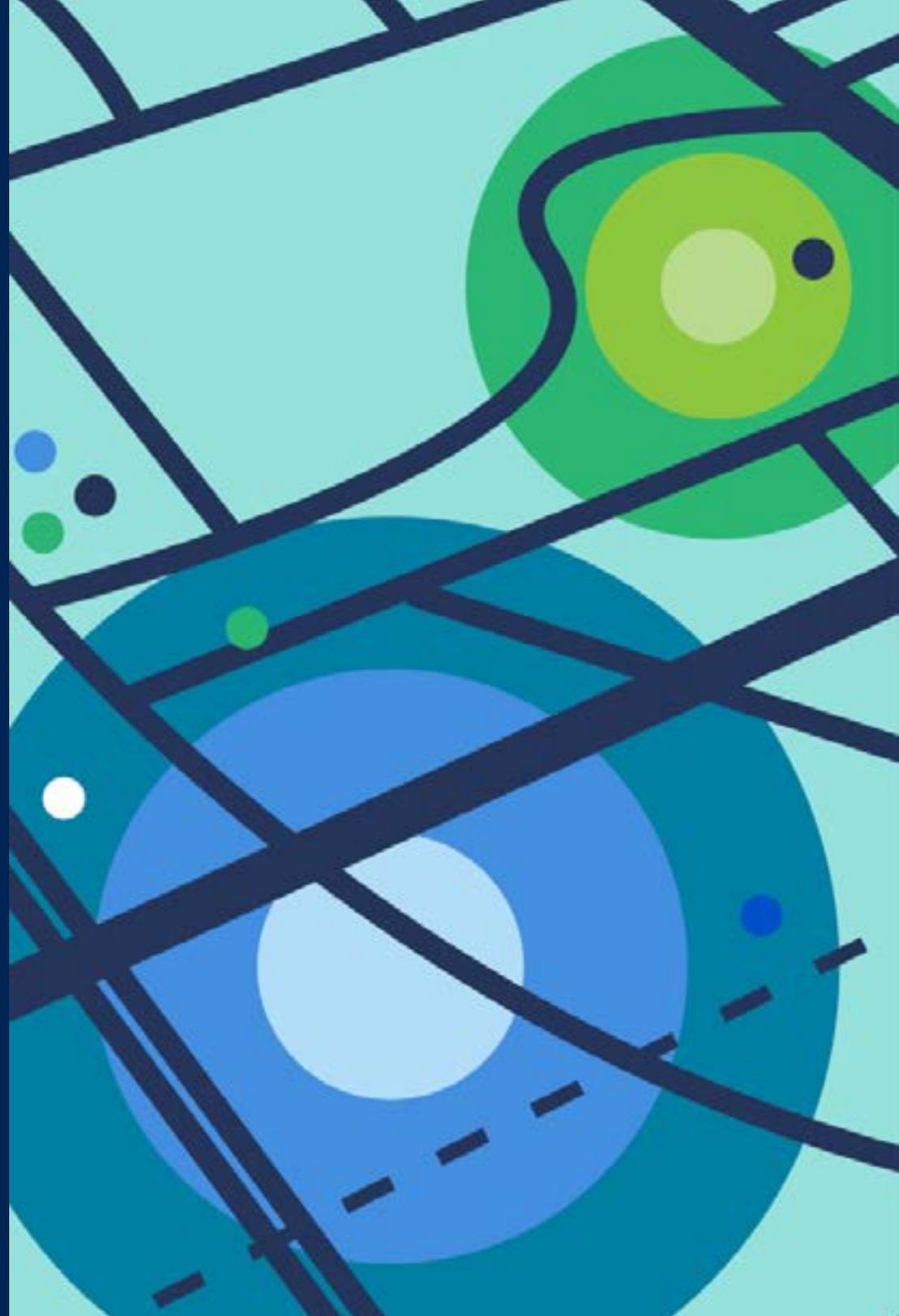


Urban Evolution: A New Framework for Understanding City Growth and Change



University of Toronto researchers are proposing a fundamental reframe of our thinking about how cities change over time.

A multidisciplinary working group, established under the banner of the [Urban Genome Project](#) (UGP), is renewing connections between the life and physical sciences and the social sciences to decode the DNA of the city. Supported by the [School of Cities](#), co-leads **Daniel Silver** (Sociology) and **Mark Fox** (Industrial Engineering and Computer Science) are exploring how the concept of evolution can apply beyond the study of living things to help us better understand our cities and the processes that influence change within them.

Originally inspired by the Human Genome Project, UGP has involved ongoing collaboration among faculty and graduate students from sociology, industrial engineering, computer science, architecture, biology, economic geography, and others at U of T and partner universities.



While the application of evolutionary concepts to cities is not entirely new, the Urban Genome Project is attempting to join them together into a novel general evolutionary model for cities. The model provides a framework for understanding how various city characteristics appear at different rates and in different places, and for understanding how those characteristics may have shared or divergent development patterns across time and space.

PROJECT LEAD:

Daniel Silver,
Department Of Sociology;
Academic Director, Toronto
Region Statistics Canada
Research Chair

Mark Fox,
Industrial Engineering And
Computer Science; Director,
Urban Data Centre, School Of
Cities

RESEARCHERS:

Robert M. Wright,
Landscape Architecture, Daniels
Faculty, University of Toronto

Thiago Silva,
Computer Science, Federal
University of Technology, Brazil
and Visiting Professor, University
of Toronto

Noga Keider,
Hebrew University of Jerusalem

Fabio Dias,
State Street

Ari Mazzeo,
Art, Design and Technology,
University of Toronto

Hamnah Majeed,
Sociology, University of Toronto

Patrick Adler,
Rotman School's Martin
Prosperity Institute, University of
Toronto

Fernando Calderón Figueroa,
Sociology, University of Toronto

Ultan Byrne,
Architecture, Columbia GSAPP

Alex Olson,
Centre for Analytics and Artificial
Intelligence Engineering

Clara Bitter,
Architecture, University of Toronto

Olimpia Bidian,
Sociology, University of Toronto

Khalil Martin,
Civil Engineering, University of

An urban evolutionary approach can reveal why and how certain urban characteristics – such as porches, cul-de-sacs or racial segregation – exist within cities, how those characteristics come into being, and why the number of them and how they function changes over time. Using an evolutionary lens can also tell us about how urban neighbourhoods and communities adapt to changes in built form or changing demographics, how our views of places change as the city evolves, and how to introduce policy interventions that are informed by and responsive to what is happening in a given place and time.

“...Where we’re at right now in a neighborhood is just a moment on its pathway going forward and back, so you have to see where it’s going and where it’s coming from. And if you have that long-term perspective, you can understand better what it is to be here now and plan for the future. You can do a much better job of evaluating things. You can understand how much a particular policy intervention had an impact, or stay the course, or decide to change course, when you have that long-term perspective.”

– **Professor Daniel Silver**

By viewing the city as an evolving entity comparable to a living organism, an evolutionary approach sheds light on the city’s history, helps us better understand its current state, and makes it possible to plan effectively for the future.

Tyler Bateman,
Sociology, University of Toronto

Amny Athamny,
Sociology, University of Toronto

Anderson Wong,
iSchool, University of Toronto

Cheryl Cheung,
Political Science, University of Toronto

Mabel Yang,
Biochemistry, University of Toronto

Anne James,
Geography and Planning, University of Toronto

Iris Wang,
Metrolinx

Marion Blute,
Sociology, University of Toronto

Richard Florida,
Rotman School of Management, University of Toronto

Shauna Brail,
Institute for Management and Innovation, University of Toronto
Mississauga

Matti Siemiatycki,
Geography and Planning, University of Toronto

Scott Sanner,
Mechanical and Industrial Engineering, University of Toronto

Ya’ara Rosner-Manor,
Urban Planning at The Urban Clinic, Hebrew University of Jerusalem

Yair Grinberger,
Geography, Hebrew University of Jerusalem

Emily Silverman,
The Urban Clinic, Hebrew University of Jerusalem

Enaya Banna,
The Urban Clinic, Hebrew University of Jerusalem

The work of the UGP creates a framework that can support the development of many different ideas and theories about urban evolution. But what are some of the central concepts of the framework, and what sort of work is growing out of those ideas? [Here we explore the answers to these questions.](#)

The Core Concepts of an Urban Evolutionary Approach

One of the most innovative concepts being developed through the UGP collaboration is that of the “formeme.” A formeme is the basic unit of urban evolution, and it is a script or a set of instructions for physically organizing space for some set of activities and groups.

A meme – the core of the term formeme – is an idea that spreads. Using the word “meme” in “formeme” suggests that information about urban form can be copied and retained. A formeme encodes a set of traits of any given spatial area, like a building, a neighbourhood or a city, comparable to the genes of a living organism. Those traits might include things like architectural styles, ways of organizing roadways, and the sociodemographic organization of people into certain areas of a city, amongst others. Any city is a large collection of formemes, or what might be called its *urban genome*.

The concept of the formeme helps to lay the foundation for a unified theory of urban evolution by considering how urban traits vary, spread, and are retained in the urban landscape. These key components – variation, selection, and retention – are central to the theory of evolution when applied to cities.

Variation describes how novel formeme variants appear in an area that could be either selected or retained. They are key mechanisms that influence urban variation that are similar to mechanisms in biological evolution, including mutation, migration and extinction events.

Selection defines the mechanisms by which formemes are replicated or reproduced in the urban environment at different rates.

Retention designates the extent to which characteristics of urban life are maintained over time, and makes it possible for existing configurations of urban life to be preserved and passed on into the future.

Modelling Urban Evolution

Some of the most significant work that has come out of the UGP to date is the push to utilize the formeme to model urban evolution over time. The team has developed a mathematical model and software that can track the formemes – or the urban genome – of a given area, enabling researchers to model what the area looks like today and how it looked in the past, and to test theories of how urban traits evolve over time. The software has already been used to model trajectories of how cities change over time, and to measure the similarity of neighbourhoods both within Toronto and between Toronto and Montreal.

The team has also developed an online interactive tool called Piccard, designed to track long-term trends within and between cities. Historically, in order to create time series of city neighbourhoods or regions, analysts would have to harmonize the data geographically by interpolating the data to reflect changes in regional boundaries change over time. The contribution of the Piccard tool is that it allows tract-by-tract comparisons and visualizations of patterns of demographic evolution within city regions over time without requiring geographic harmonization of the data. The UGP team is currently working with Social Planning at the City of Toronto to identify how the municipality might be able to utilize this data to better understand Toronto and its evolution over time.

You can explore the Piccard tool [here](#).



Revealing the Building Blocks of Urban Life

One recent initiative within the UGP that takes an evolutionary approach to studying the city, supported by the work of **Khalil Martin** (Civil Engineering) and **Clara Bitter** (Architecture), examines the evolution of the front porch. The front porch is a form with deep roots, including the *stoa* in Ancient Greece, and has since appeared in many forms and areas – it is an urban idea that spread over time and space. The porch is a successful form, both in terms of how far it has spread and in the fidelity of its copies.

Important as a threshold between home and the community, these spaces have in recent years often been considered private and have been taken for granted as a common feature of homes in Canada and around the world. During the Covid-19 pandemic, however, their value as a conduit for community-building was reinvigorated, reflecting an evolution in how they are viewed and used, and how they contribute to urban life. Examining the evolution of the threshold can facilitate a deeper understanding of how the physical characteristics of communities and neighbourhoods change as aspects of the social and economic life of cities change.



Portico



Balcony



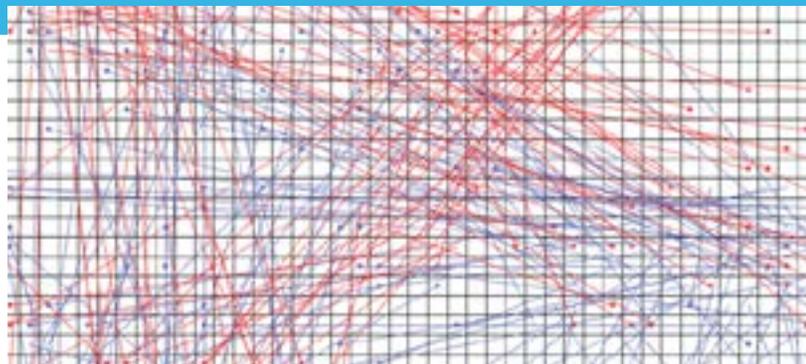
Enclosed Porch



Stoa

For more information about the evolution of the front porch, please check out the Urban Genome blog post authored by **Clara Bitter** [here](#).

Evolution of Comparative Methods and Ideas



An ongoing study led by **Tyler Bateman**, **Alicia Eads** and **Marc Cadotte** that highlights how UGP cross-disciplinary collaborations are yielding novel research utilizes an evolutionary approach to explore how conservation policy has evolved over time. Researchers examine the minutes from Toronto Conservation Authority meetings from the previous 40 years to view the path of change of ideas about conservation and invasive species.

Beyond tracking how aspects of the urban built form change and adapt over time, an evolutionary approach can also trace the evolution of ideas about urban form and development, including where new ideas come from, and how old ideas are adapted to fit new places and circumstances. This approach began to coalesce during a UGP workshop held in 2021 at the School of Cities that explored the ways in which methods in social and physical sciences overlap, and what theoreticians and practitioners across disciplines can learn from each other. An evolutionary approach to policy analysis highlights how and when certain ideas about the urban form become influential, and can be used to deepen our understanding of many prominent urban issues, from housing policy to transit planning.

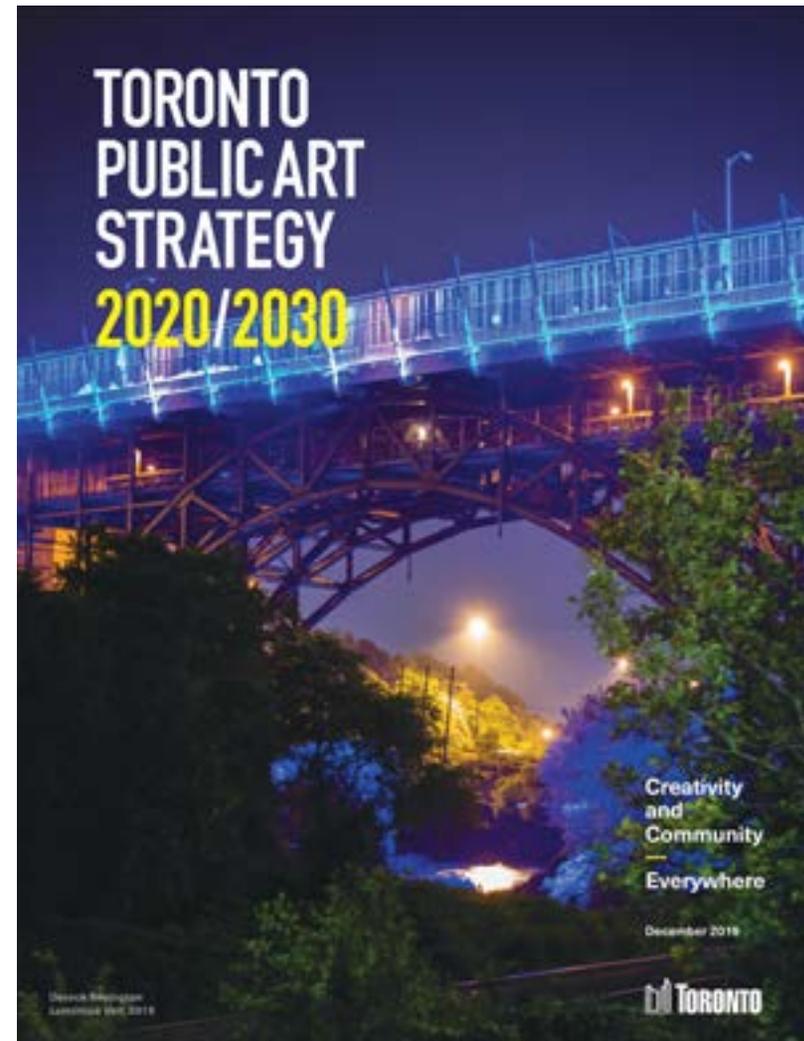
An urban evolutionary lens has also led UGP researchers to explore how ideas circulate and move from city to city, and how ideas are adopted and implemented. In a forthcoming article in the *Journal of Urban Affairs*, UGP collaborator **Noga Keidar** (Hebrew University of Jerusalem and [The Urban Clinic](#)) examines the mobility of public art policies across English-speaking metropolitan cities to explore when, where and how public art discourses tend to be adopted across cities.

Keidar's research builds on a [recent collaboration](#) between UGP researchers and OCADU researcher Sara Diamond. The team built a large database of public art policy documentation from twenty-six English-speaking cities with more than one million residents around the world. Analyzing the database, the team identified the key ideas that tend to feature in public art documents, how and why those ideas have changed over time, and important regional differences.

As a result of this research, the team provided targeted policy advice to the City of Toronto that sparked renewed municipal efforts in public art policy. In Toronto, this led to the introduction of the City's first [Public Art Strategy](#) and [ArtworxTO](#), a collaboration between U of T and OCAD University. At a time when cities across Canada and globally are grappling with how to innovatively address shared challenges like pandemic recovery, affordable housing and public transit, understanding the process of influencing and adopting new approaches has important relevance for urbanists.

“We were able to make a case that Toronto, while it had been a leader in a lot of public art policy, maybe 25 years ago, it had really stagnated. We could point to the policy tools that they [the City] had. We could point to how they could encourage a more diverse range of artists to be involved in more diverse types of media and art forms... And here some things that we could do in Toronto to move in that direction.”

– **Professor Daniel Silver**



What's Next for this Project?

Mapping the urban genome of cities is not a short-term project. In the coming months and years, the UGP researchers will continue their exciting and innovative work, and share insights to build our understanding of the nature of change in our cities.

Next, the researchers will continue to elaborate and refine the model, with a focus on some key but underdeveloped ideas such as niche construction, scaling and emergence. Some other exciting upcoming projects for the UGP:

- An ecological survey of the distribution of porches and other private-public thresholds in Toronto and Jerusalem;
- A study of the international evolution of the creative placemaking model;
- A study of the evolution of urban mapping platforms, particularly Open Street Maps;
- A study of the post-covid evolution of music venues in Ontario;
- A collaboration with Social Planning at the City of Toronto on long-term neighbourhood trajectories.



Interview with Professor Daniel Silver

How did the Human Genome Project inspire you to create the Urban Genome Project working group?

The phrase “urban genome” goes back to conversations that I had with Richard Florida, back when the notion of a School of Cities was just a glimmer in somebody’s eyes. We were talking about exciting new directions in urban studies, and somehow that phrase came out of it, reflecting a sort of multidisciplinary effort to try to get at the basic kinds of information that is encoded in the city. It became one of those things that we thought we would have a chance to pursue with the School of Cities. So, it started there, the idea of bringing together people from different disciplines to try to bring expertise to map out the basic features of this domain. As our actual project evolved, we moved away from the genome as the key metaphor, and it is much more now about the question of urban evolution.

What does building a “science of cities” involve?

There is a very interesting and long history of dialogue between social sciences and biology that goes back to the foundation of urban sociology within the Chicago school of sociology and with the concept of human ecology. But in recent years I think it had somewhat stagnated. We wondered how the work towards a science of cities would be advanced if we took on the key features of Darwinian evolution.

How has the affiliation with the School of Cities facilitated this project?

The School of Cities was instrumental to the idea that research wouldn’t necessarily be oriented towards a short-term payoff. To me that was really important. It’s a challenge for these kinds of projects. They allow you to exchange perspectives, but it’s hard to establish common language. Once you do that, and you try to start publishing, it’s hard because every field has its own things that it’s interested in at that moment. The interdisciplinary emphasis is really great if people are willing to take that step, but it’s not easy and it needs time. [Read the full interview here.](#)



Daniel Silver is Professor of Sociology at the University of Toronto. His research areas are social theory, cities, culture, and cultural policy. He is co-editor of *The Politics of Urban Cultural Policy* and co-author of *Scenescapes: how qualities of place shape social life*.

Contact Daniel -

dan.silver@utoronto.ca

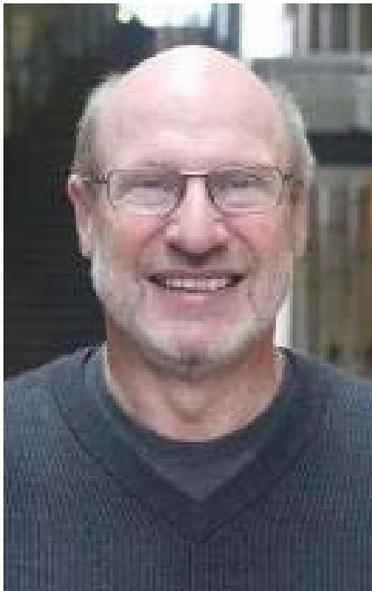
Interview with Professor Mark Fox

Tell us about your work on the Urban Genome Project.

What I have been working on is coming up with a formal mathematical model of the urban genome. The model will characterize, in essence, the genomics of a spatial area, such as a city or neighbourhood. The model is constructed in such a way that we can model what the neighbourhood looks like today, or a year ago, or ten years ago, and we can test theories of how the neighbourhood evolved over time. The whole point of the mathematical model is to provide this representation of urban forms. Once we have that model, we can create software that can encode information about that neighbourhood. And then we can perform analyses to see how the formulas have changed over time as a spatial area evolved over time, or we can do an analysis that shows similarity of this area to others.

Where do you want to go next with this work?

The next stage is really getting more data so that we can create a more 360-degree view of what goes on within a neighbourhood or spatial area. I'm currently working with a student named Anderson Wong, and he's been working on translating StatsCan census data into a form that allows us to manipulate it for the type of analyses we want to be able to do. [Read the full interview here.](#)



Mark Fox Mark Fox is the Director of the Urban Data Centre at the School of Cities. He is a Distinguished Professor of Urban Systems Engineering and Professor of Industrial Engineering and Computer Science. He is also the Director of the Centre for Social Services Engineering and the U of T Enterprise Integration Laboratory.

Contact Mark:

msf@eil.utoronto.ca

About the School of Cities

The School of Cities is a solutions incubator for urban-focused researchers, educators, students, practitioners, and the general public to explore and address the complex global challenges facing urban centres. A living laboratory, the School leverages urban data and lived experience to improve policy and decision making and collaborates with city leaders around the world to make local decisions that make cities and urban regions more sustainable, prosperous, inclusive, and just.

About City Research Insights

Urban Evolution: A New Framework for Understanding City Growth and Change is the fourth in our series of City Research Insights, designed to link the urban research being conducted at the University of Toronto with the public, other institutions, and decision-makers.

With this series, the School of Cities seeks to leverage our extraordinary community of urbanists and urban-oriented researchers to create a rich, multidisciplinary community of urban faculty, researchers, and students across disciplines and perspectives. In addition to facilitating interdisciplinary research projects, partnerships and funding opportunities, we provide a hub for urban-focused interdisciplinary and collaborative learning.



CITY RESEARCH INSIGHTS

VOLUME 1, ISSUE 4: CITY RESEARCH INSIGHTS VOL. 1, NO. 4: URBAN EVOLUTION: A NEW FRAMEWORK FOR UNDERSTANDING CITY GROWTH AND CHANGE

Authored and published by the School of Cities,
University of Toronto

© School of Cities, March 2022

Myhal Centre, Suite 853

55 St. George Street, Toronto, ON

M5S 0C9 Canada

General Inquiries:

Contact us at schoolofcities@utoronto.ca or 1-416-946-7083.

Newsletter, Events, and Seminars [Sign up for e-news.](#)

Research and Grants: [See our web page.](#)

Media Relations: Contact us at media.relations@utoronto.ca

or 416-978-0100. For members of the media looking to speak to an expert on urban topics and city issues, [visit our directory of affiliated faculty.](#)

Unless otherwise noted, all information is based on the work of the researchers.

Photo credits: Canva.com, Getty Images, Unsplash, Daniel Silver, Mark Fox

[Learn more about the Urban Genome Project here](#)



