

Future of Urban Transport - Working Paper Series

**Scenario development process for the
Future of Urban Mobility 2040**

Jude Herijadi Kurniawan

20 April 2016

Lee Kuan Yew Centre For Innovative Cities
Singapore University of Technology and Design

Scenario development process for the Future of Urban Mobility 2040

Jude Herijadi Kurniawan¹

Scenarios contain the stories of these [uncertain and plausible] multiple futures, from the expected to the wildcard, in forms that are analytically coherent and imaginatively engaging. A good scenario grabs us by the collar and says, "Take a good look at this future. This could be your future. Are you going to be ready?"

Bishop, Hines, and Collins (2007, pp 5)

1. What are scenarios?

Uncertainty is a characteristic of the future that is central to the foresight or futures research. Many things can happen unexpectedly and simultaneously, hence, future is always uncertain. However, the point is not to quantify exactly for how and what uncertain is but rather to prepare decision makers to exercise informed judgment when the unexpected becomes certain. Plausibility implies that the constructed or imagined futures are 'believable.' That means, no scenarios should go beyond the boundary of plausibility. To a greater extent, scenarios should be constraint within a certain boundary, which prevents the development of scenarios that are discernibly impossible. A good scenario must be challenging; scenarios that do not deviate from our business-as-usual perceptions are simply inadequate. Scenarios constructed by Shell scenario team over the years for example often challenged our presumption and preconception about the future we would usually think (Wilkinson and Kupers, 2015).

“Scenario are narratives of alternative environments” (Ogilvy and Schwartz, 2004, pp.2), they are not about prediction of how futures should be, but they are more like hypotheses of different futures that could highlight risks and opportunities associated with specific strategic issues. The emphasis is on ‘specific’ and it, therefore, suggests that different set of scenarios could potentially be required when the perspective over a strategic issue changes. Scenarios should be believable but should also contain future elements that are unthinkable. The scenario narrative, also known as storylines, should describe a broad range of alternative futures that are absorbing and convincing.

¹ Jude Herijadi Kurniawan is a visiting researcher at Singapore University of Technology and Design and Energy Council of Canada Energy Policy Research Fellow. He is currently working toward his PhD at the University of Waterloo (Canada) and can be contacted at hkurniawan@uwaterloo.ca

Why does scenario matter?

Singapore is familiar with scenario thinking. In 2015, Peter Ho, who is the Chairman of the Urban Redevelopment Authority and was the former chief of civil service wrote:

So for the past two decades, the Singapore government has been using scenario planning. Our experience is that scenario planning better informs policies, plans, and even budgets. Scenario planning has helped to create a culture in government that questions assumptions, and that embraces a systematic and strategic approach to planning for the future.

Wilkinson and Kupers (2015, pp 10-11)

Events and trends affecting the future could have caused chained impacts in which potential interconnections between events are becoming more significant in terms of their impact magnitude and speed of occurrence due to mostly accelerated emerging changes in the Anthropocene epoch. Such cascading effects are difficult to be intuitively and cognitively mapped let alone forecasted (Schultz, 2015). Insofar, policy makers and stakeholders have to deal with deep critical uncertainty in exercising judgment and making decisions. Over the last few decades, scenario has emerged as an important tool for decision-making under deep uncertainties (Bishop et al. 2007).

Long range planning is a rudimentary process for every planners and decision makers within transport sectors, by and large due to the invested capital on transportation infrastructures, which takes a long time to turnover (typically 20 to 30 years). However, the current techniques of forecasting future demands and utilities for transportation systems often miss the mark. Forecasting techniques mostly rely on past and historical records to develop future projections, but future changes are unprecedented rendering historical data less usable for predicting the future. For example, the recent dip in oil prices was much less anticipated by many because extrapolation of historical data on oil prices failed to show such reversing trends.

Furthermore, many exogenous factors are often ignored in transportation planning, we typically view transport systems in Singapore as local activities, which are context specific. However, the ever-changing local context is often shaped by forces, which are likely not local (Rickards et al. 2014). In order to lay the foundation of useful long term transportation planning, we approach our foresight study on the future of urban mobility by using scenario planning in a workshop setting. The objective of scenario planning is to engage decision makers and stakeholders to be involved deeply in the development of scenario plots and that they will recognize the importance of uncovering and deliberating implications of the future scenarios. The motivation for involving stakeholders in scenario development is to obtain insight and creativity from a pool of experts that otherwise would be inaccessible to the scenario researchers (Alcamo, 2008). However, care must be taken when dealing with a very diverse participants in the scenario workshop. One of the problems with participatory approach to scenario development is that bias could be introduced and directed toward a particular interest of the stakeholders (Alcamo, 2008). The onus is on the workshop facilitator to prevent discussions in the scenario workshop from being locked into a single mental model.

In the end, every scenario planning exercise must have a focus on decision making. Decision focus is shaped by asking the right questions such as *should we build a coal-fired power plant. Or, do we need*

to go really 'big' on Electric Vehicles infrastructure? The time frame of the issue in question is also to be communicated early. In this study, we ask the question on how the urban mobility would be like in 2040. In the next section, we will explain the process of the scenario planning, which we have adopted for the Future of Urban Mobility 2040. The Future of Urban Mobility 2040 is an ongoing research project by Lee Kwan Yew Centre for Innovative Cities (LKYCIC) at Singapore University of Technology and Design (SUTD) under the Future Cities initiatives which are supported by Singapore's National Research Foundation and the Ministry of National Development.

2. Scenario process agenda

As part of the scenario planning, we conducted a full one-day workshop held at SUTD on 31 March 2016. The scenario workshop was designed to bear some resemblance to the scenario workshops that are often conducted within Singapore public service. In general, the scenario planning process follows the following steps:

1. Determine focal concern
2. Identify and prioritize drivers based on impact and uncertainty
3. Analyze drivers and deliberate possible end-states related to the drivers
4. Develop scenarios around these drivers
5. Apply scenario strategy

Workshop participants were chosen based on purposive sampling. Selected participants are domain expert and stakeholders within the transport sector in Singapore. The criteria for selecting workshop participants follow a general rule laid out in Ogilvy and Schwartz (2004):

1. To include people with a thorough knowledge of the critical issue to be addressed
2. To include a diverse team of participants from a wide range of management levels, perspectives, and roles.
3. To include people with different intellectual disciplines (finance, science, economics, etc.)
4. To include people with different cultural background
5. To include thinkers from inside and outside sectors

There was a total of 22 participants, and they can be classified into three broad categories based on their professional affiliations: academia (6), government agencies (9) and industry (7). Initially, a pool of potential participant was determined, which comprised of participants from our earlier expert interview study, project funders and beneficiaries, and individuals from referral by another participant (snowball sampling). At first, an invitation was sent via email to potential participants where they could respond by indicating their willingness to participate in the said scenario planning workshop. Participation in the workshop was strictly based on a voluntary basis, and there was no remuneration or honorarium offered to the workshop participants. Upon confirmation, registered participants were provided with a scenario workshop booklet which explains the background of the project and the significance and potential impacts for each driver of change (for the list of drivers, please refer to Figure 1).

2.1 Determine the focal concern

The workshop opened by presenting an introduction to the research project, the Future of Urban Mobility 2040. The participants were then asked to think back and search for a recollection of one thing that had surprised them about urban mobility in the past 20-30 years. This exercise helped to orient participants'

mindset in recognizing that there could be a drastic or transformational shift in urban mobility over the given period of time.

2.2 Identify and prioritize drivers based on impact and uncertainty

Drivers are strong forces such as trends, challenges, and technologies, which could affect the future significantly resulting in societal and infrastructural changes to urban mobility. Before the workshop, we had identified 19 drivers (see Figure 1) through other independent studies such as expert interview, technology and horizon scanning, literature review and focus group discussion. These drivers will eventually be formulated as the scenario kernel in this scenario process. Participants were briefed on the significance, potential impact, and nature of uncertainty of all drivers. They were also encouraged to consider other drivers, which could potentially be included in this scenario development process. After having a run through on all the drivers, they were asked to identify drivers that are highly uncertain and will also have a high impact on the future of urban mobility. Following this, participants used blue sticker dots to mark highly uncertain drivers and orange sticker dots to mark high-impact drivers. If they felt strongly for one driver, they were allowed to use a maximum of three stickers on one driver.

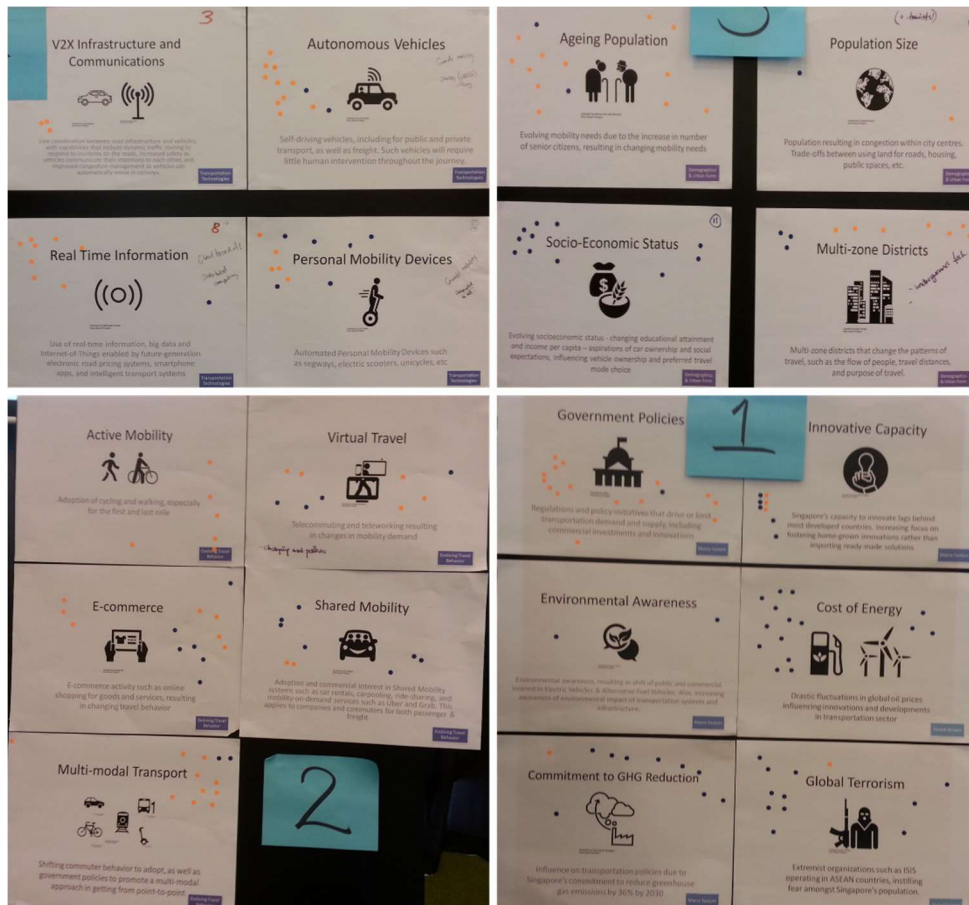


Figure 1 Scenario drivers with blue and orange sticker dots

The blue and orange dot stickers were tallied, and the result was displayed on a scatter plot. The selection of top priority drivers follows a rule as such that drivers must be highly uncertain and have a high impact on the future implications. While there were several drivers which were judged to be

extremely uncertain, they were not likely to cause any significant impact on the future of urban mobility. From the scatterplot, drivers with approximately equal points for uncertain and impact scores were chosen in this case (see Figure 2). Based on the tallied votes, the list of drivers selected for scenario kernel is shown below:

1. E-Commerce
2. Innovative Capacity
3. Multi-zones Districts
4. Personal Mobility Device
5. Virtual Travel

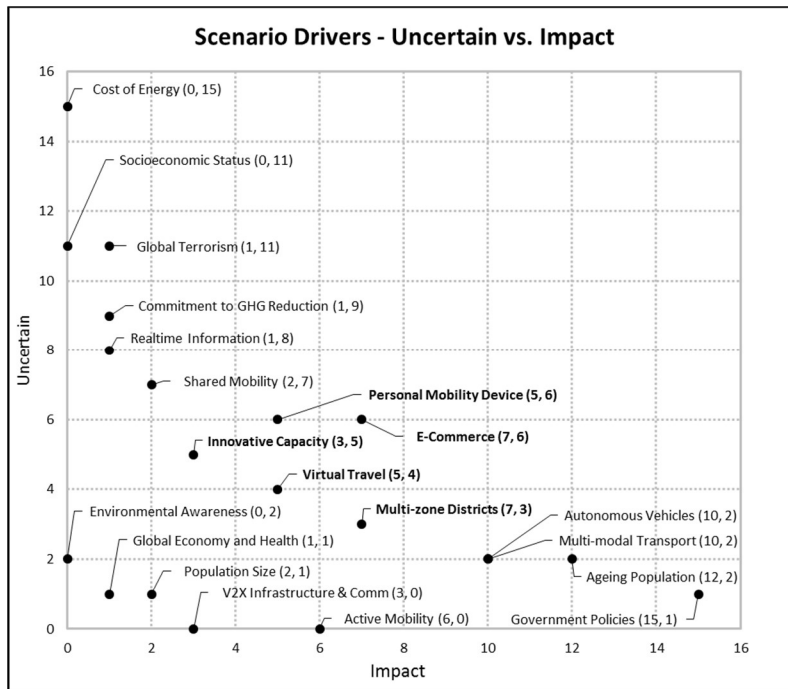


Figure 2 Determining highly uncertain and high-impact drivers

2.3 Analyse drivers and deliberate possible end-states related to the drivers

At this point, participants were divided into three breakout sessions with each group comprised of 7 to 8 participants. Participants discussed in groups to explore possible end-states for each driver in 2040. These end-states are short narratives for how each drivers might pan out in the future. Also, end-states should be mutually exclusive that means two or more end-states should not have overlapping ideas, or one end-state is not a subset of another. For example, E-commerce might turn out to be pervasive rendering shopping malls obsolete, but on the other hand, another possible end-state would be that people might regress from using E-commerce partly due to the emotional connection with shopping malls, which might emerge as an important place for social interactions in the future. The two end-states for E-commerce display a distinction that for any given end-state should occur, the other will not. During the deliberation process, participants were also encouraged to discuss each driver for how it may impact and interact with other drivers. For instance, one might suggest that pervasive E-commerce lifestyle could only be realizable when we could reach a high level of innovative capacity. By digging deeper into the interactions among different end-states of various drivers, it will become more apparent if the proposed end-sates are

plausible. The group was expected to think out to the horizon year and to consider both rationale analysis and imagination in determining plausible end-states for each driver.

Participants were instructed to discuss 3-5 drivers and create at least 2-3 end-state for each drivers. The Table A below shows the end-states for breakout session group 2 and Figure 2 shows the picture of the post-it notes during the discussion.

Table A: Breakout session group 2: Description of end-states for various drivers

Drivers	End-State 1	End-State 2	End-State 3	End-State 4
E-Commerce	Pre-emptive Purchase	E-Social Shopping	Retail Malls Makeover	Need for Touchy Feely
Innovative Capacity	Single Ecosystem –	Innovation Collaboration	Export Innovation	First Adopter
Multi-zones Districts	Organic Evolution City	Two-Layers City	Freight Nation	Time-Division Multiplex City
Personal Mobility Devices	First Last Mile	PMD-Everything	Walking Nation	
Virtual Travel	Virtual-Everything	Access-as-a-Service	Virtual not-Reality	

Participants were then asked to regroup to analyze drivers in a plenary session. Each group would present the outcome of their group discussion on plausible end-states for all the five listed drivers. After listening to each other end-states, participants noted down similarities and differences from their respective group analyses. From the feedback gathered, some participants felt that other group arrived at end-states that were unthinkable and too imaginative. While others felt that some groups were too conservative in deliberating plausible end-states thus producing end-states that did not deviate much from business-as-usual conditions. This suggests that the views from individual participants were very diverse. Since the goal of the scenario planning is not to reach a consensus on how the future might be, the diversified views of the participants in this workshop suggested that the workshop was on the right track in exploring alternative futures as broad as possible.



Figure 3 Picture of post-it notes during the discussion in determining plausible end-states for various drivers

2.4 Develop scenarios around the drivers

Participants would exercise system thinking in discussing the appropriation of each driver for the scenario plot. This means to delve deeper in the underlying patterns of each scenario. Often participants find it difficult to understand the interactions between different drivers, it may be useful to use mind-mapping techniques to discover patterns or links that connect these drivers to a scenario. To a certain extent, this workshop adopts a method akin to *morphological analysis* for mapping and pattern discovery.

Morphological analysis is a method for investigating relationships of non-quantifiable, qualitative description of variables (Ritchey, 1998). For each driver, a range of variables (i.e. end-states) is assigned, and all variables are then arranged in a matrix fashion thus producing a configuration space or a morphological field (a.k.a. “Zwicky box”) (Glenn and Gordon, 2009). Each configuration contains one value from each of these end-states, which will be the scenario kernel. For example, the Table B below shows the configuration space for the breakout session group 2. Such a morphological field will produce 5x5x5x5x3 (or 1,875) possible configurations. Some configurations may be judged as plausible because all end-states for that particular configuration are coherent and appropriate. Hence, this particular configuration is deemed to be internally consistent. A thorough search for all configurations would result in some configurations which could be inconsistent. Although the method suggests to firstly weed out all inconsistent configurations; due to time constraint, participants went straight to intuitively search for a couple of configurations that they deemed logical, plausible and challenging for their scenario development.

Table B: Configuration space (morphological field) for breakout session group 2

MORPHOLOGICAL FIELD AND CONFIGURATION FOR “TELEPHONES” SCENARIO				
Drivers	End-State 1	End-State 2	End-State 3	End-State 4
E-Commerce	Pre-emptive Purchase	E-Social Shopping	Retail Malls Makeover	Need for Touchy Feely
Innovative Capacity	Single Ecosystem	Innovation Collaboration	Export Innovation	First Adopter
Multi-zones Districts	Organic Evolution City	Two-Layers City	Freight Nation	Time-Division Multiplex City
Personal Mobility Devices	First Last Mile	PMD-Everything	Walking Nation	
Virtual Travel	Virtual-Everything	Access-as-a-Service	Virtual not-Reality	
MORPHOLOGICAL FIELD AND CONFIGURATION FOR “COCONUT TREES” SCENARIO				
Drivers	End-State 1	End-State 2	End-State 3	End-State 4
E-Commerce	Pre-emptive Purchase	E-Social Shopping	Retail Malls Makeover	Need for Touchy Feely
Innovative Capacity	Single Ecosystem	Innovation Collaboration	Export Innovation	First Adopter
Multi-zones Districts	Organic Evolution City	Two-Layers City	Freight Nation	Time-Division Multiplex City
Personal Mobility Devices	First Last Mile	PMD-Everything	Walking Nation	
Virtual Travel	Virtual-Everything	Access-as-a-Service	Virtual not-Reality	

The next part is to build a storyline around the selected scenario. The idea of building narratives is to include the ‘moving parts’ of a scenario, not just the static descriptions. The discussion among participants could produce counterintuitive consequences well down the road. Thus, narratives should

capture timing as well as path dependencies arriving at a particular scenario. To do this, we asked the participants to imagine several newspaper headlines of varying timeline leading to 2040 in which these headlines would make the chosen scenario realizable (see Figure 4) (Ogilvy and Schwartz, 2004). Time anchor or reference for 2016, 2020, 2025, 2030 & 2035 was provided to the participants that would be used to trigger discussions on possible newspaper headlines for that particular year. Some interesting headlines emerged during the discussion such as the idea of “holographic dates” could be available online by 2020. The aim of using newspaper headlines to construct a narrative was not to capture an imagination related to the future of urban mobility per se but rather to encompass a broad narrative of the social life of the future. A rich narrative about how we live our lives in the future could provide an insightful picture of the mobility infrastructure and services required for that period.

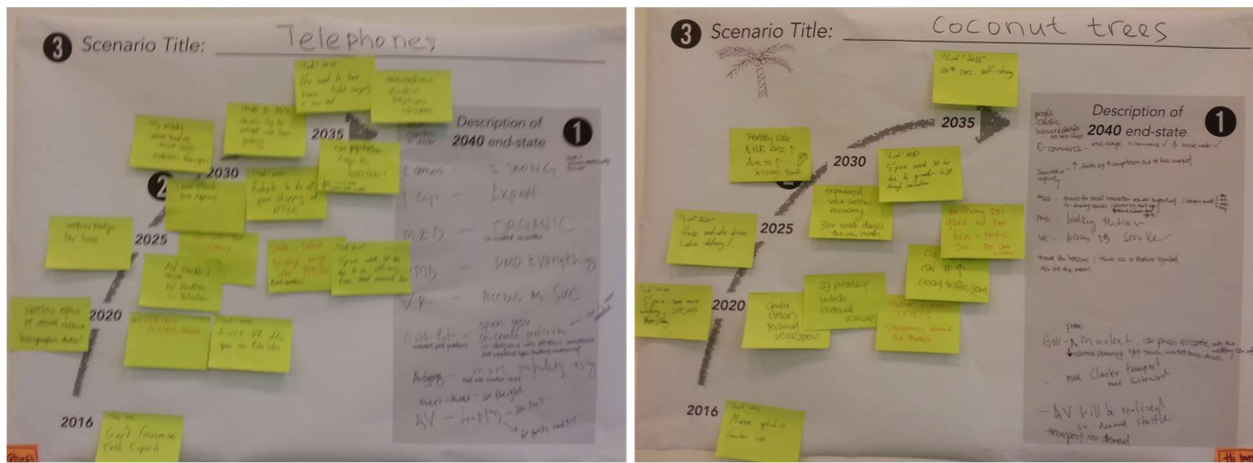


Figure 4 Scenario description and newspaper headlines for "Telephones" and "Coconut Trees" scenarios

The scenario development process was completed by giving each scenario a title. An appropriate title will convey a typical scenario plot or a distinct theme (Ogilvy and Schwartz, 2004). For example, a typical theme could be “Winners and Losers”, which portrays a zero-sum game – when a specific group or organization wins, there will be another one who loses. Another common scenario plot is “Good news and Bad news” which is a scenario plot that is represented by desirable and undesirable futures. The title of scenarios from breakout session group 2 were “Telephones” and “Coconut Trees” to represent two different alternative futures in which one future in the “Telephones” scenario portrays Singapore as a technology centric society while the “Coconut Trees” scenario portrays a people centric society.

All participants from the three breakout sessions reconvened together to decide a scenario set. They were asked to select three scenarios that are differentiated, plausible and challenging. The scenario set could comprise scenarios from any breakout session group 1, 2 or 3. The three scenarios with the highest votes were “Sharing is caring” from group 1, “Telephones” from group 2 and “Specialized Zones” from group 3.

2.5 Apply scenario strategies

After a scenario set was decided, the next important step is the sense-making. The sense-making process helps to build awareness on a given situation as described in each selected scenario. The aim of this process is to better understand future conditions despite uncertainties and complexities. By fully immersing oneself in a particular scenario, the participants attempted to imagine who the winners and

the losers would be. Participants were also asked to consider the implications of each scenario from the perspective of the society, businesses and industries, and government agencies.

From the feedback gathered, there were some interesting insights provided by participants. For instance, one participant expressed concern for automotive companies in which their current business model would no longer be viable in the future. The government must also remain vigilant in recognizing the change political landscapes. Most government agencies have specific sectoral jurisdictions. However, jurisdictions across sectors will be more interwoven in the future which could potentially impede effective governance. In sum, most participants were compelled to anticipate the potential implications and challenges that various scenarios posed. What about the future that cannot be fully anticipated?

Wild cards

The last part of the scenario workshop was dedicated to expose participants in making sense of hardly anticipated events using wild cards method. Wild cards are low-probability, high-impact events in which their occurrence gives little notice (Glenn and Gordon, 2009). Because of their potential surprises and random nature, organizations have a tendency to ignore them. Wild cards now have much more increasing reach due to globalization and technology. Even Singapore is not completely isolated from the impacts of wild card events occurred in another part of the world. Wild cards are potentially disruptive that could alter not only human physical infrastructures but also our mindset and values. It is therefore valuable in exploring wild cards to increase preparedness and resilience.

Some example of wild cards yielded in the workshop that conforms to the low-probability, high impact, and hardly-anticipated events were:

- Virulent epidemic like “super-SARS” – Devastating impacts that paralyze shared mobility
- Terror attacks and cyber warfare – taking over a government could be possible without even invading the country
- Singapore buys an island – suddenly there is more space to build
- Extreme climate change impact causing mass migration – Singaporeans flee the island-state for higher grounds in other countries
- Disruption on energy supply route – No oil entering and leaving Singapore
- Earthquake – the “ring of fire” finally decides to extend its reach to Singapore

3. Conclusions

The article is written as a step-by-step guide for conducting scenario planning workshop and describes the process of scenario development for the Future of Urban Mobility 2040 in Singapore. The scenario method applied in this project is akin to morphological analysis. However, the emphasis of this scenario planning workshop is the participatory approach to scenario development involving various stakeholders and actors from industry, academia and government agencies.

Acknowledgement:

JHK would like to express sincere gratitude to Singapore University of Technology and Design for hosting him during his stay in Singapore (Jan-Apr 2016). JHK would also like to thank Lynette Cheah for extending an invitation to join her research team on the Future of Urban Transport; fellow researchers and colleagues at SUTD: Seyed Mehdi Zahraei, Corinne Ong, Hou Yuting, Waqas Cheema and Christopher Choo; and his doctoral co-advisors at the University of Waterloo: Vanessa Schweizer and Johanna Wandel. JHK doctoral research is supported by a fellowship from the Energy Council of Canada.

References:

- Alcamo, J. (Ed.). (2008). *Environmental futures: the practice of environmental scenario analysis* (Vol. 2). Elsevier.
- Bishop, P., Hines, A., & Collins, T. (2007). The current state of scenario development: an overview of techniques. *Foresight*, 9(1), 5-25.
- Glenn, J. C., & Gordon, T. J. (2009). *Futures Research Methodology v3. 0*. The Millennium Project. Washington DC, USA.
- Ogilvy, J., & Schwartz, P. (2004). *Plotting your scenarios*. Global Business Network.
- Rickards, L., Wiseman, J., Edwards, T., & Biggs, C. (2014). The problem of fit: scenario planning and climate change adaptation in the public sector. *Environment and Planning C: Government and Policy*, 32(4), 641-662.
- Ritchey, T. (1998). General morphological analysis. In 16th EURO Conference on Operational Analysis.
- Schultz, W. (2015). *Manao: The future is not binary*. APF Compass (April 2015).
- Wilkinson, A., & Kupers, R. (2015). *The essence of scenarios: learning from the Shell experience*. Amsterdam University Press.