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A SIMULATION-BASED PARTICIPATORY MODELLING FRAMEWORK FOR STAKEHOLDER INVOLVEMENT IN URBAN LOGISTICS

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ABSTRACT

The popularity of both computer-based simulations and participatory modelling individually have supported design and research of many case studies. However, not much work has been done in the collaborative area wherein both the decision-making tools are used together for problem solving in the domain of urban logistics and the peer-reviewed literature on it remains sparse. This paper suggests a combination of the two fields for developing research in the area of development of urban logistics intensifying sustainability. In response to the requirements of simulation-based participatory modelling, we present a generic framework for developing these models. The framework facilitates dialogue among stakeholders with the help of a participation scheme which defines the level of participation of each stakeholder. Though the framework is presented in context of simulation-based participatory modelling, it can be easily extended to other modelling techniques.

1 INTRODUCTION

Simulation allows modelling and interaction of heterogeneous agents and provide analysis through visualization and numerical results (Basco-Carrera et al. 2017). Simulation models, thus, involve both administrative and scientific experts in the process through qualitative and quantitative data.

Participatory modelling techniques are becoming increasingly common across all disciplines (Smajgl et al. 2010), in response to the increased stakeholder participation. Participatory modelling, in general, allow stakeholders from all sectors involved to reach a collective consensus through iterative, flexible and reflexive process.

Simulation-based participatory modelling integrates all types of knowledge, namely, empirical, scientific and technical, from a variety of disciples and sources (Voinov et al. 2016). This helps stakeholders from all backgrounds to be included in the process by applying a set of qualitative and quantitative approaches to characterize needs, risks and knowledge from different perspectives (Hasse 2013). Stakeholders across functional domains can communicate their ideas with the help of simulation tools and have control over the granularity of the model, which is the key to participatory modelling as it facilitates dialogue and feedback from the stakeholders, providing them a platform. This also gives the possibility to local stakeholders to seek their own solutions rather than researchers providing them solutions that they developed in an isolated experimental setup (Smajgl 2010; Voinov et al. 2016; Basco-Carrera et al. 2017).

Our framework differs from traditional linear validation in another important aspect. In simulation-based participatory models, which inspire our framework, validation is done at each step by the various cross-sectoral stakeholders and mutually agreed upon on the basis of an integrated approach and follow-up

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steps are taken, instead of single issue measures, supporting a pathway to stability and sustainability. This is a significant transformation from monotonic bottom-up or top-down approaches which do not explicitly cover the different aspects of a design process. A spiral-like evolving design with increasing inputs from all stakeholders forms the basis of participatory modelling.

It has been reasserted in many studies that modeling process is iterative in nature. It is not pragmatic to be able build a good model that serves the intended goal and functions from the start and should be improved with iterations during the modelling process (Jakeman and Letcher 2003). Stakeholders participation make the modelling process adaptive as it incorporates new changes to the model as and when required.

Research has been done in the area of planning and decision-making facilitated various stakeholders but not much effort has gone into incorporating computer-aided tools into the process. This is owing to the various domain knowledge and expertise with which collaborators come into the system and the reluctance of local experts to use scientific methods and tools, for example, computer-based simulations (Basco-Carrera et al. 2017). Crucially, the inclusion of simulation models allows for stakeholder interactions where their objectives are not directly conflicting (unlike, e.g., water management) but still compete with each other (e.g., economics and sustainability). Therefore, with our framework we bring diverse stakeholders with conflicting and/or competing goals in the domain of urban logistics to the table and empower them with numerical results. Together with this, we also validate the simulation results with the stakeholders. Thus, proposing a generic approach for combining both the expert and stakeholder knowledge as well as simulation models for the aforementioned purpose. The approach has been developed and based upon empirical data, both qualitative data collected through semi-structured interview, and a workshop and quantitative data. The empirical base for the study is in the domain of production and freight logistics in urban areas, a domain characterized by multiple stakeholders, complex systems and multidimensional decision criteria, hence well fit for the purpose of developing a framework for participatory design using simulation. Additionally, the domain now has excellent high fidelity simulation tools available which make our framework possible.

In the following Section 2, our research methodology is presented with respect to a computer-based simulation and participatory design, followed by a brief systematic literature review on these topics in Section 3. In Section 4, we discuss the synthesis of the literature review in the form of a specified scientific gap and propose an empirically based-framework for simulation-based participatory modelling in the domain of production and freight logistics in urban areas. The paper concludes with discussion and analysis in Section 6 and conclusion and future work in the last section.

2 RESEARCH METHODOLOGY

2.1 Research Design

The study is considered as a first step in the process of understanding and conceptualizing simulation-based participatory modelling in the context of urban logistics. Based on the nature of the research at hand, a mixed-method based methodology was designed for the work wherein both, quantitative and qualitative methods were used as suggested by Creswell and Onwuegbuzie & Leech (2013 and 2006) and shown in Figure 1. The research methodology for the paper is adapted from the operational and empirical research methodology with an addition of multiple stakeholders perspective. Empirical research methodology is based on the data collected through the systematic literature review and through interviewing relevant personnel and through questionnaires whereas operational research methodology is adopted for building the simulation wherein both historical and forecast data are considered.

A multi-case study was chosen for creating the participatory design with the help of computer-based simulations as there are multiple strong stakeholders in the process and it is indispensable to have a common mutually agreeable way of coming to consensus. Empirical and semi-structured interviews were conducted to gather data and key performance indicators for the case study to build the concept and a follow-up workshop were conducted with experts to validate the model. A simple flowchart of how the research was designed is shown below in Figure 1.

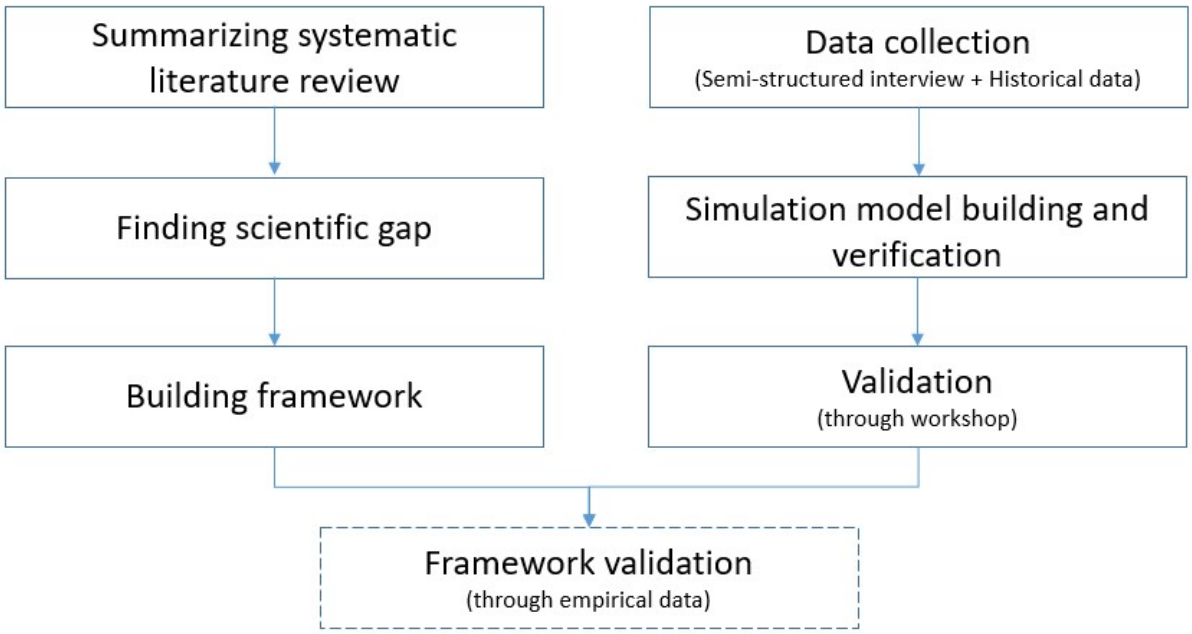

Figure 1: Research design for this paper (blocks in bold boxes indicate that the research work is completed whereas the box in dotted line indicates the future research work)

2.2 Literature review and scientific gap

From the theoretical point of view, we started with getting familiar with the current state of the art in the domains of participatory modelling and urban logistics. It was decided that the literature review would be done as per the steps enumerated by Säfsten and Gustavsson (2020). This brief literature review yielded in the scientific gap in the two aforementioned fields for which our research is designed.

2.3 Data collection

The empirical data collection phase is divided into two categories of data: quantitative and qualitative data collection. Quantitative data collection comes from the case study directly, for instance, the traffic data, traffic light data or scenario dependent data provided by the problem owners in discussion with other stakeholders. This could be both forecast or historical data. Another type of data, namely, qualitative data is collected through interviews and workshops wherein depending on the requirements all or some of the stakeholders participate.

2.4 Modelling, verification and validation of simulation models

An urban-mobility software named Simulation of Urban Mobility (SUMO), was chosen to model freight logistics and mapping resources with the help of empirical quantitative data collected during the process. Qualitative data was included in the process by understanding and quantifying it appropriately.

Verification of the data was done by mapping it to the corresponding datatypes and cleaning the data before implementing the model. Verification of the code developed for SUMO implementation was also done as described by Banks et al. (2000).

Expert validation was done for the quantitative data collected and the data was iteratively validated by the different stakeholders in the process through discussions on the simulation model as opposed to the

traditional linear validation of simulation models. This also facilitated understanding of the process and clarity on the goals and requirements.

2.5 Framework building and validation

In the final step of the research work, a framework after a literature review on the intersection of the two fields of participatory modelling and urban logistics is proposed. The framework contains three levels of abstraction; (i) project level, (ii) case studies within the project, and (iii) simulation-based models in each case study. The framework is proposed by understanding the scientific gap and the experience gained in the research project.

Further, validation of simulation-based models is done with the help of problem owners; whereas validation of the framework is the next step that is required in the study. The authors would be able to validate the framework at the end of the project.

3 LITERATURE REVIEW

In this section, the paper illustrates the findings of a systematic literature review by synthesizing the prior research done in the domain transparently which permits the reliability, replicability and rigor of the study. The section underlines the procedure of data collection and analysis as per the steps enumerated by Säfsten and Gustavsson (2020).

Scoping: It was guided by the research gap that the study is making an attempt to address. A generic framework for simulation-based participatory modelling in urban logistics with multiple stakeholders is proposed as a result to fill the research gap.

Database selection: The databases selected for the systematic search were Scopus and Google Scholar. These databases were selected due to their vast range of article indexing and covering the entirety of academic and participatory modelling research.

Keywords and criteria: Based on the scope of the literature review, in step 3 we formulated the keywords and inclusion/ exclusion criteria for articles that were required to answer the research question.

Search string: (simulation based participatory AND (design OR model*)) AND (stakeholder AND (involvement OR participation))

A search was conducted with the combination of the abovementioned keywords in their title, abstract or keywords. Asterisk (*) expands the search in the said areas.

Together with the combination of keywords, a set of criteria for including the articles in the literature review was also created. English as the language of articles was chosen as an inclusion criteria.

Data cleaning and synthesis: Based on the search criteria, 63 articles including conference papers were read in order to find the research gap in the domain. Next, the data collected so far were analyzed using descriptive and thematic analysis.

3.1 Descriptive Analysis

We see, as a general trend, an increase in the number articles published in the area of participatory modelling in various domains with the schema of stakeholder participation. Particularly, in 2019, there was a surge in the number of articles in the area.

3.2 Thematic Analysis

3.2.1 Participatory Modelling

Participatory modelling is a process of providing and assessing alternate solutions with the help of decision-making tools including computer-aided simulation tools and facilitate communication among all stakeholders. The participatory models should be designed in such a way that it elicits knowledge from all stakeholders and operate as a platform for the discourse (Carmona et al. 2013).

Stakeholder participation is increasingly important as the complexity of resources with the multiple perspective, needs, values and concerns is increasing. This requires the need for tools and dialogues that help in overcoming the complexity and uncertainty with the help of iterative numerical results with a certain degree of confidence attached to these results. Simultaneously, it is also important to choose an appropriate methodology to carry out the research. Vayssières et al. (2011) and Hasse (2013) proposed a method that employed dynamic modelling and participatory modelling which integrated participatory modelling using both quantitative and qualitative data. Case study and a mixed-method based methodology wherein both quantitative and qualitative data are recognized from the literature review and are considered together. This serves as the foundation for the presented framework

Kotir et al. (2017) in their work developed a decision-making support system to assist sustainable development in their domain. This study used causal loop diagrams for understanding of the process and decision-making. Bousquet (2010) and Voinov et al. (2016) in their multiple works on collaborative modelling discuss different types of stakeholder participation and a comparison study of a few frameworks that involve stakeholder presentation is presented. The paper is pertinent to our framework and provides a well-rounded understanding of collaborative and participatory modelling. Together with that, it also presents a well-structured level of participation. However, it focusses on the water management domain and does not include the idea of building a participatory model for stakeholders with competing objectives. This is an important criteria for defining levels of participation for stakeholders in the domain of urban logistics.

Carmona et al. (2013) in their work presented comparative case studies on participatory modelling with the aim to facilitate dialogue among stakeholders. They aim to improve the understanding of the system and provides support in decision-making. Ritzema et al. (2010) proposed a methodology to build a collaboration plan wherein all stakeholders agree on the action plan. The complexities of social and hydrological domain were thus handled together in this work. Hence, it matches the tacit knowledge of the local stakeholders with the knowledge of the domain researchers. Together with the simulation models the validation process was also replaced by the joint plausibility discussions as opposed to traditional simulation validation. Barnaud et al. (2013) in their agent-based participatory modelling build models to explicitly resolve conflicts. Thus, there is a group of studies that focusses on collaboration among stakeholders and build framework for resolving conflicts. However, the studies do not focus on the planned objectives in these cases.

Maskrey et al. (2016) in their approach used Bayesian networks to assess risks and conceptualized a framework that implements participatory modelling. Meyer et al. (2014) also developed a comprehensive stakeholder modelling framework for complex socio-biological systems. Charles and McDonough (2014) present a PACT framework that was created to guide the design of gaming systems: placing emphasis on people, aesthetics, context and technology and discusses the evolution of the framework as compared to previous frameworks.

Gray et al. (2017) combined citizen science with participatory modelling in order to facilitate planning of environmental science and demonstrated the approach with the help of a modelling software that allowed citizens or collaboratively define local conservation issues, model and represent assumptions and run scenarios to discuss potential research options and finally co-develop citizen science research. In the studies discussed above, participatory modelling is used as a planning tool together with simulation softwares in different domains. Smajgl (2010) argued that sustainable goals can be achieved by explicitly considering

many levels of governance and participatory modelling facilitates the learning process. The work also sheds light on the effectiveness of participatory modelling to question shared beliefs and hence can be potentially seen as a learning process for decision-makers. Basco-Carrera et al. (2017) in their work differentiated collaborative modelling from participatory modelling with the help of levels of participation and cooperation and presented a generic framework to illustrate the difference. It allows analysis of the modelling techniques in terms of context, specific use, information handling and stakeholder participation. Videira et al. (2009) through their work on participatory modelling provided a coherent, deliberative platform for integration of environmental policies that also helps in problem scoping and policy analysis. However, even when the studies integrate simulation softwares as a part of their participatory modelling, they do not put emphasis on the fidelity/granularity of the data and thus do not provide strong basis for simulation building, verification and validation.

Thus, the literature review systematically looks at participatory modelling in different domains including water management, land use, flood risk and citizen science areas and studies the techniques used by these domain literature to facilitate participatory modelling. There are different techniques that integrated empirical modelling involving both qualitative and quantitative data with participatory modelling. However, to the best of our knowledge and through this literature survey we discovered that none of the frameworks proposed in different domains can be translated into a guideline in the urban logistics domain as they do not explicitly address stakeholders with competing or conflicting objectives. Though they are frameworks for conflict resolution but it does not explicitly deal with competing objectives. With the initiation of Sustainable Urban Mobility Planning (SUMP), it has become indispensable for the stakeholders to have either conflicting or otherwise completing aims as a group of stakeholders might be looking at the economically feasible solutions while the other group of stakeholders might be looking for environmentally sustainable solutions. These objectives could be at times inline with each other. However, in the experience of authors from the project these are often competing objectives. Also, high fidelity simulations which can model all competing objectives form a fundamental part of the solution. Hence, it becomes important to review the frameworks in other domains but at the same time understand the requirements from the domain of urban logistics.

In the previous works reviewed, authors have combined dynamic modelling, agent-based modelling, gaming approaches, citizen science and simulation modelling approaches. We reviewed these approaches to understand the requirements and characteristics of using each approach and together with the project and domain requirements came to a decision of using computer-based simulations in the domain of urban logistics. We also enrich the framework by including validation of the simulation models together with the stakeholders which we could not find in any of the so far proposed frameworks.

3.2.2 Level of Participation

The level of participation dictates the role of a stakeholder in the modelling process. A few models have been suggested so far which explicitly define these roles for stakeholders at each level. Arnstein (1969) in their ladder for citizen participation described seven steps of citizen engagement. More recently, Pretty (1995) suggested the another participation scheme:

- Passive participation wherein all stakeholders are informed
- Information extraction where data is provided to scientists
- Decision-making in which stakeholders are promote and articulate the chosen decisions
- Interactive participation in which stakeholders analyse and diagnose the problems together and discuss the tools to be used
- Self-organization wherein the lessons learnt during the process are transformed into decisions

This scheme of participation was further narrowed down by Lynam et al. (2007) to three step ladder, viz, extractive use, co-learning and co-management. Voinov et al. (2016) in their work on environmental modelling where they proposed a nine step participatory modelling process. Very recently, Basco-Carrera et al. (2017) adapted Arnstein citizen participation ladder to describe participatory modelling as a seven

step process. However, each of these levels of participation only focusses on one case study at a time and does not include projects with multiple case studies in the ladder of participation.

3.2.3 Concluding the need of a new framework

The literature review revels that there is a dearth of simulation-based participatory models and little work has been done so far that includes both development of urban logistics and simulation-based participatory modelling. In the area of urban development, literature review shows one piece of work pertinent to the area of urban development by Jacobi et al. (2009). They proposed a three-step participatory modelling cycle for early urban design phase where step one involved a visualization method, step two translated it into simplified GIS data and implemented iteratively in urban models.

Therefore, in general we see a lack of simulation-based participatory modelling at the junction of the two areas could be found and hence this work establishes itself as one of the first in the area. We propose a participatory modelling approach that is both succinct and yet covers knowledge transfer from a case study to all other studies in a project.

4 A FRAMEWORK FOR SIMULATION-BASED PARTICIPATORY MODELLING IN URBAN LOGISTICS

Owing to the lack of literature and a need for generic guidelines, we propose a framework for simulation-based participatory modelling in the domain of urban logistics. This framework first looks at the level and type of participation of stakeholders and divides the complete process of problem solving in urban logistics in six steps. Apart from looking at the domain-specific problems to be solved through simulations, the framework also highlights how knowledge transfer takes place between the case studies in the project if the project has multiple case studies. If the project has a single case study the timeline as seen in Figure 2 for the case study becomes the project timeline.

Our approach demarcates the participation scheme through the level of participation depending on whether a participant belongs to a case study or the project. As we discussed earlier, in the Research Design section (2.1), the unit of analysis is case study and the level of each participant is based on it. The stakeholder participation is broadly divided into active and passive stakeholders. Following this we first discuss the level of participation of stakeholders and then the framework in detail.

Active stakeholders are the participants that dictate the involvement in a particular case study and come from varied fields including local experts, researchers and engineers from all sectors in the case study. They provide data, qualitative or quantitative, to build the simulation-based participatory model. Active stakeholders participate in the discussions related to conflict resolution and dictating the precedence of requirements from a participatory model (Pretty 1995; Burrows 1999; Hellsten et al. 2019).

Passive stakeholders are the participants who are involved in the project but not directly in the particular case study. So these stakeholders are not involved in the process of model-building and setting the precedence of demands from a model but benefit from the lessons and knowledge created while building such a model (Pretty 1995; Burrows 1999; Hellsten et al. 2019).

There are three levels of abstraction while creating the framework: project, case studies within the project and the core consisting of stakeholders, computer-aided simulations, and discussions & negotiations. Stakeholder data further consists of both the quantitative and qualitative data gathered during the input data collection phase.

It is of utmost importance in participatory modelling to clearly demarcate the roles and responsibilities of each stakeholder. Following are the six levels of participation in a project based on simulation-based participatory modelling with multiple case studies. (adapted from Arnstein (1969); Pretty (1995); Voinov and Bousquet (2010); Basco-Carrera et al. (2017)).

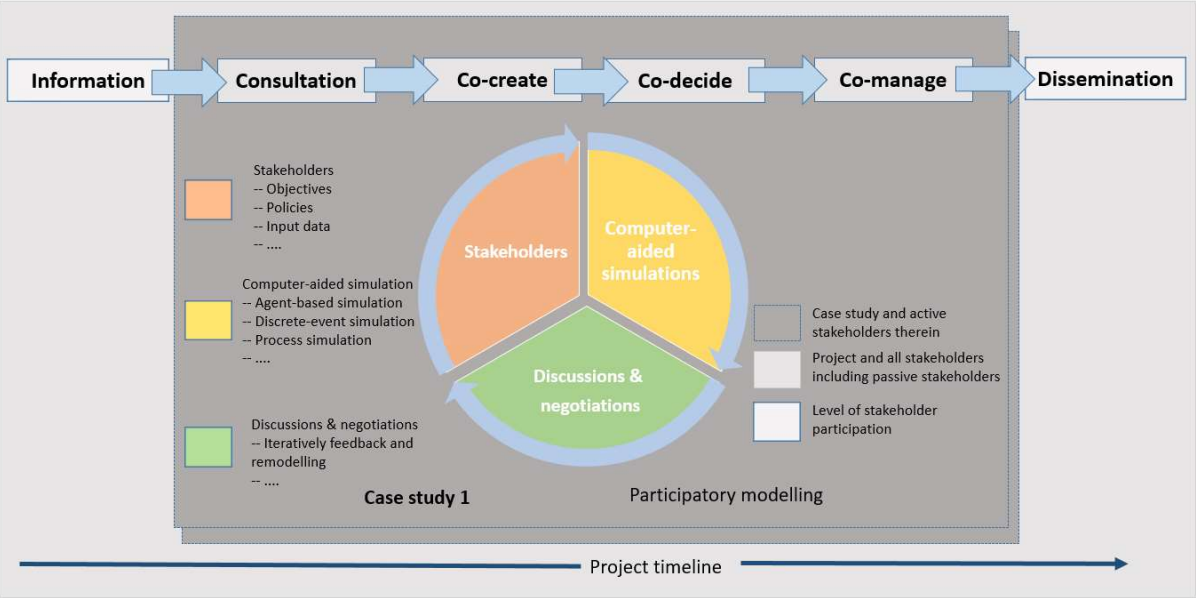

Figure 2: Generic framework for stakeholder participation in urban logistics
[Adapted from Arnstein (1969); Pretty (1995); Voinov and Bousquet (2010); Basco-Carrera et al. (2017)]

4.1.1 Information

During the information phase, both active and passive stakeholders across a project are aware of the progress and general guidelines about each case study. This involves informing and involving the participants with higher level of participation such as enabling, etc. As the structure is made of case studies it is important the delegation and updates are sent to all stakeholders. However, it does not fall in the simulation-based participatory modelling (Arnstein (1969); Voinov and Bousquet (2010)).

The workshop, questionnaire and semi-structured interviews help in the building of the core of the framework together with the ladder of participation for the active stakeholders. These present the empirical grounds for the framework. This is discussed below in detail. However, it is to be kept in mind that in this work we are only proposing the framework and validating a core of the framework in the form of simulation validation. Validation of the complete framework will be done in the next step.

4.1.2 Consultation

Consultation is the first step of the process of participatory modelling proposed in the framework for active stakeholders. Consultation is a two way knowledge flow and input and feedback are required from all active stakeholders (Voinov and Bousquet (2010); Voinov et al. (2016)). Engineers building the simulation model iteratively amend the simulation and initiate discussions among all stakeholders and receive feedback based on the discussions.

In this step, with the help of interviews, the key performance indicators (KPIs) for the simulation models were decided by posting the questions to all stakeholders. Furthermore, with the help of the questionnaire the requirements for the software to be used were discussed and based on it the software was decided.

4.1.3 Co-creation

Co-creation is acting on the agreed upon simulation models and inputs (Voinov et al. 2016; Basco-Carrera et al. (2017)). Here simulations play an indispensable part of the process. Engineers can iterate the simulation model to fit the needs of all active stakeholders if required. However, the main task is for active stakeholders to work on what is achieved from simulations.

Here both historical and forecast data helped in the process of simulation building. This, in turn, strengthened the core of the framework by providing empirical (quantitative) data and make decisions in the step based on numerical data. Workshop held helped in the next phases of the framework: co-creation, co-decision and co-management making by the virtue of validating and discussing the what-if scenarios and discussing the stakeholders and protocol for co-management.

4.1.4 Co-decision making

There is a mandate for all active horizontal stakeholders to act on the intended goals and functions (Basco-Carrera et al. 2017). Hence, making it compulsory for all active stakeholders to participate in the decision-making process to promote and articulate chosen decisions (Pretty 1995). It is important that all conflicts are resolved with the iterative process. Since it is a simulation-based participatory modelling, simulations play an important role in considering the "what-if" scenarios and finally reaching a consensus.

A dialogue facilitation was done in this step that builds the *discussions and negotiations* part of the core of the framework. This was complemented with a workshop that helped in validation of the simulation model and facilitating dialogue among stakeholders.

4.1.5 Co-management

In the phase of co-management, the onus lies on all active stakeholders for the maintenance and sustenance of the solution developed in a case study (Lynam et al. 2007). Similar to co-decision making, here also it is important that conflicts are resolved during each step and a consensus is reached while deciding the plan of action for sustenance.

The responsibilities and the protocol among all stakeholders were discussed during workshops and decided based on the conclusion from the workshop.

4.1.6 Dissemination

In the dissemination phase, both active and passive stakeholders receive information regarding the results in a case study. Knowledge flows in all directions as opposed to only two way knowledge flow between active stakeholders. For example, the urban mobility solutions developed in a particular case study in the project are shared by project partners irrespective of whether they are active or passive stakeholders. Several external presentations like public webinars were also a part of dissemination of the project results.

5 ANALYSIS AND DISCUSSION

The literature review found there is no existing framework in urban logistics domain which addresses the SUMP competing objectives and makes use of the literature review of the simulation tools and frameworks to facilitate stakeholder participation. This paper, hence, reviews the concept of stakeholder participation in various domains and based on the literature and the project experience proposes a framework for stakeholder participation in simulation-based participatory modelling in the domain of urban logistics. The data collected during the literature review process is from different domains in order to understand the various important characteristics for building a framework and guidelines for a simulation-based participatory modelling in a new domain. Since the stakeholders, and the empirical data collected during

the project are in the domain of urban logistics, we believe that the framework consists of strengths from different domains but is pertinent to the domain of urban logistics.

The unit of analysis, as we discussed earlier, is a single case study from a multiple case studies project in this framework. In case the project is a single case study, the project timeline overlaps with the timeline of the case study. Furthermore, each case study has its own problem statement and active stakeholders which go through the phases of consultation, co-creation, co-decision making and co-management depending on the power they hold and their willingness to act. During information and dissemination, knowledge flows in all directions to all stakeholders irrespective of their level of participation.

Simulation-based participatory modelling constitutes active stakeholders, computer-aided simulation tools, and discussion and negotiations among stakeholders. This modelling design increases the knowledge of each stakeholder and iteratively favor the acquisition of skills while resolving conflicts at the same time. Increased collaboration is the focus for success of a project hence resulting in participatory design as an outcome of the dialogue among stakeholders. Here we focus only on the horizontal integration of the different stakeholders, for example, personnel responsible for the logistics in companies, city management, traffic management, etc. This was done with the help of a workshop and questionnaire wherein the stakeholders come from different domains.

Stakeholders can, thus, improve the collaboration through created synergies and better understanding of impact of the solutions. This leads to better decisions when implemented result in less conflict and more success.

6 CONCLUSION AND FUTURE WORK

A simulation-based participatory modelling framework was proposed with the aim of facilitating discussions among stakeholders and providing plausible solution in the domain of urban logistics. In the process, the work demonstrated a simulation-based model learning that brings together cross-sectoral horizontal stakeholders in a team and helps in eliciting knowledge from all stakeholders. Together with the workshop and semi-structured interview, a simulation-model was built with the empirical data (both past data and forecasts) collected by stakeholders. This simulation model was discussed among participants during a workshop and future actions were decided. The simulation modelling process underwent a rigorous scrutiny and is currently decided to lead one more case study.

Simulation-based participatory modelling is found to be impactful in this research work. It facilitated understanding of the process and horizontal collaboration with cross-sectoral relevance. Simulation in SUMO strengthened the process by reinforcing the decisions through numerical results and was an indispensable part of the process. The research benefitted from the actual simulation model building as it also brought together the tacit knowledge of local experts and the scientific knowledge of researchers resulting in wholesome discussions and better coordinated results.

The study concludes that the simulation-based participatory modelling can be helpful in any scenario since it brings expertise together along with conflict resolution and inclusion of varied participants. However, it is pertinent to understanding the resilience of the process to gain deeper insights into the knowledge by validating it. Furthermore, a framework for evaluation of models as suggested by Jones et al. (2011) can be an important step to increase the rigor of the study. The study only focusses on horizontal integration and does not include vertical integration of the stakeholders and that could also be seen as a potential future work.

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