IMPACT OF MEGATRENDS ON STORMWATER MANAGEMENT

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ABSTRACT

The world is changing faster than ever which presents a challenge for designers to foresee the big issues that infrastructure will face in the future. Stormwater infrastructure especially is facing enormous changes. How do we foresee the issues that stormwater infrastructure will face? Megatrends are a powerful tool that designers can use today to prepare for the big issues that infrastructure will face in the future.

Broadly defined, megatrends are patterns or changes which occur over a long period of time that have a major impact on businesses and society as a whole. Some megatrends which irrefutably impact on the stormwater industry include, technology, increasing consumer power and urbanization. Each megatrend can have multiple impacts. There is considerable uncertainty around impacts, especially the magnitude of the impact, the time frames around impacts and the balance of conflicting impacts. This paper discusses how megatrends can be used to guide infrastructure design to cope with future issues.

KEYWORDS

Megatrends, disruptive technology, innovation, stormwater, urbanization, climate change.

PRESENTER PROFILE

Pulith Kapugama is a stormwater professional with interests in both infrastructure design and asset management. Most recently, Pulith has delivered multiple stormwater system upgrades throughout Auckland. In the asset management space, Pulith was engaged in delivering national data standards and national seismic guidelines for underground utilities.

1 INTRODUCTION

How often have you come across infrastructure that is unable to cope due to a change in the demand placed on it? Be it a highway that is in constant gridlock because of an increase in traffic or a stormwater system unable to cope with the increased demands of climate change. Poor understanding of issues infrastructure will face in the future can be disastrous. Infrastructure must meet the demands of today and take into consideration the issues of tomorrow. Without the use of a crystal ball, how does one predict what tomorrow will look like? Megatrends may help provide the answer.

Megatrends can provide a powerful tool to give insight in to the issues infrastructure could face in the future. A megatrend can be described as "a pattern or movement which has a major impact on business or society as a whole" (Lancefield, 2014).

This paper focuses on how megatrends can be used to guide stormwater infrastructure design. The paper discusses the impact of a select number of megatrends, the

uncertainty around the impact of megatrends and how to manage the impact of megatrends on stormwater infrastructure to address potential issues in the future.

2 MEGATRENDS AND WHY THEY MATTER

Consideration of future issues affecting infrastructure is not only a good practice, it is required by law under the Local Government Act (LGA). The LGA legislates "A local authority must, as part of its long-term plan, prepare and adopt an infrastructure strategy for a period of at least 30 consecutive financial years". The purpose of the strategy is to "identify significant infrastructure issues for the local authority over the period covered by the strategy; and identify the principal options for managing those issues and the implications of those options". Understanding megatrends and their impacts can help forecast issues in this timeframe.

Megatrends are characterized by the extended time taken for it to manifest itself fully. Hence megatrends are tool that can be used in the present time to understand significant issues that are likely to be encountered in the future.

Forecasting megatrends and assessing the impacts of megatrends on a given industry or organization can be a tricky business, but one that is increasingly in demand. Megatrend forecasting services are provided by several organizations including many large consultancies and government organizations. Table 1 summarizes the megatrends many of these consultants and organization have forecast.

Table 1: Summary of Megatrends

KPMG	Hay Group	EY	PWC	CSIRO	PRISM
Demographics	Globalization	Industry refined	Rapid urbanization	Limited resources	Disruptive technology
Rise of the individual	Environmental crisis	The future of smart	Climate change and resource scarcity	ecological change	Shortage of resources
Digital Disruption	Digitization	The future of work	Shift in global economic power	Increase consumer expectations	Climate change
Enabling technology	Demographic Change	Behavioral revolution	Demographic and social change	increased connectivity	Knowledge and information society
Economic shift to Asia	Technological Convergence	Empowered customer	Technological breakthroughs	Demographic change	Economic Shifts
Infrastructure investment		Urban World		change in economic power	Globalization
The environment		Health reimagined			Demographic Shit
Customer Centricity		Resourceful Planet			Urbanization and mobility

3 PLANNING FOR THE FUTURE WITH MEGATRENDS

The diagram below shows the major steps involved in using megatrends to understand future issues facing stormwater infrastructure. Each step is discussed in further detail in the sections below.

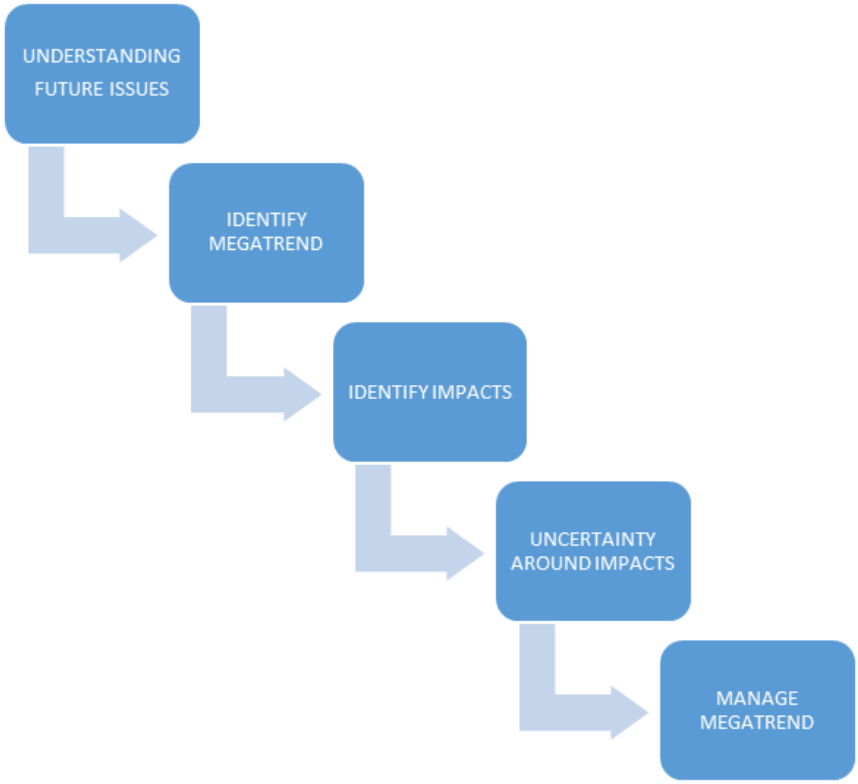

Figure 1: Planning for the future with megatrends

4 SELECT MEGATRENDS AND IDENTIFYING IMPACTS

The following sections discuss selected megatrend and their impacts. It is important to make a distinction between the two. The term megatrend is defined in earlier sections. The "impact" is the flow on effect of the megatrend. In literature, impacts of megatrends are often referred to as sub-trends. For the sake of consistency, we are using the term "impact" throughout the paper.

There is no hard and fast list of megatrends that is exhaustive and prescriptive. Having said that, there is a high degree of consensus in number of key megatrends. Some of the more commonly noted examples which have a significant bearing on stormwater infrastructure are listed below.

- Technology breakthroughs
- Increasing consumer demand
- Urbanization

It should be noted that climate change is a megatrend that will have a very significant bearing. However, this megatrend is well researched and therefore not discussed in greater detail in this paper.

Technology

Technology breakthroughs are happening faster than ever and affecting every facet of modern society. A study conducted by PWC found that 77 percent of CEOs considered technology breakthroughs as the megatrend that will disrupt their business (PWC, 2016). Modern history is filled with organizations that made the most of technology breakthroughs and thrived. Conversely, countless other businesses that ignored technology have perished.

Technology breakthroughs can occur in all sectors. While discussing what those technology breakthroughs are is outside the scope of this document, it is relevant to discuss their impacts on stormwater. Also, the impacts of various technological breakthroughs are similar. This paper focuses on two such impacts:

- Data explosion
- Changing contaminant profiles

Throughout the world, data volume is exploding. Technology is creating and collecting more and more data. In 2015, it is estimated that more data was created in the preceding 2 years than all of history (Marr, 2015). This staggering rise in data generation is only accelerating. Interestingly, it is thought that less than 0.5% of all data is used and analyzed (Marr, 2015).

Data drives better decisions. Higher quality data and better use of data leads to better decisions. The seeming lack of analysis of data raises the question of whether the data that is collected is useful and, whether there is enough guidance on the use of data.

Technology breakthroughs are changing contaminant profiles. Major sources of stormwater contaminants are motor vehicles. Motor vehicles release contaminants from emissions and brake, tyre and body wear. However, with more stringent emissions regulations in place, we can expect contaminant loads per vehicle to decrease. Emissions are further reduced by the proliferation of electric vehicles worldwide. In New Zealand, new vehicles are projected to comprise between 1.4% and 11.5% by the year 2020 and 3.1% to 27.7% by 2030 (MBIE, 2015).

Increasing Consumer Power

Throughout the world, consumer power is rising. Individuals have greater access to education, financial resources and connective technology. In New Zealand, the proportion of 25-34 year olds with a post high-school qualification underwent a steady increase from 53.2% to 57.2% (Education Counts, 2017). Increased education allows consumers to be more aware and better understand critical issues such as those around public finances and environmental issues. In 2015, a study by ResearchNZ found that 91% of individuals aged between 18-34 years owned a smartphone. These individuals are constantly connected to conventional and social media and can instantly inform or be informed of significant issues as they arise. As such, the modern consumer can quickly communicate instances where their demands have not been met or conversely, when their expectations are exceeded. While organizations have for a long time enjoyed the balance of power, this appears to be rapidly shifting in favor of the consumer.

The major impacts of increased consumer power primarily center around better solutions.

Informed consumers demand better solutions from their service providers. At a macro level, there is increased focus on goods and services with improved social or environmental responsibility, particularly from millennials. While this may seem like an

added cost to be borne by the provider, studies have show that millennials are willing to pay for sustainable goods and services. The demand for better solutions may simply entail improved amenity from the services provided to them, be it from the public or private sector.

Urbanization

Urbanization refers to the increase in proportion of people living in cities compared with those living in non-city areas. This megatrend is most pronounced in developing nations in Asia and Africa where 1 million additional residents are projected to enter cities every week for the next 40 years (Cohen, 2010). New Zealand, while already a predominantly urbanized nation, will feel the effects of urbanization. Like many urbanized countries, New Zealand will see its largest cities become even larger. Auckland is projected to be home to 37 percent of New Zealand population by 2028 compared with 34 percent in 2013. The population of the Auckland region is projected to grow by 833,000 by 2043 (Statistics New Zealand, 2017).

The major impacts of urbanization include:

- Space becomes a premium
- Natural Resources become a premium
- Pollutant loads increase from roof and vehicles.

With more and more people living in a city, space becomes a premium. Space is required for housing, infrastructure, industrial and commercial areas. Many cities attempt to control urban sprawl due to the inefficiencies it brings hence space is further constrained. With such limited space, city planners need to make decision about how best to use space. As such, single use infrastructure occupying large areas become infeasible and expensive.

Increased populations place greater demand on natural resources. Clean, safe and abundant water sources are a critical issue. The variations in rainfall and temperature as a result of climate change further complicate the issue of sourcing water. In most cases, drinking water can be sourced from other areas, but cities may find that they need to look further and further away to find the quantity and quality of water they require. All this comes at an increased cost which must be passed down to the city's residents.

Roofing and motor vehicles are the predominant sources of heavy metal pollutants in urban stormwater runoff. As urban populations increase, a corresponding increase in housing and vehicles can be expected. These increases may in turn lead to an increase in pollutant loads.

5 UNCERTAINTY AROUND IMPACTS

In earlier sections, various megatrend impacts with relevance to stormwater infrastructure were identified. A consensus can be reached that all the impacts listed will have some bearing on stormwater infrastructure. However, the uncertainties surrounding these impacts far more open to interpretation and present the real challenge in managing megatrends:

- Uncertainty about quantifying the impacts
- Uncertainty about the balance between megatrends
- Uncertainty due to changing circumstance
- Uncertainty about the timing of the change

Quantifying impacts of megatrends is a key element of managing megatrends, but one that comes with considerable uncertainty and challenge. Quantification requires analysis and research, including literature reviews, data collection, data processing and interpretation. Such analysis requires resources which may not necessarily be available. Even with the adequate resourcing any analysis will only be as good as the data available. High quality data may be hard to acquire or non-existent in which case quantification will be impossible. Where data is available, the impacts of megatrends are typically forecast within a certain range with conservative and liberal estimates. The difference between conservative and liberal estimates can sometimes vastly different. This was demonstrated in the earlier estimate for electric vehicle use where estimates vary between 3.1 to 27.7 percent. Quite obviously, there is a significant difference in management approaches between the two estimates.

Megatrends occur simultaneously with impacts being complementary or conflicting or unrelated. When megatrend impacts conflict, there is uncertainty around the overall balance of the impact. If we take for example the Technology Breakthrough and Urbanization megatrends; the former suggests that contaminants entering stormwater runoff will decrease due to the proliferation in electric vehicle use. However, the increase in population and corresponding increase in motor vehicle use due to urbanization can result in increase pollutant loads. There is often no clear answer to determining the balance of conflicting impacts.

Uncertainty also arises due to constant change. Megatrends and their impacts are forecast using information available at the time of forecasting. However, the world is continually changing, with the rate of change increasing. The danger in forecasting megatrends for the next 20 years is that there may be subtle or fundamental changes in the intermediate time that cannot be foreseen which render projections obsolete.

Making an assessment of the time frames in which impacts of megatrends take effect can be another source of uncertainty. Quantifying impacts and assessing time frames share many of the same issues. Such issues included being resource intensive, reliance on data and wide range of time frame estimates.

6 ELEMENTS TO MANAGE MEGATRENDS

Preparing for the future by assessing megatrends is fundamentally about preparing for the impacts while also recognizing the uncertainty.

With respect to stormwater infrastructure, the following elements can be incorporated to manage the megatrends discussed.

Life of Infrastructure

Certain infrastructure is built with a design life of many decades. However, as discussed, there is uncertainty surrounding the issues that infrastructure may face in the future; this uncertainly only grows further into the future. Typically, the longer the design life of infrastructure, the higher the construction cost. If there is potential for issues to arise which make infrastructure prematurely obsolete, the design life will need to be amended to reflect the actual useful life of the asset.

There is also the potential that unforeseen issues do not materialize and an asset operates for many decades as designed. To balance issues that materialize and those

that do not materialize, infrastructure should have provision to extend its life at minimal cost.

Flexibility and Modularity.

Building in flexibility and modularity into infrastructure is another element to manage uncertainty. Infrastructure can be costly hence obsolescence of infrastructure is both wasteful and can generate negative sentiment among those paying for infrastructure. Flexibility may entail infrastructure that can be used for multiple purposes or can respond to changing conditions relatively easily. Modularity is the ability to add or remove components from infrastructure as required to respond to changing conditions.

7 CONCLUSIONS

Megatrends provide a tool to help foresee the issues that may affect stormwater infrastructure in the future. While multiple megatrends are developing with myriad impacts, it is pertinent to focus on those megatrends that are most significant. Technology, Increased Consumer Power and Urbanization are among the most significant megatrends affecting stormwater infrastructure. There is considerable uncertainty around the impacts of these megatrends. However, there are key elements to managing this uncertainty; these include revising design life of assets and designing for flexibility and modularity. By adopting these key elements to managing uncertainty, while also preparing for the impacts of megatrends, we can better prepare infrastructure to cope with the issues of the future.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the contributions of the following people:

Suman Khareedi

Philip McFarlane

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