internet of Things (IoT), Cognizant Connected Products, a part of Cognizant's Digital Enterprise with focus on developing product solutions.

Arun develops solution architectures, product design, and development plans for customers across smart cities and facilities, manufacturing, medical devices, healthcare, retail, and communication products industries. His interests are in developing standardized microservices-based software and embedded solutions, device security, and product compliance. Prior to Cognizant, he served as Technical Director and Senior R&D Manager, developing and supporting enterprise level platform, hardware, and software worldwide and working at Intel, 3M, Singapore Technologies, and Central Research Labs. He holds an MS from Indian Institute of Technology, India, and an MBA from the Carey School of Business at Arizona State University.

Meredith Barrett, PhD is the Vice President of Science & Research at Propeller Health, a digital health company dedicated to improve outcomes in respiratory disease, including asthma and COPD.

She works to leverage Propeller's sensor technology to generate insights about respiratory disease for patients, providers, and communities. Her training in ecology, population health, and spatial analysis has enabled her to study the impacts of environmental change on both infectious and chronic diseases. She was a Robert Wood Johnson Foundation Health & Society Postdoctoral Scholar at the University of California Berkeley School of Public Health and UC San Francisco Center for Health and Community. She completed her PhD in Ecology with a focus on global health at Duke University, where she was a National Science Foundation Graduate Research Fellow. Her research has been published in *Science*; *Environmental Health Perspectives*; *Frontiers in Ecology and the Environment*; *Annals of Allergy, Asthma & Immunology*; *Journal of Big Data*; and *Preventing Chronic Disease*, among other journals and in popular media, such as *The Huffington Post*.

Catherine Crago Blanton is the Head of Strategic Initiatives and Resource Development in the Housing Authority for the City of Austin, TX (HACA).

At HACA, she played an active role in building the Unlocking the Connection program, a first-of-its-kind initiative to bring Internet connectivity, digital literacy, and devices to every public housing authority resident. The program was the inspiration for the White House-HUD initiative called ConnectHome. For more than 10 years, she helped the state agencies and local governments assess the business case for digital inclusion, to enhance revenue, to support emergency preparedness, and to promote equity in diverse communities.

Crago Blanton has presented at the White House and has provided testimony to the Federal Communications Commission on the impact of connectivity in low-income populations. She serves on the Board of Advisors and on the advisory boards of SXSW Interactive Festival and lectures in the University of Texas Master's in the Human Dimensions of Organizations. She also serves as Vice President of Diversity, Equity, and Inclusion of the Board of Directors of Austin CityUP, where she also co-chairs the Housing Committee, and is a Recipient of the Texas Diversity Council DiversityFIRST Award for work in diversity and inclusion.

Mike Brown is an Institute Engineer for Southwest Research Institute (SwRI). He has been a Leader in the Development of Intelligent Systems for over 22 years, serving various federal, state, and commercial clients in projects spanning the areas of advanced traffic management and traveler information systems, connected and automated vehicles, and Smart Cities. He currently serves on the Board of Directors for the OmniAir Consortium, an industry association promoting interoperability and certification for connected vehicles, intelligent transportation systems (ITS), and transportation payment systems.

As an Institute Engineer at SwRI, Brown provides expert consultation services for SwRI programs and tackles highly specialized problems on behalf of the clients. He also works with Senior SwRI and Division Staff to plan future technology needs

and to lead the development of new programs in his areas of expertise. He also serves as a Member of SwRI's Advisory Committee for Research and is a Subject Matter Expert for numerous standards committees in standards development organizations, including the Institute of Electrical and Electronics Engineers (IEEE), Society of Automotive Engineers (SAE), and International Organization for Standardization (ISO).

Adam Cason Director of Product Marketing at Futurex, is responsible for the company's virtually driven content marketing initiatives, technical documentation portfolio, and engagement strategy for customer and partner relationships. In this role, he works closely with executive audiences around the world, focusing on the growth of Futurex's thought leadership within the overall field of cybersecurity.

George Koutitas is an Entrepreneur and Academic in Electrical & Computer Engineering. He has more than 10 years of business and academic experience in smart grids, Internet of Things, augmented reality, and wireless networks.

Koutitas is an Assistant Professor of Electrical and Computer Engineering in the Ingram School of Engineering at Texas State University, is the Director of the XReality Research Lab where he works on the intersection of AR and IoT, and is also the Author of one book, two book chapters, and two patent applications. He has published more than 47 scientific publications in peer-reviewed journals and conferences. His research work has received more than 990 citations.

In 2014, Koutitas founded Gridmates (www.gridmates.com) which is the world's first cloud platform for Smart Energy Donations helping electric utilities and retailers transform their bill assistance and social responsibility programs with digital innovation. In 2019, Koutitas co-founded Augmented Training Systems Inc. (http://augmentedtrainingsystems.com), a software company which develops training platforms to help first responders improve performance while reducing training costs.

Grayson Lawrence has over 18 years of graphic design and design thinking experience, specializing in user interface (UI), user experience (UX), game, Web, virtual reality (VR), augmented reality (AR), and mobile application design.

As part of his research, he has developed award-winning designs for mobile applications, such as DocbookMD, an application designed to foster better communication between doctors and their care teams, and Govely, an application designed to encourage civic engagement among high school students. In addition, he has collaborated on interdisciplinary teams for a variety of other mobile and VR applications focused on mental health, including alcohol abuse, veteran students with PTSD, emergency medical technician (EMT) training, and medication adherence via voice UI and mobile application/wearable integration.

Joe Moorman is a Software Engineer who has worked in C++/web systems development with the Reynolds and Reynolds Company in Houston, TX, through 2017 and, more recently, in financial technology consulting with Riskcare Inc. in New York, NY. The areas of financial industry research included short-term equity

market impact models using multivariate Hawkes processes and continuous calibration, for which he implemented a C++/Python software framework. Presently, he is a Full-Lifecycle Software Engineer with Myriad RBM, Inc., of Austin, TX, in the biotechnology space, automating and streamlining quality control processes, and workflow tasks to improve immunoassay processing times and quality for a CLIA-certified laboratory.

Keith Noble is a Commander with Austin-Travis County Emergency Medical Services (EMS). He is currently assigned to the department's Homeland Security and Emergency Management Division focusing on integrating EMS into disaster, mass causality, homeland security, and emergency management plans for the City of Austin. He has been involved with EMS for over 12 years and some type of public safety for 15 years.

Noble is also responsible for one of the 13 "Am-Bus" emergency vehicles in the State of Texas, which provides full advanced life support care for large-scale incidents. Each Am-Bus provides facilities equivalent to six ambulances, including space for 20 patients. These emergency preparedness solutions consolidate resources and reduce wait times for treatment during large-scale or mass-casualty incidents.

He obtained his master's degree in Emergency Management from Jacksonville State University and is currently working on a Master's in Public Administration. He also holds a BS degree in Criminal Justice from The Pennsylvania State University.

Steve Pearson is the Lead Strategist and Founder of The Pearson Strategy Group, LLC, which has clients including legal teams, companies too small for dedicated R&D departments, inventors, and innovators across software and technology fields.

He believes that solid research is one of the most valuable tools for accelerating innovation and product development. He has staked his business reputation on knowing how and where to dig into key information to provide this competitive advantage for entrepreneurs and companies. Clients also rely on his expertise to help interpret trends, unknown competitors, and strategies in the revealed data. By delivering targeted research based on patents and markets, along with strategic consulting, he empowers clients to move forward quickly and at a minimal cost.

Pearson is an electrical engineer with experience in semiconductor manufacturing, machining, business analysis, and patent research and served aboard a Navy submarine as a Nuclear Reactor Operator. He holds several patents, with intimate knowledge of all aspects of the patent process. He is a Past Chairman of the Austin chapter of the IEEE's Power and Energy Society. He is happily married to a career coach, and they have two outgoing children and three very friendly dogs.

Eduardo Pérez-Roman is an Associate Professor in the Ingram School of Engineering at Texas State University. He received his PhD in Industrial and Systems Engineering from Texas A&M University in 2010 and his BS in Industrial Engineering from the University of Puerto Rico at Mayagüez, Puerto Rico, in 2004.

He was a Postdoctoral Research Associate in the Department of Industrial and Systems Engineering at Texas A&M University from 2010 to 2012.

Pérez' research interests are in the use of methodologies and theories in operations research, systems engineering, discrete-event simulation, algorithms and software design, and decision theory analysis to solve problems in healthcare and renewable energy. He is the Director of the Integrated Modeling and Optimization for Service Systems (iMOSS) research laboratory. His research has been sponsored by the National Science Foundation (NSF), Robert Wood Johnson Foundation, Baylor Scott & White Health System, Adventist Health System, and NEC Corporation, with results published in multiple journals, including *IIE Transactions*, *IIE Transactions on Healthcare Systems Engineering*, *Simulation*, Health care Management Science, and *Computers & Operations Research*.

Liam Quinn is a Sr. Vice President and Sr. Fellow at Dell Technologies. He has been with Dell since 1997 and currently leads the Pan-Dell Technologies 5G strategy. His key areas of focus and research include converged mobility, digital and workforce transformation, security and manageability, Internet of Things (IoT), and specific applications of augmented and virtual reality (AR/VR) in areas of remote maintenance, gaming, and 3D applications.

Quinn has over 120 granted and pending US patents and is a published Author on networking. He was named Dell Inventor of the Year in 2005, 2007, and 2014. He is a frequent Speaker at Wi-Fi and Networking Forums and also represents Dell on the boards of the Wi-Fi Alliance and the OpenFog Consortium. He has designed network systems and wireless solutions and has managed numerous engineering teams in systems architecture and product development. He serves on the Advisory Board of the University of Texas, Cockrell School of Engineering, and the Texas State Ingram School of Engineering. He holds undergraduate and graduate degrees in Electrical Engineering and Computer Engineering.

Scott Smith is the co-founder and CEO of Augmented Training Systems (ATS), a software company which develops training platforms to help first responders improve performance while reducing training costs (http://augmentedtrainingsystems.com). ATS builds custom, human-centered augmented, and virtual reality training simulators for equipment and processes that are cost-prohibitive or dangerous. Their training scenarios can be deployed anywhere and anytime to multiple trainees, saving time and money and improving situational awareness for the whole team.

Smith received a PhD in Educational Measurement and Statistics, Educational Psychology, and Learning Systems from Florida State University (PhD) and has over 10 years of clinical experience working with high-risk youth, substance abuse and addiction, families, trauma, domestic violence, and the homeless population. He is the Director of the Virtual Reality and Technology Lab, which develops treatments for returning veterans experiencing social anxiety, and an Associate Professor of Social Work at Texas State University.

Michael Stricklen is an Executive Director in the EY-Parthenon practice of Ernst & Young LLP, based in Boston, and is a Member of its Software Strategy Group. He provides deep knowledge in product and technology diligence projects and leverages 20 years of experience in software engineering and enterprise architecture to optimize software products' technology stacks, creating efficiencies, maximizing functionality, and minimizing infrastructure performance risks.

Stricklen's experience covers Executive, Entrepreneur, Board Member, and Advisor positions with high-tech companies. He has worked within and acted as an Advisor to a broad range of software and software-driven companies, including enterprise systems and data center management; healthcare management software; telecommunications and high-speed networking; integrated financial trading systems; mobile device management; governance, risk, and compliance management; and infrastructure- and platform-as-a-service (IaaS/PaaS) architectures.

Walt Trybula is the Executive Director of the Trybula Foundation, a Texas for-profit corporation founded in 1999 (http://www.tryb.org), which works with the organizations in evaluating hi-tech and emerging technologies to determine the potential for successful inclusion in the organization's strategic direction.

With the experience ranging from startups to Fortune's top ten corporations, the foundation's business acumen melds the two worlds of business and technology to provide guidance to ensure successful programs. Over the last 25 years, activities have included evaluation of the economic impact of technology on existing industry cost structures, reports on the economic impact of technology on cities and surrounding areas, and evaluation of emerging technology on corporate expansion.

Trybula is a Fellow of the IEEE and of the SPIE and was a Senior Fellow at SEMATECH where he was responsible for leading the initial effort to evaluate the feasibility immersion lithography. He has an undergraduate degree in Physics from the Illinois Institute of Technology, an MBA from James Madison University, and a PhD in Information Sciences from the University of Texas at Austin.

David Wierschem is the Associate Dean for Undergraduate Programs in the McCoy College of Business Administration at Texas State University. His academic experience includes the positon of Chair of the Department of Computer Information Systems and Quantitative Methods as well as teaching Data Communications, IT Security, Statistics, and numerous other technology-related courses.

Wierschem received his MBA from Georgia State University and his MS in Operations Research and PhD in Management Information Systems from the University of Texas at Dallas. He has written numerous articles in the areas of IT productivity, data warehousing, and IT employment. Currently, his research interests include IT employment and the use of motion capture technology to analyze human safety and efficiency in the areas of manufacturing and materials handling.