Transport modelling

for sustainable urban mobility planning, even in environments with poor and/or scarce mobility data

30 March 2023

Mobilise Your City

Training Developed By

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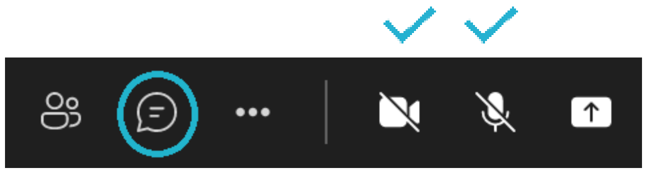
Some General Notes on this session

- Make sure you are muted and your camera is turned off



- This session will be recorded. You will not appear in the recording if your camera is kept off
- Include your questions in the chat, we will pose them in the Q&A at the end of the session

Objectives of the session

- Understand **what can be expected from urban mobility modelling**: objectives, nature, methods, limitations…

- Provide insights on how to choose **the modelling approach best adapted to the context**, especially when data is scarce

Contents

Speakers

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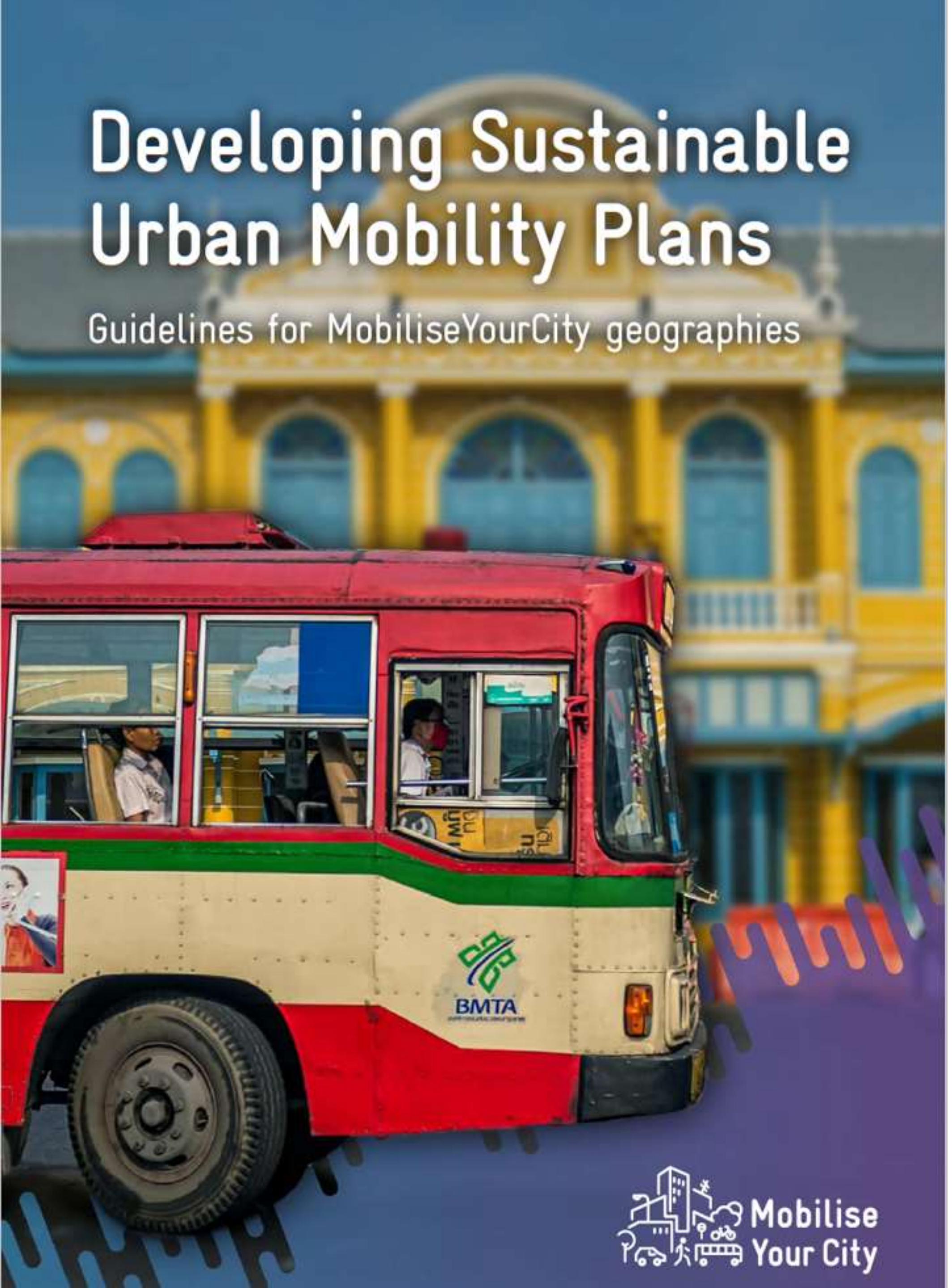

The MobiliseYourCity SUMP Guidelines

What is specific about the MobiliseYourCity SUMP methodology?

- Prepare a readiness assessment
- Set objectives in favor of climate change mitigation and adaptation
- Make the most of innovation and digital technologies' potential
- Establish sustainable mobility observatories for monitoring and evaluation of the SUMP
- The Guidelines are embedded within a robust system of support for cities

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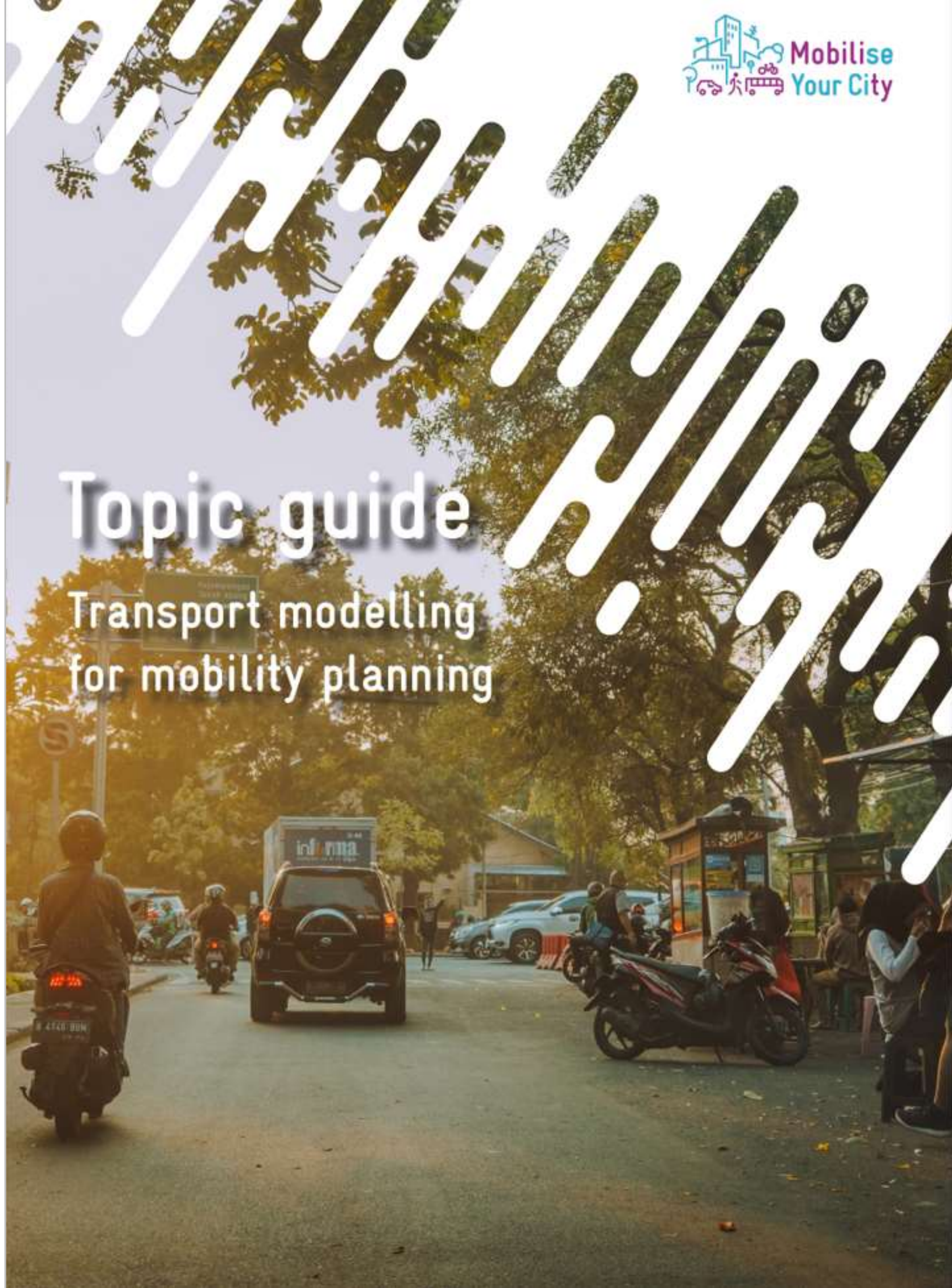
Topic Guide

Transport modelling for mobility planning

- ✓ What is a transport model?
- ✓ Why to develop a transport model?
- ✓ Types of transport model
- ✓ How to develop a transport model for SUMP development



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Warm Up Exercise

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Warm Up Exercise

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app.klaxoon.com

88FJ4EW

app.klaxoon.com/join/88FJ4EW

https://app.klaxoon.com/join/88FJ4EW

Causes of mobility changes

Urban development

Evolutions of population, employment, densities, urban extension, urban shape…

Socioeconomic factors

Evolutions of incomes, vehicle ownership, fuel costs…

Societal evolutions

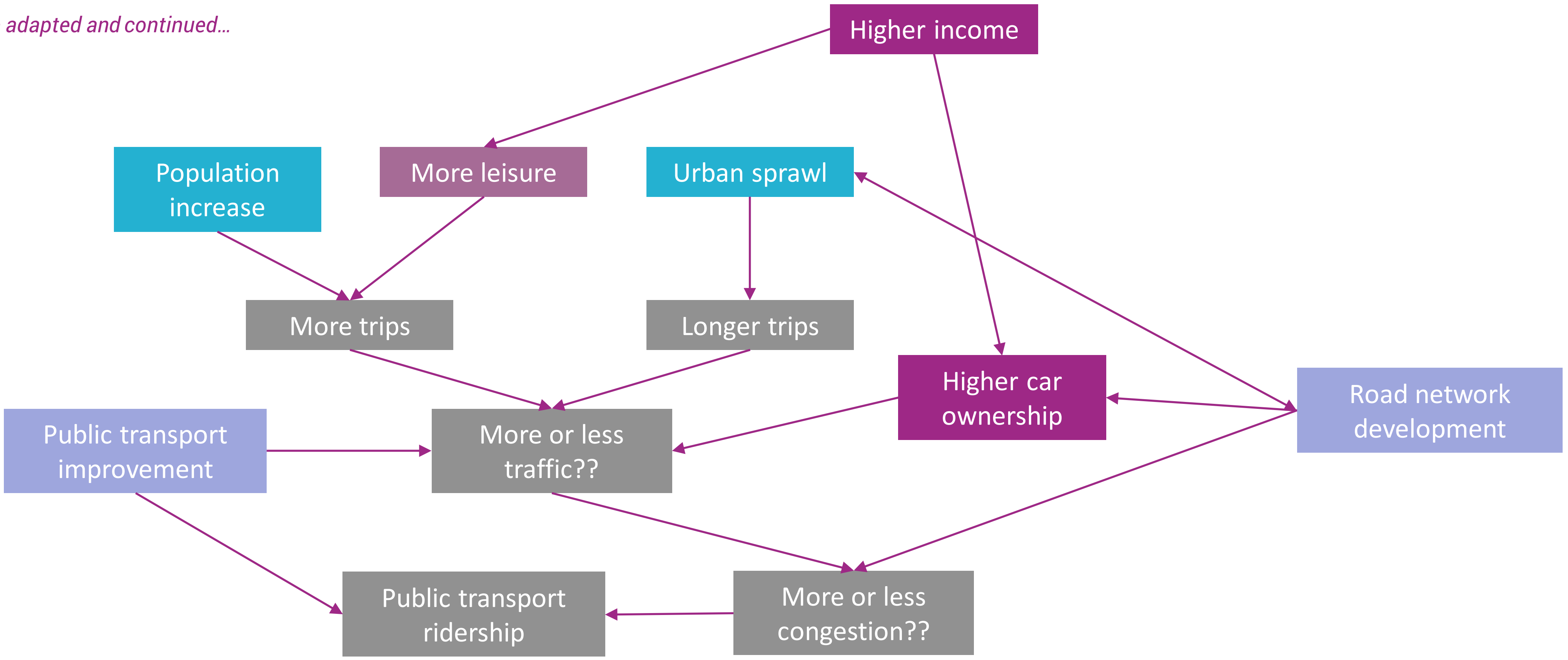
Evolutions of households size and composition, age pyramid, changes in women activities, development of leisure, changes in shopping methods, teleworking…

Transport factors

Development of road network, of public transport systems and services, of sidewalks and cycling lanes, parking possibilities, fares and tolls, deliveries, regulations, enforcement…

Example of cause-and-effects flow chart

To be adapted and continued…



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What is transport modelling and what are its main uses?

Definition of transport modelling

Objectives of transport modelling

Process of modelling

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Transport modelling: what are we talking about?

Definition in the context of this training:

→ **Methods and tools to estimate urban trips…**

I.e. number of persons moving in a city, possibly by period of time, by origins and/or destinations, by mode of transport, by trip purpose, or on a specific transport mode or infrastructure…

→ **… in situations that cannot be directly observed…**

Generally in the future, and/or with changes in demographic/economic situation, and/or changes in the transport system etc.

→ **… to be used for urban mobility management or transport planning processes.**

E.g. urban mobility plans, transport system design, traffic management plans

Objectives of transport modelling

Forecasting transport needs to develop mobility policies

How many trips in the city in 2035, from where to where?...

Dimensioning transport services and infrastructures

How many vehicles or passengers per hour and per direction?

Evaluating transport policies

How many passengers per day, per year? Mode shifts, trip time savings, vehicle-kilometres saved, GHG and pollutants emissions saved...

Reconstructing past or existing situation when data is missing

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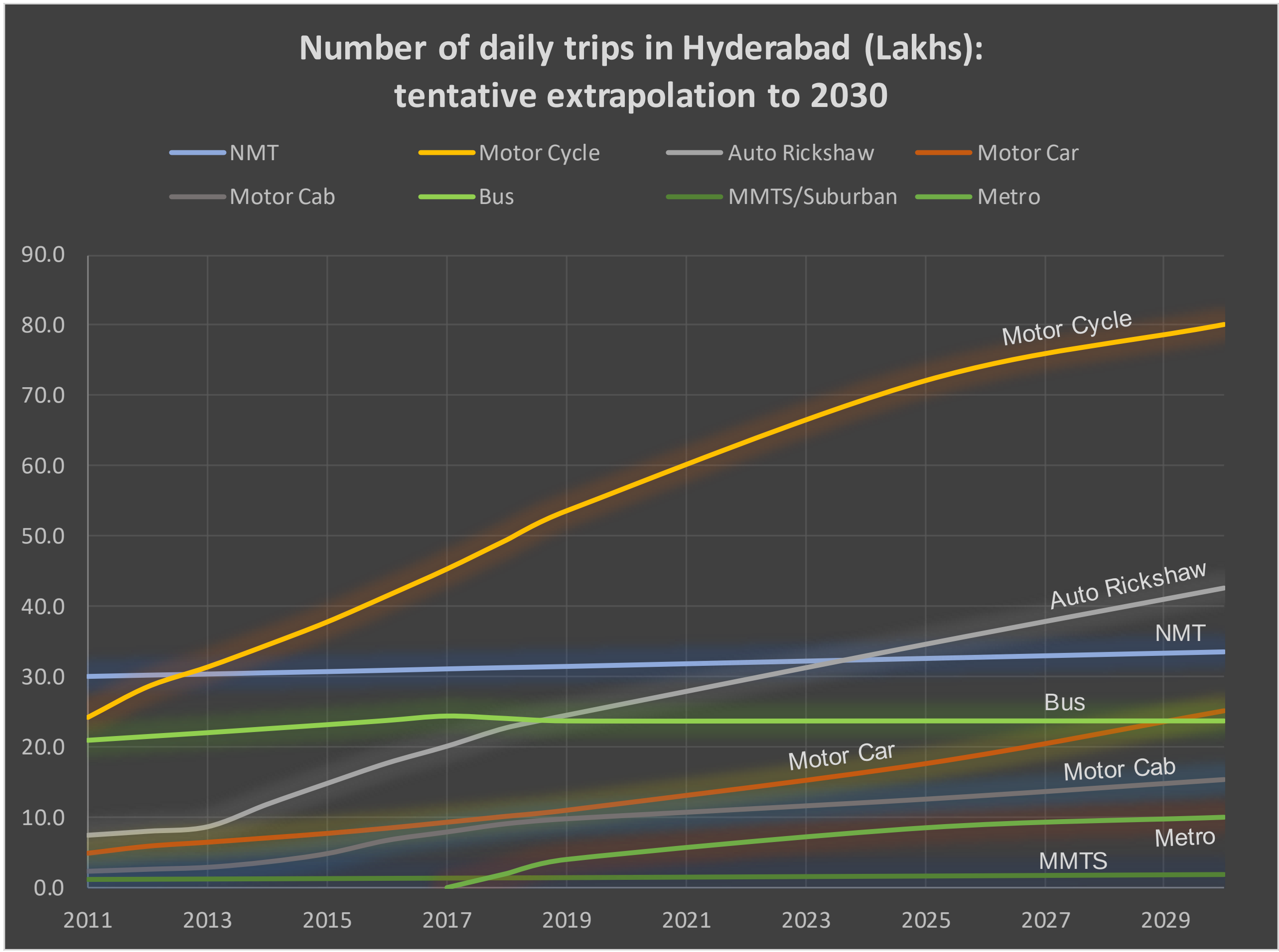
Example uses of transport models

"Prospective diagnosis" in a do-nothing scenario in Hyderabad, India

Extrapolating previous trends (population, mobility rates, registered vehicles, public transport ridership…) to show where it would lead



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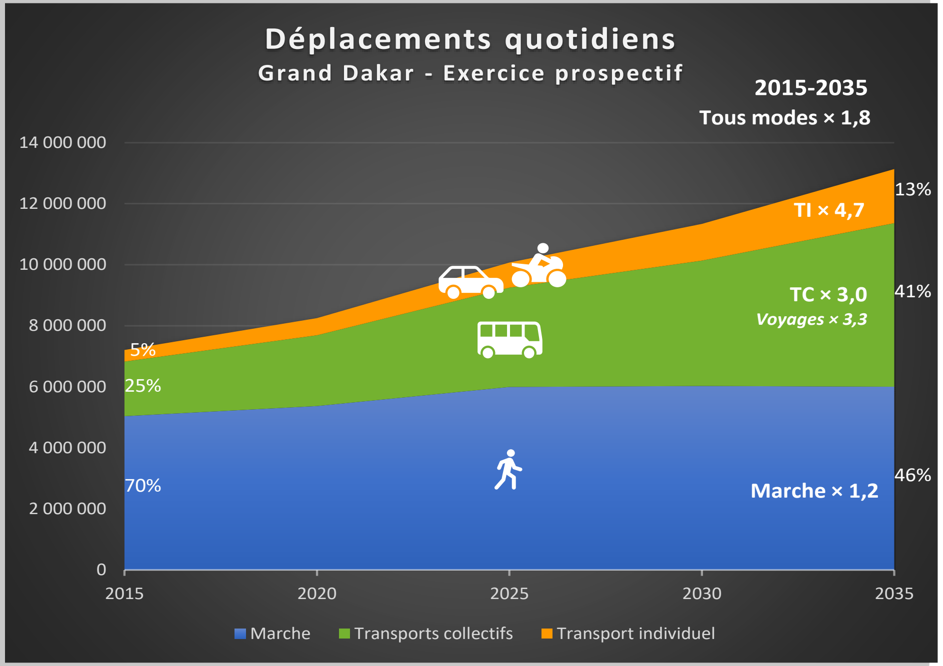

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Same approach associated with a detailed model showing unacceptable levels of congestion if nothing was done

Model assignment graph: SETEC for CETUD

“Prospective diagnosis” in a do-nothing scenario in Dakar, Senegal

Example uses of transport models

Example uses of transport models

Testing bus restructuration scenarios around the Bus Rapid Transit in Agadir, Morocco

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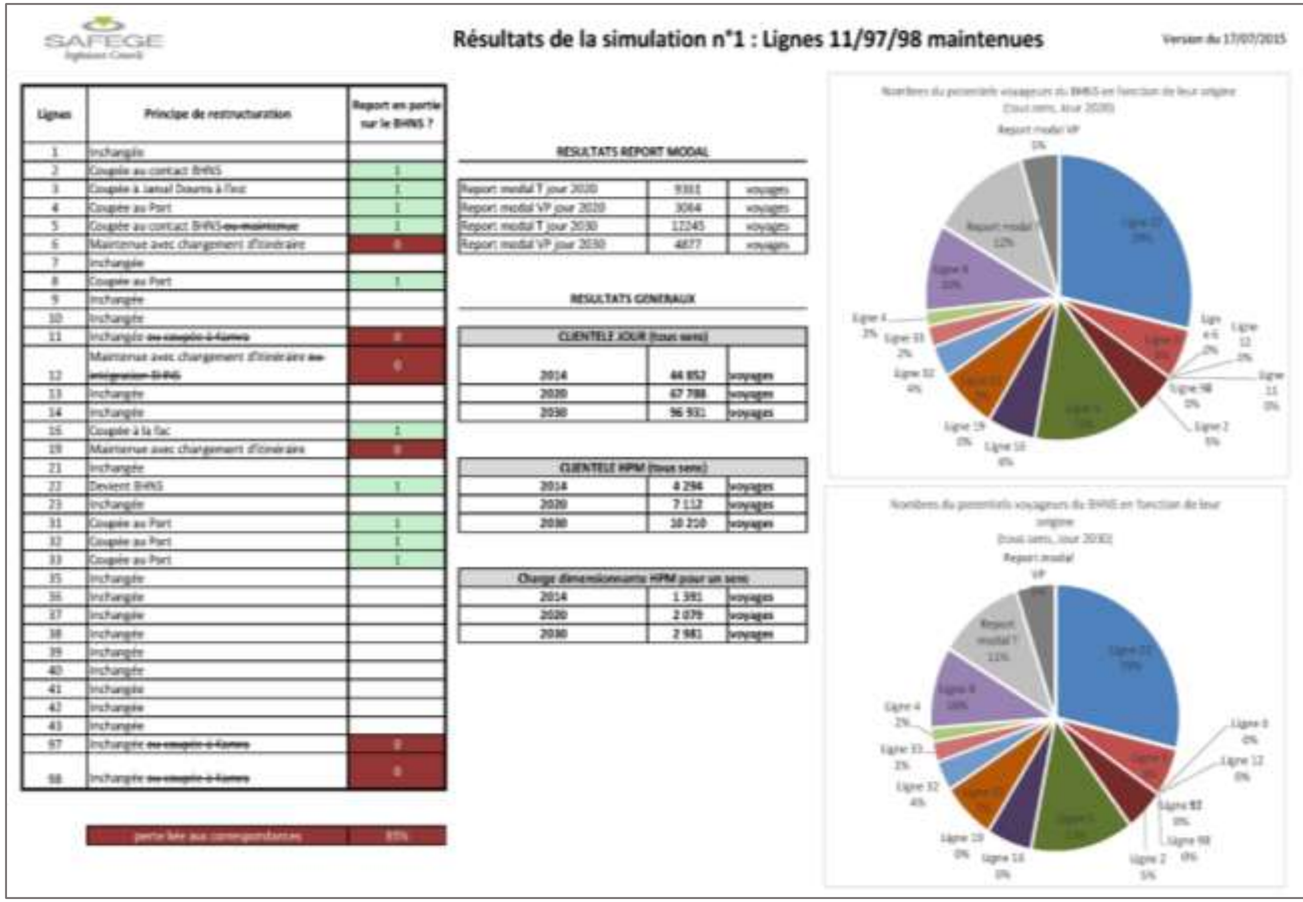
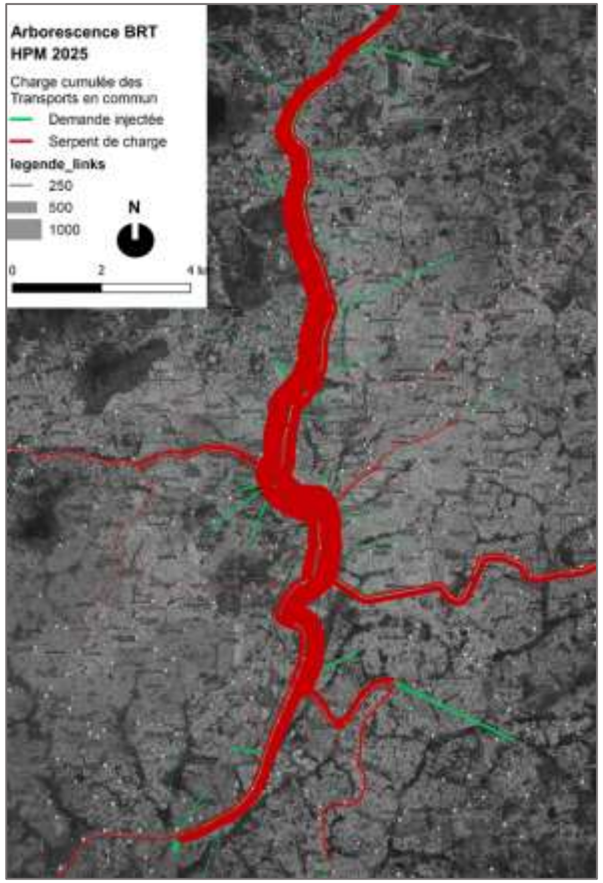
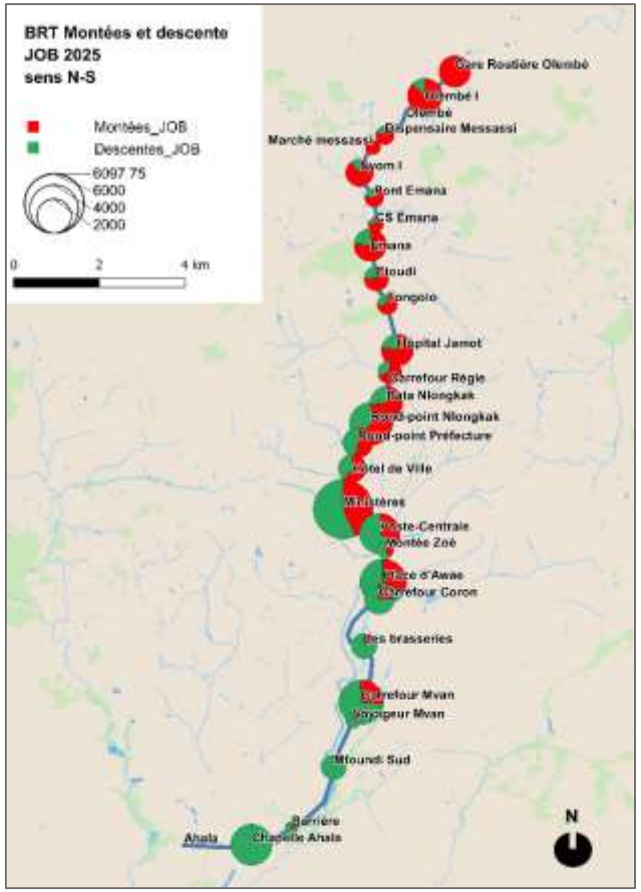


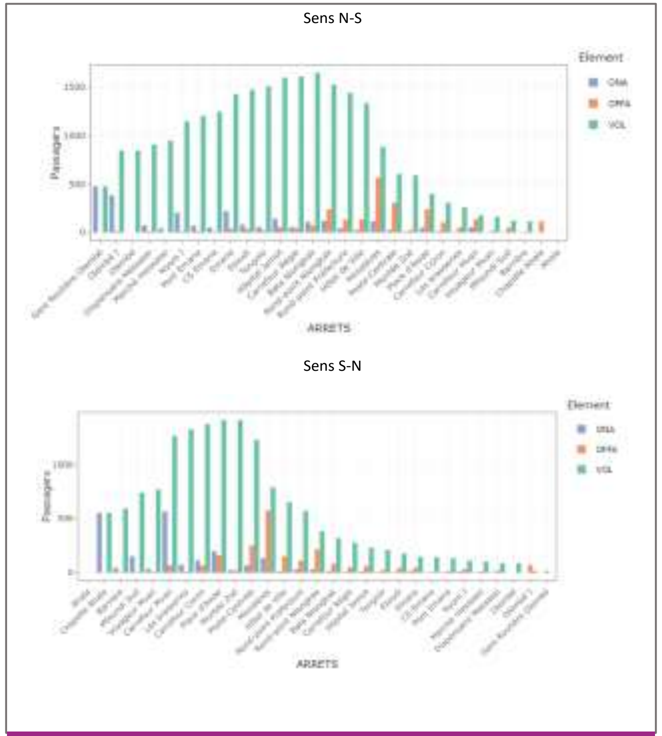
Evaluating the potential ridership of a mass transit line based on the ridership of existing bus lines

Designing and dimensioning the Bus Rapid Transit system in Yaoundé, Cameroon





Transamo for AFD/EU



Use of a full-fledged transport model based on a household mobility survey

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Example uses of transport models

Evaluating fare policies in Casablanca, Morocco

Use of a public transport model combined with a financial model

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	203
Charges d'exploitation															
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	203
VII. Rémunération de l'exploitant (Dh HT Constant 17 - TVA 20%)															
T1	206 095 628.33	142 537 575.21	0.00	0.00	0	0	0	0	0	0	0	0	0	0	
T1 modifiée / T2		53 063 729.48	206 733 135.63	210 062 912.00	215 278 134.05	217 024 335.43	215 863 244.32	226 089 915.15	225 667 094.85	250 472 279.22	253 006 704.71	249 849 638.62	249 849 638.62	249 849 638.62	249 849 638.6
Actuelle T3 (rémunération des anciennes T4 et T5 calée sur le calendrier de l'ancienne T3)		0.00	0.00	9 375 003.32	45 960 276.83	45 226 675.94	49 251 548.91	50 144 624.24	51 699 533.12	53 581 121.19	53 581 121.19	53 581 121.19	53 581 121.19	53 581 121.19	53 581 121.1
Actuelle T4 (rémunération de l'ancienne T3 calée sur le calendrier de l'ancienne T4)		0.00	0.00	0.00	0.00	150 718.25	32 197 462.84	45 489 436.94	48 513 909.14	50 627 698.97	51 121 861.58	53 423 725.39	54 967 064.76	54 928 294.86	54 928 294.8
L5		356 119.08	20 067 369.94	22 429 089.68	25 061 228.10	26 173 147.85	26 289 460.90	26 174 406.67	26 543 187.35	26 746 109.95	26 253 602.48	26 153 952.25	26 153 952.25	26 153 952.25	26 153 952.2
L6		0.00	177 010.55	14 477 435.37	18 263 615.07	20 325 317.13	20 790 463.07	20 902 861.45	21 186 873.27	20 986 679.24	20 960 171.34	20 886 017.67	20 886 017.67	20 886 017.67	20 886 017.6
Total rémunération exploitant	**206 095 628.33**	**195 957 423.77**	**226 977 516.12**	**256 344 440.37**	**304 563 254.04**	**308 900 194.61**	**344 392 180.03**	**368 801 244.45**	**373 610 597.73**	**402 413 888.56**	**404 923 461.30**	**403 894 455.12**	**405 437 794.49**	**405 399 024.59**	**405 399 024.5**
VIII. Rémunération de l'exploitant révisée (Taux d'indéxation) (Dh TTC Courant - TVA 20%)															
T1	247 314 753.99	171 045 000	0	0	0	0	0	0	0	0	0	0	0	0	
T1 modifiée / Ligne T2		63 676 000	253 041 000	262 259 000	274 146 000	281 897 000	285 997 000	305 537 000	311 065 000	352 162 000	362 840 000	365 478 000	372 788 000	380 244 000	387 849 00
T3		0	0	11 705 000	58 528 000	58 746 000	65 253 000	67 765 000	71 264 000	75 335 000	76 841 000	78 378 000	79 946 000	81 545 000	83 175 00
T4		0	0	0	0	196 000	42 658 000	61 474 000	66 873 000	71 182 000	73 314 000	78 148 000	82 014 000	83 595 000	85 267 00
L5		427 000	24 562 000	28 002 000	31 914 000	33 997 000	34 831 000	35 372 000	36 588 000	37 605 000	37 651 000	38 258 000	39 023 000	39 803 000	40 600 00
L6		0	217 000	18 075 000	23 258 000	26 401 000	27 545 000	28 248 000	29 204 000	29 507 000	30 059 000	30 552 000	31 163 000	31 786 000	32 422 00
Total rémunération exploitant	247 314 754	235 148 000	277 820 000	320 041 000	387 846 000	401 237 000	456 284 000	498 396 000	514 994 000	565 791 000	580 705 000	590 814 000	604 934 000	616 973 000	629 313 00
VIII. Autres charges d'exploitation (Dh TTC Courants/inflatés- TVA 20%)															
Energie (Lydec)	28 169 370	31 000 000	46 523 000	56 356 000	70 637 000	81 365 000	97 064 000	99 957 000	103 059 000	106 167 000	109 254 000	114 302 000	117 731 000	113 841 000	117 256 00
Vandalisme	2 000 000	1 000 000	1 501 000	1 818 000	2 279 000	2 625 000	3 131 000	3 224 000	3 324 000	3 425 000	3 524 000	3 687 000	3 798 000	3 672 000	3 782 00
Achat Supports	12 398 491	14 000 000	7 390 000	8 236 000	9 460 000	11 806 000	14 919 000	18 115 000	21 410 000	22 361 000	23 308 000	24 354 000	25 378 000	26 507 000	27 680 00
Convention sécurité Police	3 996 014	5 000 000	7 504 000	9 090 000	11 393 000	13 123 000	15 656 000	16 122 000	16 622 000	17 124 000	17 622 000	18 436 000	18 989 000	18 361 000	18 912 00
Parking Relais	520 973	645 828	969 000	1 174 000	1 472 000	1 695 000	2 022 000	2 082 000	2 147 000	2 212 000	2 276 000	2 381 000	2 453 000	2 372 000	2 443 00
Charges d'exploitation complémentaires	3 250 251	5 951 968	6 131 000	6 314 000	6 504 000	6 699 000	6 900 000	7 107 000	7 320 000	7 540 000	7 766 000	7 999 000	8 239 000	8 486 000	8 741 00
Total autres charges	50 335 099	57 597 796	70 018 000	82 988 000	101 745 000	117 313 000	139 692 000	146 607 000	153 882 000	158 829 000	163 750 000	171 159 000	176 588 000	173 239 000	178 814 00
Total Charges d'exploitation (Dh TTC Courant/inflatés - TVA 20%)															
T1	297 649 853														
T1 modifié / T2		292 319 000	317 417 000	327 554 000	339 604 000	349 597 000	355 311 000	378 270 000	387 473 000	430 915 000	444 167 000	449 418 000	459 391 000	465 079 000	475 414 00
T3		0	0	11 705 000	71 388 000	84 110 000	91 324 000	95 117 000	100 004 000	105 141 000	107 390 000	112 101 000	114 739 000	114 120 000	116 798 00
T4		0	0	0	0	230 000	62 153 000	81 941 000	88 267 000	93 262 000	96 082 000	101 605 000	106 216 000	109 020 000	111 510 00
L5		427 000	30 204 000	39 681 000	43 628 000	46 104 000	47 237 000	48 399 000	50 258 000	51 700 000	52 204 000	53 277 000	54 519 000	55 005 000	56 291 00
L6		0	217 000	24 090 000	34 972 000	38 508 000	39 951 000	41 275 000	42 874 000	43 602 000	44 612 000	45 571 000	46 659 000	46 988 000	48 113 00
Total	**297 649 853**	**292 746 000**	**347 838 000**	**403 030 000**	**489 592 000**	**518 549 000**	**595 976 000**	**645 002 000**	**668 876 000**	**724 620 000**	**744 455 000**	**761 972 000**	**781 524 000**	**790 212 000**	**808 126 00**

DVDH and Suez Consulting for CasaTransports

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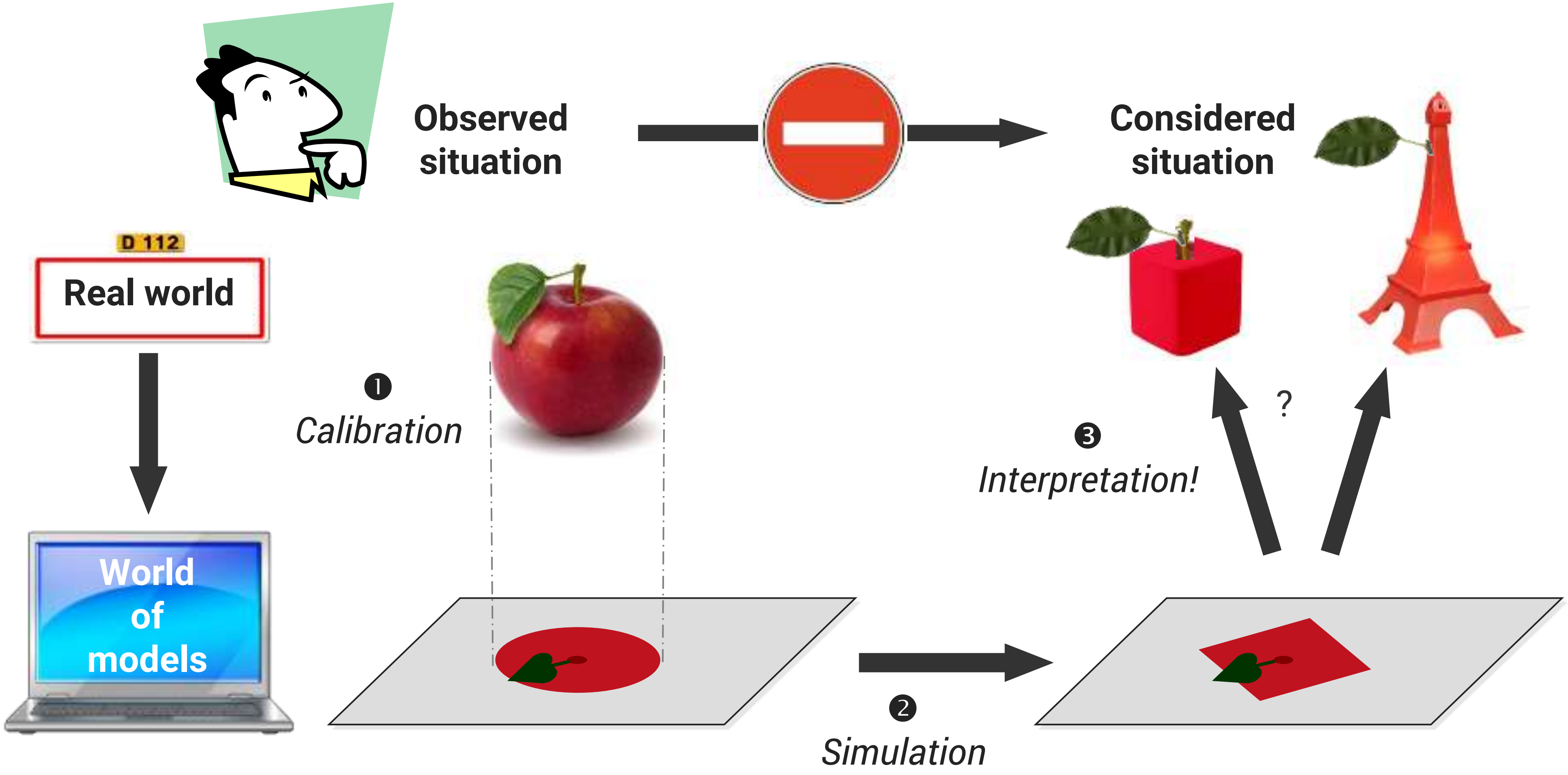
What do we intend to model? Factors impacting urban mobility

Many factors, not all possible to be modelled, all the more as we speak of… human behaviour!

- Urban structure
- Socioeconomic or cultural changes
- Individual way of life
- Transport conditions and infrastructure
- Transport fares and costs
- New technologies, such as "digital mobility"

…

The process of modelling



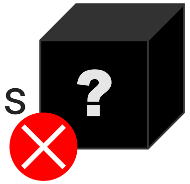
To be kept in mind

There is **no universal model**.

A model of human behaviour is **always partial**.

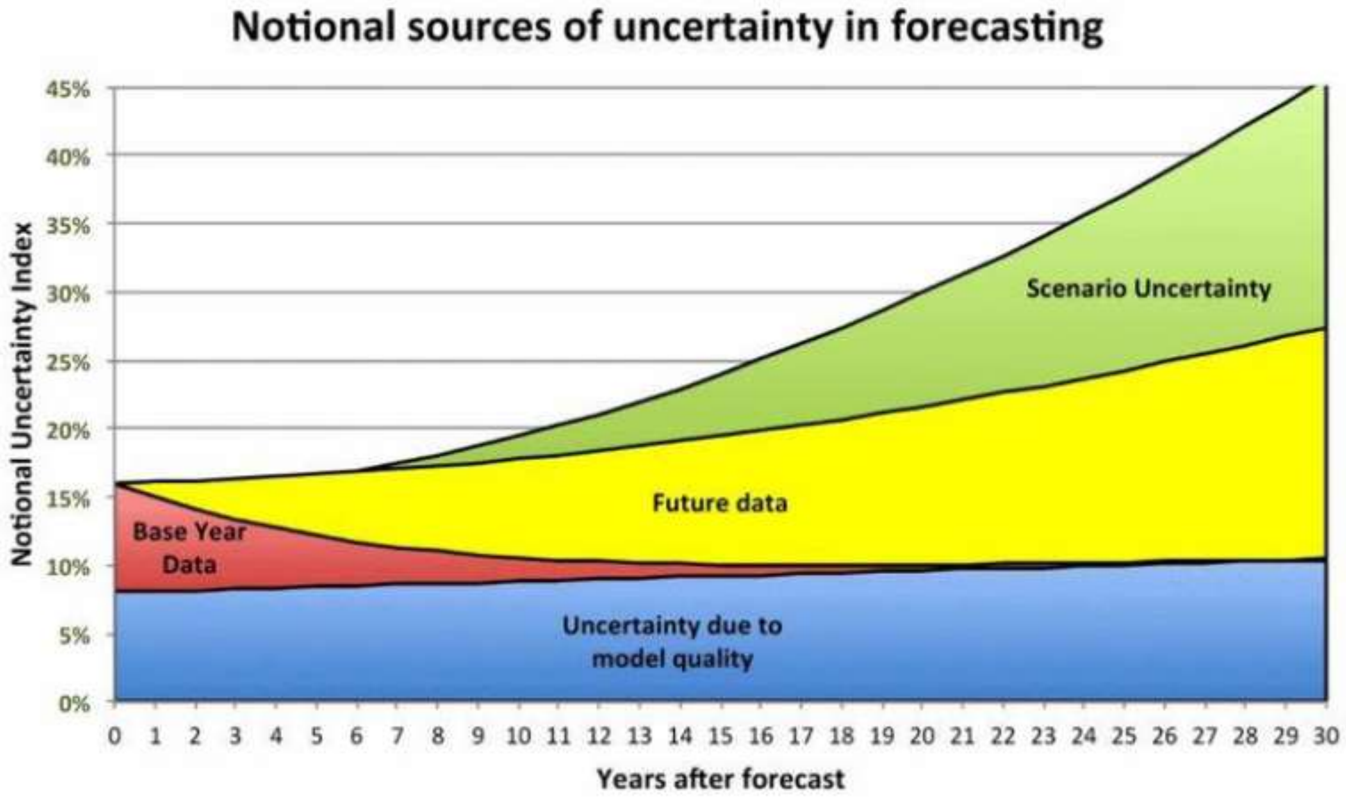
We don't make forecasts but **simulations**, based on assumptions and a simplified representation of reality.

Results interpretation is key in the process. It is only possible if the model is not a "black box".



It is recommended to **combine different approaches** (model + simplified calculations + feedback from experience + common sense etc.) to **crosscheck the results and include factors that could not be modelled**.

The issue of confidence intervals…



Source: Willumsen, Luis G. (2015). 'Dealing with Uncertainty in Demand Modelling and Forecasting', presented at the New Zealand Modelling User Group Conference, Auckland, 10 September 2015

Uncertainty is everywhere in the process (surveys, model design, assumptions, model runs…).

The reality of mobility itself is highly variable and the best surveys give only a screenshot.

But still, well used, models are necessary and useful!

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Model vs. software

There is a difference between:

- The model (approach, methods, data…)
- The software that might be used to implement the model

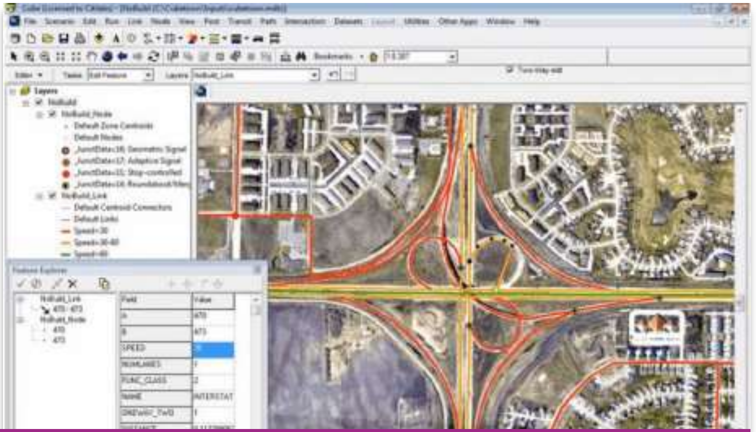
There are several specialised software, for the representation (coding) of transport networks, the simulation of route choices (assignment) and including toolboxes to model mobility choices (moving or not? to go where? by which mode of transport?)

Transport modelling usually uses software tools, but is widely an issue of know-how, of capacity to adapt the method to the objectives of a specific project and to the available data.

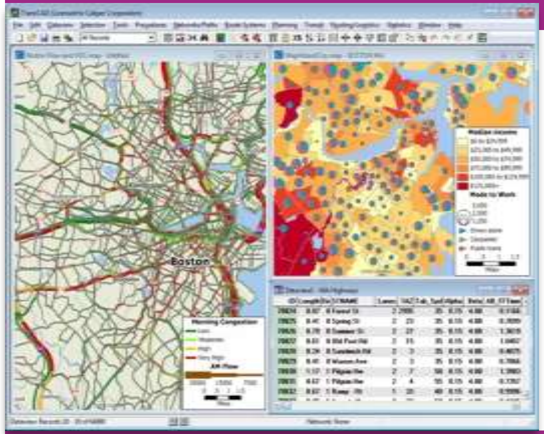
Model vs. software

Most common modelling software for transport planning:

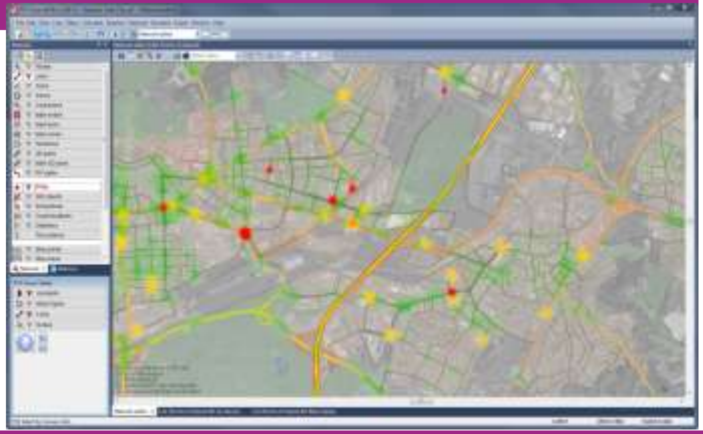
- **VISUM** (PTV, Germany)
- **CUBE** (Citilabs/Bentley, USA-UK)
- **EMME** (INRO, Canada)
- **TransCAD** (Caliper, USA)



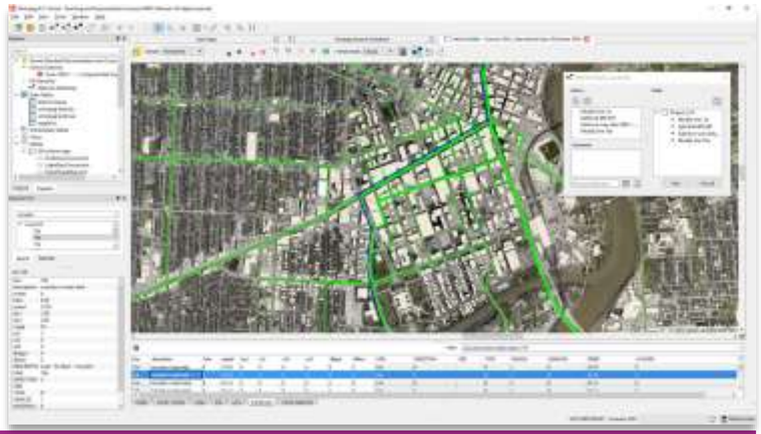
CUBE



TransCAD



VISUM



EMME

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Overview of different transport planning models

- Strategic/ macro models
- Monomodal models
- Multimodal models
- Stated preference models
- Micro/ dynamic models

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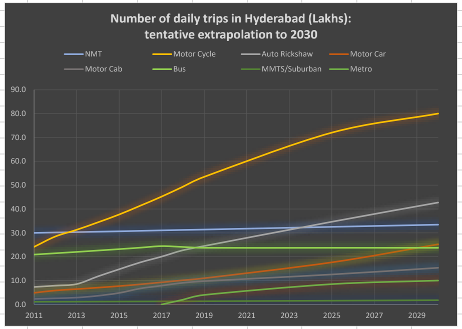
Strategic / macro models

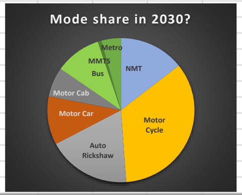
Hyderabad
Public transport corridor study
Suez Consulting for AFD

Dakar
Sustainable Urban Mobility Plan
Suez Consulting for CETUD

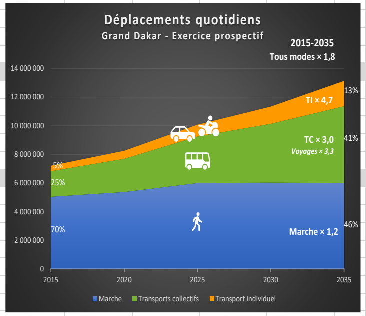
Spreadsheet-based approaches, used either alone or in combination with detailed models
Essential for crosschecks with the "full picture". Based on global or large zones indicators of population, mobility, vehicle ownership etc. and explicitation of assumptions.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2025	2030	
Population (Lakhs) GHMC	68.1	69.9	71.7	73.6	75.5	77.5	79.6	81.7	83.8	98	111.5	
Vehicles (Lakhs)												
Motor Cycle	21.1	24.91	27.36	30.1	32.97	36.22	39.55	43.17	46.79	63.0	70	
Auto Rickshaw	0.91	0.98	1.06	1.46	1.83	2.19	2.49	2.82	3.04	4.3	5.3	
Motor Car	4.81	5.8	6.37	6.98	7.62	8.36	9.2	10.05	10.9	17.5	25	
Motor Cab	0.33	0.37	0.41	0.52	0.69	0.96	1.13	1.3	1.4	1.8	2.2	
Bus	0.22	0.24	0.27	0.28	0.29	0.3	0.31	0.32	0.35			
Goods	1.48	1.62	1.78	2.06	2.26	2.54	2.86	3.3	3.56			
Others	0.86	0.92	0.98	1.49	1.8	2.19	2.71	3.31	3.58			
Total	29.71	34.84	38.23	42.89	47.46	52.76	58.25	64.27	69.62			
Daily individual mobility GHMC (2011: CTS 6-13~6-14)												
NMT	0.44	0.43	0.42	0.41	0.41	0.40	0.39	0.38	0.37	0.33	0.30	
Motor Cycle	0.35	0.41	0.44	0.47	0.50	0.53	0.57	0.60	0.64	0.73	0.72	
Auto Rickshaw	0.11	0.11	0.12	0.16	0.20	0.23	0.25	0.28	0.29	0.35	0.38	
Motor Car	0.07	0.08	0.09	0.10	0.10	0.11	0.12	0.12	0.13	0.18	0.23	
Motor Cab	0.03	0.04	0.04	0.05	0.06	0.09	0.10	0.11	0.12	0.13	0.14	
Bus	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.29	0.28	0.24	0.21	
MMTS/Suburban	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
Metro	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.09	0.09	
Total	1.33	1.40	1.43	1.51	1.59	1.68	1.75	1.83	1.90	2.07	2.08	
Number of daily trips (Lakhs)												
NMT	30.0	30.1	30.3	30.5	30.6	30.8	31.0	31.2	31.4	32.5	33.4	14%
Motor Cycle	24.1	28.5	31.3	34.4	37.7	41.4	45.2	49.4	53.5	72.0	80.0	34%
Auto Rickshaw	7.3	7.9	8.5	11.8	14.7	17.6	20.1	22.7	24.5	34.7	42.7	18%
Motor Car	4.8	5.8	6.4	7.0	7.7	8.4	9.3	10.1	11.0	17.6	25.2	11%
Motor Cab	2.3	2.6	2.9	3.6	4.8	6.7	7.9	9.1	9.8	12.6	15.4	7%
Bus	20.9	21.5	22.0	22.6	23.2	23.8	24.4	24.1	23.7	23.7	23.7	10%
MMTS/Suburban	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.6	1.8	1%
Metro							0.0	2.0	4.0	8.5	10.0	4%
Total	90.6	97.5	102.6	111.1	120.0	130.0	139.2	149.9	159.2	203.2	232.2	100%
	38.6	44.8	49.1	56.8	64.9	74.2	82.4	91.3	98.8	136.9	163.3	165%





Année	2000	2015	2019	2022	2025	2030	2035	
Population								Hypothèses modèle Setec
Dakar		1 190 441	1 278 599	1 344 718	1 431 243	1 455 803	1 481 331	
Guédiawaye		336 817	343 698	348 859	354 229	355 292	356 361	
Pikine		1 219 272	1 297 939	1 356 939	1 431 812	1 469 952	1 510 431	
Rufisque		517 292	692 367	927 333	1 325 893	1 791 747	2 415 705	
Total	**2 143 039**	**3 263 822**	**3 612 603**	**3 977 849**	**4 543 177**	**5 072 794**	**5 763 828**	
Population 11 ans et p	1 072 902	2 140 713	2 371 514	2 615 322	2 991 623	3 368 993	3 902 731	
Taux de 11 ans et plus		65.6%	65.6%	65.7%	65.8%	66.4%	67.7%	Calcul sur la base des projections ANSD
Véhicules des ménages (VP+2RM)								
Dakar		80 531						
Guédiawaye		5 527						
Pikine		17 469						
Rufisque		11 618						
Total	**41 938**	**115 145**	**156 654**	**197 338**	**248 589**	**365 259**	**536 686**	Hypothèse de croissance de 8% par an comme le parc
Déplacements de semaine								
Marche	1 915 800	5 038 800	5 280 896	5 547 636	6 000 647	6 027 926	6 003 032	Calcul par différence depl - dépl méca
TC		1 785 500	2 183 023	2 602 401	3 246 512	4 103 771	5 358 535	Calcul par différence depl méca - dépl TI
TI		380 500	517 666	652 110	821 471	1 207 010	1 773 494	Hypothèse d'évolution comme la motorisation
Mécanisés	**716 000**	**2 166 000**	**2 700 689**	**3 254 511**	**4 067 983**	**5 310 782**	**7 132 030**	Selon mobilité ci-dessous
Total déplacements	**2 631 800**	**7 204 800**	**7 981 585**	**8 802 147**	**10 068 630**	**11 338 708**	**13 135 062**	Selon mobilité ci-dessous
Ratios de mobilité								
Véhicules / 1000 habitants		35	43	50	55	72	93	
Mobilité mécanisée	0.67	1.01	1.14	1.24	1.36	1.58	1.83	Hypothèse d'évolution +3% par an comme sur 2000-2015
Mobilité tous modes	2.45	3.37	3.37	3.37	3.37	3.37	3.37	Hypothèse de stabilité
% Marche	73%	70%	66%	63%	60%	53%	46%	
% TC		25%	27%	30%	32%	36%	41%	
% TI		5%	6%	7%	8%	11%	14%	
%TC parmi mécanisés		82%	81%	80%	80%	77%	75%	
Taux de correspondance TC		1.14	1.16	1.17	1.19	1.21	1.24	Hypothèse d'évolution +0,005 par an

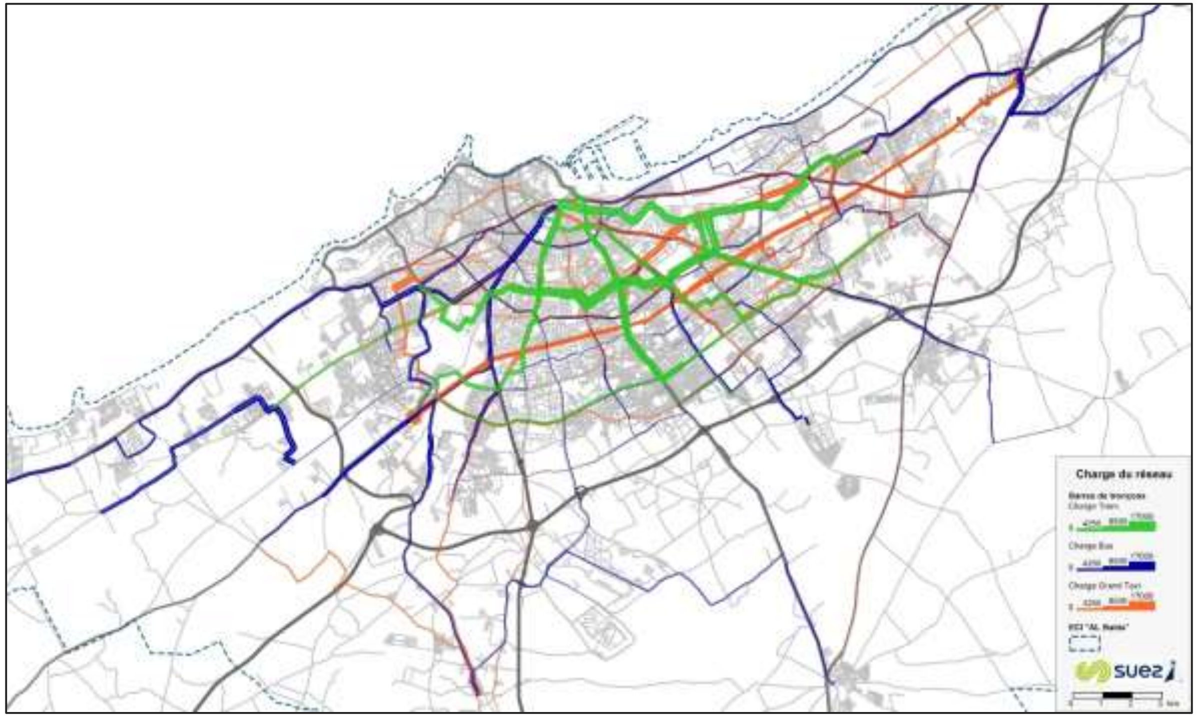


Monomodal models (road traffic only or public transport only)

Example of public transport fare policies study in Casablanca

- **Coding** tramways, buses and collective **taxi lines in VISUM**
- **Zone-to-zone trip matrix** based on an extensive PT origin-destination survey
- **Calibration of the assignment** on the network on ridership counts
- Estimation of a **"do-nothing" matrix for future year** based on population and employment forecasts and global mobility ratios based on a strategic approach
- **Test of new network and new fare policies** through elasticity of the demand to the "generalised cost" combining elements of trip time, fares and comfort factors.

A pragmatic and robust solution in many cases
For road traffic studies when modal shifts can be neglected.
For public transport studies evaluating the evolution of the demand through an "elasticity" to the service (trip times, costs…).
Easier calibration and implementation, less data required than for a multimodal model, more reliable results when the context is not changing too much.



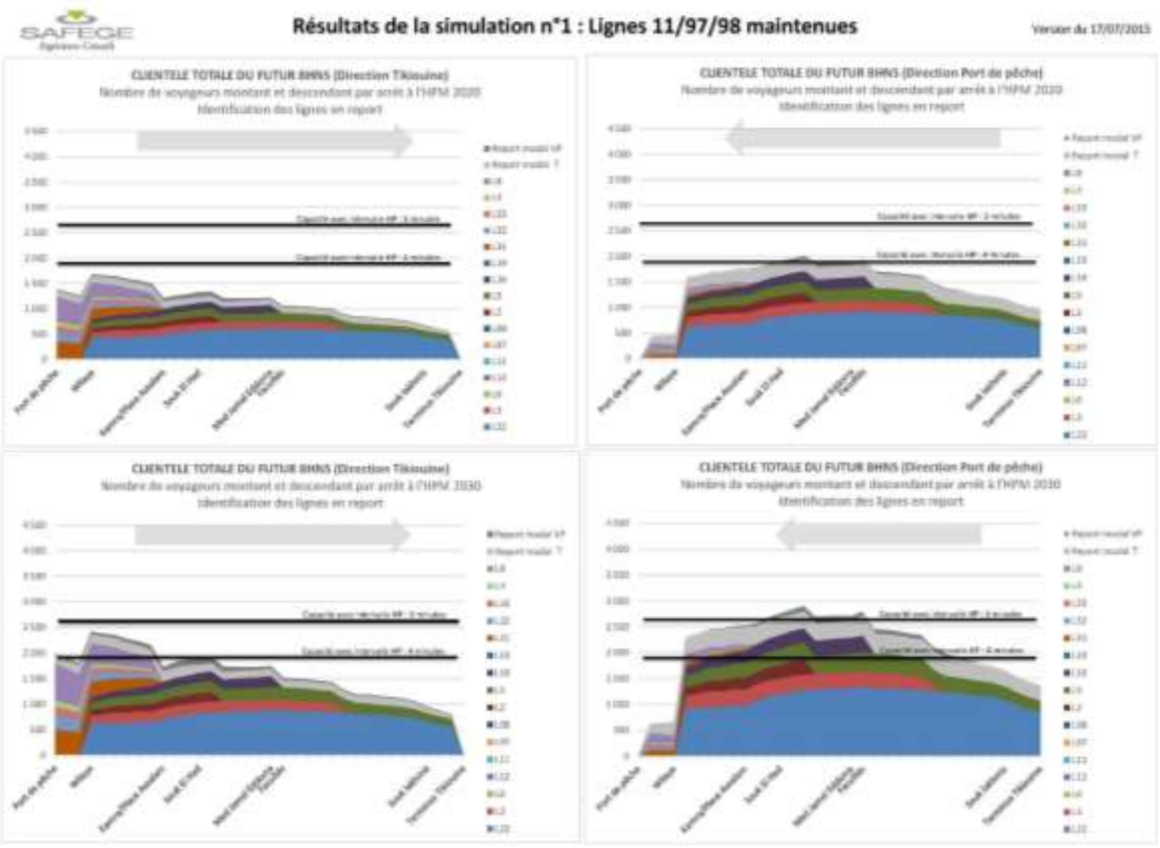
Casablanca - Business plan and fare strategy study
Suez Consulting / DVDH for CasaTransports

Monomodal models (road traffic only or public transport only)

Example: The Bus Rapid Transit of Agadir

- Detailed surveys of the **ridership of existing bus lines**: origin-destinations, boarding-alighting
- For each line, detailed analysis of the **potential transfer to the BRT** section by section if the line was suppressed or shortened
- Possibility of **rapid test of multiple scenarios** of bus restructuring on BRT ridership, comparison with BRT capacity, connection with a financial model
- **Spreadsheet-based**, no modelling software

“Reassignment model”: a pragmatic approach to test a limited reorganisation of a road or public transport network



Agadir – BHLS feasibility study update
Suez Consulting for AFD

Multimodal models

The ambition of modelling the global mobility behaviour
Extensive outputs and possibilities of testing
Requires a lot of data
Complex calibration
Much more technical and less stable results than previous approaches

- Generally/ideally **based on a household survey** including all trips made by a person on a certain day or period, with full characteristics of modes, purposes, trip times etc., as well as characteristics of the person and of the household
- **Requires zonal data and forecasts** on population and employment, with characteristics
- **Specific and highly-specialised calibration methods**
- **Reconstructs future origin-destination matrices** through methods implemented on spreadsheet or using the toolbox provided by modelling software
- **Networks model and assignment of the matrices on the networks** (route choice) made with modelling software
- **Extensive variety of results**, production of inputs for socioeconomic evaluation

Special purpose / Stated preference models

- **"Stated preference" surveys consist in asking people what they would do** (e.g. which mode they would choose) **in certain situations, close to their actual present experience**, so that their answer is reliable.
- Econometric models can be derived from the results. These models can be used to calibrate a classical multimodal model such as the ones described above, **or be used alone.**
- This method can be **very relevant when the goal is to focus on a specific project,** all the more to test the introduction of something totally new in the context (a new mode, a new fare system).
- In this case, there might be **no network coding, no matrices.** The model is **based on the sample of surveyed people**, and their individual reaction to various scenarios can be extrapolated from the answers they gave during the survey.

A model specially tailored for one project or one study

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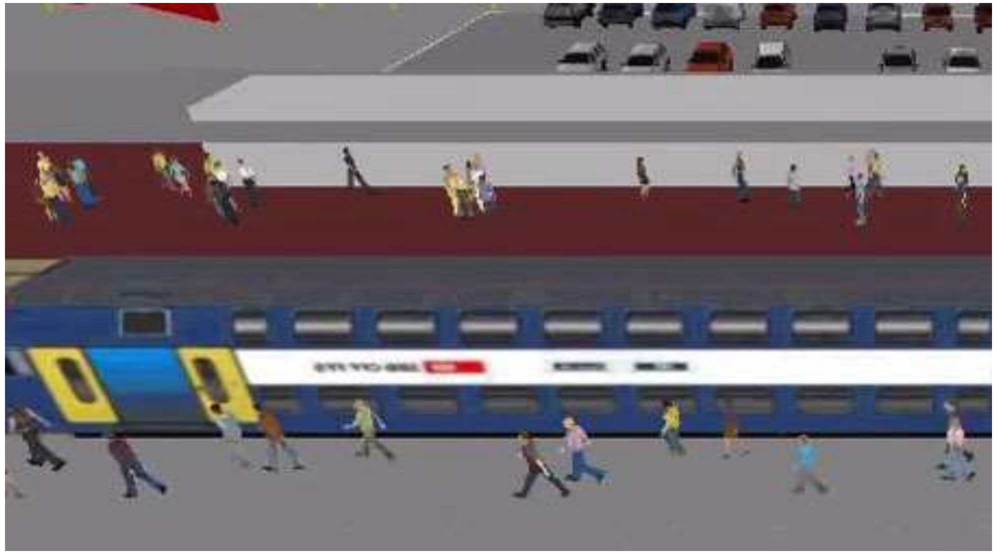
Micro / dynamic models

For a more realistic simulation of road traffic, or public transport operation, or pedestrian flows, on limited areas
To be used for operational purpose rather than for strategic planning

Specific software such as Vissim (PTV), SimWalk, CUBE Dynasim (Citilabs/Bentley), Dynameq (INRO)…



SimWalk

Dynameq

VISSIM

Required data in an ideal world

⚠ Data collection, including surveys, commonly takes months

	Macro/Strategic	Monomodal	Multimodal
Population, employment etc.	**By large zones** Present and **forecasts**	**By small zones** Preferably by level of income Present and **forecasts**	**By small zones** With characteristics of population Present and **forecasts**
Socio-economic data	Vehicle ownership Evolution of income, energy costs		Vehicle ownership
Trips	**Global ratios** (preferably from household survey main results, even if not recent) Public transport ridership	Modal counts **Origin-destination survey** **Stated-preference survey** if new mode to be introduced	**Household survey** detailed files Possibly **stated-preference survey** for mode choice calibration Traffic counts Public transport ridership
Transport networks	Possibly global ratios (public transport vehicle-km…)	As per multimodal for the selected mode	Roads: structure of network, capacities, links length and max speed… PT: lines, stops, headways, station-to-station times

Method choice grid

A tentative tool to help choosing the best modelling method depending on the context

Objective	Minimum	Ideally
Sustainable Mobility Plan	Strategic	Multimodal
Local traffic plan	Assignment software	Dynamic
Global traffic plan	Assignment software	Monomodal (road)
Road project	Reassignment methods	Monomodal (road) or Multimodal if significant mode shifts expected
Public transport (re)organisation	Reassignment methods	Monomodal (PT)
Mass transit network planning	Monomodal (PT)	Multimodal
PT/mass transit line design	Reassignment methods	Monomodal (PT) or multimodal if significant mode shifts expected
PT fare or toll road financial study	Monomodal	Multimodal or SP-based

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Modelling within the SUMP cycle

Updated simulations

Surveys and external assumptions
Model preparation
Test of do-nothing scenarios

Tests of scenarios, impacts on mobility

Final economic and financial evaluation

Tests of refined scenarios

Exercise 2

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5

Usual methodology and things not to be missed

Four-step model approach

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A usual approach: the "four-step model"

Principle: considering that mobility choices are made by steps, in a certain order

❶ Generation
Moving or not? *Number of trips emitted and attracted by each zone*

❷ Distribution
To go where? *Distribution of flows by origin and destination zones ("OD flows")*

❸ Modal choice
By which mode of transport? *Distribution of OD flows by mode*

Preferably done for a full day (more stable), possibly for peak hour or period

Conversion to peak hour, if needed

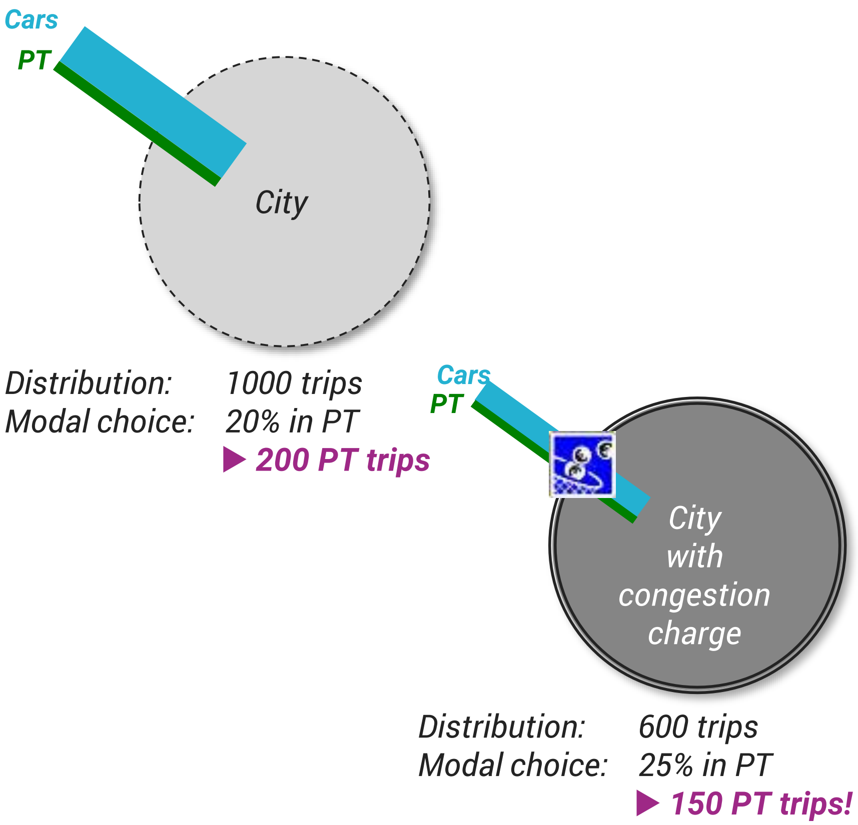
❹ Assignment
By which route? *Assignment of OD flows on transport networks, for each mode*

Must be done for a specific period of time (generally peak hour) if transport capacity is at stake

A usual approach: the “four-step model”

Some comments

- **Networks and route choices (assignment) are relatively easy to model.** However, they are based on minimisation of trip times (or “generalised costs”): will it still be relevant in the future, with the development of mobile Internet and the possible activities during the trips?
- **Modelling mobility choices** (generation, distribution, modal choice) **is much more complex and must almost be designed case-by-case**.
- Usual methods do **not include feedbacks from transport supply on transport demand**.
- **Intermodal trips** (combining private and public modes) **are generally poorly modelled**.
- The sequential character of the four-step model is **not well-adapted when there are significant modifications of the context** (see on the right).



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A usual approach: the "four-step model"

How to deal with informal transport?

Informal transport structured by lines

- To be coded as public transport lines, with average/typical headways and speeds
- Choice between formal and informal public transport can be modelled at the assignment stage
- Important to include fares

Informal transport without fixed lines

- To be coded as private vehicles, with specific costs, access times and access rules

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The role and objectives of calibration

Which phenomena are we trying to model?

- **A model needs to be validated**, to attest its capacity to represent reality.
- However, we know that **transport models are always a partial representation of reality**.
- More, **the reality of mobility patterns in a city is a… moving reality which is never fully known**.
- More: **models are generally calibrated on the situation of a specific base year, while they are used to model the evolutions between different years**.
  It is like studying the gallop of a horse based on a photo!
- More: **models are often used to test situations / transport systems that have not been observed**, at least in a comparable context. How can I model something I have not observed??
- **Conclusion: calibration must be made and judged in view of the model's scope, of its objectives, of the consistency of its results (crosschecks!)**

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Before and After: the most important stages of model runs

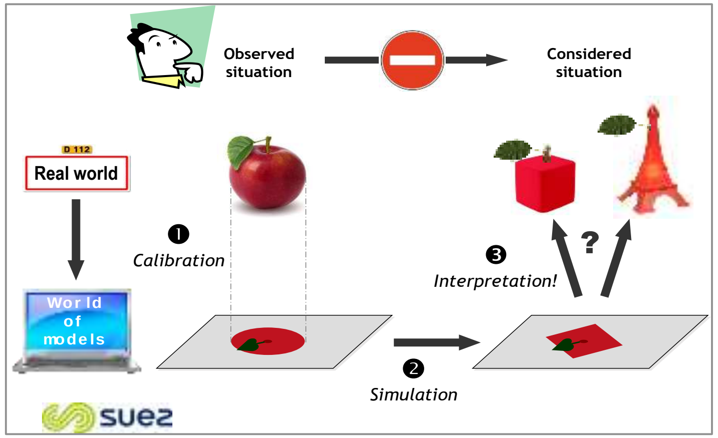
Modelling is generally focused on calibration and simulations. But major parts of the process are before and after

BEFORE

- **Some assumptions are often not questioned,** while they have major impacts on the model results: future distribution of population/jobs/trip generators, individual daily mobility rate…
- Models never include all factors impacting mobility. It means that **there are "implicit assumptions"** on the neglected factors, such as: stability of fuel costs, of transport mode perception, of climate impacts, of security context, of the "age pyramid" etc.
- It is important to keep that in mind, and possibly to analyse, at least qualitatively, the potential impacts of these factors.

AFTER

- The importance of interpretation of the results was already mentioned. ➔
- **The model is to <u>help</u> thinking, not <u>replace</u> it!**
- Post-treatment of results is mandatory before presenting them for decision-making.



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Exercise 3

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6

How to do transport modelling with poor or scarce data

How to do transport modelling with poor or scarce data

1. Focusing on the objectives

If we don't have the data for a full-fledged model, let's make a model adapted to the available data.

What do we really need to know?

- Annual ridership, maximum load, trip time savings…?

Do we need precise results or can we do with order of magnitudes?

- Might be enough to dimension a transport system or the width of a road.

Can some rough calculations, normally used for crosschecks, replace model results if there is no better option?

- E.g. evaluating population through density factors, trip emissions through mobility factors, mode shares from comparable situation and available counts…

Maybe a good survey is more important than the model itself.

How to do transport modelling with poor or scarce data

2. Data that can be used when you have none

For zonal population, employment and trip generators

- Aerial photographs, density estimates, type of housing
- On-line mapping
- Site visits
- Employment is most complex: densities difficult to guess, informal sector might be a significant part, hawkers have no permanent location… The total number can be guessed, and when the administrations and big companies have been located, the rest might be distributed in proportion of the population.

For transport networks

- Aerial photographs
- On-line mapping and data
- Site visits

For trips

- Mobility or motorised mobility ratios from comparable contexts
- Traffic/passenger counts or observation
- Number of vehicles (number of buses in the city, number of vehicles registered in the city or circulating on a road, to be combined with assumed load ratios)
- Ridership data from public transport operators

How to do transport modelling with poor or scarce data

3. Use of models to reconstruct present situation / to complement data

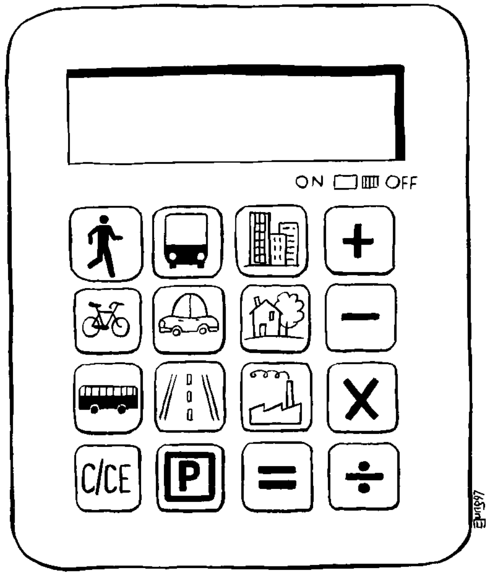
Models can be used to reconstruct missing data

- With reconstructed population/employment distribution and assumed mobility ratios, **trip generation by zone** can be estimated.
- A distribution model is necessary to estimate **trip matrices**. If local calibration is not possible, the use of a model calibrated elsewhere is an option. As an alternative or a complement, the distribution model can be calibrated in view of the likeliness of the modelled average trip distance.
- Similarly, a pre-calibrated model could be used to **split the matrices by transport modes**. It is however more hazardous than for distribution, being more complex, more site-relative, more data-consuming.
- A solution is to have the **trip generation made by mode**, based on accessibility levels from each zone and each mode. Then the distribution is also made by mode.
- A monomodal approach might be more reasonable if data is too scarce.

How to do transport modelling with poor or scarce data

4. Importance of macro approaches

Fewer the data, more important to develop a macro/strategic approach



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7

Questions, Feedback and Farewell?

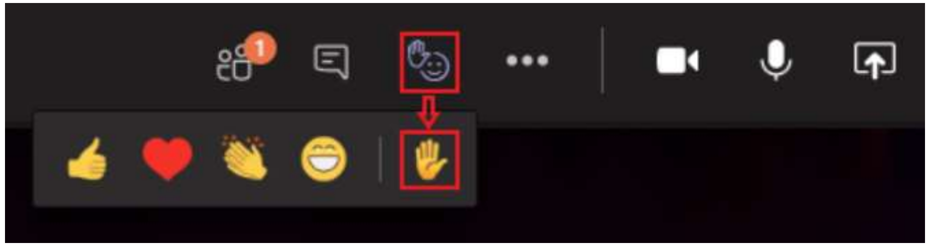
Q&A

Chat

→ Post your questions in the chat and we will include them in the Q&A

Speak

→ Select “Show reactions” in the meeting controls, and then choose “Raise your hand”. Everyone in the meeting will see that you've got your hand up.



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Our Mastering Mobility training sessions

Session	English
Diving deeper into the MobiliseYourCity SUMP Guidelines	8 March
Transport modelling for sustainable urban mobility planning	30 March
From measure selection to scenario development	12 April
Innovative mass transit options	4 May

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