Exploring the InfraWorks API to Help Cities Plan Better Public Transit

Mathews Mathai – Business Consultant, Autodesk,Inc.

Lynda Sharkey – Sustainable Transportation Product Manager, Autodesk,Inc.

Class summary

Congestion and greenhouse gas from private vehicles is a serious cause of worry, and many cities are turning to public transit to make sure citizens have safe, reliable, and regular access to their cities.

Join us for this lab to learn how to use the InfraWorks software API (application programming interface) to create functionality that enables the planning and analysis of public-transit changes in a conceptual design environment.

You will also learn how the InfraWorks software API can help determine the walkability of a neighborhood, the access to amenities, and the environmental impact of a route.

Key learning objectives

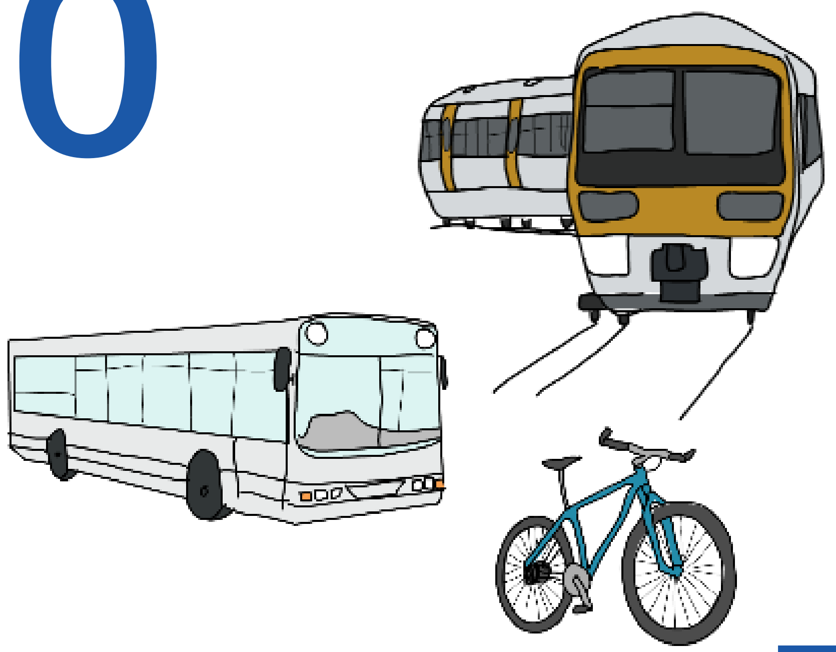
At the end of this class, you will be able to:

- **Explore** the scripting environment within Infraworks 360
- **Understand** the importance of walkability and transit-oriented development
- **Integrate** walk scores and transit scores into your model via API
- **Extend** functionality

Challenges facing Cities

Why focus on Transit and Transportation?

23%



30%

Transportation-sector emissions

Is there a Need for Public Transit?

- "Promoting higher density housing in areas close to transportation stops is an important component of the City's General Plan. Higher density housing with good access to transit helps accommodate the City's growing population and helps relieve traffic congestion, by increasing ridership on public transit..."
  - City of Los Angeles, CDP Questionnaire for Autodesk, 2011

- Walkable neighbourhoods have been deemed 15th out of 300 in the rankings of Sustainability Goals for the Built Environment, with high economic, environmental, social and cost – benefit ratios.
  - Washington DC "Sustainable DC" plan

- " We have always been a city built around transportation — first water, then rail, then roads. This will continue to be true as our transportation system continues to evolve. Where we once built expressways that divided our communities, we are now reconnecting neighborhoods with new bus lanes and extensive and expanding bicycle facilities that offer safe, green, and fit ways to travel for all ages."
  - Mayor Emmanuel, City of Chicago, 2011

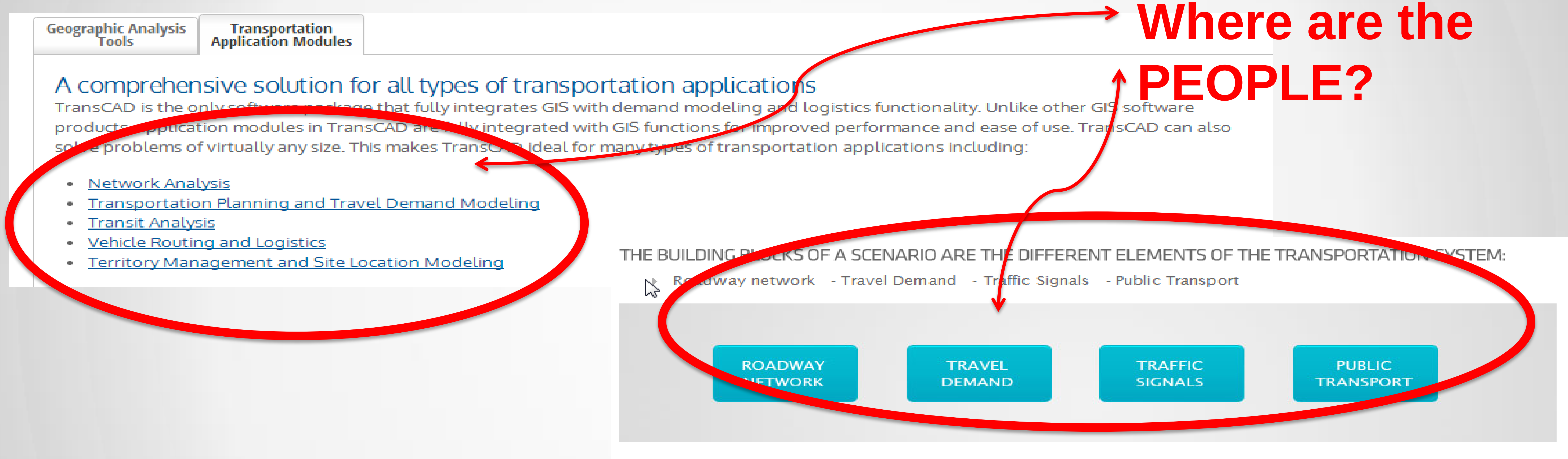
- "Anything that makes it easier for us to calculate sustainability benefits earlier in the process is going to be super useful"
  - Dan Campbell, City of Vancouver, 2013

What still needs to be done?

- Modeling more than vehicles
- Address changing transportation paradigm
- Triple Bottom Line analysis for transportation plans
- Provide ways to access traffic, transit and demographic data via Model Builder

Why model more than vehicles?

- Traditional methods disregard people moving



- Transit – oriented development and ‘Walkable Neighbourhoods’
  - Portland,OR – Pearl District
  - Arlington,VA – Rosslyn Ballston Corridor
  - Boston,MA - Haymarket

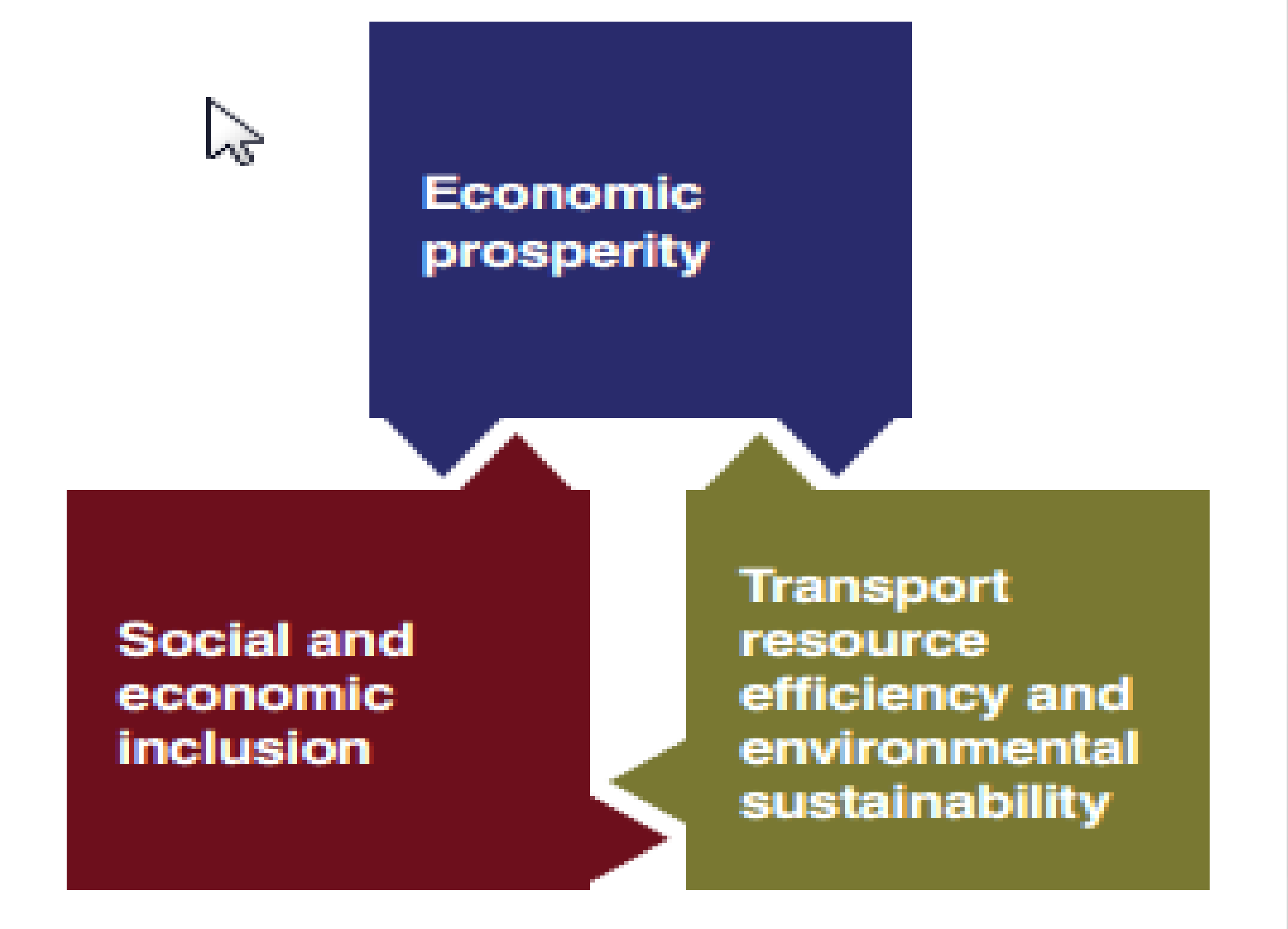
Why address the changing transportation paradigm?

- Accessibility over mobility
- Connected networks over hierarchical networks
- Evolution of LOS report card
- Greater collaboration

	Old Paradigm	New Paradigm
Definition of *Transportation*	*Mobility* (physical travel)	*Accessibility* (people's overall ability to reach services and activities)
Modes considered	Mainly automobile	Multi-modal: Walking, cycling, public transport, automobile, telework and delivery services
Objectives	Congestion reduction; roadway cost savings; vehicle cost savings; and reduced crash and emission rates per vehicle-kilometer	Congestion reduction; road and parking cost savings; consumer savings and affordability; improved access for disadvantaged people; safety and security, energy consumption and emission reductions; public fitness and health; support for strategic land use objectives (reduced sprawl)
Impacts considered	Travel speeds and congestion delays, vehicle operating costs and fares, crash and emission rates.	Various economic, social and environmental impacts, including indirect impacts
Favored transport improvement options	Roadway capacity expansion.	Improve transport options (walking, cycling, public transit, etc.). Transportation demand management. More accessible land development.
Performance indicators	Vehicle traffic speeds, roadway Level-of-Service (LOS), distance-based crash and emission rates	Quality of accessibility for various groups. Multi-modal LOS. Various economic, social and environmental impacts.

Why address the triple bottom line?

- Environmental impacts
- Economic impacts
- Social impacts

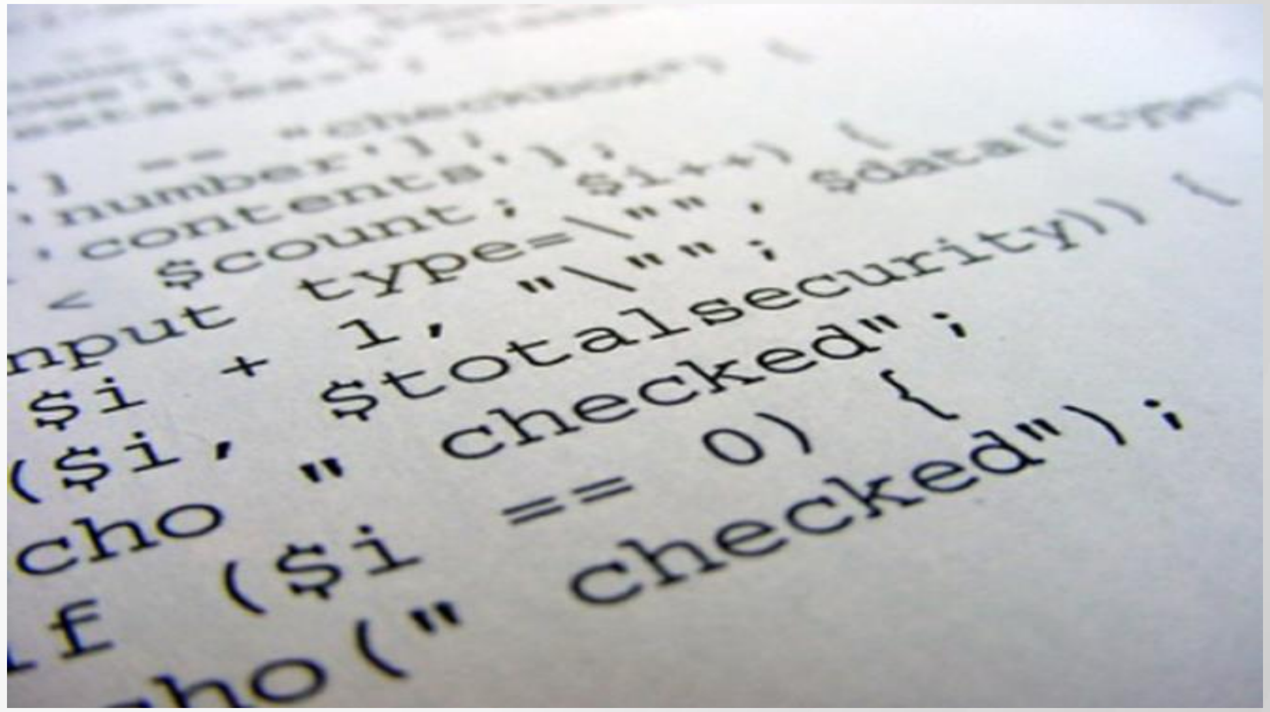


Scripting Using InfraWorks 360

- Why Script
  - Simply Workflows
  - Automate Workflows
  - Extend Existing or Introduce Additional Capabilities
  - Integrate with Other Applications

- Types of Scripts
  - Project Specific
  - Standalone

- Scripting Language
  - Javascript
  - Javascript Tutorials
  - InfraWorks API Documentation
    - Un-supported



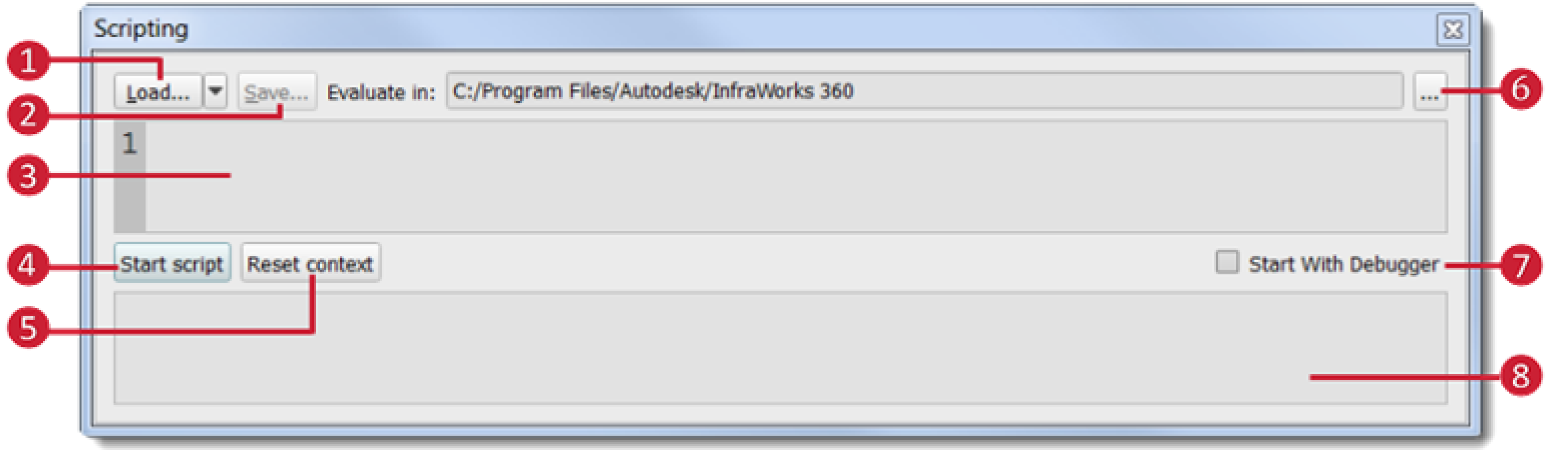
Scripting Using InfraWorks 360

Project Specific

```
function Process() {
   ROADS.ELEV_FROM = SOURCE.ElevStart;
   ROADS.ELEV_TO = SOURCE.ElevEnd;
   ROADS.LANES_BACKWARD = SOURCE.LanesTo;
   ROADS.LANES_FORWARD = SOURCE.LanesFrom;
   ROADS.NAME = SOURCE.Name;
   if ((ROADS.ELEV_FROM > 0) || (ROADS.ELEV_TO > 0)){
      ROADS.RULE_STYLE = "DefaultStreetStyles:Bridge0";
   if ((ROADS.ELEV_FROM <0) || (ROADS.ELEV_TO <0)){
      ROADS.RULE_STYLE = "DefaultStreetStyles:Tunnel0";
   } else {
      ROADS.RULE_STYLE = "DefaultStreetStyles:Street0";
   }
}
```

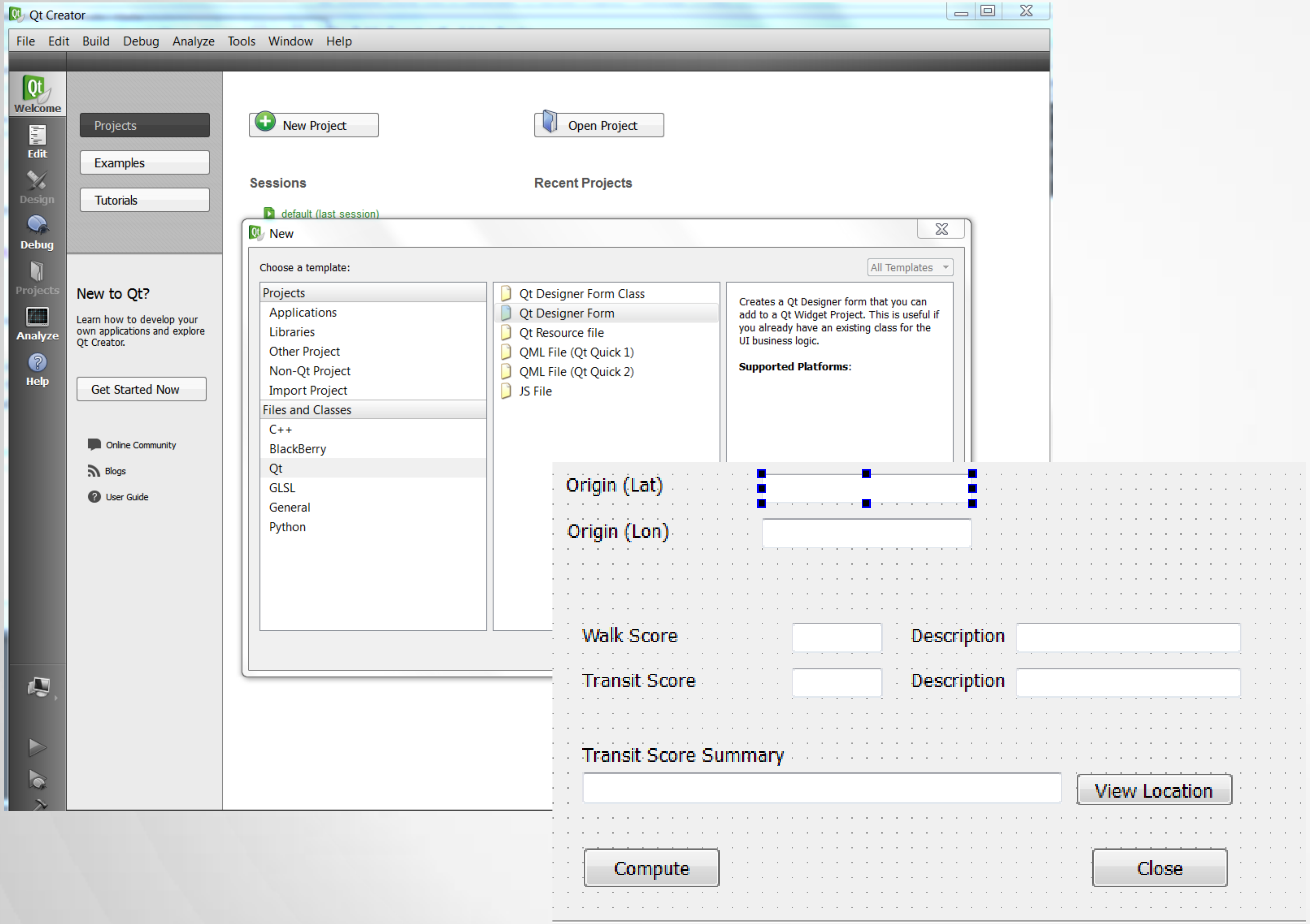
Standalone

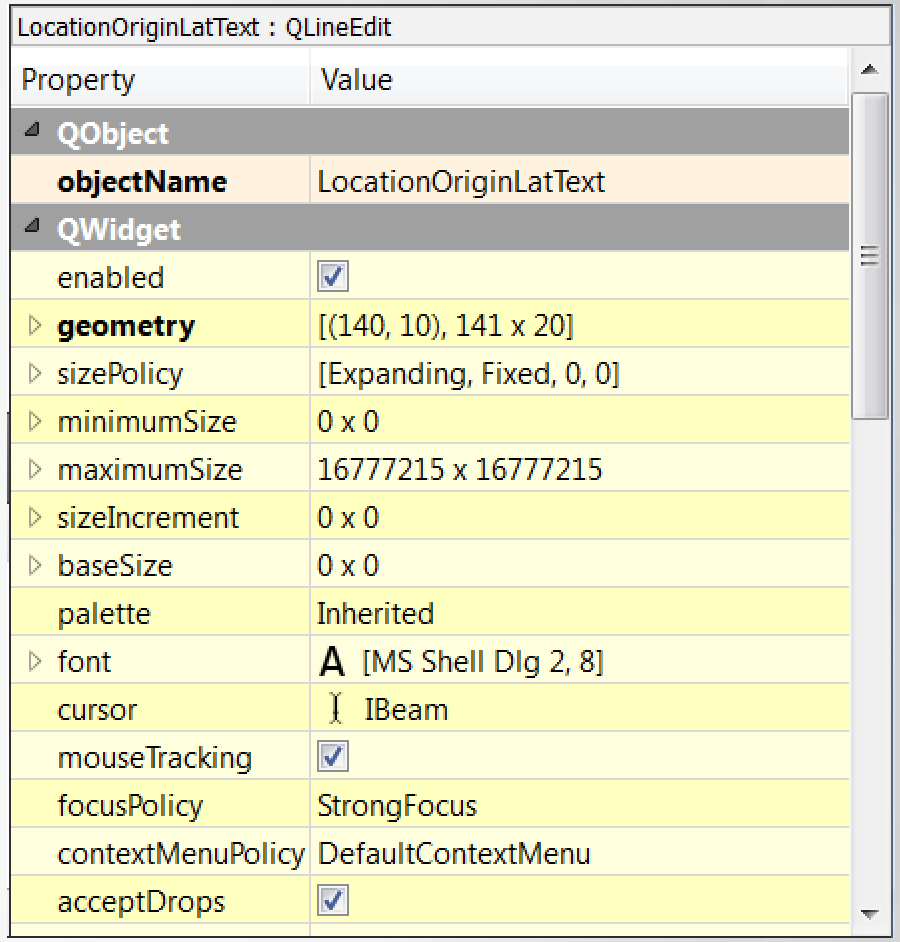
Click ➤ ➤ to open the Scripting Console.



1. Load a JavaScript file to use.
2. Save the current script.
3. Click in the Scripting Area and type or paste in a script.
4. Click to start the script.
5. Reset the context of the script.
6. Browse to a different location to evaluate the script in. This is the directory where the script will be run.
7. Select Start with Debugger to open the debugger window once a script is started.
8. Script results are returned here.

Creating a User Interface Using Qt Creator





Essentials of InfraWorks API Programming

- **Examples of InfraWorks API Classes & Members**
  - **Application**
    - ActiveModel
    - OpenUrl()
    - GetUnit()
  - **UI**
    - LoadForm()
  - **Styles**
    - getStyles()
- **Qt Creator Objects & Properties**
  - **Widgets**
    - Pushbutton
      - Name
      - Text
    - Line Edit (Text Box)
    - Combo Boxes

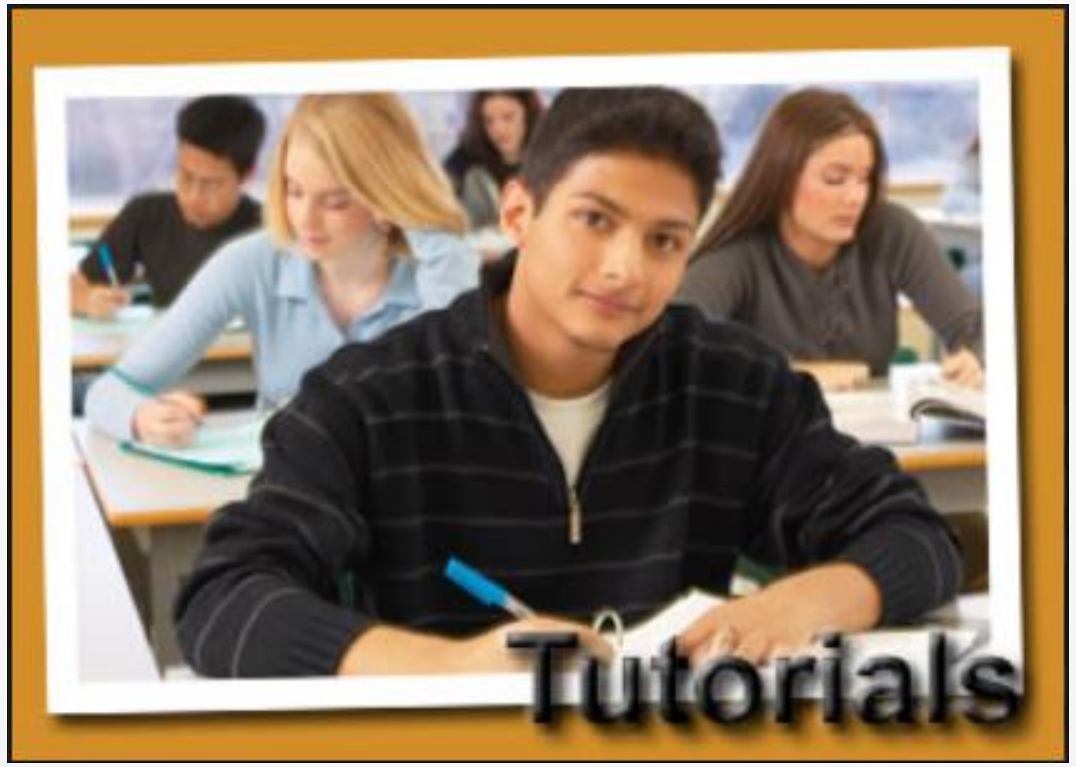
- **Common Scripting Operations**
  - **Loading and Showing a Custom Form**
    - *var form = ui.LoadForm("InfraWorks_Walkscore_Form.ui");*
    - *form.show();*
  - **Retrieving Values from a Text Box Widget**
    - *OriginLatStr = form.findChild("LocationOriginLatText").text;*
  - **Assigning Calculated Results to a Text Box Widget**
    - *form.findChild("WalkScoreText").setText(json.walkscore);*
  - **Connecting Pushbuttons to Actions**

    form.findChild("ComputePushButton").clicked.connect (CalculateWalkAndTransitScoreResults);

Tutorial #1

Extending InfraWorks Using Project Level Scripting

Data at C:\Datasets\Hands-On Labs



Walkscore, Transit Score and Travel Time

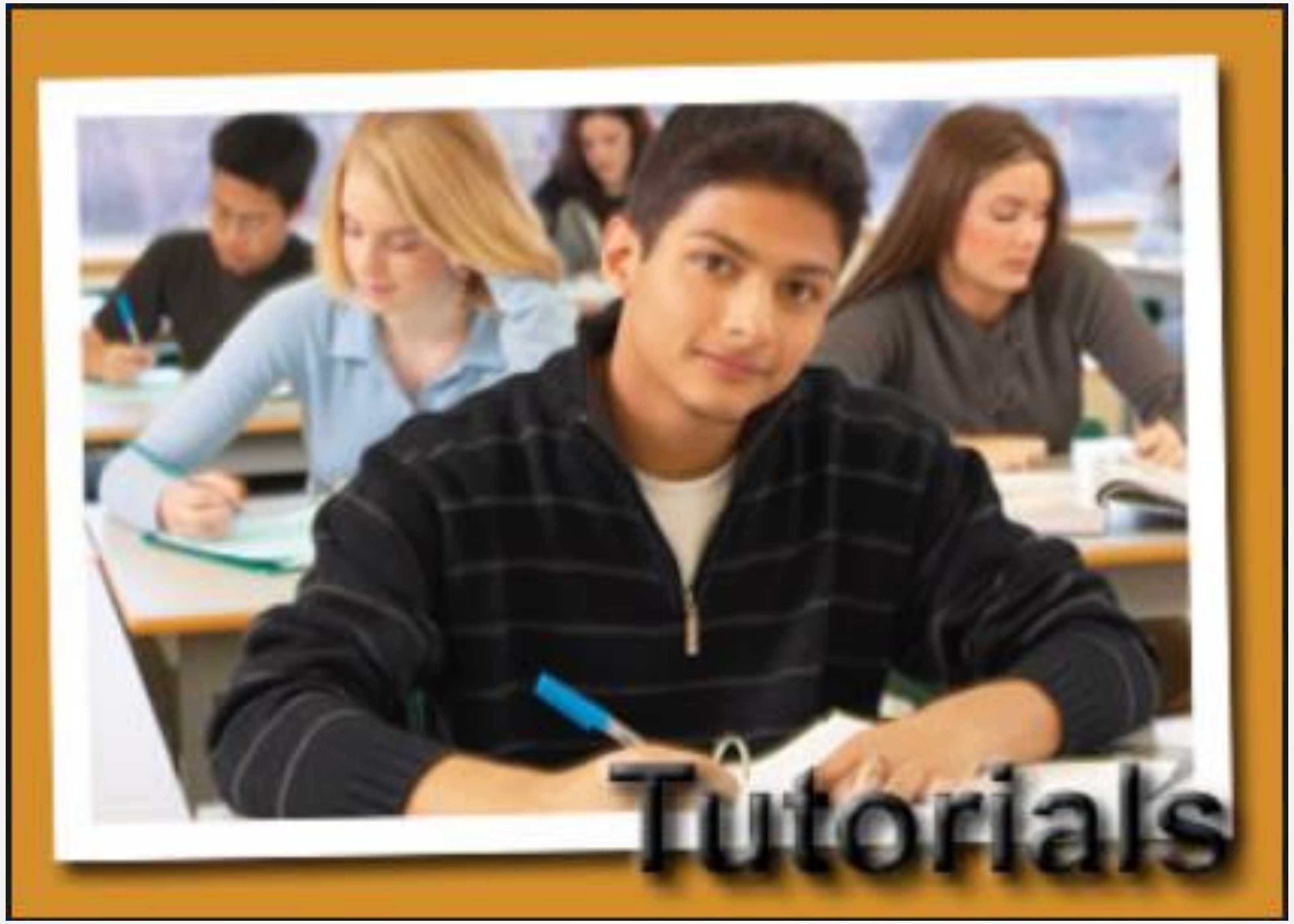
A little more information

Features

- Walkscore API returns ‘as-is’ information using existing open data
  - Walkability around a project or city
    - Measures walkability on a scale from 0 - 100 based on walking routes to destinations such as grocery stores, schools, parks, restaurants, and retail
  - Transit friendliness according to existing transit infrastructure
    - Measures transit accessibility on a scale from 0 - 100.
    - Calculates distance to closest stop on each route, analyses route frequency and type.
    - Includes location of all transit stops, routes, route frequency, and route type.
  - Access isochrones
    - Measures accessibility via walking, biking, public transit or driving
    - Takes into account natural and man-made barriers, speed limits, transit options
    - A useful way of measuring ‘freedom’ of movement

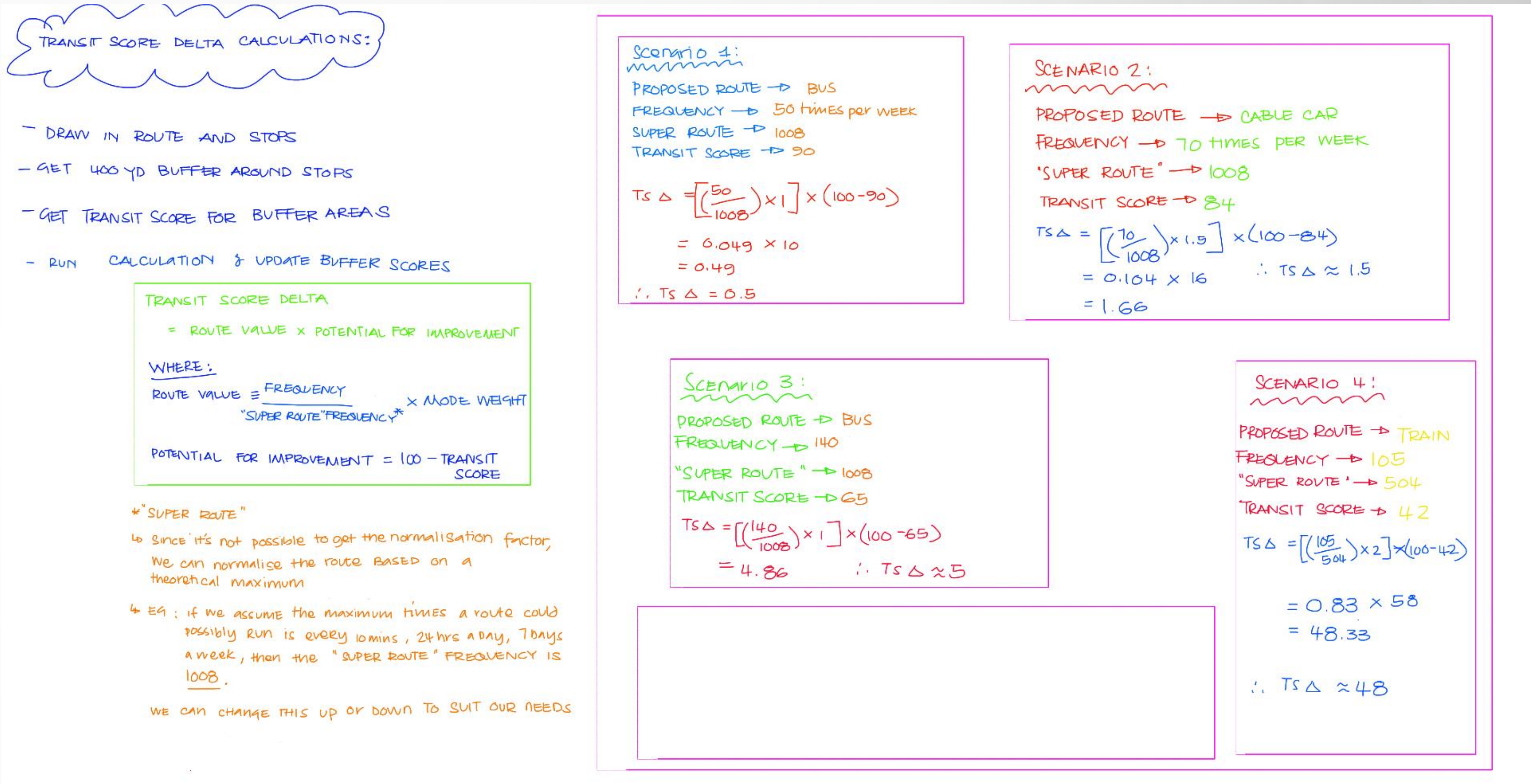
Tutorial #2

Creating an InfraWorks Walk & Transit Score Application



Trying to Predict the Future

- Walk Score and Transit Score have no predictive capability
- How can we simulate what effect changes to a transit network or neighbourhood will be?
- Need to get creative with the maths.



Changes in Transit Score

TRANSIT SCORE DELTA CALCULATIONS:

- DRAW IN ROUTE AND STOPS
- GET 400 YD BUFFER AROUND STOPS
- GET TRANSIT SCORE FOR BUFFER AREAS
- RUN CALCULATION & UPDATE BUFFER SCORES

TRANSIT SCORE DELTA

= ROUTE VALUE x POTENTIAL FOR IMPROVEMENT

WHERE:

ROUTE VALUE = FREQUENCY / "SUPER ROUTE" FREQUENCY* × MODE WEIGHT

POTENTIAL FOR IMPROVEMENT = 100 − TRANSIT SCORE

*"SUPER ROUTE"

↳ Since it's not possible to get the normalisation factor, we can normalise the route BASED on a theoretical maximum

↳ EG: if we assume the maximum times a route could possibly RUN is every 10 mins, 24 hrs a Day, 7 Days a week, then the "SUPER ROUTE" FREQUENCY IS 1008.

WE CAN CHANGE THIS UP OR DOWN TO SUIT OUR NEEDS

Scenario 1:

PROPOSED ROUTE → BUS
FREQUENCY → 50 times per week
SUPER ROUTE → 1008
TRANSIT SCORE → 90

$$TS\Delta = \left[\left(\frac{50}{1008}\right) \times 1\right] \times (100-90)$$
$$= 0.049 \times 10$$
$$= 0.49$$
$$\therefore TS\Delta = 0.5$$

SCENARIO 2:

PROPOSED ROUTE → CABLE CAR
FREQUENCY → 70 times PER WEEK
"SUPER ROUTE" → 1008
TRANSIT SCORE → 84

$$TS\Delta = \left[\left(\frac{70}{1008}\right) \times 1.5\right] \times (100-84)$$
$$= 0.104 \times 16$$
$$= 1.66$$
$$\therefore TS\Delta \approx 1.5$$

Scenario 3:

PROPOSED ROUTE → BUS
FREQUENCY → 140
"SUPER ROUTE" → 1008
TRANSIT SCORE → 65

$$TS\Delta = \left[\left(\frac{140}{1008}\right) \times 1\right] \times (100-65)$$
$$= 4.86 \qquad \therefore TS\Delta \approx 5$$

SCENARIO 4:

PROPOSED ROUTE → TRAIN
FREQUENCY → 105
"SUPER ROUTE" → 504
TRANSIT SCORE → 42

$$TS\Delta = \left[\left(\frac{105}{504}\right) \times 2\right] \times (100-42)$$
$$= 0.83 \times 58$$
$$= 48.33$$
$$\therefore TS\Delta \approx 48$$

Calculating Environmental Impacts – CO2e emitted

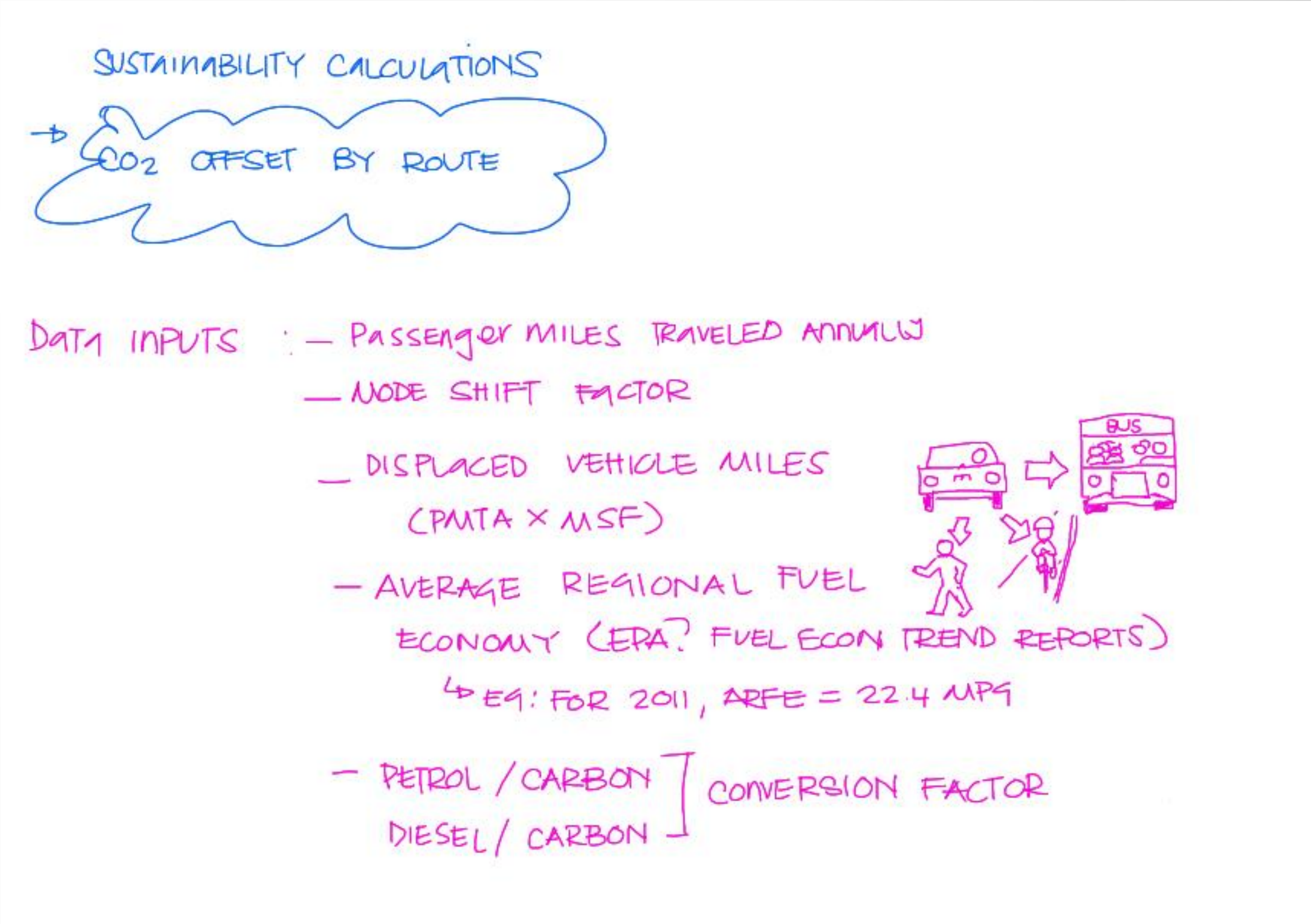
- Impact of the route on the environment
  - CO2e emissions for each fuel type
  - MPG equivalent
  - Route length
  - Route frequency

FUEL TYPE	kg CO_2 /gal	grams CH_4 / gal	grams NO_2/gal
BUS DIESEL	10.96	0.44	0.9
LPG	5.79	0.28	0.6
BIODIESEL	9.45	0.14	0.01
CNG	7.517	N/A	N/A
TRAIN DIESEL	11.27	0.45	0.09

- Output
  - CO2 emitted
  - Estimated fuel usage

Calculating Environmental Impacts – CO2e mitigated

- Estimated passenger miles travelled annually
- Mode shift
- Displaced vehicle miles
- Fuel economy
- Conversion factor



Students, *educators*, and *schools* now have

FREE access to Autodesk design software & apps.

Download at www.autodesk.com/education

Earn your professional Autodesk Certification at AU

Visit the AU Certification Lab