Framework for Personal Rapid Transit Feasibility studies

Dr. Yuval Cohen
Professor Erel Avinery
Dov Hoffman, Ran Etgar, Itai Kenet
Acknowledgement

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- It answers its call for proposals for a feasibility study of elevated transportation system

Disclaimer: This is an ongoing research
Ecological Foot Print: Also: Smaller emission and energy consumption
Comparison Between 4 Existing PRT Systems

• **Morgantown**: WV, USA

• **2getthere**: Netherland

• **ULTra**: Heathrow, UK

• **Vectus**: S. Korea
Global PRT development status

GLOBAL PRT DEVELOPMENT

History
Morgantown
Rivium
Masdar/Coimbra

In Service

Vehicles

Heathrow T5

Under Construction
Suncheon

Amritsar

Planned
Gurgaon

In Service Date

1975
1999
2010
2011
2013
2014
2015

Company or city involved
Austin
Arlanda Airport
BWI Airport
Delhi
Fresno
Fort Carson
Guadalajara
Ithaca
NJ DOT
Pampus Island
San Jose
Sodertalje
Riverbridge North LLC
Upplands Vasby
Uppsala
UVW
Winona

Unit: 100 person (Research Staff)
German trial system using cable cars
China panda system
Bad for urban arteries
4 Seats: Req.
Bad for urban arteries
SkyTran
Pod Design – seats in tandem
Israel testing skyTran hover car system

An elevated network of hover cars is to be built in Israel, carrying two-person vehicles suspended from overhead magnetic tracks.

SkyTran is partnered with NASA and Israeli Aerospace Industries (IAI).

Future: If test track successful, full system will be installed in Tel Aviv.

Passive MagLev: No power required to keep cars elevated, only to start and stop.

Rail: 6m above street.

500m test loop: Cars can travel up to 70km/h.

Boarding: Passengers would use smartphone app to summon vehicle to meet them at specific station.

500m Cost: $50m.

https://www.youtube.com/watch?v=D5zTE7Ccsu8

https://youtu.be/lW5rQyvXGOU
HERZLIA PREZENTS

From the train station to the Marina
Inexpensive

Skytran costs less to construct, operate and maintain than any other transportation system.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Cost/Mile</th>
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<tr>
<td>Bullet Train</td>
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<tr>
<td>Light Rail</td>
<td>$100 Million</td>
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<tr>
<td>Freeway</td>
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<tr>
<td>SkyTran</td>
<td>$ 9 Million</td>
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<td>Sidewalk</td>
<td>$ 2 Million</td>
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Suitability for Urban Arteries
Research Objectives

• Generating insights for PRT implementation
• Mapping, of challenges, risks, and opportunities for decisions on PRT implementation.
Research Structure

1. Transportation feasibility research
2. Operational PRT Simulation study
3. Infrastructure planning and cost optimization study
4. Feasibility and Profitability Study
1. Transportation feasibility research

• **Literature research** review of PRT applications and technologies, regulatory and statutory barriers, and variety of stakeholder objections.

• **Evaluating future demand pattern** – Using the EMME software: Including the impact of PRT ticket prices, the availability of: bus, railway, LRT, BRT, etc.

• **Evaluating stake holder objections to PRT**
2. Operational PRT Simulation study

- Failure of **HERMES** and dedicated PRT simulation
- Discrete Event Simulation (DES): **ARENA**
- Agent based Simulation +DES: **ANYLOGIC**
  - Pod movement logic
  - System parameters: speed, headway, # of pods
  - Failures, emergency, operational hazards
2. Simulation Cont.

• Estimating System’s response:
  – system capacity
  – service levels
  – Utilization
  – Pod daily mileage
  – number of travelers served)

• To changing parameter levels such as:
  – Pod speed
  – Number of pods
  – Headway
  – Halting distance
4. Transportation Research Subjects

- Technical Viability/feasibility
- Regulatory and Statutory Barriers
- Demand forecast
- Stake Holder analysis
- Risk analysis
- Financial viability
System Baseline

• Height: 8 to 10 meters above street level
• Speed: 70 KM/Hour (20 Meter/Second)
• Headway: 3 Seconds = 60 meter
• Stations: Offline
• Walking Distance: up to 350 meter
Target Year = 2030

Software

Boarding and departing Projection

Emme 4
A better way to model

INRO
The Evolution of Transport Planning
Input Data Sources

• Tel Aviv Transportation Model
• The 1996 transportation habits
• Population updates (last update – 2013)
• Running for the target year
Transportation Generators

- Employment centers
- Education Centers
- Hospitals
- Malls and shopping centers
- Entertainment centers
- Train stations
- Central bus stations
Urban Transportation Means and Their Integration

- Bus lines
- Conventional Train
- LRT lines = Light Rail Transit
- BRT lines = Bus Rapid Transit
- PRT lines = Personal Rapid Transit
- Taxi lines
Stage 1 Lines

- TAU
- ATIDIM
- Train Station
- Ayalon Mall
- T.A. Port
- Halacha
- Belinson Hospital
Stage 2 Lines
ARENA Simulation

Overall throughput of the system

72
ARENA Simulation

Overall throughput of the system

72

ערכו

2

7

הפיל

הצלה

10
AnyLogic Simulation
Barriers

- Trees
- Electricity polls
- Parking lane
Barriers

Narrow pavement
Barriers: Narrow Streets

Electric wire
Ideal Lane: Open Space

Trees

Trees
SkyTran is the Limit
Station Design
Tandem vs. Parallel parking
Station Design
Tandem vs. Parallel parking

- Speed: 1X 3597 seconds
- Vehicles left serial station: 586
- Vehicles left parallel station: 536
Design Aesthetics Considerations
Minimalistic Stations Design
Vectus (S. Korea) station design
Elevated Station Design
Ground Station Design
Cont. Ground Station Design
### Three Design Alternatives

<table>
<thead>
<tr>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
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Underground Foundations Alternatives

**Alternative 1**

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- строка 2
- строка 3
- строка 4

**Alternative 2**

- строка 1
- строка 2
- строка 3
- строка 4
Pilar + Basis Design
<table>
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<th>Poll Support force</th>
<th>Centrifugal force</th>
<th>Pod weight</th>
<th>Wind force</th>
<th>Rails self weight</th>
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![Diagram of forces](image-url)
Next Study: Pilar Design
Risk Sources

- Route (barriers and hazards)
- Statutory risks
- Infrastructure resilience
- Regulation risks
- Stake Holders
- Safety
- Competition
- Operational risks
Regulation issues - 1

- Vehicle certification
- Communications (frequencies, cables)
- Insurance
- Planning and construction
- Municipalities
- Police
- Electricity
- Environmental regulation
- Archeology
- Materials
Regulation issues - 2

- Import and certified import
- Safety standards
- Accessibility
- Privacy
- Security
- Trees – The woods secretory
- Infra structure (Gaz law, Bezeq law)
- Public transportation operation –
- The PRT heights
Regulation issues - 3

- Right of way
- Transportation organizations (ג加快发展, גת"ע)
- Municipality units
- Fire fighters
- Station construction issues
- Railway construction issues
- Financial issues
- Standardization
Barriers and Risks - 1

- Politics national and local
- Financial risks
- Psychological risks
- Public opinion, neighbors objections
- Regulation changes and laws
- Biding rules
- Competing technology
- Intellectual properties
Barriers and Risks - 2

- Statutory barriers
- Infrastructure
- Right of way
- Demand
- Costs
- Competitors
- Industrial espionage
- High levels of operational capability