A Concept of Geo-Facts for Online Discourse in "Postfactual" Times in the Context of Spatial Planning

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1 ABSTRACT

The paper discusses geo-facts and their importance in discussions. The context of the examples is spatial planning. It is assumed that geo-facts should be the basis for modern (trustworthy and reliable) e-participation in spatial planning processes. This is discussed in comparison with "alternative facts" and some ideas about necessary data on facts are presented.

Starting from an intuitive definition of facts we develop the concept of geo-facts, show their usefulness for discourse in a spatial planning environment, and points out some technical details. The paper discusses ideas and aims at presenting a vision rather than present a detailed evaluation and solution that is ready to be implemented. The goal of this paper is starting a discussion how expertise can be stored and used.

Keywords: linked data, creation, validation, spatial planning, geo-facts

2 INTRODUCTION

The current political and social situation increasingly relies on opinions. An example was provided by the Trump-administration in response to pictures from the inauguration ceremony and a comparison between the inauguration of Donald Trump and Barack Obama four years before. Trump's press secretary said that more people visited the inauguration of Donald Trump although pictures suggested otherwise and this was later defended as "alternative facts" by a senior White House aide (The Guardian, 2017). This causes a huge problem for any reasonable discussion including those on spatial planning. If there are concepts like alternative facts, how can it been decided which to use as a basis for planning? Starting from this problem the paper discusses the concept of facts, how facts are generated, and how they can be used.

Facts are statements that are created and can be validated. In this paper we discuss the concept of geo-facts. A geo-fact is a fact connected to a specific location, which may be a point, a line, or an area. In order to store these facts, they also need to have a reference, e.g., a Uniform Resource Locator (URL). This was already suggested for cadastral objects for Switzerland. After introducing and discussing these fundamental concepts, further questions on the use of geo-facts arise. How could a smart visualisation help to distinct important from less relevant facts?

In order to illustrate the ideas, throughout the paper reference to a spatial planning project in a small Austrian village will be made (see Fig. 1). It could have arbitrary topic, for instance planning a new cycle path for children, collecting ideas for a new arrangement of service stations, involving citizens in planning a public transportation line for the city, involving citizens in locating a new area for dog-walking, etc.

The remainder of the paper is structured as follows: Section 2 introduces the notion of a fact as used in this paper. Section 3 outlines the specialities of geo-facts and section 4 discusses the risk of "alternative facts" in discourse. Section 5 then provides a brief introduction to the importance of geo-facts in spatial planning and section 6 provides some ideas on making geo-facts accessible. Section 7 shows the technical requirements for geo-facts, which are necessary due to the changing (social and physical) reality. In the end we present some conclusions.

3 FACTS

The core purpose of a fact in the context of this paper is that the fact can be used as an argument in discourse. Looking up a general definition of "fact" produces something like the following:

- "something that actually exists; reality; truth

- something known to exist or to have happened

- a truth known by actual experience or observation; something known to be true

- something said to be true or supposed to have happened" (dictionary.com)

or

- "a thing that is known or proved to be true" (Oxford Living Dictionary).

However, these definitions require a concept of "truth" that is difficult to apply to complex situations. The idea that experience or observation is used to identify truth is similarly limited. It can be assumed that reality is (almost?) infinitely complex and human observations are rather limited. Thus determining truth from observation is difficult. Thus any discussion of facts and their use should avoid "truth". The concept of "something said to be true or supposed to have happened" is much weaker than the other concepts. It might sound somehow strange but this makes it a promising starting point for a discussion in this paper.

Based on this definition, what is a fact? Something, e.g., information can turn into a fact when it becomes referable and unchangeable within a defined period of time. Something is referable if it is possible to use a reference to it in a discourse. Translated into terms of scientific literature it is citable or in the domain of the Internet it is linkable. Nowadays information is primarily shared via the Internet. Therefore, a fact in the Internet needs to have a unique address (URI/URL). Examples for practical implementations of such identifier systems are the Persistent Uniform Resource Locator (PURL) or the Digital Object Identifier (DOI).

3.1 What is a fact and what is not a fact

In the context of this paper a pragmatic approach is used for the definition of what a fact is. Assuming there is no such thing as an absolute truth, it is postulated that a fact is a piece of information that can be used to argue for or against something. This applies to any information.

Understanding the fact concept might lead to conclusion, that it must be understandable for the target audience. This sometimes provides a problem, e.g., when discussing complex structures. How many, for example were capable to understand the concept of black holes in the discussion about risks connected to experiments in the Large Hadron Collider (LHC) at CERN? The physical existence of the LHC is a fact and the fear of the people as well. However, how far are the details of physics relevant facts in the discussion of the fear of the people? Is it really correct that facts only understood by experts are irrelevant?

According to WikiPedia, "information is that which informs" (WikiPedia, 2018a), in the context of this paper, information is potentially an argument in a discourse and it becomes a fact if it can be referable (compare section 7). However, even apparently useless pieces of information can become relevant even if not the whole audience can fully understand the reasoning behind the geo-fact. This means, that a subjective assumption about the quality (in the sense of plausibility) of an information is not sufficient to decide if the information is relevant or not. This also applies to the type of information discussed here, the facts. What makes the facts more useful, is the constraint that it fulfils formal criteria so it can be (but does not need to be) linked to and used in an online-discourse.

3.2 Validation of facts – telling facts from fiction

A fact can be validated if it is compared to other facts. The death of a public figure, for example, can be witnessed by persons who then can spread the information as a fact. Discussions on the death of the public figure can then be linked to this fact. If the original fact is correct, then there will be other, independent facts that agree with the original fact. Otherwise, contradicting facts will occur, e.g., press releases by the public figure that the original obituary was premature. A list of premature obituaries can be found on the web (WikiPedia, 2018b).

A standard method to validate facts could be statistics. Statistics is used successfully when dealing with observations and observation errors. Gross errors, which represent incorrect facts, can be eliminated by robust statistical methods like Least Trimmed Squares or Ransac. However, these methods can need to be applied carefully because a measurement is always affected by statistical variation whereas a fact is either true or false. A fact is more likely to be true if numerous people create multiple instances of the same fact independent of each other. Thus errors in the people's observation would be corrected because it is not plausible several people have the same incorrect observation independent of each other. When different people, for example assess the number of participants at a conference and publish this as facts, a larger number of facts will provide a better assessment of the conference size. However, the Loch Ness Monster

would be a validated fact because there are multiple, independent observations documented. Therefore, reliable validation of facts could require thorough analysis of each fact.

4   GEO-FACTS

What makes a fact a geo-fact? A geo-fact is a fact that refers to a specific location at a specific time. The location may be identified by any hierarchical concept (e.g., from country to municipality to private property), a fuzzy concept (e.g., downtown Vienna) or a discrete geometry (constructed from point, lines, polygons, etc.). A geo-fact describes any kind of information on this location, e.g., links to an event that happened on this location, refers to an object in this location, or indicates a relation between a person and a location.

It is also possible, that a social, political or geographical description is a fact by itself. An example is the definition of the boundary of the municipality Bad Gleichenberg, which was defined as a text in the 19th century (Navratil, 2011). Of course this fact makes no sense if it is not used in the correct context and linked by other facts (to the historical development in this case). This can be used, for example, to document changes in geographical names over time (e.g., Carnuntum in the 1st century AD vs. Petronell-Carnuntum today).

A difference between non geo-related facts and geo-facts is that rules of geography, i.e., the first law of geography "Everything is related to everything else, but near things are more related than distant things" (Tobler, 1970) can be used to validate geo-facts. This enables the use of statistical analysis to trustworthiness of a geo-fact. However, Goodchild and Li (2012) documented the limits of this concept in the context of Volunteered Geographic Information (VGI).

Another problem may be provided by the spatial variation of a geo-fact. The global sea-level rise is a geo-fact. However, test calculations in the 1990ies by Bretterbauer already showed that additional water will not be evenly distribute over the oceans In addition, some parts of continents are rising or falling independent of the seal-level rise. Scandinavia, for example, is still affected by post-glacial rise. If this rise exceeds the annual seal-level rise, then local gauges will report drop of sea-level and thus local geo-facts will contradict the global geo-fact of sea-level rise.

This problem is connected to granularity. Phenomena can be constructed from small pieces and these pieces may behave differently that the total phenomenon. The granularity of the phenomenon determines a maximum level of detail that is suitable for a description of the phenomenon. A dune, for example, consists of small grains and the behaviour of the dune (movement, shape change, etc.) depends on the grains and the atmospheric conditions. Looking at the phenomenon dune at a level of detail that considers parts of the grains does not improve understanding of the behaviour of dunes.

While the granularity of the phenomenon determines a maximum level of detail, the scope of discussion determines a suitable level of abstraction. Humans can deal with a limited number of aspects at any given time. Miller discussed this topic in his famous paper (Miller, 1956) for distinguishing different stimuli (e.g., shades of a colour) and memory span connected with lists of objects. This is the experimental proof that humans cannot argue about arbitrarily complex problems because detail will not stay in short term memory. Thus the amount of detail needs to be reduced for any discussion. The simplest way to do this is to make abstractions by ignoring details. A discussion of travelling in sand deserts will need to include the shape of dunes because travelling in some directions is much easier than in other directions. The shape is a direct result of grains move by wind but on a coarse level of abstraction this is ignored. If somebody needs proof that dunes have this form, either pictures of dunes (geo-facts) or theoretical models of grain movement (facts of physics) may be used.

These issues are relevant for non-spatial facts as well but they are even more relevant for geo-facts. The first law of geography suggests, that spatial autocorrelation (close things are more related) is an important assumption for geographical features. Highly correlated facts, however, can be grouped together and the information that a phenomenon has multiple instances (there are numerous dunes in a desert) can be ignored and the geo-fact "there are dunes in this area" is an abstraction of the geo-facts documenting every single dune. The selection of a suitable abstraction level (eliminating irrelevant detail and nothing more) is crucial for a fruitful discourse.

5   CONSIDERATIONS CONCERNING "ALTERNATIVE FACTS" IN ONLINE-DISCOURSE ENVIRONMENTS

Why are we referring to the concept of alternative facts? Citizens perceive the world through their sensors. Thus each citizen has a subjective view of the world. These views may vary between the citizens. Some of these differences in views may only have limited significance for the individuals, e.g., if someone likes the colour of a facade. In other cases, the view of the individual is in opposition to what the majority assumes. This is no problem for a discourse if it is treated as an opinion (the fact, that a citizen has this specific believe). However, if this opinion is translated into a geo-fact by (i) making a wrong statement (e.g., falsifying an image, reporting wrong observations) or (ii) drawing illogical conclusions (e.g., derive a general rule from one single observation like "I have once seen a red lake so lakes are red").

Like in politics and all fields of society, also in citizen participation wrong, incomplete or misinterpreted information is often used as basis for an argument. If this (wrong) argument is published online it can be named an "alternative fact". In the context of this paper, it would be an "alternative geo-fact".

It would be easy to ignore this aspect of problematic handling of information. However, the recent intense discussion in media about "alternative facts" showed that scientists should point out their position for handling this kind of geo-fact in discourse oriented communication environments. The existence of "alternative views on how things are" is a reality and a trustworthy information environment should not make the mistake to treat plausible and unreliable information in a different manner, because both are a reality in discourse. It should be repeated in this place that a fact is in the definition of this paper a referable information object that fulfils "formal" criteria (see formal criteria in section 7).

An approach for the identification of purposefully wrong facts is necessary. Such an approach can start from the currently observed pattern that correct facts are typically reported independently by different people whereas purposefully wrong facts are stated once and then repeated. A differentiation based on statistical analysis seems plausible if facts can be traced to their origin, i.e., if sets of geo-facts can be reduced to the originally published geo-facts.

6   GEO-FACTS IN SPATIAL PLANNING

The concept of geo-facts is essential for high quality discourse in public participation processes. The evolution of Web 2.0 technologies, mobile communication, and beyond enabled public participation projects using an online representation. The most common occurrence in this context is the so called blended participation where online and offline media are mixed. Assuming the following phases of participation:

(1) Pre-participation phase (information of the Stakeholder)

(2) Discussion and decision

(3) Documentation for comprehensibility of the process

The quality of the discussion in phase 2 is very much depending on the quality of information provided to the different stakeholder of the participatory project. Nowadays, phase 2 is often offline. But it can be very much assumed that much more of the communication in the future will be online. Especially if phase 2 is online (for instance for a period of some days citizen are in discussion in a web environment a special planning issue) it is essential to have geo-facts to enable an efficient discourse. Figure 1 shows a possible approach for a user interface. The participatory example in a small Austrian village refers to a made-up trail that shall be created and an online-discussion is initiated to allow the citizens to participate in the decision-making process. Different types of geo-facts like a trail-plan, a study, or a photo are represented by different symbols. In order to reduce the complexity of the presentation, a limitation of the number of shown geo-facts is possible (here 11 of 50). A discussion of the timeline can be found in the next section.

What is the vision of the paper? We aim to apply the geo-fact concept to modern participatory planning processes. We are convinced that the quality of the process and results as well as the acceptance by the involved can be very much increased. We invite the community to start a in depth discussions, how geo-facts should be specified. It seems obvious that geo-facts can be either bottom-up collections where citizens can contribute their thoughts and their local knowledge or top-down where the administration provides facts on legal restrictions or administrative settings. An example for bottom-up is the possibility to add photos as shown in Fig. 1. Photos can be used to document aspects that the local population wants addressed. A study

will typically be top-down since is it ordered and financed by the administration. The concept of geo-facts can thus incorporate both views and the planning process must later make a distinction if necessary.
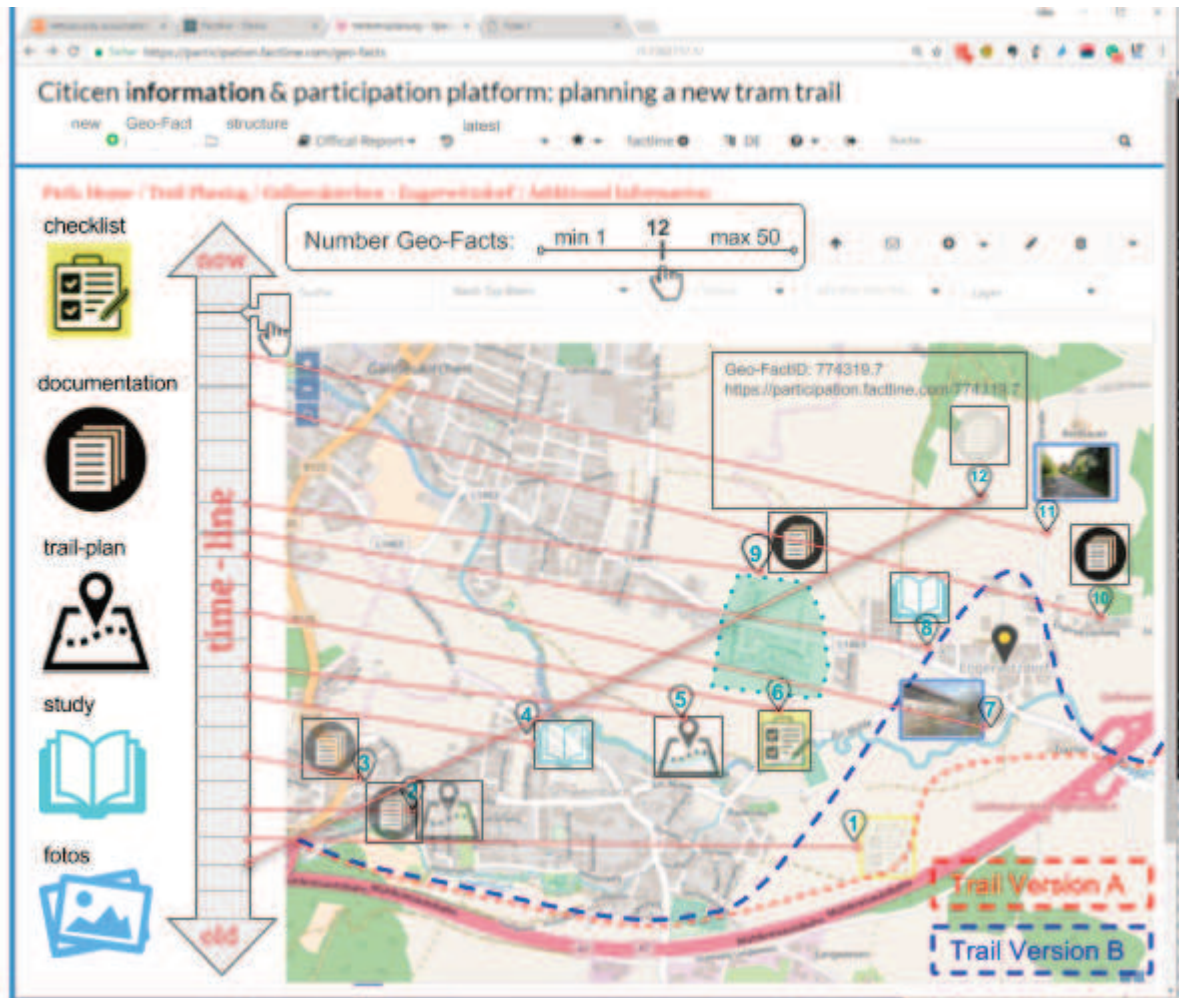

Fig. 1: A possible user interface to access geo-facts for an online-discourse in spatial planning: An example in a small Austrian village.

7 WORKING WITH GEO-FACTS

It is fair to assume future planning projects will require that better tools than providing some information on a Website, a Dropbox-Folder or some Wiki. Modern (Internet-based) society is suffering in many ways from information overload. One of the key problems might be that too much information is accessible and no reasonable filtering tools are available. Everybody with Internet access is a potential "fact-creator" and the created geo-facts are accessible for everybody else. This explains why there is so much more Information compared to former times. However, the challenge is now, how to cope with this reality.

It can also be said that that humans (participants of an online participation, spatial planning project) have a limited attention span to process Information. The attention span is thus a valuable resource. Now when suggesting a concept of information, the geo-fact, it is essential to consider how the information can be presented efficiently. Efficiency in in this context means, that a participants of a discussion process finds the relevant Information within his or her attention span. This requires the ability to separate noise (large number of geo-facts) from signal (relevant geo-facts).

Twitter is proof of the fact, that less data sometimes create more information. The concept, that the publisher of a tweet is restricted to 160 characters makes Twitter a widely used information and communication channel. The reduction of quantity is the key aspect for the consumers. The concept of geo-facts tries to apply this idea to information rich discussions in the domain of spatial planning.

Why are access permissions and fingerprints needed for geo-facts? As already mentioned, the core idea of the fact is, that it can be used as an argument in discourse. In the context of participation it is often assumed

that all information should be publicly available. But reality shows this can lead to problems. Figure 1 provides an example for a planned track in a village. Before starting the participation process, the village council will commission a consultant to analyse the area where the new trail is planned. The resulting report may contain descriptions of the private properties of the area and their condition. This Information could be used to draw conclusions on the financial status of the property owner and some property related information might even contain security relevant details.

The goal of the village council will be that all potentially affected citizens should participate. This might be persons living in the village but also people from a neighbouring village or people owning the property without living in the village. As a result it may be difficult to create a complete list of all persons who should be included in the discussion. However, all potential participants must be informed about the available relevant local facts (geo-facts) to ensure a high level of participation. The facts would provide the basis for the participants. But it cannot be published for universe (for everybody in the Internet) if it contains sensitive information.

In addition, it can be imagined that several planners are developing different variations for trails. Of course, the implementation of each trail would have a big impact on the owner of the affected property (e.g., by decreasing or increasing the property value). In the beginning of the planning process they might suggest many trails that are rejected for various reasons. But it would create irritation if the public would see all of these trails because they would naturally assume that this is a realistic track. However, later, when it becomes clear where the trail will be, the "old arguments" used to exclude these tracks might still be of value to prove that a neutral process was going on or to counter proposals for one of these fracks from the audience. So all the argument that have been invisible must later have the ability to become visible. In order to perform such changes automatically, concepts like a fingerprint of each fact (fact-hash) would be necessary.

From the above described scenarios the following additional requirements for geo-facts can be drawn. Each (version of a) geo-fact must have permission rules. It must be possible to grant access for persons in a certain group, e.g., for the neighbours of a property. As an effect of this, individuals might get different views if they belong to different groups. Persons with access to specific geo-facts may understand limitations for the planning that are more difficult to understand for outsiders, who do not have access to these geo-facts. Reasons to hide facts from the general public may be privacy or planned activities that are not yet developed for enough for a discussion in a wider audience.

7.1 A Possible Representation of Geo-Facts

A two dimensional map can present a limited number of geo-facts. The geo-facts are marked by Symbols. For instance a study is represented by the symbol of an open book. The zoom-level of the map and the total number of geo-facts determine how many geo-facts are displayed. Selection of geo-facts requires an order of relevance. This order can be represented using graphical variables. Relevant geo-facts are clearly visible; less relevant geo-facts seem to fade out. In Figure 1, the fact with the number 11 is the latest fact and the one with the number 1 is the oldest. Whereas the symbol of fact 1 is barely visible, the symbol for 11 is printed with a high saturation and the symbol is clearly visible. In addition, the facts are also connected to the timeline on the left side to make the temporal order of the facts visible. This idea was introduced in the concept of the geoTalk communication platform (Navratil and Harnoncourt, 2004).

What makes a geo-fact more relevant? This question cannot be solved completely in a short paper, but a first suggestion is possible. A new fact may be more relevant than a fact that was not explicitly known but already published earlier. In this case the relevance criterion is the actuality. So the most recently published geo-fact is "in the front" and older facts are faded out. However, only a limited number of geo-facts, e.g., the last 50 geo-facts, get displayed to make the information able to be processed. An alternative or complementary approach would be that the most important facts should be presented. The question here is to quantify importance. It can be assumed, that multiple factors make information important. For Instance, more relevant fact may be more often linked to other facts. Other possible parameters could be if the geo-fact is often commented or rated, often edited by different persons, often tagged, etc. If importance is considered as the relevance criterion, a formula to calculate importance is necessary. In contrast to systems like Google PageRank, such a formula needs to be published in order to be acceptable for public participation processes.

There have been even considerations to make the weighting of the parameters applied in the algorithm a process the community has to agree on.

7.2 Augmented Reality and GeoTalk

When assuming that mobile information sharing, communication, and participation is a growing in the information sector, especially in the field of special planning, it is essential that geo-facts can be displayed in a useful (value adding way) with smartphones. Modern participation tools could apply the concept of augmented reality (AR) to present the geo-facts but also to follow the "discourse elements" shown in Figure 1 about the specific project. Whereas Allbach et al. (2011), Broschart, et al. (2013) and Höhl and Broschart (2015), for example, focus on the inclusion of 3D models in real scenes, the concept proposed here would visualize the availability of geo-facts. Fundamentally the above mentioned concept from the GeoTalk-concept of fading of less relevant facts can be applied in an augmented reality viewer. Discussion on spatial phenomena is not simple because simplified representation of geography in the mental map leads to incorrect assessments. Typical examples are the rectangular arrangement of elements that humans intuitively perform and that frequently contradicts reality. Thus, discussion about real world phenomena is easier in the real world. Focal points in this situation are objects that the participants of the process can discuss about. However, digital fragments like facts are not visible in reality. AR-technology like special glasses can merge the real world and the digital view by depicting geo-facts in the correct location while navigating the area of interest. This can help to structure and guide a discussion process.

8   LIFECYCLES AND RELATED CRITERIA FOR GEO-FACTS

Geo-facts are created when something starts to exist or becomes relevant enough to be documented. The geo-fact changes with time. This could be a change of content, e.g., if the opening hours for a local attraction are changed. However, it could also be a change of location or extent, e.g., if a children's playground is extended or the public library moved to a different location. Finally the geo-fact is terminated when the phenomenon is eliminated. The geo-fact is still known but the phenomenon it represents does not exist anymore. This happens, e.g., when a building is demolished. This situation is similar to objects in a database: Such objects are created, destroyed suspended, and resumed. Their compositions can involve single objects, and then it is called evolving, or a group of objects. In this case it can be constructive and weak fusion, aggregation, separation, fission, or segregation. An algebraic description of such a model can be found in the work of Medak (1999) and a similar model based on identity-based change operations in the work of Hornsby and Egenhofer (2002).

Geo-facts contain more complexity than objects in databases since objects in databases are typically created by experts whereas geo-facts can be published by laypersons as well. The likelihood of mistakes is probably higher with laypersons and this may require corrections or more detailed definitions. This phenomenon is also known in other areas. Modern software, for example, frequently requires updates when new patches are available. Geo-facts equally need a possibility to be updated. However, unlike with software, it is important that the original version of the fact remains accessible Otherwise references made to the original fact could point to facts that do no longer support the claim made in the derived fact and thus nobody would be able to refer to an information and construct his argument based on other facts without freeze the referenced fact.

There are several additional aspects a "fact" has to comply with. The following list contains some aspects (formal criteria) and provides some concrete examples:

- Author or publisher (Who created the fact; who published the fact)
  Pictures of the car accident were made by A.

- Timestamp (Date of relevance for the information / When was it published)
  The car accident happened at 2:30 AM, the pictures were taken at 6:45.

- Permission (Who is permitted to view the fact)
  Police, prosecution, involved persons, and experts of the insurance company are permitted to access the pictures

- Guarantee of existence (Until what time will the fact be available)

- Metadata for correct interpretation of the fact (Language, Mime Code…..)

9 CONCLUSIONS

In the near future, major public discourse will take place in Internet and specifically in social media. Therefore, any information and communication environment that claims relevance must provide connectivity to social media. Most of the considerations for the suggested concept of geo-facts are derived from lessons learned in scientific communication. In scientific communication, the creation of information that can be cited is one of the most important aspects. The concept of geo-facts tries to transfer the concept that proved successful in science into social media. It should help to increase the quality of discussion the social media and (when used in this context) also in public spatial planning processes. A second benefit would be that the geo-scientific community would be able to publish their findings in a way that it can be the basis for a fact based online discourse.

The following core elements of the geo-fact concept are relevant

- Traceability of a fact development (version control),
- Referability and linkability,
- Guarantee of existence (How long will the information be available for sure), and
- Access permission on facts.

Geo-Facts can be the basis for a number of applications. The visualization presented in this paper is merely an incentive to imagine future applications based on geo-facts. However, it can be assumed that geo-facts could become a core asset for the developed world where augmented reality meets decision making in public space.

The above presented draft for a concept of geo-facts is a status report on an ongoing discourse building a robust framework for valuable arguments in spatial planning processes. The authors are convinced that the formal definition of a geo-fact can and should only be developed having in mind the applications and scenarios using geo-facts. There is a long list of open questions: The fading of facts requires a sorting mechanism. More discussion and the application of the idea in different scenarios will be necessary to understand, which aspects could be used to sort geo-facts. A complete set of formal criteria for facts is necessary as well as software solutions to make the tests in different scenarios.

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