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Dynamics of urban transformation and opportunities for efficiency and sustainability in the mobility system of Latin American cities

Dinámica de la transformación urbana y oportunidades de eficiencia y sostenibilidad en el sistema de movilidad en las ciudades de América Latina

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- Parking resources and services are essential regulating traffic flow in the general mobility system.
- Parking represents the storage capacity that allows the management over time of the resource "space" and its selective availability.
- Mechanical parking technologies, are today a tool capable of multiplying the performance of urban space and reducing the consumption of energy, materials and environmental impact.

Parking resources and services are essential to the regulation of traffic flow in the general mobility system. A policy oriented to creation of parking spaces tailored to the dynamics of growth and change in the city addresses the huge opportunity to add a well-conceived and managed parking system to other intense actions of urban regeneration for development and prosperity, such as the improvement of public transport infrastructures and the rehabilitation of public space in dense and consolidated urban areas. Parking is a fundamental subsystem of the general mobility system. It represents the storage capacity that allows the management over time of the resource of "space" and its availability. This management capability is strictly contextual, and therefore an adequate parking policy must comply with specific requirements related to all the conditions of the space that parking occupies and the of time it occupies that space, taking into account the different types of parking and that each one has different conditions of operation, regulation and operation. Mechanical parking technologies, in which the integration of information systems can achieve full network connectivity of managers, operators, users, at all scales, are today simpler, more flexible, lighter, versatile and more manageable systems, than they have been throughout his long history of use. The incorporation of Information and Communication Technologies, ICTs, has multiplied the versatility and, exponentially, the interactivity of the systems, which have become a tool capable of multiplying the performance of urban space and reducing in the same proportion the consumption of energy, materials and environmental impact, valuable resources that modern cities need to invest in actions for social progress.

Parking; Efficiency; Mechanical; ICT; Management; Sustainability

- Los recursos y servicios de estacionamiento son esenciales para regular el flujo de tráfico en el sistema general de movilidad.
- El estacionamiento representa la capacidad de almacenamiento que permite la gestión en el tiempo del recurso "espacio" y su disponibilidad selectiva.
- Las tecnologías mecánicas de estacionamiento son hoy una herramienta capaz de multiplicar el rendimiento del espacio urbano y reducir el consumo de energía, materiales y el impacto ambiental.

El recurso de estacionamiento es esencial para la regulación del flujo del tráfico en el sistema general de movilidad. Una política de creación de aparcamientos adecuada a la dinámica de crecimiento y cambio de la ciudad responde a la enorme oportunidad de sumar un parque bien concebido y gestionado de estacionamientos a otras acciones intensas de regeneración urbana para el desarrollo y la prosperidad, como la mejora de las infraestructuras de transporte público y la rehabilitación del espacio público de áreas urbanas densas y consolidadas. El de estacionamiento es un subsistema fundamental del sistema general de movilidad. Representa la capacidad de almacenamiento que permite la gestión en el tiempo del recurso espacio y su dosificación y puesta a disposición. Esa capacidad de gestión es estrictamente contextual, y por lo tanto, una política adecuada de estacionamiento debe cumplir con requisitos específicos relativos a todas las condiciones del espacio que ocupa y del momento, teniendo en cuenta los diferentes tipos de estacionamiento y que cada uno tiene condiciones distintas de operación, regulación y funcionamiento. Las tecnologías mecánicas de estacionamiento, en las que se puede resolver la integración de sistemas de información para la conectividad en red de gestores, operadores, usuarios, a todas las escalas, son hoy sistemas más simples, flexibles, ligeros, versátiles y manejables de lo que lo han sido a lo largo de su larga trayectoria. La incorporación de las Tecnologías de Información y Comunicaciones, TICs, ha multiplicado la versatilidad y exponencialmente la interactividad de los sistemas, que son hoy una herramienta capaz de multiplicar el rendimiento del espacio urbano y de reducir en la misma proporción el impacto y consumo de recursos energéticos, materiales y medioambientales que las ciudades modernas necesitan invertir en acciones para el progreso social.

Aparcamiento; Eficiencia; Mecánico; TIC; Gestión; Sostenibilidad

1. INTRODUCTION

1.1. MODELS OF EFFICIENT MOBILITY MANAGEMENT THROUGH PARKING SYSTEMS BASED UPON NEW SMART CONCEPTS AND MECHANICAL TECHNOLOGIES

Cities in Latin America are experiencing the unleashing of powerful dynamics of change, exceptional opportunities to decisively address the solution to structural problems resulting from simultaneous economic progress and territory imbalance; facing the challenge of applying optimally resources like experience, innovation and technology to create new models of balance, sustainability and quality of urban space.

Latin American cities are witnessing of a powerful and sustained continental economic development, which cannot be detached from the imperative to begin to solve the serious problems of imbalance and territorial injustice that deconstructs Latin American societies and fosters a flow of instability and precariousness that threatens the main republics of the Subcontinent.

In this context and as the result of two factors that we might think opposed, the economic and social development, associated with growth and territorial imbalance, Latin American cities are experiencing a dynamic of powerful growth that manifests itself in several fronts:

- The recovery of abandoned city areas, old city centers, slum neighborhoods and abandoned infrastructure, entrenched in the urban fabric.
- The implosion of development, densification of the urban consolidated fabric where the new structures grow on existing tissues exponentially multiplying its use density.
- The explosion, which means the multiplication of areas of growth on the axes of transportation and economic development of peri-urban territory.
- The unsystematic aggregation, spontaneous and uncontrolled settlement in the metropolitan context of displaced population, as they seek in the city for the basic resources that lack in the territory. A tissue that, with the only organic logic of survival, roots on occupied urban ecosystems, informally consolidating a new city exposed to risk.

Some, all or local variants of these phenomena have been studied in such diverse cities as Quito, Lima, Tegucigalpa, Sao Paulo, Cartagena de Indias, Bogota, Rio de Janeiro and Panama City; and in all cases the growth does squeak old structures, calls into question traditional ways of management and is a demanding challenge to the ability to self-organization of the city.

Panama City is a synthesis of the shortcomings, problems and opportunities emerging with the dynamics of urban transformation. The Recovery and rehabilitation of the Casco Viejo, the exponential densification of residential and tertiary tissues on Avenida Balboa, the development of a new center linked to new public transport infrastructure in the Plaza of 5 de Mayo, eradication of slums in the area of Curundú, transforming industrial areas in the Northern Corridor, and the new tertiary and residential development of Costa del Este (Fig. 1) are clear examples of this fact.


Casco Viejo


Casco Viejo. Avda. Balboa


Plaza May 5


Curundú


North corredor


Costa East

Figure 1: City of Panamá. Repertoire of contexts and situations of urban growth and development. Source: Sustainable And Advanced Systems. SAS.

1.2. POPULATION AND URBAN MOBILITY

Latin America has experienced strong population growth in recent decades, associated with this process of intense and uncontrolled urbanization. Between 1995 and 2016, the total population of the region increased from 472 million to 625 million people. This population growth influences the level of quality of life in cities where there is strong pressure for supply of public services that cannot be covered by current economical and management models [1].

The condition of the process to define mobility systems is straightforward. The form of occupation of large urban areas, coupled with the location of jobs and public services, generates a chaotic pattern of movement of people and goods.

These patterns and mechanisms present serious problems for

vulnerable street and public space users such as pedestrians and for most people in need of public transport (supply deficiencies, poor service and high prices).

On the other hand, the incorporation of more and more citizens to groups with higher incomes and growing use of cars contributes to urban sprawl and to the intensive use of limited road system, exacerbated by the transport vehicles need to adequately serve the collective.

This pattern of mobility generates increasingly important dysfunctions. Already, these problems are very serious, and in the future the situation could worsen. It is estimated that by the end of 2010 the urban population of Latin America was 441 million and it is estimated that this population will increase to 680 million by 2025 and 779 million in 2050 [2].

When considering only the increase between 2010 and 2025, 90 million additional urban dwellers made about 400 million daily trips, whether on foot, by bicycle, by public transport, by car or by motorcycle.

In parallel, in recent years, most Latin American countries have been growing and developing their vehicle fleets, largely due to rising per capita income, which enables citizens to acquire a private car.

Consequently, what for many people is a symbol of social status, convenience, comfort and class, generates many negative impacts such as increased consumption of fossil fuels, higher levels of air pollution, road congestion and accidents, as well as more infrastructure designed for cars and not for other modes of transport friendlier to people and the environment.

The ratio of vehicles per capita reached on average for Latin America is shown in Figure 2. The mean value of 169 vehicles per 1,000 inhabitants in 2007, represents a significant increase of almost 50% over 113 vehicles in 2002. Levels much higher than observed in the euro area (2.6%), North America (2.9%) or Asia and Pacific (20%) in the last 5 years.

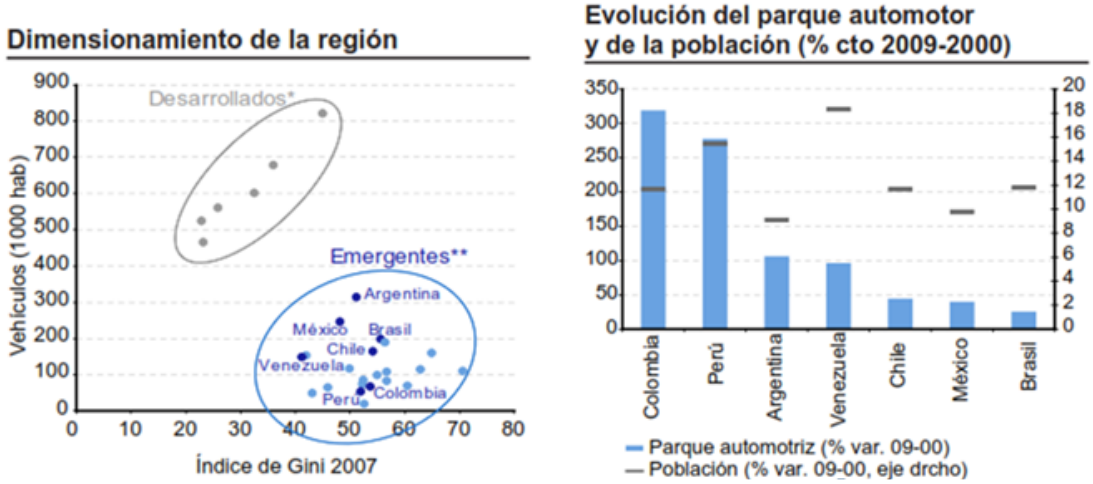

Figure 2: The ratio of vehicles per capita reached on average for Latin America. BBVA Research.

The region has a population of 400 million. Gross Domestic Product per capita average has gone from USD 3,160 per year in 1980 to USD 7,786 per year in 2009 and the International Monetary Fund forecasts reaching USD 10,770 annually in 2015, a likely springboard for strong growth of the automotive market, especially considering that the construction and operation of new railway lines and urban mass transit systems, Metro, bus, etc. is being achieved in parallel with this growth and has not yet been able to contain or moderate it [3].

Following these trends in the region, we will soon be coming to the stage where it is virtually impossible to mobilize within cities. For this reason, rather than prohibiting the use of private cars, the trend is seek measures which regulate and rationalize their use, using specific instruments of mobility management, including parking lots, to generate positive changes mitigating these negative trends.

We are intensifying the density of use of the network of streets and public and private open spaces of cities that are morphologically designed for a lower density of use and much less activity. In parallel, we are introducing ways and means of motorized use quantitative and qualitatively superior to those that we have been using for decades. This automatically generates the need to implement tools for identification, regulation and control of an increasing flow of traffic and urban mobility.

With the need to react and resolve the needs generated by this process of rapid development, many cities have undertaken the design and rapid implementation of comprehensive plans of action on all general systems of private mobility and networks and public transport systems. To this approach, whose execution is underway in many countries and cities, belong measures such as road realignment, expansion of the main structural roads for traffic, the resolution of conflict points in the network of urban roads, new systems of Metro Bus, restructuring public bus systems and building new Metro networks.

Parking resources are essential and indispensable to the process of regulating traffic flow in the overall mobility system. Developing a policy to create parking facilities

suitable to the dynamics of growth and change in the city is not only seen as a necessity factor, but also as a response to the huge opportunity to add a well-designed and well managed parking estate to other basic actions for an intense urban regeneration and the development and prosperity of cities - programs already in progress and that will be operational in the coming years, such as improving public transport infrastructure and rehabilitation of public space in dense and consolidated urban areas.

Furthermore, this dynamic change of the city offers many Latin American cities the possibility of recovering, complementing planned public space for the network of parking, open spaces and vacant lots dispersed within the urban fabric and transforming them into the physical support for a distributed and flexible network of urban parking.

Coordinated and concerted action between public administrators and land owners or investors in public infrastructure can easily create models of implementation and operation of parking lots that meet both the needs of the city to serve the common interest and private aspirations to obtain, through business and management skills, the performance that makes viable the parking allocations required to rebalance mobility systems.

The urban structure of Panama City offers plenty of opportunities in areas in transition, vacancies, for public and private development of this integrated parking network (Fig. 3). The implementation of urban public transport systems creates new dynamics of traffic, radial and cross-linked to the use of transport lines, buses, Metro.

In this context, it is essential to solve the problem of 'last mile mobility' by facilitating intermodal exchange from private vehicles to public transport. 'Park 'n Ride' parking offers an excellent solution for a city's strategic hubs, crucial to both the transport network and the parking estate, often linked to provision of complementary services for their users.

Massive Transportation System Panama City

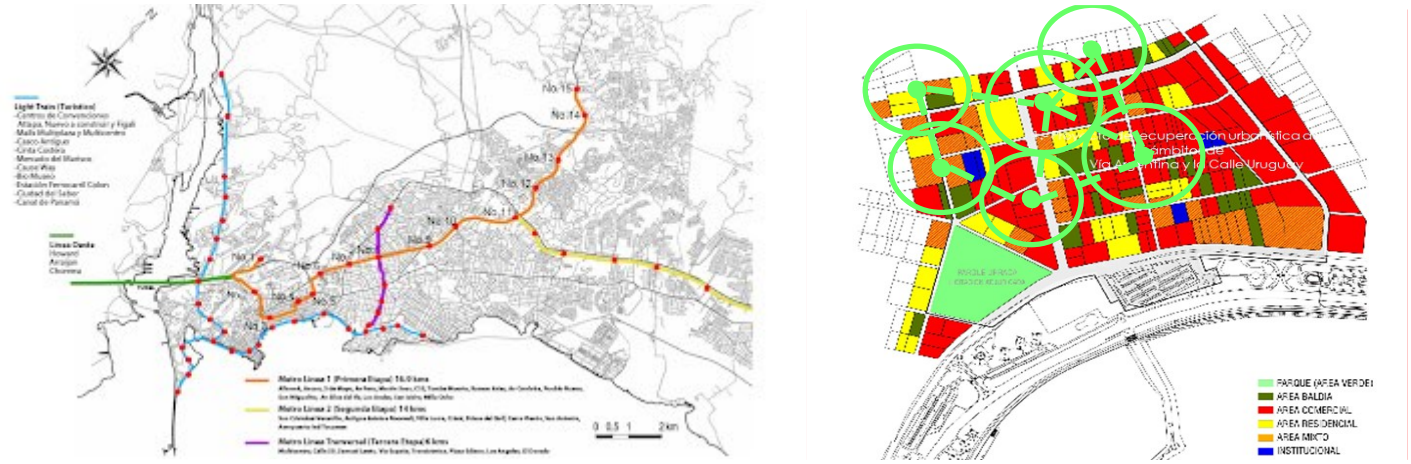

Figure 3: An integrated network service parking strategies mobility and transport. Source: Sustainable Advanced Systems. SAS.

1.3. DEMAND MANAGEMENT AND SUSTAINABLE URBAN TRANSPORT POLICY

It is important to get into detail about how to act to reduce the congestion generated by motorized transport, the lack of adequate urban planning and public transport policies that are only developed when congestion already exists.

Mobility management [4] is a relatively new field for cities and their rulers, most skilled in coverage and growth policies but not in improving service capacity of existing resources through management.

The main objective in demand management in mobility systems is trying to solve the growing problems of congestion associated with it, but not through a wider offer of road infrastructure, but through the efficient management of travel, travel modes and the vehicle management space available in the city.

Mobility management is an essential tool for developing countries. A tool where economic resources should be applied efficiently where a vast majority of its inhabitants move in non -motorized modes of transport, with public transport or walking.

This is the set of strategies aimed at changing travel behavior of people (how, when and where people travel) in order to increase the efficiency of transport systems and achieve specific public policy objectives towards sustainable development.

Management strategies of mobility prioritize the movement of people and goods over vehicles, i.e., to efficient modes of transport, such as walking, biking , public transportation, remote work from home, carpool, etc. and must therefore contemplate a repertoire of specific parking solutions oriented to multimodality, enhanced flow, release of public space, interactivity with users and self-regulatory capacity, for the balance and efficiency of mobility systems.

1.4. PARKING AND CONGESTION REDUCTION

The current situation in the region is an opportunity to prevent the problem from escalating further and congestion reaching

unsustainable levels, where finding solutions would become something really complicated. By incorporating policies and instruments of demand management is how solutions to the actual situation in the region can best be provided, and although many of these policies and instruments are not quite "popular" among citizens and / or politicians, they respond to current trends and solutions in the short and medium term [5].

In Latin America there have been initiatives to implement some kind of demand management tools, but in many cases they have not been effective because the tool is not appropriate or its implementation was not well planned and / or executed, considering that although the spectrum of needs may be similar, opportunities for resolving them are related with the multitude of features that characterize and enrich the local system in each region, each city and its inhabitants. Solutions are thus neither widespread nor exportable without further refinement, although the tools and methodology are.

For a tool or policy of demand management to be effective, it is as important that it have positive incentives, benefits and services, as negative incentives, restrictive regulations and discipline. In the synthesis of prescription and provision in the reconciliation of individual and collective interests, lies the balance and efficiency of the system mobility.

If prescription measures alone are introduced, for example to promote non-motorized transport modes without acting prescriptively on car use, the desired effect will not be achieved. The same applies to the isolated introduction of a measure of prescription; itself alone will not have the desired effect.

So it is essential to integrate both kind of measures, those that provide services such as those involving restriction, although the first principle of the natural logic of mobility systems indicates that there is an order of priority and that benefits must precede limitations imposed on citizens.

The first challenge to be addressed by the mobility manager is to improve the services and benefits of recovery and efficient use of wasted existing resources for mobility. The second principle tells us that the resources and benefits generated by improving mobility have to revert on the mobility system itself. Improving public space, quality of movement, quality of life, should result in a positive cycle of continuous improvement of the mobility system performance based in a stabilized framework of restrictions and requirements.

2. PARKING POLICIES

Parking is a major subsystem of the overall mobility system. It represents the storage capacity that allows space resource management through time, its metering and availability. This management capability is strictly contextual, and therefore adequate parking policy must meet specific requirements for all the conditions of the space it occupies and for the time it takes, taking into account the different types of parking and that each one has different operating conditions, different regulation and thus, different operation.

It is important to achieve adequate management in terms of the number and capacity of parking spaces in the city both off-street and on street, implementing a strategy oriented to rationalize the use of public space and the movement of private vehicles in urban areas.

The more indiscriminate parking spaces are in a city and the more affordable they are, the more attractive car use will become, and this is not that what is intended. Complementing such a quantitative policy for parking facilities, a qualitative parking policy should be imposed; aimed at solving multimodality and coverage of demand, interacting with collective transport systems ensures all the richness of applications and coverage for the complexity of the contemporary city [6].

It should be clarified that in addition to the types described below, it should be always kept in mind that there are different temporary uses of parking (short, long life, night, residential) in relation to the nature of the demand for parking by day of the week and time and different roles for parking within the overall mobility system (deterrence, rotation, mixed-use, residents, offices, events, business, logistics, loading and unloading, etc.).

All these possibilities space, temporal and functional determine a matrix of variables which are typological and multiple variants and applied to each location and urban context generate a rich variety of customized solutions.

The first factor to address in improving the performance of existing parking resources through management is optimizing its space efficiency, versatility and access to location and these factors depend on their position in the city and spatial typology. We find the following parking modes (Fig.4) [7]:

- On street or off street: depending on location on public street space or outside it (in separate premises). The parking on street often takes away pedestrian space, and is the first resource to be managed for the recovery of urban space.
- Street metered: this is any kind of parking subject to a fee, whether imposed by regulation or informally. Charging parking space on public streets is a highly effective injunctive measure in conjunction with a qualified policy off street, outside public parking space.
- Free Street: parking on street without charge.
- Informally charged on street: parking mode that has a provision of service and / or informal collection (by a person who has "appropriated" space and monitoring of vehicles parked there).
- On street, informal service, regulated fee: This is a kind of informal service, with a defined mechanism to standardize the parking fee.

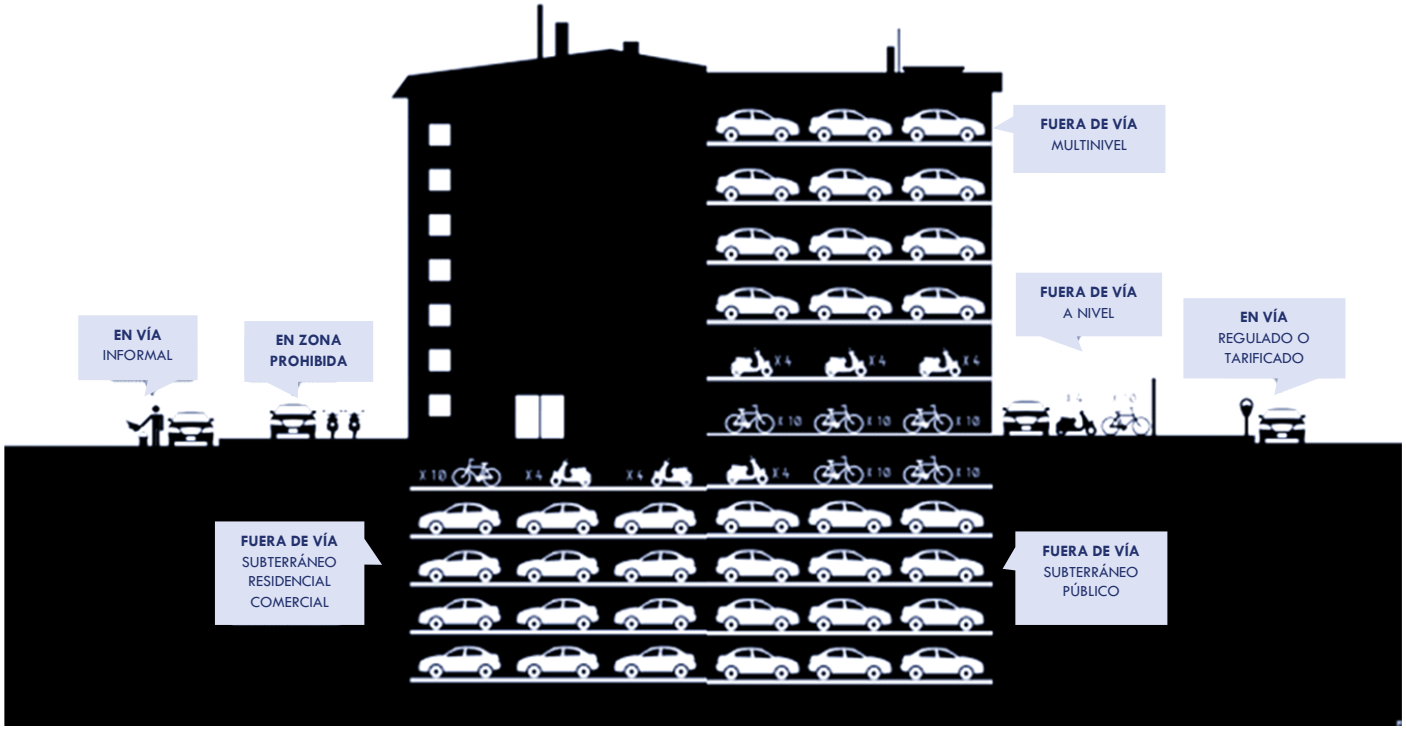

Figure 4: Types of parking by their location in the urban context and key issues to keep in mind when formulating a policy for Mobility Management that integrates the parking subsystem.

- Off street: refers to a parking facility outside the public space, roads o streets. It must comply with some kind of regulation. This type of parking can be operated by public and / or private managers.
- Outside street and linked specialized use: a parking type that is associated primarily with land use, such as residential or commercial type (e.g., a mall or an office building).

As development, densification of use and the complexity of the city progress, the space available for parking resources increases in value and decreases in availability. The need to implement a performance improvement over existing resources requires effective management tools and the implantation of technique and technology to multiply the use capacity and operation effectiveness of parking facilities.

Traditional systems design, engineering, construction and operation of urban parking lots have peaked in this endeavor, as has happened in all areas of exploitation of primary resources, energy, water, information, where paradigms have turned from models focused on generation, production and consumption to models oriented to recovery, added value and resource management.

This new paradigm, which as we said, is not other than that of sustainable management, is based on the dawn of the 21st Century in new tools that allow the possibilities of systemic operation to be fully developed.

3. TOOLS, TECHNIQUE AND TECHNOLOGY FOR EFFICIENCY IN OCCUPATION AND PARKING SPACE MANAGEMENT. MECHANICAL PARKING SYSTEMS

Connectivity and embedded capability of integration into urban smart grids resource management are two basic requirements that today must be incorporated in any resource management tool in the City.

New mobility and transport infrastructures being implemented in Latin American cities are facilitated by new, strictly contemporary, resources of connectivity that give the city a huge potential of efficiency through management [8].

In the field Parking of Technologies there are more than 100 years of trajectory applied to optimizing the use of space and the compaction of vehicle storage in urban parking facilities.

Technologies that emerged as mechanical stacking systems and mechanical vehicle movement in the context of the dynamic transformation of American cities from the early to mid-twentieth Century and thereafter spread worldwide accompanying the requirements of urban contextual development, urban transformation and densification.

From its origins in the early twentieth Century, mechanical parking technology has been an instrument of efficient management of parking space in contexts of change that have involved high efficiency requirements (Fig. 5).

Mechanical technologies of parking, which can solve integration, an essential frame for the tools of effective management intended, systems embedded information for network connectivity managers, for operators, for users, at all levels. These tools are today simple, flexible, lightweight, versatile and more manageable and affordable than they had never been.

The incorporation of Information Technology and

Communications, ICT is a fact that has increased the versatility and exponentially interactivity of these systems, which are now a tool capable of multiplying, in the terms we have explained, the performance of urban space and reduce in proportion the impact and consumption of energy resources, space, material and environmental resources that nowadays modern cities need to invest in social progress.

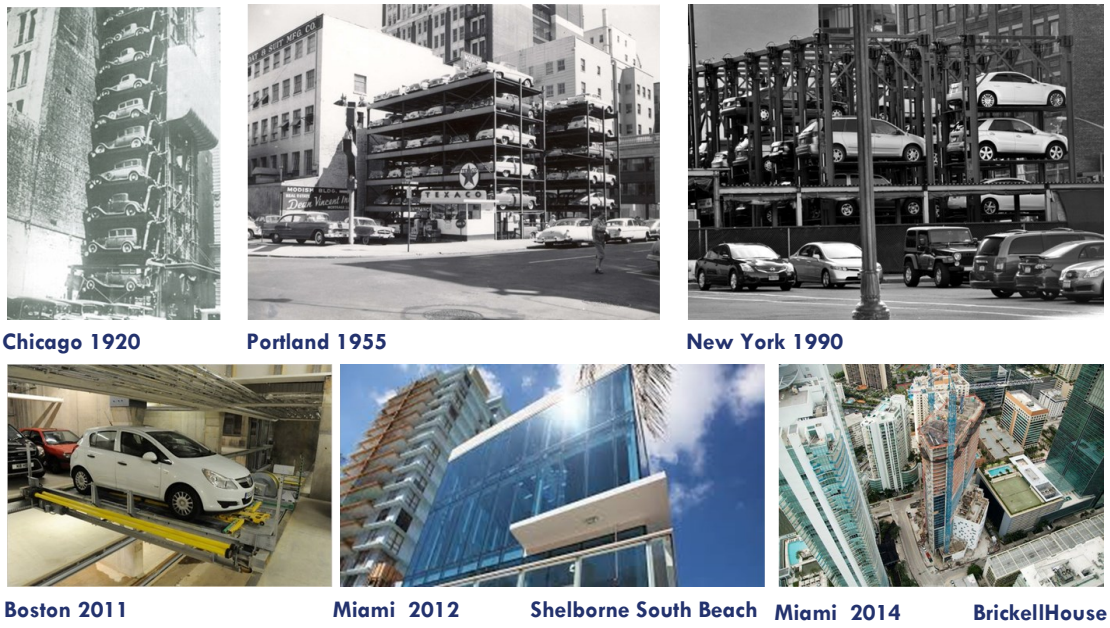

Figure 5: Mechanical parking technology as an instrument of efficient management of parking space. Source: Sustainable Advanced Systems. SAS.

These mechanical technologies with more than 100 years of experience, now integrating information management and control interaction as a powerful tool for efficiency (Fig.6).

In Latin America the possibilities to multiplying the efficiency of the overall system by applying new technologies for mobility are even wider because it is a context that requires a huge and rich variety of solutions, on a plug-in, on-line, turn-key, just on time basis.

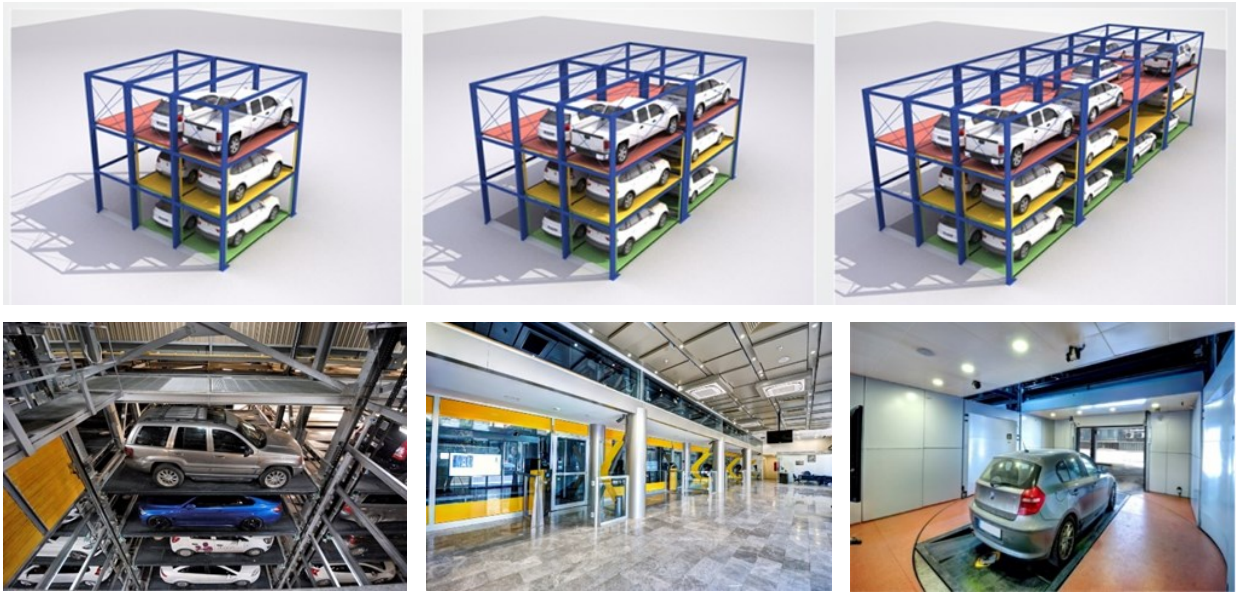

Figure 6: Mechanical parking systems, management tools for space resources, dedicated to the flow and storage of vehicles. Source: Sustainable Advanced Systems. SAS.

3.1. INCREASED EFFICIENCY BY COMPACTION

The instrument of effectiveness underlying mechanical parking systems is compaction. The ability of geometric integration in all three dimensions of space, with progressively simpler mechanisms for movement and deeper integration of information management capacities, allows to compact vehicles in the useful space, exponentially reducing surface and volume required to store each vehicle, and would reduce very significantly the proportional load space dedicated to vehicle access and circulation, thus ensuring ease of use and speed of operation with embedded systems for information

management and interaction with managers, users, operators and maintainers.

The operational possibilities of the American market also include new models of ultra efficient management by incorporating man operation (Wallet parking. A human added factor which, for example, is not accessible in most European contexts) that can result in new models of implantation of ultracompact public parking, in consolidated urban areas, others like logistics truck parking and bus storage in central areas, multimodal transport exchange, that get integrated into the city in its growth and expansion process.

These ultracompact models of semi-automatic mechanical parking for cars and trucks (Fig.7) are based on simple mechanical modules for vehicle movement and transfer and data management; parking systems are modularly developed, multiplying by two, three or four the performance space for storage, and reducing the impact and costs of construction, operation and maintenance proportionally.

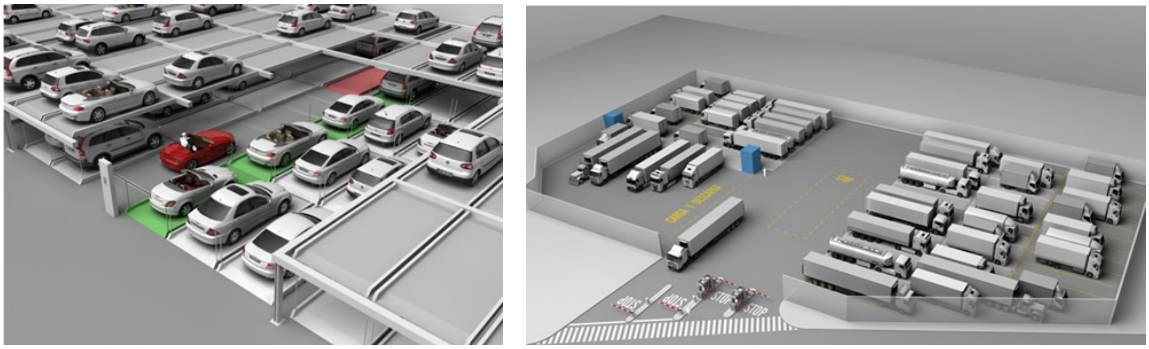

Figure 7: Ultracompact models of semi-automatic mechanical parking for cars and trucks. Source: Sustainable Advanced Systems. SAS.

The solution to these needs is beyond the scope of traditional parking design and technology and its operating procedures. Man machine interaction, that can be incorporated in these systems provides a significant capacity to adapt to dynamic demand changes, to efficiency in the application of resources and a cybernetic conception involves mechanical systems equipped with technology for management and control means for it to be governed by man. Regarding an automatic machine, the incorporation of man's capacity to system management results in multiplying its performance through the interaction between artificial and human intelligence.

3.2. INCREASED EFFICIENCY BY PROXIMITY, FLEXIBILITY AND SCALABILITY

The ability to give the best service in the right measure of demand, and adaptively, grows over time. The possibility of fragmenting parking space in units with more capacity and reduced volume, which can grow on a modular logic. Versatility in the implementation favors an important factor of efficiency, which is the proximity of parking to users, and the ability to reconcile the micro scales of each unit with the macro scale through information technology and integrated management. These are qualities of mechanical systems that manifest themselves with more intensity the more intense are the requirements and intense is the use of buildings and the requirements of the users they serve.

Any context with high intensity of use is an environment opportunity for the recovery of wasted resources. It is exactly what happens in malls and hospitals with space dedicated to parking, when we optimize and release space for the main uses, and simultaneously multiply flexibility and capacity of parking facilities with simple mechanical technologies.

Figure 8 shows the Optimization of parking at the Hospital of the city of Colon, Panama. Areas shaded red are the traditional parking facilities for employee parking, doctors, nurses, suppliers and the public.

Figure 8: Optimization of parking at the Hospital of the city of Colon, Panama. Source: Sustainable Advanced Systems. SAS.

The building structure and organization is arranged in a set of independent and specialized blocks with individual access, articulated by internal connection to a central public space and a perimeter road around the whole building.

Modules of the mechanical parking proposal are tailored precisely to the multiplicity of users, and takes advantage of existing building access infrastructure and circulation roads, they are implanted close to each of the entrances to the various wings of the building, and reduce the occupation surface to the extent that not only recuperates almost all of the space occupied by the conventional parking, but allows parking increase of capacity as new needs arise, up to, at least, double the current capacity.

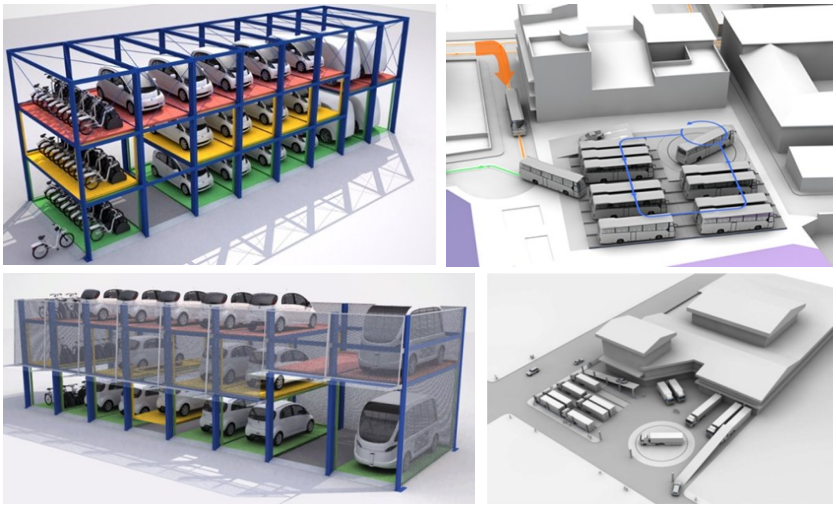

Figure 9: Multimodal parking solutions in the Old Quarter of Panama City. Source: Sustainable Advanced Systems, SAS.

3.3. MULTIMODALITY

In the contemporary city multimodality is a powerful factor of efficiency. All scales and modes of individual and collective transport are linked in the overall mobility system, and the different cases of transfer of transport resources and individual mobility linked to different types of use, urban context or coordinating role in transportation networks are also very wide and varied [9].

Multimodality in parking materializes in the integration of space and information of the different modes of transport as a multiplier resource of the adaptability of management systems to the environment and users.

In Latin America multimode variants of mechanical parking multiply to give comprehensive development, urban, and economic solutions in the areas of expansion and to address effectively the diverse needs of large areas of consolidated city, where traditional solutions could not solve or weave in space and connectivity necessary for efficient management.

Figure 9 shows how multimodality is a feature adaptation of wealth and mobility efficiency in the contemporary city, which also requires them to resolve problems affecting inherently urban economic activities, with structural problems linked to the transport of people and goods.

In the two upper images a three level semiautomated Multimodal Exchange Energy and Information Parking System, for Urban Electric Bikes, Electric Car Sharing and Driverless Shuttles. In the two lower images mechanical parking for trucks in a logistic platform in the city of Panama and a parking unit for tourist buses with five levels above stacking of automobiles for public parking in the Old Quarter of Panama City.

4. ADAPTATION TO CONTEXT

Many efficiency opportunities in urban parking performance are directly related to context. The morphology of spaces and buildings, the intensity of use of parking, interaction or the potential for interaction with other uses is subject in each urban context model to a particular implementation as a result of the versatility and flexibility of the repertoire of open solutions mechanical parking systems. As has been said, at the beginning of this article, the variety and diversity of urban contexts is a characteristic feature of the contemporary Latin American city, as well as the dynamic transformation of densities and uses that we have also described.

Some of the many contextual and conceptual developments developed in different Latin American projects are shown below. In all cases compaction, efficient use of space and optimization of management have determined the improved cost effectiveness and profitability of operation, resulting in overall viability.

Figure 10 shows how rehabilitation of homogeneous, central and consolidated areas, such as the old city of Panama City, activated by connection to new public transport infrastructure has an important social and economic component that requires that residents and working residents of connected urban areas have access to parking reserves in a context of regulated and restricted mobility.

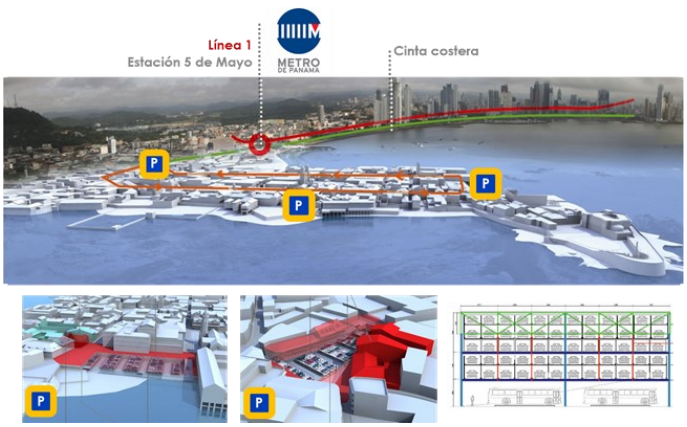

Figure 10: Connection to new public transport infrastructure at the old city of Panama Cityt. Source: Sustainable Advanced Systems. SAS.

The network of parking for residents must integrate resources to manage supply logistics and public transport, both fundamental vectors of mobility for tourism development.

Figure 11 shows how the extensive development of building in height is a feature common to many Latin American cities and a very important determinant of increased density of use and loads of traffic.

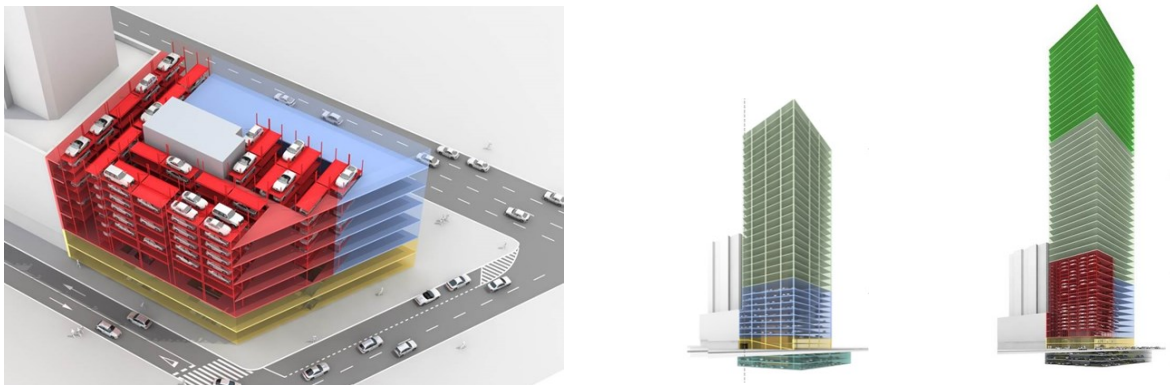

Figure 11: Extensive development of building in height is a feature common to many Latin American. Source: Sustainable Advanced Systems. SAS.

In terms of their structural, architectonical, and urban typology, these buildings address their parking requirements by devoting their lower floors, perhaps up to 10 of them, to this purpose. The resulting view from the street becomes that of a continuous vertical garage.

As an alternative to the development of this kind of urban parking, mechanical systems allow the concentration of parking facilities in back areas of the buildings, even multiplying their capacity and releasing for commercial, service, residential wide floor areas in the main facades, where buildings meet the street and the public space.

Square de 5 de Mayo is a strategic hub of the central area of Panama City (Fig. 12). It is the headspace of Central Avenue, traditional, commercial and populous axis that is the backbone of the entire center and Casco Viejo.

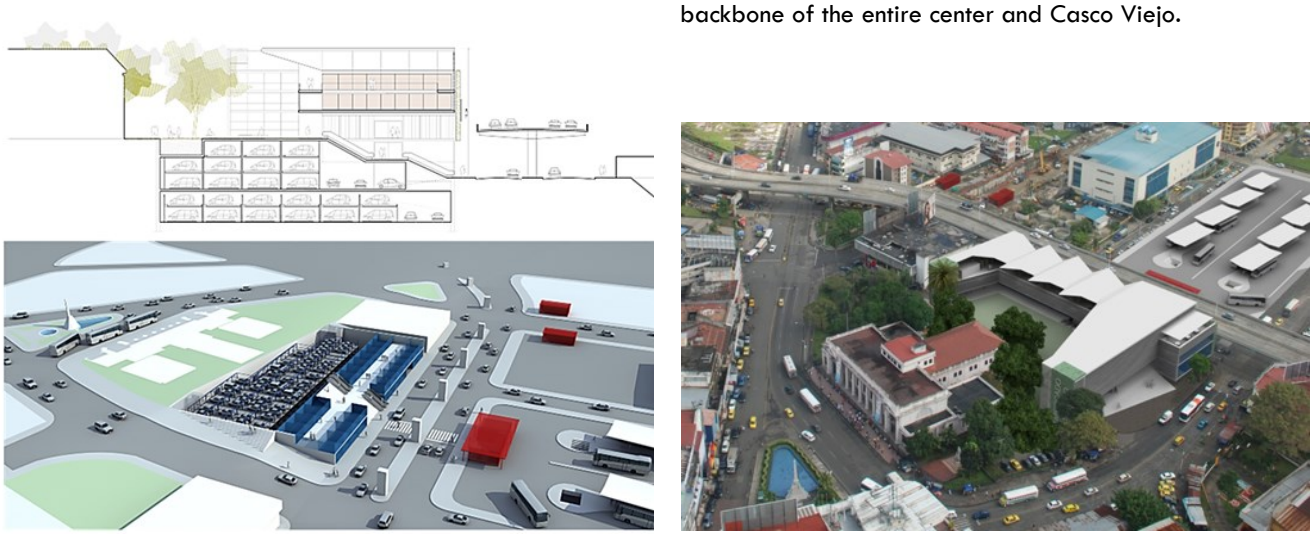

Figure 12: Square de 5 de Mayo is a strategic hub of the central area of Panama City. Source: Sustainable Advanced Systems. SAS.

New infrastructures of public transport have an important turning point in this square which is expected to have a flow of more than 35,000 people a day. In this case the release of space representing the ultracompact public parking configuration allows you to integrate broad market spaces and solve the transition with the various public spaces that articulates a new building with the old transoceanic train station and new subway and bus public stations. Winner of competition for the New Market Parking Public Square on May 5, Panama.

5. INTEGRATED MANAGEMENT AND CONTROL SYSTEMS

The growth of cities poses enormous challenges and opportunities for integrated management and control systems. The possibility that cities become more efficient in the management of mobility and parking using advanced technologies to collect more data and higher quality, intelligently analyze and connect them through more effective networking technologies, is a common opportunity. This translates into more efficient services, specifically targeted to the specific needs of citizens services [10].

Cities are using smarter solutions to manage water supply, sewage treatment, energy cycle and public safety. However, one of the areas in which the adoption of such solutions has advanced more is transportation, and possibly because many

cities have deployed intelligent transport systems and many others plan to use them as part of their mobility strategies. Full integration of parking systems in general mobility systems, through integration of information management, is now an additional powerful tool (Fig. 13).

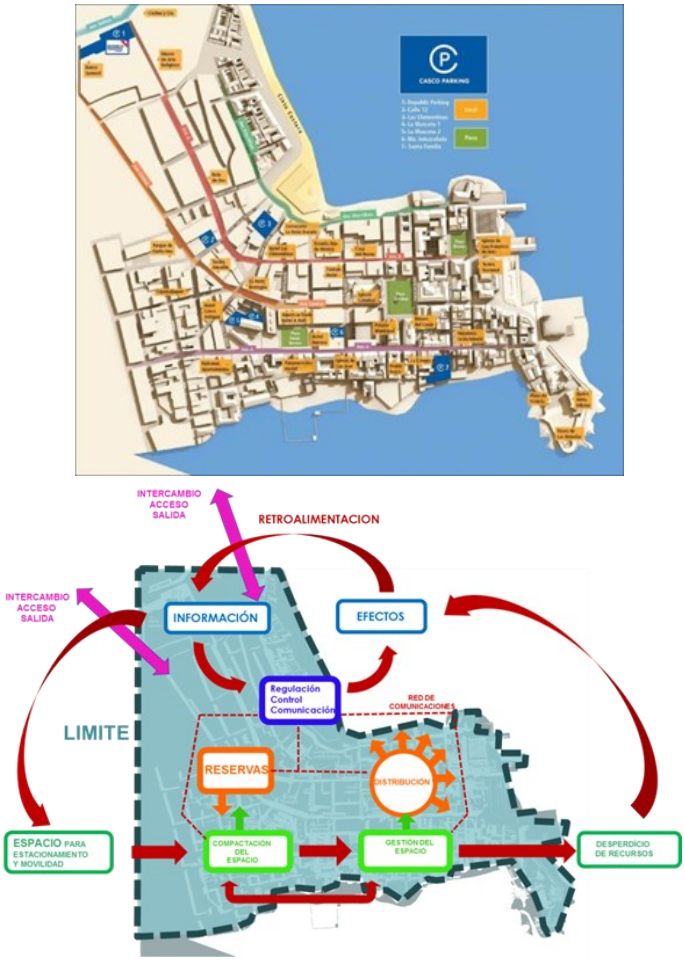

Figure 13: Square de 5 de Mayo is a strategic hub of the central area of Panama City. Source: Sustainable Advanced Systems. SAS.

Virtually all cities are developing strategies to overcome their difficulties and increase the availability of parking, usually changing the contribution of each mode of transport and improving services in general. In this sense, almost all those agents responsible for mobility point to the importance of implementing intelligent parking systems:

- Integrated management fees.
- Improved relationship management between: transportation / parking / user.
- Prediction of traffic flow and parking availability.
- Improved management of transport and traffic in relation to parking.
- Passenger information and advisory services.
- Charging for use of resources of integrated parking.
- Variable and Dynamic Parking Fees (DPP Dynamic Price Policy) as a resource for on time management action on mobility flow [11].

Strategies linked to different modes of city parking should be integrated as part of a strategy of coherent urban transport and be aligned with the strategies of municipal government in other areas (land use planning, for example) and even coordinated with the government's plans regional and national levels.

Knowing the patterns of user demand and utilization is very useful to develop appropriate strategies for parking. The most important cities are using this data to classify users into groups, so that it is possible to optimize schedules, and communicate in clear and specific way in specific groups (sending, for example texts ads on varying availability of parking and tariffs, and recommending alternatives for moving to and parking at the workplace or business or leisure). How an integrated system formulates offers to the traveler not only to provide a better value proposition for him, but also for the city is shown.

To exploit to the full extent these capabilities, parking system managers should approach more users. Gradually they have to implement techniques used in trade, such as systems management customer relationship, to sustain and strengthen the relationship with users and analyze their data. Information about user journeys, their preferences regarding parking services and purchasing patterns will be collected, as is currently done in retail.

Once you know the guidelines for parking users, municipal authorities may influence their behavior more easily through incentives and regulations.

Service integration also helps mobility system managers to provide more efficient service. By sharing information from different sources, they can build a holistic view of demand for and supply of parking services and make decisions to optimize network performance.

From the organizational point of view, the ideal model is an integrated management one that some cities have already established, and others focusing upon. Regardless of its organizational structure, it is important that everyone working in the planning and delivery of city parking services should work collaboratively with public support and real political support.

This involves coordination between technological solutions to information management and communications, can improve the user experience and integrate different emerging modes of parking and exchange and improving the quality and reliability of the preferred modes and systems through dynamic pricing (ticket prices, rates higher parking in the city center, emissions-based charging, variable rates as per schedule, schedules, occupancy, etc.).

Full parking guidance systems integrated in parking facilities, allow easy user information, user access, payment and complimentary online services. Driving from the outskirts of the city, directly to the assigned parking place is now feasible

trough personal and vehicle smart communication devices, allowing the smooth integration of multi configuration modular mechanical systems in many different arrangements, for every kind of use and all the range of users [12].

Integration of fully integrated user guidance systems with mechanical parking systems, from urban information panels to the exact location the assigned parking place, opens a wide spectrum of applications in favor of the dispersion of parking in wasted areas and spacers, impact reduction and space recovery of traditional parking places, and new models of

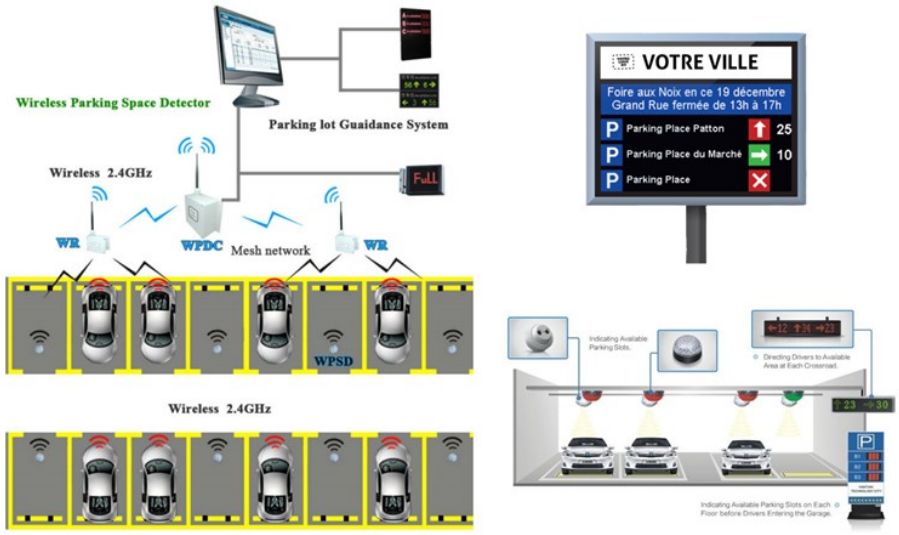

Figure 14: Integration of fully integrated user guidance systems with mechanical parking systems. Source Sustainable Advanced Systems , SAS.

landscape parking (Fig.14).

Other concerns regarding the implementation include the need to properly manage change and anticipate potential resistance from staff and users to new parking configurations with new technologies. For example, the need to respond to user resistance regarding the use of technologies that can threaten privacy, such as the recognition of license plates. We can learn from those who have successfully implemented complex information systems, both parking and other sectors. Several cities emphasize the importance of effective project teams with the right balance between technical skills and ability to manage complex projects.

Integration of information systems and communications enables integrated management and networking, at all scales in parking systems: comprehensive mobility manager, business manager, operator, maintainer and user (Fig. 15).

Figure 15: Integration of information systems and communications. Source: Sustainable Advanced Systems, SAS.

An essential part of managing new system implementation involves measuring the progress made regarding the mobility strategy of the city using clearly defined performance, service and impact parameters. Sharing more information related to traffic interaction - parking, transparently and communicating objectives and progress also helps to increase public support.

Increasingly, cities share their progress with the public using Web sites and direct and personal means of information exchange. Performance indicators are also changing and, in addition to traditional parameters such as modal percentages, length of trips, etc., today many other cities collect more user-oriented parameters, especially with regard to user satisfaction, essential in the consumption of parking services, within a sustainable city [13].

6. CONCLUSIONS

The rapid development of Latin American cities, their exponential growth and the growth of the fleet of vehicles, is taking place in parallel with strong economic growth and an evident social improvement.

This multidimensional development is an exceptional opportunity to inject into the urban context of Latin America methodological tools and tools already tested in urban development and the balance of the mobility systems of the most advanced cities of Europe and America. By doing so, Latin American cities can be placed directly at a high level of

effectiveness and sustainability for its management policies of urban systems, without having to go through decades of evolution as has happened in Europe.

On the contrary, if the advanced and integrated infrastructure and management policies that correspond to the state of the art of the 21st Century are not effectively implemented, accelerated development can become a monster that accentuates and perpetuates the social and spatial inequality and injustice of many Latin American cities.

The three components of balanced and sustainable development [14] of mobility in cities are:

1. Strategies of government, management and dynamic behavior, oriented to the recovery of public space, the quality of urban ecosystems and sustainability.
2. Infrastructures that guarantee the flow, regulation, storage and availability of individual and collective mobility resources. In the case of the mobility system, those resources are multimodal connected road networks, multimodal transport systems, parking for storage, recharging and the exchange of individual and collective mobility resources, fully dynamic management infrastructure.
3. Information and communication systems that allow the implementation of intelligent management, operation and government networks interconnected with all the agents involved in the mobility processes.

The last phase of development of the mature technologies of mechanical parking, the third generation, is transforming them into ultra-flexible, versatile, interconnected and evolving systems at the service of strategies for the recovery of space and added value for cities.

Parking systems with on-line user guidance, dynamic pricing and dynamic management, multimodality support and low impact vehicles and suitable for the multitude of uses and users required by the contemporary city.

The feasibility of using these connected third generation mechanical parking systems is based on the significant reduction in the construction and maintenance costs that it generates, and the multiplication of parking facilities: aptitude for all types of situations and vehicles, efficiency, ubiquity, proximity, flexibility, security, connectivity, long term quality, etc.

The potential for transforming public space that city managers have with such complete and powerful instruments is as important as the need to generate new models for the sustainable city of the 21st Century.

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