Transportation demand management in a deprived territory: A case study in the North of France

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Outline

1) Aim of the study
2) Methodology
3) Available Data
4) Analysis of the results
5) Conclusions

1) Aim of the study

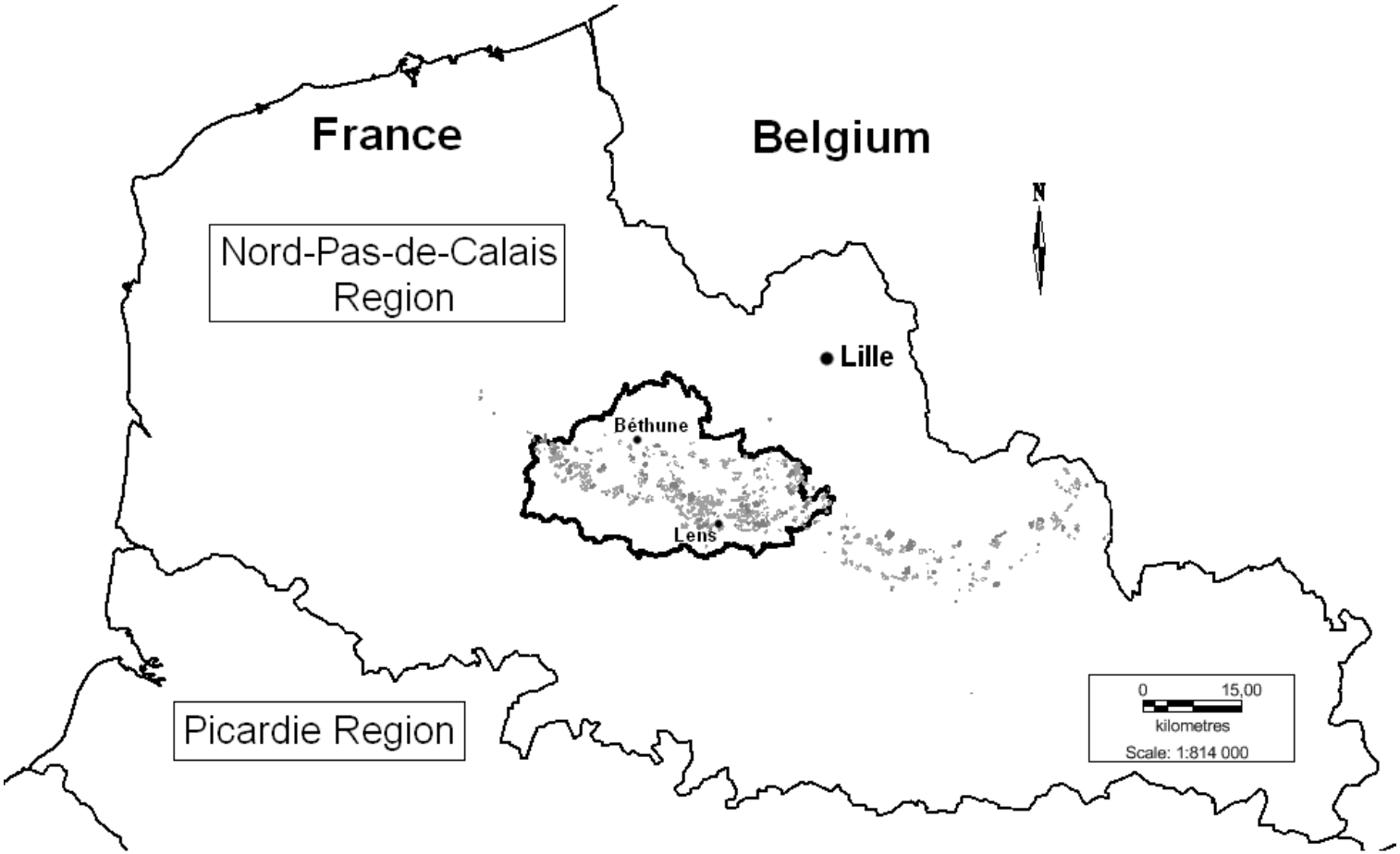
- Analysis of the transport demand in the ex coal-mining area of the Pas-de-Calais area in the North of France

  => Is there potential for up scaling public transport services to decrease the share of private car? If so, which strategy to implement?

  – Construction and analysis of the estimated parameters of a modal choice model
  – Simulation of an improvement on the transport network
  – Analysis of the induced modal shifts

- Particular context:
  – Deprived area
  – Private car is the dominant transport mode for commuting (around 70%)
  – Low share of public transport (3%)
  – Urban structure resulting from the mining history which influences mobility behaviors
  – Regeneration strategy focusing on urban projects and a new public transport infrastructure e.g. a Bus with a High Level of Service (BHLS)

1) Aim of the study



The *SMT Artois-Gohelle* area in the Nord-Pas-de-Calais Region

1) Aim of the study

Literature overview

- **Determinants of modal choice and travel behaviours**
  - (De Witte et al., 2013): socioeconomic variables, spatial indicators and journey characteristic indicators are the key determinants
  - (Meurs and Haaijer, 2001): land-use environment influences both mobility behavior and mode choice

- **Determinants of public transport demand**
  - (Paulley et al., 2006): fares, quality of service and car ownership strongly influence public transport demand
  - (Ubillos and Sainz, 2004): for university students in Spain, more frequent underground and train services, and lower fares for bus should attract new public transport users

- **Impacts of network improvement or a new transport infrastructure on modal choice**
  - (Hensher and Rose, 2007): modal choice in Sydney for commuter and non-commuter to assess different public infrastructure alternative projects
  - (Shen et al., 2009): study how environmental deterioration and network improvement should have an impact on modal choice

2) Methodology

Theoretical framework

- Mode choice modeling is used to analyze transport demand on disaggregated data.
  - Based on the discrete choice theory (Mac Fadden, 1974) (Ben-Akiva and Lerman, 1985)
  - Assumes the existence of a random utility function

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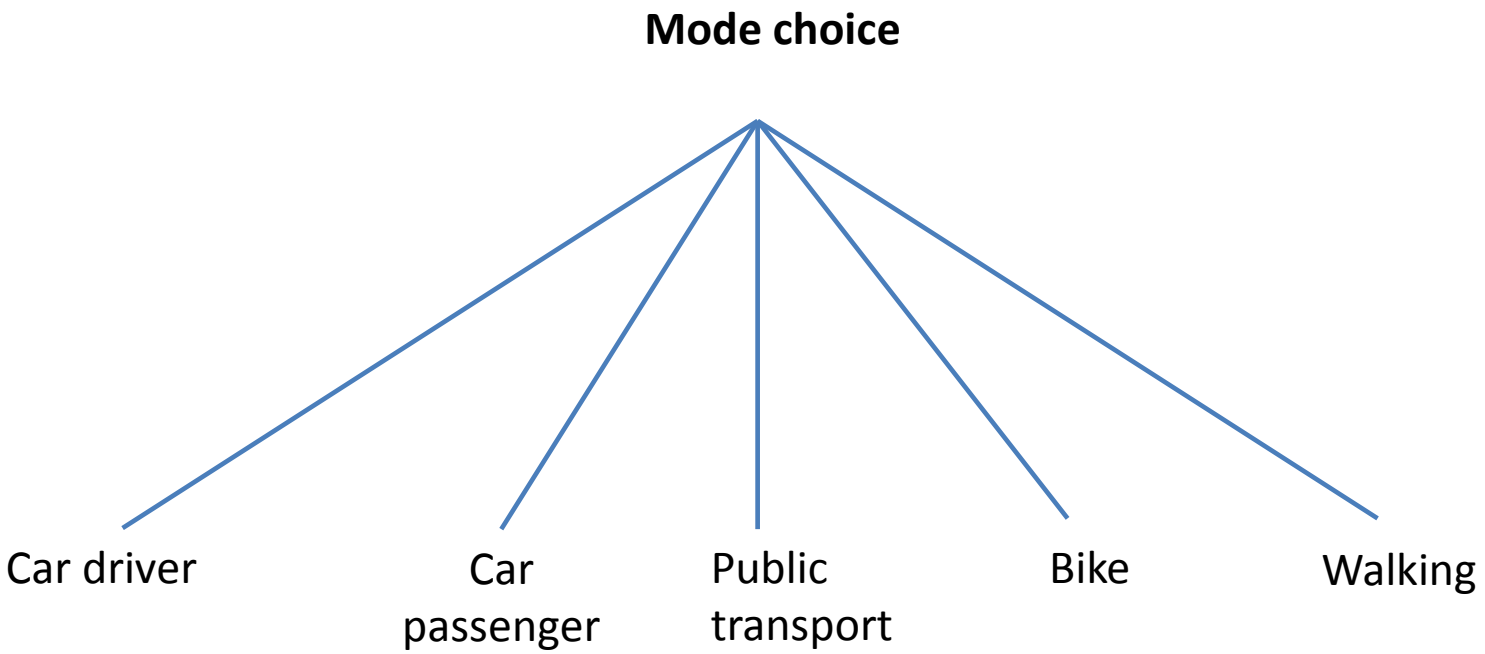
- Individuals maximize this random utility function
- For the same given choice, two individuals may have different preferences
- Taste difference is found in the error term
- Choice of the distribution of the residuals leads to two sort of models: a probit model in the case of a normal distribution or a logit model in the case of a Gumbel distribution

2) Methodology

Structure of the multinomial logit tree



3) Available data

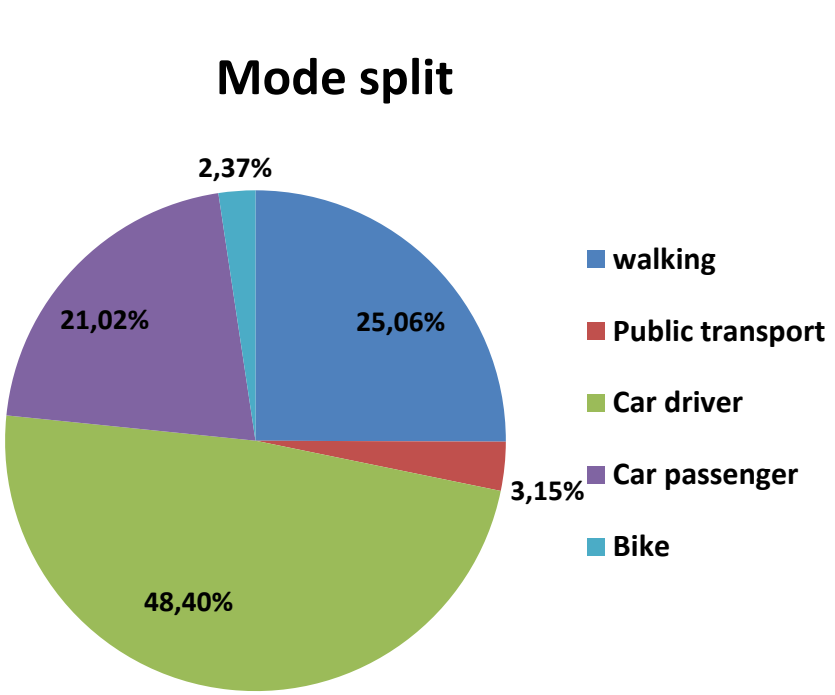
Presentation of the dlatabase

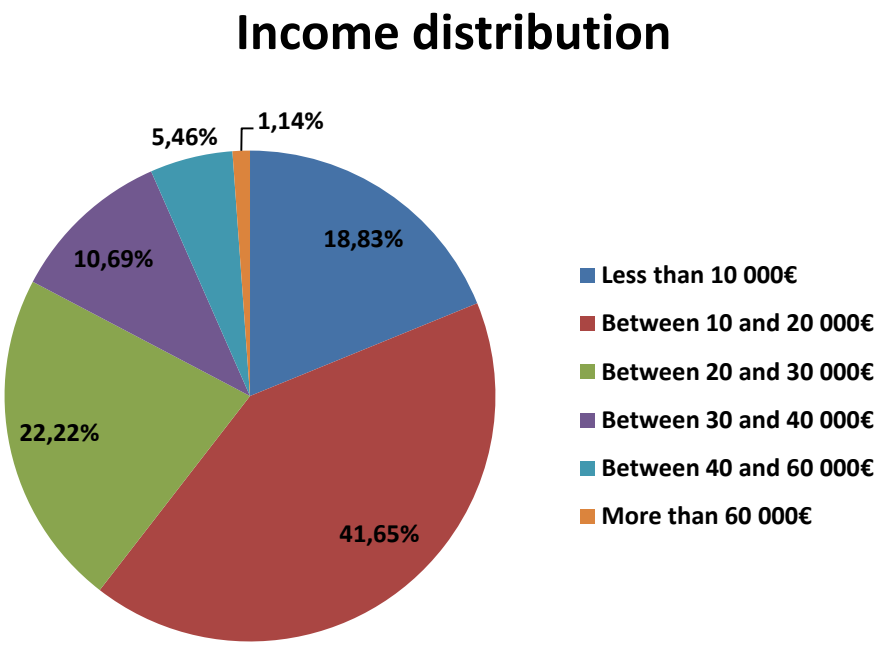
- Two Household Travel Surveys (HTS):
  - Béthune-Bruay-Noeux in 2005
  - Lens-Liévin-Hénin-Carvin in 2006
    - Representative sample of 15,628 trips within the whole studied urban transport perimeter on 1,195 zones

- These surveys are based on revealed preferences
  - Socioeconomic characteristics of travelers
  - Characteristics of observed trips
    - For the other alternative modes, trips are reconstructed with some GIS softwares
  - Location of trips
    - Land use occupation from the SIGALE® base from the Nord-Pas-de-Calais Region level to our scale of investigation

3) Available data

Descriptive statistics of the sample





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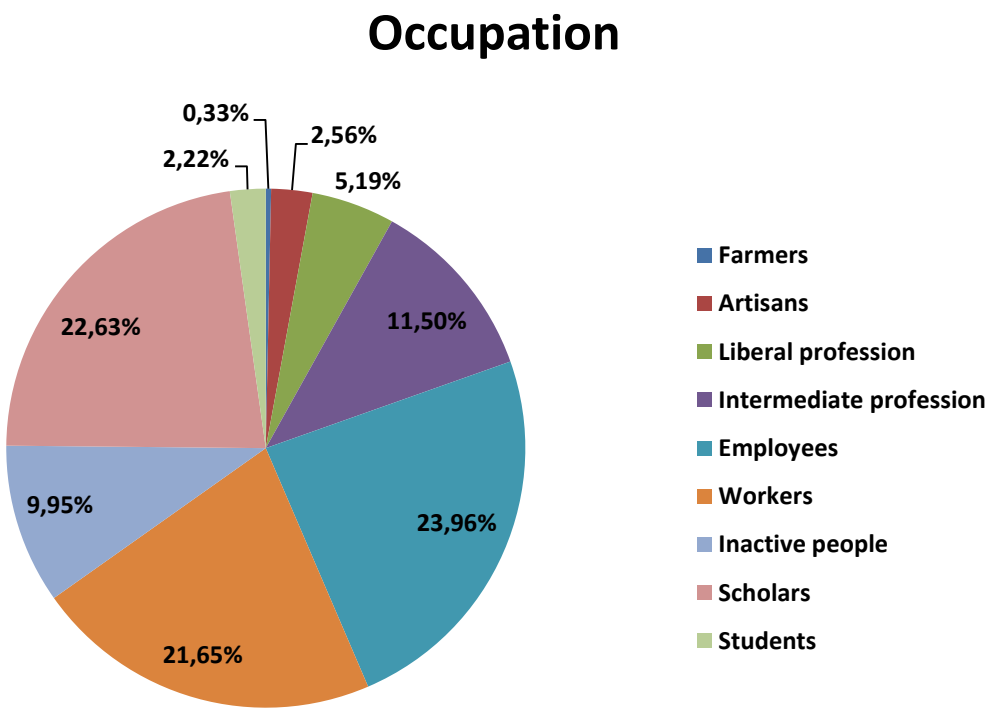

4) Analysis of the results

Multinomial logit regression results

Variables	Walk		Public transport		Car driver		Bike	
	Coefficient	(t-stat)	Coefficient	(t-stat)	Coefficient	(t-stat)	Coefficient	(t-stat)
Age	**0,0118** ***	2,85	**-0,019** *	-1,86	**0,00758** ***	2,79	**0,0324** ***	3,17
Male	**1,18** ***	12,04	0,107	0,51	**1,25** ***	16,03	**4,09** ***	16,82
Travel cost			**-6** ***	-21,31	**-1,13** ***	-10,79		
In-vehicle travel time	**-0,18** ***	-48	**-0,0589** ***	-16,59	**-0,115** ***	-30,44	**-0,276** ***	-24,47
Parking time					8,65	0,35		
Walking time to and from stops			**-0,0426** ***	-14,36				
Occupation (ref. employers)								
Pupils	-0,918 ***	-4,7	-2,48 ***	-4,73	-2,88 ***	-13,55	-2,91 ***	-6,31
Students	0,291	0,81	-2,53 ***	-3,08	-0,526 ***	-2,7	-1,04	-1,06
Intermediate profession	0,265	1,41	-0,887	-1,39	0,288 ***	2,52	-0,118	-0,27
Liberal profession	1,35 ***	5,39	-5,28 ***	-3,84	0,546 ***	2,93	-4,63 ***	-4,76
Workers	-0,483 ***	-3,24	-0,901 **	-2,33	-0,395 ***	-4,26	-0,635 *	-1,89
Inactive people	-0,496 ***	-2,91	-1,42 ***	-3,01	-1,21 ***	-11,85	0,273	0,65

4) Analysis of the results

Multinomial logit regression results

Variables	Walk		Public transport		Car driver		Bike	
	Coefficient	(t-stat)	Coefficient	(t-stat)	Coefficient	(t-stat)	Coefficient	(t-stat)
Travel motive (ref. recreational purpose)								
Work purpose	0,761 ***	4,01	2,54 ***	6,38	0,67 ***	5,88	2,21 ***	5,63
School purpose	0,855 ***	5,65	**3,15** ***	10,6	**-0,743** **	-2,34	0,164	0,46
Shopping purpose	-0,229 *	-1,89	0,227	0,62	-0,0898	-1,09	1,22 ***	4,35
Household composition (ref. single person)								
Couple without children	-0,63 ***	-3,14	-0,761 *	-1,66	-1,34 ***	-9,09	-1,99 ***	-4,19
Couple with 1 or 2 children	-0,361 *	-1,71	-0,64	-1,45	-0,634 ***	-4,12	-1,26 ***	-2,82
Large family	-0,0228	-0,1	-0,317	-0,68	-0,367 **	-2,18	-3,18 ***	-6,46
Lone parents with 1 or 2 children	-0,125	-0,52	-3,39 ***	-6,37	0,206	1,1	-1,06 **	-1,92
Lone parents with more than 2 children	0,485	1,6	1,32 ***	2,55	0,594 **	2,05	0,232	0,37
Annual income (ref. more than 40 000€)								
Less than 10 000€	-0,262 *	-1,66	**0,763** ***	2,53	-0,278 **	-2,3	-1,57 ***	-4,12
Between 10 and 20 000€	0,34 ***	2,93	-0,1	-0,38	-0,116	-1,38	0,755 ***	2,77
Between 20 and 30 000€	-0,108	-0,79	0,967 ***	3,41	-0,0194	-0,21	-0,378	-1,16
Between 30 and 40 000€	-0,0668	-0,38	-0,0304	-0,07	0,00614	0,05	-1,18 **	-2,13

4) Analysis of the results

Multinomial logit regression results

Variables	Walk		Public transport		Car driver		Bike	
	Coefficient	(t-stat)	Coefficient	(t-stat)	Coefficient	(t-stat)	Coefficient	(t-stat)
Accessibility								
Bus frequency (origin)	-0,00667 ***	-7,25	0,00122	0,73	-0,00237 ***	-4,13	-0,0138 ***	-7,93
Number of bus stops at 5 minutes (destination)	-0,443 ***	-7,52	1,21 ***	10,71	0,149 ***	3,59	0,281 **	2,19
Number of bus stops at 5 minutes (origin)	-0,259 ***	-4,6	-0,0215	-0,18	-0,0612	-1,52	-0,269 **	-2,2
Land-use characteristics (ref. residential area)								
Dense urban area	-0,569 **	-2,28	0,363	0,56	-0,184	-1	2,1 ***	3,41
Commercial area	-1,83	-1,57	-0,159	-0,09	-0,709 **	-1,93	8,79 ***	4,83
School / university area	-0,428	-0,92	3,72 ***	5,98	1,9 ***	4,08	5,35 ***	7,01
Industrial area	-1,01 *	-1,91	-0,409	-0,39	-0,0989	-0,36	1,57 *	1,71
Constant	4,38 ***	12,75	-1,42 *	-1,66	1,43 ***	6,41	-3,95 ***	-4,75

Final log-likelihood = -9083.607

McFadden's Pseudo-R^2 = 0,541

% prévisions correctes = 83%

4) Analysis of the results

Elasticities

Price, time and frequency elasticies

Elasticities	Walking	Car	Public transport	Bike
Price elasticity	-	-0,22	-5,3	-
Time elasticity	-9,9	-0,84	-1,58	-11,74
Frequency elasticity	-	-	0,05	-

- People are more sensible to the time spent in public transport than in car.
  => Confirms the lack of public transport mobility culture in this territory.
- People are more sensible to the cost of public transport than to the frequency or the time spent in a bus
  => Preferable to implement policies which have an impact on the cost of the public transport use. Public transport fares seem to be a key variable.

4) Analysis of the results

Simulations

Simulation results of different scenarios

Transport modes	Initial modal split	Free public transport (1)	Higher frequency of public transport (2)	Higher frequency of public transport (3)	(1) + (3)	Longer car travel times (4)	(3) + (4)	(1) + (3) + (4)
Walking	24.00%	19.98% (-0.16)	23.84% (+0.16)	23.41% (-0.59)	19.17% (-4.83)	24.82% (+0.82)	24.34% (+0.34)	19.82% (-4.18)
Public transport	2.83%	14.42% (+11.59)	2.89% (+0.06)	2.89% (+0.06)	15.27% (+12.44)	2.98% (+0.15)	3.06% (+0.23)	16.72% (+13.89)
Car driver	56.17%	52.61% (-3.56)	56.25% (+0.08)	56.25% (+0.08)	52.38% (-3.79)	55.45% (-0.72)	55.48% (-0.69)	50.81% (-5.36%)
Car passenger	15.06%	11.41% (-3.65)	15.46% (+0.40)	15.46% (+0.40)	11.56% (-3.50)	14.65% (-0.41)	14.99% (-0.07)	10.92% (-4.14)
Bike	1.95%	1.58% (-0.37)	2.00% (+0.05)	2.00% (+0.05)	1.63% (+0.32)	2.10% (+0.15)	2.13% (+0.18)	1.73% (-0.25)

- (1) + (3): strong transport policy which encourage the public transport use
- (1) + (3) + (4): combination of one policy in favour of public transit ((1)+(3)) and one discouraging the use of the car (4)
- (3) + (4): BHLS scenario

5) Conclusions

Main findings

- Walking time to and from bus stops has a positive impact on public transport demand.
- Frequency of bus has no influence on public transport demand but has a negative influence for all the other transport modes.
- Parking time has no influence on demand for car.
- People are less sensible to change in cost of using car or car travel times than to change in bus ticket price or bus travel times.

  => Real oppotunities to increase public transport share

  => Changes have to be extreme to lead to a significant impact on car demand.

5) Conclusions

Main findings

- More frequencies and faster travel times will have little effect on public transport demand.

- Strong inertia in car driver use

- Conventional economic instruments (travel times, travel cost) are not sufficient

5) Conclusions

Research agenda

- Robustness check on the model by using a nested logit estimation
  - Nested logit is expected to better reproduced travel behaviors by introducing correlation among alternatives
- Comparison of a similar model on a different territory in the same Region

Thank you for your attention

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