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Application of CE principles in design of an integrated participative management system to support for urban freight distribution planning: MISPPUFD model

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Abstract

One of the major obstacles for cities to achieve sustainability is the problems related to urban freight transport. Freight transport operations in urban areas are usually carried out by private companies (freight operators and carriers), using public infrastructure, governed by regulations and implemented and monitored by public authorities. In most cases, because there is no prior consultation with the other stakeholders involved in freight transportation, the negative impacts generated from the urban freight distribution are compromised by the implementation of these actions. There is a lack in the literature a decision support system an appropriate that be able to potentialize the involvement between public and private sector of urban freight. This paper look for new ways of responding to these questions. In this context, the objective of this work is to present a methodology based on the application of Concurrent Engineering (CE) principles in design of an Integrated Participative Planning Management System to Support for Urban Freight Distribution (MISPPUFD) - be able to influence and promote behavioral / engagement change to a requirement for greater interaction between policy makers and stakeholders in support of the group decision-making process with regards to urban freight distribution issues. This suggests the importance of a system that promotes interaction and dialogue - through public consultation to better understand the issues and objectives of different stakeholders in the cargo sector, including academic experts and citizens in that partnership. This approach should result in helping policy makers and stakeholders to deal with different complex objectives and decisions and guide the process of participation

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Keywords: Concurrent and Collaborative Engineering; Urban freight transportation planning; Urban mobility,

1. Introduction

Over the last couple of decades, urban freight transport has gained a wider policy context. One of the major obstacles for cities to achieve sustainability is the problems related to urban freight transport. The movement of cargo in urban areas is the hidden side of transport, since it plays the role of auxiliary in the urban planning of the cities, being the focus of this, essentially the transport of passengers [1-2].

Until recently, there was little involvement of private companies in the local transportation planning process, and, as a result, urban transport regulations and plans rarely contemplated freight transportation and were thus formulated with limited understanding of the impacts of freight transport operations [3]. However, this scenario has changed significantly in European cities, given the economic importance of freight transport and its complexity to a liveability of citizens of the inner city. Making changes in a complex scenario such as the urban freight transport system is not an easy task because decisions involve different

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stakeholders with different and sometimes conflicting objectives. In this sense, the approach to effective human communication is vital, not only for its operation, but also for its design, and any new developments and changes. Therefore, further development of human resources is crucial. Significant changes are occurring in the context of transport planning, resulting in the emergence of new communicative approaches based on *stakeholder* engagement and interaction [4-5-6-7]. A communicative approach in transportation planning consists of interactive processes, rather than the deliberative process of a single actor or group of actors, emphasizing the process of planning, participation and learning, and a reconciliation of different ways of understanding planning opportunities. In [8] Eijnatten and Putnik (2010) reinforce the role of dialogue as an important mechanism in the integration of an organization's systems by presenting the dialogical conversation, an approach to the benefits that a dialogue conversation could have for the integration of the urban mobility system. Important topics in this context are: the promotion of new ideas; understanding the individual positions of each; respect for personal points of view; and a balance in the development of the potentials of all the professionals involved, i.e., public managers and technicians, private sector, researchers, inhabitants, trade associations, and collaborators.

The research question that guides this work is:

RQ: *The application of Concurrent Engineering (CE) principles in design of an Integrated Participative Planning Management System to Support for Urban Freight Distribution (MISPPUFD) would enable influence and promotion of behavioral / engagement change to a requirement for greater interaction between policy makers and stakeholders in support of the group decision-making process with regards to urban freight distribution issues. This should be achieved by: (i) interaction and discussion and dialogue - for a better understanding of the problems and objectives of different stakeholders in the freight sector, including academic experts and citizens in this partnership; (ii) their awareness and sharing of knowledge for a long-term, reliable, long-term relationship*.

This model could be a crucial component in the search for a sustainable and environmentally friendly and responsible urban freight transportation system.

This paper is organized as follows. In section 2, a brief state-of-the-art on problems related to urban freight transportation is presented. Section 3 presents the principles of the Concurrent Engineering (CE), and Section 4 presents a framework for MISPPUFD in the decision-making process within the proposed model. Section 5 presents conclusions.

2. State of the Art

The authors' interest in these problems comes from their own experience as a logistics manager and consultant. As a researcher studying large projects, it is observed that there are several papers, books and reports on "what's goes wrong" in cooperation between local authorities and others stakeholders involved in urban freight transportation, giving slightly different answers. These reports are based on empirical evidence of literally thousands of projects. They tend to point towards the fact that things gone wrong in cooperation and project management, such as the divergence between different stakeholders with multiple objectives (public sector vs private sector) in defining the responsibilities of the tasks during the execution, or even the definition of the leader to manage the project. The amount of prove is vast. The aim is not to challenge these findings. They are certainly important, but do not seem to explain well the big mistakes. The most important problems do not seem to be adequately covered:

2.1. What is wrong with the decision-making process that leads to the real situation?

Therefore, there is a need for more research in this area. An important contribution to understanding what is wrong with these partnerships (co-operation) in the form of various papers on the lack of involvement between public and private sector of urban freight transportation has inspired the look for new ways of responding to these questions.

Freight transport operations in urban areas are generally carried out by private companies, i.e. shippers (retailers, suppliers and wholesalers) and transport companies (logistics service providers, transport operators and self-employed owners), using public infrastructure governed by regulations and measures implemented and monitored by public authorities. While these measures are essential, they generate new impacts on urban traffic. Some of the main reasons for this are that: (i) the measures substantially restrict the increase in the fleet of large vehicles, resulting in increased product cost, limiting the supply of goods, increase the risks of lack of inventory and generate more pollution; (ii) the authorities do not know how to regulate and control, e.g. the regulations implemented generally increase costs without the local authority having an understanding of urban freight transport; (iii) the different stakeholders involved in the urban freight distribution are not consulted prior to the implementation of these measures and, therefore, are not included in the decision-making process [1-9-10-11-12-13-14-15]. Sometimes it is necessary to recognize that there is a real mismatch between public authorities and the private sector. Decision- making in the Transportation Planning Process

2.2. Decision-making process in the transportation planning process

Transport systems are complex technical-social structures characterized by multiple agents that make unique individual decisions [16]. The system is composed of the aggregation of individuals' behaviors, so there is a certain difficulty in making forecast [17]. Therefore, the formulation of effective policies is an arduous and difficult task. In fact, it has to deal with transport problems, respond to stakeholders preferences, and promote sustainable behavior [18]. For Ortúzar and Willumsen [19], an ex. ante evaluation to assess the most likely impact solutions is crucial to be undertaken from the point of view of policy makers

Transportation planning implies the management of a two-way communication process that requires specific programs and ability, capable of coordinating many actors, diverse variables and conflicting interests, and advance problems.

Public participation should be planned in advance and with specific competencies. There are several tools that can be used to promote participation. For example, in [20] it is suggested development of a " Community Involvement Plan", Kelly et al. in [21], report different methods of participation according to the phases of the planning process and the purpose of the engagement; Whitmarsh et al. ([22]) use a methodology divided in two phases, with the involvement of specialists through focus groups and questionnaires, and the involvement of citizens through workshops and questionnaires. In [23] it is elaborated a procedure involving the participation of experts, citizens and stakeholders to imply in different ways with top-down phases and bottom-up phases (results derived from the participation of citizens and stakeholders).

2.3 Agent Based Model (ABM)

Le Pira et al. ([24]) developed an Agent-Based Model (ABM) to contribute to the construction of new tools to support decision-makers and practitioners in designing and conducting effective participatory processes. A model was created based on the simulation of the dynamics of opinion in a network of stakeholders, through the implementation of a multi-declared opinion dynamics and the limited trust model (*multi-state opinion dynamics and bounded confidence mode*) in order to investigate the phenomenon of consensus building.

Interaction between *stakeholders* can be a key component of success in participatory decision-making processes, as it promotes the emergence of agreements that facilitate the convergence of difference *stakeholders* towards a shared solution [24]. This conclusion corroborates the importance that the preliminary identification of the public participation and freight *stakeholders* opinions on the problems related to the urban freight transport system is fundamental. It has been demonstrated in the literature, through participatory experiences, that deliberation can change the *mindset* of *stakeholders* about transport policies [25]. ABM has already been used with the support of multicriteria analysis to replicate participatory decision-making processes with reference to a set of policies, a classification of objectives or criteria [26-27] . Marcucci et al. ([28]) have used the *design of gamification* to stimulate the *behavioral / engagement change* between the stakeholders of a reverse logistics company at the University of Rome towards sustainable transport via a user-centered gamma structure and heterogeneous preferences.

Behavioral analysis is key to attracting stakeholders' preferences for alternative transport policies and investigating their utility functions ([29-30-31-32- 33-34-35]. In this sense, it is important to involve stakeholders directly in the decision-making process to [16-24], which, in turn, will facilitate policy implementation and stimulate behavior change. In this regard, influencing behavior is crucial to ensure the success of sustainable transport policies [36]. The technique of gamification through communication approach has been shown to be quite valid to solve problems of complex systems like the urban transport system. One implication that must be considered before applying the methodology is the potential effort required for the acquisition and modeling of data. To promote the desired behavior change, design, implement and properly manage the *gamification theory*.

3 Principles of Concurrent Engineering -CE

This concept was proposed and characterized in a report by Winner et al. ([36]) in the US government's Institute for Defense Analysis (IDA). The first definition of CE was as follows: "*Concurrent Engineering CE is a systematic approach to the integrated, concurrent design their related processes, including manufacture and support. This approach is intended to cause the developers from the outset, to consider all elements of the product life cycle from conception to disposal, including quality, cost, schedule, and user requirements"*. Through this quote, it is possible to verify that the involvement of representatives of the various areas that add knowledge and experience to the product should be called to participate. The need for the formation of interdisciplinary teams, coordinated and directed towards a final aim, is therefore necessary to satisfy the needs of the clients.

To Rozenfeld and Takahashi [37], *CE is a concurrent development of design functions with open and interactive communication among all team members for the purpose of reducing lead time from the designing phase to the beginning of production.* The CE provides tools for integrate product designs that allow companies to reduce design time and achieve overall cost reduction.

There are two issues at the core of successful implementation of concurrent engineering:

- All activities related to the development of a product should be focused in the early stages of product design, so that the greatest benefits of such integration are achieved;
- The impact and constraints associated with various functional requirements should be communicated to design on a timely, accurate, and relevant basis.

In addition, activities / functions compete between possible time and resources losses, as well as minimize changes in design and manufacturing processes caused by the lack of full involvement of different parts of the organization in the project development stages, as well the improvement of development quality.

4. Concurrent Engineering Framework for MISPPUFD

4.1 Stakeholders involvement in MISPPUFD

The objective of this system is to support technicians, public managers and policy makers in the promote of sustainable urban mobility plan (SUMP), especially in small and medium-sized cities, that is, that can converge to solutions of collective commitment of stakeholders of public and private sector in the areas of planning and transportation, through public consultation and models and tools decision support system (DSS) in a participatory and integrated decision-making process. The focus of the paper is a participatory decision-making process involving multiple segments of society,

especially small and medium-sizes. Another objective is to provid3e that the proposed system could influence the behavioral/engagement change of the interaction level of the participants (expert academic or not) in relation to urban freight transportation. In order to make the local authorities sensitive to the issue of freight transport in urban areas, to help them proactively and correctly use the proposed tools, be it regulation or planning, and assist other system to diagnose and monitor the urban load distribution

The Figure 1 represents a framework for an integrated stakeholders involvement in urban freight distribution (UFD) as it relates to design of a product.

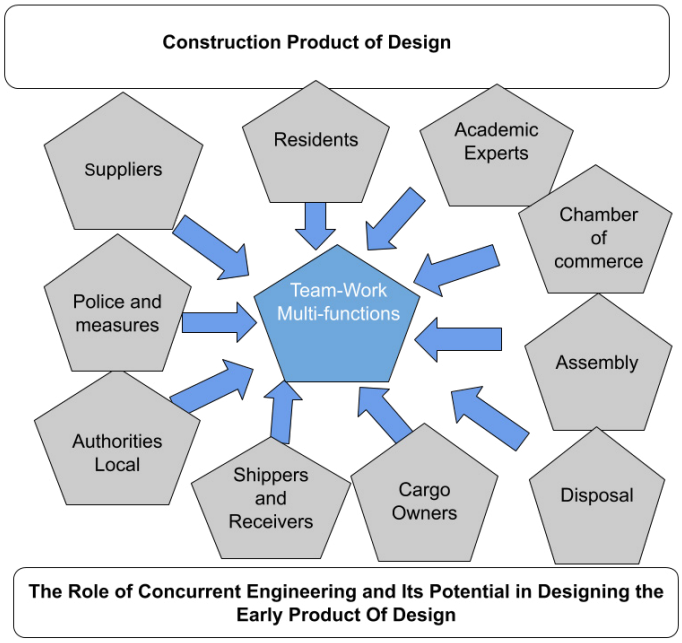

Figure 1: Integrated stakeholders involvement in UFD

4.2 Decision Support System (DSS)

A Decision Support System (DSS) can be defined, in the case of urban and transport planning, as a computational system that assists planners or decision-makers in the analysis and proposition of solutions to the problems of a given city, through the simulation of urban scenarios. This system includes: data collection on the real case, acquisition of information about the software itself, model of control system of the evolution of the project, models of data analysis and simulation, visualization of results obtained and planning of actions [38]

An integrated information management system for urban and transport planning should contain decision support tools, with which the various actors involved (technicians, decision makers, freight carriers, communities and retailers) can decide or negotiate the solution of the various urban problems diagnosed.

However, the great difficulty is not related to the implementation of the solutions or plans, but rather to the careful monitoring of the phenomena of the urban transport system, the activities of the urban transport system using an integrated information system.

4.3 Modelling social interaction in stakeholders networks -

Agent-based modelling and simulations are to be used to guide actual processes of participation and predict the results of an interaction process, and to group decision-making methods with multiple choice criteria. An agent-based model (ABM) should be modelled in order to reproduce the process of interaction between policy makers and stakeholders in the freight transportation in the designing and conduct of effective participation processes. The model will be based on processes of discussion and dialogue in a network of stakeholders through the implementation of the declared preference model to investigate the heterogeneous preferences of the actors to a real case study in the city of Braga. The model will be simulated to ascertain to what extent interested stakeholders can promote consensus.

5. Conclusions

This article discussed failures in the partnership between public and private stakeholders of urban freight transportation. How the private parts of cargo transportation should be inserted into the participatory planning process of city decision making. Part of a solution should be realized through the application of the principles of Simultaneous Engineering (CE) in the design of an Integrated Management System for Participative Planning to Support Urban Freight Distribution (MISPPUFD). Where it is able to influence and promote behavioral / engaging changes in a requirement for greater interaction between policymakers and stakeholders in support of the group decision-making process with regard to urban freight distribution issues. The system should promote interaction through discusisisons and dialogue - through public consultation to better understand the issues and objectives of different stakeholders in the cargo sector, including academic experts and citizens in that partnership.

The contribution important proposed in this paper is that its results should help policy makers and stakeholders to deal with different complex objectives and decisions and guide the process of participation. In addition, private sector participation is expected to be effective in urban transport planning and management processes in a strategic way, making their contributions fully taken into account when formulating transport planning policies and measures of urban freight.

There is a number of examples, models, strategies and appropriate tools in the literature on involvement between public-private sector in freight transport, as well as the transferability of good experiences, in order to promote sustainable urban mobility plan. There are sets of indicators as well as various planning methods and conceptual models, but the next step should be the immediate implementation of plans. Quit the theory and go to practice. How the research focus areas can be summarized as follows:

- How the MISPPUFD can contribute to influence the change of Behavior / Engagement / Understanding among the urban logistics stakeholders through a collaborative, participatory, integrated, inclusive and responsible partnership.

- How MISPPUFD" will generate sharing and co-creation of appropriate policies formulated in conjunction with the public and private sectors most likely to be successfully implemented and capable of producing beneficial and long-lasting effects.
- How "MISPPUFD" will increase the joint production of knowledge (JKP), as well as the level of awareness of the shared situation (SSA) in the transportation of cargo in urban areas, increasing the degree of maturity, i.e. the level of participation.
- From the adoption of the "MISPPUFD", the managers / technicians of the municipal authorities become aware of the need for public participation in the decision making process of urban transport planning in order to contribute to environmentally friendly freight transportation to cities without damaging the local economy.

What is important is to develop stable partnership, reliable and lasting relationships and that all the actors involved participate, perceive, understand and awareness the problems of each part as well as the relevance of the solutions. This involves research, data analysis, planning, and integration.

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