

## TRANSFORMING CITIES: MAPPING OPPORTUNITIES TO DELIVER SUSTAINABLE URBAN FORM

### ABSTRACT

*Cities are dynamic settings that are constantly evolving. Physical changes, at varying scales, occur across time. These changes are often complex and slow-moving but all contribute to ongoing transformation of the urban form. The urban form of a city, town or settlement is important as it defines the size, shape and configuration of that urban area. It is within this structural framework that the functional qualities of the city are played out; the movement of people and information, the activities and social interactions and the ecological systems that coexist with urban life. Over the last two decades, there has been a significant focus in*

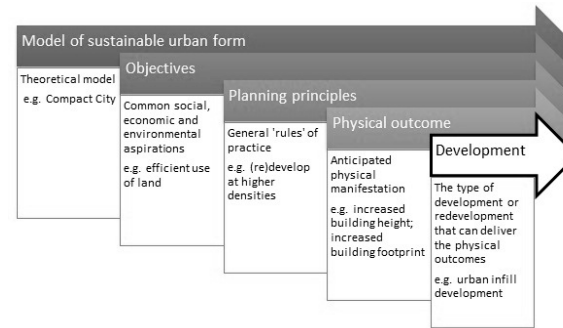
*planning discourses on how the physical design of the urban environment can influence health and sustainability and ultimately, achieve a sustainable urban form. However, the notion of a 'sustainable urban form' has been debated, and several theoretical models have been put forward that aim to achieve sustainability. This paper puts forward a conceptual framework to better understand the physical manifestation of sustainable urban form and the urban development processes that have the potential to deliver them.*

**KEYWORDS: URBAN FORM, TRANSFORMATION, DEVELOPMENT, SUSTAINABILITY, URBAN CHANGE**

## INTRODUCTION

Cities are dynamic settings, which change and evolve over time with social, economic and environmental influences (Newton & Bai, 2007). Change occurs at different rates, and in different ways across a settlement, with varying impacts on the form, structure and function of the urban area (Loorbach & Rotmans, 2010; Ward, 2004;). In most developed countries this process of change is mediated by a planning system, often seeking to achieve positive social, economic and environmental outcomes. Over the last two decades, there has been a significant focus in planning discourses on how the physical design of cities, towns and settlements can influence health and sustainability and ultimately, achieve a sustainable urban form. However, the notion of a 'sustainable urban form' has been debated, and several theoretical models have been put forward that aim to achieve sustainability, such as the 'compact city', 'smart growth' and the 'urban village' (Jabareen, 2006; Neuman, 2005; Williams et al., 2000; Jenks et al., 1996). Although variation in these models exists, there are commonalities among them and objectives of 'sustainable urban form' can be identified. From these objectives, general planning principles can be established. It is important to understand the physical manifestation of these principles in order for planners and planning policy to support the achievement of a sustainable urban form. And, finally, given the incremental nature of physical change in urban environments, it is also necessary to discern the different types of development (and redevelopment) that might occur in an urban environment, and ultimately, the opportunities that these developments offer to deliver the physical outcomes of a more sustainable urban form. Using a conceptual framework, this paper aims to distil the discourses about the physical

form of cities and identify the physical outcomes needed at the city and neighbourhood scale as well as the potential means for achieving these (Figure 1).



**Figure 1:** Concept diagram illustrating the translation hierarchy of sustainable urban form models to delivery through development (or redevelopment)

The framework identified in this paper is used to understand the opportunities for physical change in urban environments to create a more sustainable urban form. It recognises the physical manifestation of these principles at different spatial scales and the type of urban development that may facilitate desired physical outcomes. This framework can be used in planning policy and decision making to successfully identify and support developments that result in a more sustainable urban form.

The models of sustainable urban form, their common objectives and the respective planning principles are identified through a critical review of planning discourses. This paper first identifies the importance of urban form and the processes of urban change. The main models of 'Sustainable Urban Form' are identified from an analysis of the literature as well as their common objectives and the generally accepted planning principles to achieve these. The physical manifestation, or outcomes, of these principles are then derived

from this analysis. And, finally, the development and redevelopment processes by which these physical outcomes are delivered are discussed in the 'Opportunities for physical change' section.

## PROCESSES OF URBAN CHANGE

The urban environment is in a constant state of transition. This transition is a relatively slow process and the changes that are made are relatively long term or permanent. The opportunities for making changes to the physical environment are also relatively infrequent and the changes made often represent significant investment of time, resources and money. These are just a few of the reasons why it is important to ensure that these changes realise the opportunities to contribute to strategic objectives.

The manner in which these changes occur is variable. The transformation of the urban environment can be strategic and large scale (for example, brownfield regeneration, urban extension, area redevelopment) or more incremental and small scale (for example urban infill, block reconfiguration). Regardless of the scale or size of the development, it is important to recognise that all of these changes contribute to the physical transformation of the urban environment. Each change presents and opportunity to improve the physical structure and pattern of the urban environment (i.e. the urban form). In order to maximise on these opportunities, and understanding of the wider and strategic ambitions for the future form of the city is needed. The transformation of the city of Barcelona in Spain is a good example of how different types and scale of physical change can contribute to a more sustainable urban form. Barcelona has undergone significant urban transformation over the past twenty years. The city has been transformed through various changes to the

physical environment, from the urban greening in the historic core to the intensification of previously peripheral urban areas and the creation of new urban extensions (Catalán et al., 2008). These changes to the urban form in Barcelona have been incremental and insidious over a prolonged period of time. Nonetheless, the opportunities presented by the processes of urban change have been exploited to improve the quality of existing neighbourhoods and to strengthen the polycentric urban form of the metropolitan region. This has resulted in the strategic improvement of the urban form and function of the city (Rogers and Gumuchdijan, 1998).

The environmental, social and economic challenges that urban environments face now and into the future should not be underestimated. Urban areas will experience population and demographic changes, more limited resource availability, disparities in income, health and wellbeing as well as a changing climate. With an increasing majority of the world's population living in urban areas, the importance of providing liveable urban environments for all is critical (Harlan and Ruddell, 2011; Stone et al., 2010; Blanco et al., 2009; Hollander and Pallagst, 2009; Younger et al., 2008). The problem that many cities face is the rapidity of change in terms of the challenges that will face urban areas, contrasted with the slow pace of physical change (Wong et al., 2000). Therefore, as is the case with Barcelona, planning policies and processes need to be effective in the transition and incremental delivery of a desired future urban form. This requires the identification of the objectives and physical outcomes that are desired as well as the development or redevelopment opportunities that have capacity to deliver the nature and scale of change needed. This is not a new endeavour with discussions about idealised urban forms that

support liveable, healthy, energy efficient lifestyles have been around for nearly three decades.

### **SUSTAINABLE URBAN FORM**

Urban form is the composition of the physical attributes that define the size, density shape and configuration of a settlement. It provides the structural framework that underpins the connectivity, functionality and efficiency in the city. It is generally accepted that many current urban forms are not sustainable and change is needed in order to improve the function of the built environment (Jabareen, 2006). Williams defines a 'successful' urban form as those that "underpin the functioning of an array of urban systems, use resources sustainably, and provide a sound economic base that provides the setting for a good quality of life for their inhabitants. In addition, they can withstand shocks and 'bounce back' or improve their conditions post-shock (whether that shock be environmental, economic, or social)." (Williams, 2014:10).

Reducing energy use and greenhouse gas emissions in urban areas and the provision of, and access to, social, cultural and economic infrastructure for all is critical to ensure a balanced and effective society. Since the early 1990s, the role of urban form in affecting social, economic and environmental outcomes has been the focus of much debate and research. A large proportion of research around sustainable urban form has been primarily focussed on the impact of increased densities on the functional aspects of urban life, such as social interactions and travel behaviours (Newman and Kenworthy, 2011; Jabareen, 2006; Neuman, 2005; Williams et al., 2000; Burton et al., 1996) While there is mixed evidence regarding the specific contribution of urban form in achieving these objectives, there is wide acceptance that contained, higher density

and mixed use settlements are needed to underpin conditions that support sustainable urban functions and systems needed to address the significant challenges facing urban populations now and in the future (Williams, 2014; OECD Green Growth Studies, 2012).

Physical changes in urban areas provide opportunities to achieve a more desirable urban form. While different models of urban form are purported, it is generally agreed that a sustainable urban form is one that supports efficient functioning of urban systems, reduces resource use and emissions, reduces dependence on private motor vehicles, improves liveability for all; and is resilient to changing economic, social and environmental circumstances (Williams, 2014; Jabareen, 2006). There have also been several theoretical models promoted over this time with the goal of achieving some or all of these objectives. These have developed in response to burgeoning problems of urban sprawl, out of town retailing, large areas of single land uses and decreasing densities across cities (Jabareen, 2006; Neuman, 2005). These structural problems have resulted in car dependency, low levels of walking and cycling, a lack of activity on the street, limited opportunities for incidental social interaction and a loss of local economic activity, facilities and transport (Westerink et al., 2013; van der Waals, 2000; Burton et al., 1996; Commission of the European Communities, 1990).

From a review of the literature, seven models of sustainable urban form have been identified. These are: the compact city (Gaigné et al., 2012; Roo, 2000; Burton et al., 1996); polycentric city (Keenleyside et al., 2009); urban containment (Dawkins and Nelson, 2002); neo-traditional (or urban village) (The Urban Task Force, 1999); smart growth (Eames et al., 2013; Handy, 2005); transit oriented (Calthorpe, 1993); and eco-

city (Falk, 2011; Worthington and Bouwman, 2012). These models are relevant to different spatial scales, primarily focussing on the city and neighbourhood levels. Across the seven theoretical models, common objectives can be identified (Figure 2). These are: efficient use of land; reduced energy consumption (buildings); reduced energy consumption (transport); improved social interaction; improved quality of life; increased active travel; improved viability of local services and facilities; and improved safety.

Theoretical model	Common objectives
<i>Spatial scale</i>	
Compact City <i>City</i> <i>Neighbourhood</i>	Efficient use of land Reduced energy consumption (transport) Improved viability of local services and facilities Increased active travel Improved quality of life Improved social interaction Improved safety
Polycentric City <i>City</i> <i>Neighbourhood</i>	Improved viability of local services and facilities Reduced energy consumption (transport) Improved quality of life Improved social interaction
Urban containment <i>City</i>	Efficient use of land Reduced energy consumption (transport)
Neo-traditional/ Urban village <i>Neighbourhood</i>	Improved viability of local services and facilities Improved quality of life Increased active travel Improved social interaction Reduced energy consumption (transport) Improved safety
Smart Growth <i>City</i> <i>Neighbourhood</i>	Improved viability of local services and facilities Improved quality of life Increased active travel Improved social interaction Reduced energy consumption (transport) Improved safety
Transit oriented <i>Neighbourhood</i>	Reduced energy consumption (transport) Increased active travel Improved social interaction Improved quality of life Improved viability of local services and facilities
Eco-city <i>City</i>	Reduced energy consumption (buildings) Reduced energy consumption (transport)

**Figure 2:** Theoretical models that promote sustainable urban form and common objectives that underpin these models

The objectives behind these theoretical models are translated into planning principles that can be adopted in planning policy and decision-making. In order to understand how urban environments can be shaped to achieve these principles and overarching objectives, an understanding of the physical outcomes is needed. In order to understand how the objectives of a sustainable urban form and the planning principles that seek to achieve these, physical fabric of the city can be transitioned towards a more sustainable urban form, an understanding is needed about the physical outcomes anticipated by the different planning principles. In the next section the physical manifestation of sustainable urban form are identified.

## PHYSICAL MANIFESTATION OF SUSTAINABLE URBAN FORM

The previous section identified ‘models’ of sustainable urban form and established that these have some common objectives and planning principles. It also set out the conceptual framework for identifying the physical manifestation, or outcome, to planning principles. This provides the foundation to enable the identification of the physical form anticipated by sustainable urban design as well as the scale that these can be delivered (Figure 3). A two-fold approach is required as many of these planning principles apply at either (or both) the city and neighbourhood scale, and different physical outcomes are needed at different scales. (fig. 3) At the city scale, the physical outcomes include urban containment, strategic public transport and movement networks and a settlement pattern with sub-centres. These physical elements influence the shape and size of the city as well as the morphological form of the settlement. At the local, neighbourhood level, the physical form

is characterised by local networks of green and blue space, movement and transport networks, local mixed use centres and high quality public realm, and building forms that maximise building footprint and vertical space, passive surveillance, shared walls and low albedo surfaces; and the provision of local renewable energy systems.

Objective	Planning principle	Physical outcome: city form	Physical outcome: neighbourhood form
Efficient use of land	Compactness Higher densities	Urban containment	Increased building height Increased building footprints
Reduced energy consumption (buildings)	Compactness Higher density		Passive solar design Shared walls Low albedo surfaces Local renewable energy systems
Reduced energy consumption (transport)	Compactness Higher density Walkable neighbourhoods Mixed use Sustainable transport	Strategic public transport network Strategic movement networks Sub-centres (polycentric)	Increased building height Increased building footprints Connected movement networks Local facilities and shops High quality public realm
Improved social interaction	Compactness Higher density Walkable neighbourhoods Mixed use Sustainable transport	Sub-centres (polycentric) Strategic public transport network Strategic green and blue infrastructure network	Increased building height Increased building footprints Connected movement networks Local public transport network Local facilities and shops High quality public realm Local green and blue space
Improved quality of life	Compactness Higher density Walkable neighbourhoods Mixed use Sustainable transport	Sub-centres (polycentric) Strategic public transport network Strategic green and blue infrastructure network	Increased building height Increased building footprints Connected movement networks Local public transport network Local facilities and shops High quality public realm Local green and blue space
Improved active travel	Compactness Higher density Walkable neighbourhoods Mixed use Sustainable transport	Sub-centres (polycentric) Strategic public transport network Strategic green and blue infrastructure network	Increased building height Increased building footprints Connected movement networks Local public transport network Local facilities and shops High quality public realm Local green and blue space network
Improved viability of local services and facilities	Compactness Higher density Walkable neighbourhoods Mixed use	Sub-centres (polycentric)	Increased building height Increased building footprints Connected movement networks Local facilities and shops High quality public realm Local green and blue space network
Improved safety	Compactness Higher density Walkable neighbourhoods Mixed use		Passive surveillance of public space from buildings High quality public realm Local facilities and shops

**Figure 3:** Identification of the physical outcomes of sustainable urban form at the city and neighbourhood scale.

## OPPORTUNITIES TO DELIVER PHYSICAL CHANGE

The final stage of analysis is to understand how the physical outcomes identified can be delivered. This requires identifying the different types of

development and redevelopment that occurs in urban areas and analysing the degree to which these processes have the capacity to deliver the physical outcomes.

Figure 4 identifies different types of development and redevelopment derived from the literature. This is by no means an extensive list, but it represents the most common forms of development and redevelopment in urban areas. The types of development are identified at different spatial scales: city, neighbourhood and block. The additional spatial scale, the block has been added to the analysis as it was important to recognise that much development occurs below the neighbourhood scale, which has an important incremental effect on the urban form of a settlement

Scale of delivery	Type of development
City	Urban extension
	Satellite town (new town)
Neighbourhood	Area regeneration
	Brownfield redevelopment
Block	Infill
	Brownfield redevelopment
	Subdivision
	Vertical addition
	Demolition

**Figure 4:** Types of development and redevelopment at different spatial scales

The physical outcomes are then mapped against these different development types (Figure 5). It is worth noting that spatial scale(s) above could also deliver the physical outcomes identified at lower spatial scales. For example, the two development typologies identified at the city scale are capable of delivering neighbourhood-level physical outcomes. Similarly, the neighbourhood level is capable of delivering the physical outcomes identified at the block scale.

At the city scale, urban containment, strategic public transport and strategic movement networks are difficult to achieve through typical development and redevelopment projects. This needs to be recognised in planning practice as these important aspects of urban form required strategic planning and investment in order to be delivered. At the neighbourhood scale, the provision of local facilities, such as shops, open spaces and transport, have the least opportunity to be delivered across the different types of development. Another important consideration is the sensitivity to the local context in which many of these neighbourhood and block scale outcomes are designed and delivered. The increase in height and building footprint, if designed well, could have relatively minimal effect on adjoining buildings, the public realm and streetscape. However the opposite could also be true if the local characteristics and context is not sufficiently considered in the design.

### CONCLUSION

This paper has identified the opportunities for development and redevelopment processes to deliver a more sustainable urban form. This is not a straightforward task with multiple outcomes to be considered alongside the difficulty and complexity of delivering the neighbourhood and city scale outcomes. This highlights the necessity of ensuring that the incremental changes that occur in urban areas make a positive and conscious contribution to the shape of the future urban environment to improve the liveability and sustainability of the urban area. While the framework presented is based on generalisations derived from the existing discourse on sustainable urban form, and in any real life application local context needs to be considered and taken into account, they provide a useful framework for

Scale of delivery	Type of development	Physical outcome that potentially could be achieved
City	Urban extension	Sub centre(s) Local renewable energy systems
	Satellite town (new town)	Sub centre(s) Local renewable energy systems
Neighbourhood	Area regeneration	Local green and blue space Connected movement networks Local public transport network Local facilities and shops Local renewable energy systems
	Brownfield redevelopment	Local green and blue space Connected movement networks Local facilities and shops Local renewable energy systems
Block	Infill	Increased building height Increased building footprints Passive surveillance of public space from buildings Shared walls Low albedo surfaces
	Brownfield redevelopment	Local green and blue space Connected movement networks (partial) Local facilities and shops High quality public realm Passive solar design Shared walls Low albedo surfaces
	Subdivision	Increased building height Increased building footprints Shared walls Low albedo surfaces
	Vertical addition	Increased building height Increased building footprints Passive surveillance of public space from buildings Shared walls Low albedo surfaces
	Demolition	Local green and blue space High quality public realm Low albedo surfaces

**Figure 5:** The potential for the development and redevelopment types to deliver physical outcomes needed to achieve sustainable urban form.

analysing what aspects of urban form can be delivered through different processes of urban change.

In order to capitalise on opportunities of physical change in cities, it is critical to have an understanding about past urban transformations (Coenen and Truffer, 2012; Wiek et al., 2006).

Future research is needed to better understand the physical changes that have taken place within cities and the degree to which these adhere to the theoretical models and their aspirations. Intelligence about what aspects have been delivered and the reasons for any variation is needed to ensure the effectiveness of planning policy agendas in shaping the future urban form.

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