

URSY 520: Urban Systems Analysis & Planning

COURSE INFORMATION

Division: SCARP, Faculty of Applied Science

Term/period: Term 2 – Winter 2019

Instructor: Martino Tran

Course dates:

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Class meeting times: Tuesdays & Thursdays
10:30am – 12:00 p.m.

Office hours: By appointment

Class location:

SHORT COURSE DESCRIPTION

Planning for engineers. Systems theory and analysis. Demand-side planning: population and demand modeling; demand management. Supply-side planning: long term planning, strategic planning, scenario analysis. Urban data, metrics, indicators and integrated assessment modeling. This course is not eligible for Credit/D/Fail grading.

COURSE FORMAT

This course is delivered through lectures, readings, class discussions and focuses on a major group project implementation and evaluation.

COURSE GOALS

This course explores theoretical frameworks and quantitative methods for infrastructure systems analysis and planning. This course is delivered through lectures, readings, class discussions and focuses on a major group project implementation and evaluation (“the Project Simulator”) using data driven scenario analysis and modelling to devise and plan alternative future infrastructure investment strategies for a city-wide case-study.

This includes a major report that assesses system functioning and baseline conditions, macro-level drivers of change (population, economics, climate change), alternative infrastructure investment strategies, multi-attribute performance indicators, policy implications, and stakeholder engagement.

LEARNING OBJECTIVES

By the end of this course, students will be able to:

- Apply systems theory and quantitative methods including data driven scenario analysis, modelling and multi-attribute (economic and environmental) impact assessment;
- Understand and analyze macro level drivers and impacts on infrastructure service demand and capacity including population, demographics, macroeconomics, environment and climate change;

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- Understand and develop cross-sector and sector specific (energy, transport, water, solid waste, ICT) infrastructure performance metrics;
 - Understand and analyze infrastructure performance from a modelling perspective; and the benefits and limitations of metrics and modelling techniques;
 - Implement team work, leadership and project management skills acquired from Sauder platform courses;
 - Provide effective, timely and constructive feedback on project milestones/deliverables to project teams;
 - Communicate results effectively to a stakeholder/public audience.
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ASSESSMENT SUMMARY

A) Major Project Report (40%) & Presentation (10%)	50%
B) Major Project Evaluation & Debate	20%
C) Assignment 1: City Systems Analysis	15%
D) Assignment 2: City Scenarios	15%

A) MAJOR PROJECT REPORT & PRESENTATION – PLANNING INTELLIGENT CITIES

The “Project Simulator” intends to simulate a real world project implementation and evaluation reflecting the skill sets necessary for project management and technical leadership. The rationale is that in industry, you will be expected to:

- Work within and lead multi-disciplinary project teams;
- Demonstrate technical depth and broad understanding across a wide range of functional domains;
- Deliver high quality outputs (under pressure) with real-world implications;
- Successfully communicate your findings to stakeholders.

Objectives:

- To develop a strategic infrastructure investment plan for a selected city focusing on 1 sector (energy, transport, water, waste, ICT), while considering key interdependencies with other sectors;
- To have a concrete output at the completion of this course to engage potential employers.

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Organization:

- 3 Teams;
- Energy, Transport, ICT;
- Free to choose internal responsibilities but I would suggest that each team member leads a certain part of the analysis/report writing/ presentation;
- Can build on what you know, but also good opportunity to learn another skill set.

PROJECT 1: PUBLIC ENGAGEMENT STRATEGY – CITIZEN SCIENCE & OPEN DATA

Scope

- The City of New Westminster (CNW) has developed a Public Engagement Strategy (2016) and wants to understand how to develop clear and easy to access information to improve city operations and citizen engagement.
- CNW is developing technologies that align with the Intelligent City Initiative to diversify stakeholder inputs.
- Specifically, CNW is developing an open-data platform and wants to understand what data would improve city operations (internal) and community engagement (external).

Deliverable:

Best practices review on the use of open-data platform to improve city planning and citizen engagement:

- How can an open-data platform improve internal communications and planning?
- What are the key metrics to measure citizen engagement? And how can metrics improve participation?
- What are the key data streams to be collected internally (city departments) for open data platform?
- What are the key data streams to be collected externally (stakeholders) for open data platform?
- What are case examples for open data platform success? What worked? What didn't? Why?
- What is the core functionality of an open data platform for CNW?
- What's the most efficient and effective way to collect, curate and use the data?
- How can a beta version platform be tested, monitored and deployed?

Outputs

- ~30 pg. report including: graphs, data, visuals

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- Policy recommendations
- Supporting appendix (no page limit)
- PPT presentation for CNW

Resources/contact

- CNW Public Engagement Strategy

https://www.newwestcity.ca/database/files/library/CivicEngage_CNW_DraftEngagementStrategy_20161118_final.pdf

- CNW will provide initial guidance on key internal documentation, file transfer
- Case examples: New York, Amsterdam, etc.
- Networks: IBM Smart Cities, Intelligent Community Forum (ICF)

Timeline:

- January 19th - Patricia Jecks, City of New Westminster Intelligent Cities Project Coordinator
- Interim report due
- In class debate
- April 6 – CNW stakeholder presentation

April 10 – Final Report due Stakeholder presentation at City of New Westminster first week of

PROJECT 2: MASTER TRANSPORTATION PLAN – SMART CITIES & CONGESTION

Scope

- The City of New Westminster (CNW) Master Transportation Plan (2015) prioritizes walking, cycling and transit.
- The City wants to understand the impact of current and future congestion on achieving its multi-modal master transportation plan goals.
- The City wants to understand the potential for smart city concepts and related ICT technologies and strategies to mitigate congestion and achieve its master plan goals (e.g. autonomous vehicles, car sharing, etc.)
- Is there an acceptable level of congestion that encourages mode shifting while maintaining some vehicle flow on the network?
- Is there an optimal balance between having congestion that discourages people from driving through our streets, while still providing enough efficiency for inter-city travel by car (i.e. someone living in Connaught Heights wishing to go to the Canada Games Pool) i.e.

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Outputs

- ~30 pg. report including: graphs, data, visuals;
- Policy recommendations
- Supporting appendix (no page limit)
- PPT presentation for CNW

Resources/contact

- New Westminister Master Transportation Plan 2015:

https://www.newwestcity.ca/database/files/library/New_West_MTP.pdf

- Related documents: Canadian Automobile Association (CAA) Bottleneck Study:

<https://www.caa.ca/bottlenecksincanada/>

- CNW will provide initial guidance on key internal documentation, file transfer

Timeline:

- January 26th – Lisa Leblanc, City of New Westminister Transportation Director
- Interim report due
- In class debate
- April 6 – CNW stakeholder presentation
- April 10 – Final Report due

PROJECT 3: DISTRICT ENERGY & NEIGHBORHOOD REVITALIZATION

Scope:

- The City of New Westminister (CNW) is developing its Sapperton District Energy System, which is an 8MW neighbourhood-scale, renewable district energy system.
- This system is being designed to provide low-carbon heating to Royal Columbian Hospital campus, as well as new multi-residential, commercial and mixed-use transit oriented development at Braid and Sapperton SkyTrain Stations, and future new development along East Columbia Street within the district energy service area.
- Over time, and as the distribution piping for the system expands further into the neighbourhood, it may also be possible to connect existing commercial and apartment buildings when their current boilers and heating equipment reach the end of their lifecycle – an ideal time to fuel switch renewable heat.
- The overarching goal of the project is to future proof against climate change and reduce GHG emissions in line with CNW and provincial Climate Change Policy.

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- Along with meeting Climate Policy goals, the City wishes to understand how the project can support multiple objectives associated with creating a more robust, sustainable and diversified local economy.

Deliverable:

A report that includes environmental design guidelines and criteria that defines the intended economic development, site remediation and clean technology benefits to the community.

- What are environmental design guidelines for the new Sapperton Renewable Energy Centre that will guide development of architectural and site design criteria for the next stage detailed project design?
- Define the intended economic development and clean technology demonstration benefits this project will bring to the Sapperton neighbourhood of New Westminster.
- Review similar guidelines used by other low-carbon district energy projects in BC (e.g., Alexandra District Energy Utility, City of Vancouver Neighbourhood Guidelines, UBC Bioenergy Research & Development Facility, UBC Campus District Energy Centre, False Creek Flats Energy Centre (Creative Energy))
- What are the best practices/case-studies for successful deployment of renewable energy systems (or related innovations), and their role in neighborhood re-vitalization?
- How can these innovation projects achieve multiple policy goals and capture co-benefits (climate policy, economic development, community outreach, sustainability, etc.)?
- How would you evaluate and measure the potential impacts/benefits of the Sapperton project on the surrounding neighborhood and local economy?

Outputs

- ~30 pg. report including: graphs, data, visuals
- Policy recommendations
- Supporting appendix (no page limit)
- PPT presentation for CNW

Resources/contact:

- Pre-feasibility study and other docs
- Advice on existing case examples
- CNW will provide initial guidance on key internal documentation, file transfer

Timeline

- January 24th – Norm Connolly, City of New Westminster Community Energy Manager
- Interim report due

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- In class debate
- April 6 – CNW stakeholder presentation
- April 10 – Final Report due

Major Project Report Grading (40%):

- All team members given same grade;
- Will need to meet 3 milestones throughout course in advance of final due date 1) scoping analysis & presentation, 2) draft report evaluation, 3) final presentation;
- Max ~30 pages including tables and figures, word count excludes technical annexes;
- Format suggestions: font size 12, line spacing 1 - 1.5 with adequate white spacing, text justified).

Report Grading Matrix

	1. Overall structure & delivery	2. Analysis skills	3. Synthesis skills	4. Contribution to state of knowledge	5. Originality & Innovativeness	Total Score	%
S1	2.5	2.5	3	3	3	14	70.0
S2	3	3.5	3	3	3.5	16.0	80.0
S3	1.5	1.5	3	2.5	3	11.5	57.5
S4	1.5	1.5	2.5	2.5	3	11.0	55.0
S5	1.5	1.5	2.0	3	3	11.0	55
S6	3	3.5	3	3.5	3	16.0	80.0
S7	3	3.5	2.5	2.5	2.5	14.0	70.0

Scale: 1=needs work; 2=pass; 3=competent; 4=advanced

Key:

1. Structure & delivery: well defined and manageable scope, sound methodology, free of major expository, logical and/or numerical errors , clear delivery and presentation of data.

2. Analytical skills: ability to deconstruct data to inform and develop logical analysis and argumentation.

3. Synthesis skills: ability to synthesise data from different sources, situate research within wider context, recognize patterns and develop coherent argumentation.

4. Contribution to state of knowledge: sound understanding of topic while showing potential of contributing to state of knowledge in the field.

5. Originality & Innovativeness: demonstration of original thinking outside of conventional opinion, conceptual and/or methodological approaches, and logically supported with data/exposition and delivered coherently.

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Report Table of Contents Example

Background and Objectives

- Background context
- Problem formulation/Gap analysis
- Research questions

Methods

- Scope (spatial and temporal)
- Theoretical framework and methods (including justification of approach)
- Data needs, collection and gaps

Baseline/trend analysis

- System description, functioning, and current impacts (environmental, economic),
- Drivers of change: (Population, economics, environmental, climate change, technology trends, etc.)

Assessment of alternatives

- Identification of alternative investment strategies
- Changes to system functioning (demand, capacity, engineering performance)
- Impact analysis (economic, environmental, societal, sustainability, resilience)
- System interdependencies, risk and resilience
- Implementation and monitoring of alternatives
- Recommendations for policy and planning

Dissemination and communication of results

- Identification of Stakeholders
- Strategies for outreach e.g. Major report, presentation, education, etc.

Major Project Presentation Grading (10%)

- Each team will present their final major project results considering innovative ways to communicate their findings
- Communication should consider how to engage a broad audience of stakeholders e.g. industry, government, public, academia, etc.
- Multi-media is encouraged (video, music, policy brief, info-graphic, etc.)

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- Other formats include plenary session, role-play or other performances, combined approaches, etc.
- Standard presentations can also be used, but the overall goal is to communicate results effectively to a broad audience.
- Presentations will be filmed as a professional development tool, and future resource.
- Grading will come from the instructor and feedback from rest of class will be taken into account.

B) MAJOR PROJECT EVALUATION & DEBATE

The objective of this exercise is to provide timely critical feedback on written content, debate and effectively communicate your position. You are not expected to have domain expertise but apply general critical thinking skills. This approach simulates the process for academic publication but more generally the skill sets are highly relevant across most professions, particularly at the management level, where providing timely feedback is expected.

Major Project Evaluation Grading (20%)

- Each team will be responsible for evaluating (i.e. providing critical feedback) another team's draft report.
- Feedback must be provided as tracked changes by all team members on the report text; this requires having both a reasonable draft version completed, and providing timely feedback.
- Each team will then present their draft report and discuss how the feedback will inform their analysis, has been or will be incorporated into the final report, and if not, defend their position.
- This will be delivered as a debate style presentation, where the presenting team will respond to challenges by the evaluating team (and the rest of the class).
- Grading will be based on the quality of evaluation via tracked changes, and oral feedback/discussion on both sides (from instructor and evaluating teams).

C) ASSIGNMENT 1: CITY SYSTEMS ANALYSIS

- Select a major city and quantitatively analyze it in terms of current challenges and opportunities by answering the question: What are the current baseline conditions of the city?
- You can select what lens you want to analyze the city through i.e. basic functions, utilities, physical infrastructure, social infrastructure, liveability, economic opportunity, innovation, etc. or some rationale combination of metrics.

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- The lens that you analyze the city through will be constrained by data availability. It is up to you to properly scope the problem in order to develop a quantitative understanding of the city you choose, and explain why you chose the metrics/indicators/data you did.
- You can work alone or pair up and present as a comparative analysis between 2 cities.
- Power point presentations will be given to the class.
- The written assignment should not exceed 10 pages mostly based on graphs and data, with explanatory text and final reflections/conclusions.

Data Sources:

- Macro-level trends (economics, population, etc.) see UN, World Bank, IPCC, other global institutions, academic literature
- City level data (physical infrastructure, social, economic activity, etc. see city council websites e.g. Master Transport Plans, Official Community Plan, Economic Development Office, etc.
- Academic literature see UBC Library and journal database, Google Scholar, etc.

Assignment 1 grading (15%)

The major report grading matrix presented above will be used to grade this short report.

D) ASSIGNMENT 2: CITY SCENARIOS

- Scenarios are a structured way to envision how past and current trends (physical, social, economic, etc.) may change in the future.
- Scenarios are used to determine plausible future outcomes and assess the potential impacts of policy, technology, lifestyle change, or unforeseen disruptive events.
- Scenarios typically are based on a qualitative description/narrative of how the future might be, and supported by internally consistent changes to baseline data.
- You will use your city base-line conditions from assignment 1 to develop future scenarios of your city. This is why it is important to select a case-study with sufficient available data.
- You will be expected to extrapolate trends and apply basic cumulative growth functions to data.
- We will go through in-class group exercises to develop qualitative scenarios and lessons on basic data analysis.
- Power point or other media can be used for presentations given to class.

Resources:

- OECD Scenario:

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<https://www.oecd.org/site/schoolingfortomorrowknowledgebase/futurestinking/scenarios/whatarescenarios.htm>

- Shell Scenarios:

<http://www.shell.com/energy-and-innovation/the-energy-future/scenarios.html>

Assignment 2 grading (15%)

Group presentation grading presented above will be used to grade this assignment. The overall goal is to demonstrate grasp of the basic concepts (extrapolating macrolevel drivers of change, developing internally consistent qualitative narratives, etc.) and effective communication of analysis. All group members will be given the same grade by the instructor but class feedback will be taken into account.

COURSE SCHEDULE

Week 1	<ul style="list-style-type: none"> • Introduction • Discussion - What are Cities?
Week 2	<ul style="list-style-type: none"> • Lecture: Challenges and opportunities • Class exercise (pair up and present a city) • Assignment 1: City Analysis (Current challenges & opportunities; Baseline conditions)
Week 3	<ul style="list-style-type: none"> • Introduction to Major Project • January 19th - Patricia Jecks presents City of New Westminster Intelligent Cities
Week 4	<ul style="list-style-type: none"> • January 24th – Norm Connolly, City of New Westminster Energy Manager • January 26th - Lisa Leblanc, City of New Westminster Transport Manager
Week 5	<ul style="list-style-type: none"> • Lecture: Urban data, metrics and trends • Discussion – What are the pros and cons of metrics? • Feb 2 - Assignment 1: Presentations and Feedback • Feb 3 – Submit Assignment 1
Week 6	<ul style="list-style-type: none"> • Lecture: Scenario analysis and long-range planning methods • Foresight video • Macro-level drivers of change (population, economy), data forecasting • Class exercise – scenario building and mock debate • Assignment 2: Future Urban Scenarios
Week 7	<ul style="list-style-type: none"> • Lecture: Systems Theory • Systems thinking video • Discussion: What are the implications of systems thinking for the scientific method? • How can these theories be applied to cities?
Week 8	<ul style="list-style-type: none"> • Feb 20 – 24: Reading week
Week 9	<ul style="list-style-type: none"> • Feb. 28th – Assignment 2: Presentations and feedback

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	<ul style="list-style-type: none"> March 3^d – Assignment 2 paper due end of week
Week 10	<ul style="list-style-type: none"> Lecture: Complex Networks Complex networks video Discussion: What are the implications of complex networks for engineering and design? How can these theories be applied to cities? March 10th – Major project interim report sent to evaluation team
Week 11	<ul style="list-style-type: none"> Lecture: Integrated modelling Macro-level drivers of change (population, economy) Discussion: What are the scientific limitations and benefits? How can modelling be applied to policy and decision making implications of modelling?
Week 12	<ul style="list-style-type: none"> March 21, 23 - Major project interim presentation and evaluation
Week 13	<ul style="list-style-type: none"> Infrastructure case examples: energy, transport, water, ICT Discussion: Future smart cities
Week 14	<ul style="list-style-type: none"> Major Project Presentation at City of New Westminster
Week 15	<ul style="list-style-type: none"> April 14th - Major Project Submission

COURSE MATERIALS

Readings for this course are available in Connect. Students are expected to complete the assigned reading in advance of each lecture. This will be critical for class discussions and application of concepts covered.

Text (not mandatory):

- Hall JW, Tran M, Hickford AJ, Nichols RJ, (eds. [The Future of National Infrastructure: a system-of-systems approach](#). Cambridge University Press, UK.

Recommended Readings

- Tran et al. (2014) National infrastructure assessment: analysis of options for infrastructure provision in Great Britain. University of Oxford. ISBN: 978-1-874370-52-9. URL: <http://www.itrc.org.uk/wp-content/results/ITRC-First-results-WEB.pdf>
- Otto A, Hall JW, Hickford AJ, Alderson D, Barr S, Tran M. (2014) [A quantified system-of-systems modeling framework for robust national infrastructure planning](#). IEEE Systems Journal, 99: 1-12.
- Hickford, A.J., Nicholls, R.J., Otto, A., Hall, J.W., Blainey, S.P., Tran, M. and Baruah, P. (2015) [Creating an ensemble of future strategies for national infrastructure provision](#). Futures, 66: 13-24.
- Baruah, P., Eyre, N., Qardan, M., Chaudry, M., Blainey, S. P., Hall, J. W., Jenkins, N., Tran, M. (2014) Energy system impacts from heat and transport electrification. *Proceedings of the Institution of Civil Engineers – Energy*, 3: 139 - 151.

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- Tran, M., Banister, D., Bishop, J.D.K. and McCulloch, M.D. (2012) Realizing the electric-vehicle revolution. *Nature Climate Change*, 2: 328-333.

Additional Readings

City Science:

- Batty M. 2008 The size, scale, and shape of cities. *Science* 319, 769–771.
- Batty, M. et al., 2012. Smart cities of the future. *The European Physical Journal Special Topics*, 214(1), pp.481–518.
- Bettencourt LM, Lobo J, Helbing D, Kuhnert C, West GB. 2007 Growth, innovation, scaling, and the pace of life in cities. *Proc. Natl Acad. Sci. USA* 104, 7301–7306.

Global trends:

- IPCC Fifth Assessment Report (2014) Working Group III - Mitigation of Climate Change: Summary for Policy Makers
- IPCC Fifth Assessment Report (2014) Chapter 12. Human Settlements, Infrastructure and Spatial Planning.
- McKay, D.J.C. (2015) Sustainable Energy - without the hot air. URL: <http://www.withouthotair.com/>

To be continually updated...

ACADEMIC INTEGRITY

Assistance with the creation of a course syllabus is available through the Centre for Teaching, Learning and Technology, www.ctlt.ubc.ca Resources related to the development of assessable learning outcomes can be accessed through <http://ctlt.ubc.ca/resources/webliography/course-designdevelopment/> The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar at <http://calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,0>.