Public Transport Accessibility Needs Assessment Using Gaming Simulations

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Abstract

Accessibility is a complex measure, defined as the ability to perform activities that are necessary or desired by the users of the system. While being difficult to quantify, it is currently recognised as an important measure when assessing the benefits of transport networks. Accessibility is furthermore closely tied together with social inclusion, another aspect recognised in recent studies as an important variable for promoting sustainable societies. The two measures are difficult to integrate into transport models, partly due to being poorly understood and communicated between users and decision makers, as well as due to the qualitative nature of these two measurements. This article examines how gaming simulations can be used to communicate the measures of accessibility and social inclusion, to bridge the gap between the users of the transport infrastructure and the decision makers. Gaming simulations have a long track record in aiding policy making in complex issues and facilitating discussion between different stakeholders. Employing gaming simulations will provide a good aid to achieve a more comprehensive representation and understanding of the users in order to create more accessible and inclusive public transport infrastructure.

1. Introduction

The global urbanisation trend has led to more people than ever living in cities growing at rapid rates. Among other things, the rapid growth of the urbanised areas has caused challenges to the transport infrastructure of these areas in a way never previously encountered (UN, 2014). To help tackle some of these challenges to the transport network, planners have in recent years identified an important variable when assessing the benefits of a transport network to be accessibility, the ability to perform activities necessary or desired by the users of the system (Geurs and van Wee, 2004; Litman, 2015). Accessibility and many of its aspects are furthermore tightly tied together with the feeling of being included or excluded as a part of society, hereafter identified as social inclusion (Farrington, 2007; van Wee and Geurs, 2011; Lucas, 2012). The main focus for this article will thus be to try to

capture the aspects of the variables of accessibility and social inclusion in an attempt to improve on the issues that the urban transport infrastructure are facing.

As a novel approach, this work proposes to use gaming and participatory simulations to attempt to improve on the issues mentioned above. Work has been done in this field, for instance in the shape of multi-agent models simulating a system based on individual preferences, participatory processes to make urban planning more inclusive and democratic, and using the technological progress in the shape of visualisations and geographical information systems to utilise these better (Raghothama and Meijer, 2015). The next step in this process is to combine the data and simulation aspects with a participation and gaming approach. This would ideally create a method of high data dependence, high fidelity and high realism, while still retaining the component of exploration and play commonly associated with gaming simulations (Duke, 1974).

Thus this article concerns itself with the question;

How can games be designed to effectively communicate the measures of accessibility and social inclusion to be used with modern public transport planning tools?

2. Background

Looking at the current state of the art of transport planning, it tends to evaluate transport system quality mainly based on mobility, using indicators such as average traffic speed and congestion delay (Litman 2001; Iacono et al, 2010). Efforts to increase vehicle traffic speeds and volumes, and thus improve the ease of access to utilities and services for specific modes, can reduce other forms of accessibility. A fairly common effect when planning for increased mobility is constraining pedestrian travel while stimulating more car-oriented development (Litman 2015; Iacono et al, 2010). Furthermore, Geurs and van Wee notes that to ease interpretation, accessibility measures used in modern transport models are often subject to methodological disadvantages. In the Netherlands and other European countries, the most common transport models use easily communicable and interpretable criteria, such as congestion levels and travel speeds. This leads to missing out on many other vital criteria, such as land-use measures, as well as having difficulty treating temporal constraints and individual characteristics of the users of the transport network (Geurs and van Wee, 2004).

Since the ultimate goal of the vast majority of transportation activities is accessibility to a desired activity or destination, transport planning should arguably be based more on accessibility, rather than only mobility (Litman, 2015). However, as conventional planning tends to focus on primarily vehicle based performance indicators, accessibility factors have a tendency to be overlooked or undervalued. This in turn leads to the tools favouring mobility over accessibility, and car use over other modes. A lot of these biases are however technical in nature, resulting from the statistics and other data used to measure travel demands and how these performance indicators are selected (Litman, 2015; Iacono et al, 2010).

Although some ambiguity of the definition of accessibility exists, the most common in the reviewed literature are referring to the ability or potential of people to reach interactions, goods, services and activities (Litman, 2015; van Wee & Geurs, 2011; Rietveld and Bruinsma 1998; Hansen, 1959) or how these can be reached from a given point in space

(Bertolini et al, 2005). These activities can vary greatly depending on many variables, such as demographic group, income or gender (Litman, 2015; Paez et al, 2010; Mokhtarian and Chen, 2004) and can be activities such as work, leisure, shopping, education, medical care and so forth. Accessibility is also seen as an indicator for the impact of land-use and transportation systems (van Wee & Geurs 2004, 2011; Geurs et al, 2009) and the ability of a transportation system to provide a low cost and/or quick method of overcoming the distance between different locations (Ingram, 1971). Accessibility can further be described as the encounter between its functional capacity and the demands of the physical environment (Fänge & Iwarsson, 2003), determined by the "ease of travel between points in space as determined by the character and quality of service provided by the transportation system and as measured by travel distance, time, or cost" (Handy, 1993).

In their reviewed literature, Geurs and van Wee further observes that accessibility is measured using four different basic perspectives (van Wee & Geurs, 2004);

1. **Infrastructure-based measures**, which are commonly used in transport planning. They consider mobility variables such as travel speeds and level of congestion of a network.
2. **Location-based measures**, typically used in urban planning and geography studies. These measures describe the level of accessibility for certain activities within a certain distance.
3. **Person-based measures**, which measure accessibility at a personal level, such as the location and duration of mandatory activities, the time budgets for flexible activities and travel speed allowed by the transport system.
4. **Utility-based measures**, originating from economic studies, this measure analyses the economic benefits of people from various spatially distributed activities.

Within these measures four components of accessibility measurements are identified;

1. **Land-use components**, which reflect the land-use system, identifying the amount, quality and spatial distribution of opportunities supplied at each location, together with the supply and demand at other locations, which can potentially lead to competition for activities with restricted capacity.
2. **Transportation components**, describing the transport system expressed as disutility for an individual to cover a distance between origin and destination using a specific mode of travel.
3. **Temporal component**, reflecting the availability of different opportunities over different times of the day as well as the time available by the individual to partake in activities.
4. **Individual component**, reflecting the needs, abilities and opportunities of individuals. These commonly depend on demographics and geographical location and influence the individuals access to transport and opportunities.

Traditionally, each of these different measure focus on their own specific accessibility component and ignores other relevant elements (Geurs and van Wee, 2004, Litman 2015). For instance, infrastructure-based measures do not include a land-use component, and utility-based and person-based measures focus on the individual accessibility rather than the system as a whole. Due to the different components in many cases being interlinked,

properly measuring accessibility for the entire transport infrastructure requires a combination of all the measures. Attempting to assess accessibility as a general measurement without taking all four measures into account leads to problems, and is part of the reason behind the difficulties in measuring accessibility (Geurs and van Wee, 2004).

Additionally, to successfully use an accessibility measure, it needs to fulfil four criteria. These are; A strong theoretical basis, Operationalisation, Interpretability and communicability, and Usability as social and economic indicators.

Geurs and van Wee (2004) further address the issue of an adequate accessibility measure by stating four basic criteria, that need to be fulfilled;

1. A strong theoretical basis, the measure should ideally take the perspectives of all the different types of measurement approaches into account. Thus, an accessibility measure should be sensitive to changes in the transport network and land-use component. Furthermore it should be sensitive to temporal constraints of opportunities and take the needs and abilities of individuals into account.
2. Operationalisation, i.e., the ease with which the measure can be used in practice. Commonly in conflict with one or more of the theoretical criteria.
3. Interpretability and communicability, meaning that the planners, decision makers and researchers should be able to understand and interpret the measure for it to be useful. However, even the most well-explained and easily understood measure will remain unused if there is no political will to implement it.
4. Usability as social and economic indicators. The measure needs to be able to show the availability of social and economic activities for individuals or groups of people, such as jobs, health services, food, potential for social interaction, etc. Moreover, the economic benefits need to be measured both from a micro-economic perspective to assess the direct economic impacts, as well as a macro-economic perspective to analyse the wider economic effects.

3. Accessibility in transport planning

Accessibility has been a policy goal in the UK following discussion on how to improve on social inclusion (Farrington, 2007; Lucas, 2012). As various groups of people have differing accessibility needs, how they are included in the planning process thus reflect how their needs are going to be taken into account. Transport system performance indicators that are more comprehensive and inclusive are necessary. These should include additional aspects, such as considering vulnerable demographics, the diversity of transport options, including non-motorised ones, and varied land-use. Further assessment suggestions for improving social inclusion are multi-modal travel patterns, land-use accessibility, and how to plan urban areas ahead to proactively direct the growth of the city in a sustainable manner (Litman, 2003).

Social inclusion has been addressed in research done especially in the UK (Lucas, 2012; Dempsey et al, 2009) and is considered one of the main aspects of a sustainable society (Dempsey et al, 2009; Murphy, 2012). A lack of social inclusion in the society is described as lacking or being denied resources, rights, goods and services to participate in the normal

relationships and activities available to the majority of the people. Regardless of whether looking at it from an economic, social, cultural, or political perspective, these variables are tightly tied together with individual characteristics of the citizens, such as age, disability, gender and race, factors that lie with the structure of the local area, such as a lack of available or inadequate public transport services, and factors or the economy, fluctuations to the labour market, cultural influence and migration (Lucas, 2012).

The studies made in the UK have identified seven aspects related to transport accessibility that contribute to social exclusion (Church et al, 2000):

1. Physical aspects are related to the way the transport network limits accessibility for certain groups of people from using the transport system due to physical and psychological difficulties. Examples are children, elderly or handicapped people.
2. Geographical aspects relate to indications that poor access to transport leads to social exclusion. Although in a select few cases geographical inaccessibility has led to stronger local communities and labour markets, in greater metropolitan regions these examples are very rare.
3. Aspects related to access to shopping, finance, leisure, healthcare and education facilities. The lack of access to such facilities are common in areas with low levels of social inclusion. Changes in the way how public and private facilities are provided and organised can also influence monetary and temporal costs for the potential users. This is also associated with land-use trends.
4. Economic aspects relate to how income can restrain access to the transport network and thus limit the geographical extent of geographical extent of employment travel patterns.
5. Time aspects refer to the difficulties of organising commitments to allow enough time for travel given individual time constraints. This aspect is particularly problematic for single mothers.
6. The aspect of fear relates to the nature of individual fear in public and private spaces. This aspect varies a lot between different social characteristics of individuals, especially gender, and strongly influences the usage of public spaces and transport facilities.
7. Aspects of space are tightly connected to the aspect of fear. Common ways to deal with these aspects are through surveillance and management strategies. This tends to improve on the aspects of space and fear through an increased security, especially for vulnerable individuals. Certain types of strategies can however weaken the sense of ownership for excluded groups, in particular younger people.

A socially inclusive transport system can following this logic be defined as a system giving equal basic opportunities for citizens to participate in the activities and use facilities of the urban area, regardless of background or demographics. To promote a sustainable society, the design and use of public spaces and the transport system should furthermore aim at creating a sense of safety and community for its users.

4. Combined overview of measurements

Table 1 by Geurs and van Wee (2004) presents an overview on how the previously mentioned focus on a specific measure at the same time excludes other relevant aspects of accessibility. Infrastructure-based measures do not include a land-use component; i.e. they are not sensitive to changes in the spatial distribution of activities if service levels (e.g. travel speed, times or costs) remain constant. The temporal component is explicitly treated in person-based measures and is generally not considered in the other perspectives, or treated only implicitly, for example by computing peak and off-peak hour accessibility levels. Person-based and utility-based measures typically focus on the individual component, analysing accessibility on an individual level. Location- based measures typically analyse accessibility on a macro-level, but focus more on incorporating spatial constraints in the supply of opportunities, usually excluded in the other approaches.

Measure	**Component**			
	Transport component	Land-use component	Temporal component	Individual component
Infrastructure-based	Travelling speed; vehicle-hours lost in congestion		Peak-hour period; 24-h period	Trip-based stratification, e.g. home-to-work, business
Location-based	Travel time and/or costs between locations and activities	Amount and spatial distribution of the demand for and/or supply of opportunities	Travel time and costs may differ, e.g. between hours of the day, between days of the week, or seasons	Stratification of the population (e.g. by income, educational level)
Person-based	Travel time between locations of activities	Amount and spatial distribution of supplied opportunities	Temporal constraints for activities and time available for activities	Accessibility is analysed at individual level
Utility-based	Travel time between locations of activities	Amount and spatial distribution of supplied opportunities	Travel time and costs may differ, e.g. between hours of the day, between days of the week, or seasons	Utility is derived at the individual or homogeneous population group level

Table 1. Perspectives on accessibility and components by Geurs and van Wee (2004)

Looking at the seven aspects of social inclusion, there is overlap between these and several of the various measures and components of accessibility. For example, geographical aspects are closely related to both the transport and land-use component and location-based measures. Economic and time-based aspects overlap with practically all the various measures and their components thereof. Although there are already methods to collect data for the various measures and their components, such as various types of surveys, sensor data and official transport system characteristics. Adding the perspective of social inclusion to the data collection could still make a valuable addition to creating a socially inclusive transport system along with a different way of looking at the various measures and components of accessibility.

5. Gaming simulations for decision support

Gaming simulations have been chosen as a method for communicating issues in planning transport infrastructure due to being good tools for assessing the social and informal spaces

of urban transport systems (Raghotama and Meijer, 2015). Aiming at assessing the seven aspects of social inclusion, while taking the different accessibility components into account, gaming simulations can be useful, both for assessing accessibility and for promoting socially inclusive transport planning.

Gaming and gaming simulations have previously been examined for improving on issues involving the government. Mayer (2009), for instance, states that government agencies have been realised to act less than a unitary body, but rather more like society, as fragmented groups with their own interests in mind. Policy making can thus be defined as taking place in a complex multi-actor setting with conflicting interests of public and private stakeholders. Government intervention in this setting therefore requires the analysis of the policy problem within its own strategic multi-actor context. This leads to complex policy problems to have two aspects of a problem, one social and political, consisting of the interactions between stakeholders, and the other technical and physical, consisting of the interactions between economic, physical, and technical aspects of the system. This leads to these complex policy commonly be labelled socio-technical systems. The problem regular simulations face with modelling policy making decisions is that irrational human behaviour is difficult to model and are commonly just reduced to factors, such as variables or agents, affecting a model. Thus it becomes apparent that other types of methods are necessary to be able to support both the social and technical aspects of policy making (Mayer, 2009).

Bruijn et al (2009) further describe that modelling and intervention possibilities in socio-technical systems, systems with both technical and physical perspectives, differ greatly as compared to a strictly social or technical system. However, rather than the common aim of integrating these two perspectives, they come to the same conclusion as Mayer (2009), that the aims should be to facilitate both of the perspectives side by side, not discarding either. They present several solutions, among them hybrid models such as serious gaming and agent-based modelling as good candidates for bridging the gap between stakeholders in socio-technical systems. Mayer (2009) goes further and mentions how (serious) gaming makes it possible for the actual behaviours of people to be modelled, as the agents used are the actual stakeholders involved in the issue.

Games are also known to bridge boundaries between stakeholders. They can bring people together around the same table using a common language. These advantages of gaming are pointed out in a multitude of different contexts such as the ability of non-professionals to participate in a debate, providing a good medium for communication, and as a discussion tool for an interested community or individual (Barreteau et al, 2001; Hanzl, 2007; Huayi, Zhengwei and Jianya, 2010; Langendorf, 1992; Mayer, 2009; Reddel and Woolcock, 2004).

Lo and Meijer (2014) describe a series of experiments at ProRail, the Dutch railway administration, to test the value of gaming in complex settings. The experiments measured how gaming simulations can influence and measure situation awareness in the context of railways traffic control. Commonly, studies on situational awareness are conducted on, typically more expensive, field training or human-in-the-loop simulations. In the experiments performed at Prorail, different stakeholders of the railway system, traffic controllers, train drivers, etc., people that normally are distanced from each other came together to play a serious game illustrating real world scenarios that could happen to the railway network. They

conclude that using abstract forms of gaming simulations can cost less and be less time consuming than human-in-the-loop simulations to simulate an environment for operators.

Although many cases documented in literature come from the United States and Europe, applications in countries with other levels of industrialisation can also be found. In India for instance, the Energy game with the goal of making the participants aware of the complexity of the design of energy policies in India. The players take on the three different roles and perspectives modelled after the institutional structure for energy policy in India, the Department of Atomic Energy, Ministry of New and Renewable Energy and the Ministry of Power. The goal of the game is for the participants to together design the mixture of additional energy capacity to be added during India's next five-year plan. The results from the several sessions conducted show how the participants indeed experienced the tensions between the different institutions and showed an increased understanding for the complexity of the matter (Hoysala, et al, 2013).

Barreteau et al (2001) and Bousquet et al (2002) go through experiments performed with role playing games in Senegal, where farmers, regardless of educational background and even literacy rate came together to share knowledge and develop plans for irrigation schemes and land allocation in the Senegal river delta. The game served as a form of dialogue between the models used and the stakeholders, enabling all the stakeholders to fully understand the results of the model.

Another example of a gaming simulation conducted in cooperation with government agencies in India is the Communication Protocol Game. The goal of the game is to promote communication between agencies in the case of a disaster in the country. The different agencies commonly develop their own reactions to disasters. To ensure the optimal response when several different agencies are involved, good communication between them is key and preventing miscommunication should be a main objective. The simulations identified several critical points where communication could go wrong and highlighted the importance of not just having a protocol, but also how to adhere to it (Palavalli, et al, 2012).

What is important to note between the games previously described is the different cultural contexts. Meershoek et al (2014) write about the importance of taking great care to adapt the game to the cultural context of the players for which the game is intended. Otherwise it runs the risk of the behaviour of the players preventing the intended objectives to be reached. Regardless of whether it is the cultural context within a company or a country, the players will bring their own cultural contexts into the gaming session, and that needs to be taken into account when creating the game. Certain methods have been developed to identify and examine the cultural contexts of a serious game to adapt it to the intended player culture to increase the likelihood. These methods can be used to assess the contexts of the game and provide a set of guidelines to avoid conflicts from occurring between the game and the players (Meershoek et al, 2014).

Methods to validate the efficiency of gaming simulations are further being developed. A video-based tool to analyse gaming simulations have been used to examine and validate the results from gaming simulations (Palavalli, et al, 2013). The validity of games can be assessed through analysing the results from the game and the behaviour of the players. Standard methods of observing however are very cumbersome for larger numbers of players

over several sessions, and the authors instead propose creating a framework to use automated techniques to improve on the design of serious games. Using multi-modal analysis tools, it is possible to create feedback from the results of a session, alongside being able to validate the learning outcomes. Using a video analysis techniques it is possible to map the behaviours and interactions of individuals in a group. A machine learning process can then further interpret how the different individuals perceive and communicate with each other, identifying patterns of interaction between the players to see, for instance, how they cooperate, compete or plan strategies to validate the model used (Palavalli, et al, 2013).

Conclusively, participatory planning processes are considered useful tools for including perspectives commonly difficult to assess. Gaming simulations can fill an important role in this context, as they, although being data demanding, are generally cheaper than field training or other simulations with similar goals. Furthermore, they are able to facilitate discussions between laymen, experts and decision makers, even potentially sidestepping issues of literacy rates, providing a good base for a socially inclusive participatory planning process.

6. Game design

As a pilot study, the city of Bangalore has agreed to evaluate a game to add to their transport planning processes. The idea behind the game is enabling the city of Bangalore in India to evaluate and improve on its public bus transport network by employing participatory simulations. Through soliciting public opinion decision makers and BMTC, the biggest public transport provider in Bangalore, will be more aware of the local conditions when planning and realising an infrastructure project in a designated area.

Assuming an issue is identified, designing a game would typically require identifying three aspects (Krishna et al, 2016);

1. The target audience, i.e. the stakeholders
2. The objectives of the game, i.e. the interactions under study
3. The objectives in the game, i.e. the set of parameters that define the game-specific context

Depending on the objective and input used for a given gaming simulation, the results may then vary from quantitative or qualitative data about the system. Examples include capturing aspirations and service quality from transport infrastructure, modelling the social contexts for various stakeholder, identifying gaps in protocol, standards or institutional structure or testing of hypothetical future scenarios and their demand requirements (Krishna et al, 2016)

Eventually, the idea is that the decision makers through the participatory planning processes can make a more informed decision in regards to the local contexts of the areas in which transport infrastructure is being developed. In many countries, it is mandated by law to have local citizens and interest groups involved in the infrastructure planning process. In Bangalore however, there are no such laws, and thus citizens use other means of voicing their opinions, such as writing to newspapers or the BMTC with their issues with the transport network (Deccan Herald, 2017). In the future BMTC does intend to create an online function where the citizens of Bangalore can report issues or suggestions (BMTC, 2017).

To create a fruitful participatory process where social inclusion and accessibility are in focus, it is firstly important to have as clear an issue as possible identified. Secondly, the stakeholders need to be mapped well to include all different groups affected by the decisions being made. Third, the various views of the aspects of social inclusion should be identified, either through meetings, looking into written complaints, questionnaires, surveys or through other methods. Finally, through participatory gaming simulations, aim at having the players experience issues that may arise in the transport planning process. This gives a good opportunity to show the importance of the various aspects for different groups. The players could assume different stakeholder roles to visualise problems that could arise depending on which plans are followed.

The objective of the games being examined in this article is to improve the accessibility and affordability of the marginalised communities in Bangalore to the BMTC public transportation service. A simulation can estimate both schedules and costs for the service in the area under consideration, and an optimising algorithm can do so given the required data. However, there will be many scenarios where the planners will have to make informed trade-offs between competing parameters.

Consider the example of reducing costs for certain routes or increasing frequency of buses. Although a reduction in the fares for certain routes will result in an overall loss to the company in the short term, it may allow BMTC to achieve a higher service level and thus be in a position to raise funding from the public themselves. However, such a trade-off can be difficult to adopt unless it is understood in a realistic setting. A gaming simulation would be an ideal tool for testing such strategies. The use of gaming simulations will allow planners to prioritise among the different trade-offs they have to make, in order to achieve long or short-term objectives. Gaming simulations will also allow planners the capability to consider priorities of trade-offs that emerge from gaming sessions to tune their plans for a given context.

6.1. Game Design 1

The first game design is a collaborative approach to design routes and schedules. The player group can consist of planners and management from BMTC, civic society groups involved in improving public transportation and commuters from the marginalised communities.

6.1.1 List of parameters:
1. Locations where commuters are using the public transportation.
2. Routes associated with the locations under plans.
3. Fares and services associated with the locations under plans.
4. Schedules associated with the routes passing through the locations under the plans.
5. Estimated demand for the locations.

6.1.2 Game Mechanisms
Players form two teams. One team represents the public transport company, the other team represents the commuters. Each team will get a set of individual objectives.

6.1.3 Objectives of the public transport company
1. Optimise the routes, schedules, services to within the resources available.
2. Do not let the company go bankrupt.

6.1.4 Objective of the commuters
1. Reduce individual cost and time taken when using public transportation.
2. Ensure an equitable service quality.

The teams will also have to satisfy common objectives such as:

1. Reduction in pollution.
2. Reduction in private transportation requirements.

The game will be played from one financial year to another until one of the objectives fail or all the objectives are reached.

6.1.5 Outcomes of the game:
The players will be able to learn the current constraints that each stakeholder is facing at a macro scale. The outcome is mainly targeted towards the planners in the public transportation company to allow them to identify the missing information in their planning contexts and the ability to understand the circumstances from the local commuter's point of view.

6.1.6 Limitations of the game mechanism:
1. This type of game represents the macro operations of the public transport system. It will not be able to model the day to day complexities of running such a company.
2. The game requires player representation from more than one stakeholder group.

6.2. Game Design 2

Competitive game to run a successful public transportation system. The player group can consist of planners and management from BMTC.

6.2.1 List of parameters
1. The total travel demand for the given locations in terms of number of people travelling.
2. Locations where commuters are using the public transportation.
3. Routes associated with the locations under plans.
4. Fares and services associated with the locations under plans.
5. Schedules associated with the routes passing through the locations under the plans.
6. Location of bus-stops.
7. Estimated demand for the locations at various times of day.
8. Budget for the company
9. Fleet size, performance of fleet

6.2.2 Game Mechanisms
Players from multiple teams with each team representing one public transport company. Each team member can represent the administrative, finance and operations in the given company.

Each team will run their respective companies in their respective cities. All the teams will play for multiple rounds, each round representing a financial year.

The game ends when upon hitting a round limit or when a team fail to avoid bankruptcy. The following are the objectives that each of the teams pursue:

1. Reduction in pollution.
2. Increase the total ridership for the company.
3. Increase the total share of public transportation in the total market.
4. Keep the company from going bankrupt.

The teams will play in competition with each other. At the end of the game the players will discuss their strategies in running the company in the game.

6.2.3 Outcomes of the game:

The outcome is mainly targeted towards the planners in the public transportation company to allow them to identify the missing information in their planning contexts and be able to understand the trade-offs between short-term and long-term strategies while running a public transport company. It also allows them to understand the limitations of private entities in the system and the need for them to stay competitive.

6.2.4 Limitations of the game mechanism:

1. This type of game provides a lot of room to include micro interactions related to running of a public company. Interactions with respect to maintenance of vehicle fleets, personnel, maintenance and the need to balance budgets can be included in the game.
2. The game requires player representation from more than one stakeholder group.

7. Discussion

With regards to the discussed perspectives on accessibility and social inclusion, the games will have different outcomes. The first game has the benefit of recruiting the player group from a diverse set of stakeholders, able to encompass a multitude of variables concerning their needs and preferences. As the second game is more directed to transport management, to be able to capture an equally diverse set of variables it is important to take care to include these in the background data going into creating the game.

The goal of the gaming simulations in this context is not to select a winner, but to highlight the difficulties and trade-offs necessary to create a solution when taking the various accessibility measures into account, while considering the attributes of the aspects of social inclusion that are important to the stakeholders. The end goal of a gaming session would be highlighting not only the differences in the various measures, but at the same time the overlap between them. Additionally the game should highlight the importance of the seven different aspects for the various stakeholders, being able to illustrate and describe the dilemmas that might occur in real life.

The simulations thus need to capture the four perspectives of infrastructure, location, person and utility into account and be able to convey these to the intended audience, as well as being able to represent the different aspects of social inclusion. The idea is not to introduce accessibility as a variable on its own, but rather create a way to present the various aspects thereof side by side in an interpretable manner to both public and decision makers.

8. Conclusions and future work

This article describes some of the issues faced in the modern transport infrastructure. Furthermore it describes the importance and difficulty in assessment of accessibility and the

related issue of social inclusion. To improve on the transport planning process this article discusses a framework to employ gaming simulations as a means to addressing these issues. Additionally, the article also explains two test cases to be evaluated in Bangalore, India.

The next steps are finalising development and testing of the gaming prototypes and evaluating them from the perspective of the framework discussed in this article. Following that, further testing involving a greater variety of stakeholders will be required, along with using a framework for translating a successful game to different cultural contexts.

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