Question of Perspective

Information Visualisation in Games and its Possible Application in Planning Communication

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Abstract. The densification of urban spaces is a major challenge for future cities. With new forms of online consultation, we observe a movement towards open government in urban planning. A stronger participation between a more diverse body of players in a networked environment, is unveiling various discrepancies in the understanding of projects by the different actors in planning, due to access to and the comprehension of planning information. To recognise and utilise the associated capabilities of current transformations, communication between the actors in planning and their sharing of knowledge is vitally important. Information visualisation is an essential form of communication, prompting this explorative paper in considering elements specific to games visualisation and their implications for urban planning. Based on a framework for information visualisation in games it was found that the specifications for actor groups in planning processes mirror the specifications specific to target audience groups in games.

Keywords: Gamification, Urban Design, Information Visualisation, Collaborative Design, Public Participation

1 Introduction

Major cities and metropolitan regions are recording ever increasing populations due to being able to supply an attractive job market; good public transport and education infrastructures; and ample recreational structures and facilities [1]. The resulting and on-going densification and over-population of these areas has a considerable impact on existing urban structures and future planning decisions. Recognising the effects and identifying the arising potentials and challenges is therefore becoming an important factor in urban planning. Current planning communication practices are proving inefficient to analyse and communicate this information. The results are most obvious in public objections to big projects such as the new Berlin International Airport (problems with internal communication) or Stuttgard21 (problems with public communication). Providing appropriate planning solutions, fulfilling sustainability targets and gaining large social acceptance of building proposals, requires a sharing of

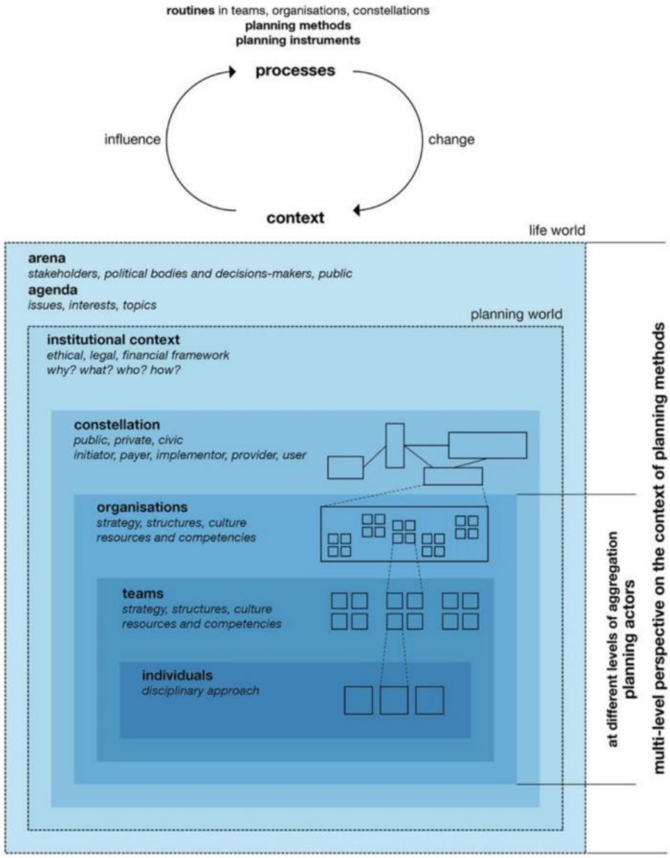

Fig. 1. A multi-layer perspective on the driving bodies involved in planning [2]

knowledge between the driving forces in planning. Globalisation and its accompanying migration mean that the diversity of cities is also on the rise as people from different cultural backgrounds move around. In terms of communication, this can pose problems as signs, symbols and cultural codes differ in use and meaning and are no longer fixed to physical locations. Therefor we can say that communication in planning is affected by the number of people involved and their culture and codes.

When regarding planning processes in terms of communication we find there are two important facets, the driving bodies and planning cycles. Both Förster and Schönwandt see a distinction between what they term the planning world and the life world [2], [3]. According to Förster (Figure 1), the life world includes stakeholders; political bodies, decision-makers; and the public. The planning world includes public, private, communal or civic bodies; initiators, payers, implementers, providers and users. They can take the forms of organisations, teams or individuals. In the life world preservation or modification outcomes are implemented in spatial, social, economic,

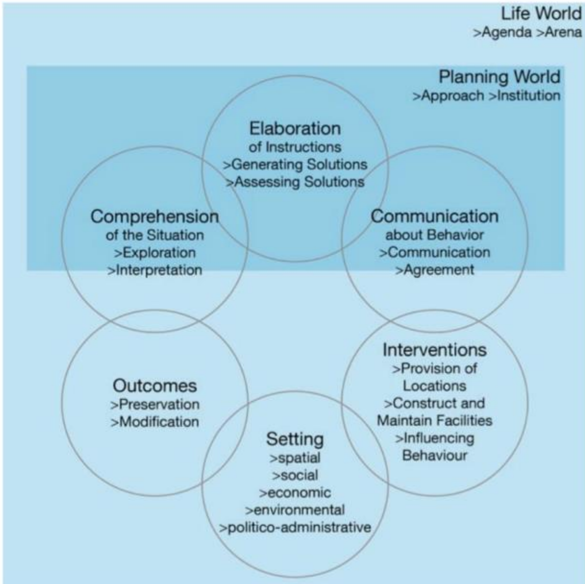

Fig. 2. Planning cycle according to Schönwandt (2002) as presented in Förster (2014) [3], [2]

environmental and politico-administrative settings, causing planning interventions to be constructed in a precise location, influencing their surroundings and needing maintenance, based on Schönwandts planning cycle as seen in Figure 2 [3]. In the planning world, a situation is comprehended through exploration and interpretation; instructions are elaborated to form general solutions which can be assessed; and communication occurs.

Förster states that planning is human interaction, therefore the way in which urban development and interventions are communicated, how local people are involved in the decision-making processes and the transparency of these procedures determine the effectiveness of planning communication [2].

The practice of using games design elements in non-gaming contexts is known as gamification [4]. It has become an interesting field of study within business management, media, sport and education. A successful example within the world of science is *'FoldIt'*, developed by the University of Washington, to utilise crowd-sourcing for research purposes [5]. *'FoldIt'* is a game where the aim is to solve a puzzle by folding proteins. Researchers then analyse the highest scoring variants, to determine if they are usable for real world purposes. Another example is the fitness app *'Zombies, Run!'* by Six to Start, where players follow a story where they are chased by virtual zombies to motivate them to be more active.

Within a larger research project the author is considering the benefits of implementing gamification methods and technologies within urban planning to improve planning communication. Information visualisation is one of the most important forms of architectural communication, which is why this paper takes an explorative approach and considers how using elements specific to games could impact architectural visualisations and how information visualisation relates to gamification. Questions posed include, whether there are any information visualisation elements specific to games and how architectural information visualisation compares to them.

2 Background

Parlett distinguishes between informal and formal games [6]. The first being described as *'undirected play, or "playing around?"'* [6], the second as being defined by having both a means and an end. What he means by this is that a game must have a predefined end, for example a game might end after a specific score is reached, and it has a set of rules which has been agreed upon by the participants. It can be added that these rules are known by all participants making a game something which is transparent with clearly structured objectives. Deterding et al. agree that games are different to play because games adhere to a set of rules, but they take the idea further, dividing games into being inside the game world or outside of it. A game which uses augmented reality would be an example of a game outside the game world [4]. Salen and Zimmerman on the other hand describe games as *'a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome'* [7]. Here again we see that rules are a defining part of games, but also that the outcome is quantifiable. If there is a lack of quantifiable data within urban planning, this last aspect is interesting in regards to possible uses of game elements within a planning context.

Gamers tend to be more spatially aware and have a higher visual literacy than non-gamers [8]. One form of presenting data is by using visualisations. It is important to note, that information visualisations are not the same as the graphics of gameplay. They provide the player with extra information, which the character in the game might not have.

For this paper, a literature review was conducted examining information visualisation, information visualisation within planning communication processes and information visualisation within games. The gathered information was evaluated, relationships between the fields considered and implications of using information visualisation elements specific to games in planning identified. Finally, the process and findings were reviewed and possible future questions and investigations proposed.

2.1 Information Visualisation

To visualise means *'to form a mental image of'* or to *'make visible to the eye'* [9]. These definitions express the nature of why we visualise: to show what we know and to explore what we don't [10]. Card et al. conducted an experiment in the late nineties to examine how using external tools such as a pencil and paper effects our mental performance [11]. They discovered that when asked to perform a complicated multiplication, people would be five times as quick if they used external aids. What they had shown is that humans can increase their mental processing power by using *'tools of thought'* [12] as this frees up working memory, which enables extended and more complex processing. Norman wrote *'the power of the unaided mind is highly overrated. Without external aids, memory, thought, and reasoning are all constrained. […] The real powers come from devising external aids that enhance cognitive abilities'* [12] and indeed correlations between the development of cognitive tools over time, such as the written word, mathematics, maps, etc., and the development of human civilisation have been drawn [13].

Visualisation allows large amounts of data to be comprehended, and enables the perception of patterns and properties within large complex information which might otherwise be hidden within the data structure [8], [14]. It facilitates the understanding of information beyond a person's expertise [8] and aids the process of forming hypotheses [14]. Mazza describes visualisation as *'a discipline concerned with the creation of visual artefacts aimed at amplifying cognition'* [15]. Ware too picks up on the relationship between the *'internal construct of the mind'* [14] and a visualisation being *'an external artefact supporting decision making'* [14]. To make and communicate decisions we need information. Information visualisations differ from other types of visualisation, such as scientific visualisation where physical properties are made visible even if we can't physically see them, by its ability to be abstract in nature and its degree of disconnection to the physical world. With the introduction of computers, visualisation capabilities have increased and real-time interaction with data facilitated. It allows for a layering of information, temporal integration, simulation possibilities and gives the user control over what content they wish to view [14], enabling an active examination of data.

In his eloquent description of the strong link between visualisation and human perception, Tufte stated that *'when principles of design replicate principles of thought, the act of arranging information becomes an act of insight'* [16]. Ware identifies three levels that govern how we perceive the world around us [14]. The first level of Wares framework comprises of details within our field of view which we perceive in quick succession. They are directed by certain factors and include direction, length, thickness, colour, brightness, number, form, size, movement and most importantly spatial positioning [10], [17]. On a second level, we detect and recognise patterns through the proximity of elements, their similarities and relative connection [10], [17]. Lawson wrote *'we are not very good at any form of perception, but we are much better when relying on relative comparisons'* [17]. The visual-semantic language of the brain governs these aspects [17]. Important examples include the laws of proximity, similarity, continuation, figure-ground, symmetry.

Goal-orientated and sequential processing make up the final level of perception, where a verbalisation of the perceived occurs [10].

Whilst there is evidence that visualisations are universal by nature, it can be argued that only certain aspects are indeed, universal. Tufte argues that *'the principles of analytical design are universal – like mathematics, the laws of Nature, the deep structure of language – and are not tied to any particular language, culture, style, century, gender, or technology of information display'* [18]. In contrast Ware clearly differs between arbitrary and sensory principles and aspects. Sensory aspects are described as biological, using the brains perceptual processing power without a need for learning. They allow cognition without prior knowledge, are resistant to instructional bias, and are valid across cultures [14]. Arbitrary aspects however, are governed by society and culture. Because they are symbols which don't resemble their object [19] they are hard to learn, can be easily forgotten; are capable of rapid change; and are formal in structure, such as in mathematics [14]. In traditional planning and architectural visual communication, many of the visualisations fall into this second category.

2.2 Planning Communication

People who have knowledge on a specific subject, such as planning experts, tend to assume that others have that knowledge too, they overestimate how widely spread that knowledge is and they overestimate the depth of knowledge others may have on that topic [20]. In his book, Rambow examines communication processes within architecture and looks at how both experts and laymen perceive the world around them [20]. He found that there are distinct differences between the way experts and laymen organise information, the former sorting domain specifically, whilst the latter uses descriptive categories. Whilst architects are competent in predicting laymen's knowledge levels and architectural understanding there is a significant visual-semantic communication gap when it comes to two- and three-dimensional thinking and translating; and there are conventional and abbreviation discrepancies. This indicates a third factor stressing the planning situation in cities and metropolitan regions, as people's level of planning knowledge varies. The public body has knowledge ranging from novice to expert. These aspects make planning communication processes about providing the right amount of information to meet knowledge levels, whilst using conventions which can be understood by the majority.

Traditionally architects communicate through their work and communicate predominantly among themselves by use of visual tools, whilst spoken and written descriptions are secondary [20]. Over time various visualisation techniques have developed to express planning information. The most common form are maps, which show physical properties of an area of land or sea and consist of a *'collection of data showing the spatial arrangement or distribution of something over an area'* [9]. Scale, global orientation, the time and a key are important features [21] as maps are abstract due to the prioritisation of clarity and legibility over accuracy when scaled [22]. Most common in planning, maps with a scale greater than 1:5000 are referred to as plans. As two dimensional-representations plans, sections, and elevations represent three dimensional spaces, with the aim to show large amounts of detailed information. This has caused plans to be filled with contextual codes. To counter problems in spatial translation perspective drawings and computer generated images attempt to visualise atmosphere, while detailed drawings provide building instructions for construction workers.

Within the scope of this research three driving groups made up of the various actors involved in planning were determined. The political body makes planning legislation, monitors building codes, regulates development, and plans urban structures to fulfil criteria set by political agendas or people's needs. Planners include all sub-groups in the AEC (architecture, engineering and construction) community, who focus on various aspects of a buildings lifecycle, such as design, planning application, construction or maintenance. Both groups are proficient in planning conventions. The public body however, as the largest group with high cultural diversity and a wide range of planning knowledge, are the people who experience and use architecture, and they are most concerned with how development impacts them and their quality of life.

Formal communication processes are laid out by planning legislation. Planners or authorities must inform the public of planning proposals both prior to and again during planning application to allow for feedback. As a project increases in size and political or social importance, the percentage of the population included is increased. Despite a rising complexity in formal communication processes, the same traditional planning methods are being employed. They include letters informing the public about development proposals, forms detailing area, etc., design plans and physical models. In Germany, law does not require informal communication processes. The aim of these is to involve the public in the design process. Methods are more varied ranging from leaflets to presentations, workshops, discussion and deliberations. The objective is to create local solutions to local problems and achieve public approval. Informal processes often enable higher degrees of participation including consultation, placation, partnership, delegation and control [23].

Based on the conducted research, deficits within planning communication were identified:

Noise. Noise is the unintended addition to a signal created by a "noise source", such as the sound of static on a telephone line, making the encoded and decoded signals different. This means that a message, or planning information, might not be understood in the way it was intended [24].

Convention. Convention describes the rules by which arbitrary signs work and must be learned to be understood. Architectural drawings or the translation of two dimensional drawings into a three-dimensional building are examples of convention and help to counteract noise by making a message more predictable and plans clearer to understand. Whilst planners learn planning convention, not everyone in the political and public bodies do [1].

Access. Access to planning information is a two-fold problem. Firstly, many pieces of planning information are not available in digital form and secondly different aspects of planning information are in different places.

Temporal Displacement. The transition of time can be considered a further problem in current communication processes as different people gain different knowledge at different times. Though it stops information overload it can cause discrepancies in the understanding of a proposal by the different planning bodies.

2.3 Information Visualisation within Games

As mentioned above, visualisation in games is not the same as visual graphics in games. The former provides further information about what is happening to the player within the game world, whilst the latter describes the visual, normally three-dimensional graphics of the game world. In this paper, we consider the former only. Visualisation in games differ from visualisations in general as they need to be *'"useful" and "pleasing" rather than "utilitarian"'* [8] and visualisations within game-play must not be disruptive. Research in this area approaches the topic of information visualisation in games from two opposite fronts. One direction of research looks at the application of visualisation technology in games [8], the other centres around the use of game elements in visualisations [25], [26].

Game specific methods of visualisation demonstrate more sensibility to human perception and are better at avoiding information overload whilst still providing complex information, a concept Bowman et al. agree with [8]. They see the benefit of visualisation technology for games to enable *'better gameplay, easier balancing and debugging, and more enjoyable spectating'* [8]. In their analysis of game visualisation techniques, they aimed to find features *'specific to the intersection between games and visualization technology'* [8], which could benefit the world of information visualisation by promoting mass adoption catering to an existing and motivated user base. Diakopoulos on the other hand believes the benefit of game visualisation to be in their non-linear arrangement and narrative capabilities [25]. For her *'games provide an alternative method for structuring a story, not bound by a linear arrangement but still providing structure via rules, goals and mechanics of play'* [25].

Many authors distinguish between software information visualisation and casual information visualisation within game visualisations. The difference lies predominantly in their target audience. The first is directed at developers and includes log traces, program structure. The second targets the gamers. Pousman et al. define casual visualisation as *'the use of computer mediated tools to depict personally meaningful information in visual ways that support everyday users in both everyday work and non-work situations'* [27].

Bowman et al. go beyond simple definition and identification of game-specific information visualisation, building up a framework within their paper useful to the research questions posed in this paper regarding a comparison to the field of

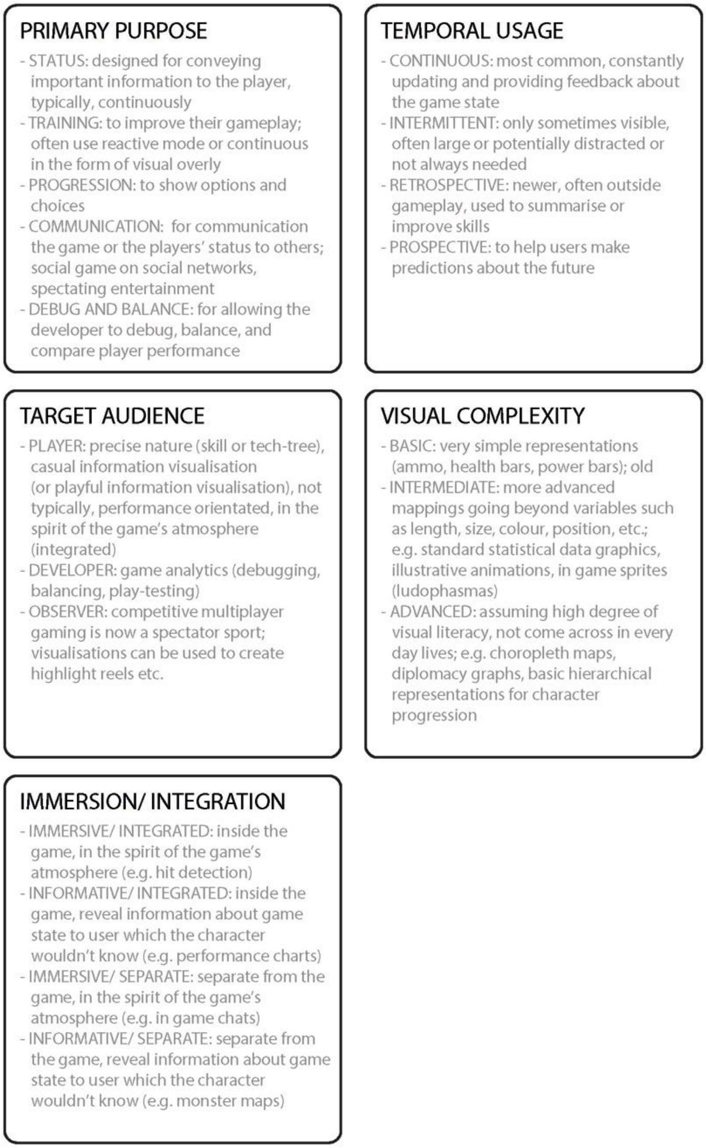

Fig. 3. Summarising the five categories used to classify specific visualisation techniques found in computer games according to Bowman et al. (2012) [8].

architecture and urban planning. Using their analysis of games, they determined five categories as demonstrated in Figure 3: primary purpose, target audience, temporal usage, visual complexity and immersion/ integration. Primary purpose describes the intended use of the visualisation which they divided into status (e.g. health bar), training (visualisation to improve gameplay), progression (displaying options to help with character or level progression), communication (informing other players of status etc.) and debugging (to help developers improve gameplay). Target audience could be players, developers or watchers. Temporal usage describes the amount of time different information is visible. It ranges from continuous, to intermittent, retrospective and prospective. Visual complexity defines how complicated a visualisation is and immersion/ integration specifies if a visualisation is perceived as part of the game, e.g. heads up display, or as separate from it, e.g. skill trees in World of Warcraft. Summarised below are game specific or predominant aspects extracted from the paper, described in a little more detail.

Time. This describes the amount of time information is visible for. Important information such as status bars tend to be continuously visible, whilst other types such as ammunition count are only displayed intermittently when needed. Time also includes retrospective and prospective simulation capabilities.

Dynamic / Static. Closely related to time, this describes how information is highlighted when it becomes relevant by becoming more dynamic at that point. The sudden movement or appearance of the information draws a players' attention.

Layout. The location of different information on a screen determines how important or relevant it is perceived to be. Games which have their gameplay in the centre often have more important information closer to the centre making it more prominent and therefor more relevant.

Immersed / Separate. This describes whether information is integrated within the game, e.g. in a heads-up display, or separate from a game, e.g. information trees etc. Another example of immersed information is blood-spatter in first person shooters which indicate both that the player is being shot at and the direction from which they are being shot from.

Ludophasmas [26]. A term used for ghost cars in driving games where a ghost image of either a player's previous lap, or an opponent's drive path is shown. Here I am also using it to describe elements such as wheel marks rendering optimal racing lines in car games. They express a teaching function.

Multi-User. In multi-player games, different people can often see different information. For example, in multi-player shooters you may only be able to see areas of the playing field which members of your team can see, whilst your opponent will see other areas. Similarly, if one player had the option of using night-time goggles, he would receive different information to his team-mates.

3 Comparison

Based on the framework proposed by Bowman et al. (Figure 3), a comparison between games information visualisation and planning information visualisation was conducted. Looking at the five categories, several observations were made [8].

3.1 Primary Purpose

Status. Visualisations are used in games for different purposes. Displaying status to convey important information about a character's condition, the state of play or the play situation creates a frame of reference for a player. In games, it is typical that this type of information is displayed continuously and updating regularly providing feedback about the game state.

Displaying the most important information about a planning proposal, the main contacts and the stage of the project is also a common practice in planning communication. This information is presented continuously, but not automatically. It is updated but the regularity is dependent on the party providing the information. The aim is to create a frame of reference of the stage and state of the project.

Training. Games use visualisations to help a player improve. The training techniques are employed either retrospectively through video summaries, or through reflective modes, or practice runs and levels; or continuously in the form of visual overlays using effects such as Ludophasmas.

In architectural education, ongoing architects participate in multiple practice projects, some wholly fabricated situations and others with real world application. Outside of architectural practice the use of legends, simulations, and visual diagrams are implemented to help facilitate understand and communicate underlying thought processes within the different planning stages.

Progression. In games progression is linked to development, for example character development (World of Warcraft – Skill Tree) or building strategy development (SimCity, Anno1602). To demonstrate options and choices, a player's progression is visualised, for example by implementing visual skill and technology trees.

In planning maps are used to visualise city development showing building zones, allowing people to see what can be built where. The progression through design stages may be visualised.

Communication. When talking about communication it is possible to distinguish between in game communication and of game communication. In their paper Bowman et al. [8] focus on visualisation to communicate information about a player's status or to communicate game information on social networking platforms.

Most planning visualisation is to communicate planning information and decisions. Plans, sections, elevations, perspectives, visualisations, simulations, etc. are all created to communicate abstract ideas or explore a design notion. Whilst architecture is shared on social networking platforms, the target audience is mostly field specific.

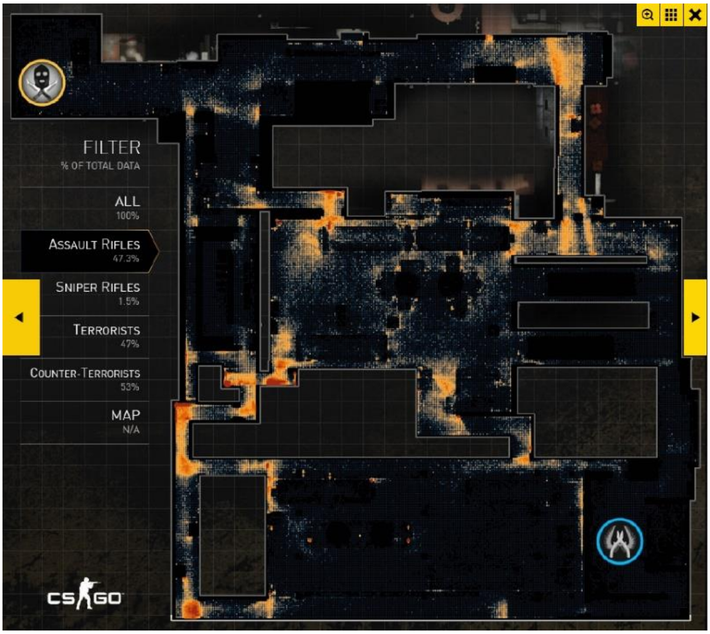

Fig. 4. A heat map showing the death zones on a Counter Strike Global Offensive mission as an example for a player performance comparison [28]

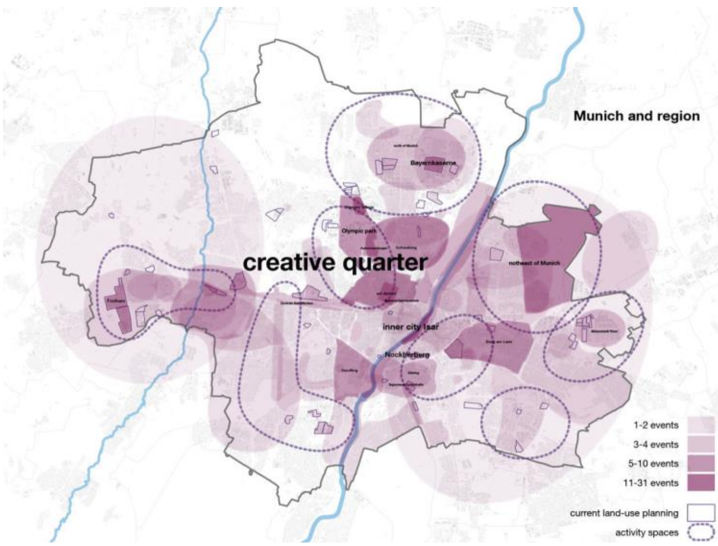

Fig. 5. A heat map showing the spatial pattern of a recent public debate in planning in the city of Munich, Germany. An example of player performance comparison in Planning [29]

Debugging/ Balancing. In games software information visualisation is used to aid developer's debug and balance games as well as compare player's performance (Figure 4).

Possible correlations within urban planning are visible within public participation processes (Figure 5) in early planning phases, where the aim is to identify and prevent problems at later stages, which are often accompanied by higher costs and planning delays.

3.2 Target Audience

Bowman et al. distinguish between three main groups: players, developers, and observers. Different visualisation techniques dominate the different target audiences [8]. Player specific visualisations communicate distinct or casual information. They are often in keeping with the style and atmosphere of the game and their primary purpose is giving the user feedback, skill improvement, in-world awareness and the communication of achievements and progress. Developer specific visualisations provide information for debugging, balancing, player performance evaluation, and play testing, in other words, for analytics. They also use visualisations to draw inspiration from player behaviour. Competitive multi-player games have become a spectator sport, with observers who watch other players play games [8]. Observer specific visualisation promotes observer enjoyment and player performance analysis facilitating peer-to-peer learning.

The specifications for actor groups in architectural planning processes mirror the specifications specific to target audience groups in games - player, developer or observer.

Planners can be compared to developers, as their primary purpose is the development and implementation of a suitable design solution. In planning, we can say that most visualisations are made to communicate ideas within the planning community in the planning world. They represent design stages and fulfil an explorative function or act as instructions. In educational settings, they may be used for skill improvement. In this sense, they are like the debugging and play testing functions used by developers. But they do not function on the player performance or game analytics levels. Players are comparable to users, the public and stakeholders as they both have wide ranges of game or planning knowledge and form the most heterogeneous groups. With the promotion of public participation, visualisation for this group of target-audience is increasing. It serves the purpose to give and receive feedback to and from users, promote planning world awareness and communicate proposals, achievements and progress. It is unclear how the observer group would relate to the planning world. In terms of visualisations being included to make watching players play games more entertaining, a comparison to media documentation could be draw. If the idea of visualisations is to make observers more aware of how and why players are playing the way they are, or to make the players actions more obvious and clear, or perhaps to help predict player's outcomes, then a comparison to the political bodies and decision-makers is more plausible.

3.3 Temporal Usage

The most common form of visualisation in games is continuous. This is the case within architecture too, however whilst in both the information is continuously there, in games it is also being continuously updated. Relevant information which is not always needed or if a visualisation is large or potentially distracting, it is only displayed when needed within games. As much of the information presented within urban planning is not in digital form, information is either considered important enough to be put on a plan, or not important enough to be mentioned. Intermittent information presentation is considerably easier within a digital context. In planning, the consequence is that lots of important information is spread out over many different media platforms. Games display retrospective and simulative information to summarise gameplay, to improve skills or to enable users to make predictions about the future. Simulation is a commonly used tool in planning, to help predict planning problems and to visualise solutions. Retrospective information is visualised case specifically for individual planning projects, to establish a fundamental understanding of the situation.

3.4 Visual Complexity

Visualisations have different levels. This is true both for games and architecture. They range from simple or basic visualisations, through more complex intermediate representations demonstrating relationships between different information, to advanced mappings requiring high levels of perception and visual understanding. It can be argued that this element of the Bowman et al. framework is neither game specific nor planning specific, but is part of the topic of visualisation in general. With ample Literary representation, this aspect goes beyond the research within this paper.

3.5 Immersion/ Integration

Immersion and integration describe how immersed a visualisation is in the game and if it is part of the game application or not. If a visualisation is inside game-play and in keeping with the game's atmosphere, such as in-game hit-detection, it is considered immersive/ integrated. If it reveals information to the player about character or game state it is considered informative/ integrated. If it is separate from game-play but in keeping with the atmosphere of the game, for example an in-game chat, it is considered immersive/ separate. If it is separate from the game and reveals information on character or game state, then it is considered informative/ separate, for example monster maps or skill trees. Within planning this distinction is less defined. Working off Förster and Schönwandt's theory of separate real and planning worlds, we can speculate that there are architectural visualisations which show both information concerning the planning world, such as a floorplan, as well as information regarding the real world, where it is located on the globe. In this respect, the immersion/ integration aspects would function similarly within planning where one could distinguish between information in the planning and the real world.

4 Discussion and Outlook

Within the comparisons section the game world and planning world were compared to each other, based on the framework presented by Bowman et al. [8]. We can see that there are many parallels between how visualisations are used to display information between these two disciplines, however their main use of visualisation is directed at different target audiences. From the literature review, we can say that the gamer fraction of the population is more invested in improving their spatial understanding of the game world and more motivated to improve their game-play and are therefore able to understand a lot more information, people who do not play. In architectural spheres, this is a problematic aspect as the public body often chooses not to understand planning information, resulting in rationally ignorance [30]. Within planning participation there are an increasing number of examples where the processes are gamified to counter these aspects [31]. The hypothesis drawn here is that the way in which visualisations are constructed determines how easy it is to go from novice to expert. It is based on the observation that gamers find it quicker and easier to become experts within games due to their motivation, than the public does when attempting to understand planning information. Games help players adapt their behaviour to observe different information.

One significant difference between the way visualisations are implemented within games and within urban planning is their temporal factor. Whilst both use continuous visualisation and simulation functions, games use intermittent information and retrospective technologies more effectively. Architectural communication tools, such as plans, are usually static and therefor show all necessary information at once. The temporal use of information within gaming visualisation provides a frame of reference for depicting large amounts of detailed and complicated information without overloading. They also demonstrate how information can be highlighted through techniques such as movement, colour and distance from centre. Retrospective and prognostic capabilities provide huge potential in areas of variant simulation and progression monitoring.

Furthermore, inspiration could be drawn from established games such as World of Warcraft who successfully display separate information outside direct game play, such as skill trees. In this way planning legislation, could be made more legible, accessible and understandable for both planners and the public by presenting connections between different legislation paragraphs and documents.

When considering the purpose of visualisation in the two fields we can draw the conclusion that they are applied more diversely within games than in planning and that there are game specific visualisation practices which could benefit traditional planning ones. Aspects little used within planning information visualisation include teaching and training aspect outside the planning sphere; demonstrating choices and options more clearly, especially in public participation procedures; utilising social networks more effectively and promoting social engagement, particularly outside the planning sphere; and analysing planning statistics, comparing performance, and 'debugging' to allow planning problems to be highlighted.

The immersion/ integration aspect holds potentials in planning practice, as well as a possible approach to a question posed within the scope of the larger research project surrounding this paper in finding a definition for gamification within planning: how are information visualisation and gamification connected? The differentiation between game world and real world is a similar model to the differentiation between the planning world and the real world, even if the models were not established within the same context. In both we see that visualisation occurs to target one or the other, or to translate information from one into the other. Developers use visualisation within the real world to depict game world happenings. Similarly, planners prepare visualisations to communicate ideas based in the planning world, in real world participation processes.

Bowman et al. are not the only people to suggest this divide within games. In their search for a definition of gamification, Deterding et al. see this distinction as an important factor. For them games which extend beyond entertainment in the private home or games which have salient features extending beyond the spatial, temporal or social boundaries of game-play are terminologically outside the game world. Gamification is the *'the use of design elements characteristic for games in non game contexts'* [4] or *'designing for gameful experience'* [4] and is terminologically located within the game world. But how does this help define whether information visualisation is an aspect in gamification? Both the real world and the game world use different information visualisation techniques, so information visualisation, by Deterding et al., cannot be an element of gamification. However, in this paper we see that there are visualisation techniques characteristic for games, which can be employed within non-game contexts. Deterding et al. define game elements as *'a set of building blocks or features shared by games that are characteristic to games'* [4]. This research also questions the definition of gamification as it is currently employed in industry, something Deterding himself has done in a recent contribution to a publication on the relationship of urban planning and games design [32]. Within this paper, the author proposes the term could be broadened to include narrative aspects [25] and learning from established, pleasing, interactive and effective visualisation techniques.

The research conducted was based on a literature review and functions as an aspect within a larger research project considering the benefits of gamification in planning. Whilst there is little literature on information visualisation in games there are potentials to been gained from further research both in literature, but also in practical application, in this field and its relationship with planning visualisation. Although it remains unclear how exactly information visualisation and gamification relate to each other, it is clear that certain visualisation techniques are game specific and that they aid storytelling and goal orientation. The knowledge gained in this review will be implemented, along with other elements researched within the larger urban planning project, to examine the effects of game elements in implemented prototypes to improve architectural communication.

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