Re-Imaging Rural Transport Transitions and Futures in South Africa

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Abstract

This paper re-imagines rural transport transitions and futures in South Africa. While, rural transport transition and futures foresight studies exist these face multiple inadequacies in terms of conceptual coverage, methodological completeness and "full cycle" foresight intelligent scenario development. Making use of a gap and thematic analysis technique, existent literature on rural transport in South Africa and beyond is examined. Invariably, critical rural transport transitions are identified and their implications regarding advancement in science and technology discussed. Furthermore, employing a system of innovation and transitions theoretical framework, transport futures in South Africa are predicted. Overall, results confirm requirements for sustainable rural transport project implementation, the need for the development of appropriate and adaptive transportation technology applications in respond to the rural development planning matters in the country. In any case, the intelligent application of rural transport foresight studies is fundamental to unleashing the full potential of rural areas. The paper concludes by postulating that establishing contextually relevant and appropriate future rural mobilities in South Africa requires interventions from a intra, inter, cross and multi - disciplinary and cultural approaches from all stakeholders working in the rural transportation and related areas.

Keywords: Rural transport, transitions, futures, scenarios, skills, South Africa

1.0 Introduction

A (rural) transport system can be defined as a socio-economic, technical, environmental and political system that consists of a cluster of aligned elements. The critical elements include: artifacts, knowledge, markets, regulation, cultural meaning, infrastructure, maintenance networks, and supply networks, etcetera (Geels & Kemp, 2012). In South Africa, rural transport transition and futures foresight studies exist but are inadequate regarding the application of 'circular' foresight methodologies. Consequently, the rural transport deployment of practical solutions that address decisively rural transport and development matters remain elusive despite various progressive instruments in place to advance rural and development planning in South Africa (Department of Transport, 2007; DRDLR, 2009; NATMAP, 2010; National Development Plan (NDP), 2010; Department of Transport, 2011; Department of Transport, 2015:23). The sum effect of these inadequacies is that approaches in the rural transport domain fail to dispel the uncertainty in anticipating future opportunities and threats as a part of the rural transport transitions and futures strategic planning process. The current set-up can be explained in terms of the existence and utilization of incomplete foresight traditionally based approaches that anticipate the future of rural transport systems through mainly focusing on analyzing and extrapolating past trends and forecasting future trends (Auvinen, Tuominen & Ahlqvist, 2013: 343).

In South Africa's rural areas, the road infrastructure is a fundamental component in the development of successful, vibrant, sustainable, integrated and thriving communities (DRDLR, 2009).

The road network is part of the social fabric that links people and communities together through improving transport linkages and reducing isolation (Mashiri, Chakwizira & Nhemachena, 2008). Along with serving the essential purpose of connecting people, roads support the trading of goods and services, and sustain the agricultural activities that occur in rural environments.

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Although since the 1994 dawn of the new democracy in South Africa, household access to basic services has improved, much remains to be done to further improve the livelihoods of poor people who continue to receive inadequate, incomplete and at times no services; especially in rural areas (Department of Transport, 2015: 23). Government has over the years set high targets regarding access to services (NATMAP, 2010). However, the biggest constraint has been availability of infrastructure and the application of appropriate delivery technologies in remote rural areas. This can be understood in the context of access to rural education, rural healthcare, roads, transport, information, communication technologies (ICT) and others (StatsSA, 2011; National Household Transport Survey, 2013).

In the medium term, the Department of Transport (DoT) seeks to develop and implement access road development plans (ARDP) to improve rural road infrastructure in identified municipalities (Department of Transport, 2015: 23). The Department of Transport is poised to also develop and implement the integrated public transport network (IPTN) plans in rural municipalities. The Rural Transport Strategy (RTS) for South Africa (RTSSA) has been reviewed to enhance access and mobility in rural spaces (Department of Transport, 2016). The National Learner Transport Policy (NLTP) will be finalized and implemented to provide norms, standards and operational guidelines for learner transportation and subsequently enhance a safe transportation environment by ensuring that operators comply with the National Road Traffic Act (Act 93 of 1996) as well as provisions of the National Land Transport Act (Act 33 of 2009) (Department of Transport, 2015:23).

1.1 Theoretical background

In terms of the theoretical background, this paper emerges from integrating insights located in two disciplines (i.e. transportation engineering and spatial planning). The integration of these knowledge domains is achieved in the context of seeking to reconcile and align the long-term foresight and socio-economic, technical, political and environmental transitions. This is achieved through exploring rural transport transitions and futures strategic intelligence platform development aimed at facilitating enhanced decision and policy-(re)making.

1.2 Research Aim and Objectives

The aim of this paper is to present scenarios linked to re-imagining rural transport transitions and futures in South Africa and explore the policy implications for South Africa. This aim is achieved through answering the following paper's objectives, namely:

1. What is an appropriate conceptual framework in seeking to understand rural transport transitions and futures in South Africa;
2. Which methods and or techniques can be employed in carrying out a comprehensive rural transport transitions and futures study/project in South Africa;
3. What are the possible rural transport transitions and futures in South Africa that can be (re)imagined from analyzing existing literature; and
4. Are there any policy implications and directions that a rural transport transitions and futures scenarios development based approach can suggest for South Africa?

2.0 Research Methods

Using South Africa as a case study, the paper employs a gap and thematic analysis technique to analyse existent literature in terms of (re)imagining rural transport transitions and futures in South Africa. Through this process and reflecting on a combined experience of half-a century of practice shared between the authors, rural transport transitions and futures in South Africa are identified and their implications regarding innovation in science and technology explored. Along with employing a system of innovation and transitions theoretical framework, (im)possible transport futures in South Africa are predicted.

3.0 Literature Review

3.1 The mobilities syntax for rural transport in South Africa

In seeking to understand rural transport transitions and futures in South Africa there is need to explore the concept of mobilities and what meanings (i.e. clues) does it offer for rural transport in South Africa. Table 1 presents a mobilities concept mapping application illustration in South Africa as informed by literature review.

Table 1: Mapping the mobilities concept application in South Africa: a review of literature

1. Mobilities concept	2. Fast travel normative approach
• Travel of people for work, leisure, family life, pleasure, migration and escape, organized in terms of contrasting time-space patterns ranging from daily commuting to once-in-a lifetime exile migration. • Physical movement of objects including food and water to producers, consumers and retailers; as well as the sending and receiving of presents and souvenirs in space. • Imaginative travel effected through the images of places and peoples appearing on and moving across multiple print and visual media and which then construct and reconstruct visions of place, travel and consumption. • Virtual travel often in real time transcending geographical and social distance and forming and reforming multiple communities at-a distance. • Communicative travel through person-to-person messages via personal messages, postcards, texts, letters, telegraph, telephone, fax and mobile.	• Growth of Automobiles throughout South Africa. • The rapid growth of cheap air travel based on new budget business models for example Kulula Airways. • A significant resurgence of rail transport. • Emergence of new kinds of globally significant themed leisure environments that must be visited from afar. • Increased 'miles' both flown and travelling on the world's 90,000 ships by manufactured goods, components and foodstuffs. • Much greater distances travelled by work colleagues, members of leisure organizations, families and friends in order to sustain patterns of everyday life 'at-a- distance' (friendship miles).
3. Mobility "social practices"	**4. New high carbon systems and implications for rural transport in South Africa**
• Discovery travel of students, young people on their 'overseas experience' (i.e. constituting a 'rite of passage' and involving going overseas to civilization centres. • Medical travel to spas, hospitals, dentists, opticians and so on. • Military mobility of armies, tanks, helicopters, aircraft, rockets, spy-planes, drones, satellites and so on which have many spinoffs into civilian uses. • Post-employment travel and the forming of transnational lifestyles within retirement. • 'Trailing travel' of children, partners, other relatives and domestic servants. • Travel and migration across the key nodes within a given diaspora such as that of overseas Chinese. • Travel of service workers around the world and especially to global cities including the contemporary flows of slaves (estimated at 27m). • Tourist travel to visit places and events and in relationship to various senses especially through the 'tourist gaze'. • Visiting friends and relatives but where those friendship networks may also be on the move. • Work-related travel including commuting which is itself increasingly varied and complex.	• The development of electric power and national grids so ensuring that more or less every home in the country is lit, heated and populated with electric-based consumer goods (resting especially on coal and gas). • The spreading of the steel-and-petroleum car (now over 11 566 560 (May 2017) cars in South Africa) and associated roads and a widely distributed, or sprawling, infrastructure linking most places of residence, work and leisure. • The development of suburban housing distant from places of work and which has to be commuted to by car/bus and can be filled with household consumption goods powered by electricity. • The emergence of various electricity-based technologies, stand-alone telephones, computers, laptops, networked computers, mobile phones, and blackberries and so on, those network colleagues, friends and families who can now be more geographically dispersed. • The proliferation of many specialized leisure sites, supermarkets, fast food, national parks, sports stadia, theme parks, most necessitating travel from home and neighborhood especially by car and new systems of air travel (also normally involving the long-distance movements of objects and water).

Sources: Urry, 2013: 6; Authors own construction, 2017

From table 1, we can deduce that rural transport transitions and futures in South Africa are faced with a multitude of complex, dynamic drivers, factors and issues that make predictions difficult, probable and delicate. Seeking to domesticate future rural transport and transitions requires finding the right balance between suggesting pragmatic and practical policy choices and options for decision makers.

3.2 Taxonomy of Innovations and implications for rural transport transitions and futures

The literature on innovation contains different forms in categorizing innovation along many different dimensions. Two of the most common terms – incremental and radical innovation – are often distinguished using one or both of the following criteria (Bell & Figueiredo, 2012: 26):

1. The novelty of the knowledge base underlying the innovation; and
2. The scale and significance of the economic (and other) consequences of the innovation.

Table 2, presents the taxonomy of innovations as advanced by Freeman and Perez (1988).

Table 2: Freeman and Perez (1988) Taxonomy of innovations

Type of innovation	Description	Examples in the transport sector
Incremental innovations	Innovations that occur continuously, that are not the result of deliberate research and development (R&D), but outcomes of inventions and improvements suggested by people involved in production or proposals by users ("learning-by-doing" and "learning by- using").	Continued improvements to the wheel
Radical innovations	Discontinuous events, usually as a result of deliberate R&D in an enterprise or university. They lead to growth of new markets and investments, and are relatively significant in aggregate economic impact	Motor car by Henry Ford
Changes of technology systems	These represent far reaching changes in technology, affecting several branches of the economy, as well as giving rise to entirely new sectors. They are based on a combination of radical and incremental innovations affecting more than one or a few firms.	Computers and intelligent transport applications and systems deployment
Changes in "techno-economic paradigm ("technological revolutions")	A major influence on the behaviour of the entire economy ("pervasive effects"). Created through many clusters of radical and incremental innovations. Not only create a new range of products, services, systems and industries, but also affect almost all the other branches of the economy. The changes involved go beyond engineering trajectories for specific product or process technologies and affect the input cost structure and conditions of production and distribution throughout the system.	Ground positioning systems (GPS navigators)

Sources: Authors own conceptualization, 2017

From Table 2, we can deduce that at times in transport innovation, there is the application of "recombinant transport innovation".

This innovation captures the idea that the next (sustainable transport) industrial revolution may be located significantly within the progressive and cumulative transformation of existing systems of production and consumption to make them more resource efficient and less polluting, than being altogether radical revolutions.

3.2.1 (Co-) evolutionary

A co-evolutionary approach to innovation is an overarching theme in modern innovation theory. Co-evolution occurs when different sub-systems have mutual interactions which affect the development of each system. In particular, analyzing transition pathways calls for a co- evolutionary understanding of the development of technologies, institutions, social practices and business strategies (Geels, 2005).

The co-evolutionary understanding is an attempt to overcome the dichotomy between the two dominant approaches advocated to achieve sustainability - technology-oriented versus behaviour oriented approaches (Brand, 2003).

3.2.2 Uncertainty in modelling rural transport transitions and futures

Implicit in a number of the above considerations is the presence of uncertainty, particularly fundamental or intrinsic uncertainty. Fundamental transport uncertainty refers to situations that are not – or cannot – be known in advance, because they are outside existing transport conceptual models. In some characterizations, fundamental uncertainty is due not so much to the limits of transport imagination as to the possibility of creativity and non-predetermined structural change, making prediction inherently impossible. Thus, a full list of possible outcomes is not predetermined or knowable ex ante, as the future is yet to be determined (Brent, 2015).

3.2.3 Knowledge and learning in rural transport transitions and futures

Knowledge is often claimed to be the most fundamental resource in an innovation system, while learning is the most important process (Lundvall, 2007; Wieczorek & Hekkert, 2012). As innovation theory has developed, the understanding of different kinds and forms of knowledge (e.g. tacit as opposed to explicit knowledge) and learning (e.g. learning-by-doing, Arrow 1962; learning-by-using, Rosenberg 1982; learning-by-interacting, Lundvall 1988; single loop and double loop learning, Argyris and Schon, 1978) have expanded our insights into the development and diffusion of innovations (refer to table 3).

Table 3: Strategic rural transport transitions and futures niche management guidelines and potential dilemmas

Rural transport policy area	Rural transport policy guidelines and potential dilemmas
Policy guidelines and potential dilemmas	• Be flexible, engage in iterative visioning exercises; adjust visions to circumstances and take advantage of windows of opportunity. • Be persistent, stick to the vision, persist when the going gets tough.
Learning	• Create variety to facilitate broad learning. • Too much variety dilutes precious resources and prevents accumulation. It also creates uncertainty and may delay choices/commitments (by consumers, policy makers)
Upscaling	• Stepwise learning and bricolage strategy. Disadvantages: (1) slow, (2) incremental steps • Breakthrough strategy and big leaps to achieve success rapidly. Disadvantages: (1) danger of failure, (2) misalignment with selection environment
Network	• Work with incumbent actors, who have many resources, competence and "mass". Try to change their agenda, visions et cetera. • For radical innovations, it is better to work with outsiders, who think "out of the box" and have new ideas. Incumbents have too many vested interests and will try to hinder or encapsulate radical innovations.
Protection	• Protection is needed to enable nurturing of niche-innovations. • Do not protect too long and too much. This might lead to limited exposure to selection pressures (and the danger of creating white elephants)
Niche-regime interaction	• Wait for cracks in the regime, and vigorously stimulate niche-innovations. Until such windows of opportunity arise, niches should be nurtured to facilitate stabilisation. • Use niche experiences to influence perceptions of regime actors and actively create cracks in the regime.

Source: Adopted after Geels & Schot, 2007.

3.3 Rural transport transitions and futures

Rotmans, Kemp & van Asselt., (2001) have defined (rural transport) transitions as gradual, continuous processes of change, in which the structural character of a society transforms. A transition is the result of developments in different domains, and it can be described as a set of connected changes, which reinforce each other but take place in several different areas, such as technology, the economy, institutions, behaviour, culture, ecology and belief system (Geels, 2005). Taking this into consideration, instead of conducting a comprehensive study of the transportation discipline in South Africa, we focus in this paper on one sub-system, i.e. the rural transport system. System-level changes or transitions have recently been identified as an important area of research in the literature and many related concepts and phenomena are poorly understood (Rootman, Kemp & van Asselt., 2001; Geels, 2005; de Haan & Rotmans., 2011; Elzen and Wieczorek, 2005; Geels, 2004) However, this had been much more inadequate in the rural transport sub-system. This is despite the observation that the rural transport sub-system can be considered as a model example of a large socio-economic, technical, political and environmental system. Table 4 presents the mainstream rural transport and transitions technological theories and approaches that can be utilised in unpacking rural transport transitions complexities in any area.

Table 4: Mainstream rural transport and transitions technological theories and approaches

Name of Rural Transport Transitions and Futures Technology Innovation System Approach	Rural Transport Transitions and Futures Technological Innovation Aspects	Rural Transport Transitions and Futures Stabilization Dimensions
Large Technological Transport Systems (LTTS) theory and approach	• Technological systems wider than the technology (or artefact itself). • Systems are inclusive as they incorporate aspects of the social, economic, environmental, political and scientific factors. • 'System builders' travel between the different domains, such as engineering, politics, economics, spatial planning, technology and social change, and weave a 'seamless web' into a functioning rural transport system 'whole'. • Technology development or expansion of LTTS has seven (7) phases, namely: invention, development, innovation, transfer, growth, competition and consolidation. • Key concepts also include: technological momentum (which systems acquire as they mature) and technological style (i.e. a unique brand or identity) that are important in (re)discovering or (re)understanding new aspects in technological development.	• Social construction of transport technology (SCOTT). • A complementary approach to the Large Technological Transport Systems (LTTS) theory and approach. • Rural transport technological stabilization is referred as 'closure' concept (i.e. a phenomenon in which "social groups involved in designing and using technology decide that a problem is solved. The result is that the rural transport technology is either stabilized or consolidated resulting in technology closure. This varies from one group to another").

Sources: Derived from Hughes., 1987; Pinch & Bijker., (1987); Author's own construction, 2017

From Table 4, we can infer that the concept of rural transitions and futures "fore-sighting" can take a number of dimensions. This entails that rural transport transitions and futures should be embedded in approaches and theories that advance critical thinking concerning long-term rural transport developments, foster conversations aimed at deepening rural transport and development participatory democracy and (re)shaping the rural transport and development future, especially by influencing public policy and decision (re)making. Consequently, rural transport fore-sighting intelligence encompasses a range of approaches, e.g. scenario building and delphi methods that combine the three aforementioned activities (Burbidge, Knowlton & Matheson., 2007; Waskowiak, Garber & Durham., 2007).

3.4 Rural transport transitions and futures vision building process in South Africa

In order to anticipate potential rural transport system transitions and futures, a vision building process needs to be developed.

The process should consist of three inter-related steps, where appropriate transition and futures methods and or techniques are used to involve the transport sector experts in the formulation of one or several images of the future transport system. Suitable time frame ranges from 50 to 100 years into the future. The three steps of the rural transport system transitions and futures vision building process are:

1) Rural transport system transitions and futures environmental scanning: This is a stage in which forces of change are identified, assessed and discussed, where trends and signals to impact the transport system and the entire society in the selected time frame is developed. Literature research and expert workshops serve as input for this step. The list of forces of change can be organised using PESTE (political, economic, social, technological and environmental) analysis. Relevant transport sector experts to be involved include policy-makers, authorities, practitioners and academics. The outcome of the first step is a list of forces of change organised by levers, namely: rural landscape and environment; rural transport system and structures and rural transport technologies and (re)solutions;

2) Rural transport system transitions and futures visioning: This requires the arrangement of a futures workshop where relevant transport system stakeholder groups take part in the vision (re)making processes. Before the workshop, the list of forces of change compiled in the first step needs to be reduced to a compact list of 10 to 20 topics by an expert panel. Selected forces of change will serve as variables in the futures table, and three to six alternative futures will be generated to describe each variable. To fill up the futures table by formulating the alternative futures is the first task in the futures workshop for transport sector experts, and

3) Describing rural transport system transitions and futures visions: The vision path is formulated by selecting a suitable alternative future describing each variable to define the vision. According to the objectives of the vision (re)making processes, the participants of the workshop should be encouraged to find a consistent, mutually agreed transport system vision or a set of alternative visions for implementation.

In any case, the rural transport transitions visioning exercise is an intensive programme that is intensive in terms of financial resources, technical resources, participation approaches as well as timelines. It should be acknowledged that scenarios "can be qualitative, aimed at informing work on the rural transport trends, influences and changes in the South African society that will impact on rural transport system into the future" (McKenzie, 2016: 2).

3.5 Implications of conventional views from rural transport practitioners on rural transport transitions and futures

In seeking to address rural transport transitions and futures in South Africa, it is prudent to appreciate the mainstream conventional viewpoints as understood by rural transport practitioners. This is vital in better understanding the past, present and seeking to locate the transport philosophical thinking in the context of futures prospecting. Three key messages can be advanced from literature review, namely:

1. Engineering and construction paradigm: Transport is viewed as an enabling technology that facilitates mass production and globalisation (Knowles, 2006).
2. Spatial economic science paradigm: This relates to an approach that integrates space time convergence into transportation leads. The end result is enhanced understanding of how rural transport transitions and future will play out in a context where concentration and specialisation of economic activity predominates in the creation of comparative economic advantage of regions and areas (Janelle, 1969).
3. New directions paradigm: This insight is based on an expanded understanding of how the new economic geography theory which is based on optimising the economic laws of increasing returns to scale and competitive advantage are linked to the transport dividend (Krugman& Lawrence., 1994).

Therefore, transport practitioners view on rural transport takes the following further dimensions, namely:

- Advancing a clear understanding and application of the multiple nature of transport. In this categorization, rural transport can be understood as:
- A derived demand;
- A substitutable input; and

- Transport as an engine of growth.

Transport infrastructure and accessibility. This takes the following two forms:

- External accessibility and the 'two-way' road; and
- Internal accessibility and efficiency.
- Accessibility, the cost of transport and economic efficiency; and
- User benefits and the wider economic benefits of transport.

From the above review, one can appreciate why space and place are viewed as distance with a physical measure of travel in the transportation field (McKenzie, 2016). As a result, planning has an instrumental role in reducing trip lengths as advanced by the sustainable mobility paradigm (Banister, 2008). Figure 2, presents a graphical illustration of the sustainable mobility paradigm which resonates with the need for rural transport transitions and futures in South Africa.
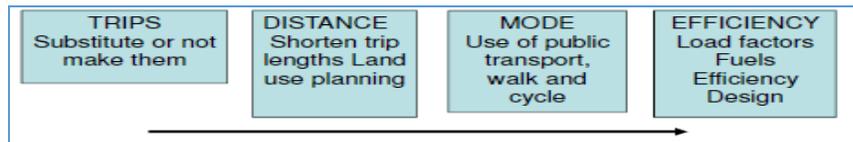
Figure 2: Illustration of the sustainable mobility paradigm

Source: Bannister, 2011:10

From Figure 3, we can deduce that the co-modification of time results in the dominance of one aspect of time (i.e. travel time). However, the reality is much more complex because there are links between technology, flexibility in the use of time, compression of time, and re-organization of transportation networks.

3.6 Problems related to travel in and through rural areas

Table 5 presents the outcome of a gap analysis linked to rural transport. Rural areas in South Africa face complex, dynamic and interrelated challenges of accessibility and mobility that an exercise aimed at addressing rural transitions and futures should not miss addressing.

Table 5: Problems related to travel in and through rural areas

	Problems related to travel in and through rural areas				
		Lack of accessibility for those without access to cars	High carbon emissions from rural car use	Congestion on inter-urban roads	Inter-urban carbon footprint
Potential solutions	Technology that reduces vehicle emissions	No effect	Reduction in emissions	No effect	Reduction in emissions
	Inter-urban transport network with rural stops	Benefit to a proportion	Small reductions in emissions	Reduced	Reduction in emissions
	Local rural public transport provision	Better local accessibility	Possible small-scale modal shift	Negligible effect	Negligible effect
	Inter-urban public transport with local rural transport links	Better local accessibility	Reduction in emissions	Reduced	Reduction in emissions

From table 5, we can deduce that the application of technology will not solve rural problems, although this makes significant contribution towards the reduction of rural transport problems. Along with this, it should be acknowledged that the local rural transport provision will not help much in alleviating national problems, although this is fundamental is fighting local level rural transport issues. Consequently, there is need to have rural transport and development policies that will help in addressing problems from a macro, meso and micro perspective.

3.7 Rural transport system transitions and futures conceptual framework

A robust, efficient and functional rural transport system is a vital component of a sustainable, integrated and inclusive rural community (DRDLR, 2009). From this point of view transport is an enabler, providing mobility in the society. The transport system is however affected and impacted on by other systems e.g. energy systems, environmental systems and social structures. Transport services are created using resources and technologies from a multitude of cross, inter, trans and multi-disciplinary application areas. Along with these considerations, we (re)advance the utilisation in South Africa of a socio-economic, political and environmental, technological changes and transition processes in the transport system as being an intervention area that can be explored using a three-lever rural transport transitions and futures framework. The three levers are inspired and adopted from Geels & Kemp (2012) work and however further adapted to the context of rural transport transitions and futures realities in South Africa as detailed below:

- Rural transport lever A: Rural planning, network design, landscape and environment;
- Rural transport lever B: Rural transport governance, system, institutions and structures; and
- Rural transport lever C: Rural transport policies, strategies, technologies and (re)solutions implementation platforms.

In this regard, the positioning of each rural transport transition and futures component is linked to the relevant lever where interventions and activities are implemented and monitored. However, all levers are interrelated thereby constituting s system of levers. Figure 3, presents a diagram showing possible typologies of rural transport transitions and futures in South Africa.
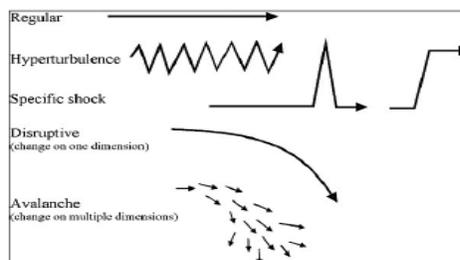
Figure 2: Typology of rural transport transitions and futures pathways (Geels and Schot, 2008: 399–417)

From Figure 3, we can deduce that rural transport transitions and futures may take one, a combination or a mixture of regular, hyper-turbulence, specific shock, disruptive or an avalanche of innovations as informed by the contextual realities during implementation.

4.0 Discussion of Findings and Results

This section presents a discussion of study findings and results. While the issues are discussed as topics, in practice the issues are interconnected and interdependent and therefore demand attention as whole and integrated policy (re)solutions.

4.1 An advanced understanding of rural transport transitions and futures

Figure 4, presents an advanced understanding of rural transport transitions and futures diagram that illustrates the complexity involved in seeking to resolve rural transport transitions and futures.
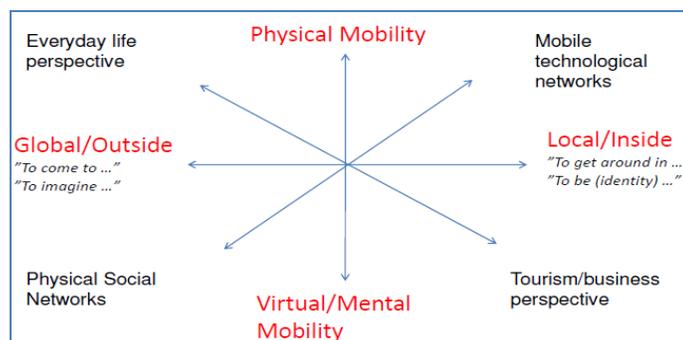
Figure 4: Advanced understanding of rural transport transitions and futures
Source: Model from the C-MUS sponsored regional Think Tank MobilitetsudfordringNordjylland ©, 2017

From figure 4, we can deduce that tackling rural transport transitions and futures requires an understanding of the changing face of technology and impacts on travel, transport and interactions for society. Consequently, in seeking to make better sense of South African rural transport domain, we can gain a leaf from the attempts of the European making sense experience, i.e. "As transport policy turns towards integration of nodes, and towards a reassertion of the role of public transport, the tendency is to pursue the functional model … cultural interests are overlooked in this friction-free utopianism" (Jensen and Richardson, 2004:51). Indeed, mobilities do not 'just happen' or simply 'take place'. Mobilities are carefully and meticulously designed, planned, and 'staged' (from below, above and besides) (Jensen, 2011: 17). Figure 5 presents the main actors involved in land based rural transport transitions and futures in South Africa.
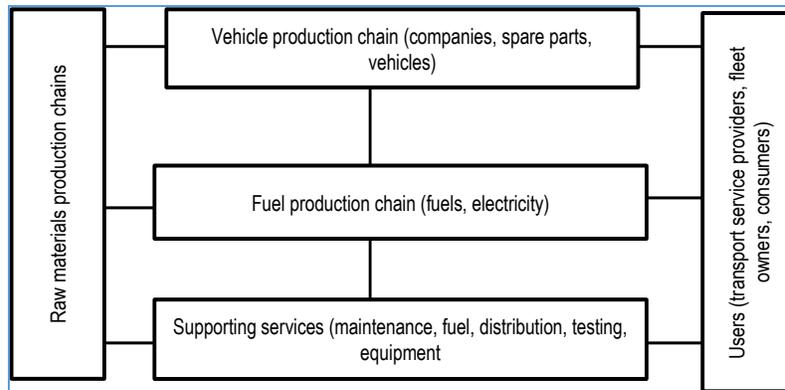
Figure 5: Rural transport transitions and futures in South Africa
Source: Authors own conceptualization, 2017

From Figure 5, we can deduce that rural transport transitions and futures in South Africa will be attached to images linked to storytelling. This can be powerful ways of seeking to illustrate a set of rural transport scenarios that can be described as "a way of telling stories about the rural transport future" (Heinzen, 2004).

4.2 Methods for mapping rural transport transitions and futures in South Africa

An instructive theoretical framework for responding to many of the gaps and critiques of the transition literature can be found in Inayatullah's (2008) "Six Pillars for futures thinking". These pillars are linked to methods and tools, while being developed through praxis. The six pillars are: mapping, anticipating, timing, deepening, creating alternatives and transforming, each with a set of tools and methods that can be used to facilitate pathways to desired futures. Table 6 describes the processes and methods for transforming rural transport futures in South Africa.

Table 6: Process and methods for transforming the rural transport future in South Africa

Futures pillar	Description	Associated rural transport transitions and futures methods
Mapping	Mapping methods involve identifying where we have come from and where we are going to - mapping the past, present and future in relation to an issue, topic or system.	Futures Triangle, Shared History, Futures Landscape
Anticipating	Anticipation methods look at the consequences of current activities over longer-time periods or where new social innovation may emerge.	Emerging Issues Analysis, Futures Wheel
Timing	Timing methods question what the future looks like over macro scale time periods to look at patterns of change.	No specific method. Questioning stakeholders i.e. in terms of macro-historical view of time, the future and change
Deepening	Deepening the future requires unpacking assumptions through questioning dominant discourses and images of the future by exploring underlying worldviews and stories.	Causal Layered Analysis, Four Quadrant Mapping
Creating Alternatives	Scenarios are the dominant tool facilitating the generation of alternative futures - through exploring the range of uncertainty and opening up the present.	Nuts and Bolts (structural functional analysis of organisations), Scenarios
Transforming	Transforming is related to the achievement of the preferred future that is identified through the principles used for the other pillars. It involves identifying the necessary steps to create the preferred future. Creative visioning, together with back-casting, are two complementary tools, which help to do this.	Creative visualization methods, Back-casting, Transcend Method

Source: Adopted from Boons, Montalvo, Quist & Wagner., 2013: 1–8.

From Table 6, we can deduce that transitional management is essential in terms of moving from the "now" rural transport scenario to the "then" future desired rural transport in South Africa. A participatory and all-inclusive approach is critical in making this a success.

4.3 Possible rural transport transitions and futures scenarios in South Africa

It can be hypothesized that possible rural transport transitions and futures in South Africa are simply scenarios representing strong narratives that have been or are to be developed with stakeholders input covering a wide range of plausible rural transport futures in the country. Their purpose is to prompt conversation and engagement on where we might be headed as well as where we are now.

The scenarios are therefore alternative visions of what could possibly happen. They are therefore possible future scenarios representing not what we think should occur, nor are they predictions of what is most likely to occur. While it can be tempting to just focus on probable and preferable futures, plausible futures can help prompt new insights by taking a wider view. The five types of futures described by Voros (2003) can be helpful to illustrate the potential range of rural transport transitions and futures that may occur in South Africa. The rural transport transitions and futures could take any of the following types (refer to Figure 6), namely:

1. Potential rural transport futures: alternative futures in general, including those we cannot even begin to imagine;
2. Possible rural transport futures: all the kinds of futures we can possibly imagine;
3. Plausible rural transport futures: futures which could happen according to our current knowledge;
4. Probable rural transport futures: futures which are considered likely to happen;
5. Preferable rural transport futures: what we want to happen based on subjective value or normative judgments.
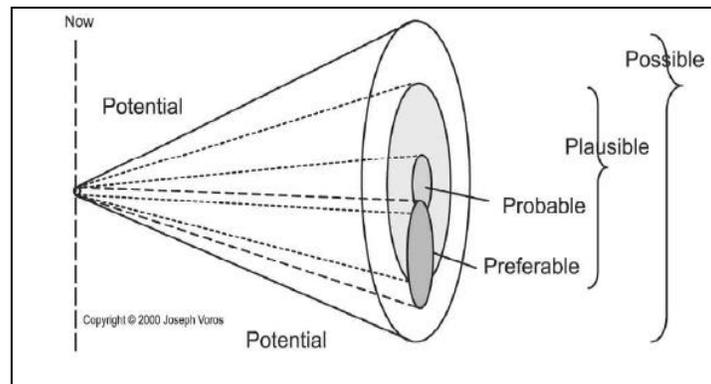
Figure 6: Five Types of the Future (Voros, 2003)

From Figure 6, we can deduce that judgment of what is possible, plausible, probable, or even preferable; will differ between people, authorities, government and over time. This is what makes discussions about scenarios so engaging and important. It is these discussions which can generate rich insights into the future, and inform decisions in the present. Given that making sense of large elements of the unknown can be daunting, a possible framework in understanding rural transport transitions and futures in South Africa has been generated as indicated in Table 7.

Table 7: A possible framework in understanding rural transport transitions and futures in South Africa

Scenario	Description	Factors and Drivers	Comment
Growth Scenario	Stories of this type are generally about continuation and growth of current trends	This includes growth in domains such as economics, science, technology and cultural complexity. Other factors that might grow or expand are population, the size of urban settlements or agricultural areas, or the amount of resources used. Growth could also be in terms of advancements in health or even democratic engagement	This scenario is about the (sometimes exponential) continuation of present trends and behaviour. Radical changes in behavior or resource usage would be considered under other scenarios.
Restraint Scenario	Stories of this type focus on encountering and responding to resource-based limits to growth. It typically involves exercising discipline to address undesirable outcomes - generally slowing growth to 'live within our means' whether this is environmentally, equity or poverty reduction focused or not.	Undesirable 'restraint', where the strong beliefs of one part of the population are imposed on or used to exclude other parts of society can turn into a collapse scenario.	Scenarios involving fundamental changes to society's behaviour or values usually fall under 'transformation', although the boundaries are not always clear.
Collapse Scenario	Stories of this type are about the loss of many valued aspects of society. It is a future where conditions deteriorate from present levels and critical systems can fail.	A collapse scenario might emerge because good intentions did not work out (for example, resource depletion while pursuing economic growth or resource protection leading to economic decline). Collapse might also result from direct destruction or from shocks and emergencies such as a severe global financial crisis or pandemic.	The deciding factor in how bad a collapse scenario can get is whether society is prepared a society for the shock and whether it results in destroying a people's health and wellbeing.
Transformation Scenario	Stories of this type are about fundamental changes from the current state of society for the better (as opposed to undesirable changes which are considered under collapse).	It is caused by a disruption to current patterns, values, norms or behaviour, with the development of new ones. Transformations might also result from significant technological changes and/or major changes in culture, attitudes, policies, and practices. It can include growth.	The difference from a typical growth scenario is that present trends are discontinued, and growth emerges from a totally new regime based on innovation and new behaviour. Transformation occurs due to radical changes to core features of today's world.

Source: Authors own compilation, 2017; Adopted from AAS (2015) and Townsend (2014)

From Table 7, we can deduce that the development of a rural transitions and future framework scenario is important since it helps to ensure that the scenarios are logical, relevant and credible. However, in addition to logic, scenario development also requires a degree of imagination and intuition.

In developing a rural transport transition and futures scenario framework, several approaches and a mix of inductive and deductive reasoning need to be adopted. Factors that can influence change in the rural transport sector in South Africa may include any of the following, namely: Automation; Shared mobility; Consumer demand for convenience and new services; Data availability; Consumer trust; Pricing transparency; Demographic shifts; Energy availability and cost; as well as transport service providers sustainability service and delivery responses. Table 8 presents possible rural transport transitions and futures factors of change in South Africa. These have been developed from reviewing existing literature on rural transport and development in South Africa. Ideally, such scenarios require confirmation and validation through hosting a national transport commission and having dedicated panel experts to work on identified and prioritised scenarios.

Table 8: Possible rural transport transitions and futures factors of change in South Africa

Factor of change	High	Low
Consumer demand for convenience and new services	Consumers place a higher value on stability of systems and familiar faces. Minimum user requirements are acceptable	Consumers place a high value on convenience and new services – everything is tailored to their needs and there are few barriers
Automation	Availability and uptake of automated transport options is low because of factors such as technology not reaching full capability or low user trust	Availability and uptake of automated transport options is high
Shared mobility	Willingness to share (rather than personally own) and availability of shared vehicles, public transport and other mobility devices is low. Indicators of this could be: Data on the peer to peer economy. E.g. low level of peer to peer trading in private assets as well as low use of mass transit services	Willingness to share (rather than personally own) and availability of shared vehicles, public transport and other mobility devices is high. Indicators of this could be: Data on the peer to peer economy. E.g. high level of peer to peer trading in private assets and willingness to use and availability of mass transit services
Data availability and sharing	Private and aggregated data is difficult to access, held by organisations (whether due to strict privacy rules or other factors such as a loss of consumer trust resulting in a refusal to share valuable data)	Private and/or aggregated data is highly available and shared between organisations (whether due to lax privacy rules or due to robust and highly trusted systems for data protection and sharing)

Source: Authors own compilation, 2017

From table 8, we can deduce that there is need to recognise that these factors will impact differently on different scenarios hence necessitating the need for a classification system indicating whether the occurrence of the indicating scenario is likely to be either 'high', 'medium' or 'low' for each factor to be also developed.

5. Recommendations

5.1 Towards a Cross, Inter, Trans and Multidisciplinary rural mobilities futures map

From the preceding discussions, one may postulate that there is need to anchor and establish future rural mobilities in South Africa as a cross - cultural disciplinary field. Figure 7 presents the Cross, Inter, Trans and Multidisciplinary rural mobilities futures map in a diagrammatic fashion.
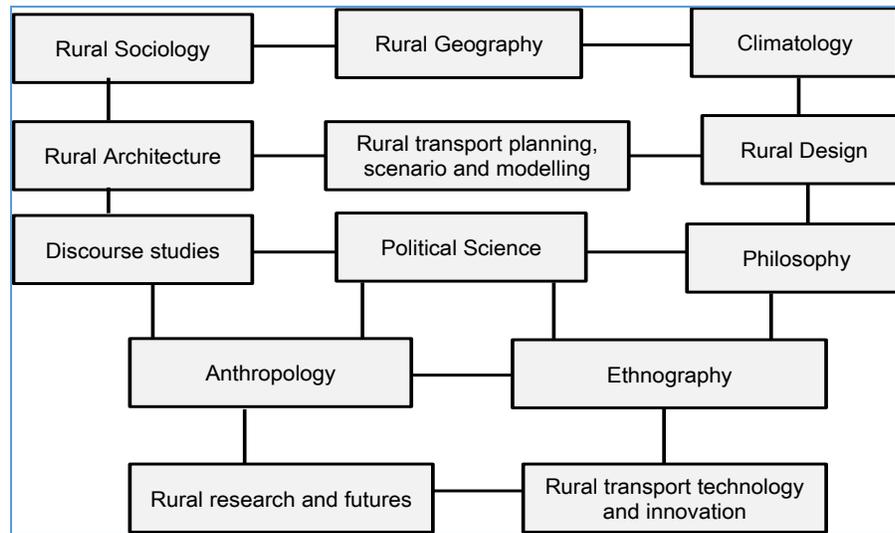
Figure 7: Cross, Inter, Trans and Multidisciplinary rural mobilities futures map

From figure 9, we can depict that cooperation and collaboration between and among disciplines in critical in building a sustainable, integrative and inclusive rural transport transitions and futures outlook for South Africa.

5.2 Lessons for rural transport interventions transitions and futures in South Africa

From the preceding analysis and review of pertinent literature, the sum effect of these reflections is to stimulate reflection regarding how best to respond to rural transport transitions and futures challenges matters such as climate change within the contexts of human settlement and health; energy; agriculture, forestry and fisheries; and biodiversity and ecosystems as examples. Table 9, presents lessons for rural transport interventions transitions and futures in South Africa.

Table 9: Lessons for rural transport interventions transitions and futures in South Africa

Summary of Lesson	Observations	Practical Lesson & Responses
Lesson 1	• Move from reactive to proactive planning	• Apply and develop tools for reframing issues • Take calculated risks • Apply systems thinking • Adopt social tools that involve citizen participation, dialogical leadership, institutional and technological innovation, community networking
Lesson 2	• Technology and identity are linked (i.e. technology becomes a social agent once created) • Technology can foster a false sense of security	• South Africa needs innovative technology that links with innovative identity • Work on social choices produced through technology • Cultivate identity between a technology and its utility as a response to climate change
Lesson 3	• Adaptive leadership fosters adaptive institutions • Adaptive institutions emerge over time and only through collective effort	• Change takes time but needs effective leadership • Institutional building needs to anticipate the desired change
Lesson 4	• Scenarios challenge our thinking about the present	• Use short, medium and long-term thinking • Use scenarios to challenge constructions of what is possible • Be clear about value base and base choices and responses around these • Do not be shy about prompting preferable futures
Lesson 5	• South Africa needs to couple imagination with social will, institutional creativity and empowered leadership	• There needs to be a deep engagement with the imaginative and structural bedrock of our civilisation
Lesson 6	• Set aside outdated plans for a future that is unlikely to arrive	• Will Rodgers once advised Americans that to get out of a hole, the first thing to do is "STOP DIGGING".

Source: Authors own construction, 2017

From table 9, we can deduce that the implementation of the practical lessons could lead to the creation of a transformed rural environment in South Africa.

5.3 Re-imaging rural transport transitions and futures in South Africa: The case of transport policy objectives - a rejoinder

One way of re-imagining rural transport transitions and futures in South Africa is through (re)questioning existing transport policy objectives as found in mainstream policy documents. Some of the key questions one may ask include the following, namely: Is transport over-burdened as a sector?; Are transport issues playing subordinate to wider policy interests?; Is there an evident over-reliance on the role and scope that transport can play in solving all of a region's or country' problems which may be construed as being "unwise"?; Is it wrong to question instances where transport policy and decision making is involving significant capital expenditure that may also be inefficient (as this has the potential to lead to over-investment) as examples. Table 10, presents how policy objectives and actions can be revised from a rural transport transitions and futures lens so that they become more efficient and relevant to addressing contemporary rural transport transitions and future matters.

Table 10: Revisiting rural transport transitions and futures objectives making use of a rural transport transitions and futures lens

Enhancing profiles and competencies	Increasing efficiency and innovation	Mutual practice and learning
Connecting national strengths Cover national gaps Establish knowledge cluster(s) Rethink national strategies	Sharing research infrastructure Exchange experts Harmonizing research frameworks for better solutions Joint calls and evaluation panels	Comparative research Sharing models and experiences Improving practice and reducing non-successful projects

Source: Authors own conceptualization, 2017

From table 10, we can deduce that cooperation patterns in the field of research, technologies and innovation for both rural and urban development demonstrate the importance and role of national strategies and programmes (i.e. in terms of addressing national needs and priorities) and preparing the national community for national and local level collaboration.

5.4 Rural transport transitions and futures pathways for the creation of new business opportunities

It is paramount to envisage the rural transport transitions and futures as presenting pathways for creating and expanding existing and new business development and growth opportunities. Figure 8, presents a schematic illustration of rural transport transitions and futures as a vehicle for the creation of new business opportunities.
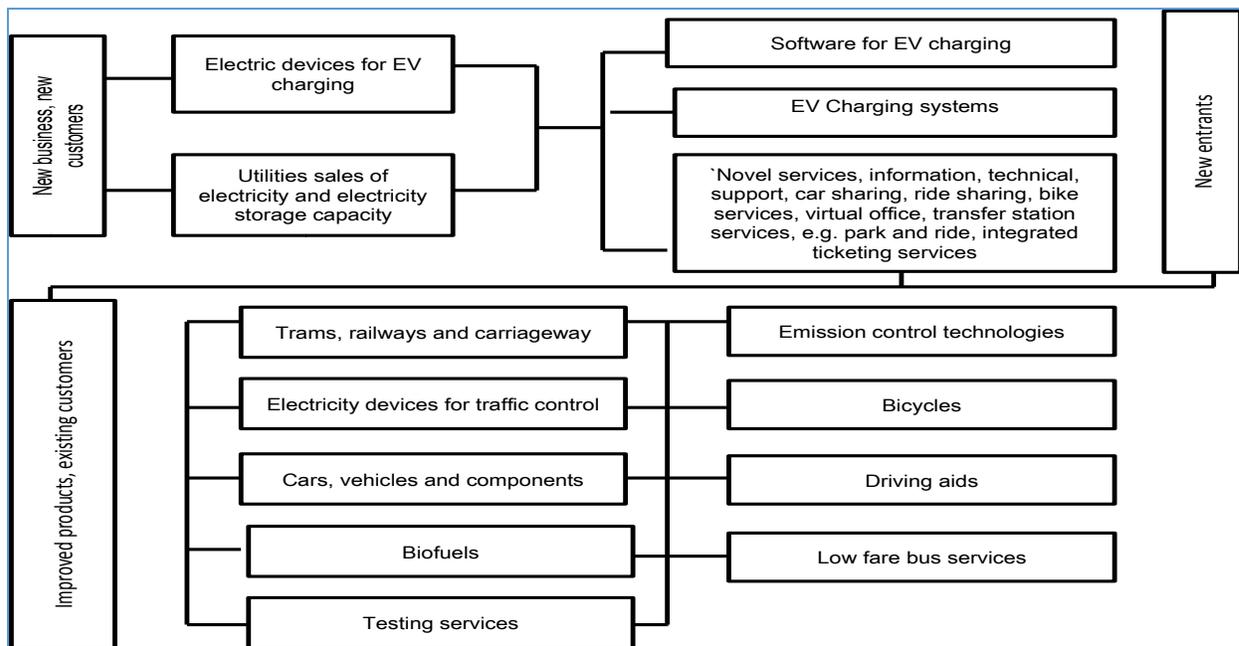
Figure 10: A schematic illustration of rural transport transitions and futures as a vehicle for the creation of new business opportunities

Source: Authors own construction, 2017

From figure 8, we can deduce that the intelligent application of rural transport foresight studies is fundamental to unleashing the full potential of rural areas. The transport sector can be used as a conduit and window for accessing and facilitating the realization of this.

6. Conclusions

Global warming, energy supply, urbanisation, global markets, scarcity of financial resources, security issues, aging population as well as digitalization of our environment are grand challenges, which we need to consider carefully as we make strategic plans for future transport systems.

Potential measures and innovations to tackle the grand challenges are often systemic, resulting in system innovation or transition (Auvinen and Tuominen, 2013: 343). Indeed, there may be multiple guiding visions and multiple rural transport transition and futures paths in South Africa for each vision (Kemp and Loorbach 2003). Consequently, rural transport transition paths are routes toward the final image. These rural transport transition and futures paths incorporate interim goals and objectives which evolve and become more concrete the closer they are to the present (Kemp & Loorbach., 2003). One practical way of fast-tracking the realization of the guiding visions encapsulated in the rural transport transition and futures paths is through the implementation of flexible and intelligent practical experiments (which explore rural transport transition paths) as a binding transformation and transition agenda. Therefore, in conclusion, we should all realise that "people and economies thrive in places where it is easy to do business, be creative and live a healthy lifestyle" (Government of South Australia, 2016: 6).

References

AAS,. (2015). Australia 2050: Structuring conversations about our future. Australian Academy of Science (AAS), Canberra
Argyris, C., &Schön., D. A., (1978). Organizational Learning. A Theory of Action Perspective. Reading: Addison Wesley.
Arrow, K., (1962), The economic implications of learning by doing, Review of Economic Studies, 29(3), 155-173.
Auvinen H., Tuominen A., Ahlqvist, T. (20132). Towards long-term foresight for transport: envisioning the Finnish transport system in 2100. Foresight 14(3):191–206

Auvinen, H., & Tuominen, A., (2013). Future transport systems: long-term visions and socio-technical transitions, SpringerLink

Banister D. (2011). The Trilogy of Distance, Speed and Time, Transport Studies Unit, School of Geography and the Environment, University of Oxford

Bell, M., & Figueiredo. P.N., (2012). Innovation capability building and learning mechanisms in latecomer firms: recent empirical contributions and implications for research, Canadian Journal of Development Studies / Revue canadienned'études du développement Vol. 33 ,Iss. 1,2012, pp. 14-40

Boons, F., Montalvo, C., Quist, J., Wagner, M. (2013). Sustainable innovation, business models and economic performance: An overview. J. Clean. Prod. 2013, 45, 1–8.

Brent, A. (2015). The transition to a green economy: A systems approach to managing technology, Inaugural lecture delivered on 19 October 2015, Engineering Management and Sustainable Systems, Department of Industrial Engineering, and Centre for Renewable and Sustainable Energy Studies, Faculty of Engineering, Stellenbosch University, Editor: Language Centre, PRINTING: SUN MEDIA, ISBN: 978-0-7972-1593-1

Burbidge, T.K., Knowlton, T., Matheson, A. (2007). Wasatch choices 2040.A new paradigm for public involvement and scenario development in transportation planning. Transport Research Record 1994:147–153

Cervero, R., (not dated). Mobility, Place-making & Economic Competitiveness, University of California, Berkeley

deHaan, J.H., Rotmans, J. (2011). Patterns in transitions: understanding complex chains of change. Technology Forecast Sociology Change 78(1): 90–102

Department of Transport, (2011). National Transport Master Plan (NATMAP 2050). Departmental publication on website: www.transport.gov.za. Pretoria. (2011)

Department of Transport, (2015). National Transport Master Plan 2050-Synopsis Update.Final Report. Departmental document. Pretoria. 2015.

Department of Transport, (2016). National Land Transport Strategic Framework (2015/16 – 2019/2020). Final Draft. Government Gazette Notice 823 of 2015.Government Printer.Pretoria.:23)

Department of Transport., (2007). Rural Transport Strategy, Pretoria, South Africa

Department of Transport., (2016). Reviewed Rural Transport Strategy (Draft), Pretoria, South Africa

DRDLR, (2009). Comprehensive National Rural Development Programme, Pretoria, South Africa

Elzen B., Wieczorek, A., (2005). Transitions towards sustainability through system innovation. Technology Forecast Sociology Change 72(6): 651–661

Freeman, C., and Perez, CT., (1988). Structural crises of adjustment: Business cycles and investment behaviour. In: Dosi G. et al. (Eds). Technical Change and Economic Theory // London: Pinter, pp. 38–66.

Future Foundation., (2002). Scenario Building for Twenty Year and Fifty-Year Futures. Department for Environment Food and Rural Affairs, London.

Future Foundation., (2006). Rural Disadvantage. Commission for Rural Communities, London.

Geels, F. W., & Kemp, R., (2012). 'Findings, conclusions and assessments of sustainability transitions in transport', in Geels, F. W., Kemp, R., Dudley, G. & Lyons, G. (eds.) Auto mobility in Transition? A Socio-Technical Analysis of Sustainable Transport, Routledge, pp. 335-373.

Geels, F., &Schot, J., (2008) 'Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy', Technology analysis & strategic management Volume: 20 Issue 5 (2008) ISSN: 0953-7325

Geels, F., Schot, J. (2007). Typology of socio technical transition pathways. Res. Policy 2007, 36, 399–417.

Geels, F.W., (2004). From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory. Res Policy 33(6–7): 897–920

Geels, F.W., (2005). Processes and patterns in transitions and system innovations: refining the co-evolutionary multi-level perspective. Technology Forecast Sociology Chang 72(6):681–696

Government of South Australia., (2016). Shaping South Australia's planning future, Department of Planning Infrastructure, Australia

Heinzen, B., (2004). Feeling for Stones: learning and invention when facing the unknown. London, self-published. Available at http://www.barbaraheinzen.com/ Publications

Hughes, T.P., (1987). The evolution of large technological systems. In: Bijker WE, Hughes TP, Pinch T (eds) The social construction of technological systems. New directions in the sociology and history of technology. MIT Press, Cambridge, pp 51–82

Inayatullah, S., (2008). Six pillars: Futures thinking for transforming. Foresight 2008, 10, 4–21

Janelle, D., (1969). Spatial reorganization: a model and concept, Annals of the Association of American Geographers, Volume59 pp. 348-64

Jensen, A., (2011): Mobility, Space and Power: On the Multiplicities of Seeing Mobility, Mobilities, 6:2, 255-271

Jensen, O., and Richardson, T., (2004). Making European Space: Mobility, Power and Territorial Identity, London: Routedge.

Kemp, R., & Loorbach, D., (2003). Governance for sustainability through transition management. Paper presented at EAEPE 2003 Conference, November 7-10, 2003, Maastricht, the Netherlands.

Kemp, R., Loorbach, D. and Rotmans, J., (2007). Transition management as a model for managing processes of co-evolution towards sustainable development. The International Journal of Sustainable Development and World Ecology 14(1): 78-91.

Knowles, R.D., (2006). Expansion of the Journal of Transport Geography. Journal of Transport Geography 14 (1), 1–2.

Krugman, P. & Lawrence R., (1994). "Trade, Jobs and Wages", Scientific American, CCLXX (1994), 22-27

Lundvall, B., (2007). Innovation system research and policy: Where it came from and where it might go, Aalborg University, Olso

Lundvall, B.-Å., (1988). 'Innovation as an interactive process: From user-producer interaction to the National Innovation Systems', in Dosi, G., Freeman, C., Nelson, R.R., Silverberg, G. and Soete,L.,(eds.), Technology and economic theory, London, Pinter Publishers.

Mashiri. M., Chakwizira, J., and Nhemachena, C., (2008). Rejecting the inevitability of poverty": Empowering women for sustainable rural livelihoods through community-based employment intensive rural infrastructure maintenance projects". Science real and relevant: 2nd CSIR Biennial Conference, CSIR International Convention Centre, Pretoria, 17&18 November 2008

McKenzie, F., (2016) Scenarios for Land Transport in 2040. The Australian Futures Project, Prepared for the National Transport Commission, September 2016, La – Trobe University, Australia

National Household Transport Survey., (2013). Department of Transport, Pretoria, South Africa

NATMAP., (2010). National Master Transport Plan, Pretoria, South Africa

NDP., (2010). Vision 2030, Presidency, Pretoria, South Africa

Pinch, T.J., Bijker, W.E., (1987). The social construction of facts and artefacts: or how the sociology of science and the sociology of technology might benefit each other. In: Bijker WE, Hughes TP, Pinch T (eds) The social construction of technological systems. New directions in the sociology and history of technology. MIT Press, Cambridge, pp 17–50

Rosenberg, N. (1982). "Learning by Using," in N. Rosenberg, Inside the Black Box. Cambridge, Cambridge University Press, 120-140.

Rotmans, J., Kemp, R., van Asselt, M., (2001). More evolution than revolution: transition management in public policy. Foresight 3(1):15–31

Rural Transport Strategy., (2007). Department of Transport, Pretoria, South Africa

StatsSA., (2011). Census 2011, Pretoria, South Africa

Think Tank Mobilitetsudfordring Nordjylland., (2017). Model from the C-MUS sponsored regional Think Tank Mobilitetsudfordring Nordjylland, Germany

Toleman, R., Rose, G., (2008). Partnerships for progress. Toward sustainable road system. Transport Research Record 2067:155–163

Townsend, A., (2014). Re-programming mobility. The Digital Transformation of Transportation in the United States (Vol. 36). New York, NY: Rudin Center for Transportation Policy & Management.

Urry, J., (2013). Does mobility have a future or the end of the Road? Department of Sociology, Lancaster University

Voros, J., (2003). A generic foresight process framework. Foresight 5 (3) pp.10 - 21.

Waskowiak, P., Garber, K., & Durham, C., (2007). Envision Houston region. Shaping the future together in Texas. Transport Research Record 1994:154–158

Wieczorek, A. J., Hekkert, M., (2012). Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. Science and Public Policy, 39:74–87