Taxi service

combine advantages of individual car and public transportation – belong to public passenger transportation

most personalized, most convenient, but most expensive

temporal and spatial availability is limited – pre-order is required in most cases

efficient coordination of demands and capacities

supplementary services of PT, car

motivations of travel by taxi

- to airport
- no parking opportunities
- to unknown locations (e.g. tourists)
- with huge/many luggage
- at night (e.g. no satisfying night service)
- after alcohol drinking
- elderly, disabled people

taxi services are in cities with more than 10-15.000 citizens

1 taxi / 400-500 citizens; 1 bus / 1000 citizens

comparison of transportation modes

		taxi	car	РТ	bike
individuality		individual without the comfort of own vehcile	individual	public	individual
scope of users		anybody with own vehicle anybody		anybody	anybody with own vehicle
convenient		+++	++	++ +	
volume of price		ХХХ	xx	+	++
scale of price		fix based on distance and time	changable according to fuel price	fix based on distance, time or trip	-
traffic sensibility		x	ххх	X (except track based PT)	+
spatial	directness point-to-poin		nearly point-to- point	egress walking	point-to-point
	location of get on/off	nearly anywhere	parking places	stop/station	nearly anywhere
	fixity of routes	roads	roads	fix	cyclable roads
	average distance in urban area*	10 km	17 km	8-13 km	3 km
temporal	waiting time	x	+	XXX	+
	timetable	netable no		fix	no
	operational time	0-24	0-24	6-22 (+ night service)	0-24

* in case of Budapest, data in 2012

centralized - decentralized

types of taxi services

- company with cars (e.g. Green Taxi)
- company without cars private car (e.g. Főtaxi)
- private taxi (private chauffeur with own car)

well-regulated - barely regulated

official brand, similar service level, specification of vehicle, form of payment

tariff system

- fix official price (e.g. Budapest)
- maximum price (e.g. Győr)
- not-controlled

controlling

- authorities (e.g. tax office)
- transportation organization (e.g. BKK) engine
- combustion engine, (hibrid)
- full-electric

	types of taxi services				
		company			
	private car	not-private car			
		private car car			
repair/	chauffour	chauffour	company		
maintanence	chauneur	chauffeur			
regulations	national,	national, municipal			
regulations	municipal	+ company regulations			

electronic vehicles is ideal for taxi

- no environmental pollution
- less maintenance
- cheaper fuel cost
- time between task is enough for charging fix fast charging point for taxis in taxi stations

Situation in Budapest

12 taxi company + hundreds private taxi = cca. 4500

- biggest: Főtaxi (cca 1000 car)
- with only electric (65 car)

well regulated from 2013 September

- same appearance yellow car
- strict specification of vehicles
 - age (not older than 10 years)
 - air-condition, no smoking
 - minimum size of boot
- fix price
 - base fare: 450 HUF
 - time-base fare unit: 70 HUF (if speed is less than 15 km/h)
 - distance-base fare unit: 280 HUF
- payment options:
 - cash
 - credit card
 - application (in case of several taxi companies)
- controlling authority: BKK (e.g. fill out authority for driver, controlling provided service level, handling passenger feedbacks)

official taxi company from/to airport (Főtaxi)



company without cars - private car (e.g. Főtaxi)



company with cars (e.g. Green Taxi)



private taxi (private chauffeur with own car)

airport – city center taxi: 6500 HUF PT: 700 HUF

Information management



demand request:

- hailing or getting on a taxi in a station
- ordering a taxi via phone (voice based dispatcher needed) or via application, internet human dispatchers with machine support → automatized demand-capacity assignment payment: cash, card → via application (virtual)

Ride-sourcing

- automated demand-capacity assignment
- no human dispatcher
- ordering, information provision, payment: via application
- dynamic tariff system (considering demand)
- chauffeurs with private car
- no regulation (insurance issues, responsibility, complaining)
- feedback driver/passenger rating
- personalization (type of car e.g. SUV, wheelchair accessible)
- registration (e.g. credit card data)

shared ride-sourcing (e.g. uberPOOL) (↔ collective taxi)

taxi vs. ride-sourcing \rightarrow forbidding or competition different service levels



enhancing service level of taxi (e.g. similar mobile application)







Analysis of mobile applications

development opportunities:

- voice commands,
- adding regular travel options
- calendar notification
- personalization (e.g. wheelchair, number of passenger, animal)
- modification of destination during travel
- automatic/combined payment

Source: Szilárd Sziget: Autonóm járművekkel történő közforgalmú közlekedés üzemeltetési	6. A
modelije, TDK, 2016	

	Functions	Főtaxi	Budapest Taxi	GreenTaxi	Uber	Lyft
	1.1. Online ordering possibility	Web/mobile app	mobile app	web/mobilie app	Web/mobile app	mobile app
	1.2. Language options	HU/EN/GE	HU/EN	HU	EN/Local language	EN/Local language
1 Cananal	1.3. Availability	Budapest	Budapest	Budapest	Global	Global
1. General	1.5. Customization	✓	\checkmark	×	\checkmark	\checkmark
	1.6. Feedback options	✓	\checkmark	×	\checkmark	\checkmark
	1.7. Help	✓	\checkmark	×	\checkmark	\checkmark
	2.1. Navigation among the functions	✓	\checkmark	×	\checkmark	\checkmark
	2.2. Advanced map interface	✓	✓	✓	✓	✓
2. Visual display	2.3. Displays vehicles on map	×	\checkmark	✓	\checkmark	\checkmark
	2.4. Dynamic display of availability	×	\checkmark	×	×	×
	2.5. Photo of vehicle	\checkmark	×	×	×	✓
	3.1. Vehicle information	Car brand, type, plate number	Car brand, type, plate number	plate number	Car brand, type, plate number	Car brand, type, plate number
3. Textual	3.2. Dynamic information		Calculate	ed arrival time, calcu	lated fee	-
display	3.3. Additional information	Driver rating	Driver rating, vehicle cleanliness	×	Driver rating	Driver rating
	4.1. Enter starting point Automatically with GPS, map, text					
	4.2. Enter arrival point	Text	text	text, map	Text	text, map
	4.3. Departure time adjustability	✓	✓	×	✓	 ✓
	4.4. Order parameters	animal transport, air-condition	number of passengers	×	×	×
1 Before travel	4.5. Optional vehicle category	 ✓ 	√	×	✓	✓
4. Delore traver	4.7. Navigation to starting point (in ride-sharing mode)	×	×	×	\checkmark	×
	4.8. Tracking of arriving vehicle	 ✓ 	\checkmark	✓	\checkmark	✓
	4.9. Notify on vehicle arrival	Text message				
	4.10. Order cancellation	Application or phone	only phone	Application	Application	Application
	5.1. Sending destination automatically to driver	×	×	×	\checkmark	\checkmark
	5.2. Displays vehicle on map	 ✓ 	\checkmark	✓	\checkmark	✓
	5.3. Sharing arrival time	×	×	×	×	✓
5. During travel	5.4. Calculation of fares	Base fee, kilometre/ minute fee	Base fee, kilometre/ minute fee	Base fee, kilometre/ minute fee	Base fee, kilometre/ minute fee, cancellation fee	Base fee, kilometre/ minute fee, cancellation fee
	5.5. Discounts	×	×	×	\checkmark	\checkmark
	5.6. Application of variable fees	×	×	×	\checkmark	\checkmark
	5.7. Payment options	Cash, credit card, taxi card, voucher, app	Cash, credit card, taxi card, app	Cash, credit card, taxi card, app	арр	арр
	5.9. Built-in fare calculator	\checkmark	×	\checkmark	\checkmark	\checkmark
			1	~	1	1
	6.1. Save travel information	✓	×	^	•	•
6.	6.1. Save travel information6.2. Driver rating possibility	✓ ✓	✓ ✓	~ ✓	 ✓ 	 ✓
6. After travel	6.1. Save travel information6.2. Driver rating possibility6.3. Vehicle rating possibility	✓ ✓ ×	✓ ✓ ✓	~ ✓ ×	✓ ✓ ×	✓ ×

Future opportunities

integrated application for taxis (not-company separated) \rightarrow for all transportation modes electric taxis

Ride-sourcing (taxi) instead of PT, DRT

- in case of small demands, PT is not efficient
 - non-peak hour, at night
 - low availability of PT, low-density areas
- reduced passenger fare + government subsidy
- especially in USA
- disadvantage:
 - without smart phone the service is unavailable
 - more expensive than conventional PT for user

Autonomous taxi, ride-sourcing

• pilot programs: Singapore, Pittsburgh-San Francisco (UBER)

Merged transportation modes (TS-DRT)

Merged transportation modes (TS-DRT) Elszállított utasmennyiség many Conventional transportation **Telematic-based Shared Demand Responsive** Transportation (TS-DRT) **D**RT Chauffeur/ Ride few Car-Taxi Indivudal Carservice 'sour car **Bike-sharing** Bicycle unflexible flexible Flexibility C ceasing altering no alteration Legend: new

Future transportation modes

"Amusement" transportation

vehicles/modes which provide more than pure travelling/commuting

travelling for "fun"

types:

- travelling only for fun
- travelling on purpose (e.g. commuting)

track

mixed

general features:

- extraordinary outlook
- special operational methods
- environmental friendly (electric)
- public transportation modes are mostly automated



Light Electric Vehicles – LEV (2-3 wheeled electric vehicles)

human-powered, electric engine (for supporting) track: public roads, (pedestrian area) purpose:

- everyday transportation
- touristic
 operational area

operational area:

- mostly urban area ownership:
- mostly private
- renting for touristic purpose
- individual modes













e-motor scooter



segway

comparison of LEVs

	pedelec citybike	pedelec mountain bike	pedelec cargo	e-bike	e-motor scooter (robogó)	e-scooter (roller)	segway
user group	commuters, tourists	open to activity	individuals, delivery companies	elder, hardly moving people	individuals, delivery companies	younger people	younger people, tourists
purpose	commuting, bike-sharing	leisure activity	urban delivery	commuting	commuting, delivery	reach public transport	commuting, sight seeing
travel distance	short	short	short	medium	medium	very short	very short
operational area	urban	recreational area	urban	urban, suburban	urban, suburban	urban	city center, (recreational area)
advantages	advantages easier to use (support riding)		without driving licence	eco-friendly: replace conven- tional scooters	portable	good driving ability	
disadvantages range limitation, without electric motor riding is harder			no health promotion, dangerous for bikers	only with driving licence	dangerous for walkers	difficult to use, dangerous for walkers	
power [W] max 250		250	800	100	2*350-1500		
range [km]	10-150			30-60	30-50	10-15	20-25
speed [km/h]		max 25		max 45	45-50	15-20	15-25

Automated People Mover (APM)

automated – guideway system is necessary track:

- track-based
- separated track, mostly above the ground
- small angle of elevation

purpose:

- especially for special purposes (e.g. between airport terminals, close to touristic attractions)
 operational area
- operated in small-scale areas
- only a few stops

ownership:

- private/public companies
- mostly part of public transportation

capacity of the vehicle and the passenger traffic by hour are less than in the case of underground

types (technology):

- rubber tires + cable-propelled (e.g. Birmingham, Venice)
- rubber tires + third rail (e.g. Siemens VAL (automatic light vehicle) – Lille, Paris)
- rail + cable-propelled (e.g. San Francisco cable car)
- monorail only one rail
 - conventional (e.g. Las Vegas)
 - suspended (e.g. Wuppertal Schwebebahn)
 - maglev not physically contact the beam (e.g. Transrapid)



cable-propelled APM - Birmingham



rubber tires + third rail APM - Lille



rail + cable-propelled - San Francisco conventional monorail - Las Vegas

suspended monorail - Wuppertal

maglev – Transrapid (Germany)

cable-railways (drótkötélpálya)

automated

track:

- track-based
- separated, suspended track purpose:
- touristic
- part of public transportation
- cargo transportation operational area:
- mostly in hilly areas (high altitude differences)

ownership:

- mostly private ownership
- separated systems bare integration to the public transportation

capacity: 2000-4000 passenger/hour

weather sensitive - especially strong wind (+ dense fog, heavy rain)

advantages	disadvantages
environmental friendly	small distance (cca. 7 km)
(noise, air pollution)	weather sensitivity
undisturbed, separated track	difficult evacuation
high traffic safety	
small installation cost	
land-use is small (only pillars)	

categorization

cableway:

- mono-cable, rotary (English system)
- bi-cable (German system): carrier cable, traction cable
- tri-cable
 - 2 carrier cables, 1 traction cable (Swiss system)
 - 1 carrier cable, 2 traction cables
- 1 carrier cable, 1 traction cable, 1 breaking cable type of passenger cabin:
- cage lift
- chair lift
- cable car (small or large cabin)
- hybrid lift (chair lift + small cabin)
- + ski lifts (T-bar lift, J-bar lift, platter lift)

detachable/undetachable

operation:

- one-way: continuously moving
- pendular: two cabins, converse way, stop in the terminus



T-bar lift



J-bar lift



platter lift



cage lift - Pian dei Fiacconi



chair lift – Budapest Libegő



cable car (large cabin) - Rote Nass

cable cars in public transportation:

- London Emirates Air Line, England
 - connect to district above Thames
 - part of public transportation but extra fee (cheaper with public transportation pass)
 - extra services (renting cabins)
- Teleférico del Puerto Barcelona, Spain
 - to the port
 - no integration
- Metrocable Medellín, Columbia
 - connect district hilly territory
 - integrated different tariff packages (combination of transportation modes)







funicular

cable-railway track:

- rail-based + cable-propelled
- pair of railway cars
- pendular moving:
 - alternately ascend and descend
 - attached to a common cable
- track types:
 - four-rail (e.g. Budapest)
 - three-rail
 - two-rail (e.g. Prague)

purpose:

- touristic: no integration to the public transport (e.g. Budapest)
- part of public transportation (e.g. Lisbon) operational area:
- to hills only a few stops (mostly only the termini)
- high angle of elevation



track types (source: wikipedia)



four-rail funicular - Budapest



two-rail funicular - Prague

support walking

elevator

- between floors
- speed: 0.5-0.75 m/s, capacity: thousand kilograms

escalator

- outdoor: steep rise
- indoor: between floors in common spaces
- theoretical capacity: 4500-9000 passenger/hour (depending on step width), speed: 0.5-0.65 m/s
- · effective capacity depends on crowdedness and speed of the escalator

moving walkway

- replace walking movement
- indoor especially in intermodal junctions, airports
- with or without rise
- high-speed (accelerating) walkways





Ships

non-automated – mostly diesel (electric) track:

- inland/marine shipping waterways purpose:
- commuting long-distance, ferry, regional, urban
- touristic sight-seeing, (long distance) voyage
- cargo

ownership:

- individuals private usage (jetsky, rowboat, sailboat, motorboat)
- private companies public tours
- public companies part of public transportation (e.g. Budapest, Venice, Amsterdam)

weather sensitive – strong wind, dense fog, heavy rain, ice water level sensitive



sight seeing (Budapest)



urban public transportation (Budapest)



ferry (Vác)



hydrofoil - regional commuting/touristic (Budapest – Visegrád)