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Towards a collaborative Geographical Information System to support collective decision making for urban logistics initiative

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Abstract

This paper describes how a Geographical Information System (GIS) applied to urban logistics can be used for modelling complex urban freight situations, such as those related to the 'last mile deliveries'. It also highlights the fact that combining a GIS with tangible technologies enables creating a collaborative tool that can be used by a wide range of logistics stakeholders, even the non-specialists. It is explained how this collaborative GIS has been subject to experimenting in workshops related to urban logistics in European cities (London, Brussels and Luxembourg). The specific case study of Luxembourg is detailed. Finally, the paper stresses the key benefits of such a collaborative GIS, namely to foster discussions around specific topics and to make collective decisions.

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Keywords: urban logistics; geographical information system; collective decision; tangible interface; last mile; urban freight; intelligent transport system

1. Introduction

While numerous studies have explored the usage of Geographical Information Systems (GIS) as Intelligent Transport Systems (ITS) for city logistics, this paper explores how such system could be opened to a wide range of stakeholders to support collective decisions. With a review of the R&D initiatives in the field of ITS applied to city logistics that rely on the use of GIS, the authors demonstrate the interest of GIS for analysing local city logistics

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contexts and for making decisions related to the development of improvement initiatives. Then, the authors describe how, during a European project, a GIS for urban logistics stakeholders (municipalities, transport providers, retailers…) has been set up. The authors describe how relevant data were selected, collected, implemented, and represented with the aim of being used by non-specialists. They then describe how a GIS can be combined with tangible technologies to be used within a collaborative approach. Next, the authors expose a case study, presenting three situations where a GIS has been used for the City of Luxembourg. Finally they conclude on the benefits of such a collaborative GIS and they present foreseen future works.

2. Research background

Urban distribution plays a major role in cities' economy by supplying retailers, individuals, food businesses, offices, administrations or construction sites. It contributes significantly to environmental nuisances and has become a major challenge for public policies. The transport of urban goods in cities contributes to traffic jams with around a fifth of the road occupancy. Freight transport generates local harmful pollutants like carbon monoxide (CO), nitrogen oxides (NOx) and particles (PM10 and PM2.5) up to 20% - 60% depending on the pollutant. In cities, road transport is the major generator of noise which starts to be considered as a public health problem. However for many years, urban transport strategies have mostly focused on passengers. Now taking into account the development of e-business and the new dynamic of local shops in cities centres, difficulties generated by the transportation of goods in urban areas have considerably raised.

Lindholm (2010) stresses the fact that freight transport is rarely considered in urban planning, denotes the lack of knowledge sharing among stakeholders involved in urban freight transport, and argue for more collaboration on the issue driven by public bodies (in particular municipalities). Both van Rooijen and Quak (2014) and Witkowski and Kiba-Janiak (2014) confirm this situation and relate the low level of cooperation between local authorities and other urban logistics stakeholders while stressing the need for such clear communication and cooperation between stakeholders on urban freight issues. One can note that the lack of collaboration and knowledge sharing is neither new and nor inherent to city logistics but is rather generic by nature. Hall, Moore, Knight, and Hankey (2009) expose such case in an environmental context (oyster fisheries in New-Zealand) and show that the collaboration around a GIS is fruitful in filling this gap. GIS seems then to be a possible solution for collaboration and collective problem resolution. Any improvement approach starts by a clear representation of the current situation so as to identify problems that occur as well as improvement opportunities. Applied to urban logistics, a GIS allows to structure domain knowledge so as to make an assessment of the city logistics activities, and to develop and test scenarios of urban planning, regulations, and logistics operations. A GIS system allows to model complex situations both through large data sets and the data interactions. In addition, offering a visual representation of such data helps the collective understanding of situation. Thus, a GIS offers a communication channel that can be used to share knowledge with any kind of stakeholders, whatever their level of expertise in the domain.

2.1. Public Participation GIS

The collective usage of GIS have been studied in the environmental field and in urban planning (Balram, Dragicevic, and Feick (2009)). When the GIS usage includes the broad participation of the public, this usage is qualified as Public Participation GIS (PPGIS in short). Salter, Campbell, Journeay, and Sheppard (2009) describe the combined use of a PPGIS and immersive technology during specific workshops and the successful stakeholders' collaboration on urban planning issues. Bugs, Granell, Fonts, Huerta, and Painho (2010) explain the building of a PPGIS prototype for urban planning and assess the participation level after the deployment of the prototype. Davies, Selin, Gano, and Pereira (2012) show that participatory GIS have been used in many different areas and have demonstrated that they foster the participants' engagement in collective decision making in urban planning contexts.

Various technological approaches to PPGIS exist. In Table 1, we compare the type of interactions between participants (synchronous or asynchronous), the qualitative number of participants in the collaboration, and the capacity of the participants to interact with the GIS models (directly or indirectly) with regard to the type of PPGIS technological approach.