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Network Northamptonshire: total transport smart city procurement theoretical framework for sustainable economic and social change

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Culture, governance and procurement remains under-researched in current academic literature within a smart city transportation context, with evidence suggesting that procurement is a much-needed aspect of bringing about change at local government level; however, little evidence exists to support this. This paper showcases the research based upon the "Network Northamptonshire" total transport project, whereby a review of the county's transportation, both public and private, is being undertaken in order to gain greater economies of scale across a shared cross-border knowledge exchange in the UK. Through the process of "Network Northamptonshire", the research team have identified and created a theoretical framework "total transport smart city procurement" that brings together much-needed elements of peer-reviewed research that purport success in the delivery of the smart city concept, allied to identifying gaps in the literature relating to best in class business practice that could, in tandem with the "Network Northamptonshire" transportation network, deliver a horizontally aligned network of private, public and voluntary bodies allied to a sustainable solution that eradicates challenges associated with culture, governance and procurement to deliver economic and social good. Furthermore, the paper demonstrates that there is a disconnect between the ideals of the smart city and actual development needs, having identified that purported risks such as population movements to areas of low to high technology can actually be leveraged as an asset in sustainable development. Therefore, the authors support the need for further research in the area of smart cities' connection to culture, governance and procurement through the framework in order to convey the wider European smart city concept and continue the sharing of best practice to bring about economic and socially connected conurbations.

Keywords: smart cities; transportation networks; public transportation; economic and social good; procurement

1. Introduction

There is much being discussed across Europe in terms of smart cities and how regions can achieve sustainable growth while meeting the need to reduce CO_2 emissions. Smart cities have been characterised and defined by a number of factors including sustainability, economic development and a high quality of life. Improving these factors can be reached through infrastructure (physical capital), human capital, social capital and/or ICT infrastructure. In smart cities, digital technologies translate into better public services for citizens, better use of resources and less impact on the environment [1].

However, growth and sustainable development become more challenging for areas of lower urban density, as carbon emissions increase per capita in relation to their larger, dense urban area [2]. Therefore, greater size would intimate improved economies of scale, yet as conurbations increase in population and achieve the long-run margin reductions associated with purported sustainability benefits, the various flows of goods in to regions that support operational existence, coupled with the outputs of waste material increase (inbound/outbound), which when not fully measured, understood and procured can hinder economic and social standing [3].

The aim of this research is to explore the existing academic literature on "smart city transportation" and contribute an understanding to the existing body of knowledge, areas of good practice allied to potential topics of future research. Additionally, the paper will review "Network Northamptonshire", a project appraising public and private transportation networks for the county of Northamptonshire, UK with the prospect of including freight and logistics at a latter phase II stage. By understanding the current literature on smart city transportation and encircling the existing data on four key spheres affecting society (business, crime, education (skills) and health care), the authors develop a conceptual total transport smarter city procurement (TTSCP) theoretical model (Figure 3) to assist provision of sustainable networks that support growth in a manner that mitigates risks of economic and social problems that can lead to wider issues pertaining to crime, health, skills shortages and waste [4]. This need to underpin economic and social decision-making around

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procurement is crucial, and despite there being a case for innovative procurement to become more prevalent in local government strategies, little evidence surrounds knowledge and benchmarked accomplishment [5], with current smart city research not having fully understood the auspices of culture, governance and procurement in the smarty city context (Figure 1).

This paper will give an outline to smart cities, bibliometric review of current smart city research identifying the gap in present thinking and how the project will embrace a data-driven environment to encircle a best-in-class procurement culture and convey a conceptual overview of "Network Northamptonshire".

2. The smart city landscape

There are a myriad of definitions pertaining to what a smart city is, such as models which take the literal sense of replacing the word "smart" with "digital", drawing inference to the concept that it's all about the use of data or devices [1]. However, more recent research into the smart city concept suggests there's a greater need to tie the needs of community and societal needs together in order for the notion of connected data to deliver change in society [6]. This area (societal) is further strengthened when local governments can link public services, healthcare systems, transportation networks, green initiatives, and emergency services, all coming together to foster a truly smart environment to support a city's inhabitants [7].

For the purposes of continuity the authors will utilise the European Commission's view of a smart city, whereby the digital technologies that reside within a region's boundaries can be utilised to reduce environmental impacts, enhance innovation, and assist in policy advancement to improve the life of a city's residents [1], allied to ensuring that the auspices of business, education, health and security are embraced.

3. Technology's role in delivering social change

Even with societal issues being integral to the concept of the smart city, there is a need to have technology central, which proffers its own challenges around fully understanding the correlation between fostering innovation and its limitations. A key challenge for local governments and other stakeholders involved in bringing a smart city to life is

Topic	Journal count
Transportation	28
Sustainable Development	28
Smart City	19
Article	17
Urban Planning	17
Cities	16
Land Use	15
Urban Areas	15
United States	13
Economics	13
Urban Development	12
Intelligent transportation systems	10
Smart Growth	9
Smart Cities	7
Public Transport	7
Sustainability	7
Infrastructure	7
Cloud Computing	6
Information Technology	5
Internet	5
Civil engineering	2
Expert systems	1
Smart structures	1

Figure 1. Topics contained with current "Smart cities transportation" research.

identifying the tipping point where technology begins to cause inefficiencies and instigates a negative correlation to the true auspices of the smart city [8]. Further to this is the notion that at times adopters of technology often look for instant gains or uncomplicated steps in development, which is frequently not achieved in the unrealistic time lines set by project stakeholders, deeming project outcomes as a failure. However, the authors believe that a framework which has a governance structure horizontally aligned across all partners nurtures the agility and flexibility to embrace continual mutually understood, achievable and measured benefits across multifaceted stakeholder teams [9].

Nevertheless, even if the auspices of technology embracement are understood, another significant area to consider for any city that undertakes projects of social change that deliver benefit is migration from cities of non-technological advancement and innovation to conurbations that embed these strategies for the benefit of its (city) residents [9]. However, as much as this can be viewed as a risk to potentially already constrained resources, in today's society of scarce skills and resources, this risk can be turned into a benefit and a uniqueness to a local government, which then becomes a precursor to attract businesses to locate to the region, thus increasing revenues for the local authority.

4. Transportation's role in change

A significant portion of "Network Northamptonshire" centres around transportation networks that reside within the county and how these can be better utilised through a governance-led procurement process to bring together synergies while delivering social good. This is aligned to the auspices of good city routing, which when wholly connected permits the flows of traffic and persons around a municipality to be synchronous and enables superlative mobility solutions to come to the fore [10].

This concept of routing is an important notion when reviewing boundaries outside of the traditional controlling of personal and public transport, and is fundamental for smart cities to convey truly synchronised services that encourage economic and social value. It is the capacity of the "synchronous solution" across a myriad of transportation solutions that permits a city to function correctly, such as but not limited to public and personal transport, local authority support services, emergency services and health care, etc., and a topic (synchronous solution) the authors purport holds real value in resolving operations that promote economic and social good.

The authors see the following activities as particular priorities for the development of the network.

- Facilitating knowledge exchange, joint action and project partnerships between industry, academia and public authorities with the aim of strengthening our research and innovation capacity.
- Designing joint strategies and innovation policies to support the local economy.
- Assessing the sustainability of technologies (i.e. their impact on companies and on society).
- Market potential assessment and commercial exploitation.
- R&D project financing by pooling resources from private and public financial bodies.

5. Procurement and city decisions

In simultaneously bringing together the elements of various stakeholders in local government through today's digitally reliant systems, discussion and focus is concentrated around the style of governance that should be adopted [11]. Governance is a topic that requires the input of all stakeholders across the various multiconnected systems, making the smart city concept a horizontally aligned process of connectivity. In previous traditional silo operations, the governance mechanisms always remained within the boundaries of the organisation and required very little interaction or alignment to other actors in a "supply chain". However, when organisations look to align and connect systems, it becomes evident that governance needs to be interconnected. This is where challenges arise, as quite often anticompetitive behaviour or silo mentality can creep in, which precludes solutions arising that meet the needs of all actors, increasing risk and diminishing resilience in the smart city concept and its associated systems. Furthermore, as much as governance has been held as crucial to success, there is no attention in current smart city transportation research (Figures 1 and 2) relating to the fundamental challenge of culture when working across horizontally integrated collaborations, such as those needed in a smart city concept.

It is therefore the authors' argument that good governance comes from a truly collaborative approach to designing the smart city; after all, it is only when the business community, local government and its associated agencies, voluntary bodies and educational institutions align their processes while being cognisant of varying organisational cultures that the practice of collaborative horizontal data interchange can begin to drive aligned and connected transportation networks that proffer synergistic improvements to deliver economic and social good.

Topic	Journal count
Cities	241
Studies	233
Economics	208
Issues in Sustainable Development	188
Urban Areas	164
Experiment/Theoretical Treatment	131
Sustainability	108
Smart Cities	81
Networks	73
Sensors	70
Energy	65
Smart City	59
Internet of Things	56
Algorithms	47
Innovation	42
Air Pollution	37
Wireless Sensor Networks	24
Renewable Energy	23
Smart Grid	22
Cloud Computing	20

AQ11 Figure 2. Peer-reviewed research topics "Smart cities transportation".

6. Methodology

The bibliometric literature review (BLR) process employed in this research provides a structured understanding and research gap identification for prospective researchers, which has been an established methodology in academia, permitting researchers to remain objective [12]. The research team selected this method in order to review the current literature in the field of smart cities transportation networks, facilitating the identification of gaps that exist allied to best-in-class thinking in the field of smart cities transportation delivering economic and social good.

The keywords used for the BLR search were "Transportation" and "Networks", all prefixed by the term "Smart cities". These keywords were selected owing to the authors' preceding experience in the transportation and logistics discipline, coupled with wider dialogue with academics and practitioners within the local government, public and private transportation field of operation.

In the case of this BLR, a variety of databases and journals were initially screened across the University of Northampton database (NELSON) which encapsulates 34,000 journals with 53 million citations. In order to maintain relevance to the subject field, inclusion criteria were concentrated on the Association of Business Schools (ABS) journal listings due to their global acceptance, impact and standing in business research, while ensuring scope of research remained focused.

7. Research objectives and process

The Total Transport Fund which underpins "Network Northamptonshire" has been set up to provide support for innovative approaches to attaining sustainable, effective and efficient supply of transportation networks across a diverse collection of organisations, such as but not limited to traditional public transport, healthcare and education. Over a two-year period the project (Network Northamptonshire) will work collaboratively with public and private partnerships to create a body of information across the UK that can have a positive impact on service delivery.

In order to understand fully the hypothesis, the research team will test across a four-staged process in the Northamptonshire region the ability of a total transport smart city procurement theoretical framework's ability to have a direct impact on economic and social factors.

Network Northamptonshire project methodology is underpinned on a data collation process from key areas of the county's infrastructure:

- schools
- healthcare
- business
- higher education

These areas were chosen by the project board's steering group, which is drawn from a vast cross-functional experience. Having ensured that the key development pillars for Northamptonshire were underpinning the project, the team further identified that these areas are not only integral to the social well-being of the county's residents, but further to the future development of the infrastructure needed for growth, therefore also carry economic impact.

The region (Northamptonshire) contains a very highly developed business infrastructure comprising a mix of small- to medium-sized enterprises and mainstream high brand organisations, which cut across a myriad of industries; however, there are three uniquely developed areas in food, high-performance engineering and the supply chain sectors. The county has a population of 692,000 at the 2012 census, its largest conurbation. Northampton comprises 287,700 occupied flats or houses and an unemployment rate as of April 2014 was 2.4% compared to the UK national average of 6.8%.

In a bid to move entirely away from the traditional model of local government, Northamptonshire County council aims to transition from direct delivering services into a "Next Generation" model. Services currently run directly by the council would leave its direct control and become separate, stand-alone organisations free to compete with others for council contracts to deliver those services designed to achieve the twin aims of safeguarding the council's most vulnerable and creating greater well-being in the county, which will see four new separate organisations being established over the next five years.

Northamptonshire has a core ambition of being at the leading edge of the digital economy. This is consistent with our desire to respond to the growing challenges associated with an increasingly mobile population. As an area that actively encourages economic growth, we recognise that we need to manage growth in the demand for travel.

There are strong ambitions for growth in and around the town. However, it is vital that the future highway network needs to be able to accommodate the town's growth proposals and economic prosperity. It is also important that we actively support sustainable transport modes, which is where intelligent connected transport systems have an important role to play. Transport and mobility are the focus of future investment, enabling residents and visitors to become better-informed, "smarter" travellers. The objective is to place the "customer" at the centre of transportation in Northamptonshire by enabling them to make informed decisions about their journey options. This initiative will utilise the latest technology and applications to provide dynamically driven and more accessible information. The intention is to deliver an integrated group of travel tools, commuter challenges and business engagement information. These tools align Northampton with the Smart City philosophy by making better use of existing infrastructure, empowering citizens to make informed travel choices and creating "Smart Commuters".

7.1. Stage I

Having completed a thorough literature and bibliographic review and after analysing the data of all transportation movements across the four identified critical development and innovation areas of the county's infrastructure, the project will gain an understanding to any cross-functional synergies that exist and further advance crucial insight to service providers and levels of provision.

7.2. Stage II

The second stage of the project will give rise to the operation of four pilot programmes pertaining to Business, Health, Higher Education and Schools. These critical pillars of economic and social development were chosen due to the research team's hypothesis that resource and customer service benefits can be stimulated across a horizontally aligned collaborative public and private network. The outputs are expected to provide an understanding of the top-level holistic advantages of cross-functional collaborative transport synergies and the associated cost and service benefits these may bring through a centralised, procurement-led function, which encompasses a centrally designed governance structure allied to the needs of the various stakeholders. This phase will also begin to evaluate various data collation and technology methods that could enhance and address the needs of connectivity across the horizontally aligned stakeholder team.

7.3. Stage III

This stage will review the connectivity of transport, economic and social impact, in partnership with local government agencies such as but not limited to NHS, Office of Police and crime commission (OPCC) and voluntary agencies, whose

currently dispersant data will be collated and overlaid to review areas such as but not restricted to emergency response times, health challenges, crime statistics, social housing need, future construction developments, and depravation, all achieved by deploying the conceptual TTSCP framework and its associated data and technology capture techniques.

A detailed appraisal will be undertaken in parallel to consider the cross-organisational culture, governance, procurement and network infrastructure, once more identifying synergies and cause–effect relationships allied to areas where the collaborative use of data and technology can bring in promoting economic and social benefit. This is a crucial step in producing the framework, as alignment and/or understanding of culture, governance and stakeholder input is imperative to collaborative "non-competitive" behaviours needed to push and pull data in a smart city concept.

7.4. Stage IV

A detailed review of cross-organisation platform technology that can deliver a "live view" of the county's infrastructure, informing a "real-time" decision-making focus to be maintained allied to a governance and procurement structure that delivers a true smart city.

The outputs of this platform would inform future development and research in the area of connected smart cities, and in the auspices of the total transport project be disseminated for wider sharing across Europe, to ensure that a connected and innovative network of operations continues to develop.

8. Smart cities bibliographic review

A search of the NELSON database generated a total of 260 journal articles (Figure 1) related to "smart cities transportation". When the impetus for change to smarter cities by the European Commission is considered, it does appear this is an under-researched topic that is not meeting the requirements of economic and societal need. However, to contextualise the extent of research in this field, the first studies were undertaken in 1989, with 145 (56%) journals of the body of research having taken place in the past 4 years, which indicates a rise in academic interest across the field, from which one could infer that "smart city transportation" is a current and expanding theme in research, and therefore not a subject to be ignored, and in fact should be encouraged by the wider research community.

Despite the initial findings of the BLR being a positive correlation into an expanding body of knowledge, what is noticeable in its absence and directly related to this paper is focused research into the areas of culture, governance and procurement in both journal topics (Figure 1) or the detailed keyword search of "smart cities transportation" papers (Figure 2). However, what is noticeable are the high percentages of research focusing individually on transportation, sustainable development, economics and public transportation.

Therefore, it is the authors' positioning that the TTSCP framework is the first of its kind in bringing together the aspects of best-in-class research across the areas of smart cities underpinned with culture, governance and procurement to deliver economic and social benefits to a city's residents and associated service providers.

9. Toward a smarter city "Network Northamptonshire"

Much has been purported in the sphere of the smart city and this is where "Network Northamptonshire" is taking a lead in terms of reviewing the connected Total Transport network philosophy and utilising this as a strategy to bring about a better-connected, smarter city delivering economic and social good.

Instead of taking the traditional forced view on collaboration which quite often breeds anticompetitive or silo mentality behaviours, the research project will construct a cooperative, horizontally aligned governance structure permitting public- and private-sector actors a platform where collaborative working can come to the fore. Allied to the governance structure, a centralised procurement function is suggested as a natural gatekeeper to cultural indifferences that manifest themselves when bringing together public, private and voluntary sectors, and under the regulation that the TTSCP framework permits, maintain watch over cross-functional transportation networks through robust best-in-class procurement processes. This topic (procurement) is an underexploited area that is devoid in current smart city academic research (Figures 1 and 2), crucial to local government success but not fully understood and central to the Network Northamptonshire smart city theoretical framework (Figure 3).

Although this project and its associated research is centred on transportation networks, the research team theorises the development of a connected service network being crucial to the success of a local authority (Police, Health, Education and Voluntary) and its associated public-sector businesses, permitting the auspices of a smart city to permeate throughout society and deliver true social value. Furthermore, by building in a governance structure that is not

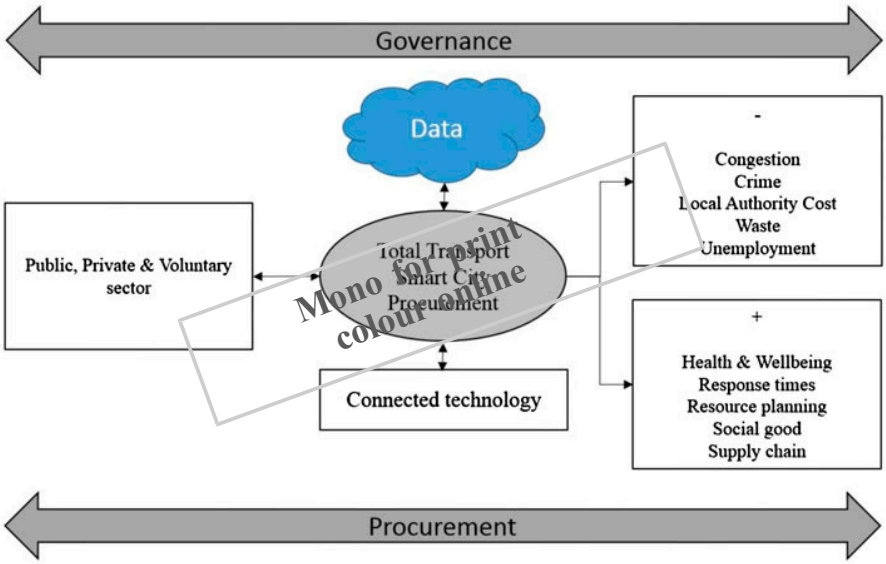

Figure 3. Total transport smart city procurement framework.

exclusively focused on the associated benefits connected to economies of scale arising from horizontally integrated collaborative data and technology use, the TTSCP framework can regulate and advise on the boundary between technology causing benefit versus inefficiency in the system and as such build agile and flexible networks that are responsive to economic and social need, while being able to perceive risk and remain resilient.

Further to the cost and service benefits, a developing region such as Northamptonshire needs to achieve growth in a sustainable manner, which despite being a well-researched area currently has no correlation to culture, governance or procurement enabling economic and social need (Figure 1). However, in recognising and connecting the areas that bring true sustainability in an economic and social context, the framework will embrace and mitigate the risks purported in the smart city research of population movements between low-technology regions to smarter, more connected conurbations. Given the current skills shortages being experienced in all sectors of industry, TTSCP will leverage the smart city concept allied to population shifts by attracting skills to the county which will in turn ensure that investment in the region is sustainable and growth can be achieved in line with the needs of the public and private sectors, particularly as the county has one of the lowest unemployment rates within the UK, and therefore the need for growth is intrinsically linked with the necessity to attract fresh skill sets.

By leveraging off of the current research in the field of smart cities, the research team has identified the TTSCP framework which will test the hypothesis as to the ability of the framework to deliver a connected smart city that is not just about data and devices, but further pulls on all sectors of the community collaboratively to bring about economic and social benefits to the county of Northamptonshire.

10. Conclusion

A theoretical framework on Total Transport Smart City Procurement has been presented. The concept delivers an ability to pull on the actors required in a horizontally integrated collaborative process to gain a smart city transportation concept that is not just centred on data and technology, but appreciates other factors associated with "connected" success in delivering economic and social change and development in a resilient and sustainable manner.

Through a data-driven approach, the research project will review, pilot, test and roll out with assistance from private and public agencies a full identification of network synergies across the county of Northamptonshire that complement that desire to adopt a data-driven approach that embraces technology for economic and social good.

As this is a live study in its infancy, there will undoubtedly arise areas of future research connected with the research findings, which will be published in subsequent connected papers.

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Notes on contributor

L. Fassam is a Senior Lecturer and researcher in the subject of Logistics, Supply chain and Transport. Senior management professional with over 24 years' experience within the logistics and supply chain arena, which has delivered exposure to clients such as Apple Inc., European Commission (EC), Hilton, HP, Musgrave group, Lloyds pharmacy and Sodexo. Voted in 2015 as a top 10 Global Supply Chain Power Influencer, leading the way in debate and education on social media. Furthermore, in 2011, Liam was invited to participate in the European Union seventh framework project (FP7-SME-2011) delivering subject matter expertise in UK and German rail/road intermodal markets, with particular focus on food category management, market share, logistics business opportunity coupled to multimodal effectiveness and is currently engaged as an expert adviser to the European Commission's Horizon 20/20 project in the areas of Supply Chain Food security. He is also the Chair for Chartered Institute of Logistics and Transport (Northamptonshire), Chair for the Modern Slavery board (Northamptonshire) and sits on the strategic board for logistics development for Northamptonshire Council.

References

AQ6 [1] O'Grady M, O'Hare G. How smart is your city. Science. 2012;353:3. European Commission. Smart Cities. 2015.
[2] Hammer, S Kamal-Chaoui, L, Robert A, et al. Cities and green growth: a conceptual framework OECD Regional Development Working Papers; 2011. 8.
[3] Turcu C. Re-thinking sustainability indicators: local perspectives of urban sustainability. J Environ Planning Manage. 2013;56:4.
[4] Beradi U. Sustainability assessments of urban communities through rating systems. Environ Dev Sustain. 2013;15:6.
[5] Lember V, Kalvet T, Kattel R. Urban competiveness and public procurement for innovation. Urban Stud. 2011;48:7.
[6] Albino V, Berardi U, Dangelico R. Smart cities: definitions, dimensions, performance and initiatives. J Urban Technol. 2015;22:1.
AQ7 [7] Komminos, N, Schaffers, H, Pallot, M Developing a policy roadmap for Smart Cities and the future internet. ICECC; 2011
AQ8 [8] Bruni, L Regenerating the flipped virtues, Avvenire. 2008 Nov 10
[9] Pileri P. Technological city and cultural critism: challenges, limits, politics. City Territ Archit. 2015;2:1.
AQ9 [10] De Domenico M, Lima A, Gonzalez M, et al. Personalized routing for multitudes in smart cities. EPJ Data Sci. 2015;4:1.
[11] Di Bella E, Corsi M, Leporatti L. A multi-indicator approach for smart security policy making. Soc Indic Res. 2015;122:3.
AQ10 [12] Toncich, D Key factors in post graduate research. Chrystobel Eng. 2006.