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Applying systems thinking to city logistics: A qualitative (and quantitative) approach to model interdependencies of decisions by various stakeholders and their impact on city logistics

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Abstract

Concepts for city logistics require the cooperation between several types of stakeholders. As different stakeholder types have different objectives and different decision spaces, we suggest a top-level qualitative approach (system thinking) to model the interdependencies of the different factors which are influenced by these stakeholder decisions. We also suggest using this qualitative system thinking model as a meta-structure for further quantitative sub-models (as e.g. system dynamics models). We present a methodological approach to create such a meta-structure (i.e. a system thinking model) and give an example on how this meta-structure can be expanded by quantitative sub-models.

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1. Introduction

Freight and service trips in urban areas are only subsets of larger operational concepts, which include operations (e.g. type & structure of used physical fleet¹, offered delivery frequencies, add on services,), infrastructures (e.g.

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distribution centers, automated parcel pickup stations), process models, ITC-technologies and, last but not least, business models.

Nomenclature

AU: Authority (SH)	CI: Citizen (SH)	CU: Customer (SH)
FTL: Full Truck Load	LM: Law Maker (SH)	LS: Logistics Service provider (SH)
LTL: Less than full Truck Load	OD: Origin-Destination	PR: Producer (SH) RE: Reseller (SH)
SD: Systems Dynamics	SH: Stakeholder	ST: Systems Thinking

These freight and service logistics concepts are subject to many individual decisions taken by three different types of stakeholders:

1. Hundreds of companies (in the roles of producers, vendors and logistics service providers²),
2. Millions of individuals (in the role of customers and in the role of city-citizens), and
3. Various administrative bodies (from local city authorities to national and European authorities).

As each stakeholder pursues different particular goals with its decisions, these decisions are all but orchestrated. Nevertheless these partial decisions directly and indirectly have an impact on the concepts, and thus on the structure and volume of freight and service trips (see Fig. 1).

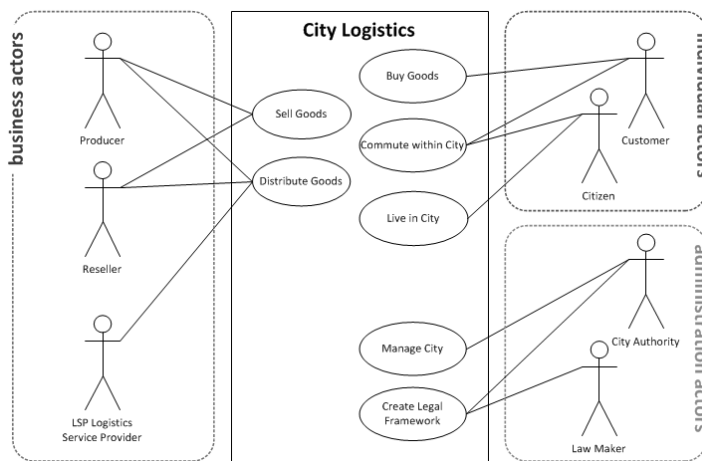


Fig. 1. Multiple stakeholders involved in designing city logistics operations.

1.1. Research Questions

One general research objective in city logistics is to understand if and how freight and service traffic can be reduced within urban areas in order to minimize CO₂-, particle- and noise- emissions and traffic related dangers & inconveniencies. At the same time, different stakeholders within a city logistics context pursue different commercial,

¹ Combustion or electric trucks, postman bikes, drones...

² In order to minimize overlaps of different roles on the one hand and in order to simplify our model on the other hand, we consider units of producers and resellers, which conduct transport logistics services as “in-house logistics service providers” which are included in the stakeholder group of “logistics service providers within our model.

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