RIGHT SIZE PARKING
Urbanism Next 2019

Aric Ohana, Envoy Technologies
Lisa Nisenson, Wantman Group- WGI
OK! PARKING MAXIMA

NO!! RIGHT SIZE PARKING 2.0
WHAT IS RIGHT SIZED PARKING 1.0?

The preset values below represent subregional (CBD, Urban and Suburban) average/median values, from field work for building (with no affordable units) and parking specifications. These represent the default values, as a starting point, for which parking use ratios are estimated. Scroll down to view parking optimization estimates and guidance on unbundled and affordable housing options:

<table>
<thead>
<tr>
<th>NUMBER OF UNITS</th>
<th>AVERAGE RENT ($)</th>
<th>RESIDENTIAL AREA (SQ FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STUDIOS</td>
<td>20</td>
<td>$975</td>
</tr>
<tr>
<td>1 BEDROOMS</td>
<td>60</td>
<td>$1,150</td>
</tr>
<tr>
<td>2 BEDROOMS</td>
<td>60</td>
<td>$1,450</td>
</tr>
<tr>
<td>3+ BEDROOMS</td>
<td>10</td>
<td>$1,575</td>
</tr>
<tr>
<td>TOTAL</td>
<td>150</td>
<td>$1,275</td>
</tr>
<tr>
<td>AFFORDABLE UNITS</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>PARKING STALLS</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>PRICE PER STALL ($/MO)</td>
<td>$50</td>
<td></td>
</tr>
</tbody>
</table>

Optimized Parking Supply and Market Price
Modeled parking utilization per building is n parked cars and this estimate has a range of nn - nn cars per building.
Observed vehicles per occupied residential unit (or parking/unit ratio) in 2012 & 2017

Independent variables:
- Average Unit's Ft²
- Average Occupied Bedroom Count
- Average Unit's Rent (adjusted for 2017)
- Parking Price per Month (adjusted for 2017)
- Parking Stalls Provided per Housing Unit
- Percent of Units Designated Affordable
- Gravity measure of Employment
- Gravity measure of Population
- Gravity measure of Transit Service

What's Missing?
1. Commercial/Mixed Use
2. Technology
3. Vehicle Trends
# Table 4: Parking Requirement Adjustment Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
<th>Typical Adjustments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic Location</td>
<td>Vehicle ownership and use rates in an area.</td>
<td>Adjust parking requirements to reflect variations identified in census and travel survey data.</td>
</tr>
<tr>
<td>Residential Density</td>
<td>Number of residents or housing units per acre/hectare.</td>
<td>Reduce requirements 1% for each resident per acre; Reduce requirements 15% where there are 15 residents per acre, and 30% if there are 30 residents per acre.</td>
</tr>
<tr>
<td>Employment Density</td>
<td>Number of employees per acre.</td>
<td>Reduce requirements 10-15% in areas with 50 or more employees per gross acre.</td>
</tr>
<tr>
<td>Land Use Mix</td>
<td>Range of land uses located within convenient walking distance.</td>
<td>Reduce requirements 5-10% in mixed-use developments. Additional reductions with shared parking.</td>
</tr>
<tr>
<td>Transit Accessibility</td>
<td>Nearby transit service frequency and quality.</td>
<td>Reduce requirements 10% for housing and employment within % mile of frequent bus service, and 20% for housing and employment within % mile of a rail transit station.</td>
</tr>
<tr>
<td>Carsharing</td>
<td>Whether a carsharing service is located nearby.</td>
<td>Reduce residential requirements 5-10% if a carsharing service is located nearby, or reduce 4-8 parking spaces for each carshare vehicle in a residential building.</td>
</tr>
<tr>
<td>Walkability</td>
<td>Walking environment quality.</td>
<td>Reduce requirements 5-15% in walkable communities, and more if walkability allow more shared and off-site parking.</td>
</tr>
<tr>
<td>Demographics</td>
<td>Age and physical ability of residents or commuters.</td>
<td>Reduce requirements 20-40% for housing for young (under 30) elderly (over 65) or disabled people.</td>
</tr>
<tr>
<td>Income</td>
<td>Average income of residents or commuters.</td>
<td>Reduce requirements 10-20% for the 20% lowest income households, and 20-30% for the lowest 10%.</td>
</tr>
<tr>
<td>Housing Tenure</td>
<td>Whether housing are owned or rented.</td>
<td>Reduce requirements 20-40% for rental versus owner occupied housing.</td>
</tr>
<tr>
<td>Pricing</td>
<td>Parking that is priced, unbundled or cashed out.</td>
<td>Reduce requirements 10-30% for cost-recovery pricing (i.e. parking priced to pay the full cost of parking facilities).</td>
</tr>
<tr>
<td>Unbundling Parking</td>
<td>Parking sold or rented separately from building space.</td>
<td>Unbundling parking typically reduces vehicle ownership and parking demand 10-20%.</td>
</tr>
<tr>
<td>Parking &amp; Mobility</td>
<td>Parking and mobility management programs are implemented at a site.</td>
<td>Reduce requirements 10-40% at worksites with effective parking and mobility management programs.</td>
</tr>
<tr>
<td>Management</td>
<td>Design Hour Number of allowable annual hours a parking facility may fill.</td>
<td>Reduce requirements 10-20% if a 10th annual design hour is replaced by a 30th annual peak hour. Requires overflow plan.</td>
</tr>
<tr>
<td>Contingency-Based</td>
<td>Use lower-bound requirements, and implement additional strategies if needed.</td>
<td>Reduce requirements 10-30%, and more if a comprehensive parking management program is implemented.</td>
</tr>
<tr>
<td>Planning</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table summarizes various factors that affect parking demand and optimal parking supply.
In Mixed-use Districts, parking is oversupplied by 65% on average.

Rachel Weinberger, Joshua Karlin-Resnick
By & For Bankers

Real Time Inventories Critical

Public & Private Spaces
Office parking demand is increasing ... Why?
> 4 workers per 1000 ft² assumed in zoning

Los Angeles is adding new cars at 4X rate than in the 90's
TNCs reducing demand for parking: entertainment districts & airports

- Avoid drunk driving and hassles of parking
- Parking at hotels down 15-20% (Ace Parking)
- Non-car owners cite lack of transit (Henao & Marshall)
STILL NEED PARKING!

LIFE IS GOOD!
Deloitte: By 2040, > 50% VMT traveled in the US could occur in shared autonomous vehicles
Summit New Jersey: Cancelled $10M garage; opted for shared-use pilot with Uber in 2017 (renewed with Lyft 2018)
Davidson NC: Cancelled municipal garage citing AVs (2018)
The last-mile delivery challenge

Giving retail and consumer product customers a superior delivery experience without impacting profitability
Technology driven innovations in last-mile delivery

Last-mile logistics leads the pack in terms of retail technology funding, with $1.3 billion in capital raised in Q2 2018. This is driven by the early adoption of new autonomous-delivery models in developed markets as well as an attractive business case founded on urban demand and the prevailing high labor costs for fulfillment.

7-Eleven was the first to successfully complete a Federal Aviation Administration-approved drone delivery in July 2015. The retailer partnered with drone operator Flirtey to make the delivery. Since then, several retailers – including Amazon – have piloted these.

Ford, Walmart, and delivery service Postmates are collaborating to design a service for delivering groceries and other goods to Walmart customers using autonomous vehicles. It aims to use autonomous vehicles by 2021 to reduce the costs of delivery.

Self-service lockers allow customers to select any locker location as their delivery address. They can then retrieve their orders by entering a unique code, removing the need for human involvement. Amazon was among the first to implement this, with Home Depot and Walmart among the major retailers to adopt it.

A service that allows couriers to access a person’s vehicle, allowing them to deliver packages inside. John Lewis has teamed up with Jaguar Land Rover’s mobile and venture arm – InMotion – to trial delivery to shoppers’ cars. Amazon launched this service in partnership with General Motors and Volvo.

A delivery service that allows couriers to enter a customer’s home and leave packages. Waitrose is the first retail supermarket in Britain to offer this service. The Dutch supermarket chain, Albert Heijn, a subsidiary of Ahold Delhaize, is also experimenting with this service.

Online Orders Delivery

<table>
<thead>
<tr>
<th>Delivery Type</th>
<th>Warehouse</th>
<th>Retail Storefront</th>
<th>Retail Store Backroom</th>
<th>Dark Stores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same-day delivery</td>
<td>15%</td>
<td>19%</td>
<td>43%</td>
<td>24%</td>
</tr>
<tr>
<td>12-hour delivery</td>
<td>12%</td>
<td>57%</td>
<td>12%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: Capgemini Research Institute, Last-mile delivery executive survey, October–November 2018, N=500 executives.
Bottom Line:
It’s not just parking & loading: circulation (also in plans & codes) is gonna get crazy
WHAT IS RIGHT SIZED PARKING 2.0?

PARKING DEMAND “ECOSYSTEM”

FOR PEOPLE & GOODS IN DISTRICTS

USING EXISTING & TRENDING TDM PRACTICES

WHILE ANTICIPATING EVOLVING TECH & TRENDS

RESPONDING WITH ADAPTIVE BUILDING/GARAGE/STREET DESIGN
THE PARKING DEMAND ECOSYSTEM

**SITE DESIGN**
- Location Factors (Proximity to Transit, Use Mix, Connectivity)
- Mobility Rooms
- Showers & Lockers
- Secure Bike Parking
- Pick Up/Drop Off
- On-Site Car & Bikeshare
- Vehicle Charging
- Real Time Transit Info
- Real Time Inventory
- Facilitated Delivery
- Parking - Shared Vehicles
- Automated Parking

**DISTRICT DESIGN**
- Concentrated Destinations
- TOD/Mobility Hubs
- Use Mix
- Connectivity
- Access Management
- Multimodal Infrastructure
- Public & Private Parking
- Parking Benefit District
- District Delivery Plans
- Side Street Loading
- Designated Shared Spaces
- Digital Infrastructure
- District Smart Parking
- Contingency Parking
- Pick-Up/Drop-Off Zones
- AV Parking (Remote)
- Drone Paths

**MODES**
- Walking
- Scooters
- Bikes
- Bikeshare (Dock, Dockless)
- E-Bikes (owned, shared)
- Mopeds, Motorcycles
- Ridehailing (single, shared)
- Cars (+AV)
- Car Share (RT, Pt2Pt, P2P)
- NEVs
- Shuttle/Microtransit (+AV)
- Buses (+AV)
- Bus Rapid Transit (+AV)
- Rail Transit (+AV)
- Delivery Drones (Air & Ground)
- Passenger Drones

**POLICY & PRICING**
- Parking Benefit District
- Promoted Parking Apps
- Guaranteed Ride Home
- Unbundle Parking
- Partial Unbundle Parking
- Shared Parking Rules
- Parking Cash Out
- In-Lieu-Of Fees
- Dynamic Meter Fees
- Curb Parking/Pricing
- Residential Permits
- Valets
- TNC Fees
- Contingency Parking
- Enforcement (Delivery Impact Fees)
On-Demand Electric Vehicles for Communities
City of Boston,

In Board of Aldermen,

May 1, 1889.

ORDERED: That consent and permission is hereby granted to the West End Street Railway Company in addition to the rights now possessed by it to establish, construct, maintain and use the overhead single trolley electric system of motive power so called, in the operation of its cars in and on all of the streets, ways and squares...
Using land exclusively for parking is not effective. Every car requires at least three parking spots—at home, at work, and at any third location the driver visits.”

Urbanland.org - The Future of Growing Cities Requires Less Parking, More Shared Rides
MOBILITY AS AN AMENITY

We’re the first company to provide community-based car sharing.
## COST-BENEFIT ANALYSIS FOR PROPERTIES

<table>
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<tr>
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<th>Capex (startup cost)</th>
<th>Rent Premium (rent/month)</th>
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<tr>
<td>Pool</td>
<td>$500K - $1M</td>
<td>+$9</td>
</tr>
<tr>
<td>Gym</td>
<td>$100K - $500K</td>
<td>+$11</td>
</tr>
<tr>
<td>Mobility</td>
<td>$0</td>
<td>+$13</td>
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# COST-BENEFIT ANALYSIS FOR PROPERTIES

<table>
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<tr>
<th></th>
<th>Capex (startup cost)</th>
<th>Rent Premium (rent/month)</th>
<th>Opex/Revenue</th>
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</thead>
<tbody>
<tr>
<td><strong>Pool</strong></td>
<td>$500K - $1M</td>
<td>+$9</td>
<td>-$250</td>
</tr>
<tr>
<td><strong>Gym</strong></td>
<td>$100K - $500K</td>
<td>+$11</td>
<td>-$150</td>
</tr>
<tr>
<td><strong>Mobility</strong></td>
<td>$0</td>
<td>+$13</td>
<td>$500+</td>
</tr>
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</table>

MONTHLY REVENUE / VEHICLE

Utilization over 15% (3.6 hours/day) results in positive revenue for property.
337 EVs
2,800 EV Chargers
263 PROPERTIES
APARTMENTS + OFFICES + HOTELS
TOTAL ADDRESSABLE MARKET (residential)

10% EXISTING ENVOY CLIENTS

57,000 PROPERTIES (OVER 100+ UNITS)
13M RESIDENTIAL UNITS
260K VEHICLES

6,000 PROPERTIES
WHAT'S THE FUTURE OF TRANSPORTATION?
### Vehicle Info

<table>
<thead>
<tr>
<th></th>
<th>Volkswagen e-Golf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate/Min</td>
<td>$0.15</td>
</tr>
<tr>
<td>Rate/ Hour</td>
<td>$9.00</td>
</tr>
<tr>
<td>Daily Rate</td>
<td>$55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>10/18</th>
<th>11/18</th>
<th>12/18</th>
<th>1/18</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Vehicles</td>
<td>76</td>
<td>108</td>
<td>233</td>
<td>300</td>
</tr>
<tr>
<td>Booking Count</td>
<td>4776</td>
<td>10004</td>
<td>17680</td>
<td>24841</td>
</tr>
<tr>
<td>Avg. Duration</td>
<td>62.8</td>
<td>92.6</td>
<td>75.9</td>
<td>82.8</td>
</tr>
<tr>
<td>Utilization %</td>
<td>11.1%</td>
<td>23.2%</td>
<td>40.9%</td>
<td>57.5%</td>
</tr>
<tr>
<td>Utilization % Per Vehicle</td>
<td>5.5%</td>
<td>11.6%</td>
<td>20.5%</td>
<td>28.8%</td>
</tr>
</tbody>
</table>

### Map of Trip Destinations

![Map of Trip Destinations](image_url)

### Utilization / Revenue

- **All Vehicles**
  - 10/18: $716.40
  - 11/18: $838.35
  - 12/18: $1192.40
  - 1/18: $2312.60

- **Avg. Revenue / Car**
  - 10/18: $358.20
  - 11/18: $419.18
  - 12/18: $598.20
  - 1/18: $1156.30

### The Crossings

- # of Apartment Units: 225
- Vehicle Count: 2
- Cost to Owner / Unit: $0.01
- Revenue split: 50%

![Graph of Booking Count and Trip Duration](image_url)
The mixed-use project includes 1,682,876 ft² in four phases: office/commercial, 250-room hotel, 312-bed assisted living facility, 5,012 apartment units (752 units for student housing and 184 units for independent living).

Eliminated 9,000 parking spaces

5-0 vote for approval
CASE STUDY: PARKSIDE PLACE

Technology 3 Ways

Mobility Technology
(space-light options, MaaS)

Parking Technology
-monitoring to meet permits,
ability to rent excess space

Partnerships
(developer as new mobility catalyst)
How we did it:

- Used scenario planning to forecast technology
- Aligned tech evolution with development phasing
- Monitoring & contingency

**Case Study: Parkside Place**

**Now**

**Technology**
- Payment apps
- Navigation, sensors & apps
- Smart parking meters
- Carshare

**Parking**
- Designated carshare parking
- Guide drivers to spots
- Payment-by-app

**Planning**
- TDM
- Valets
- Dynamic pricing
- Parklets, Streateries, Corrals

**Trending**

**Technology**
- Autonomous Parking
- Shared Use Mobility
- Microtransit
- Electric charging

**Parking**
- Pickup/Drop off zones (passengers & deliveries)
- Smart garages

**Planning**
- Queuing
- On-street space reallocation
- Parking districts
- Flexible garage design
- Ubiquitous charging stations

**Emerging**

**Technology**
- Autonomous Shuttles (1st fixed route, then demand-response)
- Mobility-as-a-Service (MaaS)

**Parking**
- Off-site parking
- Shared, automated, district parking

**Planning**
- Shuttle route planning
- Transition (driver/driverless)
- Coordination with transit
- Repurposed garage spaces

**Future?**

**Technology**
- Individual cars - % of fleet?
- Owned or shared? Publicly or privately operated?

**Parking**
- What are the best parking locations to balance demand-response with lower congestion & VMT?

**Planning**
- How should parking be priced?
- How should cities retool parking revenue?
WHAT’S TRENDING: GARAGE TECH

Stanley Robotics

May Mobility
Convert grade level to commercial space

Vehicle pick up and drop off

Shared vehicle staging, charging and service

Convert parking to warehousing, office, residential or other uses

Green roof conversion

Partial demo for other use

*Flexpark is TM

Kerkstra Precast Co
Land
Bank

Kerkstra Precast Co
AV car-parks can decrease the need for parking space by an average of 62% and a maximum of 87%.

*Mehdi Nourinejada, Sina Bahrami, Matthew J. Roordab*
WHAT'S NEXT: GRAB & GO MOBILITY
WHAT'S NEXT: ZERO PARKING FOR TOD
REAL TIME, RIGHT-SIZE PARKING CALCULATOR
Strategic “bundles” of Tech + TDM?
Plan & code audits + re-write?
Simulations & predictive analytics?
(Circulation – Looking at you!)
Redundancy (Cyber? Outages?)
Your idea here cause it’s time for Q&A!!
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