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Parking Management

Strategies, Evaluation and Planning

9 October 2024

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Abstract

Parking management refers to various policies and programs that result in more efficient use of parking resources. This report summarizes the book, *Parking Management Best Practices* (Planners Press, 2006), which describes and evaluates more than two-dozen such strategies. It investigates problems with current parking planning, discusses the costs of parking facilities and potential savings from improved management, describes specific parking management strategies and how they can be implemented, discusses planning and evaluation issues, and describes how to develop optimal parking management in a particular situation. Cost-effective parking management programs can usually reduce parking requirements by 20-40% compared with conventional planning requirements, providing many economic, social and environmental benefits.

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Introduction

Parking is an essential component of the transportation system. Vehicles must park at every destination. A typical automobile is parked 23 hours each day, and uses several parking spaces each week. Parking convenience affects the ease of reaching destinations and therefore affects overall accessibility.

Parking facilities are a major cost to society, and parking conflicts are among the most common problems facing designers, operators, planners and other officials. Such problems can be often defined either in terms of *supply* (too few spaces are available, somebody must build more) or in terms of *management* (available facilities are used inefficiently and should be better managed). Management solutions tend to be better than expanding supply because they support more strategic planning objectives:

- Reduced development costs and increased affordability.
- More compact, multi-modal community planning (smart growth).
- Encourage use of alternative modes and reduce motor vehicle use (thereby reducing traffic congestion, accidents and pollution).
- Improved user options and quality of service, particularly for non-drivers.
- Improved design flexibility, creating more functional and attractive communities.
- Ability to accommodate new uses and respond to new demands.
- Reduced impervious surface and related environmental and aesthetic benefits.

Parking management refers to policies and programs that result in more efficient use of parking resources. Parking management includes several specific strategies; nearly two dozen are described in this report. When appropriately applied parking management can significantly reduce the number of parking spaces required in a particular situation, providing a variety of economic, social and environmental benefits. When all impacts are considered, improved management is often the best solution to parking problems.

Parking Management Principles

These ten general principles can help guide planning decision to support parking management.

1. *Consumer choice.* People should have viable parking and travel options.
2. *User information.* Motorists should have information on their parking and travel options.
3. *Sharing.* Parking facilities should serve multiple users and destinations.
4. *Efficient utilization.* Parking facilities should be sized and managed so spaces are frequently occupied.
5. *Flexibility.* Parking plans should accommodate uncertainty and change.
6. *Prioritization.* The most desirable spaces should be managed to favor higher-priority uses.
7. *Pricing.* As much as possible, users should pay directly for the parking facilities they use.
8. *Peak management.* Special efforts should be made to deal with peak-demand.
9. *Quality vs. quantity.* Parking facility quality should be considered as important as quantity, including aesthetics, security, accessibility and user information.
10. *Comprehensive analysis.* All significant costs and benefits should be considered in parking planning.

Parking Management Benefits

- *Facility cost savings.* Reduces costs to governments, businesses, developers and consumers.
- *Improved quality of service.* Many strategies improve user quality of service by providing better information, increasing consumer options, reducing congestion and creating more attractive facilities.
- *More flexible facility location and design.* Parking management gives architects, designers and planners more ways to address parking requirements.
- *Revenue generation.* Some management strategies generate revenues that can fund parking facilities, transportation improvements, or other important projects.
- *Reduces land consumption.* Parking management can reduce land requirements and so helps to preserve greenspace and other valuable ecological, historic and cultural resources.
- *Supports mobility management.* Parking management is an important component of efforts to encourage more efficient transportation patterns, which helps reduce problems such as traffic congestion, roadway costs, pollution emissions, energy consumption and traffic accidents.
- *Supports Smart Growth.* Parking management helps create more accessible and efficient land use patterns, and support other land use planning objectives.
- *Improved walkability.* By allowing more clustered development and buildings located closer to sidewalks and streets, parking management helps create more walkable communities.
- *Supports transit.* Parking management supports transit oriented development and transit use.
- *Reduced stormwater management costs, water pollution and heat island effects.* Parking management can reduce total pavement area and incorporate design features such as landscaping and shading that reduce stormwater flow, water pollution and solar heat gain.
- *Supports equity objectives.* Management strategies can reduce the need for parking subsidies, improve travel options for non-drivers, provide financial savings to lower-income households, and increase housing affordability.
- *More livable communities.* Parking management can help create more attractive and efficient urban environments by reducing total paved areas, allowing more flexible building design, increasing walkability and improving parking facility design.

This report describes various parking management strategies, how to evaluate these strategies and develop an integrated parking plan, plus examples and resources for more information. Most parking management strategies have been described in previous publications but no existing document describes them all or provides guidance on planning and implementing a comprehensive parking management program. This report summarizes the book *Parking Management Best Practices*, published by Planners Press in 2006. If you find this report useful, please purchase the book for more information.

Examples

Below are three illustrative examples of parking management programs.

Reducing Building Development Costs

A mixed-use building is being constructed in an urban or suburban area that will contain 100 housing units and 10,000 square feet of commercial space. By conventional standards this requires 200 parking spaces (1.6 spaces per housing unit plus 4 spaces per 1,000 square feet of commercial space), costing from $2 million for surface parking (about 9% of the total development costs), up to $6 million for underground parking (about 25% of total development costs). However, because the building is in a relatively accessible location (on a street that has sidewalks, with retail business and public transit services located nearby) and on-street parking is available nearby to accommodate occasional overflows, the building owners argue that a lower standard should be applied, such as 1.2 parking spaces per housing unit and 3 spaces per 1,000 square feet of commercial space, reducing total requirements to 150 spaces. To further reduce parking requirements the developer proposes the following:

- *Unbundle parking*, so parking spaces are rented separately from building space. For example, rather than paying $1,000 per month for an apartment with two parking spaces renters pay $800 per month for the apartment and $100 per month for each parking space. This typically reduces parking requirements by 20%.
- Encourage businesses to implement *commute trip reduction programs* for their employees, including *cashing out* free parking (employees are offered $50 per month if they don't use a parking space). This typically reduces automobile commuting by 20%.
- *Regulate* the most convenient parking spaces to favor higher-priority uses, including delivery vehicles and short errands, and handicapped users.
- Include four *carshare vehicles* in the building. Each typically substitutes for 5 personal vehicles, reducing 4 parking spaces.
- Incorporate excellent *walking facilities*, including sidewalk upgrades if needed to allow convenient access to nearby destinations, overflow parking facilities and transit stops.
- Incorporate *bicycle parking* and changing facilities into the building.
- Provide *information* to resident, employees and visitors about transit, rideshare and taxi services, bicycling facilities, and overflow parking options.
- Develop a contingency-based *overflow parking plan* that indicates where is available nearby if on-site facilities are full, and how and *spillover impacts* will be addressed. For example, identify where additional parking spaces can be rented if needed.

This management program allows total parking requirements to be reduced to 100 spaces, providing $100,000 to $500,000 in annualized parking facility capital and operating cost savings (compared with $20,000-$50,000 in additional expenses for implementing these strategies), as well as providing improved options to users and reduced vehicle traffic.

Increasing Office Building Profits and Benefits

An office building has 100 employees and 120 surface parking spaces, providing one space per employee plus 20 visitor spaces. The building earns $1,000,000 annually in rent, of which $900,000 is spent on debt servicing and operating expenses, leaving $100,000 annual net profit.

Parking management begins when a nearby restaurant arranges to use 20 spaces for staff parking during evenings and weekends for $50 per month per space, providing $12,000 in additional annual revenue. After subtracting $2,000 for walkway improvements between the sites, and additional operating costs, this increases profits 10%. Later a nearby church arranges to use 50 parking spaces Sunday mornings for $500 per month, providing $6,000 in annual revenue. After subtracting $1,000 for additional operating costs, this increases profits by another 5%. Next, a commercial parking operator arranges to rent the building's unused parking to general public during evenings and weekends. This provides $10,000 in net annual revenue, an additional 10% profit.

Inspired, the building manager develops a comprehensive management plan to take full advantage of the parking facility's value. Rather than giving each employee a reserved space, spaces are shared, so 80 spaces can easily serve the 100 employees. A commute trip reduction program is implemented with a $40 per month cash-out option, which reduces parking requirements by another 20 spaces. As a result, employees only need 60 parking spaces. The extra 40 parking spaces are leased to nearby businesses for $80 per month, providing $32,000 in annual revenue, $9,600 of which is used to fund cash-out payments and $2,400 to cover additional costs, leaving $20,000 net profits.

Because business is growing, the tenant wants additional building space for 30 more employees. Purchasing land for another building would cost approximately $1 million, and result in two separate work locations, an undesirable arrangement. Instead, the building manager stops leasing daytime parking and raises the cash-out rate to $50 per month, which causes an additional 10 percentage point reduction in automobile commuting. With these management strategies, 87 parking spaces are adequate to serve 130 employees plus visitors, leaving the land currently used by 33 parking spaces available for a building site. To address concerns that this parking supply may be insufficient sometime in the future, a contingency plan is developed which identifies what will be done if more parking is needed, which might involve an overflow parking plan, providing additional commuter incentives during peak periods, leasing nearly parking, or building structured parking if necessary.

This parking management plan saves $1 million in land costs, a $50,000 annualized value. Parking spaces can still be rented on weekends and evenings, bringing in an additional $25,000. These parking management strategies increased total building profits about 75%, allow a business to locate entirely at one location, and provide parking to additional users during off-peak periods. Other benefits include increased income and travel options for employees, reduced traffic congestion and air pollution, and reduced stormwater runoff.

Downtown – Addressing Parking Problems

A growing downtown is experiencing parking problems. Most downtown parking is unpriced, with 2-hour limits for on-street parking. During peak periods 90% of core-area parking spaces are occupied, although there is virtually always parking available a few blocks away, and many of the core spaces are used by commuters or long-term visitors, who moved their vehicles every two hours to avoid citations.

Local businesses asked the city to build a $5 million parking structure, which would either require about $500,000 in annual subsidies or would require user charges. Experience in similar downtowns indicates that if most public parking is unpriced, few motorists will pay for parking so the structure would be underutilized and do little to alleviate parking problems. Local officials decide to first implement a management program, to defer or avoid the need for a parking structure. Parking surveys are performed regularly to track utilization and turnover rates, in order to identify problems. The program's objectives are to encourage efficient use of parking facilities, insure that parking is convenient for priority uses (deliveries, customers and short errands), and maintain parking utilization at about 85%. It includes the following strategies:

- Increase enforcement of regulations, particularly during busy periods, but insure that enforcement is friendly and fair.
- Reduce on-street time limits (e.g., 2-hours to 90 minutes) where needed to increase turnover.
- Expand core area boundaries to increase the number of spaces managed for short-term use.
- Encourage businesses to share parking, so for example, a restaurant allows its parking spaces to be used by an office building during the weekdays in exchange for using the office parking during evenings and weekends.
- Encourage use of alternative modes. The city may partner with the downtown business organization to support commute trip reduction programs and downtown shuttle service.
- Develop special regulations as needed, such as for disabled access, delivery and loading areas, or to accommodate other particular land uses.
- Implement a residential parking permit program if needed to address spillover problems in nearby residential areas, but accommodate non-residential users as much as possible.
- Provide signs and maps showing motorists where they may park.
- Have an overflow parking plan for occasionally special events that attract large crowds.
- Establish high standards for parking facility design, including aesthetic and safety features, to enhance the downtown environment.
- Price parking, using convenient pricing methods. Apply the following principles:
    - Adjust rates as needed to maintain optional utilization (i.e., 85% peak occupancy).
    - Structure rates to favor short-term uses in core areas and encourage longer-term parkers to shift to other locations.
    - Provide special rates to serve appropriate uses, such as for evening and weekend events.
    - Use revenues to improve enforcement, security, facility maintenance, marketing, and mobility management programs that encourage use of alternative modes.

Paradigm Shift

Parking planning is undergoing a *paradigm shift*, a fundamental change in how a problem is perceived and solutions evaluated. The old paradigm assumes that parking should be abundant and free at most destinations. It strives to maximize supply and minimize price. The old paradigm assumes that parking lots should almost never fill, that parking facility costs should be incorporated into the costs of buildings or subsidized by governments, and that every destination should satisfy its own parking needs.

The new paradigm strives to provide *optimal* parking supply and price. It considers too much supply as harmful as too little, and prices that are too low as harmful as those that are too high. The new paradigm strives to use parking facilities efficiently. It considers full lots to be acceptable, provided that additional parking is available nearby, and that any spillover problems are addressed. It emphasizes sharing of parking facilities between different destinations. It favors charging parking facility costs directly to users, and providing financial rewards to people who reduce their parking demand.

The old paradigm tends to resist change. It places a heavy burden of proof on innovation. The new paradigm recognizes that transport and land use conditions evolve so parking planning practices need frequent adjustment. It shifts the burden of proof, allowing new approached to be tried until their effectiveness (or lack thereof) is proven. Table 1 compares the old and new parking paradigms.

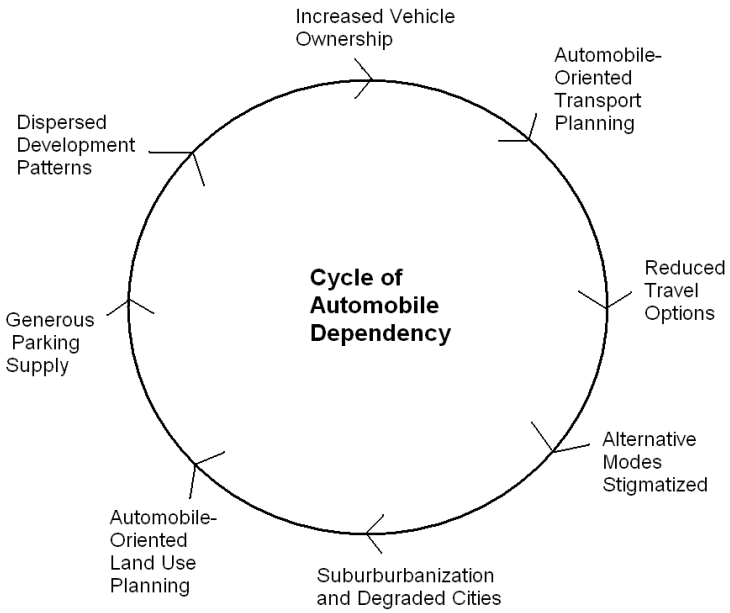
Table 1 **Old and New Parking Paradigms Compared**

Old Parking Paradigm	New Parking Paradigm
"Parking problem" means inadequate parking supply.	There can be many types of parking problems, including inadequate or excessive supply, too low or high prices, inadequate user information, and inefficient management.
Abundant parking supply is always desirable.	Too much supply is as harmful as too little.
Parking should generally be provided free, funded indirectly, through rents and taxes.	As much as possible, users should pay directly for parking facilities.
Parking should be available on a first-come basis.	Parking should be regulated to favor higher priority uses and encourage efficiency.
Parking requirements should be applied rigidly, without exception or variation.	Parking requirements should reflect each particular situation, and should be applied flexibly.
Innovation faces a high burden of proof and should only be applied if proven and widely accepted.	Innovations should be encouraged, since even unsuccessful experiments often provide useful information.
Parking management is a last resort, to be applied only if increasing supply is infeasible.	Parking management programs should be widely applied to prevent parking problems.
"Transportation" means driving. Land use dispersion (sprawl) is acceptable or even desirable.	Driving is just one type of transport. Dispersed, automobile-dependent land use patterns can be undesirable.

Parking management changes the way parking problems are defined and solutions evaluated.

The old paradigm results in *predict and provide* planning, in which past trends are extrapolated to predict future demand, which planners then try to satisfy. This often creates a self-fulfilling prophecy, since abundant parking supply increases vehicle use and urban sprawl, causing parking demand and parking supply to ratchet further upward, as illustrated in Figure 1.

Figure 1 **Cycle of Automobile Dependency**



Generous parking supply is part of a cycle that leads to increased automobile dependency. Parking management can help break this cycle.

It is important to define parking problems carefully. For example, if people complain about a parking problem, it is important to determine exactly what type of problem, and where, when and to whom it occurs. Increasing supply helps reduce parking congestion and spillover problems but increases most other problems. Management solutions tend to reduce most problems, providing a greater range of benefits and so are supported by more comprehensive planning.

How Much Is Optimal?

Optimal parking supply is the amount that motorists would purchase if they paid all costs directly and had good parking and transport options. But conventional planning practices reflect an assumption that it is desirable to maximize parking supply and minimize user charges. They consider parking management a measure of last resort, to be applied only where it is infeasible to expand supply.

Conventional planning determines how much parking to provide at a particular site planners based on recommended minimum parking standards published by various professional organizations. This provides an *index* or *parking ratio* used to calculate the number of spaces to supply at a particular location. These are *unconstrained* and *unadjusted* values, which generally reflect the maximum supply that could be needed.

These standards are often excessive and can usually be adjusted significantly downward. To appreciate why it is helpful to know a little about how parking standards are developed. Conventional parking standards are based on parking demand surveys, the results of which are collected and published in technical reports such as ITE's *Parking Generation*. This process implies a higher degree of accuracy than is actually justified. Fewer than a dozen demand surveys are used to set standards for many land use categories. The analysis does not usually take into account geographic, demographic and economic factors that can affect parking demand, such as whether a site is urban or suburban, and whether parking is free or priced.

These standards err toward oversupply in many ways. They are derived from parking demand studies that were mostly performed in automobile-dependent locations. They are generally based on 85th percentile demand curves (which means that 85 out of 100 sites will have unoccupied parking spaces even during peak periods), an 85th occupancy rate (a parking facility is considered full if 85% of spaces are occupied) and a 10th design hour (parking facilities are sized to fill only ten hours per year). Applying these standards results in far more parking supply than is usually needed at most destinations, particularly where land use is mixed, there are good travel options, parking is managed for efficiency or priced.

Most people planning apply parking standards have little understanding of the biases and errors they contain, and the problems created by excessive parking supply. The application of generous and inflexible parking standards is often defended as being *conservative*, implying that this approach is cautious and responsible. Use of the word *conservative* in this context is confusing because it results in the opposite of what is implied. Excessive parking requirements waste resources, both directly, by increasing the money and land devoted to parking facilities, in indirectly, by increasing automobile use and sprawl. Better parking management actually tends to be more *conservative* overall.

Alternative Ways to Determine Optimal Parking Supply

There are better ways to determine how much parking to supply at a particular site. *Efficiency-based standards* size facilities for optimal utilization. This means that most parking lots are allowed to fill, provided that management strategies can insure user convenience and address any problems. For example, parking facilities at a store can be sized to fill daily or weekly, provided that overflow parking is available nearby, motorists have information about available parking options, and regulations are adequately enforced to address any spillover problems that develop.

Efficiency-based standards take into account geographic, demographic and economic factors that affect parking demand. They also reflect the relative costs and benefits of different options, so less parking is supplied where parking supply is relatively costly to provide or where management programs easy to implement. Efficiency-based standards should also reflect strategic planning objectives such as a desire for more compact development, or to reduce traffic.

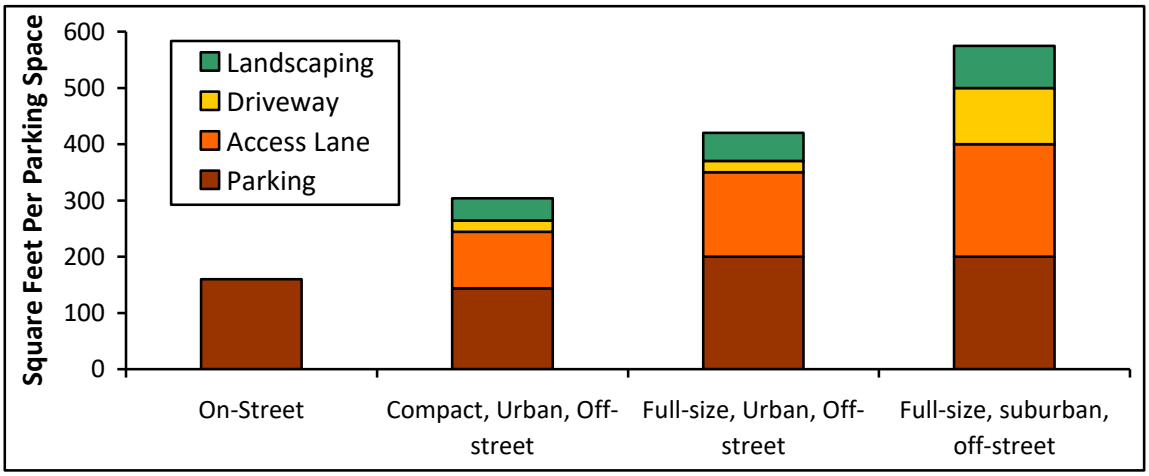
Because it is not possible to predict exact parking demand and management program effectiveness, efficiency-based standards rely on *contingency-based planning*, which means that planners identify solutions that can be deployed if needed in the future. For example, if a new building is predicted to need 60 to 100 parking spaces, the conventional approach is to supply either the middle value (80 spaces), or the maximum value (100 spaces). With contingency-based planning, the lower-bound value (60 spaces) is initially supplied, conditions are monitored, and various strategies are identified for implementation if needed. This may include banking land for additional parking supply and various parking management programs. This allows planners to use lower parking standards with the confidence that any resulting problems can be easily solved.

Parking Facility Costs

A major benefit of parking management is its ability to reduce parking facility costs. Parking facilities are expensive and their costs are usually borne indirectly through higher taxes, rents and prices for other goods, so most people have little idea of parking facility costs and the potential savings from more efficient management.

A typical parking space is 8-10 feet (2.4-3.0 meters) wide and 18-20 feet (5.5-6.0 meter) deep, totaling 144-200 square feet (13-19 sq. meters). Off-street parking requires driveways and access lanes, and so typically requires 300-400 square feet (28-37 square meters) per space, allowing 100-150 spaces per acre (250-370 per hectare). Parking covers a major portion of urban land (Kisin 2022).

Figure 2 **Typical Parking Facility Land Use** ("Parking Evaluation," VTPI, 2005)



Land requirements per parking space vary depending on type and size. Off-street spaces require driveways and access lanes. Landscaping typically adds 10-15% to parking lot area.

Considering land, construction and operating expenses, the annualized cost of a parking space typically ranges from about $500 per space if otherwise unused land is available, and construction and operating costs are minimal, to more than $3,000 for structured parking with attendants (Litman 2023). On-street parking requires less land per space than off-street parking, since they do not require access lanes, but their opportunity costs can be high if they use road space needed for traffic lanes or sidewalks. The *Parking Cost, Pricing and Revenue Calculator* (www.vtpi.org/parking.xls) can be used to calculate these costs for a particular situation.

In addition to these direct costs, parking facilities impose indirect costs, including increased stormwater management costs and heat island effects, plus increased vehicle traffic and sprawl. Put more positively, parking management can help solve a variety of economic, social and environmental problems, increase economic productivity, and make consumers better off overall.

Parking Management Strategies

This section describes various parking management strategies. For more information see Gies, Hertel and Tully (2021); ITDP (2021); Litman (2020); MTC (2021); Pressl and Rye (2020); and Park4SUMP.

Shared Parking

Shared Parking means that a parking facility serves multiple users or destinations ("Shared Parking," VTPI, 2005). This is most successful if destinations have different peak periods, or if they share patrons so motorists park at one facility and walk to multiple destinations. Parking facilities can be shared in several ways.

- *Shared Rather Than Reserved Spaces*. Motorists share parking rather than being assigned reserved spaces. For example, 100 employees can usually share 60-80 spaces, since at any time some are on leave, in the field, commuting by alternative modes or working another shift. Hotels, apartments, and dormitories can share parking spaces among several units, since the number of vehicles per unit varies over time. Sharing can be optional, so for example, motorists could choose between $60 per month for a shared space or $100 for a reserved space.
- *Share Parking Among Destinations.* Parking can be shared among multiple destinations. For example, an office building can share parking with a restaurant or theater, since peak demand for offices occurs during weekdays, and on weekend evenings for restaurants and theaters, as indicated in Table 2. Sharing can involve mixing land uses on single site, such as a mall or campus, or by creating a sharing arrangement between sites located suitably close together.

Table 2 **Typical Peak Parking Periods For Various Land Uses**

Weekday	Evening	Weekend
Banks and public services		
Offices and other worksites	Auditoriums	
Park & Ride facilities	Bars and dance halls	
Schools, daycare centers and colleges	Meeting halls	
Factories and distribution centers	Restaurants	Religious institutions
Medical clinics	Theaters	Parks
Professional services	Hotels	Shops and malls

This table indicates peak parking demand for different land use types. Parking can be shared efficiently by land uses with different peaks.

- *Public Parking Facilities.* Public parking, including on-street, municipal off-street, and commercial (for profit) facilities generally serve multiple destinations. Converting from free, single-use to paid, public parking allows more efficient, shared use.
- *In Lieu Fees.* "In lieu fees" mean that developers help fund public parking facilities instead of providing private facilities serving a single destination. This tends to be more cost effective and efficient. It can be mandated or optional.
- *Special Parking Assessment*. Businesses in an area can be assessed a special assessment or tax to fund parking facilities in their area, as an alternative to each business supplying its own facilities. This is often implemented through a downtown business improvement district.

Parking Regulation

Parking regulations control who, when and how long vehicles may park at a particular location, in order to prioritize parking facility use. The table below describes common regulations and the type of parking activity they favor.

Table 3 **Common Parking Regulations**

Name	Description	Favored Activity
User or vehicle type	Spaces dedicated to loading, service, taxis, customers, rideshare vehicles, disabled users, buses and trucks.	As specified.
Duration.	Limit parking duration (5-minute loading zones, 30-minutes adjacent to shop entrances, 1- or 2-hour limits).	Short-term users, such as deliveries, customers and errands.
Time period restrictions	Prohibit occupancy at certain times, such as before 10 am, to discourage employee use, or between 10 pm and 5 am to discourage resident use.	Depends on restrictions.
Employee restrictions.	Require or encourage employees to use less convenient parking spaces.	Customers, deliveries and errands.
Special events	Have special parking regulations during special events.	Depends on restrictions.
Accommodate short-term users.	Provide options for vehicles that make numerous short stops, such as special parking passes.	Delivery and service vehicles.
Residential parking permits	Use Residential Parking Permits (RPPs) to give area residents priority use of parking near their homes.	Residents.
Options for special users.	Establish a system that allows specific parking spaces to be reserved for service and construction vehicles.	Vehicles used for special activities.
Restrict overnight parking	Prohibit overnight parking to discourage use by residents and campers.	Shorter-term parkers
Street cleaning restrictions	Regulations that prohibit parking on a particular street one day of the week to allow street sweeping.	Street cleaning. Insures motorists move their vehicles occasionally.
Large vehicle restrictions	Limit on-street parking of large vehicles, such as freight trucks and trailers.	Normal-size vehicles
Arterial lanes	Prohibit on-street parking on arterials during peak periods, to increase traffic lanes.	Vehicle traffic over parking.
abandoned vehicles	Have a system to identify and remove abandoned vehicles from public parking facilities.	Operating vehicles.

Various regulations can increase parking efficient and prevent problems.

More Accurate and Flexible Standards

More accurate and flexible standards means that parking requirements at a particular location are adjusted to account for factors such as those in Table 4.

Table 4 **Parking Requirement Adjustment Factors**

Factor	Description	Typical Adjustments
Geographic Location	Vehicle ownership and use rates in an area.	Adjust parking requirements to reflect variations identified in census and travel survey data.
Residential Density	Number of residents or housing units per acre/hectare.	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.
Employment Density	Number of employees per acre.	Reduce requirements 10-15% in areas with 50 or more employees per gross acre.
Land Use Mix	Range of land uses located within convenient walking distance.	Reduce requirements 5-10% in mixed-use developments. Additional reductions with shared parking.
Transit Accessibility	Nearby transit service frequency and quality.	Reduce requirements 10% for housing and employment within ¼ mile of frequent bus service, and 20% for housing and employment within ¼ mile of a rail transit station.
Carsharing	Whether a carsharing service is located nearby.	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.
Walkability	Walking environment quality.	Reduce requirements 5-15% in walkable communities, and more if walkability allow more shared and off-site parking.
Demographics	Age and physical ability of residents or commuters.	Reduce requirements 20-40% for housing for young (under 30) elderly (over 65) or disabled people.
Income	Average income of residents or commuters.	Reduce requirements 10-20% for the 20% lowest income households, and 20-30% for the lowest 10%.
Housing Tenure	Whether housing are owned or rented.	Reduce requirements 20-40% for rental versus owner occupied housing.
Pricing	Parking that is priced, unbundled or cashed out.	Reduce requirements 10-30% for cost-recovery pricing (i.e. parking priced to pay the full cost of parking facilities).
Unbundling Parking	Parking sold or rented separately from building space.	Unbundling parking typically reduces vehicle ownership and parking demand 10-20%.
Parking & Mobility Management	Parking and mobility management programs are implemented at a site.	Reduce requirements 10-40% at worksites with effective parking and mobility management programs.
Design Hour	Number of allowable annual hours a parking facility may fill.	Reduce requirements 10-20% if a 10th annual design hour is replaced by a 30th annual peak hour. Requires overflow plan.
Contingency-Based Planning	Use lower-bound requirements, and implement additional strategies if needed.	Reduce requirements 10-30%, and more if a comprehensive parking management program is implemented.

This table summarizes various factors that affect parking demand and optimal parking supply.

Reduce Residential Street Width Requirements

Most jurisdictions require wide residential streets in order to provide on-street parking. This practice is not justified for safety or by consumer demands, since many households would not choose to pay for parking if it were unbundled, and so represents a hidden subsidy of automobile ownership and use (Guo, et al. 2012). Reducing minimum residential street widths in municipal zoning codes and development policies allows developers to build *new urbanist* communities with narrower streets and less parking, and rely more on efficient parking management.

Parking Maximums

Parking Maximums means that an upper limit is placed on parking supply, either at individual sites or in an area. Area-wide limits are called *Parking Caps*. These can be in addition to or instead of minimum parking requirements. Excessive parking supply can also be discouraged by reducing public parking supplies, imposing a special parking tax, and by enforcing regulations that limit temporary parking facilities. Maximums often apply only to certain types of parking, such as long-term, single-use, free, or surface parking, depending on planning objectives.

Remote Parking and Shuttle Service

Remote Parking (also called *Satellite Parking*) refers to the use of off-site parking facilities. This often involves shared facilities, such as office workers parking at a restaurant parking lot during the day, in exchange for restaurant employees using the office parking lot evenings and weekends. It can involve use of public facilities, such as commercial parking lots. Remote parking can also involve use of parking facilities located at the periphery of a business district or other activity center, and use of overflow parking during a special event that attracts large crowds. Special shuttle buses or free transit service may be provided to connect destinations with remote parking facilities, allowing them to be farther apart than would otherwise be acceptable. Another type of remote parking is use of *Park & Ride* facilities, often located at the urban fringe where parking is free or significantly less expensive than in urban centers.

Figure 3 **Overflow Parking Sign**

Remote parking requires providing adequate use information and incentives to encourage motorists to use more distant facilities. For example, signs and maps should indicate the location of peripheral parking facilities, and they should be significantly cheaper to use than in the core. Without such incentives, peripheral parking facilities are often underused while core parking is congested.

Smart Growth

Smart growth (also called *New Urbanism*, *Location Efficient Development* and *Transit Oriented Development*) is a general term for development policies that result in more efficient transportation and land use patterns, by creating more compact, development with multi-modal transportation systems ("Smart Growth," VTPI 2005).

Smart growth supports and is supported by parking management. Parking management reduces the amount of land required for parking facilities, reduces automobile use and increases infill affordability. These land use patterns, in turn, tend to reduce vehicle ownership and use, and so reduce parking requirements. They allow more sharing of parking facilities, shifts to alternative modes, and various types of parking pricing. Smart growth usually incorporates specific parking management strategies, as indicated in Table 5. Effective parking management is a key component of smart growth.

Table 5 **Conventional and Smart Growth Parking Policies**

Conventional Parking Policies	Smart Growth Parking Policies
Managed only for motorist convenience	Managed for transport system efficiency
Maximum parking supply	Optimal parking supply (not too little, not too much)
Prefers free parking	Prefers priced parking (user pays directly)
Dedicated parking facilities	Shared parking facilities
Favors lower-density, dispersed development	Favors compact development.

Walking and Cycling Improvements

Walking and Cycling (together called *Non-motorized*, *Active* or *Human Powered* transport) improvements support parking management strategies in several ways ("Walking and Cycling Improvements," VTPI 2005):

- Improving walkability (the quality of walking conditions) expands the range of parking facilities that serve a destination. It increases the feasibility of sharing parking facilities and use of remote parking facilities.
- Improving walkability increases "park once" trips, that is, parking in one location and walking rather than driving to other destinations, which reduces vehicle trips and the amount of parking required at each destination.
- Walking and cycling improvements allow these modes to substitute for some automobile trips.
- Walking and cycling improvements encourage transit use, since most transit trips involve walking or cycling links.

Increase Capacity of Existing Parking Facilities

Increase capacity of existing parking facilities means that parking supply increases without using more land or major construction. There are various ways to do this:

- Use currently wasted areas (corners, edges, undeveloped land, etc.). This can be particularly appropriate for small car spaces, motorcycle and bicycle parking.
- Where there is adequate street width, change from parallel to angled on-street parking.
- Maximize the number of on-street parking spaces, for example, by using a curb lane for parking rather than traffic during off-peak periods, and designating undersized spaces for small cars or motorcycles.
- Provide special, small parking spaces for motorcycles. Allow and encourage motorcycles to share parking spaces when possible.
- Reduce parking space size. Shorter-term parking requires larger spaces, but employee and residential parking spaces can be somewhat smaller. A portion of spaces can be sized for compact vehicles, which require about 20% less space than full-size stalls.
- Use car stackers and mechanical garages. These can significantly increase the number of vehicles parked in an area. However, they are only suitable for certain applications. They generally require an attendant to move lower-level vehicles when needed to access upper-level vehicles, and stackers may be unable to accommodate larger vehicles such as SUV, vans and trucks.
- Use valet parking, particularly during busy periods. This can increase parking capacity by 20-40% compared with users parking their vehicles. Commercial lots often have attendants park vehicles during busy periods, but not off-peak.
- Remove or consolidate non-operating vehicles, equipment, material and junk stored in parking facilities, particularly in prime locations.

Mobility Management

Mobility Management (also called *Transportation Demand Management* or *TDM*) is a general term for strategies that increase transportation system efficiency by changing travel behavior (VTPI 2005). It may affect travel frequency, mode, destination or timing (for example, shifting from peak to off-peak). There are many different mobility management strategies, as summarized in the table below.

Table 6 **Mobility Management Strategies** (VTPI 2003)

Improved Transport Options	Incentives to Shift Mode	Land Use Management	Policies and Programs
Alternative Work Schedules	Bicycle and Pedestrian Encouragement	Car-Free Districts	Access Management
Bicycle Improvements	Congestion Pricing	Compact Land Use	Campus Transport Management
Bike/Transit Integration	Distance-Based Pricing	Location Efficient Development	Data Collection and Surveys
Carsharing	Commuter Financial Incentives	New Urbanism	Commute Trip Reduction
Guaranteed Ride Home	Fuel Tax Increases	Smart Growth	Freight Transport Management
Security Improvements	High Occupant Vehicle (HOV) Priority	Transit Oriented Development (TOD)	Marketing Programs
Park & Ride	Pay-As-You-Drive Insurance	Street Reclaiming	School Trip Management
Pedestrian Improvements	Parking Pricing		Special Event Management
Ridesharing	Road Pricing		Tourist Transport Management
Shuttle Services	Vehicle Use Restrictions		Transport Market Reforms
Improved Taxi Service			
Telework			
Traffic Calming			
Transit Improvements			

Mobility management includes numerous strategies that affect vehicle travel behavior. Many affect parking demand.

Mobility management both supports and is supported by parking management. Mobility management programs often reduce parking demand, and many parking management strategies help reduce vehicle traffic create more accessible land use patterns or support other mobility management objectives.

Efficient Parking Pricing

Parking Pricing means that motorists pay directly for using parking facilities, with prices that vary to reflect facility and parking congestion costs (Shoup 2005). This may be implemented as a parking management strategy (to reduce parking problems), as a mobility management strategy (to reduce transport problems), to recover parking facility costs, or to raise revenue for any purpose. It is often intended to achieve a combination of objectives.

Currently, most parking is inefficiently priced; it is provided free, significantly subsidized, or bundled (automatically included) with building purchases and rents, forcing consumers to pay for parking facilities regardless of whether or not they want it. When motorists do pay directly for parking, it is often a flat annual or monthly fee, providing little incentive to use an alternative mode occasionally. Rates should be set to optimize parking facility use, called *performance-based pricing*, which means that about 15% of parking spaces are vacant and available at any time (King County 2018; Shoup 2006). Efficient pricing can include (Litman 2017):

- Expand when and where municipal parking is priced, including meters and permits required for on-street parking.
- *Parking cash out* means that non-drivers receive the cash equivalent of parking subsidies provided to motorists.
- *Parking unbundling*, which means that parking is rented separately from building space, so rather than paying $2,500 per month to rent an apartment with a parking space occupants pay $2,250 for the apartment and $250 for each parking space they use, so car-free households are no longer forced to pay for costly parking facilities they don't use.
- Shorter payment periods, such as charging buy the hour rather than the day, or the day rather than month or year (Gutman 2017).

Improve Parking Pricing Methods

Much of the resistance to parking pricing results from inconvenient pricing methods. They often require payment in specific denominations (coins or bills), charge flat fees for long time periods, are unable to adjust prices to reflect conditions, are confusing or slow to use, have high operating costs and have arbitrary or excessive enforcement.

Better payment methods are available. Newer electronic systems are more convenient, accurate, flexible, and increasingly cost effective. They can accommodate various payment methods (coins, bills, credit and debit cards, and by cellular telephone or the Internet), charge only for the amount of time parked, incorporate multiple rates and discounts, automatically vary rates by day and time, and are convenient to use. Some can be integrated with payment systems for other public services such as transit, roads tolls, and telephone use. Some employ contactless technology which automatically deducts payment. Newer systems also produce printed receipts and record data for auditing, which prevents fraud and increases convenience for customers, operators and local governments. They can also automatically record data on utilization and turnover, which improves planning and administration.

Financial Incentives

Financial Incentives means that travelers (particularly commuters) are offered financial benefits for reducing their automobile trips ("Commuter Financial Incentives," VTPI, 2005). These benefits represent the cost savings that result from reduced parking demand. There are various types of incentives. *Parking cash-out* means that commuters who are offered subsidized parking can choose cash instead. *Transit benefits* means that employees receive a subsidized transit pass. *Universal transit passes* means that a group purchases discounted, bulk transit passes for all members. Another incentive is to provide *discounted* or *preferential parking* for rideshare (carpool and vanpool) vehicles. Consumers value these options because they provide positive rewards for those who reduce vehicle trips and parking demand.

Financial incentives such as transit benefits and parking cash-out typically reduce automobile travel 10-30%, depending on the value of the incentive, and various factors. In urban areas commuters tend to shift to walking and transit. In suburban areas they tend to shift to cycling and ridesharing. These programs have been particularly successful at college and university campuses.

Unbundle Parking

Unbundling means that parking is rented or sold separately, rather than automatically included with building space. For example, rather than renting an apartment with two parking spaces for $1,000 per month, the apartment would rent for $800 per month, plus $100 per month for each parking space. This is more equitable and efficient, since occupants only pay for parking they need.

Parking can be unbundled in several ways:

- Facility managers can unbundle parking when renting building space.
- Developers can make some or all parking optional when selling buildings.
- In some cases it may be easier to offer a discount to renters who use fewer than average parking spaces, rather than charging an additional fee. For example, an office or apartment might rent for $1,000 per month with two "free" parking spaces, but renters who only use one space receive a $75 monthly discount.
- Parking costs can be itemized in lease agreements to help renters understand the parking costs they bear, and to help them negotiate reductions.
- Informal unbundling can be encouraged by helping to create a secondary market for available spaces. For example, office, apartment and condominium managers can maintain a list of residents who have excess parking spaces that are available for rent.

Parking Tax Reform

Parking tax reform includes various tax policies that support parking management, including *commercial parking taxes* (a special tax on parking rental transactions) and *per-space parking levies* (a special property tax applied to parking facilities). These can help reduce parking supply and increase parking prices, as well as providing revenues for public programs.

Bicycle Parking and Changing Facilities

Bicycle parking and changing facilities increase the convenience and security of bicycle transportation ("Bicycle Parking," VTPI 2005). In some situations, bicycle parking facilities can substitute for a portion of automobile parking, particularly if implemented as part of a comprehensive bicycle improvement and encouragement program. Optimal bicycle parking supply depends on the level of cycling that occurs in that community and the type of destination. Some destinations, such as schools, campuses and recreation centers have 10-20% of visitors arrive by bicycle, at least during fair weather.

Improve User Information and Marketing

User information refers to information for travelers about parking availability, regulations and price, and about travel options, such as walking, ridesharing and transit. Many parking problems result in part from inadequate user information. User information can be provided by signs, maps, brochures, websites, and electronic guidance systems. It is particularly useful if there is a perceived parking shortage, although space are actually available in an area.

Improve Enforcement and Control

Improve Enforcement and Control means that parking regulations and pricing requirements are enforced more frequently, more effectively and more considerately. Evading parking regulations is a folk crime. Many otherwise upstanding citizens who otherwise never steal will proudly ignore parking regulations and evade payments, reducing their effectiveness. Improving enforcement and control supports parking management by increasing regulatory and pricing effectiveness. As parking management activities expand, so too should enforcement activities.

Transportation Management Associations and Parking Brokerage

Transportation Management Associations (TMAs) are private, non-profit, member-controlled organizations that provide transportation and parking management services in a particular area, such as a commercial district, mall or medical center ("Transportation Management Associations," VTPI 2005). TMAs can be an effective way to implement parking management programs. TMAs are typically funded through dues paid by member businesses, and local government grants.

Overflow Parking Plans

Overflow parking plans describe the management strategies that will be applied when parking facilities fill, for example, during special events, peak shopping periods, or temporary reductions in parking supply. Because most parking facilities are sized to accommodate peak demands that seldom occur, an overflow parking plan can significantly reduce the amount of parking needed, and provide reassurance that reduced supply will not create problems.

Address Spillover Problems

Spillover parking problems refers to the undesirable use of offsite parking facilities, such as when business customers and employees park on nearby residential streets or use another

businesses' parking lot. Concerns about spillover impacts are used to justify excessive parking requirements and opposition to management solutions. Addressing spillover problems can increase parking management program acceptability and effectiveness. There are several ways to address spillover parking problems.

- Provide information indicating where motorists may and may not park.
- Use regulations to control spillover impacts, such as time limits and permit programs on residential streets near activity centers.
- Use pricing to control spillover impacts, such as charging non-residents for parking on residential streets near activity centers, and businesses charging non-customers for using in their parking facilities.
- Create *Parking Benefit Districts* in areas that experience parking spillover problems, so on-street parking is priced (residents can be exempt).
- Compensate people who bear spillover parking impacts. For example, a high school can send complementary sport event tickets to residents of nearby streets who experience spillover parking problems.
- Establish a monitoring program to identify where parking spillover is a problem. This may include surveys to identify who is parking where, and ways for residents and businesses to report spillover problems.

Improve Parking Facility Design and Operation

Parking facility design and operation refers to physical layout, construction and day-to-day management. Improved design and operation can better integrate parking facilities into communities, improve the quality of service experienced by users, support parking management, and help address specific problems.

Summary

The table below summarizes potential parking management strategies and their impacts.

Table 7 **Parking Management Strategies**

Strategy	Description	Typical Reduction	Traffic Reduction
Shared Parking	Parking spaces serve multiple users and destinations.	10-30%	
Parking Regulations	Regulations favor higher-value uses such as service vehicles, deliveries, customers, quick errands, and people with special needs.	10-30%	
More Accurate and Flexible Standards	Adjust parking standards to more accurately reflect demand in a particular situation.	10-30%	
Parking Maximums	Establish maximum parking standards.	10-30%	
Remote Parking	Provide off-site or urban fringe parking facilities.	10-30%	
Smart Growth	Encourage more compact, mixed, multi-modal development to allow more parking sharing and use of alternative modes.	10-30%	✓
Walking and Cycling Improvements	Improve walking and cycling conditions to expand the range of destinations serviced by a parking facility.	5-15%	✓
Increase Capacity of Existing Facilities	Increase parking supply by using otherwise wasted space, smaller stalls, car stackers and valet parking.	5-15%	
Mobility Management	Encourage more efficient travel patterns, including changes in mode, timing, destination and vehicle trip frequency.	10-30%	✓
Parking Pricing	Charge motorists directly and efficiently for using parking facilities.	10-30%	✓
Improve Pricing Methods	Use better charging techniques to make pricing more convenient and cost effective.	Varies	✓
Financial Incentives	Provide financial incentives to shift mode such as parking cash out.	10-30%	✓
Unbundle Parking	Rent or sell parking facilities separately from building space.	10-30%	✓
Parking Tax Reform	Change tax policies to support parking management objectives.	5-15%	✓
Bicycle Facilities	Provide bicycle storage and changing facilities.	5-15%	✓
Improve Information and Marketing	Provide convenient and accurate information on parking availability and price, using maps, signs, brochures and the Internet.	5-15%	✓
Improve Enforcement	Insure that regulation enforcement is efficient, considerate and fair.	Varies	
Transport Management Assoc.	Establish member-controlled organizations that provide transport and parking management services in a particular area.	Varies	✓
Overflow Parking Plans	Establish plans to manage occasional peak parking demands.	Varies	
Address Spillover Problems	Use management, enforcement and pricing to address spillover problems.	Varies	
Parking Facility Design and Operation	Improve parking facility design and operations to help solve problems and support parking management.	Varies	

This table summarizes the parking management strategies described in this report. It indicates the typical reduction in the amount of parking required at a destination, and whether a strategy helps reduce vehicle traffic, and so also provides congestion, accident and pollution reduction benefits.

Not every strategy is appropriate in every situation. Actual impacts vary depending on geographic and demographic factors, how a strategy is implemented and other factors. Below are some general guidelines.

- Impacts are higher where there are more parking and travel options. For example, parking pricing will have greater demand reduction impacts if implemented in conjunction with improvements in rideshare and public transit services.
- Financial incentives tend to have greater impacts on lower-income consumers.
- Some strategies are complementary. For example, shared parking becomes more effective if implemented with suitable regulations, pricing and walkability improvements.
- Impacts generally increase over time as programs mature. A Low value may be appropriate the first year, but increases to Medium after two or three years, and High after five or ten years.

Special care is needed when predicting the impacts of a program that includes multiple parking management strategies. Be careful to take into account strategies with overlapping impacts. For example, Transportation Management Associations (TMAs) provide an institutional framework for implementing strategies that directly affect parking requirements. While it would be true to say that a TMA can reduce parking requirements by 10-30% compared with not having such an organization, it would be incorrect to add the demand reductions of the TMA to the impacts of the individual strategies it helps implement.

Total impacts are multiplicative not additive. Shared parking reduces the parking requirements by 10%, to 90% of the original level. The 10% reduction of Parking Pricing reduces this further to 81% of the original level, and another 10% reduction from Mobility Management results in 73% of the original level, a 27% reduction, somewhat less than the 30% reduction that would be calculated by adding three 10% reductions.

Some combinations of strategies have synergistic effects (total impacts are greater than the sum of their individual impacts), and so become more effective if implemented together. For example, sharing parking and walkability improvements may each reduce parking requirements just 10% if implemented alone, but 25% if implemented together because they are complementary.

Developing An Integrated Parking Plan

Below are recommendations for integrated parking planning. This should be adjusted to reflect the needs of a particular situation.

Define Scope

Define the geographic scope of analysis, such as the site, street, district/neighborhood and regional scale. It is desirable to plan for a walkable area, such as a business district or neighborhood, since this is the functional scale of parking activities.

Define Problems

Carefully define parking problems. For example, if people complain of inadequate parking it is important to determine where, when and to whom this occurs, and for what types of trips (deliveries, commuting, shoppers, tourists, etc.).

Strategic Planning Context

Parking planning should be coordinated with a community's overall strategic vision. This helps insure that individual decisions reflect broader community objectives.

Establish Evaluation Framework

Develop a comprehensive *evaluation framework*. This provides the basic structure for analyzing options, insuring that critical impacts are not overlooked and different situations are evaluated consistently. A framework identifies:

- *Perspective and scope*, the geographic range and time-scale of impacts to consider.
- *Goals* (desired outcomes to be achieved) and *objectives* (ways to achieve goals).
- *Evaluation criteria*, including costs, benefits and equity impacts to be considered.
- *Evaluation method*, how impacts are to be evaluated, such as benefit/cost analysis.
- *Performance indicators*, practical ways to measure progress toward objectives.
- *Base Case* definition, that is, what would happen without the policy or program.
- *How results are presented*, so results of different evaluations can be compared.

Survey Conditions

Survey parking supply (the number of parking spaces available in an area) and demand (the number of parking spaces occupied during peak periods) in the study area.

Identify and Evaluate Options

Develop a list of potential solutions using ideas from this report and stakeholder ideas. Evaluate each option with respect to evaluation criteria.

Develop an Implementation Plan

Once the components of a parking management plan are selected, the next step is to develop an implementation plan. This may include various phases and contingency-based options. For example, some strategies will be implemented the first year, others within three years, and a third set will only be implemented if necessary, based on performance indicators such as excessive parking congestion or spillover problems.

Conclusions

Current parking planning practices are inefficient, resulting in economically excessive parking supply, increased automobile traffic, and more dispersed destinations, contributing to various economic, social and environmental problems. There are many reasons to use management strategies that result in more efficient use of parking resources, in order to address parking problems without expanding supply.

Parking facilities that serve multiple destinations and are efficiently regulated or priced to favor higher value users (for example, delivery vehicles and customers over commuters and residents) tend to be efficiently used. On-street metered parking and commercial parking are particularly suitable for this type of management, and so should be favored over unpriced, off-street parking that serves a single destination.

This report describes more than two-dozen management strategies that result in more efficient use of parking resources. These strategies are technically feasible, cost effective, and can provide many benefits to users and communities. Although all of these strategies have been implemented successfully in some situations, they are not being implemented as much as economically justified, due to various institutional barriers. Parking management implementation requires changing the way we think about parking problems and expanding the range of options and impacts considered during planning.

Most parking management strategies have modest individual impacts, typically reducing parking requirements by 5-15%, but their impacts are cumulative and synergistic. A comprehensive parking management program that includes an appropriate combination of cost-effective strategies can usually reduce the amount of parking required at a destination by 20-40%, while providing additional social and economic benefits.

Management solutions represent a change from current practices and so various obstacles must be overcome for parking management to be implemented as much as optimal. Current planning practices are based on the assumption that parking should be abundant and provided free, with costs borne indirectly, incorporated into building construction costs or subsidized by governments. Current parking standards tend to be applied inflexibly, with little consideration of demographic, geographic and management practices that may affect parking requirements. Parking management requires changing current development, zoning and design practices. This requires that public officials, planners and the public change the way they think about parking problems and solutions, and become familiar with the full menu of parking management strategies available and the benefits they can provide. It requires an institutions and relationships, such as transportation management associations, and activities to improve enforcement and addressing potential spillover impacts.

This report summarizes the book *Parking Management Best Practices*, by Todd Litman, published by Planners Press in 2006. If you find this report useful, please purchase the book, which contains more detailed information.

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