Long-term Perspectives of Stakeholders' Perceptions of Visualisation Media in Participatory Planning: The Case of Sanguan Temple Square in Guangzhou

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Abstract: Despite recent developments in the field of visualisation technology and evaluation studies, little research has been carried out on how stakeholders perceive different visualisation tools over the longitudinal development of planning projects. Using questionnaires and semi-structured interviews, this study examines the effectiveness of analog tools (sticky notes, photographs, paper maps, 3D physical models), digital visualisations (2D digital images, 3D modelling) and news coverage throughout a community micro-regeneration process. 3D physical models and 3D modelling were considered the most useful in terms of aiding comprehension and discussion. The longitudinal impacts of different visualisations were observed, ranging from information and communication to social, cultural and political influences on public awareness, cultural rehabilitation and political attitudes. The findings suggest using a combination of analog and digital visualisations overall suits stakeholders' needs best.

Keywords: Longitudinal, visualisation, analog, digital, perception

1 Introduction

The advantages of using analog and digital visualisation tools to support participatory planning have long been recognised (AL-KODMANY 2002, BISHOP 2013, LANGE & BISHOP 2005). Studies have demonstrated the effectiveness of visualisation tools in cognitive, affective, and behavioural dimensions, such as information and motivation (WISSEN HAYEK 2011, HEHL-LANGE & LANGE 2017), communication and interaction (AL-KODMANY 2002, LANGE & HEHL-LANGE 2010), changes in public awareness and action (LU et al. 2020, SHEPPARD 2005), and informing policy development and adjustment (PETTIT et al. 2011, SCHROTH et al. 2015). Most usability evaluations of visualisation tools have been conducted in controlled workshop environments. Their application in real-world planning practices, however, has hardly been investigated (BILLGER et al. 2017)

A typical planning project undergoes inventory, planning and design, evaluation and decision-making processes before its final implementation. Many evaluation studies of visualisations concentrate on a particular point in time during the process. Although they effectively determine the potential or limitation of different tools, they fail to take into account the long-term perspective in the overall process (BISHOP 2013, SCHROTH et al. 2015). A longitudinal study offers a way to look back at past events and collect data showing the impact such events have had over a long period (ELLIOTT et al. 2008). Using a longitudinal examination of a community micro-renewal project, this study explores how stakeholders perceive different visualisation tools used at various planning phases and the impact of these tools over time.

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2 Methods

2.1 Study Context

Sanguan Temple Square in the Puntoon Wuyue Village, Guangzhou serves as a crucial node for local people to gather and pursue cultural activities. Since 2017, local people's needs were identified by the community planners through various focus groups as part of an overall renewal project. A number of improvements have been proposed and further illustrated in the design stage through exhibitions and workshops. Special attention was given to the reinstating of a gatehouse in the square. Using a range of media and with the help of a 1:1 physical model construction and a gate design competition, the final decision was approved in expert meetings. At the time of writing, the major part of the project has been implemented, while the gatehouse construction remains on hold.

2.2 Presentation Format

Seven types of visualisation tools were adopted during the participatory process. These encompass analog as well as digital media. Examples as used during the entire process are presented in Figure 1.

a) An A0 board with sticky notes to solicit opinions about the site;
b) A series of A5 photographs presenting the history of the square;
c) A series of A4 paper maps showing the historical evolution of the site;
d) An A2 digital plan of the square design with detailed illustrations of key landmarks;
e) A 1:1 physical model (approximately 4 x 5 x 1 m) of the proposed gatehouse;
f) 3D renderings showing the proposed gatehouse in the square for the design competition;
g) TV news informing the on-going implementation of the project.

The photographs and maps (Fig. 1-b, 1-c, 1-g) were prepared using museum archives and private collections. The plan in Figure 1-d was created by designers using Photoshop and CAD. 3D renderings as represented in Figure 1-f were exported from selective perspectives (eye-level and bird's-eye view) of gatehouse SketchUp models by different competition participants. Some visualisation tools allowed people to interact with them. For instance, the large 1:1 physical model was pre-cut and arranged jointly by local people and planners (Fig. 1-e). The sticky notes enabled participants to express their concerns (Fig. 1-a) and vote for their favourite design (Fig. 1-f).

Fig. 1: Examples of visualisation media used during the participatory process

2.3 Data Collection and Analysis

Drawing on BISHOP (2013), triangulation methods combining interviews and questionnaires were conducted with five stakeholder groups: villagers, tenants and other residents (V), planners, designers and competition participants (P), news media (N), construction teams (C) and government officials (G). Through ethnographic observations and interviews with stakeholder representatives (V=10, P=3, N=2, C=1, G=1) between 2018 and 2020 the effects of visualisations were investigated. Interviews were transcribed and analysed using NVivo 12 software.

To get an overall picture of the performance of different visualisation tools and to support the qualitative interviews, surveys were conducted with 57 stakeholders (V=38, P=8, N=3, C=3, G=5), who have been involved in various planning phases (Inventory=28, Design=43, Decision-making=10, Implementation=16). Their demographic information is as follows: 42 were male and 15 were female; 12 were aged 18-30, 16 were aged 31-45, 16 were aged 46-60 and 13 were aged 61 or above; 13 held an education level of middle school or below, 19 people were educated to high school level, 18 had an undergraduate degree, and 7 were educated at master's level or above. They were asked to evaluate the visualisation tools they have used concerning their easiness to comprehend and helpfulness for discussion and state their ideal tools for each of the planning phases they participated in. Descriptive statistical analysis using SPSS 25.0 was used to show similarities or differences of the stakeholder groups.

3 Results

3.1 Perceived Effects of Visualisations throughout the Process

Suffering from long periods of housing demolition in their district, Group V was initially opposed to the renewal project when approached. Analog visualisations helped to build trust between Groups V and P. P1 recalled: "We made a physical model of the ancestral hall, [The villagers] pointed at it and advised on renovation using sticky notes. Later, they were much more open to us." The old photographs (Fig. 1-b) and paper maps (Fig. 1-c) have invoked the hidden history of the village especially for many younger-generations (noted by V3, V5, V7, V9). One example is illustrated by V3: "I was not aware that there was a river winding through the village, nor did I know about the cultivation of Puntoon Wuxiu (five kinds of water crops) in this area." These have aroused their sense of cultural belonging, which later became the inspiration for the design, according to P3, "to restore local culture through different design elements, such as pavements, stone lion sculptures, rebuilding the ancient bridge, and levelling the square for cultural activities."

During the design and evaluation stage, visualisation created an active environment for social engagement and communication of design. To promote the local culture, an exhibition showing the history and future of the site was initiated by some people from Groups V and P. Visitors of the exhibition commented on the 2D plans (Fig. 1-d) and physical models as "it was direct to see the past and forthcoming future of the area through which we could suggest our needs" (V4, V6, V8, V10). The reinstating of the historical gatehouse involves several government sectors, and its associated management problems have hindered its development. A 1:1 physical model was jointly made by Groups V and P, taking a half-day to build (Fig. 1-e). According to V1, V2, P1, P2 and N1, the aims were two-folded: "compare design alternatives and attract social attention through news reports and the on-site exhibition."

Visualisations have effectively shifted political attitudes and decision-making. In the initial stages the project failed to achieve approval due to disagreements between Groups G and P over the gate's location. A design competition was subsequently conducted using SketchUp renderings in which people were invited to vote for their favourite design (Fig. 1-f). This was in effect, attracting a large audience. One design competition participant (P5) recalled: "Many passers-by dropped into our exhibition and looked at different proposals; several journalists reported the event, one of whom even participated as a designer." The social impacts have greatly influenced the decision-making process. "The winning projects were against my proposal and I have to compromise," said G1. P1 and P2 also noted changes of political behaviours after the competition: "G1 assisted us with the administrative process" and "Group G in the second-round evaluation approved our design and praised the competition voting as a collaboration example between designers and the general public".

Along with ongoing implementation, visualisation has had a wider socio-cultural impact. Many people visiting the square will stop and look at the photo exhibition (Fig. 1-b). This was reinforced by villagers" spontaneous behaviours and different forms of publicity by news media (Fig. 1-g). N2: "I hope to make more people aware of the site, and promote the local culture and the place's identity. This also has implications for other community renewal projects in Guangzhou." V5 explained his intention to initiate the village-based WeChat platform: "We hope to attract more attention to the village and disseminate our local culture… Several blogs went viral, much more reads than our account followers…"

3.2 Utility Evaluation of Visualisation Tools

Tab.1 illustrates different tools used during the participatory process. Analog tools were mostly adopted at the inventory stage. The design period saw use of a combination of both types of tools, whereas more digital visualisations were utilised during the decision-making process. In the implementation and maintenance phase a combination of both tools was used. Of the seven types of visualisation tools, 3D physical model, photographs, and 3D digital modelling were seen by most participants, with sticky notes and news media being less frequently seen. Stakeholders' evaluation of the ease of comprehension of the visualisation tools was generally positively linked to their helpfulness for discussion. 3D physical models were regarded as the most helpful for comprehension and discussion, followed by 3D digital modelling. Paper maps were ranked the least useful in both metrics.

In relation to inter-group comparisons, groups P and V vary significantly in perceiving 2D digital images and 3D modelling. Among those who evaluated both tools with high ease of comprehension, the scores by Group P (75%, 78%) were twice that of Group V (35%, 36%). Age differences were also a factor in the perception of digital imagery. More than 60% people aged 18–30 considered them to be easy to comprehend and helpful for discussion while the rating for the 61+ group was 20%. Education level was observed to affect the perception of digital visualisation tools. Those holding an undergraduate degree or above felt more comfortable with digital tools compared to those who were at junior-school level or below. Gender did not impact stakeholders' perceptions of the digital visualisations. There were also no significant proportional differences between various stakeholder characteristics (stakeholder category, age, gender, and education level) in perceiving analog tools and news media.

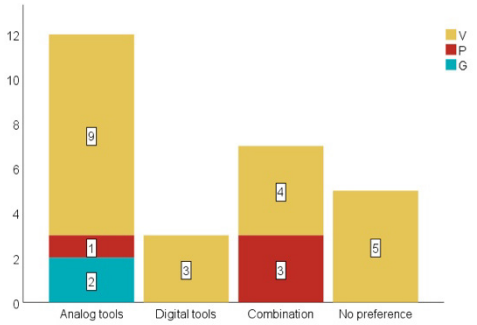
Table 1: Utility evaluation of visualisation tools

Availability during planning phases					**Number of people have seen**	**Ease of comprehension**			**Helpfulness for discussion**		
Category	PP1	PP2	PP3	PP4	Number	Low	Medium	High	Low	Medium	High
Sketch and sticky notes	X	X			22	9%	41%	50%	9%	32%	59%
Paper map	X	X			31	6%	61%	32%	10%	45%	45%
photo	X	X		X	34	0%	50%	50%	0%	44%	56%
Physical model	X	X	X		42	0%	26%	74%	0%	26%	74%
2D image		X	X	X	29	3%	48%	48%	3%	31%	66%
3D modelling		X	X		34	3%	38%	59%	3%	26%	71%
News media		X	X	X	27	0%	56%	44%	0%	33%	67%

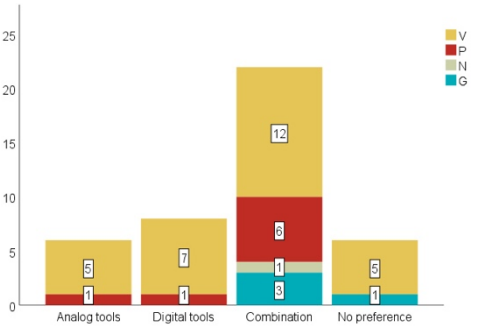
0-25% 26-50% 51-100%

Note: PP1= inventory, PP2=design, PP3= decision-making, PP4=implementation and maintenance; Light grey to dark grey indicates an increasingly stronger view regarding ease of comprehension or helpfulness for discussion.

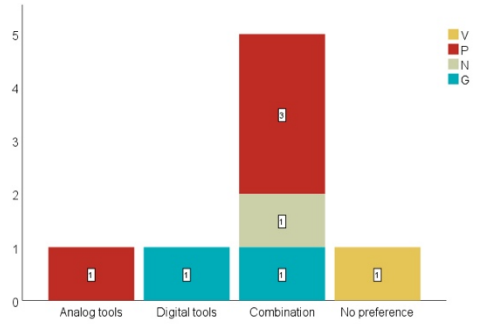
Stakeholders were asked to indicate their ideal visualisation tools for planning communication at each phase they had been engaged in. Figure 3 suggests that the preferences of major stakeholders (Group V, NM and G) moved from using analog tools in the inventory stage to combining analog and digital devices as the project progressed, which were in line with the observed use patterns (Table 1). Group P preferred combining both tools throughout the process. Figure 4-a shows that most stakeholders prefer using 3D physical models among the analog tools. Concerning digital visualisation tools, 3D and more advanced technology were most popular with stakeholders (Fig. 4-b), particularly in the younger generations and those with a higher education degree.



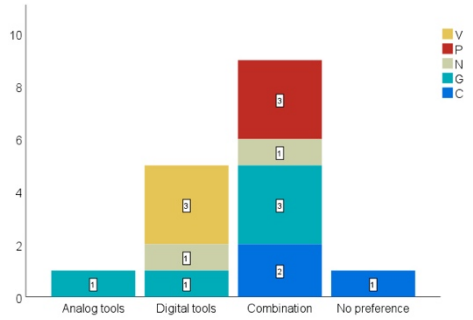
(a) Inventory



(b) Planning and Design

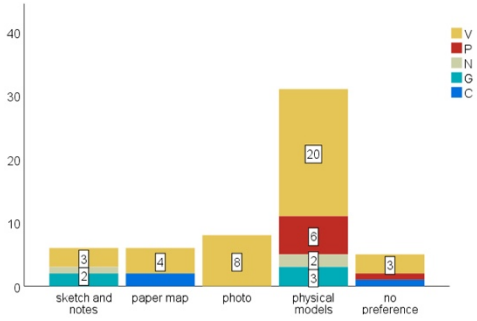


(c) Decision-making

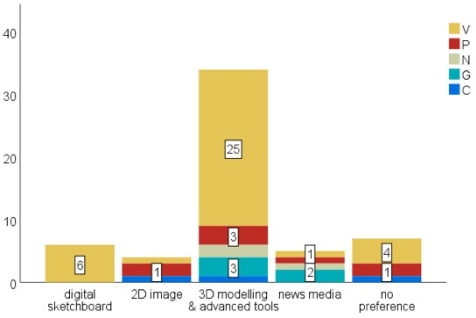


(d) Implementation and Maintenance

Fig. 3: Stacked bar count of stakeholders' preferences for visualisation tools at different planning phases. (a) inventory; (b) design; (c) decision-making; (d) implementation and maintenance



(a) Favourite Analog Tools



(b) Favourite Digital Tools

Fig. 4: Stacked bar count of stakeholders' preferences for visualisation tools: (a) analog tools; (b) digital tools

4 Discussion

The interviews have demonstrated the effectiveness of visualisations in terms of information and communication during the planning process, which corresponds to previous work (HEHL-LANGE & LANGE 2017, WISSEN HAYEK 2011). Visualisation tools with larger dimensions, such as photo exhibitions, design competitions and a 1:1 physical model (Fig. 1-b, e and f), were observed to trigger wider social attention. This confirms Lu et al. (2020) 's findings that landscape visualisations with larger dimensions are more likely to attract and sustain people's attention. This increase in social awareness further contributed to the shift of political attitudes. The findings align with SCHROTH et al. (2015) where governmental policy and operational changes occurred after exposure to visualisations.

Notably, the effects of visualisation related to cultural identity were consistent at various stages, indicating that analog and digital tools could serve as bridges to increase cultural awareness through both intangible elements and material forms. The results reflect those of HEHL-LANGE & LANGE (2017) who also found that participants related their memories and experiences to visualisations. A limitation of longitudinal studies is that some compounding variables (e. g. policy or environment) may also affect the project beyond the roles of visualisation tools. Triangulation methods are needed to complement participants' statements and examine the findings in different contexts.

Both analog or digital 3D visualisation has demonstrated superiority over 2D representation in usability evaluations and preferred items. This has been confirmed by the participants' ratings of various visualisation tools in the workshop experiment by GILL et al. (2013), which could be explained by the fact that 3D visualisations allow viewing the proposed design from multiple perspectives (LANGE & BISHOP 2005). Generally, differences were found in the evaluation of digital images and 3D modelling in terms of aiding comprehension and discussion. These were evident between lay people and experts, the highly educated and less educated, and the young and the old. Studies have shown that experts differ from novices or lay persons in processing image contents (DUPONT et al. 2015). SCHROTH et al. (2015) have also noted the difficulty of the older generation in understanding digital devices.

5 Conclusion

This study has highlighted the effects of analog and digital visualisation tools in the various stages of a planning and design project. It provides implications regarding when and how various tools could be tailored to meet different purposes in various participatory settings. The results indicate that a combination of analog and digital visualisation throughout the participatory process would best suit diverse stakeholders' needs and could potentially cater to a wider audience. It could be used as a basis to develop more detailed visualisation guidelines. We expect advanced visualisation techniques permitting on-site visualisation (e. g. HAYNES & LANGE 2016, HAYNES et al. 2018) to play an increasingly important role in visualisation and stakeholder involvement in the future.

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