Participatory Design Games in Urban Planning: Towards a Distributed and Massively Multi-player Online Collaboration Model

By

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Abstract

As modern cities grow in size and complexities, the conventional approach of top down planning becomes increasingly inadequate to address the complex issues that shape cities on the ground. Large sweeping urban interventions that dominated early post World War II discourses, crumbled by the second half of the 20th century. In the 70s, Participatory Design emerged out of a workplace democracy movement as an alternative to the top down model. The practice subsequently found widespread adoption in many disciplines including the realm of urban design. As the 20th century comes to an end, the rise of a networked and globalised world fundamentally changed how cities functioned.

The first decade of the 21st century saw the proliferation of personal and mobile computing devices. Access to information and communication over long distances have never been easier. Massively Multiplayer Online Games have also grown in popularity and sophistication, developing new ways for large amount of people to interact over digital intermediaries such as consoles, personal computers and increasingly mobile phones.

Set among this backdrop of unprecedented revolutions, the field of urban design has also evolved to adopt new technologies, developing powerful new tools. However, there still seem to be unrealised potentials within the domain of Participatory Design in urban planning. This paper will attempt to highlight what has been done and what can be done.

This paper will analyse key literatures to provide an understanding into cities and the field of participatory design. Subsequently, this paper will analyse specific case studies over the last decade, to understand how participatory design has been utilized in urban projects and attempt to understand the mechanism behind these interactions. After which, a survey of existing urban design tools will allow the understanding of current capabilities. In addition, specific Massively Multiplayer Online Games will be studied to gain insight into facilitating online multiplayer interactions.

Finally, this paper will conclude with a call for action, by highlighting that a Distributed and Massively Multi-player Online Collaboration Model of participatory design is well within our reach and propose some general recommendations for a possible implementation.

Table of Contents

List of Figures

1.0 Introduction

This paper will attempt to present a set of ideas that prompts a re-evaluation of existing approaches towards *Participatory Design (PD)* in urban planning, specifically on current implementations of 3D mock-ups that mirrors reality through the use of digital platforms. I will argue that while current efforts have used digital tools to enhanced conventional PD methodologies (e.g. real-time calculations, realistic graphics), they fall short in exploiting the full potential of digital platforms to enable interaction and democratize participation. Of the many advantages of the digital platforms of the present day, two important features remains largely untapped and unexplored.

The first, is the unparalleled reach of information technology that allows digital platforms to enable *distributed participation over long distances*. The second, is the capacity to allow *massive numbers of participants* to simultaneously interact within a digital space. Both of which offer new opportunities that are impossible to achieve within the conventional setting of PD which necessitates direct, face to face interactions. The goal of this paper is to demonstrate that these two areas of exploration are the logical next steps to take, to devote greater research attention to pick the proverbial low hanging fruits, enabled by existing digital tools and commercial products.

This paper will be structured to lay the necessary theoretical groundwork to understand Participatory Design and the various digital platforms out in the market, before I present a critique on the untapped potentials of these platforms before finally presenting what I termed the *Distributed and Massive Multi-player Online Collaborative Model*.

Chapter 2 will attempt to present an understanding of the city as a system that is *open, complex, self-organizing* and also provide an introduction to participatory design. First of all, we will reference Juval Portugali's book *Complexity, Cognition and the City,* where he presents the Complexity Theories of Cities (CTC). Secondly, I will also provide an overview of participatory design, looking at its origins, its key philosophies and some of its applications.

In chapter 3, I will discuss in detail how PD is used in urban design. I will first show the value of local engagement by presenting *Rebuild by Design*, a reconstruction initiative that emerged after Hurricane Sandy. Secondly I will introduce an approach of PD in urban design that uses a physical 3D mock-up, a "city game" conducted by *Play the City*, to illustrate the self-organization dynamics of a city (refer to chapter 2) and as a result show that the city game can be a useful city analogue for designers to generate and evaluate design.

Chapter 4 will address one of the key premise of this paper, the potential opportunities that could arise if massive numbers of citizens could participate. This chapter will attempt to dissect the key interactions within "city games" and discuss how these interactions can be scaled up to involve massive number of participants.

Chapter 5 will discuss how digital tools are currently used for PD in urban planning. I will provide a survey of existing digital urban design tools and look at how Massively Multiplayer Online games manages player interactions.

Chapter 6 will provide a short summary and conclude with recommendations that outlines how digital tools can enable *distributed participation over long distances* and harness the collective wisdom of *massive numbers of participants*.

2.0 Understanding Cities and Participatory Design

In this chapter, I will attempt to arrive at a working definition of cities for the discussion of participatory design games in urban planning. In the first part of this chapter, I will present an understanding of the city through a body of work known as Complexity Theories of Cities. The second part will provide an introduction into the field of participatory design by presenting the context for its emergence, the key philosophies behind the practice and listing out some of its applications in very diverse fields.

2.1 Complexity Theories of Cities

Cities are complex entities. Complex in the sense that there are many agents and variables interacting in a network, in a non-linear flow. It is a manifestation of numerous decisions made by the individuals that inhabit them, constantly evolving and changing. A prominent voice against Corbusian urbanism during the 60s, Jane Jacobs provides an intuitive observation of the streets alludes to the capacity of a complex system to self-organize, without an external intervening force. When describing how sidewalks can promote safe streets by informal surveillance (Jacobs 1961), Jacobs eloquently writes that "under the seeming disorder of the old city … is a marvellous order for maintaining the safety of the streets … an intricate ballet in which individual dancers and ensembles all have distinctive parts which miraculously reinforce each other and compose an orderly whole". *Complexit*y arises from the presence of many actors within the streets each with the capacity to exert change. In the absence of a masterplan from an external authority, the unplanned portion of a city with its many actors, managed to *self-organize* to create some form of order that maintains the safety of the streets.

By the end of the 20th century, the rise of a globalised network and the coming of age of information technology became a powerful influence that shaped the cities we know today. In the essay T*he Spaces of Flows*, Manuel Castells writes about the emergence of new urban forms, an interconnected network of cities that is shaped by the global flow of information and resources, made possible by advance communication technology. Cities are shaped by incoming flows of information and resources from others cities that are physically disjointed over great distance (Castells 1996). Hence, in order to understand modern cities, we need to acknowledge that a city's development is not limited by geopolitical constraints and must be studied as an *open system* that is subjected to external influences.

Within the development of these new understanding of cities, there is a body of work that may provide us with a way to breakdown and describe these somewhat complex interactions and behaviours that we see in modern cities. Juval Portugali coined the term Complexity Theories of Cities (CTC) to describe a rich body of work and literature that investigates the phenomenon of *self-organization*, initially developed within the scientific community, in the understanding of cities. The authors who first studied the phenomenon were intrigued by systems that showed properties of non-causality, where "external forces acting on the system do not determine or cause its behaviour, but instead trigger an internal and independent process by which the system spontaneously self-organizes itself"[1] (Portugali 2011). Many authors working in the area of CTC have developed specific formalism and models (Portugali 2011), but they nearly all share the general view that cities are *open* "in the sense that they exchange matter and information with their environment", *complex* "in the sense that their parts are numerous and form a complex network with feed-forward and feedback loops", and that cities have the capacity to *self-organize.*

Among these authors, Hermann Haken's work on synergetics and Iilya Prigogine's work on dissipative structures were the first to be applied to the study of cities and urbanism (Portugali 2011). Specifically within CTC, key texts include *Fractal Cities* (Batty & Longley 1994), *Self-Organisation and the City* (Portugali 2000), C*ities and Complexities* (Batty 2007), cellular automata and agent based urban simulation models (Benenson & Torrens 2004)[2]. In particular Haken and Portugali developed a framework called *Synergetic Inter-Representational Networks,* which describes how self-organization occurs, providing us with a way to use the phenomenon to develop an urban design process. I will revisit this framework in detail in chapter 4 after introducing participatory design and show how PD has been used in urban design scenarios.

For the moment, I hope to have established an understanding that cities are *open, complex* and *self-organizing* systems. This is intended to help contextualize the challenges of urban planning and begin to show the limits of a top down planning process. The following section will introduce the concept of participatory design, which was created in defiance of the norms of top down design and planning.

[2] The authors listed are not exhaustive.

2.2 Participatory Design

Participatory Design refers broadly to "a set of theories, practices and studies related to end-users as full participants in activities", which has its roots in a Scandinavian workplace democracy movement back in the 1970s (Muller & Durin 2007). Due to its political roots, early works were mainly experiments conducted through the collaboration of researchers and organized labour (Ehn 1993; Gregory 2003; Levinger 1998). The works subsequently expanded to include more social justice issues like inclusive design (Light & Luckin 2008), women's needs (Balka 1995; Greenbaum 1991; Nisonen 1994) and much more[3]. Researchers then concentrated their efforts on integrating complex and isolated knowledge to solve real world design challenges, with the common belief in "the integrity and rationality of multiple voices and multiple knowledges" (Muller & Durin 2007).

This leads to the development of various methodologies that are characterised by the subversion of the process of a top down design approach, where designers decide what they deemed is the best for the users and instead facilitate a bottom-up model where both designers and users are directly involved in the design process. The approach assumes that the users have the greatest capacity to contribute as they have "the most knowledge about what they do and what they need" (Schuler 1993). Designers who are trained in their area of expertise then facilitate the design process as technical consultants. The PD approach has since been adopted by a broad and diverse spectrum of domains, utilizing methods that facilitates *collaboration by involving potential users, other external stakeholders and designers from various discipline as partners in the generation of a design solution* (Sanders 2010).

It is however, unrealistic to think that just the mere act of involving everyone in projects would bring about successful outcomes. Light & Luckin (2008) cautions that "believing in the potential of everyone to design" is different from indiscriminately "involving every potential user in every design project, or at all stages, or in the same way as the next person". The diversity of participants' background and often the complex nature of many design projects, necessitates careful consideration into the methods and technique used to engage these participants. Hence, in order to understand the interactions that could occur in PD sessions for urban planning, the next chapter will look at specific case studies that demonstrate some of the approaches that practitioners have used to resolve or tackle urban projects.

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[3] Refer to (Muller & Durin 2007) for a comprehensive list.

3.0 Participatory Design in Urban Planning – Case Studies

This chapter will now take a closer look at examples of PD sessions in urban planning. It is intended to provide an overall picture of approaches employed by some practitioners over the last decade. I will first highlight the value of local engagement by introducing *Rebuild by Design*. Next, I will show how a group of non-experts can come together to generate a complex urban form using a predefined tool kit of modular parts by introducing *Indosity*. After that, I will present an example from *Play the City*, to illustrate the concept of self-organization in the generation of urban forms.

3.1 Rebuild by Design – The value of local engagement in a collaborative design process

In the wake of the destruction that Hurricane Sandy caused in 2012, came a realization that conventional re-reconstruction back to pre-storm conditions would not prepare coastal communities for the inevitabilities of weather induced disasters. The Hurricane Sandy Rebuilding Task Force identified that a "successful intervention would rely upon intensive collaboration between community members, government agencies and talented experts from a variety of fields". As a result they brought about an initiative, *Rebuild by Design*, a design competition with an emphasis on bringing the "impacted communities into heart of the design process" to produce solutions that address future uncertainties (Rebuild by Design 2015).

Our focus here is to understand why local engagement is a valuable asset that propels the designs forward. We will briefly present the final proposal from the Bjarke Ingels Group (BIG) team, as well as their accounts of their experiences.

The BIG Team explored the problem of protecting the coastline of Manhattan from flooding in the event of a storm surges (Fig. 1). Their solution was to create a series of public amenities (Fig. 2) along the shore that was integrated into the large flood protection infrastructure. These flood protection features "would only serve their purpose for a small percentage of its lifetime" and that "it is essential that it be designed as an improvement to the city's coastline, which can be enjoyed by citizens on a daily basis". The team facilitated multiple discussions sessions with community members where they constructed a collection of models to show their schemes. The "models facilitated conversation and made the project instantly understandable to the group" as the community were invited to propose their own design and make modifications to the ones proposed by the team (Fig. 3, Fig. 4).

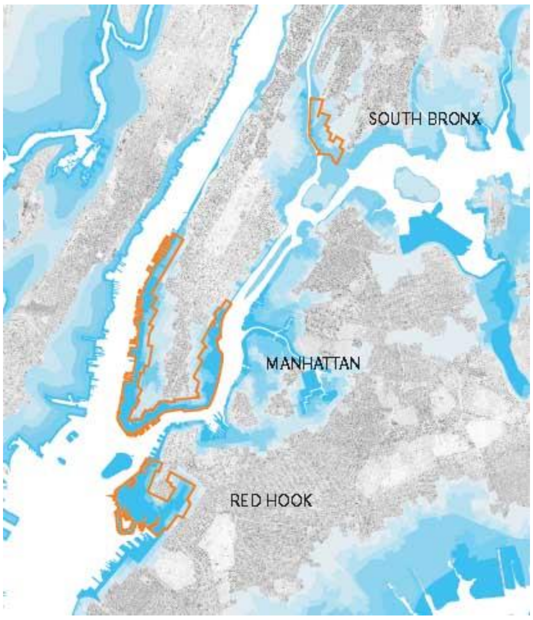

Figure 1 (Left) Location of flood protection intervention around New York. (Rebuild by Design 2015)

Figure 2 (Bottom) The team's proposal of how the flood protection features can be adapted into public amenities. (Rebuild by Design 2015)

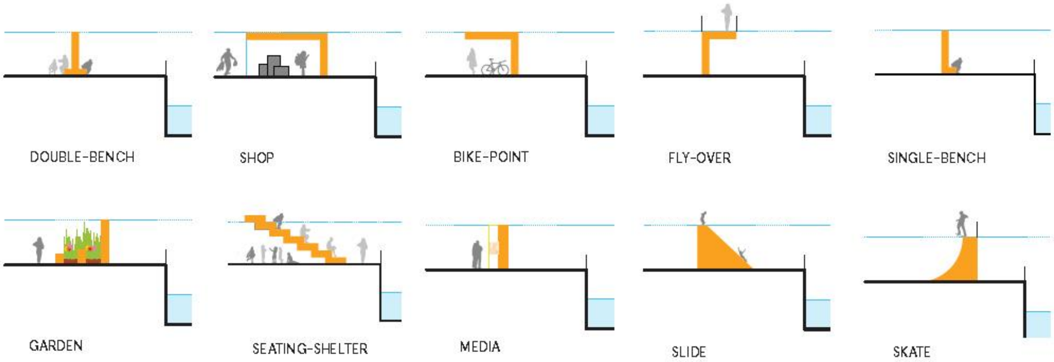

Figure 4 Models of site and foam cut outs of flood protection berms, flood walls and public amenities from a session titled "Build Your Own WaterFront". (Rebuild by Design 2015)

Figure 3 Photo of a discussion session. (Rebuild by Design 2015)

The following extract from the project's publication (Rebuild by Design 2015), describes how the communities contributed to the design process.

> "… the community members built their own waterfront using foam models (Fig.3) … Locals worked together to develop plans that suited their desire for different community improvements and protections from storms like the one that flooded them in 2012. The knowledge and insights gained from the process became critical features of the team's proposal."

The key value of these local engagement sessions was essentially allowing the team to form clear pictures of what the community needs. This is especially important given the nature of the team's scheme to incorporate new and extensive public amenities. Its success will ultimately be measured by how well the scheme is able to cater to their needs.

What is also clear from this example is that the use of a physical model reduces ambiguity and improves clarity of ideas presented by all parties. This is necessary as the scale and complexity of the intervention increases. The next example takes the use of physical models one step further, by having participants generate entire urban districts.

3.2 Indosity – Non-experts generating complex urban forms

In this section, I will present an example that demonstrates how a group of non-experts can generate complex urban forms with predefined blocks and minimal training. Back in 2008, Dr. Markus Zahnd and his team consolidated the findings of their research in two Javanese cities, Yogyakarta and Semarang into the design of an urban model kit (Fig.5). The initiative was a result of a frustration over ineffective approaches towards urban planning in many cities that they had observed within Southeast Asia (Zahnd 2008). The concept was then further developed into a virtual planning tool known as *Indosity* and as of this writing, the latest software package developed by the team is known as *modularCity.* I will provide a closer analysis of it in Chapter 5, where I will compare a selection of various software packages out in the market.

For the moment, I shall be focusing on the physical model kit that was first developed by the team, to illustrate how complex urban forms can be generated by non-experts, in a participatory design setting. The model is scaled at 1: 1000, with a model area of 2m^2 representing an actual area of 2 km^2 (Fig.5). In a three hour session, a group of 20 students from various field of studies, generated a complex urban model using the pieces available in the kit (Fig. 6). The final model (Fig.7), although somewhat idealised, achieved a level of density and compactness that is not unlike that of a city in Java (Fig. 8).

The authors of the research did not specify in the publication the initial brief given to the participants, hence the exact facilitation process involved in the session is not clear. However, it is still possible to infer that there are formal guidelines that the participants adhere to from the resulting model (Fig. 7). For instance, the road axis are always flanked on both sides by the tallest building type packed back to back against each other, forming stretches of wall that surrounds building clusters of a different type that are typically shorter, with periodic breaks that allows access into these clusters.

Whether these formal guidelines are provided by the facilitators or a collective decision by the participants is unimportant in the generation of the model. Notice the similarities in the hierarchy of the road axis and the size of the building clusters. The similarities might be unsurprising as the team did based the design of the model kit on prior studies on Yogyakarta and Semarang. However, what is remarkable is that a group of non-experts, adhering to some basic rules, produced an urban form with a level of density and formal language that is similar to that Semarang (Fig.8), within a span of 3 hours. Despite many unresolved portions within the plan (Dr. Zahnd acknowledges this in the paper), this demonstration in a certain sense dispelled the notion that urban planning is reserved for trained professionals and that citizen participation, non-expert participants could be a potential avenue for generating urban designs.

The next section will show a more complex example where aside from urban forms, the program and function of each building are also taken into consideration, in a PD session that resembles this one.

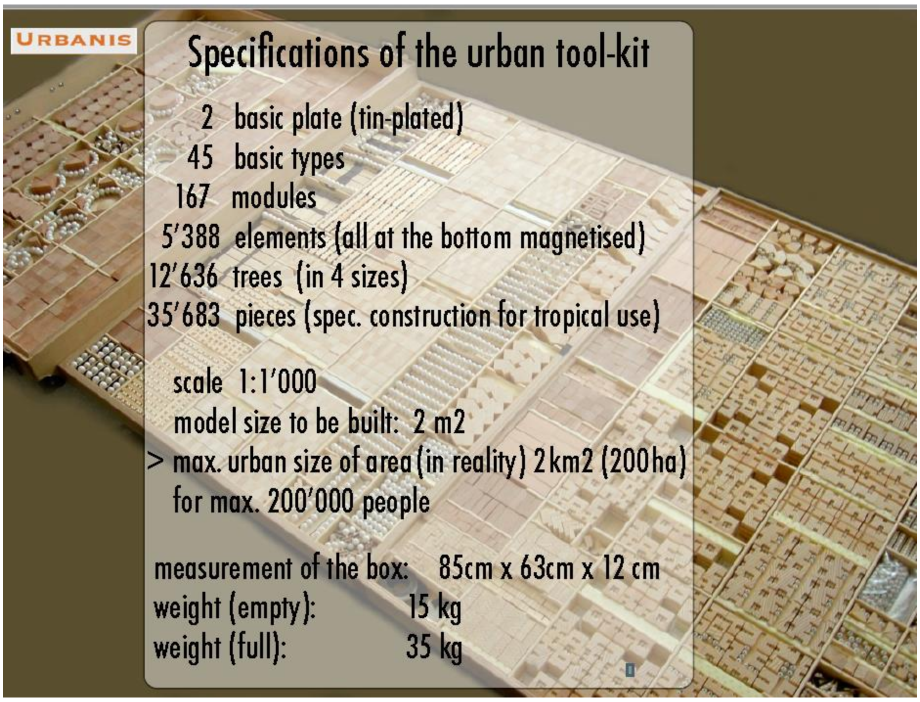

Figure 5 The model kit & its specification. (Zahnd 2010)

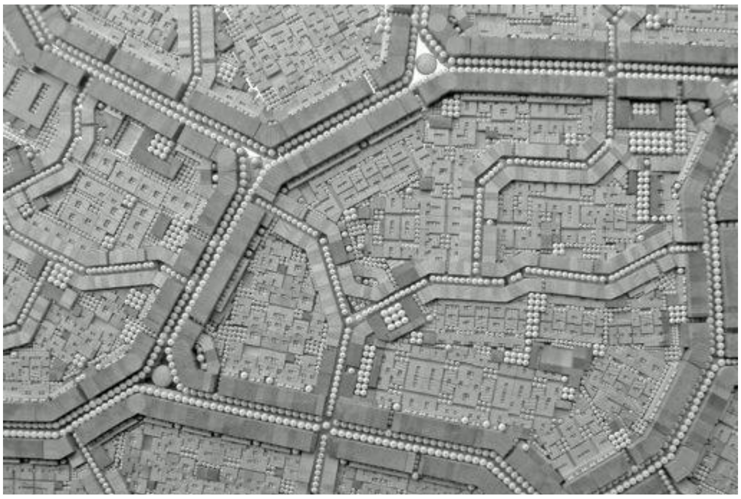

Figure 6 (Above) Participants in the midst of constructing the model. (Zahnd 2008)

Figure 7 A city layout generate from one of the sessions. (Zahnd 2008)

Figure 8 A satellite view of a portion of Semarang city. <Image from Google Earth>

3.3 Play the City – Collaborative play using a city mock-up game

Play the city is consultancy service based in the Netherland founded by Dr. Ekim Tan. They design tailor-made "city games" where stakeholders, both experts and non-experts, can come together in an interactive game session that facilitate conflict resolutions and decision making on urban projects (Play the City 2016).[4] Each city game consists of a scaled mock-up of a city district known as the 'game table', where players can place a variety of predefined 'building blocks', which are defined based on the initial research on the project. Each building block is a simple volume, colour coded to reflect the program category, with basic information like name and floor area indicated on the surface. The simple masses allow the participant great flexibility to shape and mould forms to generate complex urban layouts (Fig. 9, Fig. 10). A game master facilitates the session, where the stakeholders in their respective roles play towards a solution that is acceptable to all participants. The game is typically consists of timed rounds, where at the end of each round the game master provides an overview of the decisions made and helps to orientate the participants for the next round. The game then ends after series of rounds.

I shall illustrate this through the project titled "Play Noord"[5]. It consists of sessions conducted from 2011 to 2012 (Play the City 2016), the consultancy took on the challenge to come up with an alternative development for a new urban centre in Amsterdam, which was put on hold after the financial crisis of 2010. The outcome of the game sessions influenced the authorities to change the legal plans of the area by 2014 and adopt proposals generated from the game.

An iterative process of proposals and negotiations occurs with the aid of the physical scale model, where players add and remove blocks from the game table. The model allows for everyone in the room to visualise the various proposal within the existing urban context (Fig.10). We can see the interplay between a player's internal vision and the external manifestation of physical model, leading to the emergence of a collective and complex model through a *self-organisation* process.

[4] Although the consultancy did not explicitly mention the term "Participatory Design", the manner of which the workshops are conducted fits most description of participatory design.
[5] http://www.playthecity.nl/17149/en/play-noord

Figure 9(Left) Simple volumes with labels and colour codes are placed on the site model for visualisation and discussion. Here we see one iteration of a dense, mixed used high rise generated by the participants. (Play the City 2016)

Figure 10 (Bottom) A typical negotiation process, where participants express their intention by interacting with the model directly. Notice that the image also depicts another iteration of a proposal that differs from Fig. 9. (Play the City 2016)

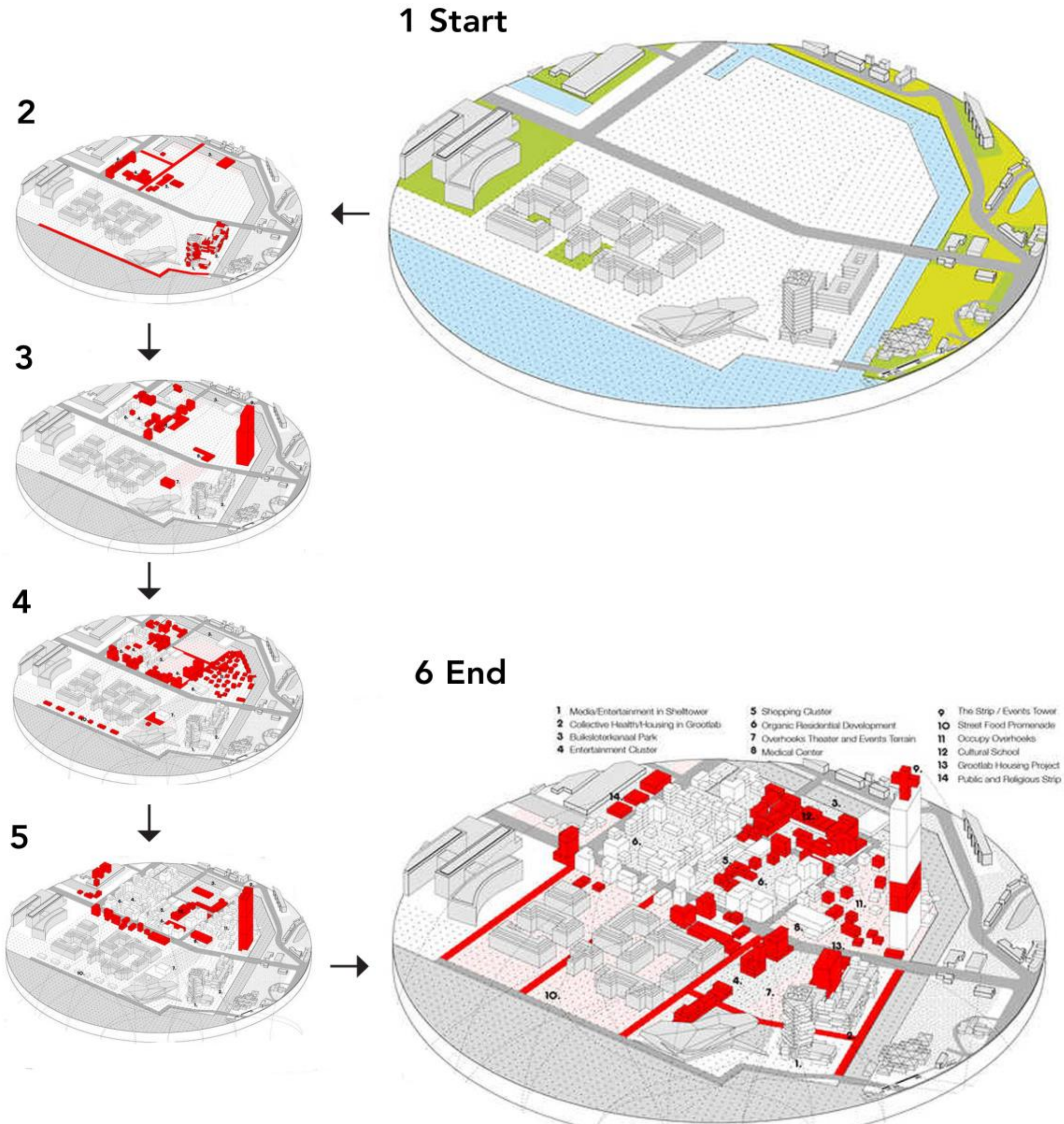

Figure 11 The documented process of one session in "Play Noord". The red blocks represents the cumulative development of the model at each stages. (Play the City 2016)

In this particular session of 'Play Noord' (Fig. 11), we can make some observations of how the plan develops. The intervention started at a corner at an existing T-junction and the waterfront (See Fig 11-2). We can see a plot carved out by the extension of 2 roads, one of which comes from across the river. The buildings within the plot are then first placed along the perimeter, and then intensified. This can be observed with subsequent stages (See Fig 11-4 to 11-6), where we see roads extended and development first occurring around these roads before being intensified. The choice of where to start might well be arbitrary. Instead, the focus should be on how the development starts and the urban form that emerges with it.

Unlike a tabula rasa, the city already has an existing order which defines the existing layout. This order is born out of an interplay of how the players perceive the city model, their personal beliefs and their interaction between each other. It dominated the initial stages of development (See Fig 11 - 2). This process is repeated as the city model develops, generating new orders that dominates subsequent stages (See Fig 11-4 to 11-6). The city model used in the PD game session is an abstraction of the actual city and the number of participants involved represents a tiny fraction of the end-user population. Despite such limitations, the city game is able to demonstrate the process of self-organisation, which to an extent mimic same process that occur in an actual city over a compressed time frame. The game format seems to offer not just a means to design, but also a means to simulate city growth.

3.4 Chapter Conclusion – What is next?

This chapter has surveyed examples PD in urban design. Each of these examples faced the challenge of communicating to non-professionals and engaging them in the design process. Each of them converged on using abstracted models of one form or another to facilitate this process. It seems that the use of abstracted models helped to reduce ambiguity in the discussion process, in terms of placement, massing and program. Among the three examples surveyed, *Play the City* provides us with the most complete documentation of the sessions conducted, giving us the opportunity to propose improvements to the format.

An obvious limitation is that the current game format can only cater for a relatively small number of participants. If we put this in perspective of an urban block or quarter, the proportion of people that can be involved, in part due to various practical logistical and funding constraints, is very small. It may therefore be seen as an incomplete vision of end-user participation that PD had set out to achieve. Hence, a logical next step would be to consider how we can increase the number of participants while preserving the methodologies that we see in the city games conducted by play the city. At the same time, its capacity to simulate the development of an actual city, could be explored for research purposes to test out urban theories.

4.0 Bigger City Games – Increase the number of participants?

This chapter will explore the notion of involving more people in a city game design process. But first, I will return to the domain of CTC to introduce a specific set of theory, Synergetic Inter-Representation Network (SIRN), which Dr Ekim Tan and her team referred to for the design of the city games (Tan & Portugali 2012), for a more comprehensive understanding the dynamics of self-organization. Chapter 2 had provided the basis to understand cities as complex, open and self-organizing systems. The section on SIRN will provide a more detailed explanation of the self-organising process and how the insights are used in the design of city games.

I will then use our understanding from SIRN, and attempt to dissect the key interactions within a city game. We will look at another game session organised by *Play the Cit*y, "Play Tirana"[6], where there are extensive video documentation on the game session. The video provides a good coverage of the interactions by the participants to aid in our discussion. I propose that there are three key interactions *the pitch*, *the negotiation*, and *the decision,* that contributes to the process of self-organisation within the city game.

After this, I will make a case about the advantage of increasing the number of participants so that we have a larger sample of a given population. The collective decisions made by the participants are more likely to benefit the full population as minority interests can be better represented in participatory design initiatives. In addition, in urban research areas that uses Agent Based Models (ABM), having actual human participants instead of digital agents programmed with simple interaction rules, could yield more accurate insights into urban development.

By the end of the chapter, I will show that digital platforms can enable us to overcome the limitations of a physical setup to conduct a city game with larger number of participants and possibly with *massive* numbers of participants.

4.1 Synergetic Inter-Representation Networks (SIRN) – A sequential explanation of self-organising cities

Synergetic Inter-Representation Networks (SIRN) were proposed by Haken and Portugali (Haken & Portugali 1996). They combine the understanding of Haken's work on synergetics which discusses the phenomenon of self-organizing systems, and Portugali's Inter-Representation Network, which describes "cognitive processes that cannot be executed in a single cognitive act"

[6] http://www.playthecity.nl/17192/en/play-tirana

but instead a "sequential interaction between internal representations constructed in the mind" and "external representations that are constructed in the world" (these could be any artefacts like text, cities etc.). Specifically SIRN describes how "the interaction between internal and external representations gives rise to an *order parameter* that enslaves the cognitive system and brings it into a steady state" (Tan & Portugali 2012).

Applying SIRN to cities, it is proposed that the typical urban dynamics can be represented in a system model, consisting of agents (*people*) and a collective reservoir (*city*). The people in a city are subjected to the influences of *internal inputs* constructed by the mind (*cultural background, beliefs etc.*) and the influences of *external inputs* of legible information coming from the city and other agents (*what people perceive with their senses*). The interaction of the two inputs results in a "competition" between various "decision rules", rules that determine behaviour and action of the agents (Tan & Portugali 2012). A winning rule(s) then emerges, termed the *order parameter.* A chain reaction occurs as more and more agents follow the *order parameter* which eventually takes over and governs the whole system to create the final stable order. This is how a system (the city and its people) self-organise to generate order.

SIRN provides us with a viable framework to understand and explain how cities self-organise. This same framework is applied by Ekim Tan and her team in the design of the city games (Tan & Portugali 2012), which mimics how actual cities self-organise.

When applying SIRN to the context of the city game, the collective reservoir is substituted by the city model. The interactions between the participants' own agenda, the city model and other participants, results in a "competition" of ideas/proposal. The winning idea/proposal that emerges, governs developments in subsequent decisions. Note that this "competition" of ideas/proposal occurs at multiple scales and permutations. It can happen between a single participant and the model, between two participants, among the whole group or many other permutations. Ultimately, a single scheme eventually emerges.

The city games have shown that the principles within SIRN can be successfully adapted into a functional design process. At the same time, the city games have demonstrated that the process that resulted in the formation of complex urban forms over the period of years, can be replicated using an abstracted analogue and compressed into a session that lasts only a few hours. This suggests that the city game format has a potential to be a research test bed for urban theories as well as a platform for testing and generating designs. While SIRN provides the theoretical context that explains the formation process, it does not elaborate on how the "competition" plays out, on how the conflicts are resolved and on how decisions are made. In order to understand this, we need take a closer look at interactions that occur between the participants within the city.

In the next section, I will attempt to distil the key interactions that constitutes the "competition" within a city game, as I explore avenues to improve on the format.

4.2 Key interactions within a City Game –More participants?

"Play Tirana" is a city game based on the premise of generating future scenarios for Tirana's intermodal train station. The "competition" aspect of the self-organisation described by SIRN can be visualised in an iterative process consisting of three main types of interactions. They are what I termed as *the pitch*, *the negotiation*, and *the decision*. These interactions occur prominently within the game at 2 two levels. They occur spontaneously at an individual level between the participants and at the group level where it is facilitated by the game master.

The process starts with *the pitch,* an individual participant or a group of participants would present an idea or a configuration of an urban layout to all participants and state their case or rationale. Due to the diversity of stakeholders involved in the session, it is almost certain for there to be disagreements between the participants as the schemes would seek to maximise the interest of those who proposed them.

This conflict would lead to *the negotiation*, where the conflicting parties will bargain and negotiate with each other to arrive at a compromise (Fig. 12). The interesting aspect is that all of the participants would also contribute multiple suggestions and schemes towards the issue as the discussion process is public. The process typically consist of many small negotiations between multiple parties that happens organically without much prompting. The game master would only enforce a time limit for each session and would not intervene in the negotiations. The participants would continually discuss and collectively work towards a solution until the allocated time runs out.

At a certain point, a *decision* has to be made. At the individual level, either multiple parties will reach a compromise or a single party dominates and makes the decision. On the group level, all of the participants will vote to decide on a winning scheme (Fig. 13). The session then comes to an end.

This session of "Play Tirana" suggests that *the pitch*, *the negotiation* and *the decision* could well be the key interactions necessary for self-organization to occur in a city game. At this point of our discussion, the notion of increasing the number of participants does not prohibit these interactions from occuring. The same cannot be said if we were to decrease the numbers down to a single individual, in which case there is no one to pitch to or negotiate with. Large numbers do not limit these interactions, instead it is the physical constraint of the current setup that limits the size of the session. Hence, if there are means to overcome the physical constraints, it is possible to for a much larger city game to be conducted. I will return to this point in the chapter's conclusion after I have presented my case for a larger city game.

Figure 13 (Left) Participants vote on proposed schemes using the "star" tokens. (Play the City 2016)

Figure 12 (Top) Participants tugging at a building block as they negotiate to resolve a conflict. (Play the City 2016)

4.3 A case for a larger city game – Improving PD in urban planning and studies on Agent Based Models

I have shown how participatory design methodologies has been implemented in urban planning projects. The potential of participatory design to serve as an alternative to the top down approach of urban planning has been demonstrated by the examples highlighted in this paper, with schemes that are either being adopted by the city authorities (*Play Noord*, in Amsterdam) or schemes that are funded by the authorities (*Rebuild by Design* is federally initiated and funded). In this section, I will proceed to make the case to improve PD in urban planning by facilitating larger sessions with the city game format, which involves much larger number of participants.

The motivating factor behind PD is the desire to facilitate a bottom up design approach through engaging the eventual stakeholders and users of the project, as these stakeholders would know what they need. The current approach of the city game sessions seen in *Play the City,* would fall short in achieving this ideal as the participants involved represents only a small section of an urban population. It is unlikely that a small group of participants would be able to fully represent the nuances, the needs and aspirations of an entire urban population. This is in a way similar to polls where a larger sample size would be a more statistically accurate representation of a population. Unlike PD's roots in the Scandinavian workplace, the scale and number of stakeholders involved in an urban project is vastly different. What was envisioned for a few hundred workers in a factory would not be able to fully cater for the thousands involved in an urban project. Yet the current approach has not been able to address the stark discrepancy in representation. Hence with these contexts in consideration, finding a solution that would enable the participation of much larger groups in city games is the logical step forward.

Within CTC itself, Agent Based Modelling (ABM) has been used by researchers as a tool for urban analysis. In this area of research, an agent is broadly defined as "a computer system situated in some environment that is capable of *flexible autonomous* action in order to meet its design objectives" (Jennings et al. 1998). This usually manifests in programs that are computationally intensive with results that offer limited insights as the parameters fed into the simulation leans heavily on assumptions. This is specifically so with research that simulates the interactions of autonomous agents in a virtual environment, such as Epstein and Axtell's *Sugarscape* model[7] (Fig 14), and Batty's experiments with mobile agents that migrates

[7] Agents (the black dots) populate a landscape of "sugar", a resource they need to survive and reproduce. The agents are programmed with basic rules to seek out sugar and to reproduce. The sugar deposits vary in

between locations (Batty 2007). A Participatory Design session with large numbers of people may offer a solution to the problem by facilitating actual people as agents as they interact within a controlled environment. This eliminates the need for expensive decision making computations required for each autonomous agent and the assumptions made to approximate human behaviour.

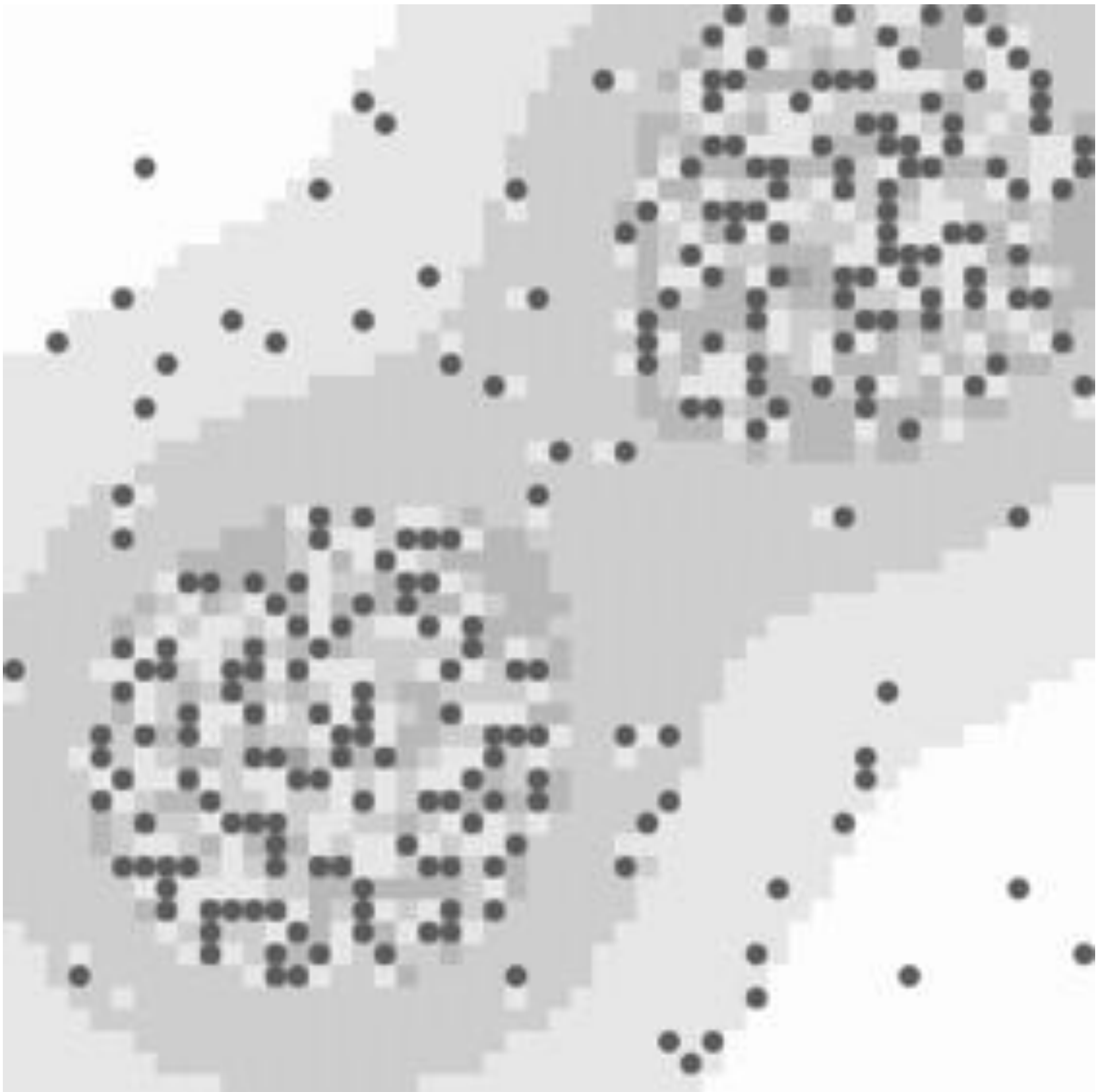

Figure 14 A sketch from Epstein and Axtell's Sugarscape. (Batty 2007)

concentration across the landscape (darker grids indicates higher levels of sugar). In the image, there are 2 large mounds of deposits. The resulting distribution of agents seen here is generated from successive runs.

4.4 Chapter conclusion – How can we facilitate larger numbers?

I have made my case in section 4.3 that a larger city game would enable a greater representation of the population and that it would be an ideal test bed for urban theories. There are however, several challenges that stands in the way of simply scaling up current PD approaches. Due to the inherent limitation of a physical setup, the size of the model and location venue becomes a significant constraint. The model needs to be big enough for the participants to interact with, but beyond a certain threshold it would become too unwieldy to manage and the cost to create it would not justify such an investment. The venue would need to be able to accommodate large number of participants and as with the model, beyond a certain threshold the cost and logistical difficulty of acquiring a venue would outweigh its benefits. In order for us to feasibly scale things up, there needs to be a paradigm shift away from the use of a physical setup.

The use of digital platforms can allow us to break away from the constraints that comes with a physical setup. Chapter 5 will first provide introduction of existing digital urban design tools and will then look into Massively Multi-player Online games, highlighting certain insights on managing very large numbers of players. I will return again in Chapter 6 to discuss in detail how the three interactions necessary for the self-organization process in a city game, *the pitch*, *the negotiation* and *the decision,* can be facilitated using digital mediations.

5.0 Computational Tools and Interactions over a Network – A look at Digital Urban Design tools and Massively-Multiplayer Online Games

The ubiquity of personal computing devices and easy access to the internet has changed the way people interact on a daily basis. The average consumer now has access to powerful computation tools that were only available to professionals just a decade ago. Networked communication over great distance is almost instantaneous and the sharing of information has never been easier. This too has impacted the practice of Participatory Design, bringing about new possibilities where people interact through a digital intermediary. This chapter will discuss how these power digital tools are currently being used in urban planning. I will first provide a survey of existing digital urban design tools including those that are not designed with collaborative design as a priority. While I will discuss about the capabilities of digital platforms, greater attention will be devoted to evaluating the interfaces, understanding who the stakeholders are and how interactions between the stakeholders are facilitated.

Subsequently, I will examine Massively-Multiplayer Online (MMO) games. These are online games with thousands of players interacting in a virtual "Third Space", mediated through a computer interface (Muller & Durin 2007). I will attempt to show how these games have found ways to manage the interaction of massive numbers of people and how such an insight can be useful for implementing PD sessions on a similar scale.

5.1 A survey of existing digital urban design tools

There currently exist many digitals products that are used for urban design. This section will provide a selection of finished product that are already in available on the market and has been utilized in real life projects. The projects that I will present are either purpose made or adapted from games that we initially designed for entertainment. The majority of the products surveyed are proprietary and companies do not necessary share all information. This made it difficult to obtain a comprehensive understanding of each software. Information presented here are based on what is publically accessible, which would include publications, websites and videos. This chapter is structured such that, I will first provide a brief description of each case studies, then return to comment on the various observations.

5.1.1 Indosity & modularCity – The advantage of a city model in a virtual space

In an earlier chapter, I had introduced Dr Markus Zahnd's work on a physical urban tool kit and showed how non-experts used the kit to generate a complex urban form. This concept of was further developed into the software *Indosity*, which evolve into its current variants *urbanROIdesigner* and *modularCity*. Among the two, *modularCity* is tailored for socio-economic development and exploration, which is more in line with our discussion on engaging end-users through participatory design.

The software *modularCity* is fundamentally a recreation of the urban tool kit in a virtual space. In place of a bulky physical setup (Fig. 6), users interact with a digital model (Fig. 15) using computer terminals, which drastically reduces the space required to conduct a session.

The interface of *modularCity* features a main display port that shows a three dimensional scene which the user can directly interact in. Navigation within the viewport is similar to modern 3D modelling software, with options to pan & rotate. Statistical information in displayed in panels around the viewport. The project consists of "layers" that corresponds to a specific area of concern for stakeholders, such as "Planning", "Real Estate Investment", "Real Estate Management" and "Social". Nested within these layers are option for statistical data such as "Living space per resident" and "Age median" (Fig. 15, right panel), which can be toggled on and off. These data are inserted when the user models the urban blocks. The result is an interactive city scape that can be used to visualise statistical data to aid in decision making.

The product's website and publication are scarce on details pertaining to interactions between the stakeholders, both the *high level stakeholders* (e.g. planning authorities, developers) and the *low level stakeholders* (e.g. end-user, residents, tenants). By inferring from available information[8], the tool seems to be used primarily as a visualisation tool to either gather public opinion through online surveys or used in a workshop setting where stakeholders conduct discussions visualise decisions. The design of the software seems to be catered for high level stakeholders, as the bulk of the tools provide a quantitative, macro view of the development.

What modularCity represents, is an attempt to address the space limitations that comes with having bulky physical model of a city. While it addresses that, it also shows how a city model in virtual space can be used to provide real-time statistical calculations and feedback.

[8] http://www.modularcity.ch/index-en.html

Figure 15 Screen shot of the interface within modularCity. <http://www.modularcity.ch/index-en.html>.

5.1.2 City Engine – Pursuing realistic visualisation and performance evaluation

City Engine is a power digital urban planning tool kit developed by GIS giant, *Environmental Systems Research Institute (ESRI)*. The software allows users to define highly customisable "building rules", to procedurally generate buildings, streets, facades, landscapes and more. In a corporate video that features the *Urban Redevelopment Authority (URA)* of Singapore, the demonstrators showcased the software's ability to procedurally generate a set of buildings with pre-defined building rules that complies Singapore's planning guidelines on an empty plot within the city[9].

The interface resembles that of *modularCity* that features a main view port surrounded by toolbars and display panels, with similar means to navigate the model space. The parameters that defined the buildings can be modified with the sliders on panels seen on the right and in doing so the buildings generated in the viewport are instantly updated to reflect the changes (Fig. 17). Like *modularCity*, *City Engine* is able to generate statistical data and present them in consolidated reports. The software supports and exports popular 2D and 3D formats. Its procedural geometry creation features can also be embedded in 3d modelling tools as well as game engines.

[9] http://www.esri.com/software/cityengine

City Engine itself does not support a participatory design framework. Instead, there is a separate tool within the *City Engine* ecosystem known as *3D Web Scene* (Fig. 18), that allows 3D models, analysis results or design proposals to be shared with the public & decision makers via the web. This is to allow the public to understand the urban and an avenue to provide feedback. While this add-on does provide some avenue for stakeholder participation, the design process within *City Engine* still relies largely on trained professionals due to the software's relatively technical interface and the stakeholders do not directly interact with the working model.

Overall, *City Engine* is primarily still a tool for professional use and is not specifically developed with collaborative design in mind, despite the integration of *3D Web Scene*. What it does show is that we have the capabilities to generate realistic cities and perform a comprehensive performance evaluation of design options within a very short amount of time.

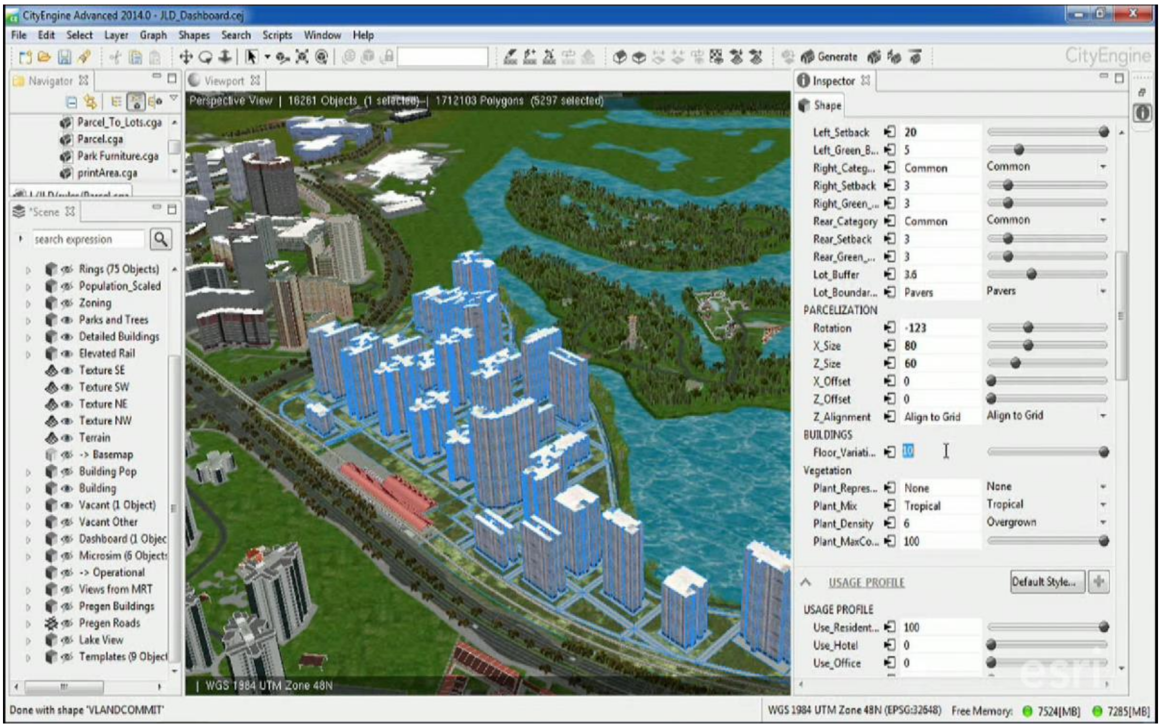

Figure 16 Screen shot of the interface within CityEngine Advanced. The area depicted is a development in Singapore's Jurong Lake District. The project is used as a demonstration of CityEngine's capabilities in a conference back in 2014. <http://www.esri.com/software/cityengine>.

Figure 17 Screen shot of 3D Web Scene. <http://www.esri.com/software/cityengine/features>.

5.1.3 Tygron Engine – Abstracting information using a game like interface

Tygron Engine is a GIS based digital design platform, from the Dutch company *Tygron*. It is conceived with an emphasis on stakeholder participation through serious games. Serious games broadly refers to games that are designed to achieve a set of objectives or tasks, where the primary goal is not entertainment. The capacity of games to engage participants by immersing them in simulated scenarios then having participants play out decisions based on those scenarios, proved to be a powerful methodology for conflict resolution and planning. A typical *Tygron Engine* project starts with an initial design plan generated within the game environment by relevant design professionals (e.g. architects, planners and engineers), which is then passed to a panel of stakeholders who then discuss and work with the design professionals within the same environment to generate new design iterations (Fig. 18).

Tygron Engine's main interface is catered to non-expert users and looks starkly different from what we have seen in *modularCity* and *City Engine*. However, it would be familiar to anyone who has played strategy game titles such as *Civilisation* or the *Command & Conquer* series. These games require the player to navigate large virtual maps, balance the consumption of limited resources to achieve multiple in game objectives, which is not unlike the challenges of a typical urban planning scenario. These strategy games have pioneered solutions with specific a focus to keep players immersed in the game by presenting key game information in the most undisruptive means possible and condense complicated game data into something palatable for a layman user.

Tygron Engine's interface demonstrates many of these innovations (Fig. 19). The model viewport takes priority and occupies almost the full screen. Tool bars and information panels are pushed to the edges and occupies the minimal amount of screen real estate. Information panels are hidden away until the user interact with specific tools or objects in the viewport. Complex data are compiled into simple metrics (e.g. water storage, green, liveability and climate) and graphically represented at the top. The mini-map allows the user to keep track of viewport's location in relation to the rest of the model space. These features contributes to a user friendly interface that allows non-experts to easily pick up the tool and participate directly in the design process.

Tygron Engine is designed to facilitate interaction and discussion between stakeholders in a room like setting with a facilitator (Fig. 20). Each stakeholder, interacts with a digital model through a laptop connected to a Wi-Fi network. The stakeholders conducts discussions face to face within the room. *Tygron Engine* has predefined categories of stakeholders [10] (civilian, developer, municipality etc.), with each type given vary level of access. While all stakeholders have access to the 3D world, not all stakeholders need to be present or be "playable". Non-Playable stakeholders are represented by facilitator hosting the session. This is similar to the workshops conducted by *Play the City* (refer to Chapter 3), with *Tygron Engine* using a digital setup instead of physical models. What *Tygron Engine* has shown is a way to abstract complex information into simplified graphical metrics and keeping information hidden until it is required by the user. This helps the user manage large amount of data and makes it less intimidating for non-expert users.

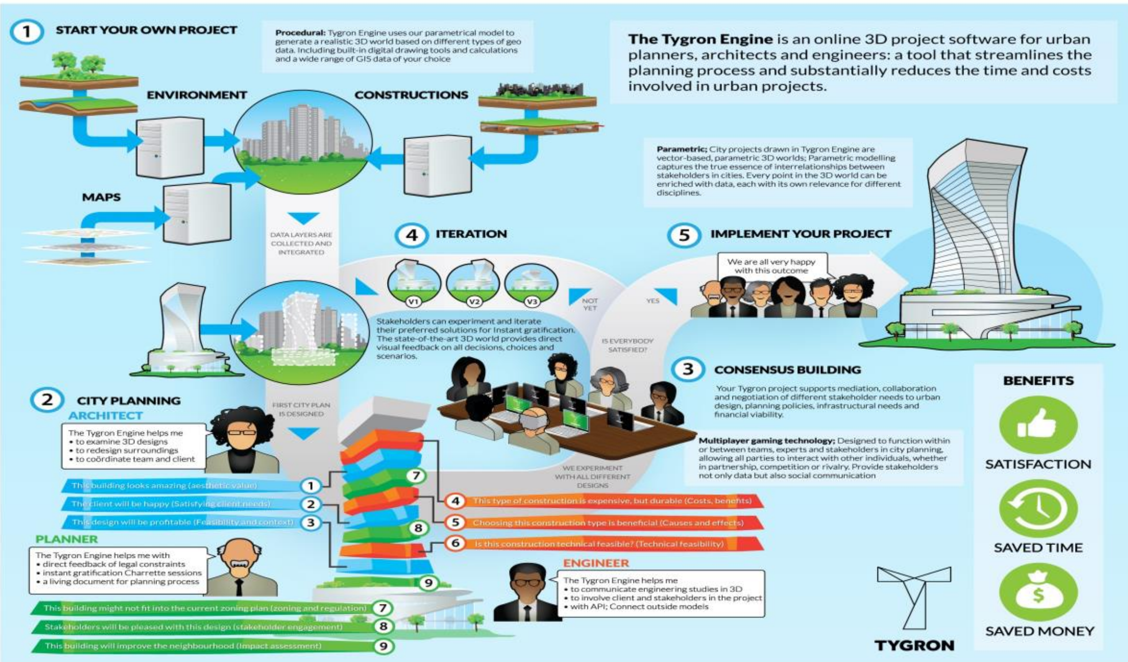

Figure 18 Tygron Engine workflow. <http://www.tygron.com/tygron-engine/>.

[10] http://support.Tygron Engine.com/wiki/Stakeholders

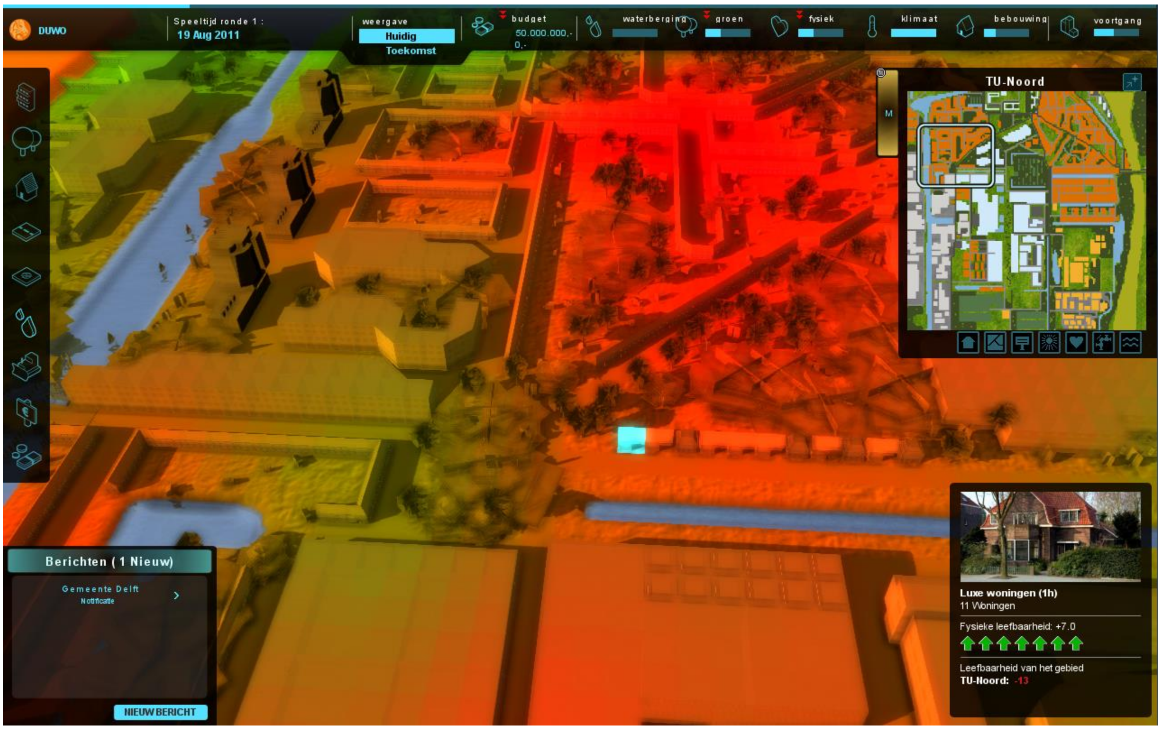

Figure 19 Screenshot of the interface within Tygron Engine. <http://www.tygron.com/>.

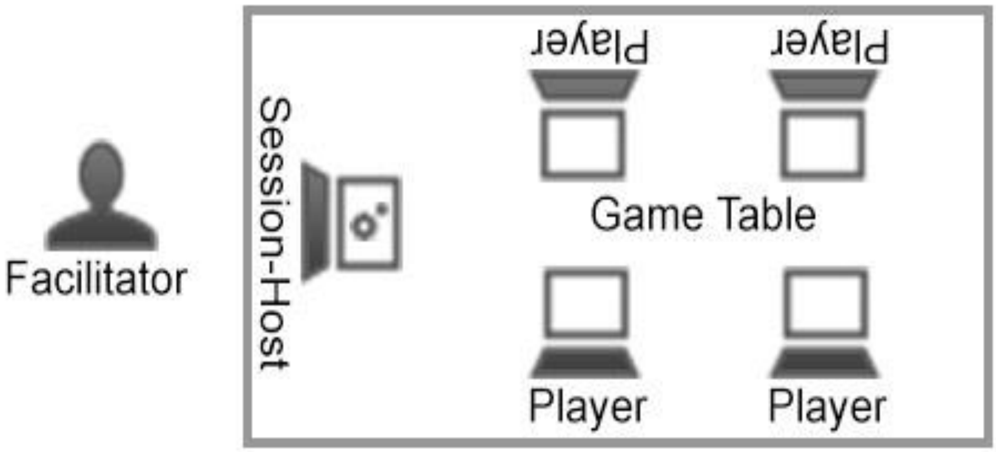

Figure 20 A typical Tygron Session setup. <http://support.tygron.com/wiki/Main_Page>.

5.1.4 Block by Block – Communicating ideas using simple modelling tools

Block by Block is a result of a partnership between UN Habitat and Mojang, the company behind the popular sandbox game *Minecraft*[11]. It is a participatory design initiative that utilises Minecraft's open world and building gameplay, to allow local communities to visualise and express

[11] http://blockbyblock.org/how-does-it-work/

their ideas to professionals and policy makers, by "building" them within the virtual environment of *Minecraft*. Proposals are then deliberated by all stakeholders before agreeing on a final design.

The real world environment is first modelled within *Minecraft* by experienced users (Fig. 23). The local community is then invited to propose ideas and designs within this environment. They build their designs simply by placing voxel like blocks (Fig. 22). The participants are able to "fly" within the virtual space, making it possible to see both a bird's eye view of the site (Fig. 23) and what the project looks like from street level (Fig. 21). Each session is conducted in real time, using a setup similar to *Tygron.* The participants interact within a physical location and use a series of computers connected within a network, to build within the virtual space. An important difference is that the participants are low level stake holders, end-users who will be directly affected by the project.

Within *Block by Block*, we can also observed how simple in game actions like stacking voxels can be utilized effectively to recreate a city scape while at the same time allowing end-users to easily and quickly create build forms to express their intentions.

Figure 21 (Left) Plaza Tlaxcoaque, Mexico City, modelled within Minecraft. <http://blockbyblock.org/projects/>.

Figure 23 (Above) Screen shot of Minecraft. Players are free to build anything using a plethora of voxel like blocks. <Image from Minecraft game client>

Figure 22 (Left) Bird's eye view of a model from a workshop in Kosovo. <http://blockbyblock.org/projects/>.

5.1.5 Betaville – Collaborating in a massive mirror world

Betaville is a project developed by Carl Skelton, Skye Book and the M2C Institute at Bremen City University of Applied Sciences. *Betaville* can be described as a Massive Multiplayer Online (MMO) platform. MMO is a term that is commonly used to describe games that can simultaneously accommodate very large numbers within a single virtual environment or a virtual "world". *Betaville* creates an editable "mirror world" of existing cities using GIS data and allow users to upload digital models into this virtual realm. Users are then able to see each other's creation both from a bird's eye view and from the ground level by walking through virtual streets. The world within *Betaville* is envisioned as a repository of ideas and information. Currently users can access these information by interacting with the virtual buildings and landmarks while contribution to the discussions by tagging comments on a building. Portions of the model can be toggled to be shown or hidden away to allow users to understand the project in a greater depth.

Betaville's interface, like *Tygron Engine,* puts priority in the model viewport, with collapsible windows that serves as information panels (Fig. 24). The software is designed with the intention to engage a spectrum of stakeholders from professionals using elaborate software like Autodesk Maya[12] to a non-professional user using simple software like SketchUp. However, by not implementing native modelling function and instead choosing to facilitate file imports from external applications, might have made it difficult to implement real time statistical feedback. The lack of statistical computations greatly limits how *Betaville* can be used as an evaluation tool. It is also important to note that unlike previous examples, players do not interact with each other on a face to face level and do not communicate in real time.

Betaville represents a vision of recreating entire cities within a virtual realm and demonstrates a way where people can collaborate on development projects in a MMO setting. I shall further elaborate on the challenges of MMO interaction and how some games tackle it in Section 5.2.

Figure 24 Screen shot within Betaville. Buildings can be selected to display windows that shows building information or comments left by other users. <http://betaville.net/>.

[12] http://betaville.net/. The source did not specify specific file formats. It is likely that common popular 3D sharing formats such as *.obj*, *.dae* are included.

Figure 25 Screen shot within Betaville. Buildings can be selected to display windows that shows building information or comments left by other users. <http://betaville.net/>.

5.1.6 Section Conclusion – The contradiction between the quest for statistical evaluation and stakeholder engagement

Each of the tools that I have surveyed showcases the many possibilities and ways of using digital tools to enhance the design process. There seem to exist a gulf that divides tools that pursue comprehensive statistical evaluation and tools that attempt to focus on stakeholder engagement. A contradiction between the utility of comprehensive statistical data to inform and the tendency for such functionality to overwhelm non-expert stakeholders. This is reflected in the rather polarised examples that we see. On one end of the spectrum, we see examples like *modularCity* and *City Engine*, with a seemingly inexhaustible list of statistical parameters for users to modify (Fig. 16). The perceived technical complexities involved seems to confine them for professional use. On the other end, *Block by Block*'s simple interface and modelling tool allows user to quickly pick up the required skills to interact. Its ease of adoption is shown in numerous successful workshops that *Block by Block* has conducted all over the world[13]. *Tygron* sits in between these two extremes, as it attempts to mitigate the contradiction by abstracting technical statistics into simple graphic based representations (Fig. 19). This simple notion of *information abstraction,* showing only information relevant to the context while hiding the rest, could proof useful in the development of future platforms for participatory design.

[13] http://blockbyblock.org/projects/

Among these examples, *Betaville* stands out as it is the only one surveyed that can be considered as a MMO platform. In our quest to understand user interactions within MMO settings, *Betaville* has demonstrated how large numbers of users can communicate outside of real-time, by tagging comments and information onto virtual landmarks. I shall continue to explore the intricacies of MMO interactions in the next section where we look at real-time interactions.

5.2 Massively Multiplayer Online Games – Managing the interaction between massive numbers of users

Massively Multiplayer Online (MMO) games are characterised by massive numbers of participants[14] being concurrently active in an online server. In chapter 4, I have discussed how city games can be an effective tool in participatory design and presented the case for an online implementation with massive numbers of participants. This section will discuss the challenges of interactions on this scale by looking at two distinct examples and attempt to understand how digital intermediaries are used to manage massive online traffic.

5.2.1 Twitch Plays Pokémon – Coordinating a collective will

Twitch Plays Pokémon is both an experiment and a popular channel, hosted on a video streaming service Twitch, where massive numbers of users attempt to finish a game of *Pokémon* by simultaneously issuing direct commands through the channel's chat room. The Pokémon game's objective involves controlling an in-game avatar to navigate and perform tasks within a virtual world. The game is initially designed for a single player. The experiment allows anyone within the chatroom to issue commands that directly controls the actions of the avatar. In 2014, despite the chaos of unregulated inputs, compounded with rouge players attempting to sabotage the completion of the objective by issuing erroneous commands, the community of players managed to finish a game of *Pokémon Red* over the course of sixteen days. A total of 1,165,140 users provided the inputs[15].

Twitch Plays Pokémon is powerful example of an extreme case of unregulated real-time interaction between thousands of people over a digital intermediary. The problems that emerges from this phenomenon and the subsequent strategies that the community of players utilized to finish the game, are invaluable resources in the understanding of MMO interactions. I shall focus

[14] http://minecraftservers.org/. This webpage provides a real-time overview of the numbers of active users on popular Minecraft servers. Numbers averages around the hundreds, with the top servers handling upwards of 10, 000 players at a given time.
[15] https://blog.twitch.tv/tpp-victory-the-thundershock-heard-around-the-world-3128a5b1cdf5#.iiksylg1p

on two important areas, communication and decision making. Figure 26 is a screenshot of an analytics console of a game session. This will be used to illustrate key interaction mechanics.

As the game started to gain significant popularity and player numbers increases exponentially, what became immediately obvious was a need to devise a proper way to communicate. A script was written to filter out commands (See Figure 26, 2-3) from the chat window to allow some form of communication to take place. Despite this effort, communication is still problematic with an average of eight messages (See Figure 26, 3) a second flooding the chat window. It was useful for disseminating short messages such as “go up”, which users can echo in the chat, to respond to real-time game events. However, the rate and volume at which the messages are coming in, makes it impossible to discuss any strategy. Hence, a separate sub-reddit thread was created by players to post real-time commentary, to discuss and coordinate game strategies[16]. This instance highlights the utility of two distinct types of communication channels, a real-time chat for immediate responses and a slower but structured forum to facilitate discussion.

The next issue is how thousands of people would decide the movements of a single avatar. The massive numbers of distinct simultaneous command inputs (See figure 26, 4) created a phenomenon where the command with the greatest number of user input at a given time becomes the dominant input which decides the movement of the avatar. This is visualised in (See figure 26 5-6). What we see here is essentially a voting system and a self-organizing complex system (refer to section 4.1) where the dominant input, the *order parameter* takes over the system (the command inputs), giving rise to a stable order (the command input that gets executed). This shows the utility of a voting system to facilitate the decision making process of massive groups.

[16] https://www.reddit.com/live/sw7bubeycai6hey4ciytwamw3a

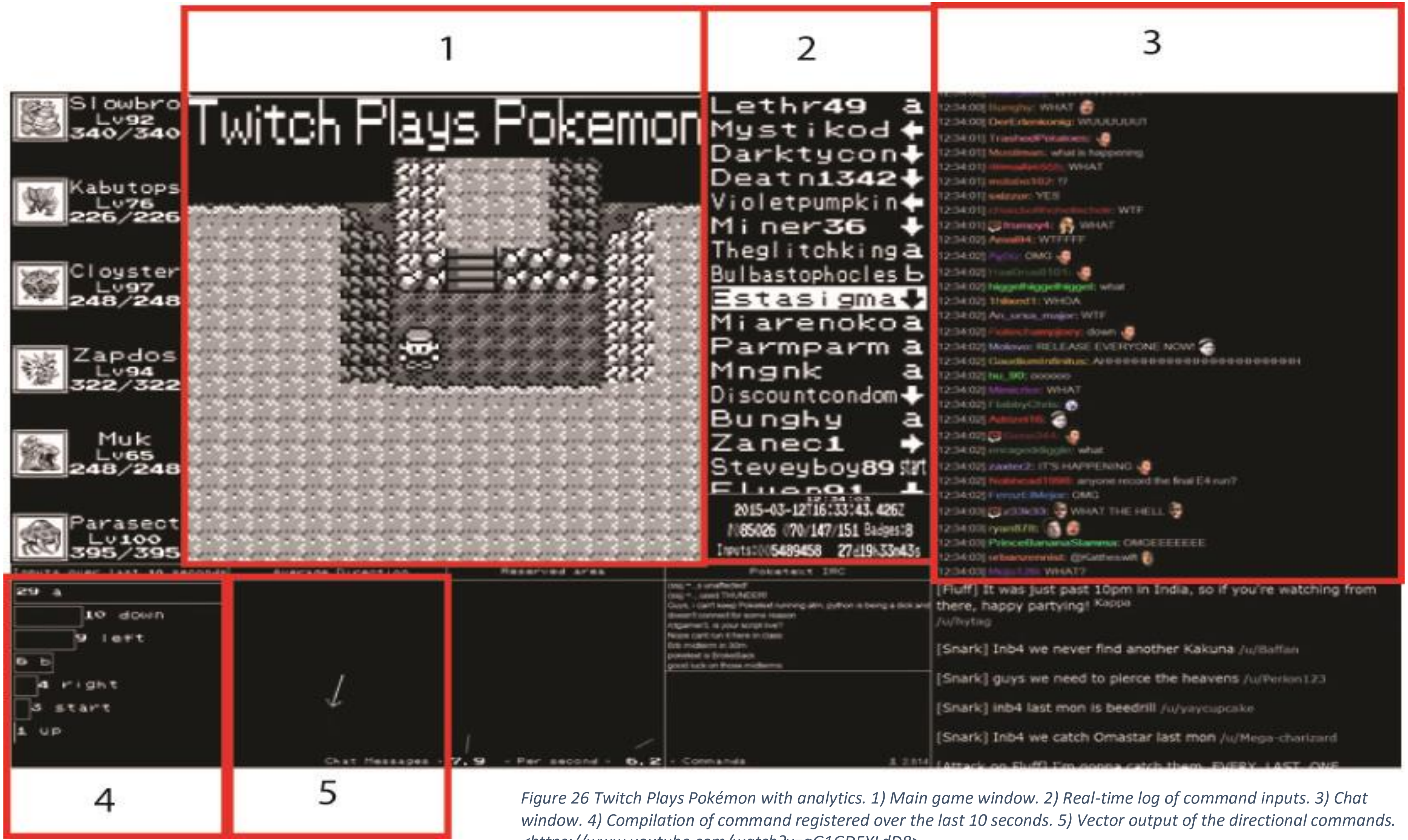

Figure 26 Twitch Plays Pokémon with analytics. 1) Main game window. 2) Real-time log of command inputs. 3) Chat window. 4) Compilation of command registered over the last 10 seconds. 5) Vector output of the directional commands. <https://www.youtube.com/watch?v=aG1GD5YLdD8>.

5.2.2 Minecraft – Players managing virtual plots

I have introduced *Minecraft* earlier in section 5.1.4 where I discussed *Block by Block,* an effort by UN Habitat and Mojang to use *Minecraft* as a medium for PD. This short section will look at *Minecraft* games hosted on online servers and specifically at servers which allows the "creative mode" (Fig.27), where the player's objective is simply to build anything they want within the virtual world.

In creative mode servers, it is important to ensure that players have their own "plot of land" to build on, that a player's creations are not vandalized by ill-intentioned players and that players can manage building access to plots for collaborative builds. Most servers enable this by allowing players to claim virtual plots and have the players themselves manage the access for these individual plots (Fig. 27). Players who owns a plot or has been granted building access to another players plot have the right to make modifications to anything that is built within the plot. Any players who have not been granted building access, can see and move around these plots be are not able to make any modifications to it. In addition to the controls built into the game system, notice how individual players are given the authority to manage their own plots, in place of an administrator. This examples shows that a combination of system automation and distribution of management responsibilities to individual players reduces the need for administrators to intervene, allowing the player community to effectively self-govern.

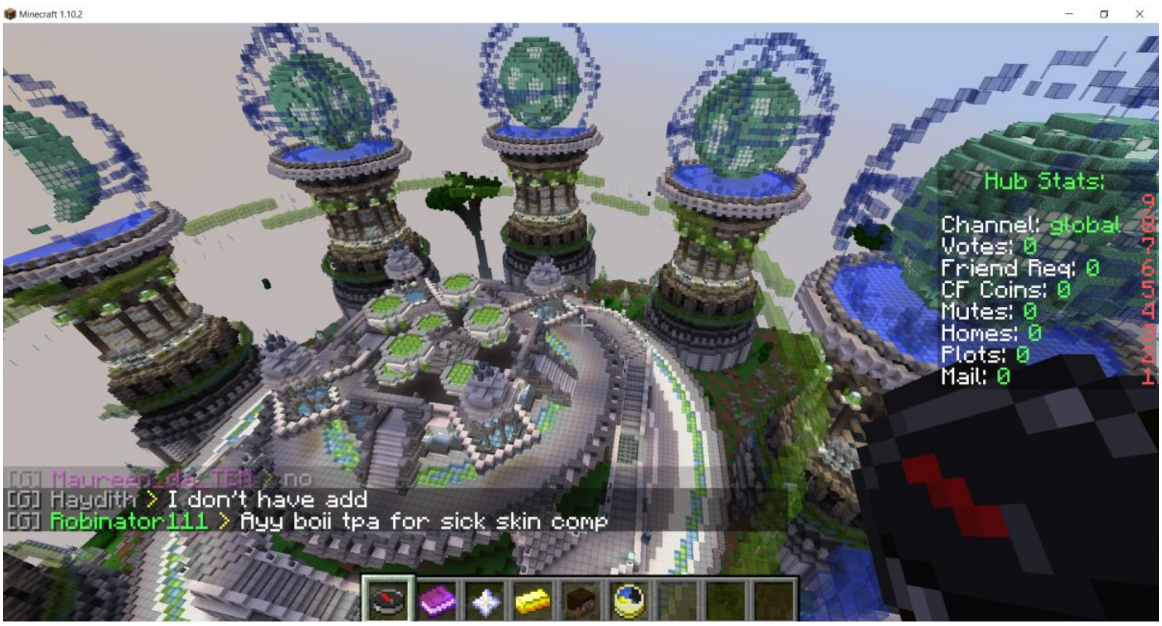

Figure 27 Buildings constructed within the creative server game mode. <Image from Minecraft game client>.

Figure 28 List of command for individual players to manage plots and access <Image from Minecraft game client>

5.2.3 Section Conclusion – Insights from MMO Games

The two examples have offered us strategies to manage the interactions in an MMO setting. The use of a real-time chat for immediate responses, a separate forum for discussion, an automated system to manage player controlled properties and empowering individual players with the responsibility to manage their own interactions, are key insights that we can consider when implementing MMO interactions. The final chapter will provide a summary of our discussion and conclude with recommendations for future works.

6.0 Summary and Recommendations – Distributed and Massively Multiplayer Online Collaborative Model

Over the course of the paper, I have introduced CTC to understand cities as *open*, *complex*, *self-organizing* systems and point out the inadequacy of a top down planning approach to urban planning. The practice of participatory design emerged as a possible alternative to subvert the entrenched idea of top down planning. I have shown three examples from the last decade that demonstrate how PD can be used in an urban design process. In particular, the city game format by *Play the City* stood out as it has a track record of successful implementations and provides the most comprehensive documentation of each sessions. In chapter 4, I have demonstrated the effectiveness of city games by showing how they are designed around SIRN, a concept that can be used to describe actual cities. I then proceed to breakdown the key interactions within a city game to three key parts, *the pitch*, *the negotiation* and *the decision*. I made my case that a larger city game allow us to have better representation of the end-user population as well as a better tool to conduct studies that utilizes ABM. Subsequently, I argued that digital tools can allow us to circumvent the physical constraints of conducting a larger city game and looked at the capabilities of existing digital urban design tools as well as MMO games to understand how we can manage interactions between massive numbers of people.

While a discussion on a specific setup of a *Distributed and Massively Multiplayer Online Collaborative (DMMOC)* form of PD is not within the scope of this paper, I will attempt to propose a general concept based on insights from the case studies. It is essential that we seek to preserve the interaction between the participants that we see within city games as we increase the number participants and transit to an online platform. While face to face interaction will not be possible online, real-time communication can still be preserved. As such a possible implementation could consist of both a digital city model and a forum hosted online, that mitigates real-time interactions and interactions outside of real-time, supported by statistical feedback to support participants in making informed decisions.

Figure 29 Conceptual diagram of a possible implementation. <Image by author>

Finally, I would conclude this paper by stressing that the implementation of a *DMMOC* is well within our reach and is the next step forward. The technology to host massive online multiplayer sessions is already mature and constantly improving. The expertise to facilitate interactions within massive online sessions can be found in the many MMO games around us. The proliferation of personal and mobile computing platforms has made citizen and participation easier than ever. What seems to be lacking is a coherent research interest and financial incentives to advance the development of this process. As contemporary cities get more complex, new tools will be needed to plan and understand the cities of tomorrow. We need not look too far, for the solutions are right under our noses.

-End-

References

Batty, M & Longley, P. (1994). Fractal Cities. London: Academic Press.

Batty, M. (2007). Cities and Complexities: Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals. The MIT Press.

Balka, E. (1995). Political frameworks for system design: Participatory design in non-profit women's organizations in Canada and the United States. In J. Gaertner and I. Wagner, editors, *Workshop Proceedings: Political Frameworks of System Design From a Cross-Cultural Perspective*. 1995.

Benenson I, Torrens PM. (2004). Geosimulation: Automata Based Modelling for Urban Phenomena. New York/London: Wiley.

Bødker, S. (1996). 'Creating conditions for participation: Conflicts and resources in systems design', Human Computer Interaction 11 (3), pp. 215 - 236.

Choi, J. (2015). 'Democratic Play: Crowd-Sourcing through Digital Games for Architectural Designs', *Collaboration and Participation Volume 2, eCAADe 33,* pp. 187-197*.*

Ehn, P & Kyng, M. (1987). 'The Collective Resource Approach to Systems Design', Computers and Democracy - A Scandinavian Challenge. Aldershot, UK: Avebury. pp. 17–58.

Ehn, P. (1993). Scandinavian design: On participation and skills. P. S. Adler and T. A. Winograd (Eds.), *Usability: Turning technologies into tools*. New York: Oxford University Press. http://www.cpsr.org/conferences/pdc98/history.html

Gregory, J. (2003). Scandinavian approaches to participatory design. *International Journal of Engineering Education 19* (1), 62-74.

Greenbaum, J. (1991). Toward Participatory Design: The head and the heart revisited. In I. V. Ericksson, B. A. Kitchenham, & K. J. Tijdens (Eds.), *Women, work and computerization: Understanding and overcoming bias in work and education*,. Amsterdam: Elsevier Science Publishers (North Holland), 33-39.

Haken H. (1977). Synergetics – An Introduction. Berlin/Heidelberg/New York: Springer

Haken H, Portugali J. (1996). 'Synergetics, inter-representation networks and cognitive maps' *The Construction of Cognitive Maps*, Dordrecht: Kluwer Academic, pp. 45–67.

Jacobs, J (1961). *The Death and life of great American cities*, Vintage.

Jennings N.R, Sycara K. (1998). 'Wooldridge M.A roadmap of agent research and development'

Autonomous Agents and Multi-Agent Systems, 1 (1998), pp. 7–38

Levinger, D. (1998). Participatory design history. http://www.cpsr.org/conferences/pdc98/history.html

Light, A., and Luckin, R. (2008). *Designing for social justice: People, technology, and learning*.

Muller, MJ & Druin, A. (2007). 'Participatory Design: The Third Space in HCI', pp. 1-70.

Nicolis G, Prigogine I (1977). Self-Organization in Non-equilibrium Systems: From Dissipative Structures to Order Through Fluctuations. New York: Wiley-Interscience

Nisonen, E. (1994). Women's safety audit guide: An action plan and a grass roots community development tool. *CPSR Newsletter* 12(3), Summer, 1994. http://www.cpsr.org/publications/newsletters/issues/1994/Summer1994/nisonen.html

Play the City - City Gaming Method. (2016).

Available from: http://www.playthecity.nl/17300/en/city-gaming-method/. [01 August 2016]

Portugali, J. (2011). 'Complexity, cognition and the city', *Springer-Verlag Berlin Heidelberg*.

Rebuild by Design. (2015). Available from: www.rebuildbydesign.org/ [04 August 2016]

Reed, S, Kreylos, O, Hsi, S, Kellogg, L, Schladow, G, Yikilmaz, MB, Segale, H, Silverman, J, Yalowitz,

S, & Sato, E. (2014). 'Shaping Watersheds Exhibit: An Interactive, Augmented Reality Sandbox for Advancing Earth Science Education', *American Geophysical Union (AGU) Fall Meeting 2014*, Abstract no. ED34A-01

Sanders, EBN, Brandt, E, & Binder, T. (2010). 'A framework for organizing the tools and techniques

of participatory design', *Proceedings of the 11th biennial participatory design conference*, pp. 195-198.

Schuler, D., & Namioka, A. (1993). 'Participatory design: Principles and practices', CRC Press.

Skelton, C & Koplin, M. (2014), *Soft city culture and technology: The Betaville project, Springer*

Science & Business Media, New York.

Susi, T, Johanneson, M & Backlund, P. (2007). 'Serious Games – An Overview', *Technical Report*

HS- KI -TR-07-001.

Tan, E & Portugali, J. (2012). 'The Responsive City Design Game', *Complexity Theories of Cities*

Have Come of Age, pp. 369-390.

Tygron | Tygron Engine n.d,

Available from: http://www.tygron.com/tygron-engine/. [13 July 2016]

Yehuda, EK & Jeong, Y. (2003). 'Collaborative Design Simulation Game', *International Journal of Architectural Computing,* pp. 423-434.

Zahnd, M. (2008). 'New Model for Contextualized Urban Design: An Effective Approach towards Modern Urbanism based on Studies of two Indonesian Cities', Available from: http://www.urbanis.com/deutsch/unsere_publikationen/fachartikel/artikel_jseaa_vol112009.pdf. [13 July 2016]

Zahnd, M. (2010). 'Planning and Evaluation of Scenarios of Urban Development with Indosity' Available from: http://www.indosity.com/images/stories/indosity/concepts/indosity-overview.pdf/. [13 July 2016]