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Exploring Future Cityscapes through Urban Logistics Prototyping: a Technical Viewpoint

1.0 Introduction

Interest in the role that urban supply chain management can play in the future planning of cities, has accelerated with the rapid advance of the digital economy (DE) (e.g. the Internet of things, Cloud Computing paradigm, Big Data) and the rise in popularity of smart city designs. The "*smart city*" concept can be used to link wider social concerns around inclusiveness, resilience, good governance, long-term sustainability and economic competitiveness with developments in Information and Communication Technologies (ICTs).

Cities are complex entities, like cells. They do not work simplistically but are composed of many technical, social and physical systems that interact in a myriad of ways, like a human body or an eco-system. But they need to be resilient. If something goes wrong with such a complex entity, it takes a long time to cure. If a city is to change, and be resilient it takes time. Again, it takes time for deep resilient structures to have an effect on smaller, more subtle logistic structures.

The French philosopher Gaston Berger, pointed out that if current events reflect decisions of the past, future events will be the result of decisions of the present, however this mental attitude of what enables one to prepare for the future is not always in the minds of people and institutions. Miles (2010) graphically notes that the ability to survive in an accelerating world of change and challenge, calls for even greater creativity in our thinking and for more effective strategic planning and foresight. In his words: "*Mankind has always had tremendous concern about the future"* (p. 1448). That concern is even greater today as the rate of change accelerates, with technological innovations that crowd in on us, breaks with the past multiply and an impression of chaos takes over from the well regulated order of things.

Miles'(*ibid*) concern about the ability to survive in a changing world is reflected in the rise of notions of resilience generated by governments, policy makers, academics, businesses and others over the last few years as a way of dealing with change and disruption. Dynes (2003) for instance defined resilience as conveying a sense of emergent behaviour: *"which is improvised and adaptive in rapidly changing and usually ambiguous conditions"* (p. 17).

More recently emphasis has been placed on the resilience of communities in coping with future disruption (Twigger-Ross *et al*, 2011). In this respect Deeming (2013) discusses the challenges that will face communities in the future suggesting that they will become "*quicker, harder, more often and from different directions"* (p. 16) and that those seeking to build resilience will need to be constructive and think innovatively. He further suggests that future generations living in "*mega cities*"[1] will continue to be constrained by "*wicked"* problems that are beyond their control and that we need to nurture types of resilience that address these issues. We must also be vigilant to the problems that will be faced by business that are not prepared for change and do not utilize resilience strategies. As early as 1976, Turner noted that organisational failure was more often than not down to a failure of foresight, sloppy management and the inability to engage with all stakeholders.

Conceptualising resilience as transformation and complex entities such as cities, businesses and communities as owning the need for change means a holistic systems approach that considers adaption and innovation combined with cultural variances, the complex nature of communities, and existing and future networks transforming to meet future challenges. It provides the opportunity for an economic and social renaissance, for a new culture of

[1] A mega-city is usually defined as a metropolitan area with a total population of over 10 million people (Caplice and Blanco, 2006, p. 10).

enterprise and re-skilling whilst at the same time reducing uncertainty. Future trends may include spatial dimensions such as resilient landscapes and smart cities and social/cultural dimensions such as communities that are adaptable, innovative and inclusive through increasing social capital fostered for example, by the use of digital technologies that provide knowledge, information and new foresight techniques that may even provide the ability to accurately predict future problems and disruptions.

In recent years, scenario planning has struggled as an effective (logistics) foresight technique to deal with the speed and scale of disruptive innovation. For instance, it failed to predict the rise of peer-to-peer (P2P) illegal downloading and its impact on the music industry and, more recently social media and its influence on value creation activity in the news industry supply chain. While the dramatic rise of mobile telephony likewise was not anticipated. Many are now questioning the relevance of popular scenario techniques and methods (such as Delphi), in an increasingly volatile and technologically-driven business environment. Others are calling for revisionism in scenario techniques such that they embrace more human engagement with every day citizens and social input (Coates et al., 2010). One such revisionism could come from blending together more imaginative and creative disciplines with strategic planning.

A logistics fiction (LF) prototype uses science fiction, visionary art, fantasy, architectural images and creative expression based on science fact as a design tool in the development of future city logistics planning and resilient communities. They aim to provide a virtual reality in which the implications, problems and benefits of future city and urban logistic issues can be explored (Johnson, 2011). The main purpose of this technical viewpoint is to provide a commentary of how we went about using logistics prototyping as a method to engage with

science fiction (SF) writers and small-to-medium sized enterprises (SME's). Six urban logistic prototypes were built on the themes of future cities; community resilience and urban logistics, and these are summarized, together with details of the data collection procedure and the methodological challenges encountered. Our investigation aimed to demonstrate the potential of logistics prototyping to develop both "*creative/fictional*" and "*small/medium firm*" approaches to future city design and urban logistics decision-making.

2.0 Fictional "city" transformation, scenario planning and logistics prototyping literature

Auroville City (which is located 10km outside of Pondicherry, Tamil Nadu in India) provides an example of how future fictional visions could be transformed into a living reality. This city was built on people's imaginations without following the norms, and conventional political requirements (Namakkal, 2012). Auroville was envisioned by the Indian freedom fighter (turned yogi) Sri Aurobindo Ghose (1872-1950) and Parisian spiritualist Mira Alfassa (1878-1973) who is more commonly known as la Mere or "*the Mother*". Aurobindo and The Mother established an ashram in Pondicherry in 1926, when Pondicherry was still the centre of French colonialism in 1926.

They both had a vision to create an international city that would serve as: "*a bridge between a series of binaries: East/West, Past/Future, Rich and Poor"* (ibid., p. 74). In reality although the city was designed to embed itself in the Tamil community the locals were largely uninspired by this "*utopian*" project. The Aurovillans were perceived by the locals as neo-colonizers who had come to take their land and to exploit their labour. Namakkal concludes that the failure to transform fictional vision into reality was largely because they had not built the subjectivity of local people into their planning: "*a subjectivity of a local population shaped and reshaped through centuries of struggles with colonizers from all over the World*"

(ibid., pp. 81-82). Auroville did not meet its utopian ideal[1] as it was informed by social processes of hierarchy, a hierarchy that had previously been established throughout centuries of colonialism, which placed the West above anything else[2].

For the company, scenario planning (which emanated out of military planning in the Second World War) is a process of long term strategic planning. It involves the development and use of future scenarios of the problem or system at hand. A scenario is simply a vision of a possible future state of the world and relevant environment. Scenarios are methodologically constructed stories about alternative futures in which today's decisions might play out. A good scenario must be plausible, internally consistent and challenging for strategic purposes (Wack, 1985a). It should make the decision makers see the future in new ways and question their unspoken assumptions. A scenario planning engagement should involve the use of multiple, mutually exclusive scenarios (Wack, 1985b).

A major impediment to supply chain planning in the face of uncertainty is that we become tethered to establish beliefs and accepted wisdom – in other words hidden assumptions. Yet to operate effectively in this environment we must open up our minds to multiple possibilities rather than use mental constructs that are rooted in past experience and guided by personal beliefs and preferences (Schwartz, 1991).

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[1] A "*utopia*" is a community or society possessing highly desirable or near perfect qualities. The word was coined by Sir Thomas More in Latin for his 1516 book *Utopia*, describing a fictional island society in the Atlantic Ocean. The term has been used to describe both intentional communities that attempt to create an ideal society, and imagined societies portrayed in fiction. It has spawned other concepts, most prominently "*dystopia*".

[2] For further information please refer to this article: https://www.academia.edu/2476990/European_Dreams_Tamil_Land_Auroville_and_the_Paradox_of_a_Postcolonial_Utopia (Namakkal, 2012).

One of the most difficult questions relates to the scenario creation process is how to evaluate the quality of scenarios created by the process[1]. Scenarios are planning aids used to develop long range plans by considering potentially different futures; they are not predictions. Therefore their validity cannot be evaluated by seeing if one of the scenarios in a set comes to fruition. In lieu of objective tasks, scenario planning literature provides the desired attributes of scenarios. So what makes a good scenario (Lindgren and Bandfield, 2009; Phadnis, 2012). First, the users should believe that the scenario can grow logically from the past and the present and second, the logic should be consistent, that is the scenarios internal needs to be aligned. One aspect of the scenario cannot contradict the other. This also helps improve plausibility (Caplice and Blanco, 2006).

In most cases the scenarios are developed in an iterative fashion. The initial scenarios are tested in small groups for plausibility, consistency and so forth and are continually developed until they represent a full set of potential futures for which to invent. Imaginative/qualitative approaches to forecasting, foresight and futurism may be nothing new. But we are currently observing a movement towards more creative and imaginative involvement in "*future hunting*" whether that be related to technology, firm innovation, "*smart city*" design or digitally enhanced and resilient urban communities (Caplice and Blanco, 2006).

Fictional prototyping can dynamically "*test*" objects or tools or storylines. The historical problem with scenarios is that they tend to be "*fixed*" extrapolations into the future. However, the future rarely moves in predictable, incremental ways. Often seemingly small changes in technology, demographics, regulations, economics, or a myriad of other factors have dramatic and unintended impacts on how any organization (public or private) plans and

[1] Caplice and Phadnis (2013) provide a fascinating in-depth evaluation of the historical evolution of scenario planning methodologies.

operates. These nonlinear impacts are very difficult to predict using traditional forecasting methods and techniques since they, by definition, do not follow any historical patterns. The technique of fictional prototyping allows the inventor or storyteller to adapt their scenario as they evolve and as the users or participants give their reactions.

The design of a prototype is challenging as they require the developer to be both a scientific and technological expert and also to be able to write compelling fiction (Johnson, 2010). The fictional prototype initially used imaginative narratives based explicitly on science fact as a design tool in the development of future technology trajectories. This emerging methodology largely focuses on the social, economic and ethical influences of future technology. Prototypes could be taken as indicators of design paths in the on-going search process of an industry.

Further, more recently, logistics prototyping has enabled forecasters and futurists to have a creative and imaginative dialogue with all stakeholders. Fictional prototyping could be claimed to be an emerging foresight technique attempting to analyse the future as a multiple reality. However as Sutter (1983) notes: "*within any study of possible and desirable futures created through imaginative and creative means, it remains of limited interest if not destined to have a real influence on action*" (p. 2). The ability of the developer ultimately relies on tacit knowledge about science, technology, logistics practice, people, institutions, narrative structures, the creative process, and proper presenting and critiquing skills. The problem with relying on tacit knowledge for foresight is that one's visions are going to be infected with unexamined biases, and may confirm what you want to know rather than challenge and transform your vision of the future.

3.0 Prototype construction

The Boston prototyping experiment was an investigation we conducted between May and August 2013 with urban logistic executives working in the small and medium sized enterprise (SME) sector together with published science fiction writers. The prototype development process is presented in Figure 1. This process initially involved creating a strategic context for the story narratives to be developed (detailed in Section 3.1).

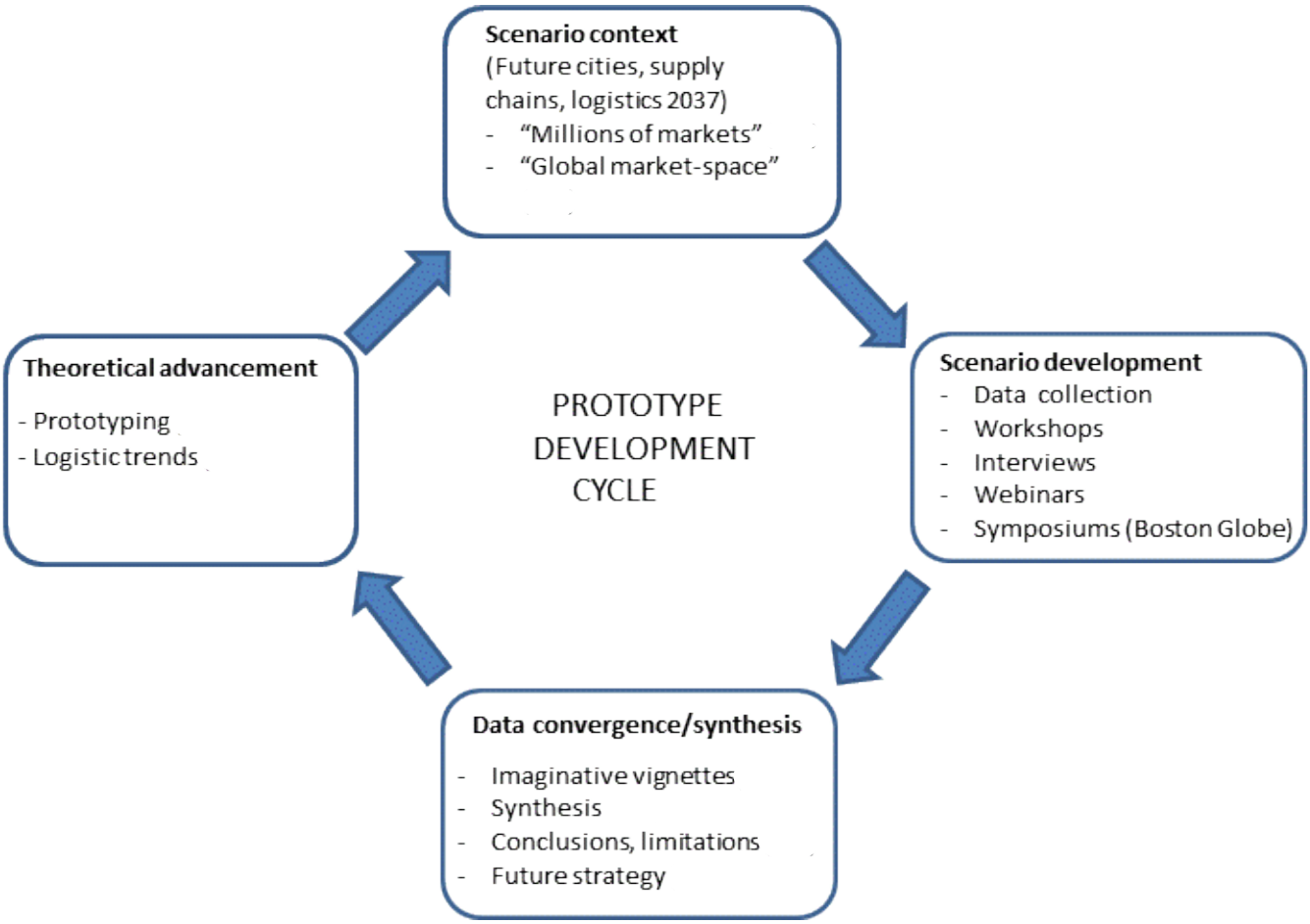

Figure 1 The prototype development process
Source: Graham (2014, p. 3).

From these contexts, fictional narratives were then developed which would be designed to extrapolate forward future technology (e.g. AI, robots, 3D printing) that could influence

smart city production structures and urban logistics systems to the year 2037. The participants were asked first to envision the city landscape generated by one of the four strategic contexts.

Science fiction is ideal for modelling these long-term changes, especially their human impact. Again, there is a deep science fiction tradition of writers exploring the evolution of cities over decades (and even centuries) – for example, "*Cities in Flight"* by James Blish and the "*City and the Stars"* by Clarke. A select number of science fiction texts were therefore used to illustrate certain landscapes and concepts such as Clarke's self-organizing city, Dispara[1] presented in the "*City and the Stars*".

Several major cities have figured prominently in predictive science fiction including: London (Wells, Moorcock); Manchester (Burgess, Noon); New York (Asimov) and; Los Angeles (Dick). Every city is different with its own unique future, despite the overlapping influence of new technologies. Therefore extracts providing such *"visionary*" city imagery were presented as posters, graphic artistry and extract readings conducted in order to catalyse strategic concept development and intellectual debate.

Using this fictional imagery and strategic contexts the participants were then asked to select their own future technology or logistics concept. They were then required to extrapolate this to 2037, and then produce a main story plot with associated character and scene development. Each narrative would be designed to focus on human-technological interaction and second order sociological consequences (whether this was framed in social, economic, resilience or ethical sub-plots).

[1] Dispara was a fully functioning, self- organizing city where all its inhabitants market demands and needs (food, shelter, energy) were all produced within the boundaries of the city. It was assumed by city planners that no one would ever want to or need to leave Dispara.

3.1 Long run supply chain strategic environments

The first stage of the prototyping process was to develop several alternative future supply chain and freight scenarios. MIT's Chris Caplice who had previously worked with the U.S Transportation Research Board (on scenario planning for freight transportation infrastructure investment) was invaluable in helping the researchers to construct and test with his staff and students four long run environment scenarios. These strategic scenarios were projected forward to the year 2037 using the structural axes of global trade and resource availability. From the initial scenario development we generated the matrix that is presented in Figure 2. In the quadrant matrix the alternative supply chain environment scenarios can be categorized as follows:

- *Millions of markets (low global trade/high resource availability)*

World where advanced technological breakthroughs have enabled the US (and other countries) to become highly self-reliant in terms of energy, agriculture, manufacturing and

Figure 2 Strategic quadrant matrix

other needs. There is increased migration towards smaller urban areas that are supported by nearby regional innovation hubs that can manufacture highly customized goods.

- *Naftastique (low global trade and low resource availability)*

This is a world where trade has moved away from a single global market toward a number of emerging trade blocs (China, Europe, S. America) from their own clusters. N. America is a self-sufficient community.

- *Global marketplace (high global trade and high resource availability)*

This is a highly competitive and volatile world. Open, vigorous trade between virtually all nations has led to market-based approaches to most contemporary challenge.

- *One world order (high global trade and low or restricted resource availability)*

This is a highly regulated and managed world. Facing global security of key resources, nations establish international rules to ensure their fair and sustainable use. Global trade thrives, but the very visible hand of regulation at times, an iron fist in a velvet glove sharpens its course.

The main differences between the four scenarios are summarized in Table 1 below.

Driving forces	*Naftastique!*	*One World Order*	*Global Marketplace*	*Millions of Markets*
Global Trade	Low	High	High	Low (physical)
Resource Availability	Low	Low	High	High
Energy Cost Level	High	High	Low	Low
Energy Cost Variability	Low	High	High	Low

Level of Environmental Awareness	Same as today	High	Low	High
Population Dispersion	Growth in SW	Growth in Biggest	Growth in Biggest Cities	Rise in Mid Tiered Cities
Energy Sources	Majority NA	Mix Foreign & Domestic	Majority Foreign	Majority Domestic
Level of Migration	High w/in Bloc Low between	High	High	Low
Migration Policy	High	High	Low	Low
Currency Fluctuation	Low w/in Bloc	High	Moderate	Low

Table 1 Driving forces used for each N. American strategic scenario
Source: Adapted from Caplice and Padnis (2013, p. 35)

3.2 Scenario development

We organized a series of story workshops to extend these long run supply chain trends to participants building their fictional narratives around the strategic themes of economic production, distribution or logistics related activity. The general framework for each prototyping workshop was the same. There was an introduction to the concepts and approach followed by small group immersion and breakout sessions, with a final group debrief and discussion. Within this general structure however each workshop was designed differently using the following nine key components (presented in Table 2) which are in a rough chronological order as they were implemented.

Scenario Development: Story Workshop Structure
• Scope ("*millions of markets*" and/or "*global marketplace*" etc.) • Objective (visioning/or evaluating) • Duration (half day) Participants (Story workshop one: eight science fiction writers (n =8); Story workshop two: seven SME (supply chain and freight) managers (n =7)). • Strategic questions (to provide input and guide participants decision making) • Evaluation elements (future technologies, cities, communities, new economic models) • Evaluation mechanism (plausibility, logic, ideology and rationality underpinning story construction) • Scenarios ("*fictional*" based scenarios) • Debrief and follow up.

Table 2 Structure of the story focus groups

3.3 Sample characteristics of the story workshops

The sample presented in Table 3 is composed of two story workshops. A total of 15 participants (who were all permanent residents in Boston) participated in building prototypes. The story workshop was organized as a "*fictional focus group*"[1]. As with most "*focus group*" research our sample strategy relied on purposive sampling (Miles and Huberman, 1994), with researchers selecting participants based on the theoretical requirements of the project and the

[1] A focus group is a form of qualitative research in which a group of people are usually asked about their perceptions, opinions, beliefs, and attitudes towards a product, service, concept, advertisement, idea, or packaging. Questions are asked in an interactive group setting where participants are free to talk with other group members (Miles and Huberman, 2014). In the focus group users are perceived as external actors providing marketing input into the design process. With fictional prototyping the user is made central to product or concept development. They provide a virtual reality in which the implications, problems and benefits of the technology can be explored (Graham and Mehmood, 2014).

potential conceptual contribution of participants. This sample was selected using a combination of "*snowball*" and purposive or theoretical sampling.

Workshop Theme	Date(s)	Number of participants	Sample composition
Future Cities/Social, human and ethical implications	07.06.13	8 participants	Science fiction writers
Future Cities/urban supply chain implications	14.06.13	7 participants	SME Freight/supply chain managers (Boston area)

Table 3 Sample characteristics

The first story workshop consisted of 8 members of the Boston Science Fiction writers group (over 300 members across the US). They had been selected, by the Head of the writers group. Every participant had published (novels, novellas short stories) works and they all had used a "*future city*" setting for their published story.

The second workshop was comprised of seven SME freight and supply chain executives. They were all attending the "*Future freight transport symposium*" organized by the Mega City Lab of the Centre for Transport and Logistics (CTL). Out of 30 US executives attending the 3-day symposium, seven were working in SME's in Boston. Existing work on future city logistics and freight (in Boston), is focused on large corporations (Caplice and Phadnis, 2013). There is a distinct lack of analysis at the SME level. Therefore we wanted to purposively sample across as many sectors as possible to broaden the practical scope of the insights into our theory building. This resulted in a sample compromising executives from manufacturing (n = 2), retailing (n = 2), bio-technology (n = 1), freight (n = 1) and telecommunications (n = 1) sectors.

3.4 Limitations and procedural complexity

In basing our prototyping experiment within one city then this might be seen as limiting the

complexity of the empirical context – however the situation within different cities is inherently complex. Experiments also attract criticism on the grounds of not being representative – in this situation they might be criticized as imperfect indicators of what transpires in other situations. However this technical viewpoint suggests that in spite of its limitations, prototyping facilitates an imaginative and creative approach to theory generation and concept building, if one can overcome its innate procedural complexities. Figure 3 below presents some of the invisible entities that surround the prototyping framework contributing to its procedural complexity.

People are narrative thinkers; they naturally organize their world into stories, and understand when a story makes sense, and when it does not. By combining realistic characters and social milieus with novel technology, science fiction can engage multiple ways of thinking, and draw out underlying values and sites of conflict and confusion.

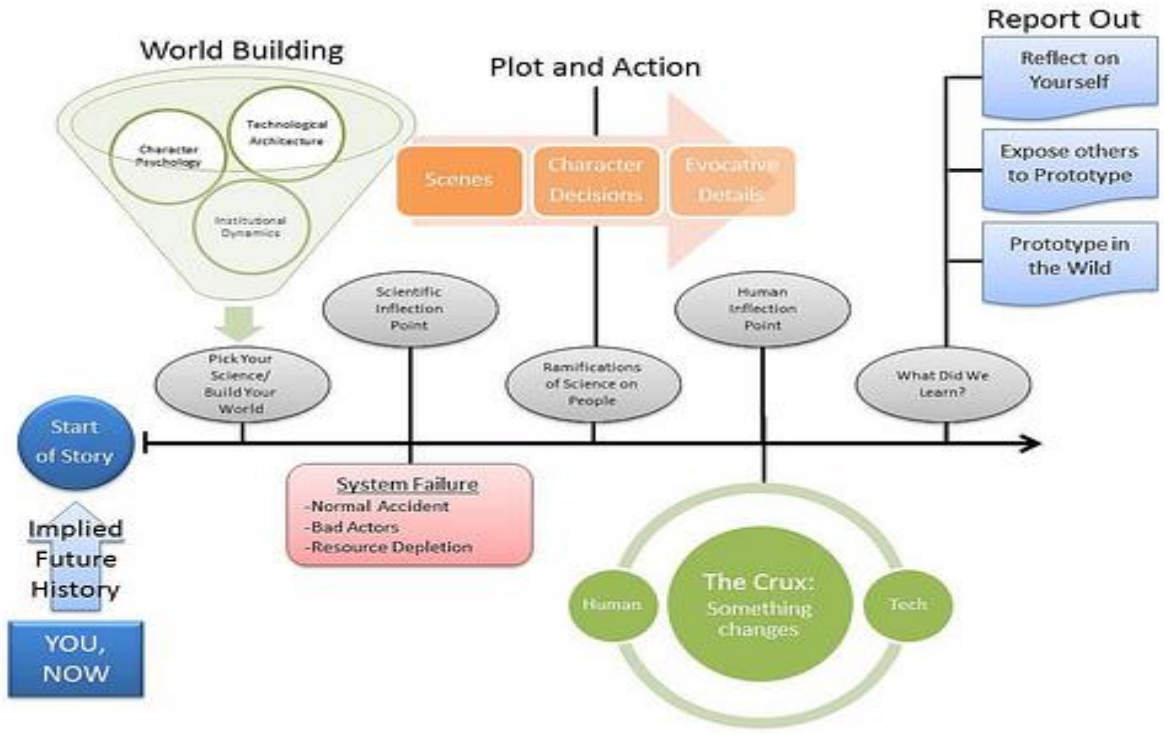

Figure 3 The procedural complexity of science fiction prototyping
Source: Graham and Mehmood (2014, p. 89.)

However the envisioning process is complex and depends on the information you have access to: what you know about science and technology, your own life experiences and beliefs, and any related materials provided by the supply chain futures or foresight community. Pitching and dialog are definitely learned skills, and different people have very different levels of aptitude at them. For instance, it is a difficult technical skill to express and write a concise short story.

The ability of the developer ultimately relies on tacit knowledge about science, technology, people, institutions, narrative structures, the creative process, and proper presenting and critiquing skills. The problem with relying on tactic knowledge for foresight is that your visions are going to be infected with unexamined biases, and may confirm what you want to know rather than challenge and transform your vision of the future. The main check against such bias is the scientific expertise of the other participants (for instance, reviewers, colleagues, co-authors and science fiction writers) involved in the prototype development process who can check the validity of the original scientific principles under examination.

3.5 Prototyping data analysis

In order to achieve data convergence (between the scenario data, digital economy technologies, future cities and "*human-driven*" fictional narratives), Lowe's (1993) QCM (qualitative coding matrix) procedure was implemented. Data was also collected on the story themes and more general freight and supply chain issues in the US (see Appendix 1). The QCM involves converting the qualitative data into numeric codes. There are three phases of analysis. Phase 1: is the basic "*open*" coding or labelling of the data; phase 2 is more advanced "*axial*" coding where initial linkages between data clusters are established and;

phase 3 "*selective*" coding where data patterns are established, interpreted and synthesized (triangulated) with other data sources.

The participants were each given a month to write up their own narrative and these were then submitted to our research team. While the first workshop took place off-site in Newton-Highlands (suburb of Boston) the second took place in the Executive Room of the Sloan School of Management.

4.0 Logistics Prototypes

We co-created six individual prototypes with the SME managers and SF writers. These were selected using the scenario reliability metrics designed by Caplice and Phadnis (2013). They were all plausible scenarios, internally consistent and challenging for strategic purposes (Wack, 1985a). The narratives were generated around the themes of 3D printing (production); fracking technology; robotics; AI intelligence and singularity. Here we present some of the key story themes, underpinning logistics and technological trajectories and strategic contexts driving the development of each fictional narrative. Basically, the social science fact guiding the social science fiction (Johnson, 2010).

4.1 3D Printing *("millions of markets*")

"*Millions of Markets*" provided the strategic context for our first scenario which concentrates on the achievement and challenges of 3D printing. 3D printing or additive manufacturing is a process of making a three-dimensional solid object, of virtually any shape, from a digital model. 3D printing is achieved using an *additive process*, where successive layers of material are laid down in different shapes. 3D printing is also considered distinct from traditional machining techniques, which mostly rely on the removal of material by methods such as cutting or drilling (subtractive processes).

The first prototype *Made in Boston* focused on the "vision" of future high-end 3D printers being made available locally, together with high individual engagement in the manufacturing processes involved. The vignette describes the experience of the main character shopping for shoes and describes new financial systems as well as the social issues around how consumers might be drawn, or reject this new innovation. 3D scanning allows customization but this form of manufacturing is not as 'rapid' as anticipated. In this scenario the engagement of individuals with the technology is high, so that it is anticipated they become peer producers in the design process, but the individuals are perceived more to be part of a supply chain production "vision" rather than a "self-led" peer-to-peer craft based movement. The possible inspirations posed, by the developer, for user involvement with 3D printing included: "*comfort, convenience; aesthetic qualities and personal utility*".

The use of 3D printing in community settings without profit, was also the focus of the prototype: "*Fayettenville free library*". The "3D Printing @ The Library" initiative in New York is one such example organized by community mediators. The power of prototypes lies in them capturing current technological trends and transposing them into the future. In this instance, issues arising from interaction with mediators, who engage with technology on behalf of the users, and also in the use of a shared non-corporate community printing space. In order to show relatively low engagement with the technology, the character's interaction with the library personnel and equipment is depicted, particularly emphasizing assistive technologies in support of the, most likely, underpaid or volunteer mediators.

Another prototype which was only partially developed focused on 3D printing in schools. This could inspire a future generation of local-based craftsmen designing anything from

sports cars to jewellery. However the story element never convincingly explored the human and social implications of schools-based 3D production.

Each of these prototypes suggested that 3D printing could foster community cohesion and resilient localized economic futures. With more local communities self-sufficient in their economic production. The focus however, was purely on economic modes of resilience.

4.2 Robots *("global marketplace"*)

In this scenario, all supply chain operations-based activities from creation, manufacturing and retail distribution was assumed to be carried out by robots. The branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing is robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behaviour, and/or cognition.

RoboMall is the world's first shopping mall completely operated and serviced by robots. All the distribution and retailing experience is designed at the human-robot interface. The Chief Operating, RoboPrimus controlled all the other RoboPrima's. On the launch day there is much excitement from the human directors of the financial potential of the venture. Although "sunk costs" are high, apart from incurred maintenance expenses, robot costs over the production life-cycle are far lower than the employment of humans. GlobalMall (the world's largest shopping centre) built serves the "mega city" that stretched from Miami to Montreal and profit from huge scale economies. On the first day of opening, profits are searing and record takings are made.

Towards the evening there is the first test of this perfectly seamless transaction-oriented supply chain, with the chase of a thief. Robots have the ability to follow the thief but since they are not very fast, they cannot catch up with a running human being. Instead they have to contact the supervising Chief, RoboMall and send photographs and motion patterns to other robots that can then continue to follow the suspect. The RoboMall Primus can tell the thief to surrender and also inform the thief that the police have been notified. The successful escape of the thief, is technologically relayed around the Mall by people using "*hologramic*" social media and this triggers copycat stealing of retail stock. . Soon rioting and looting breaks out in the mall.

4.3 AI Intelligence and Singularity ("*One world order*")

One World Order provided the strategic context for our next narrative. Ray Kurzweil embraced *the Singularity* as a term, in, *The Age of Spiritual Machines* (1999). Kurzweil describes his law of accelerating returns which predicts an exponential increase in technologies like computers, genetics, nanotechnology, robotics and artificial intelligence. He suggests that this will lead to a technological singularity in the year 2045, a point where technological progress is so rapid it outstrips humans' ability to comprehend it. The "global" narrative framework provided a strategic context for a detailed description of an imaginative future news media world, its technological advancements, its international relations, and social divisions (two classes exist; the news media rich (on a "healthy" information diet) and the news poor (on their "malnourished" diet). Among the news visions explored was that one global newspaper controlled the factors of futuristic news production, through Verne's concept of "telephonic journalism". This concept can be traced back to the science fiction story "*In the Year 2889*" by Jules Verne and Michel Verne. Conversations are telephonically converted by machine algorithms into news copy.

The prototype *Earth Herald* explored the intelligent workings of an AI capture system (the so called News Media Cloud) that now floats around the Earth's major cities collecting and distributing news. Every morning instead of being digitally written as in antiquity, the Earth Herald is 'spoken' through machine imagery which converts conversation into story copy.

Readers for free, can get acquainted with the day's issues through the countless sensing engagement points downtown. In this prototype, we see one organization dominating the world's news diet. But unforeseen to the Earth's citizens is the data that is being collected on them every day, by the cloud. Data the Earth Herald sells to corporations and the one world order government. Eventually, a team of renegades and disruptive hackers develop information "wormholes" that provide an "underground scoop" of this abuse of public data and public confidence in the Herald rapidly falls away and their share price plummets.

4.4 Fracking ("*Naftastique"*)

Induced hydraulic fracturing (hydro fracturing; also commonly known as fracking) is a mining technique in which a liquid, typically water, is mixed with sand and chemicals, and the mixture is injected at high pressure into a wellbore to create small fractures (typically less than 1mm), along which fluids such as gas, petroleum, and brine water may migrate to the well.

The *Battle of Citizenville* is based on the premise that fracking leads to a "gold rush" style migration within NAFTA (North American Free Trade Agreement) to live in communities, such as Citizen Ville, because of the new work opportunities and the energy independence. But soon the dream evaporates as the capitalists lower the wages over time. As well as surplus labour protestors are congregating in the tents and trailers aggregating around

the fracking mines. Mine X's Security becomes greater and greater and brutal enforcement more prevalent. When three local children are found dead in a nearby boating lake, the population of Citizenville erupts. Mine X with its forces of dogs, drones and riot-control weapons go head to head with the protestors and workers. As the videos of the events are streamed across the Internet the brutality against the demonstrators is echoed around the World, confidence is lost in the firm and its ability to provide what it promised sustainable energy for NAFTA. The story presented a worst case scenario of the exploration of the second-order sociological effects of large scale resource exploitation in the US whose citizens have rarely had to witness the environmental consequences of their energy footprint in the immediate vicinity.

Though in theory, energy independence would potentially foster improvements in community resilience, the environmental implications and exploitative labour practices in this example actually facilitated community break-down. There are however 'resilience' lessons to be learned from all of the prototypes discussed whether it be securing the localization of resources through planning and preparedness and/or engagement with all stakeholders including the local community.

5.0 Conclusions and reflections on the prototyping method

In conclusion, decision making in future cities and urban logistics is often a notable challenge, balancing the varying needs and claims of multiple logistics stakeholders, while negotiating in acceptable trade-off between their competing claims. Engagement with all logistic stakeholders and active encouragement of stakeholder participation in the supply chain aspects of future cities is increasingly a feature of 21st century social decision making (ibid., p. 11). This viewpoint suggests that the prototyping method allows for unique

individual perspectives from actors not usually considered in supply chain foresight decision making such as fiction writers and SME's.

This work also attempts to demonstrate that prototyping can create sufficiently cogent environments for future city and urban logistic theories to be both detected and analysed therein. New and emerging theory can be built creatively and imaginatively with all stakeholders, such that this theory can potentially be co-created to have significant social and economic impact (for instance, logistics driven entrepreneurship, community-embedded resilience and new economic models). Although this is an experimental field of urban logistics theory building, more conventional theories could also be "*tested*" in the same manner.

Our culture does not have many cross-disciplinary people. The persistent Anglo-Saxon (English-speaking) problem of the 'two cultures' (Science and Technology versus Arts and Humanities) identified by C P Snow will be a deep problem for those planning future cities. Science fiction, art and design have a great deal to offer the future cities project, not just technology, architecture and engineering. How do we break the false dichotomy between these two approaches and get them interacting? Science fiction in its various forms (the visual, not just the literary) allows researchers to conceptually 'test drive' their future city plans, incorporating the human angle on technological change.

There is a deep tradition of dystopian SF exploring the problems of future urban life, for example John Brunner's Stand on Zanzibar. SF is the royal road to more joined-up. Cities are complex entities, like cells. They do not work simplistically but are composed of many technical, social and physical systems that interact in myriad ways, like a human body or an

eco-system. If something goes wrong with such a complex entity, it takes a long time to cure. If a city is to change, it takes time. Again, it takes time for deep structures to have an effect on smaller, more subtle structures. Science fiction is ideal for modelling these long-term changes.

This emerging research method seeks to break new ground for supply chain planners and futurists in our understanding of the rich and varied multi-disciplinary dimensions of future cities, resilience and urban logistics innovation. It does not have the largely implicit biases toward certain kinds of "*value knowledge*" and "*rational outcomes*" of more traditional foresight methods which have failed to deal with major uncertainties, for instance the rise of cell phones, tablets and social media in politics.

Logistics fiction prototyping is definitely useful, but there are still many questions which need answering through further research before it becomes fully trusted as a foresight methodology. Some questions are procedural: What is the best preparation before going into the prototyping process? How should information and questions be framed so that non-practitioners find it productive? How can you train people to pitch and critique ideas more effectively? Is there a way to develop the prototype that is faster than writing a whole story around it? How can the constructive process of dialog continue throughout the development cycle? How can individual communicate a prototype to a group in an impactful way? Other questions are related to the core concepts of logistics prototyping, and are harder to resolve: What is the proper way to develop the supply chain technology or logistics trend/theme through the course of the story, is it a character, a prop, or something else? How does an author recognize their biases and blind spots? How can logistics prototyping be used to prompt reflexive deliberation on the future? What does the dialog involved in prototyping

imply for the authorship of the work, and the origins of its ideas? Does one need to make logistics fiction prototypes to find them useful, or is consumption of the right kind of science-fiction adequate for foresight?

The vignettes demonstrated in our Boston experiment that the use of fiction can be a powerful tool in visioning the potential human consequences of so-called 3D printing and localized craft-based production, fracking, robots, AI and singularity. For instance, a popular premise, being that 3D printing could permit many final objects to be made near to or even by consumers on just-in-time printing' machines. This revolution in making would have many implications for the economy-and-society in the future by seriously augmenting or indeed replacing, current systems of manufactured production and consumption all occurring at a distance The other prototypes emphasized the tensions between profit-focused modes that exploit future technological, energy and logistic trends and their second order sociological effects. It also raises issues of the notions of future community resilience which is not often considered in future supply chain planning.

The 2037 contexts were well received by the participants and the extracts used in the workshop seemed to blend well into the personal narratives. They also gave the workshop organizer a shape for projected future worlds enabling participants to focus in on the specificities exclusive to each scenario. There can be no doubt that the fictional accounts enabled people to think beyond traditional scenario concepts of future cities and urban supply chain management. Logistics prototyping could be a powerful tool in the social science repertoire for dealing with the human complexity of issues surrounding future cities, resilience and new logistics model planning. Finally, prototyping provides a democratic approach to future city planning and, urban supply chain design. It involves collectively

imagining socio-technical futures and second order sociological effects through the writing of science fiction narratives or building 'design fictions'.

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Appendix 1: Boston prototyping experiment May-August 2013

Nature of research activity	Date	Workshops/focus groups	Interviewees job title/comments
Interview	03.06.13		Assistant Dean and Director MIT Public Service Centre
Interview	04.06.13 15.07.13		Director of MIT's Centre for Transport and Logistics (CTL)
Pilot testing: prototyping context scenarios	05.06.13	5 MIT Faculty	
Story Workshop 1 Fictional Cities	07.06.13	8 participants (8 published SF writers)	Head of Boston Science Fiction Writers Group
Interview	10.06.13		Postdoctoral Research Associate (CTL)
Interview	10.06.13		MIT Media Lab Research Fellow
Interview	11.06.13		Intel SCM Manager
Interview	11.06.13		MIT Agelab Research Fellow
Interview	14.06.13		Shell Logistics Director
Story Workshop 2 Urban Logistics	14.06.13	7 participants	SME Freight/supply chain managers (Boston area)
Prototype discussion	13.06.13		Head of the Boston Fiction Writing Group
Follow up prototype	19.06.13		CEO: Saltmoney.org

interviews			
Interviews	21.06.13		Senior Assistant Metro Editor
			Globe News Reporter,
			Globe News Reporter
			Globe Crime Reporter
			Globe Creative Technologists
Interviews	07.07.13		Boston Media Makers
			3 News Media Executives
Interviews	18.06.13		Director@ MIT SENSEable City Lab
			Assistant Director: MIT SENSEable City Lab
			Freight Expert: North Eastern University
Interview	20.06.2013		Entrepreneur Voltage Café (Crowdfunding)
Faculty presentation	24.06.2013	Presentation of initial prototype summaries to the MIT Centre for Transport and Logistics Faculty	
Focus Group	28.06.13		MIT CTL Research Fellow (RF) 1
			MIT CTL RF 2
			MIT CTL RF 3

			MIT CTL RF 4
			MIT CTL RF 5
Planned future transport mobility project	28.06.2013		In collaboration with North Eastern University
Public Symposium	08.07.2013	Dissemination of prototypes to MIT Media Lab public symposium (50 people attended)	
Dean Meeting	11.07.2013		MIT Engineering Systems Division Dean
Webinar	19.07.2013	Student action for university community investment	
Interview	12.07.2013		Head: Cambridge Community Development Department
Interview	12.07.2013		Head: Solar IS Civil Defense
Interview	15.07.2013		Director MIT Community Lab
Interview	20.07.2013		CEO: Recover.org