Technological Forecasting & Social Change xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

journal homepage: www.elsevier.com/locate/techfore

Investigating traffic congestion: Targeting technological and social interdependencies through general morphological analysis

Guy Duczynski

Australian Graduate School of Policing and Security, Charles Sturt University, 10–12 Brisbane Avenue, Barton, Canberra, Australia

ARTICLE INFO

Keywords:
General morphological analysis
Strategic planning
'Wicked messy' problems
Complexity
Social change
Operational design

ABSTRACT

Many (all?) large cities are experiencing traffic congestion in one form or another. This is typically manifested in the morning and afternoon commutes as the largest numbers of public transport passengers (on rail, tram, bus and ferry) and private car users seek to negotiate transport corridors that are not designed for those volumes within those compressed time frames. It has become known as 'gridlock' and is characteristic of a system pushed well beyond a tipping point. The problem has both technological and social origins with one contributing to and indeed magnifying the other. It is a 'wicked, messy' problem and one that has not responded to (and likely never will) conventional planning practices. This paper investigates the utility of General Morphological Analysis to present the causal factors from a systems-based perspective; expose the underlying and unfavourable conditions that conspire in knowable ways to create this congestion; and offer a more favourable set of conditions based on necessary technological and social adjustments that can eliminate, or at least reduce, the congestion. The method outlined encourages planners to appreciate the complexity of the problem space and design meaningful lines of effort based on a deepened appreciation of numerous interdependencies. The research findings can benefit any large city experiencing congestion and low participation levels in public transport.

1. Introduction

Consider this dialogue between two public policy officials who are seeking to investigate the nature and consequences of traffic congestion:

Official A. "*Why don't more people catch public transport to work*?" "*Our major roads are choked with commuters twice each day for several hours and always at the same times*". "*Aside from being a ridiculous and costly situation, it is economically and socially unsustainable*". "*Why is there a single occupant in each vehicle, this is crazy*"? *There must be something we can do to encourage more of these commuters into public transport*".

Official B. "*Well, we've tried … it's complicated*".

Official A. "*How complicated can it be*; *it's just people, cars and their making a choice on getting to and from work*?"

Official B. "*There are lots of factors involved, possibly hundreds of individual concerns. Each individual has their own set of concerns that combine to discourage them from using public transport more frequently*". "*It really is a wicked, messy problem*" *with both technology and social considerations*.

Official A. "*Okay, if it is a wicked, messy problem, then it is reasonable to assume that it will not respond favourably to conventional planning approaches or analysis*". "*We need to look at this differently, our current approaches are not presenting us with any additional information*". "*Is there another approach that can give us deeper insights into what is going on and possibly signal what could be done to correct the situation*?"

It is easy to sense the frustration in these individuals who, despite their best efforts, appear unable to develop satisfactory solutions to what is a complex yet common problem (Arnott et al., 2005). Similar problems plaguing public officials in other contexts are: obesity, terrorism, people smuggling, land degradation and climate change with all seeming to defy all reasonable attempts to achieve a solution. Furthermore, "wicked problems are part of the society that generates them, any resolution brings with it a call for changes in that society" (Brown et al., 2010, p. 4). One of the most spectacular paradoxes and apparently unsolvable wicked problem is gun ownership in the United States. It is clearly the domain of social planners and social planning (Lewin, 1947) and the overall effort represents a means of improving the functioning of organisations [and represents a] circular feedback in which goals are clarified, paths identified, and actions kept to the path (Stacey, 1996, p. 198).

Accompanying this apparently unsolvable traffic congestion situation is a ritualised twice-daily transmission across various media of the 'traffic

E-mail address: gduczynski@csu.edu.au.

http://dx.doi.org/10.1016/j.techfore.2017.05.019
Received 16 February 2017; Received in revised form 14 May 2017; Accepted 16 May 2017

report', whereby we seek to demonstrate to ourselves and the world that we are in control, the ebbs and flows are understood, they are being tracked and responded to in detail. The reality is that the system has progressed into a failure mode (again) and we are trapped, almost stationary, within it until it self-corrects (Bando et al., 1995; Downs, 1962).

> What makes people use or prefer the car more than public transport? What will facilitate the use of public transport? An understanding of the factors that affect mode choice is essential to the promotion of more sustainable behaviour and the achievement of the state's transport targets.
> [and]
> Techniques to study and quantify the mode choice process have been in use and development for decades. The methodologies are involved and reflect the complexity of the travel behaviour, the range of factors that impact on the choice process, the interaction between variables during decision-making and the variability due to the diversity of travellers making these decisions themselves.
> (Corpuz, 2007, p. 1)

It remains one of the most intractable problems and (coping with) it has become "an essential part of human life, especially in cities" (Polat, 2012, p. 1) and "if considered and used responsibly, design should be the crucial anvil on which the human environment, in all its detail, is shaped and constructed for the betterment and delight of all" (Heskitt, 2002, p. 1). As noted by Arnott and Small (1994, p. 446) "Time spent ensnarled in traffic is not simply time wasted; for most of us, it is time *miserably* wasted [emphasis added]".

2. Theoretical framework

The more generalised form of Morphological Analysis (MA) originated with Fritz Zwicky in the 1940s. It extended already successful morphologies within biology, geology, botany, linguistics and astronomy and allowed a planner to represent, "categorise and investigate the total set of relationships contained in multi-dimensional, non-quantifiable problem complexes" (Ritchey, 2006, p. 1). Ritchey had earlier (1998, p. 1) coined the term General Morphological Analysis (GMA) and has done much to popularise the method within national security, scenarios, strategy and later general policy and planning. It should be viewed as widely applicable within complex problems and is an "orderly way of looking at things …. [and] the only innovation … is to carry morphological thinking to a degree of generality not commonly realised" (Zwicky, 1948, p. 121). For our area of interest here of participation levels on public transport and associated traffic congestion our "aim is to achieve a schematic perspective over *all* of the possible solutions of a given large-scale problem [emphasis added]" (Zwicky, 1948, p.121) to discover both the technology (built environment) and social (behavioural) contributors.

3. 'Solving' wicked problems

As a means to overcoming these and other planning difficulties the Australian Public Sector Commission has provided its staff with a policy document titled: *Tackling Wicked Problems: A Public Policy Perspective*, providing much valuable advice, including: "it is their social complexity that is often the hardest part of tackling wicked problems and that overwhelms most current problem–solving and project management techniques" (Australian Public Service Commission, 2007, p. 17). Although not specifically mentioning GMA the document points towards the need for methods to be "capable of grasping the big picture, including the interrelationships among the full range of *causal factors* underlying them" (Australian Public Service Commission, 2007, p. iii, emphasis added)

> Policy should probably address accessibility and other improvements in public transport not in isolation but along with interventions that consider other factors that may amplify the benefits and which are less costly to implement.
> (Corpuz, 2007, p. 6)

The problem our public policy officials in the introduction are attempting to solve – public transport and commuter traffic – possesses an unusual set of characteristics and will often frustrate efforts to bring forward meaningful change (Taylor, 2002). Furthermore, "a main problem in the study of organizational change is that the environmental contexts in which organizations exist are themselves changing, at an increasing rate, and towards increasing complexity (Emery and Trist, 1965 p. 21,). The act of planning is continually undermined and interfered with by unknown (but knowable) actors and events.

In their article titled *Dilemmas in a General Theory of Planning*, Rittell and Weber (1973) offered an explanation for why planning in large social policy contexts has become excruciatingly difficult. The act of planning, having (usually) a straightforward objective of achieving an outcome, has in the presence of competing stakeholder interests the potential to arouse numerous and surprising forces of resistance, neutrality and support; with these positions changing without warning, for often unexplainable reasons, and "one of the most intractable problems is that of defining problems" in order to begin solving them (Rittell and Weber, 1973).

The term 'wicked, messy' problem was an appropriate characterisation and signalled a warning that "you can never merely do one thing" (Hardin, 1968); consequences may be unintended, however, they should not be unexpected and the inherent complexity and ambiguity must be approached with caution. Wicked, messy problems have also attracted the label of "unstructured reality" (Horn, 2001) as, while they may embody a quite peculiar situation or set of circumstances that requires effort to understand, they are nevertheless part of the lived-in world.

Rittell and Webber (1973) described ten characteristics, several that are relevant to this investigation are outlined here:

1. **Wicked problems are difficult to define** and comprise a variety of stakeholders each with their own version of the facts
2. **There is no clear solution** that can accommodate all needs, often a good enough arrangement will serve to manage the situation, albeit temporarily
3. **In wicked problems, you cannot go back and try something else**, every action is a one–shot operation, the system or area of interest has been altered in ways that may not be immediately evident and you can only go forward
4. **Every wicked problem is essentially unique**; despite many common features a few subtle differences can change Instability is a constant condition, as soon as an acceptable appreciation is formed that gives confidence to actions the key elements have altered

4. The research focus

This paper investigates the combined social, policy and technology problem of under–utilisation of public transport in a capital city in Australia, with many of the key factors and underlying conditions loosely applicable to other capital cities – the factors are key and "the current literature makes great emphasis on the factors that influence demand" (Polat, 2012, p. 1212).

Remaining alert to the wickedness and messiness of this subject, the paper seeks to explore this subject using General Morphological Analysis – a method proven to be highly suited to these and other similar problems where complexity is a dominant characteristic. It demonstrates that to reach a meaningful solution there must be an appropriate amount of attention