

Urban Sustainability Transition – A ‘Tipping Point’ Approach

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Abstract: The *Melbourne Principles for Sustainable Cities* – developed through the United Nations Environment Programme and adopted at the 2002 World Summit on Sustainable Development in Johannesburg – are presented as providing the holistic framework required for setting urban sustainability goals and attracting the participation and commitment of key stakeholders to achieve them. Because of the multitude of ‘actors’ and the inherent complexity in the structure, processes and interactions in a city, we can expect myriad pathways. Aiming for efficiency (i.e. shortest path and best use of limited time and resources) and effectiveness (i.e. sustained change over time), this paper proposes a ‘tipping point’ approach. Key conditions that lead to tipping point are discussed with examples from various fields and as related to urban sustainability transitions. Combining the concept of leverage points, soft system methodology and complex systems modelling, it will be possible to understand transformation drivers, investigate transition pathways and identify tipping point conditions for urban sustainability. Our cities are already in a state of overshoot; time is the ultimate non-renewable resource. A tipping point approach that has the capacity to facilitate rapid rates of transformation is required.

Introduction

A city is analogous to an organism whose metabolism demands inputs (materials, nutrition and energy) and ecological service to treat and adsorb its wastes. As cities have increased in size and complexity they have increasingly needed to access their hinterlands (near and far) to meet the needs of its metabolism. Their very survival therefore depends on the continuing effectiveness and integrity of these support systems, which are stressed if not overwhelmed by these demands (Dogan and Kasarda 1988). To add to these problems, social stresses through overcrowding, creation of slums and inadequate employment opportunities contribute to the sustainability crisis of cities.

Brunner et al. (1994) estimated that the material throughput of a modern city is about an order of magnitude larger than that in an ancient city of the same size. Australia, being one of the most urbanised countries in the world, has been estimated to have an Ecological Footprint of 7.7 global hectares (gha) per person, which is well beyond the level of what the planet can regenerate on an annual basis – about 1.8 gha per person per year – if applied to all cities (WWF 2006). Sydney’s Ecological Footprint (i.e. its notional hinterland) is said to be 150 times greater than the actual land area of Sydney itself (McMichael, cited in House of Representatives 2005).

Vision of a Sustainable Future

The response to creating more sustainable urban areas has been fragmented. Different professions have offered solutions within the confines of their disciplines. With the division of responsibilities between different levels of government, uncoordinated and sometimes incompatible programs have been generated at the political level. This fragmentation has also meant that solutions are spatially limited which means that dysfunctions in the urban metabolism are inadequately addressed. Above all, few programs engage with urban communities in developing solutions and they are often one dimensional, lacking adequate appreciation of the interactions between the economic, social and ecological spheres.

Putting aside jurisdictional issues and differing disciplinary viewpoints, without a common goal or destination, a holistic and integrated approach to the transformation of cities to sustainability is unlikely. Rather, the current situation of atomized programs (e.g. ‘sustainable energy futures’, ‘sustainable water futures’ or ‘sustainable transport futures’) will continue without considerations of cross-linkages and broader interdependent factors such as overall resource use or substitution, policy and regulations, market demands and social attitudes, technological and ecological impacts, among others.

Even if the main players can be brought together, other pre-conditions are necessary to create an integrated approach. They need to work from a common starting point and agreed framework. They not only need to involve with professionals, but also engage the commitment and enthusiasm of the communities that make up cities to achieve real transformation.

The starting point then is to define what a sustainable city is. The report on the Australian House of Representatives (2005) inquiry on Sustainable Cities emphasised the dilemma and challenge. One approach is to define or describe what an 'unsustainable city' is like (Ekins and Cooper 1993). Alternatively, we can consider the different perspectives on what a sustainable city should be like and cast them into a coherent set of goals or framework.

The work of the European network on sustainable urban development (also known as BEQUEST, which stands for **B**uilding, **E**nvironmental **Q**uality **E**valuation for **S**us**T**ainability) has provided an extensive review of frameworks and goals for sustainable development, in general, and cities, in particular (Curwell et al. 2005, Deakin et al. 2007). On the basis of the historical views on sustainable development and related concepts, BEQUEST adopted the urban development framework with four main headings:

- ecological integrity,
- equity,
- public participation, and
- futurity.

There are other frameworks, but one that has been selected in this paper is the set of ten guiding principles that came to be known as the *Melbourne Principles for Sustainable Cities*, which was developed through a Charrette organised by the United Nations Environment Programme (UNEP 2002). The Principles were adopted as part of Local Action 21 at the World Summit on Sustainable Development in Johannesburg (*The Johannesburg Call* 2002)) and subsequently adopted by the Australian Local Government Association (AGLA).

The Melbourne Principles provide a holistic framework within which institutions, communities and individuals can draw together the attention and valuable resources of all the professional, political and community participants in urban sustainability. In addition, they serve to highlight the interdependence between all the urban participants and between urban areas and their hinterlands. They also serve a pedagogical function of presenting the elements of what makes a city sustainable, without being prescriptive.

The Melbourne Principles have an additional advantage of having an authority bestowed on them by adoption at the World Summit on Sustainable Development and, in Australia, by AGLA. Furthermore, it is compatible with the intent and recommendations of the House of Representatives inquiry, and by not specifying any particular pathway, presented a highly flexible approach to encourage multiple pathways.

Transition Pathways

The logical next question then becomes 'how do we transition our current cities to a state which is more sustainable?' Because of the multitude of 'actors' and 'agents', and the inherent complexity in the structure, processes and interactions in a city, we can expect myriad solutions. This paper explores urban sustainability transition pathway(s) that: (a) are likely to be the shortest and most efficient route (i.e., the best use of limited time and resources), and (b) establish and maintain development towards the ultimate goal (i.e., irreversible or sustained over time).

In the study of epidemics, the point when a disease begins to spread rapidly and extensively by infection at a rate that substantially exceeds what is 'expected' is called a '*tipping point*'. Gladwell (2000) identified the key principles and conditions that have been observed to lead to tipping points, and demonstrated their applicability in a variety of historical situations. This paper extends the relevance/application of tipping point theory to urban sustainability transitions and the implications for policy development, urban management and research and development (R&D).

The 'Melbourne Principles for Sustainable Cities'

Genesis

Through UNEP's working group on Cities As Sustainable Ecosystems (CASE) an international Charrette was held in Melbourne between 3 and 5 April 2002 that brought together 40 experts from around the world.

The inspiration for the Melbourne Principles was the Hannover Principles that were developed by McDonough and Braungart (2003) in 1992 for EXPO 2000 in the City of Hannover. The attraction of this approach was that distillation of complex systems to a set of fundamental principles would allow

decision makers, practitioners and the community to establish a common understanding of the challenge.

Content and intent

According to one of the organizers of the Charrette (Blutstein 2005):

The Melbourne Principles are ten simple principles by which a city could develop strategic and action plans. They address the urban environment holistically, and are based on a triple-bottom-line framework. The language of each principle is straightforward and can be easily communicated to decision-makers, stakeholders and the general public. They apply to both developed and developing countries, and are designed to guide thinking and provide a strategic framework for action.

The Melbourne Principles (Appendix A) are intended to create a common starting point for this dialogue, to help communities, decision makers and other stakeholders to create a vision of the sustainable city and the basis for their participation and cooperation. Without this, transforming cities to sustainable pathways will not be possible.

The Melbourne Principles also suggest a process that is based on pedagogy, engagement and holistic problems solving. Furthermore, action-based programs that come out of this process will be strategic in scope and tailored to the particular circumstances of each city.

Moving forward

Following the Charrette, the Melbourne Principles were presented to the World Summit on Sustainable Development in Johannesburg in September 2002 at the Local Government Session. There they were endorsed as part of Local Action 21 (also referred to as *The Johannesburg Call*), which was the Implementation Framework for the post-Johannesburg decade of Local Agenda 21. Thus it was considered the successor program to Local Agenda 21. In the Preamble (*The Johannesburg Call* 2002),

Ten years after the 1992 Rio Earth Summit, Implementation of Agenda 21, the Rio conventions, and the Habitat Agenda is proceeding so slowly that the horrors of global poverty and environmental disruption are becoming ever more overwhelming. We demand, therefore, a profound shift in the current development model to one based on true equity and deep reverence for the processes of nature. We commit ourselves to the Earth Charter and the Melbourne Principles ...

The language of this document reflects the **urgency** felt at Johannesburg that urgent action was needed rather than gradual change. The type of viral campaign suggested by the tipping point presents an attractive and effective avenue to achieving the urgent changes envisaged by Local Action 21.

It is recognized that additional tools need to be developed to operationalise the Melbourne Principles. This has become one of the key objectives and foci of the Sustainable Cities research theme at CSIRO (Foliente et al. 2007).

The 'Tipping Point' Approach

Concept

The concept of the tipping point was drawn into the public dialogue by Malcolm Gladwell, a staff writer for the *New Yorker* magazine, who observed that if the right conditions existed 'ideas and products and messages and behaviours spread like viruses' (Gladwell 2000). In what was akin to social contagion just a few people could infect a whole market, community or even society.

There are indeed parallels between the way an idea is propagated and gains acceptance within a community and how an infection progresses through a population. For this to happen the pathogen must be capable of transferring from one individual to another and there must be a mechanism available through which this transfer can occur – a suitable vector. But even where these mechanisms are present pathogens do not necessarily lead to an epidemic. There is also a question of local density. The pathogen must be able to get to a new host and that host must be accessible to the vector. In the case of a health epidemic we are dealing with the physical transfer of material in the form of a pathogen. For societal change we are dealing with the transfer of an idea – but the principles are the same. We need an idea in a form that can be transferred, we need a method of communicating that idea and we need mutual support to be generated by those that have acquired the idea in a continuing process of propagation.

The term was actually first used in sociology in the late 1950s, and coined, by Grodzins (1958) when he discovered that most of the white families would remain in the neighbourhood so long as the comparative number of black families remained very small. But, at a certain point, when a critical number of arriving black families was reached, the remaining white families would move out en masse in a process known as 'white flight'. He called that moment the 'tipping point'.

The concept is illustrated as Path 1 in Figure 1, in comparison with two other processes, in the context of achieving a positive change in a system's sustainability. Path 2 is a process that reaches near enough the desired state ('successful' process) without a critical turning point, over a long enough time period. Path 3 demonstrates a process that seemed to be slowly heading the right direction but then loses steam, then fails eventually. Path 1, on the other hand, may start similar to the other paths, even beset with high levels of uncertainty and may include a few false starts. Within this turbulent milieu, however, a situation may arise where a process of propagation begins and gains momentum. Once this happens, the conditions created by the progress of change then stabilise and perpetuate the conditions for more change within a very narrow time window. This positive feedback system then drives change rapidly as it progresses. Then, in turn, as the opportunities for further change decrease the process slows down and gradually approaches its limit. Tipping point theory sets out to identify the conditions under which this tipping process operates (shaded area 'a' in Figure 1). (Shaded area 'b' asks a different question: what caused Path 3 to fail compared to Paths 1 and 2?)

The tipping point, based on this observed characteristic of sudden radical change within a short period of time, can also be compared to phase transition in physics or the angle of repose, an inflection point, in mathematics. Most people are resigned to a long-drawn process of change for systems that are complex and have many facets – this is indeed a reasonable expectation. But the tipping point concept provides an alternative pathway that achieves the best (or desired) outcome with the shortest and most efficient route (i.e. the best use of limited time and resources).

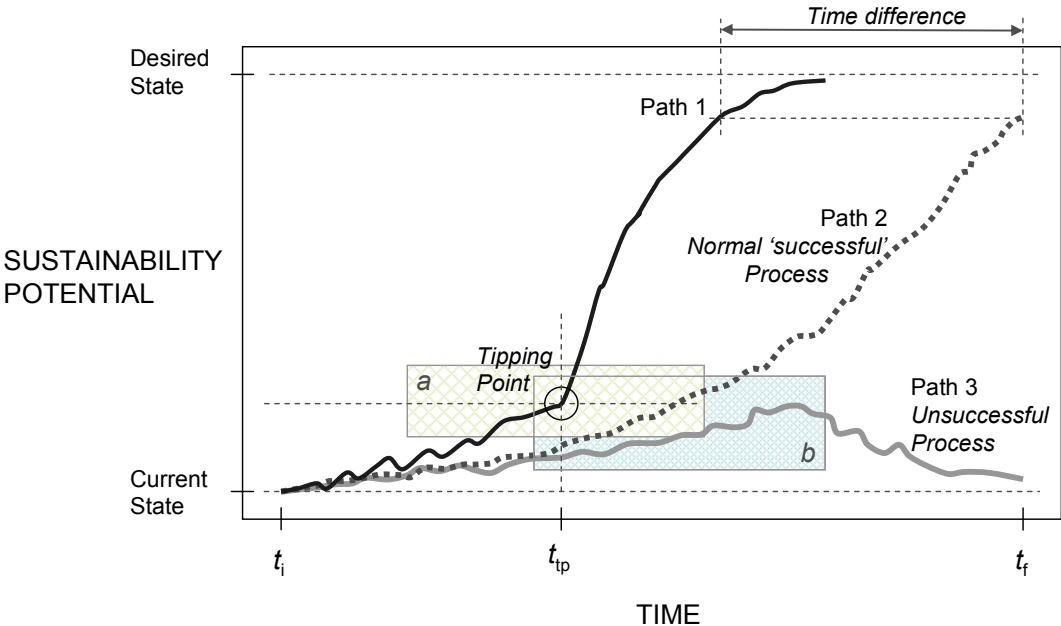


Figure 1. Illustrative diagram of a tipping point process

Key conditions

If the Melbourne Principles is accepted as a generic set of goals for sustainable urban future (the 'Desired State' in Figure 1), there remains the pressing problem of how they are to be achieved. Consideration has to be given to the processes through which ideas can become reality and that in turn requires understanding of the conditions under which communities make the adequate commitment to change; that is, conditions that bring about a tipping point, and differentiate Path 1 from Path 2 (shaded area 'a' in Figure 1). So, attention turns to what are the conditions necessary for change to occur. If we could describe these conditions we might then use this understanding to create or nurture the development of such a propitious situation. The challenge becomes 'what needs to be done to facilitate the major societal and physical transformation that would facilitate sustainable urban futures?'

In his book, Gladwell (2000) uses examples that range from the sales of shoes to crime reduction in New York. He even uses it to suggest how the levers of change could be put together to dissuade teenagers from smoking. One of the attractions of the concept is that in each example we see for relatively little effort sudden and often wide-ranging social changes can occur. Gladwell distilled the common characteristics from his examples into three general principles. These are summarised below, with brief comments about their implications to urban sustainability transitions.

Principle 1: 'Law of the Few'

Gladwell takes as his starting point the need to enlist the support of three groups who are essential to creating the conditions that promote a tipping point. They are:

- the *mavens*, people with deep and/or broad knowledge in the target area,
- the *connectors* who know all the important people and can bring them together, and
- the *salesmen*, people who can effectively sell an idea.

Those with these skill sets have disproportionate influence over the spread of social phenomena. Without their aid, such dissemination is unlikely ever to occur. In Gladwell's Law of the Few, it is just a matter of recruiting a few key people to create a tipping point situation.

Local governments endorsed the Melbourne Principles in Johannesburg, demonstrating their awareness and commitment for the transformation of urban centres into sustainable cities. As connectors and salespeople, they are in an ideal position to contribute to the creation of a tipping point, but the process will need to be an inclusive process involving key opinion leaders in business and industry, the community, non-governmental organisations (NGOs) and other levels of government.

The main area in which local government is weak is as a maven. Organisations such as the Australian Conservation Foundation (ACF), the International Council for Local Environmental Initiatives (ICLEI), the universities and CSIRO, which have available, or have the capacity to develop, the required knowledge could partner with local government in their endeavour.

Principle 2: 'Stickiness Factor'

Next Gladwell discusses the stickiness of the message. This concept deals with inventing and applying messages that are readily understood and act as a persuasive prompts that, under the right circumstances, compel action. The secret of stickiness is to have a message that is both simple and irresistible. From the TV programs Sesame Street and Blue's Clues, Gladwell demonstrates how it is possible to hone a message that makes it so sticky that, in these examples, children's uptake of the key messages was significantly increased.

The Melbourne Principles provide an avenue to presenting a 'sticky' message on sustainable cities. Its very simplicity, strong direct language and presentation as a set of common sense principles representing best practice thinking positions it ideally to meet this function. However, further work is required to package the key themes embodied in the principles into a few memorable and compelling messages. The current state of 'information glut' makes it harder and harder for any message to stick, and even more so to precipitate action.

Principle 3: 'The Power of Context'

The last law in Gladwell's thesis is the Power of Context, stating that environmental influences play an important role. Human behavior is strongly influenced by external variables of context. The example he uses is how New York City's 'zero tolerance' campaign worked to dropping the crime rate by creating an atmosphere in which everyone knew that the least transgression would be punished.

In Australia, there are six issues that provide context for the uptake of the Melbourne Principles. They also have a high level of visibility and urgency; while they are not necessarily directly linked to cities, they can influence societal attitudes and actions. These issues, matched with the relevant Melbourne Principles, are identified as follows:

- Global warming – control of greenhouse gas emissions will require a major transformation of our cities so that not only sustainable production is addressed but also sustainable consumption (Melbourne Principle 9; see Appendix A)
- Water scarcity has become an encompassing national issue where high levels of urban consumption draw water from rural areas.

- Infrastructure renewal is a universal priority deriving from decades of under-investment. Optimising value for money can be achieved through sustainable solutions (Melbourne Principles 4 and 5)
- Population pressure has made planners reconsider how they can accommodate larger numbers of people while meeting with the environmental, economic and social benefits and services and amenities Australians expect (Melbourne Principles 1, 2, 4, 5 and 9).
- Greater willingness of people to shape their communities provides a vehicle to drive change (Melbourne Principles 1, 4, 7 and 8)
- Australia projects itself as 'clean and green'. The Melbourne Principles provide an opportunity to convert Australian cities into exemplars of sustainability (Melbourne Principles 1 and 6).

Applications and implications for change

Engineering a tipping point is difficult because of the complexity of the systems within which the sustainability contagion needs to take hold. It has to be recognised that there cannot be any guarantee of when or even if the tipping point will occur. Despite this inherent uncertainty, the idea has been picked up by business and others, with the strategies identified by Gladwell being applied to:

- business leadership, management and corporate change (Kim and Mauborgne 2003, Shapiro 2003, Checketts 2006, Herrero 2006),
- transformation of the construction industry (Foliente and Boxhall 2002, Bakens et al. 2005),
- community transformation (Hille, n.d.), and
- conservation cause (Sadovy, 2005), among many others.

In pursuing the goal of urban sustainability it becomes clear that no one agency 'owns' the problem, and solutions will need to come from a cooperative effort from a wide range of parties that include (but are not restricted to) national, state and local governments, managers of infrastructure and services, business and industry, and finally community groups and the public.

But considering the Law of the Few, an intelligent and strategic plan of action can enhance the conditions for – and thus increase the probability for - a tipping point for urban sustainability. First, we should note that this principle is very similar to:

- the 'Pareto Principle' also popularly known as the '80/20 Rule', which states that for many phenomena 80% of consequences stem from 20% of the causes (in fact, this is also sometimes referred to as the 'law of the vital few'); and
- the innovation (or technology) diffusion model.

In the latter, the focus is on how an innovation (product or idea) moves through a population. In this field, it has been observed that the likelihood of an innovation being adopted by a larger population is increased if it is first utilised by a smaller group of 'opinion leaders' (Rothman et al. 1976). Typically, the successful diffusion of an innovation involves a two-step process:

1. uptake by early adopters and opinion leaders, and
2. subsequent adoption by a larger population.

Figure 2 shows the five types of adopters and their relative place in the diffusion process (Smale 1996).

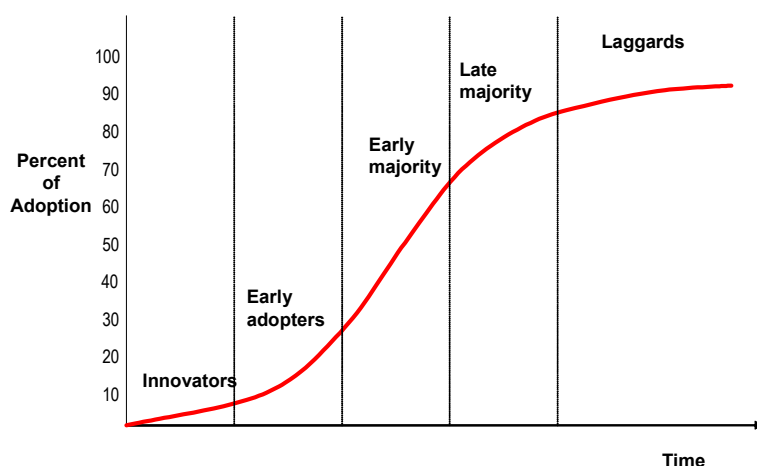


Figure 2. Adopter types in the diffusion process (Smale 1996)

Gladwell's vital few correspond well with the 'Innovators' and the 'Early adopters', who create and adopt ideas before many others. But more than this, the connectors, mavens, and salesmen make it possible for innovations to connect with other adopters in a very short period of time. They can translate ideas into a language the rest of us can understand (stickiness factor). They

can drop extraneous details and enhance other details so that the message itself acquires a deeper meaning. The key concept in the tipping point that would be of great interest to diffusion consultants, professionals and researchers is, again, understanding and bringing about the conditions that account for the sudden change – the inflection point in Figure 1.

Sustainability Transition – A Few Examples

A tipping point approach to urban sustainability is very attractive and thus advocated herein because it: (1) offers the shortest and most efficient route (i.e., the best use of very limited time and resources), and (b) often results in irreversible or sustained outcomes over time. A few examples are presented in this section to demonstrate the potential of the tipping point approach to transition our cities to a more sustainable state.

Tipping point leadership in urban setting

In a *Harvard Business Review* paper, Kim and Mauborgne (2003) presented and analysed how William Bratton, New York City's police commissioner, when he got the job in 1994, addressed a spiraling crime problem and low morale in the police force. His actions turned New York into the safest large city in the US in less than two years. Of special interest is that this was the fifth law-enforcement agency that Bratton had turned around. In each case, he *succeeded in record time* despite limited resources, a demotivated staff, opposition from powerful vested interests, and an organisation wedded to the status quo. In short, Bratton has consistently demonstrated what the authors called 'tipping point leadership'.

A summary of his approach is described below (Kim and Mauborgne 2003):

Bratton begins by overcoming the cognitive hurdles that block companies from recognizing the need for radical change. He puts managers face-to-face with operational problems. Next, he manages around limitations on funds, manpower, or equipment by concentrating resources on the areas that are most in need of change and that have the biggest possible payoffs. He meanwhile solves the motivation problem by singling out key influencers – people with disproportionate power due to their connections or persuasive abilities. Finally, he closes off potentially fatal resistance from powerful opponents.

Although on a much broader scale and occurring over a longer period, but perhaps in a similar vein it can be said that key to the well-known and highly-regarded success of Curitiba in Brazil as an example of urban sustainability is tipping point leadership, primarily by Jamie Lerner, the chief architect of Curitiba's Master Plan, three-term mayor of the city and two-term governor of the province. His vision and leadership were exemplified by Lerner and his colleague's creative/innovative and cost-efficient answers to complex urban problems.

In summing up his assessment of Curitiba's success, Gnatek (2003) concluded that:

...for the most part, the keys to its current urban successes lie in the visions of those who created the Curitiba Master Plan. To ensure that their ideas would be realized, many planners and architects sought and served public office, where they had the power to implement them.

And most importantly, their vision, values and commitment have not only been adopted by its people but are now ingrained in the citizenry (an example of ultimate stickiness) (Gnatek 2003). Lerner had been quoted to say (Meadows, n.d.):

There is no endeavour more noble than the attempt to achieve a collective dream. When a city accepts as a mandate its quality of life; when it respects the people who live in it; when it respects the environment; when it prepares for future generations, the people share the responsibility for that mandate, and this shared cause is the only way to achieve that collective dream.

Context and stickiness – shopping bags

In Australia, one example that substantiates the framework provided by Gladwell is the fast-growing adoption of reusable bags over plastic bags.

With around 6 billion single-use plastic bags consumed per year, this represented a burden on landfill and presented a serious little problem, particularly in waterways where wildlife could get entangled in waste bags and even swallow them, resulting in higher mortality rates. They also present a significant aesthetic problem, as they are a highly visible component of litter (Nolan 2002).

This problem was known for some time, and was an issue when the first resource recovery legislation was introduced in Victoria in 1990. A component of that Bill that was defeated in the Legislative

Assembly was the inclusion of a possible levy on bags if the suppliers failed to produce an adequate resource recovery plan. This aborted attempt to target plastic bags through legislation did, however, result in the Australian Retailers Association issuing a 'Code of Practice for the Management of Plastic Bags' in October 1993, that was endorsed by the Environment Protection and Heritage Council (EPHC) in October 2003. After that the Packaging Covenant came into play, but its main emphasis was on resource recovery of containers and other large consumables like tyres, batteries and electrical goods rather than plastic bags.

While levies or bans on plastic bags had been on the agenda for policy makers and environmentalists for some time, the practicality of this measure was not known nor was there any appreciation on how the community would react to such an intervention. This changed in March, 2002, when the Irish legislature introduced a tax on LWPBs. A 15 euro-cent levy is charged on all plastic bags except: bags used solely to contain fresh meat, fish, ice, poultry, loose fruit and vegetables and other unpackaged foods; strong, thick reusable bags that are sold for 70 euro cents (\$A1.30) and a mesh type bag sold for 1 Euro (\$2). The response from the public was positive, which showed that such a measure was both practical and relatively popular. The Irish Government estimated that use of plastic bags has fallen by more than 90 per cent. This provided a strong justification for other countries to adopt similar strategies (i.e. the power of context is at play).

Organisations such as Planet Ark acted as a maven, feeding the media information of the effectiveness of overseas bans (Peatling 2002). The key messages that plastic bags caused litter and pollution problems proved to be sticky. As momentum built up, newspapers ran graphic stories of the perils of plastic bags, from strangled fish to criticism of plastic bags by Craig Lowndes, who during the Bathurst 1000, run in 2002, was forced out of the race after a plastic bag blew on to the track and clogged up his engine's air duct (Peatling 2002).

Prior to the 2004 Federal election bans on plastic bags had become an election issue as Mark Latham announced that the ALP would ban the bags from 2007. By the time that the EPHC revisited the issue in 2006 the public had embraced reusable bags in increasing numbers, and the opposition of supermarkets started to evaporate when their customers showed that they did not support their opposition to a plastic bag tax (Pennells 2003).

R&D implications and challenges

Society and cities operate as a very complex system. We may have some understanding of low-level unit processes in the system, but these units link and interact with others in the system in a very dynamic way, resulting in system behaviour and outcomes that are very hard to predict based solely on unit process characteristics. Not only are the system's internal mechanisms dynamic, they also have inherent stochasticity (some units more uncertain than others). All the concepts of emergence, coherence (and synchronicity), self-organisation and adaptivity in complexity science apply (Salingaros 2005). Many researchers have studied urban dynamics using complex system concepts and models such as cellular automata, agent-based models and fractals (Batty 2005), system dynamics and network theory.

It is this capacity to explain or at least give practical insight to the workings of very complex systems that makes the tipping point approach so very attractive. If we identify and operate on the right 'leverage points' in this complex system, the transition to a desired state can happen suddenly or at a very rapid rate. Meadows (1999) defined leverage points as 'places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything' – the exact same concept that we have been discussing with the tipping point!

Different scenario analyses based on different inputs and assumptions will allow confirmation or revision of identified leverage points and guidance on which direction the different levers need to be turned to. [Interesting to note here an example cited by Meadows (1999) where the managers in a company seemed to have correctly identified the levers to improve performance but were 'trying very hard to push it in the wrong direction!'] Complex systems are often counterintuitive; 'leverage points are not intuitive' (Meadows 1999). Good urban dynamics modelling tools will allow us to test our intuitions virtually (without real harm) and different options repeatedly. Tipping point pathways will emerge.

Summary and Concluding Note

A case for urban sustainability transition pathway(s) that are both efficient and effective was presented. The tipping point approach – i.e. the idea of spreading ideas, products, messages and behaviours like

viruses, aiming for a radical change within a short period of time – was proposed as a desirable pathway to an urban sustainability future articulated through the Melbourne Principles for Sustainable Cities. Combining the tipping point's three simple conditions – the Law of the Few, the Stickiness Factor, and the Power of Context – with the concept of leverage points, soft system methodology and complex systems modelling could lead to a virtual set of tools or a whole platform for testing the impacts and consequences of our intuitions, policies and actions under different sets of factors/parameters (i.e. that define context) on the state of our cities. The practical goal is to identify the key pathways and conditions that will most likely lead to a tipping point. This process is not guaranteed to always lead to the desired outcomes, as Meadows (1999) had cautioned:

Magical leverage points are not easily accessible...There are no cheap tickets to mastery. You have to work at it, whether that means rigorously analysing a system or rigorously casting off your own paradigms and throwing yourself into the humility of Not Knowing.

But we can not waste very limited resources on pathways to nowhere; we cannot waste time because our cities are already in a state of overshoot. We need to try to do something now. Time is of the essence; it is the ultimate non-renewable resource. This is why a tipping point approach that has the capacity to facilitate rapid rates of transformation is downright necessary.

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Appendix A. The 'Melbourne Principles for Sustainable Cities'

A Vision for the Creation of Sustainable Cities

To create environmentally healthy, vibrant and sustainable cities where people respect one another and nature, to the benefit of all.

The Ten Melbourne Principles

The *Melbourne Principles* provide a simple set of statements on how a sustainable city would function.

- Principle 1** Provide a long-term vision for cities based on: sustainability; intergenerational, social, economic and political equity; and their individuality.
- Principle 2** Achieve long-term economic and social security.
- Principle 3** Recognise the intrinsic value of biodiversity and natural ecosystems, and protect and restore them.
- Principle 4** Enable communities to minimise their ecological footprint.
- Principle 5** Build on the characteristics of ecosystems in the development and nurturing of healthy and sustainable cities.
- Principle 6** Recognise and build on the distinctive characteristics of cities, including their human and cultural values, history and natural systems.
- Principle 7** Empower people and foster participation.
- Principle 8** Expand and enable cooperative networks to work towards a common, sustainable future.
- Principle 9** Promote sustainable production and consumption, through appropriate use of environmentally sound technologies and effective demand management.
- Principle 10** Enable continual improvement, based on accountability, transparency and good governance.