

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	PT	bike
individuality		individual without the comfort of own vehicle	individual	public	individual
scope of users		anyone	anyone with own vehicle	anyone	anyone with own vehicle
convenience		+++	++	+	x
price		xxx	xx	+	++
tariff system		fix based on distance and time	changable according to fuel price	fix based on distance, time or trip	-
traffic sensibility		x	xxx	x (except track based PT)	+
spatial	directness	point-to-point	nearly point-to- point	egress walking	point-to-point
	get on/off location	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	no	no	fix	no
	operational time	0-24	0-24	5-23 (+ 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		
	private car	company	
		private car	not-private car
repair/ maintenance	chauffeur	chauffeur	company
regulations	national, municipal	national, municipal + company regulations	

electronic vehicles are ideal for taxi

- *no environmental pollution*
- *less maintenance*
- *lower 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)

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



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

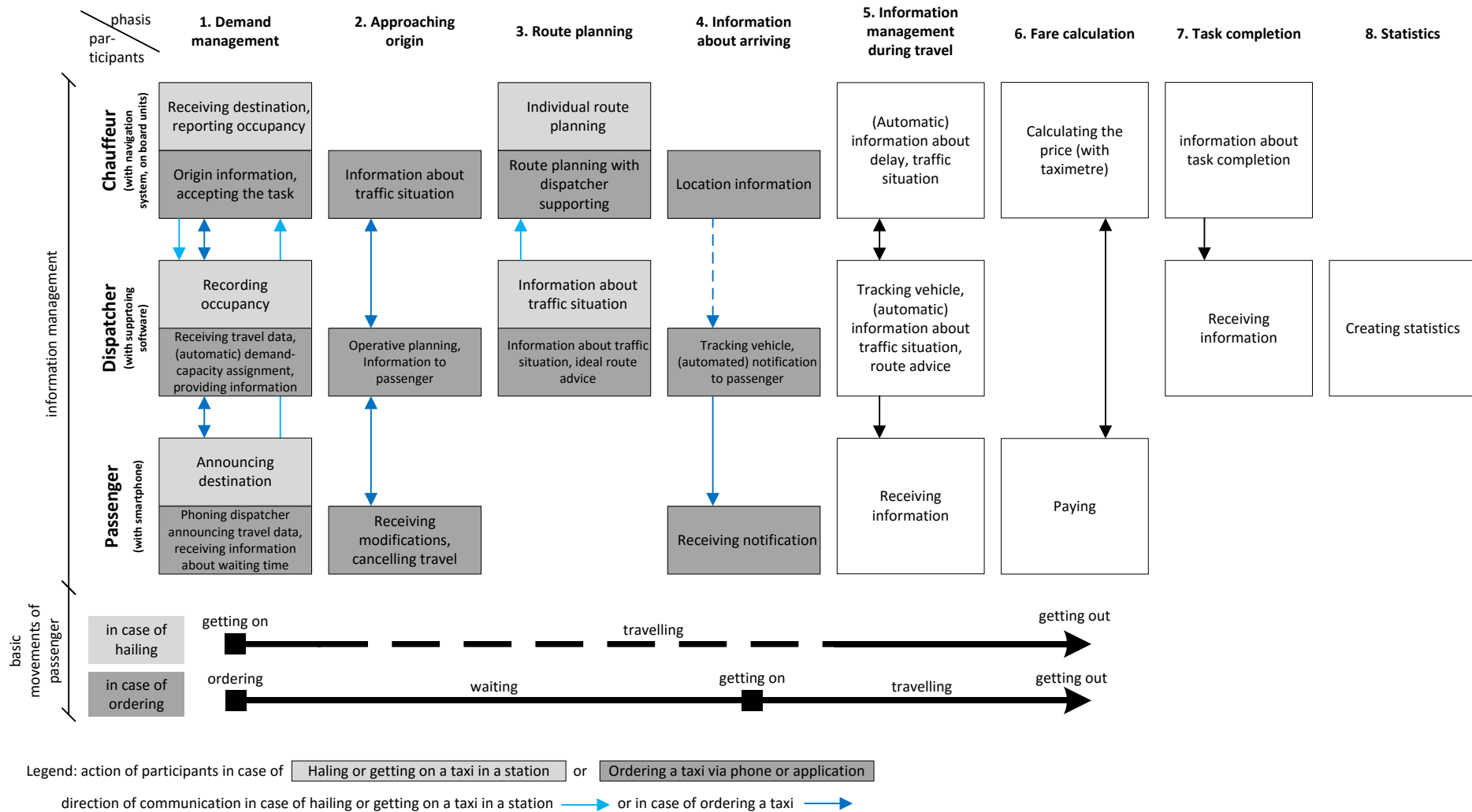


company with cars (e.g. Green Taxi)



private taxi (private chauffeur with own car)

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)



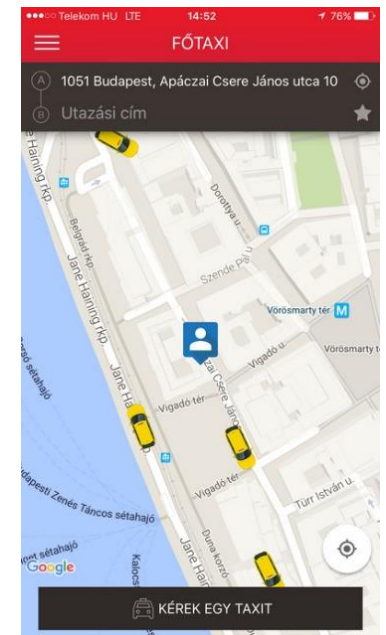
shared ride-sourcing (e.g. uberPOOL) (↔ collective taxi)

taxi vs. ride-sourcing → 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

	Functions	Főtaxi	Budapest Taxi	GreenTaxi	Uber	Lyft
1. General	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
	1.3. Availability	Budapest	Budapest	Budapest	Global	Global
	1.5. Customization	✓	✓	✗	✓	✓
	1.6. Feedback options	✓	✓	✗	✓	✓
	1.7. Help	✓	✓	✗	✓	✓
2. Visual display	2.1. Navigation among the functions	✓	✓	✗	✓	✓
	2.2. Advanced map interface	✓	✓	✓	✓	✓
	2.3. Displays vehicles on map	✗	✓	✓	✓	✓
	2.4. Dynamic display of availability	✗	✓	✗	✗	✗
	2.5. Photo of vehicle	✓	✗	✗	✗	✓
3. Textual display	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
	3.2. Dynamic information	Calculated arrival time, calculated fee				
	3.3. Additional information	Driver rating	Driver rating, vehicle cleanliness	✗	Driver rating	Driver rating
4. Before travel	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	✗	✗	✗
	4.5. Optional vehicle category	✓	✓	✗	✓	✓
	4.7. Navigation to starting point (in ride-sharing mode)	✗	✗	✗	✓	✗
	4.8. Tracking of arriving vehicle	✓	✓	✓	✓	✓
	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	✗	✗	✗	✓	✓
5. During travel	5.2. Displays vehicle on map	✓	✓	✓	✓	✓
	5.3. Sharing arrival time	✗	✗	✗	✓	✓
	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	✗	✗	✗	✓	✓
	5.6. Application of variable fees	✗	✗	✗	✓	✓
	5.7. Payment options	Cash, credit card, taxi card, voucher, app	Cash, credit card, taxi card, app	Cash, credit card, taxi card, app	app	app
	5.9. Built-in fare calculator	✓	✗	✓	✓	✓
	6.1. Save travel information	✓	✓	✗	✓	✓
6. After travel	6.2. Driver rating possibility	✓	✓	✓	✓	✓
	6.3. Vehicle rating possibility	✗	✓	✗	✗	✗
	6.4. Passenger rating possibility	✗	✗	✗	✓	✓

Future opportunities

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

Ride-sourcing (taxi) instead of PT, DRT

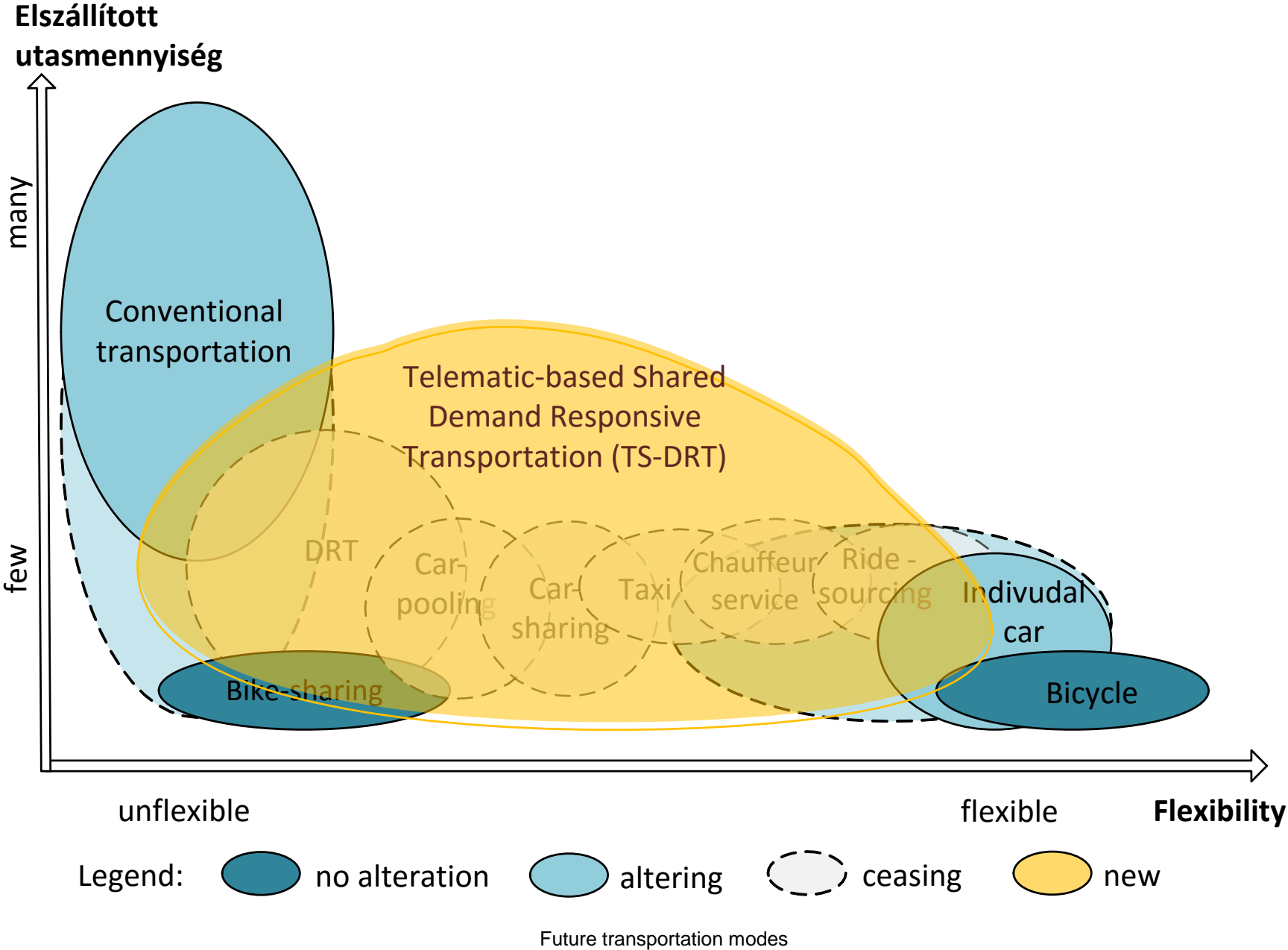
- in case of small demands, PT is not efficient
 - non-peak hour, at night
 - low availability of PT, low-density areas
- reduced passenger fare + government subsidy
- especially in USA
- disadvantage:
 - without smart phone the service is unavailable
 - more expensive than conventional PT for user

Autonomous taxi, ride-sourcing

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

Merged transportation modes (TS-DRT)

Merged transportation modes (TS-DRT)



"Amusement" transportation

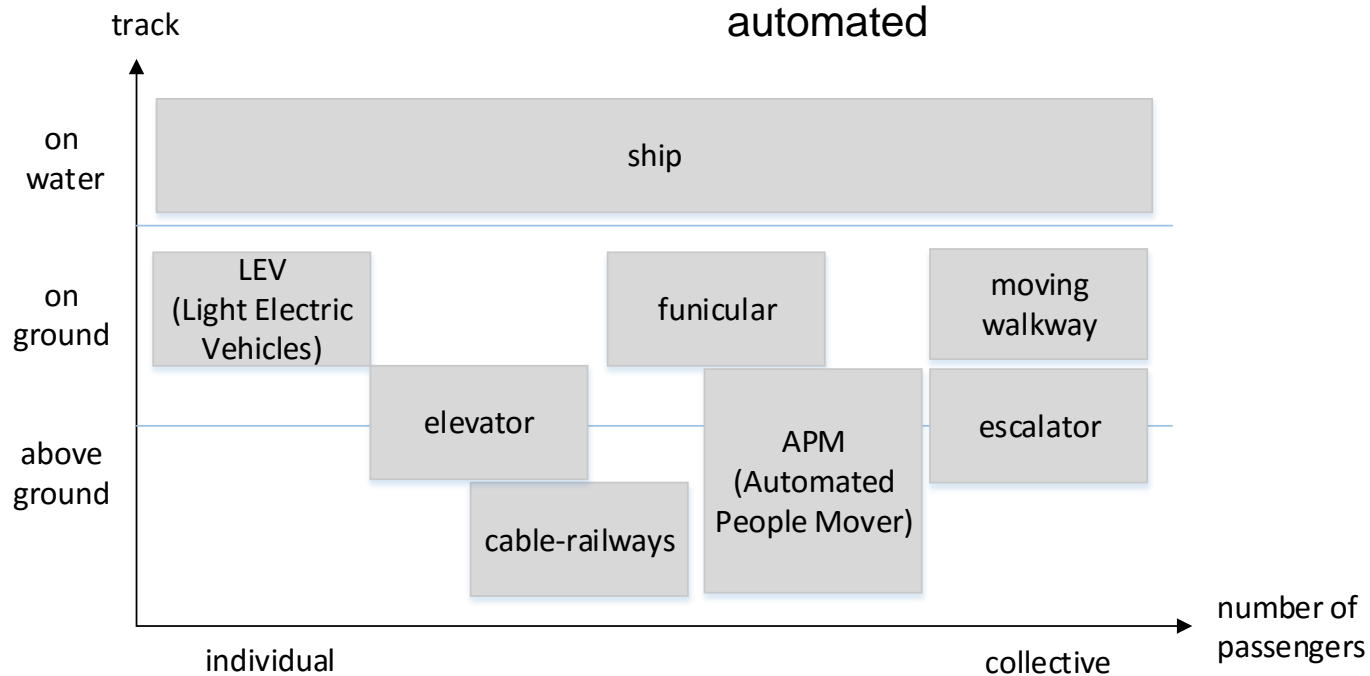
vehicles/modes which provide more than pure travelling/commuting
travelling for "fun"

types:

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

general features:

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



Categorization of amusement transportation

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:

- mostly urban area

ownership:

- mostly private
- renting for touristic purpose
- individual modes

advantages	disadvantages
faster	expensive
less human effort to drive	unfamiliarity
	fear of the new
	limited range



e-scooter



segway



pedelec



e-bike



e-motor scooter



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	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 (noise, air pollution)	small distance (cca. 7 km)
undisturbed, separated track	weather sensitivity
high traffic safety	difficult evacuation
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



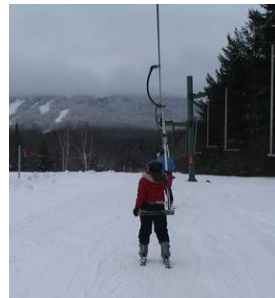
cage lift - Pian dei Fiacconi



chair lift – Budapest Libegő



T-bar lift



J-bar lift



platter lift



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:

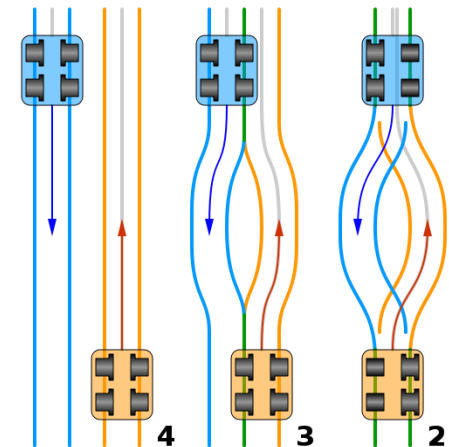
- rail-based + cable-propelled
- pair of railway cars
- pendular moving:
 - alternately ascend and descend
 - attached to a common cable
- track types:
 - four-rail (e.g. Budapest)
 - three-rail
 - two-rail (e.g. Prague)

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

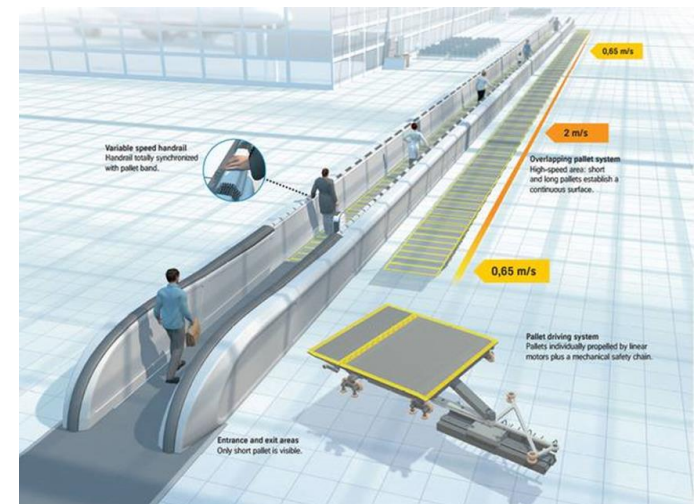
- between floors
- speed: 0.5-0.75 m/s, capacity: thousand kilograms

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



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)