

A Preliminary Analysis on Parklets: Can They Contribute to the Realisation of a Walking Friendly City in Italy?

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Abstract. The most current city models banish the concept of a car-oriented city by promoting a series of actions and strategies that allow users to choose more sustainable solutions aimed at walking and cycling, and contemporarily promoting the concept of proximity city. In recent years, parklets have played a crucial role among the different strategies found in the literature to reach this goal. Parklets are built on equipped public areas used for parking cars and can also be an extension of the sidewalk. In this way, they become meeting places where you can stop drinking, eating, or relaxing. The present work focuses on a review of European and non-European literature on the implementation of parklets and the estimation of SWOT analysis in various contexts, emphasising the purpose of these interventions and considering the peculiarities of Italian urban areas where parklets have already been built or where they could be in the coming months. An analysis of the literature on mathematical modelling for vehicular traffic is also included, to enrich the paper with a rigorous description of the vehicle and pedestrian interactions in a street and to predict the impact of the actions of urban planning by evaluating the most suitable way to model the phenomena arising from the previously discussed urban interventions. These results can serve as a basis for local administrators to improve strategic planning and sustainable mobility in Italian cities.

Keywords: Parklets · SWOT analysis · Walking city · Urban and sustainable mobility · Tactical urbanism

1 Introduction

Since the end of the nineties, various tactical urban planning interventions such as the introduction of different technologies, sensors, and sustainable mobility have been carried out to encourage smarter and happier urban mobility and to reduce pollution [1, 2].

In particular, various urban planning actions have aimed towards models of proximity cities, where all services are within fifteen minutes walking distance and therefore consider a substantial modification to the scale model in the neighborhood. However,

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other interventions aim more specifically at the reconversion of spaces, especially after the recent pandemic phase [3, 4]. The latter, together with the need to make urban spaces more usable, have allowed the spread of some space reconversion actions, such as parklets [5, 6]. A study conducted by [7] underlined how parklets are solutions capable of supporting urban development and mobility planning in the post COVID-19 phase by improving the quality of public space and social distancing near shops and activities, benefiting from this micro-regeneration urban. This study also highlighted features for identifying and planning spaces where parklets can be deployed to improve sustainability and support post-pandemic recovery. They can be defined as a simple, low-cost tool for the recovery of public spaces as well as traffic-calming functions. The creation of parklets is a useful tactic for structuring a strategy aimed at reducing vehicular traffic for the benefit of mobility on foot and by bicycle. The explosion of the pandemic has highlighted the importance of managing public spaces in terms of both physical and social resources [8–10]. This is a way to raise awareness among citizens about the value of the road space currently used for parking. An increasing number of studies have highlighted how cars remain stationary and unused for 95% of their life cycle. These data require a reflection on how much precious space in our cities is dedicated exclusively to the parking of private cars, taking it away from other uses [11].

The design of a parklet varies depending on the wishes of partners or applicants. Designs may include seating, greenery, bike racks, or other features but should always strive to become a focal point for the community and a welcome gathering place.

Parklets involve the conversion of two or more parallel parking spaces, or three or four angled parking spaces. The configuration varies depending on the site, the context, and the desired character of the installation. Parklets can be installed on streets with a high pedestrian volume and local commercial activities but without public spaces for pedestrians. In cases where on-street parking is frequently obstructed owing to dispersed street activity, the city may permit the rezoning of one or more parking spaces through a permitting process, requiring the spaces to remain open and accessible to the public. These urban acupuncture initiatives have experienced remarkable success. Furthermore, they generate the opportunity to revitalise roads that were previously exclusively traffic axes [12]. Parklets can obviously have temporary characteristics and thus fall within the great voice of tactical urbanism, or they can have a definitive character to highlight the vision of public administration towards the management of urban space. Parklets, as small-scale, short-term urban interventions, can be the result of studies on urban improvement efforts often led by citizens and, in some cases, incorporated into more formal planning processes [13]. In Italy, such urban planning interventions are still struggling to spread due to various regulatory, economic, and social critical issues. What comes closest to the idea of parklets are dehors, structures with tables, and umbrellas, typically linked to the ownership of private catering establishments, while parklets maintain their characteristics of a public place. The following paragraphs provide an overview of the space-time diffusion of parklets in the world, outlining the benefits and critical issues, and defining a series of strategies and recommendations developed starting from the first interventions in the city of San Francisco. Subsequently, attention was paid to the importance of analysing test pilots and preparing SWOT analysis applied in various contexts and then defined in the Italian context.

A SWOT analysis required for the approach allowed to try to understand the opportunities that arise from the implementation of the aforementioned urban planning interventions according to the aspects of public or private actions, define the parameters for a better spatial-functional, economic, and social definition of the ecological and environmental well-being of populations; highlight the need for a multidisciplinary approach to the study of such interventions. Furthermore, the analysis of the mathematical models presented in the literature provides a wider perspective. Indeed, the issue of parklets installation can also be considered mathematically as an optimization problem in which the variables of the optimization are the position and shape of the parklets in a street. Trying to capture the features of the phenomena arising from the installation of parklets, we can choose the most realistic and suitable model to describe in a rigorous way the urban planning interventions previously discussed. Mathematical modelling also has the advantage of having on one hand a predictive function and on the other hand a fitting role, in the sense that by collecting data from street experiments, a mathematical model could be a perfect tool to analyse the data and from that, to create a function depending on the time, to analyse the macroscopic variables describing the dynamics of vehicles and pedestrians and the interactions between them.

2 The Spread of Parklets in the World

The first parklets were born in San Francisco in 2010 inspired by various Park(ing) Day initiatives [14, 15]. Such tactical urban planning interventions are having great success in numerous cities around the world [16], from New York [17] to London [18], passing through the most recent case of Bern, Switzerland [7]. To date, the largest number of studies on parklets has been conducted in the Americas. In particular, cities such as New York and San Francisco have introduced pop-up interventions on the streets and the reconversion of spaces such as car parks and squares [19]. A parklet pilot program began in Vancouver in June 2013, mapping and comparing the aforementioned case studies with those first implemented in San Francisco. Research has revealed that parklets begin as corporate-sponsored projects and evolve into community partnerships over time. Therefore, recommendations need to be developed for emerging and established programs in North America [17]. In the same context, the study addressed by [20] attempted to define which factors influence the feasibility and success of implementing parklets and public squares, and to define what the social and environmental outcomes of building parks and public squares are at a site-specific level and on larger urban scales. Research has emphasised promoting a wide range of uses and can serve as localised nodes. On a larger scale, design considerations can be used to change the perception of an area or neighbourhood development and have the potential to create a connected system that provides widespread circulatory and ecological improvements. Furthermore, creating programs that facilitate the installation of parklets and conversion of squares offers cities and communities the greatest value for money because they provide low-cost flexible spaces. Therefore, it is possible to state that parklets and public squares are feasible projects for providing green spaces and promoting pedestrian circulation within neighbourhoods and communities. In California, a series of studies have been carried out to define a series of advantages and disadvantages, as well as the common and different

characteristics of the "flex zone" and the parklet, to understand replicability in different contexts. In particular, the study conducted by [21] on three Californian roads provided ideas for the implementation of parklets in Japan.

The research clarified the common characteristics and differences between them relating to flexible zones and parklets and then explored their advantages and disadvantages such as their uniqueness as methods of producing outdoor spaces for eating and drinking. As regards the methods of implementation in Japan, the research underlined the importance of considering specific implementation methods in accordance with the purposes and existing conditions of the target area, responsibilities, systems and measures to ensure pedestrian safety, consistency with the relevant ordinances and their necessary revisions. Furthermore, in 2023, a study conducted in Southern California made a series of recommendations from the perspective of landscape designers, urban planners, and municipal officials interested in creating infrastructure for parklets and extended sidewalks, underlining the need to modify the permitting process and ensure that these interventions are long-lasting for the future design of the commercial street landscape [22]. Finally, the diffusion of such interventions and the creation of a network of multiple intervention points has been proven in the suburban landscape of Bryan, Texas, to have not only an impact on the economy and sustainability of transportation but also an impact on public health by increasing walking/reducing driving to obtain daily food. In fact, increasing the spaces used for walking and decreasing the propensity to use cars reduce the negative impacts of a sedentary lifestyle on residents. These interventions are related to low-capital investments and tactics that can be used by design professionals in collaboration with neighborhoods, local governments, and service organisations to begin to reverse the trend against sedentary lifestyles associated with the spread of chronic, costly, and debilitating diseases [23]. In Australia, similarly to the mapping of Vancouver, research was conducted in Melbourne, observing its spatial distribution, and identifying numerous urban design factors that provide capacity for parklets or inhibit them. The research also highlighted how smaller side streets can provide parking capacity, but many design conditions prevent this [24]. The study conducted by [25] has analysed the spread of parklets in Australia since 2005, outlining how these urban planning interventions have adapted to rapidly evolving social needs and priorities for economic activity, health, safety, socialisation and on-street parking, as well as changes in road function. Parklets have been absorbed into institutional urban planning practice since 2008 as a strategic tool to improve community engagement, test possibilities, and gain support for long-term spatial transformations. Since 2012, Australian commercial parklet programs have been developed to encourage local businesses to expand into street parking, to calm traffic, and improve pedestrian amenities. In 2022 the study conducted by [26] focused on the deployment of Melbourne's parklets reveals both the potential both obstacles to convert automotive space on streets to new uses, placing particular focus on the spread of hundreds of café parklets that have incrementally transformed Melbourne's streetscape to cater the new needs of hospitality businesses to provide socially distanced outdoor dining. The research revealed little dislocation where streets are devoid of pedestrians, including commercial areas such as indoor shopping centres, which have different urban morphologies that largely separate streets and cars from pedestrian spaces. They lack business-to-street interfaces in which parklets can intervene. In parallel in the city of

Melbourne and Stonnington in 2024 a study conducted by [27] outlined the evolution of the design, programming, approval process and reception of a "playful park", available for free public use, which was transformed and relocated between four urban contexts in Melbourne as an action of tactical urbanism. An analysis of its playful, portable, and flexible design points out three areas of innovation: testing new possibilities for governance and engagement post-COVID; incorporating adaptability and incremental adjustment into parklet design; serving as a platform for new social and spatial game modes [28]. On the Asian continent in 2023, a study focusing on the Japanese city of Higashi-Hiroshima was released. The behaviour of people who parked in street parklets was studied by analysing the data relating to the attributes and duration of people's stay in street parklets based on surveys of traffic volume, surveys on the measurement of comfort levels, and images from fixed-position cameras. The results showed that the number of pedestrians doubled during the experiment and that the attractiveness of the street space as a "fun place to spend time" was clarified [29]. On the African continent, the study conducted in [30] Jazan City was fundamental as a reference for all cities in the Saudi Kingdom, as it outlines parklets as a new idea with the simplicity of solutions capable of solving some social and environmental problems at the same time. Starting from theoretical investigations and rethinking the approach of future road design as a new redistribution of safer and more comfortable spaces for all users, as well as places of conviviality for communities. In the European and English contexts, several studies have been conducted over the last decade. In London, the transport company Transport of London (TfL) financed two parklets, and these interventions are aimed at street innovation, including one on a very busy commercial street in central London. In particular, the flexible design of the installation allowed it to be easily dismantled and/or moved to another site, while the flexible management of the project helped respond to feedback quickly. The basis for this intervention was a potential study of users, including the possibility of antisocial behaviour, which could have helped overcome objections to the project [31]. A study conducted by [32] analysed the "street experiments" (SE) and evaluated aspects related to upscaling, acceptability by the public or professionals and underlined that to date there are few studies that openly explore the value that citizens attribute to SE in context of daily life on the street. To fill this gap, this research analysed four different parklet and square interventions in three neighbourhoods of London, Munich, and Bologna. The results show that in all three cities, the majority of citizens evaluated the public life dimensions of these interventions to a greater extent than the benefits for active mobility, including the attractiveness of the streetscape, the provision of public spaces for stationary activities, and the creation of opportunities for social and civic interaction within neighbourhoods. A study conducted by [33] highlighted how such interventions and parklets, in particular, have been criticised when their installation leads to the long-term loss of parking spaces. This research has revealed substantial divisions of thought related to these interventions, underlining that they undermine small actions in support of decarbonising futures and healthcare infrastructures, which are the basis of broader and more urgent social and environmental gains. Another research conducted in Edinburgh, was carried out through the dissemination of an online questionnaire whose results underlined a considerable interest on the part of the community in the concept of parklet and its design and implementation. At the same time, a clear

division of support also emerged, and a statistically significant correlation emerged for people under the age of 45 and for residents who do not own a car who feel a strong sense of belonging to the community and are in favour of being present of parklets in their neighbourhood. In contrast, older and car-owning respondents were not in favour [34]. The city of Berlin has promoted the spread of tactical strategies such as parklets to facilitate and make possible active mobility integrating street observations and brief surveys in different neighborhood streets. This research has also revealed that parklets contribute to creating liveable streets, replacing car parks with public, green, and multi-functional spaces for active mobility users. Furthermore, parklets alone do not directly influence active transportation behaviours. However, in combination with traffic calming interventions, parklets facilitate active mobility by prioritising pedestrian needs to rest and walk on a safe and lively street. Overall although parklets are not great motivators in themselves, they can be strong facilitators of active mobility if combined with sufficient greenery and placed on slow-moving neighbourhood streets [35]. In recent decades, many European and non-European municipalities have temporarily closed roads for vehicular traffic to open them to people and promote the community.

3 SWOT Analysis

SWOT analysis is a simple and effective strategic planning tool that is useful for highlighting the characteristics of a project, a program, an organisation, and the consequent relationships with the operational environment in which it is located, offering a reference framework for the definition of strategic orientations aimed at achieving an objective. SWOT analysis allows us to think about the objective to achieve while simultaneously considering both internal and external variables. The internal variables are part of the system and on which it is possible to intervene; the external ones, not depending on the organisation, can only be kept under control, to exploit the positive factors and limit the risk factors that compromise the achievement of the set objectives. The SWOT Analysis was constructed using a matrix divided into four fields, in which we have Strengths, Weaknesses, Opportunities and Threats. The advantages of an analysis of this type can be summarised in three points: the in-depth analysis of the context in which one acts, made possible by the preliminary observation and collection of data and their skillful interpretation, translates into a precise delineation of strategies; the continuous comparison between the needs of the organisation and the strategies adopted leads to an enhancement of the effectiveness achieved; it allows greater consensus on strategies to be reached if all parties involved in the intervention participate in the analysis. The limits linked to this type of analysis are essentially: the risk of describing reality in a too simplistic way; the risk of subjective procedures by the valuation team in stock selection; the requirement of a context of partnership that, if not achieved, leads to the risk of a disconnect between the theoretical and the political and pragmatic level. This type of analysis can therefore only be a good starting point for the evaluation of a potential feasibility study of the aforementioned interventions. For the definition of the SWOT analysis related to interventions on urban spaces, a critical analysis of the literature relating to emblematic case studies of interventions on urban spaces, such as those conducted in the city of Santa Monica through the pilot case study for main roads carried out in 2019, is fundamental [36].

3.1 SWOT Analysis Applied to Parklets

Cities vary greatly in size, history, development pattern, design, shape, and citizens' attitudes towards public spaces. Parklets fall under the classification of emerging infrastructure because, rather than being planned and imposed from the outside, parklets emerged from within as a response to people's needs. The study conducted on an American urban scale has revealed some indications on how to improve the implementation processes of both parking lots and parklets [37]. The means of communication and dissemination of these interventions are also fundamental, as demonstrated by the study conducted by [38] applying a case study approach and considering social network analysis to investigate the diffusion of parklets, an innovative way of transforming car parks into green and public spaces on Twitter. The results of this research demonstrate the complexity of the responses deriving from the diversity of the participants and their activities, as well as from the variety of relationship structures and at the same time underline the importance of the technologies and possibilities offered by Web 2.0 to address urban challenges through collaborative models of urban governance. Likewise, the dissemination of digital tools relating to basic information, a map of the parklet's potential, a design tool and a form for requesting the necessary permits were fundamental for the diffusion of such urban planning interventions in Vienna, especially since a dissemination campaign among citizens' organisations and through social media channels [39]. In the same city the study carried out by [40] highlighted that while such tools could inform people about the possibilities in the city, other aspects, such as previous involvement, play an essential role in the perception of new tools and their potential adoption. Over the years, SWOT analysis has been performed to define the pros and cons of implementing parklets in various parts of the world. For example, a study conducted on the city of Lubumbashi in the Democratic Republic of Congo (Africa), which has recorded strong demographic growth and a large, rapid and anarchic urban spatial expansion, has underlined how important the streets are in the urban context, underlining their role as a place of transition and first-rate social diversity [41]. The study conducted by [36] in the city of Toronto released a SWOT analysis underlining the importance of spreading a collaborative approach between citizenship institutions and associations for the temporary development of urban interventions with reference to the transformation of the car parks of a suburban shopping centre into a meeting place. The results of this research outline a reference framework that facilitates the evaluation of the impact of public spaces, while providing a tangible and real application through the implementation of a parking redevelopment project. The study conducted by [42] in Vancouver aims to expand the parklet deployment program to new locations in North Vancouver with the goal of addressing the complex issue of social integration within the city. The research outlines through a SWOT analysis a series of recommendations to help policy makers guide the City of North Vancouver through the process of community development and partnerships. In particular, the study promoted an analysis of the interested parties and the environment which includes SWOT and PESTEL analysis indicators on the feasibility of such interventions [42]. Starting from these studies it was possible to construct Table 1 with a SWOT analysis divided into 3 macro areas, namely landscapes and resources (connected to regulatory and legal aspects in the field of urban planning

and mobility and use of resources), economic and social aspects (relating to the different types of parklet users) and health.

Table 1. Comparative SWOT analysis related to the study of various parklet interventions implemented.

Strengths	Weaknesses	Opportunities	Threats
Landscape and resources			
– Reduction of car spaces and promotion of soft mobility – Increase in poles of attraction for food and beverage – Increase in poles of attraction for recreation and wellness – Increased liveability of street spaces – Improved planning of parking areas (especially near the historic centre)	– Lack of town planning regulations – Lack of functional geometric standards for roads – Need to define actions to contrast private transport and improve walking and local public transport – Seasonal use due to weather – Potential dissatisfaction from residents and city users	– Improved urban development – Increased meeting places – Creation of places for various segments of the resident and non-resident population – Improvement of pedestrian and cycle mobility infrastructure – Increase in the number of seats in the area concerned – Presence of temporary covers for annual use – Creation and definition of standards and guidelines for planning, design and management – Analysis of past case studies to gain experience	– Overestimation of the expansive phenomenon when planning city development – Reduced demand for the settlement of economic activities – Limited synergy with associations and entrepreneurs – Risks of transformation of some areas into less utilised districts – Weaknesses of public transport and school system in the examined area
Economic and social aspects			
– Increased proximity trade as opposed to large-scale distribution – Balanced integration between the productive economic system and the social system – Definition of a commercial and proximity network for the urban area and beyond – Increased community involvement – Very low-cost operation for the city with corporate sponsorship	– Reduced number of interventions in proportion to population density – Lack of financial resources (budget constraints) that may prevent the necessary interventions from being carried out	– Redevelopment of disused urban spaces – Creation of new urban cultural spaces – Improving the safety of pedestrian traffic – Greater liveliness of citizenship and spirit of hospitality – Enhancing and relaunching the establishment of businesses in the area – Redevelopment of the built heritage and use of urban spaces to reduce housing density	– Rainwater management and irrigation systems – Security, damage and vandalism – Disputes between small businesses and the city – Loss of parklet benefits – Misuse of space

(*continued*)

Table 1. (*continued*)

Health			
– Reduction of sedentary lifestyle and related diseases – Reduction of vehicular traffic emissions	– Reduced presence and use of parklets and thus reduced psychological well-being and health	– Improvement of psychophysical well-being – Increasing green or equipped spaces to increase walking and/ or also encourage sporting activities	– Possible injuries in outdoor areas near parklets

The above table therefore highlights how different sectors are connected to the benefits and critical issues produced by the implementation of parklets. If on the one hand the lack of legislation or the lack of regulatory homogeneity between the various states creates critical issues of implementation in a continuous version and not only as temporary installations, on the other hand the need to increase social spaces and spaces for complement of the economic life of cities for general benefits. To promote the diffusion of these installations on a continuous basis, it will be necessary to carry out greater training and information campaigns for citizens to make them understand not only that their installation has the advantage of being reversible and, therefore, they can also be tested for predetermined periods, to verify its effectiveness and any critical issues. Finally, the idea that the parklet can be understood as a simple, low-cost tool for the recovery of public space, also with traffic calming functions, must be promoted.

Therefore, of fundamental importance is the study on the actual and project status of the areas and infrastructures to be donated to parklets together with a study of the demand for transport and diffusion of services present in the analysed area, both current and potential. The study also reveals that the key issue also in the Italian context is to guarantee the introduction of parklets in appropriate places that will encourage their use as demographic data and possible users change (citizens, tourists, commuters).

The SWOT analysis preliminarily highlights positive and negative aspects of previous interventions and suggests improvements for new installations. At the same time, it is essential to correlate SWOT analyses with more in-depth studies on transport supply and demand and current regulations in the transport and transport sector, considering individual case studies.

Furthermore, evaluating the relative correlations between factors is very important and useful.

In fact, a more in-depth study of the literature relating to the mathematical models that describe user behavior and the discretization of mobility infrastructures and services is necessary to better describe the analyzed contexts.

Furthermore, it is essential to be able to calibrate the equations and therefore describe the phenomena from a mathematical point of view, giving a more robust justification to the preliminary results or to the results deriving from actions such as data acquisition campaigns through surveys and questionnaires or even the drafting of calculated preventive scenarios through dedicated software or even the comparison of results between case studies.

4 Mathematical Modelling Literature

In order to help with the analysis of the different interventions possible in an urban context, bibliography research about mathematical modelling is also presented in this section. First attempts at developing the mathematical models for traffic flows were undertaken by Lighthill and Whitham [43], Richards [44], Greenberg [45], Prigogine [46]. More details about the results obtained could be found in Whitham 's book [47].

The mathematical models more used in literature can be grouped into the following categories: cellular automaton approach, mean field game theory, a microscopic approach given by the force-based models, a macroscopic approach devised by the hydrodynamical models, and the kinetic approach that could be considered in a mesoscopic scale, between the two previous mentioned models. Cellular Automaton simulation [48, 49] is based on a mathematical idealisation in which space and time are discrete and physical quantities are evaluated on a set of discrete values. Cell state is also an important parameter. Every cell has one certain state value from a finite set of possible states. Consequently, the continuous variables like length, speed and time have to be discretized for the sake of effective modelling. The idea is to divide the simulation domain into cells. These cells must be regular, so that they form a regular grid. The grid structure can form different patterns depending on the performance of each to a particular simulation. The basic forms are triangular grid, rectangular grid, and hexagonal grid. Mean field game approach [50–52] is a mix between the game theory and the mean field theory. The game theory part enters because each agent (vehicle or pedestrian in our case) is considered as a player in the sense of game theory and each player behaves in order to reach a Nash equilibrium, that is to say that he is rational, and he tries to take the best decision for himself but also for the other agents (players). Mean field theory enters in the sense that one starts from a microscopic formulation and then one passes by the limit for N that tends to infinity, where N is the number of the agents, to a mean field formulation in which mean and average macroscopic quantities are considered. The approach is like that of stochastic or classical mechanics.

Another approach used to describe pedestrians and vehicles movements is the force-based one [53]. In this case, the idea is to represent each pedestrian or vehicle like a particle that obeys to the Newton laws of dynamics. Most of the force-based models describe pedestrian dynamics qualitatively fairly well but there are only poor quantitative descriptions of these phenomena. Usually, implementations of the repulsive force require additional elements to guarantee realistic behaviour, especially in high density situations. Sometimes strong overlapping of pedestrians or negative and high velocities occur as artefacts of the force-based description. This kind of model has the limitation that it doesn't consider the anisotropy of the space around a pedestrian, because we usually consider only the people in front of us and not behind; furthermore, the physical contact doesn't product a repulsion strength like for two particles, therefore this kind of model sometimes can lead to an unrealistic choice of parameters. The Centrifugal Force Model (CFM) is an attempt to overcome these issues. In this case the force is anisotropic since its range of influence is reduced to the range of vision of pedestrians, which is 180°, furthermore it describes clearly "collision detection technique" to deal with the problem of overlapping pedestrians and succeed in managing collisions among pedestrians, which can be interpreted as a failure of the avoidance-mechanism expressed in the form of

repulsive forces. Therefore, under some additional assumptions, this kind of model could be improved. A totally different approach with respect to the previous is the macroscopic approach. These kinds of models are based on fluid dynamics [54–57]. They try to describe complex systems, i.e. interactions between particles in a dynamic context. The name comes from the analogy with the equations used in the fluid dynamics field. The idea is to see each pedestrian or vehicle like a particle in a fluid and therefore to use the same equations used for fluids moving in a pipe for example, to describe the dynamics of people or vehicles in a road or in a room. The feature of this approach is to deal with variables that are macroscopic like local average of density, velocity, flow, and the equations used are partial differential equations (PDEs) like continuity equation (for the first order models) with suitable initial conditions and boundary conditions or constraints in order to take into account the limitation or the obstacles present in a road or in a room. Sometimes also the moment equation is included and therefore the velocity variation, for second order models.

The last model analysed is based on the kinetic approach [58, 59]. The idea for the modelling of vehicular traffic is based on the choice of an intermediate representation scale between the macroscopic and the microscopic ones, technically called mesoscopic. Rather than looking at each single car or pedestrian of the system, like in the microscopic approach, a distribution function is introduced depending on the microscopic state of the vehicles. The distribution function represents a measure of the number of vehicles at a certain time, position, and velocity. The knowledge of the distribution function enables one to recover the usual macroscopic variables of interest as local averages over the microscopic states of the vehicles. Then, the macroscopic and microscopic approach are mixed here. In this case we deal with the Partial Differential Equation like continuity equation or Boltzmann equation, depending on the specific application to simulate. All the previous models describe essentially the dynamics of vehicles and/or pedestrians in a street or in a closed room, but also the variables of position and shape of the parklets on a street could be included in this kind of models, by reformulating them in a suitable way.

4.1 Analysis of Advantages and Disadvantages for Each Mathematical Model

Advantages and disadvantages for each mathematical models analysed are summarised in the following:

- Cellular automata: In this case the approach is based on rules behaviour and not on equations and this aspect could be considered an advantage because it could simplify the description of the phenomena occurring in the streets. On the other hand, they furnish a discrete idealization of the PDEs (Partial Differential Equations) and through this idealisation the description could be less realistic.
- Mean field games: In this kind of model, the mean field limit is used to obtain nonlinear PDEs, so that some average quantities are deducted from complex nonlinear PDEs, and this is the advantage of this approach. Contemporary the hypothesis of rationality considered from the game theory is restrictive and not realistic. One of the criticisms of game theory, as applied to the modelling of human decisions, is that human beings are, in practice, rarely fully rational.

- Force based model: This kind of models are detailed but they do not consider the chaotic description of the street phenomena and vehicle and or pedestrian movement. Furthermore, they are computationally expensive, because they describe the dynamic of each pedestrian or vehicle by ODEs (Ordinary Differential Equations) and for this reason the number of equations could be very high to be simulated in a short time.
- Fluid dynamics models: These models have the advantage of being computationally not expensive, but they lose something in terms of a detailed description of the situations. Indeed, they deal with macroscopic quantities, it is to say, mean or average quantities that don't take into account the nature of the single vehicle or pedestrian in the vehicle flux.
- Kinetic models: This last model is a mix of the previous two models and takes the advantages of both. On one hand the continuum hypothesis (the idealisation of vehicle flux like fluid flux in a continuum) is a bit strong and not realistic, because the cars or pedestrians are not particles in a fluid, but their movements are discrete, with spaces between the elements that take part in the street's phenomena and interactions.

On the other hand, this kind of model can be improved by introducing a granular nature of the flux that mathematically corresponds to the introduction of some class of velocities which the vehicles belong to. In this way we can be more detailed about the description of vehicle fluxes and at the same time, we can overcome the disadvantage of the huge amount of time to simulate a microscopic model.

The aim is to reach a realistic mathematical model describing the vehicles/pedestrian dynamics in a case study in order to simulate traffic components evolution in time as well as how it changes with surrounding environment. It allows to support the SWOT analysis in the investigation of an optimal plan and design of parklet implementation for adaptive and durable transformation of spaces.

5 Conclusions

In this study, the analysis of literature on the space-time diffusion of tactical urbanism interventions such as parklets is carried out as the first step of research analysis. Subsequently, this work shows a comparison of case studies, highlighting the limited presence of parklets in the Italian context and providing some specifications relating to the potential and critical issues of implementing such interventions through the definition of a SWOT analysis. Specifically, the research focused on this type of analysis to outline in a general and local (Italian) way the potential of the territory with particular reference to the small urban scale and at the same time underline the weaknesses and threats generated by users. A first analysis shows that the advantages would be for everyone: for shops since a city re-designed on a human scale improves everyone's life, increasing the feeling of well-being, optimism, and propensity to shop; for apartment owners because urban villages become quieter and less invaded by cars and smog, they automatically enhance everything they contain, starting with the apartments which rise in value; for citizens because a tidier, cleaner, and safer city constitutes a natural invitation to live it to the full; furthermore, the presence of controls and attention to detail favours social relationships which are more open and constructive with a strong reduction in vandalism and petty crime. This research underlines the need to disseminate greater

challenges and for strategies not only of tactical urbanism but also of a legal and regulatory nature and finally also connected to the development of digital placemaking and how these strategies can contribute to broader smart city initiatives. A new generation of commercial "parking cafes" has emerged during the COVID-19 pandemic, facilitated by American and Australian local governments to support the hard-hit hospitality sector. Their design and construction show continuous innovation, growing scalability and professionalism, but also standardisation. Such examples could be particularly useful in the Italian national context and could be useful for the definition of national recommendations and guidelines reiterating the strong similarities in spatial contexts, needs, risk factors and technologies that have defined this practice in different global contexts. Through this document, the benefits and critical issues arising from the implementation of parklets instead of car parks are researched, analysed, and evaluated. The creation of parklets must be based on a series of problem definitions and possible scenarios considering a process of small-scale interventions scale and from bottom to top. Starting from the problem of car-centric urban areas, it is necessary to analyse the national and local regulatory limitations as well as structural and infrastructural ones.

Of fundamental importance is the analysis of the pedestrian context and the possibility of greater pedestrian use and valorisation as well as a cycle path. To help with this analysis, mathematical modelling literature is also included, underlining the advantages and disadvantages of each type of model considered. This last analysis brings us to prefer a kinetic model approach to describe the insertion of parklets in a street and the consequences of this intervention in vehicular traffic. Indeed, in a kinetic model we can also consider the capacity of the street and a possible narrowing of the street, by varying the maximum capacity and density of vehicles and/or pedestrians. In this way, a parklet installation could be simulated and consequently the effect on the traffic could be analysed and described. Furthermore, an in-depth study on the user demand present in the area will allow us to attract a greater number of people of all ages to socialise through the establishment of these car-free spaces. This article therefore demonstrates that tactical urban planning can be an effective methodology to improve the use of urban spaces or their reconversion in the short term, underlining the need to carry out more in-depth and multidisciplinary studies.

This research confirms, through a literature and comparative analysis of different case studies in different global contexts, how the SWOT analysis is an effective operational tool for context analysis and therefore allows us to highlight the strengths of the project an event in the territory, its weaknesses, opportunities, and threats. This allows us to carry out an assessment of the utility/disutility of creating parklets and therefore allows us to make the "optimal" decision to achieve one or more strategic planning objectives.

The research also underlines the need to resort to a mathematical approach in continuation of the SWOT evaluation to better correlate the factors that describe the demand and supply of transport connected to the implementation of the interventions and therefore be able to simulate a series of scenarios as the aforementioned changes factors and their correlations.

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