Signaling Smartness: Smart Cities and Digital Art in Public Spaces

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ABSTRACT

Informational urbanism is a new research area in information science. In this study, art history joins informational urbanism: Are digital artworks in public urban spaces recognized as essential assets of a smart city? We employed case study research, working with the example of the huge digital media façade of the Arthouse Graz as an artwork in a public space. In a mixed-methods approach, we asked passers-by and interviewed experts on Graz as a smart city and on the Arthouse's role concerning the image of Graz as a smart city. The research found strong hints that indeed digital artworks with large screens or media façades at public spaces are parts of a city's weak location factors as well as of the city's urban structure and may symbolize the city's smartness. A practical implication of this finding is that artists, computer and information scientists, city planners, and architects should include interactive contemporary digital art into city spaces in order to demonstrate the city's way towards knowledge society.

Keywords: informational urbanism, smart city, digital art, public space, media façade, Arthouse Graz (Austria)

1. INTRODUCTION

Information urbanism is a new and exciting research topic in information science. It studies cities of the upcoming knowledge society in terms of "informational" cities or "smart" cities in an interdisciplinary perspective. Although smart city research is an emerging research field, the majority of the studies are technologically oriented, and library and information science (LIS) "has been very little involved in a 'smart city' research domain so far" (Luterek, 2018, p. 52). Important LIS topics in smart city research are the new functions of public and academic libraries in smart cities (see e.g., Dresel, Henkel, Scheibe, Zimmer, & Stock, 2020; Gremm, Barth, Fietkiewicz, & Stock, 2018; Henkel, Scheibe, Zimmer, & Stock, 2019; Kosior, Barth, Gremm, Mainka, & Stock, 2015). In this article, we introduce digital art as a research topic of informational urbanism.

In their comprehensive study on smart cities, Barth et al. (2017a, 2017b, 2018) state that especially interactive digital art in public spaces is a characteristic momentum of smart cities' weak location factors and of the city's creative infrastructure. We read, "[t]he union of the digital, art and participation is nothing less than a symbol of a smart city" (Barth et al., 2018, p. 39). It is a truism that certain epochs generate their specific arts in public spaces, as, for instance, reliefs and statues especially of emperors in ancient Rome or the construction of pavilions, monuments, and fountains with cherubim in art nouveau about 1900. Is digital art really the typical art form of smart cities? And how do citizens and tourists of a smart city recognize digital art in public spaces of their city?

The notion of a city's "smartness" is blurred (Fietkiewicz & Stock, 2014). However, the most appropriate term, "informational city" (Castells, 1989; Stock, 2011), was not able to gain acceptance. Moreover, the term "smart city" has its origins rather in marketing than in science; for example, the computer company IBM holds the trademark "smarter cities" and applies it in its smarter city campaign (Söderström, Paasche, & Klauser, 2014). Sometimes, "smart city" is more a narrative than reality (Valdez, Cook, & Potter, 2018). In the context of this article, a "smart city" is considered as a future-oriented municipality which banks to a great degree on (digital as well as analogous) information and knowledge as well as on information and communication technology, thus forming a prototypical city of the upcoming knowledge society and—anyway!—the "smart society."

Informational urbanism (Barth et al., 2017a; Stallmeyer, 2009; Stock, 2015), also called "smart urbanism" (Luque-Ayala & Marvin, 2015), is a multidisciplinary endeavor for research on smart cities consisting of urban studies, city sociology, city economics, architecture, and city planning on the one hand as well as of computer science and information science on the other hand. In this study, art history joins informational urbanism.

1.1. Informational Urbanism and Smart Cities

Informational urbanism studies all aspects of knowledge and information, be it digital or physical, man or machine generated, which has implications for cities, their spaces, their institutions, and—most important—their people. Albeit information and communication technology is the heart of a smart city, we may not forget knowledge both in the form of tacit knowledge (bound to persons) as well as in the form of explicit knowledge (bound to documents) (Stock & Stock, 2013).

Similar to the approach of Fistola and La Rocca (2013) we understand the city as a dynamic and complex system consisting of urban subsystems. Only a few smart city models consider aspects of creativity and art (Caird & Hallett, 2019); however, there are creative smart cities with manifestations of creative economy in place (Waitt & Gibson, 2009) as well as with creative spaces (Evans, 2009). The applied conceptual framework of informational urbanism (Barth et al., 2017a) is composed of seven building blocks, of which five are subsystems of the system of a smart city, the sixth represents the information behavior of the cities' stakeholders, and the last one includes problem areas (Fig. 1):

- information and knowledge related infrastructures (digital/ubiquitous city, green and sustainable city, knowledge city, creative city),
- economy (sectoral mix and labor markets),
- spaces (space of capital, power and information flows, space of places),
- politics and administration (e-governance and e-government),
- location factors,
- information behavior (use of digital media and the stakeholders' information literacy), and
- problem areas (e.g., gentrification, exploitation of labor, loss of identity).

1.2. Digital Art in Smart Cities

Digital art in public places is part of the city's creative infrastructure as well as of the space of places; it is a weak location factor, it influences people's information behavior, and it has effects on the city's knowledge-based and creative economy. Political and administrative support is needed to foster the installation of digital art in public areas. Digital art is surely more than a "feel good" factor (Pratt, 2009) of a smart city, and
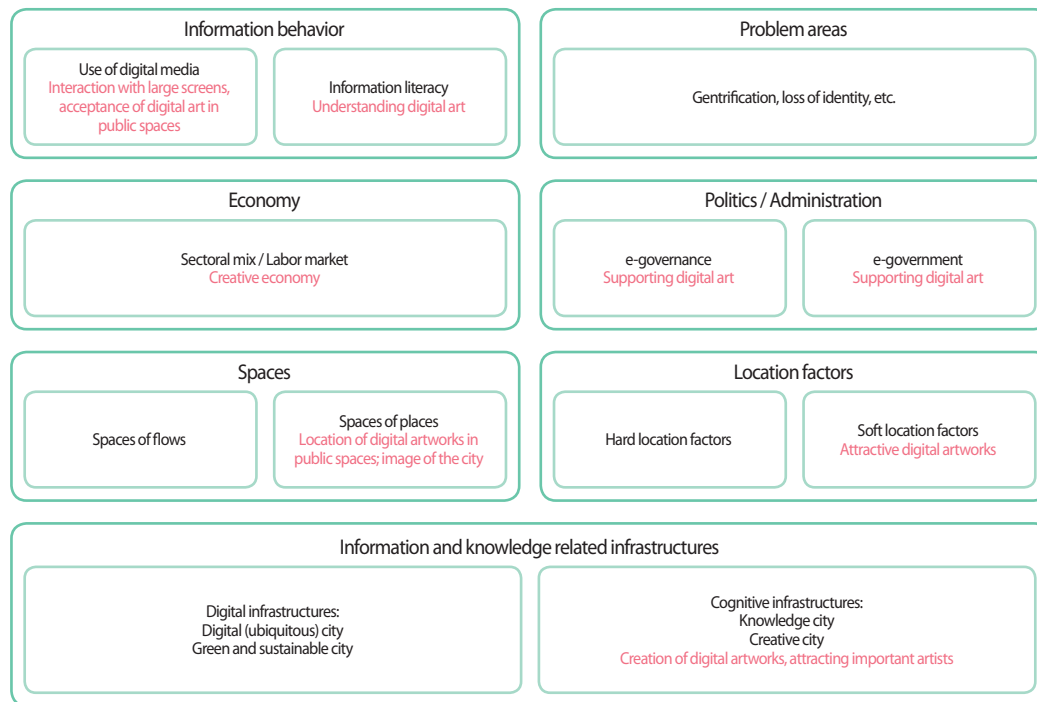
Fig. 1. Building blocks of a smart city and the importance of digital art in public places.

is namely an essential building block of such cities. Digital art employs digital computer technology and software programs in order to present the work of art (Paul, 2015).

2. BACKGROUND

2.1. Smart Society and the Noösphere

Starting with industrialization, mankind plays the major role in the development of earth leading to the term of "anthropocene" for this epoch (Crutzen & Stoermer, 2000). In the anthropocene, both the geosphere as well as the biosphere have been massively damaged. For Crutzen and Stoermer, the solution is to overcome the anthropocene and to bank on the noösphere (Vernadsky, 1945).

To develop a world-wide accepted strategy leading to sustainability of ecosystems against human induced stresses will be one of the great future tasks of mankind, requiring intensive research efforts and wise application of the knowledge thus acquired in the noösphere, better known as knowledge and information society (Crutzen & Stoermer, 2000, p. 18).

For Mainka (2018), a smart society is a knowledge society

that fulfills additional conditions. A smart city, quoting from Mainka:

- displays all characteristics of an information and knowledge society
  - in which networks of information are increasingly growing (including the Internet of Things and Open Data)
  - with advanced holographic and speed principles which grow from 'at any time and anywhere' to 'through anything, at any time and anywhere
- sustainability and health become important factors for the society and economy
- empowered citizens that engage in a more creative, innovative, and democratic future (open innovation on city level) (Mainka, 2018, p. 13).

With smart citizens (Zandbergen & Uitermark, 2019), co-creation of public buildings and even entire city districts as well as small-scale improvements (say, maintenance, repair, and overhaul of streets) are realistic scenarios (Mainka et al., 2016). A requirement of "open innovation" is the public access to and use of all (not personalized) data of the city including official statistics, city-related social media posts, and real-time data (e.g., from sensors). Therefore, upcoming smart societies and smart cities may form the epoch of the "noöscene" (from "nous,"

Greek for "mind," and the ending "-cene") (Cascio, 2009).

According to Florida (2002, 2005; Florida et al., 2011), creativity is the driver of the twenty-first century city. Cities attract members of the creative class in order to apply their knowledge in the city's companies and administrations. For Florida, the creative class includes all kinds of creative professionals, i.e., scientists and engineers (scientific and technological creativity), entrepreneurs (economic creativity), and artists (artistic and cultural creativity). Art in public spaces—both physical as well as digital—is clearly one aspect of a city's creative infrastructure or—defined more broadly— its cognitive or "noöscene" infrastructure (next to universities, science parks, business incubators, theatres, galleries, etc.) and can lead (especially in larger cities) to stronger employment (Polèse, 2012).

2.2. Smart Cities' Location Factors and the Place of Spaces

A location factor is a bundle of quantitative as well as qualitative indicators of attractiveness and location quality of geographic locations. It is used, for instance, for site selection of companies and as a decision-making basis for employees to work and live in the region or not. Economic research distinguishes between hard and weak location factors. Hard location factors are quantifiable aspects such as the position of the city concerning traffic routes (motorways, harbors, railways, airports), proximity to markets, natural resources, costs for labor, subventions, and taxes; weak location factors are, for instance, cultural institutions, schools, leisure facilities, shopping malls, and an innovative economic climate. With the transition towards smart cities the importance of location factors is shifting: In the past, hard location factors dominated from an entrepreneur's perspective, whereby in smart cities preference is given to weak location factors from the point of view especially of employees (Stryjakiewicz, 2010). It is therefore crucial to invest in weak location factors to inspire the desired knowledge workers and creatives for the city (Thite, 2011). This magnetic effect of a smart city, which of course affects not only employees but also companies, is reflected in attractive neighborhoods, well-paid jobs in knowledge-intensive and creative firms and institutions, optimal leisure and shopping facilities, and in good schools for employees' children.

Though Castells (1989) correctly states that in informational (i.e., smart) cities the space of flows outperforms the space of places, physical places still play an important role in cities. Castells also underlines the importance of the space of places in smart cities, too.

When analyzing spatial transformation in the Information

Age and showing the emergence of a new spatial form (i.e., the space of flows), I emphasized the persistence of the space of places, as the most usual form of spatial existence for humankind. I also observed that, while most dominant activities were constructed around the space of flows, most experience and social interaction was and still is organized around places (Castells, 1999, p. 296).

For Gómez (2013a, 2013b), digital art as, for instance, the media façade of Arthouse Graz (which is Gómez' example) visualizes aspects of the space of flows in the space of places: "The city is arranged according to the different ways in which the information can be visualized and hence becomes what could be considered the aesthetic manifestation of the 'space of flows'" (Gómez, 2013a, 2013b). It is the urban structure which makes a city livable and makes it desirable to live and work in the city or to visit it, and there are landmark buildings giving orientation for the people and a reason for visiting them. Therefore, digital art in public spaces should fit into the urban structure and fulfill the role of being a landmark in this structure.

How can cities' stakeholders show their citizens, tourists, and companies that their city is "smart?" "How can urban smartness be promoted?" (Fistola & La Rocca, 2013, p. 520). The necessity of signaling "smartness" results from existing information asymmetries, i.e., one side of the communication process (e.g., the citizens or tourists) is less informed than the other side (e.g., the city's administration): "Signals always play a role for unobservable characteristics or intentions about which a credible statement must be made" (Linde & Stock, 2011, p. 480). So signaling is a part of a smart city's communication policy in order to demonstrate the city's smartness. May digital art in public spaces be such a signal?

2.3. Digital Art in Public Places

Some cities rely on digital art in public spaces hoping that the "Times-Square Effect" will occur. This effect sees "architectural surfaces 'dematerialized' by the very screens that they physically support" (Sade, 2014, p. 58). Partially interactive video installations can be found on façades, walls, floors, stairs or ceilings: "the public art of the city has … begun to digitize" (Jiang, 2019, p. 1). Many digital installations work with large screens (David & Chalon, 2015) or even mega screens (Papastergiadis et al., 2013) and media façades (Haeusler, 2009) leading to interactions with the digital art (Behrens, Fatah gen. Schiek, & Brumby, 2015) and to the creation of a new sense of place (Tomitsch, McArthur, Haeusler, & Foth, 2015). Media façades are "installations in which displays are integrated into architectural structures" (Dalsgaard & Halskov, 2010, p.

Fig. 2. Arthouse Graz with reflecting media façade by day (images courtesy of Mechtild Stock).

2277); mostly they are the product "of the combination of LED technology and the curtain wall system" (Gu & Gu, 2013, p. 811).

Interesting examples of installations of digital art in public spaces are, for instance, the Ars Electronica in Linz, Austria (de Lange, Synnes, & Leindecker, 2019), the Crown Fountain in Chicago's Millennium Park (Gilfoyle, 2006), the huge media façade of Belarus' national library in Minsk (Vatin & Gamayunova, 2015), the Chanel building in Tokyo's Ginza shopping area (Gu & Gu, 2013), the Greenpix façade in Beijing (Gu & Gu, 2013), the Galleria Centercity in Cheonan, South Korea, and the façade as well as the large screens of the 300 m high Aspire Tower in Doha, Qatar (Gremm et al., 2018), not to forget the "classics," namely New York's Times Square, London's Piccadilly Circus, or Fremont Street and the strip in Las Vegas (Barnett, 2019; Kunzmann, 2019). Museums present further interactive digital art installations, for instance, the impressive exhibition of digital art in Tokyo's Odaiba by teamLab Borderless (Varnava, 2019).

What were the selection criteria for our empirical case? The city should be (1) a smart city, and (2) houses an established digital artwork in public space, while "established" means that the artwork is well recognized by inhabitants and visitors since many years. We identified the city of Graz, Austria, and its Arthouse (*Kunsthaus*) Graz with one of the oldest media façades worldwide as a suitable case.

3. GRAZ AND THE ARTHOUSE GRAZ

3.1. Graz, Styria, as a Smart City

Graz is the capital of the Austrian state (*Bundesland*) Styria, and has about 286,000 inhabitants in the core city and about 630,000 inhabitants in the metropolitan region (as of 2017). To decide whether Graz is a smart city or not, we look at typical

building blocks of such a city (Fig. 1). With eight institutions of higher education and about 60,000 students and with a gross domestic expenditure on research and development (GERD) of 5.16% in Styria in 2017 (which is the highest value in Europe), Graz is one of the leading centers of research and innovation in Europe and so without any doubt is a knowledge city. Graz has a rich historical center, which became a UNESCO world heritage site 1999; it has "one of the best preserved historical downtowns worldwide" (Arandelovic, 2015, p. 78). Graz was the European Cultural Capital in 2003; it is a member of the UNESCO Creative Cities network since 2011 (Arandjelović, 2008, 2012). It is evident that Graz is a creative city as well. There are some projects concerning the construction of sustainable city-quarters, especially of an industrial wasteland (Waagner-Biro) now called "Smart City Graz," leading to the cautious assumption that Graz is on its way toward being a sustainable city. As there are open data and open government in Graz implicating the government's transparency, citizen participation and collaboration, e-governance, and e-government exhibit characteristics of a smart city.

Dominating companies in the metropolitan region of Graz are both classical manufacturers as well as producers of electronics. The top three companies (by revenues in 2017) are *Andritz AG* (machine construction), *AVL List* (powertrain systems for combustion engines and electric powertrains), and *Energie Steiermark* (energy). However, there are also companies in the information and communication technology (ICT) construction and application market (Austrian Federal Economic Chamber, 2015), such as *ams* in Premstätten (sensors), *AT&S* in Leoben (circuit boards for semiconductors), *c.c.com* in Grambach (software development), *EFKON* in Raaba (electronic toll collection), *FELMI-ZFE* in Graz (electron microscopy and nanoanalysis), *NXP* in Gratkorn (contactless identification systems), *Anton Paar* in Graz (analytical instruments), or *TDK Electronics* (formerly *Epcos*) in Deutschlandsberg (electronic components, modules, and systems), some of them being "hidden champions" (Simon, 2009) in the ICT market.

In the space of physical places, Graz is Styria's road and rail hub with two important motorways and a widespread system of commuter trains (*S-Bahn*); however, the airport is small. Due to its universities, Graz is an international center in the space of information flows. According to the Globalization and World Cities Research Network (GaWC, 2018), Graz is no world city, but a Sufficiency Level city, which means that such cities are not dependent on other cities. Graz especially lacks a prominent position in the flows of financial capital, as there is no stock exchange. All in all, it indeed proves Graz to be a smart city. This result is in line with the data from the European Smart Cities

Fig. 3. Arthouse Graz with illuminated media façade at night (images courtesy of Mechtild Stock).

project, which follows the definition of smart cities as urban regions with a smart economy, smart people, smart governance, smart mobility, smart environment, and smart living (Giffinger et al., 2007). In the ranking of 70 medium-sized European cities, Graz is placed in the 13th position and has a good score especially in smart living and in smart governance (European Smart Cities, n.d.).

3.2. The Arthouse Graz

The Arthouse Graz (Figs. 2 and 3) is located at the banks of the river Mur in downtown Graz in the direct neighborhood to buildings from the Renaissance and Baroque periods; it is a "biomorph" bubble construction—called "friendly alien"—by the architects Peter Cook and Colin Fournier (Cook & Fournier, 2003). The *Kunsthaus* was finished as part of the European Capital of Culture celebrations in the year 2003; the museum's exhibition program specializes in contemporary art.

The media façade BIX ("Big Pixels") is an idea of Tim and Jan Edler and their company realities:united (Bullivant, 2005; Croci, 2010; Edler & Edler, 2010, 2015). The two describe their artwork:

> As the most important criteria were scale and affordability, we developed a grid of fluorescent lamps that could be controlled individually and adopt a brightness level between 0% and 100% in 1/18 of a second... Our 930 'pixels' (circular fluorescent lamps and the space surrounding them) have an individual size of about one square meter (Edler & Edler, 2015, p. 173).

The resolution of the matrix is very low, "with only 930 pixels – 0.2 per cent of the pixels in a conventional TV screen – that are black and white" (Bullivant, 2005, p. 84). Instead of being part of typical screens, "these 'pixels' immediately became architectural elements on their own right" (Edler & Edler, 2015, p. 173). For Bullivant (2005, p. 85), the Arthouse Graz breaks

fresh ground for urban constructions: "The Kunsthaus' fusion of architecture and design software, and media technology, defines a new standard in architecture—an approach that is likely to be a guiding strength of many future urban building schemes." Following Zarzycki (2010, p. 28), the media façade is part of a "digital landscape."

At this point, we have well-confirmed knowledge that Graz is a smart city (or is at least on the ways towards being a smart city) and that the Arthouse Graz with its media façade is a remarkable example of digital art in a public space. Now, we are able to define our research questions (RQs) for the empirical part of our study:

- RQ1: What do people—inhabitants as well as tourists—think about the importance of digital art in a public space for signaling the smartness of the city of Graz?
- RQ2: What are the opinions of experts on the importance of digital art in a public space for signaling the smartness of the city of Graz?

What is new in our study? The idea that digital art is a signal for a city's smartness is not new, as Barth et al. (2018) discussed it in a theoretical way. However, they had no empirical evidence for this statement. In this article, we empirically investigate the relationships between a smart city and digital art in this city's urban structure.

4. METHODS

First of all, our approach is case study research (Hays, 2004). Cases should make it possible to discover new explanations or interpretations that, in addition to specific cases, contain hints of general hypotheses. However, we only analyzed one single case. But "one can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods" (Flyvbjerg, 2006, p. 228). There is no reason to be pessimistic about the validity of our study, but we should indeed handle our interpretations with care.

In order to answer the two research questions and to arrive at quantitative and qualitative data, we integrated quantitative (for answering RQ1) and qualitative research methods (for answering RQ2) into a mixed-method technique (Bryman, 2006). Therefore, we conducted both a passers-by survey as well as expert interviews. The survey and the interview guide consisted of four basic questions:

1. Do you consider Graz to be a future-oriented, smart city?
2. Do you consider the Arthouse Graz as a work of art?

3. Do you consider the façade of the Arthouse Graz as an expression of a future-oriented, smart city?
4. Should such façades be built in other cities?

Additionally, we asked two questions of minor importance, namely "Do you think that there is communication between the media façade and the old town (*Altstadt*) of Graz?" and "Does the Arthouse fit into the surroundings of Mur and Graz' old town?" In the survey, we applied a 5-point Likert scale from 5 (*strongly agree*) to 1 (*strongly disagree*); additionally, there was the option 0 ("no idea"). Moreover, we noticed the gender and the passer-by's role in the city (inhabitant of Graz and surroundings versus tourist). The passers-by surveys took part in close proximity of the Arthouse Graz in the entrance hall of the Arthouse, in the Arthouse's café, and at the streetcar stop *Südtirolerplatz* in front of the Arthouse on January 12 and 13, 2019. We informed all respondents on the characteristics of a smart city; however, most of the persons immediately asked for clarification. We received 114 valid surveys from the passers-by. As the data is ordinally scaled, we calculated mode, median, and interquartile range (IQR). We conducted eleven interviews with experts (coded as Interview Partner [IP] 1 to IP 11 in the transcript) from information science, architecture, and art history in December 2018 and January 2019. The interviews were guided by the questions; however, there were open questions and the interviewer acted neutrally. We conducted eight of the interviews face to face in Düsseldorf, Germany, and in Graz, Austria, one interview by e-mail, one by Skype, and, finally, one by telephone. All texts of the interviews were transcribed in order to be evaluated qualitatively.

We have to confess limitations of the study. With eleven semi-structured expert interviews, the qualitative part of the study has a satisfactory empirical foundation. However, with only 114 surveys from the passers-by and a non-random sample (we could only consider people who stayed nearby the Arthouse in the two days of January 2019 and consented to speak with us), the quantitative part is rather limited. Therefore, we take the passers-by results only as a starting point of our study, while banking in more detail on the findings of the expert interviews.

5. RESULTS

5.1. Quantitative Results (RQ1)

We spoke with 114 passers-by; thereof were 44 men and 70 women as well as 36 tourists from German-speaking countries and 78 inhabitants of Graz and surroundings. The quantitative results for questions 1 to 4 are shown in Table 1. *Question 1*: Only 5.4% of all passers do not agree that Graz is a smart city; however, the median (and the mode) is the neutral value 3, while 49.5% agree or even strongly agree that Graz is indeed a smart city. *Question 2*: For nearly all participants the Arthouse Graz is an artwork by itself (mode: 4, median: 4, IQR: 1). *Question 4*: The estimation of the Arthouse's function as a role model for other cities is only a little bit less positive than the evaluation of the Arthouse as an artwork (mode: 4, median: 4, IQR: 1); however, here are fewer 5 ratings and more 1 ratings. The accompanying questions on the communication between the Arthouse's façade with the *Altstadt* and on the fitting of the Arthouse into the ensemble of the houses in the old town

Table 1. Passers-by's estimations of the "smartness" of Graz and the Arthouse Graz[a]

	(1) Graz is a smart city	(2) Arthouse Graz is an artwork itself	(3) Arthouse Graz is a symbol for a smart city	(4) Arthouse Graz is a role model for other cities
	Rel. freq. (%)	Rel. freq. (%)	Rel. freq. (%)	Rel. freq. (%)
Response				
Strongly agree (5)	9.0	39.8	29.1	21.6
Agree (4)	40.5	46.9	32.7	34.0
Neither agree or disagree (3)	45.0	10.6	26.4	23.7
Disagree (2)	2.7	2.7	10.9	12.4
Strongly disagree (1)	2.7	0	0.9	8.2
Number	111	113	110	97
Median	3	4	4	4
IQR	1	1	2	1

Rel. freq., relative frequency; IQR, interquartile range.
[a] Passers-by survey; Graz, Austria, January 2019; n=114 (missing values: answer "no idea").

Table 2. Passers-by's estimations of the Arthouse Graz as a symbol for a smart city by inhabitants and tourists[a]

	Arthouse Graz is a symbol for a smart city (Question 3)	
	Inhabitants, Rel. freq. (%)	Tourists, Rel. freq. (%)
Response		
Strongly agree (5)	28.6	30.3
Agree (4)	28.6	42.4
Neither agree or disagree (3)	28.6	21.2
Disagree (2)	13.0	6.1
Strongly disagree (1)	1.3	0
Number	77	33
Median	4	4
IQR	2	2

Rel. freq., relative frequency; IQR, interquartile range.
[a] Passers-by survey; Graz, Austria, January 2019; n=114 (missing values: answer "no idea").

generate neutral or positive results (communication: mode: 3, median: 3, IQR: 1; fitting: mode: 4, median: 4, IQR: 1).

The most important question (*Question 3*) is on the Arthouse's character as a symbol for the smart city Graz. More than 60% of all participants agree or strongly agree and thus support this assumption, while only about 12% disagree or strongly disagree. The mode as well as the median equal 4 ("agree"), and the statistical dispersion (IQR) is 2. If we take a closer look at tourists and inhabitants (Table 2), tourists vote slightly more positively in favor of the proposition that the Arthouse Graz is a symbol for the smart city. While only 57.2% of the inhabitants agree or strongly agree with this thesis, 72.7% of the tourists support it.

In the quantitative part of our study, inhabitants and tourists in Graz estimated the smartness of Graz and the role of digital art in Graz by using the example of the media façade of the Arthouse Graz. For the majority of respondents, Graz is indeed a smart city and the Arthouse Graz is an artwork itself. And, again, the majority of interviewed passers-by agree that the façade of the Arthouse Graz as an example of digital art is signaling the smartness of this city and may act as a role model for other cities.

5.2. Qualitative Results (RQ2)

In the qualitative part of the study, we report on the interviews with experts. Is Graz a smart city for our interviewees? Concerning *Question 1*, Graz has been future-oriented since decades; however, nowadays the characteristic "smart" should be added (IP 3). IP 3 noted that in 2001 (as the Arthouse was planned) nobody knew what a "smart city" was. There is no doubt for IP 3 that Graz is a knowledge city (due to the Karl Franzens University, the Technical University, and the Medical University) and a creative city as well (as there happens to be, for instance, the *Steirischer Herbst* festival). Styria is the most innovative region in Europe and, as Styria is strongly fixed upon Graz, Graz is a typical future-oriented city of the 21st century (IP 4). However, for people from the digital arts scene there is only little support in Graz, so that they left Graz and went to Linz—the city of the Ars Electronica (IP 5). IP 7 sees the lack of an academy of art in Graz. The city's administration has tried to construct a sustainable green city quarter (IP 2). In resolutions of the local government the term "smart city" only rarely occurs and when, only in relation to the former industrial wastelands (IP 5). The newly built so-called "smart city" offers rental units which could be built cheaply (IP 6, IP 7). IP 10 sees the absence of large flows of financial capital in Graz (in contrast to, for instance, London). The answers vary between a clear "yes—Graz is a smart, future-oriented city" and a somewhat more cautious formulation "not yet."

Coming to *Question 2* and the accompanying questions (What about the Arthouse Graz as a work of art, does it fit Graz' old town area, and is there any communication of the Arthouse's façade with its surroundings?), for nearly all of our interviewees, there is no doubt that the media façade is digital art: "The three conditions of the façade, namely interface, architectural expression, and historical urban context, cause that the façade is an artwork in its own right" (IP 8). This kind of art is made by creativity and digitalization (IP 2). The media façade is in strong contrast to the red roofs of the old town (IP 3). This is similar to the artworks in the city park, where neoclassical fountains and sculptures with cherubim are located next to an artwork by Serge Spitzer from 1985 called "rusty

nail" (IP 3). The Arthouse is a "provocation" (IP 9); it is not in line with the surrounding buildings for formal, art historic, and functional reasons. However, these exact contrasts are the Arthouse's strengths. "It would be too short-sighted to say what does not look alike does not fit together. On the contrary ... in my view, the Arthouse suits the environment very well" (IP 8). "Does the Arthouse Graz match the surroundings? Thank God: no!" (IP 4). It is the tension which makes a city interesting. "The tension arises because the city has works of art from different periods. The tension is lost if it is not so, and that's why the Arthouse … does not fit the old town" (IP 4), and that is only an advantage for Graz. Communication can only occur after dusk as one cannot see the pixels in the daytime (IP 5); however, the façade's structure (but not the messages) can be seen day and night. There are rather high trees in front of the Arthouse, which disturb communication with viewers (IP 4, IP 5, IP 6). We heard massive criticisms on the communication of the façade, as it has far too little interactivity. "So it really should be more interactive" (IP 6).

Our most important question (*No. 3*) is on the signal effect of the façade of the Arthouse for Graz as a future-oriented, smart city. The Arthouse was famous in 2003 and a signal of a forward-looking city (IP 6) and it was an important mark that it was permitted to be built (IP 7). Neither today nor in the year 2003 was the façade's technology high-tech. For IP 4, it is not a question of the technology's quality, but of the impact of the artwork. "For me, the façade is expression of a future-oriented smart city" (IP 4). "In terms of symbolism, this is a good cause for Graz," another interviewee (IP 9) said. The Arthouse is a part of the city's architainment; "it is a real attractor" (IP 10) and it is—as an expression of our times—"unavoidable" (IP 10). The so-called "Smart City Graz" (i.e., the former brownfield) is surely no bearer of the city's aura, but the Arthouse is (IP 7). It is indeed a tiny piece of a puzzle of the entire smart city Graz (IP 8).

Is the Arthouse a role model for other cities (*Question 4*)? For IP 2, the construction of the building including the media façade is a prototype for other cities. Any smart city should have such a signal of its smartness, as otherwise a city runs into the danger of realizing only smart shutters, smart lighting, smart meters, and other smart trivialities (IP 3). The concrete embodiment of the Arthouse is no role model; it is an artwork and as such is unique. "The façade was developed specifically for this space and this time" (IP 10). In addition, the Arthouse "sets a high bar and cannot be copied" (IP 9). So other smart cities should pass "similar issues and similar process designs" (IP 8) in order to arrive at city-specific and unique signals for their smartness.

6. CONCLUSION AND DISCUSSION

6.1. Digital Art as a Signal of a City's Smartness

The results of our case study obviously demonstrate that digital artworks in public spaces are parts of the city's weak location factors as well as of the urban place of spaces, and they symbolize the city's smartness on its way towards a knowledge society. The digital art of the façade of the Arthouse Graz is indeed much more than a "feel good" factor of the smart city Graz, as it signals the city's smartness to citizens and visitors.

How to interpret these results? As every era has its own style of art, the typical art of the knowledge era, the smart era or the nooscene, seems to be digital art. Located in public city spaces, digital art combines the physical space with the "cyberspace" (Light, 1999) or the "electronic space" (Crang, 2000). Digital art becomes an essential part of a smart city:

Sometimes, art takes up urban space as a living gallery with which it can engage with everyday life, its meanings, cultures and rhythms. Oftentimes, art enters urban space in critical response to what is perceived as instructive mechanisms in digital culture and existing networks, applications or interfaces of the 'intelligent' city (Ag, 2017).

The shift of borders inside the digital space and by the digital space leads to people's experience of a unit of the physical and the digital in the urban space of a smart city. There is a kind of "eruption" of the digital into the physical: "We no longer go into the network; instead, it is the network that comes into us" (Lodi, 2013, p. 12). Digital art in smart cities' public urban spaces forces citizens as well as tourists to deal with the new digital nooscene. We agree with Gu and Gu (2013, p. 814): the "media façade is the grasp of this city of the future." "When dusk began, constantly changing content has become a special light spot, becoming the city's scenic spots, forming a huge attraction to the visitors, people into a lingering in the square of light" (Gu & Gu, 2013, p. 811).

Digital art in public spaces is a visible signal to emphasize the city's smartness and its way towards a future-oriented city of the 21st century. Our results are in line with other observations: "Urban public art is an important part of the urban landscape, and it is the organic composition of the city, it represents a city's appearance and characteristics and is the card displayed by the city outward the world" (Zhou & Fu, 2017, p. 496). The results are also in line with observations by Allam and Newman (2018) that culture—in our case digital art—is an important building block of smart cities: "Cultural and historical attributes of cities create unique and special urban areas for local communities and visitors. Culture can also be a special driver for regenerating

economic growth; ICT can enable uniqueness and special qualities to be generated as part of a smart culture approach" (Allam & Newman, 2018, p. 20).

6.2. Participatory Interactive Digital Art

For Zhou and Fu (2017, p. 505), interactivity in digital art is essential. In their terminology, the Arthouse Graz offers viewing interaction and experiential interaction; however, it lacks participatory and virtual interaction (i.e., the audience has only experience and feedback with the artwork). Our interviewees also criticized the missing participatory functionalities of the Arthouse. Such participatory interaction with digital art may lead to new content, which is not fully controlled by the artist. As we have learned from Mainka (2018), citizen participation is essential for a smart city as a prototypical city of the 6th Kondratieff wave, which leads to "cultures of participation" (Fischer, 2011). The Arthouse Graz is a very early installation of digital art and lacks such participatory interaction. The example of the experiment "Aarhus by Light" in Aarhus, Denmark, with a media façade showed different forms of participation, namely individuals interacting with the media façade in the public space, people watching and exploring together, people entering a dialogue with the artworks, and, finally, collective actions of groups (e.g., planned choreography) (Brynskov et al., 2009, p. 166). Another example, now with interactive public displays, the StreetGallery in Oulu, Finland, exhibits positive aspects. Participants of a survey on the special public form of an art gallery state, "public urban spaces are well suited for exhibiting art" and "having an exhibition in StreetGallery was overall a positive experience" (Kukka et al., 2017, p. 41). In smart cities, the design process of the city's architecture is focused on "the communication between people and buildings" (Gehring & Wiethoff, 2014, p. 474). Means of this communication are large screens (public displays) as well as media façades enabling interactions between art and men in public spaces. However, too many installations may lead to light pollution and confusion in the city (Lee, 2016).

6.3. Digital Art in the Urban Structure

The Arthouse Graz and many other media façades can not only be considered as artworks, but also as elements of the urban structure because—following Lynch (1981, p. 135)—"people use many different clues to establish (environmental) structure – the recognition of characteristic form or activity in areas or centers, … landmarks …" leading to an image of the city. Do media façades indeed help people (especially by night) to find their way through a city because of their "imageability" (Lynch, 1960) or their interactive "playability" (Stevens, 2006)? Digital art can play an important role in the smart city, but only if it considers the entire urban system as well as peoples' paths through the city and not as an isolated element. In Graz, the media façade founds its ideal place in the historic city center at the banks of the river Mur in close neighborhood to a widely used bridge (*Erzherzog-Johann-Brücke*) and a crowded place (*Südtirolerplatz*), creating a stark contrast to the historic buildings in its surrounding and thus forming a landmark, a "flagship urban space" (Caprotti, 2019) and a special image of Graz.

A practical implication of our results is that artists, computer and information scientists, city planners, and architects should include contemporary (especially participatory interactive) digital art into city spaces in order to signal the city's way into a smart society, and—not to forget—to allocate financial support for such projects (Naber, Schäfer, & Becker, 2018). As one of our study's limitations is case study research with only one case, next steps in this research program should include more smart cities and more digital artworks in public spaces. Additionally, researchers ought to consider the different levels of interactivity of the digital art (viewing, experience, participation), the different genres of digital art (media façades and large public displays), and the audience's and experts' evaluations of those artworks and their interactivity levels.

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