

# Designerly Ways of Exploring Crowds

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## ABSTRACT

In this article, we present examples of using designerly ways to explore “crowd” phenomenon in a cross-disciplinary project named EWiDS. The phrase ‘designerly ways’ refers to visual communication methods such as drawings and videos, which are widely acknowledged as effective approaches to cross-disciplinary collaboration. This study started with designerly ways of exploring crowd experience and crowd management. Three crowd situations, public transportation, outdoor event, and indoor event, were selected as representative crowds that are distinguishable by crowd size, level of interaction, and emotional intensity. Current activities and problems in these crowds were visualized, and some possible solutions were presented as scenarios. These visualizations and scenarios were used as conversation stimulators in a plenary meeting of EWiDS and received positive feedback on their effectiveness in assisting project members in communication.

**Keywords:** Designerly ways, Crowd, Visual communication

## 1. INTRODUCTION

May 4, 2010 was the annual National Remembrance Day (*Dodenherdenking*) in the Netherlands, where around 20,000 people gathered on the Dam Square in Amsterdam. During the two-minute silence, an unexpected loud shout from a man panicked the silent crowd, which resulted in an uncontrollable and dispersion of "human waves". Recently, on June 9, 2014, the annual famous Dutch pop music festival Pinkpop was ravaged by storms. The organizers called the 67,000 visitors to stay on the ground, away from all the towers, trees and tents. Crowds of visitors were shrouded in ponchos and huddled in groups against each other. Fortunately, most visitors were used to large crowds and did not panic.

The two examples above represent extremes. However, they ended differently. The first incident caused injuries to over 50 visitors. There were no injuries in the second one. Crowds are so mysterious that you might wonder why a loud scream can result in a panicked stampede, while the threat of lightning did not turn a crowd into chaotic swarms. Indeed, the crowd at Pinkpop continued celebrating after the storms.

Crowds are so complex that the research into the types of crowds and crowd membership is limited. Challenger et al. (2010) suggested ten potential dimensions for a crowd typology: (1) purpose of the crowd; (2) duration of the events; (3) start time (e.g. a football match or a concert has a fixed start time); (4) event boundaries (e.g. indoor or outdoor event); (5) event atmosphere (e.g. peaceful or aggressive crowd); (6) crowd membership identification: the extent to which crowd members share a sense of social identity (e.g. acquaintances or strangers, allies or opponents, groups of family or friends); (7) level of interaction; (8) heterogeneity of crowd membership; (9) size of group unit (e.g. mainly singletons or mainly groups); and (10) amount of luggage.

To date, there is no consensus on the definition of a crowd. Some researchers defined crowd as a temporary gathering of individuals who share a focus of interest (Forsyth, 2005) or a social identity (Reicher, 2001). Similarly, Challenger et al. (2010) defined a crowd as a sizeable number of people gathering at a specific location for a measurable time period, with common goals and displaying common behaviors. However, people in crowds usually do not have the same goal. For example, people who go to a large railway station do not always go there to take a train. Sometimes, they pass through the station or go shopping there. At present, train stations and airports have become social gathering places where people meet, eat, and shop. Therefore, Wijermans (2011) defines a crowd as a large gathering of people at the same physical location, at the same time, not necessarily sharing the same goal or interest.

Since crowds appear at large events and in everyday locations such as public transportation or busy shopping streets, crowd management has become top priority in many event organizations and government policies. This is where the EWiDS<sup>1</sup> project began. The EWiDS project is a technology-driven project, aimed at developing large-scale sensor networks to sustain crowd well-being and assist crowd management. Academic and industrial researchers from a variety of disciplines collaborate in EWiDS, including computer science, industrial design, and physics. Effectively communicating and sharing knowledge with each other is critical. As Henderson (1991) observed, information sharing should be flexible and facilitate multiple interpretations, similar to the way "white boards" carry visual representations in a "shared interactional space" (Suchman, 1988).

Thinking in a visualized form is probably an innate ability of humans. It is not difficult for listeners to form images in their minds when hearing a vivid story. Designers are used to visualizing

<sup>1</sup> EWiDS stands for Extreme Wireless Distribution Systems. It is a project under Dutch COMMIT program, developing and testing large-scale wireless sensor networks to be used in crowd management.

form and turning mental images into sketches or tangible artifacts, which enhances the communication between the project members that come from different fields (Athavankar, 1997). Similar to white boards, designerly ways of communicating can serve to communicate ideas to others. The term 'designerly way' refers to visual or other nonverbal communication methods to deal with obscure problems and tacit knowledge, setting a boundary and stimulating the conversation among project members at the initial stage of a project (Cross, 1982).

An important strategy for designerly communication is the use of scenarios. Scenarios are widely applied in different organizations and industries for planning, envisioning, and decision-making. According to Go and Carroll (2004), four communities actively use scenarios in different forms: strategic planning (SP), human-computer interaction (HCI), requirements engineering (RE), and object-oriented analysis/design (OOAD). For example, crowd managers use scenarios in the form of computer simulations and prepare strategies accordingly. Dutch Royal Shell Group applied SP scenario in 1960s-1970s, foreseeing the future uncertainties with the best and the worst scenarios (Wack, 1985). Designers are quite solution-driven (Lawson, 1980). They usually use scenarios in the form of visual storyboards and videos, aiming at visualizing problems and possible solutions (Go & Carroll, 2004). As a project continues, the design problems may evolve into more specific and detailed scenarios accompanied by the evolution of more detailed solutions. These visualized solutions track the evolution of the problem (Henderson, 1991).

The benefits of working in a designerly way are threefold. First, "making" and "doing" can assist designers' thinking process and reduce their cognitive load (Sleeswijk-Visser et al., 2005). Designers are trained to express ideas visually or as physical objects, instead of retaining them

in mind (Athavankar, 1997). Second, design thinking brings a human-centered consideration into a technology-driven project (Brown, 2008). Explicitly sharing ideas in this manner can also form a basis for later evaluation and further development. The third benefit is creating a common language among people from different fields (Goldschmidt, 2007). Under the rubric of "a picture is worth a thousand words", it is important for a team to always have a shared vision of the whole project. Darke (1979) believes that designers are the "primary generator" of a project. Grocott (2010) defines designers as "integrators", who appropriate aspects of many disciplines such as psychology, computer science, and materials technology.

The EWiDS project has two goals: developing technological solutions for (1) sustaining the well-being of crowd members, and (2) assisting crowd managers in management. Crowd well-being refers to crowd members' evaluations of their emotional reactions and moods as well as the judgments they form about their satisfaction, goals, or need fulfillment in a crowd situation. Maintaining crowd well-being does not necessarily exclude all negative experiences, but should guarantee that crowd members' positive experiences surpass their negative experiences (Li et al., 2013).

In this article, we illustrate the designerly way of working applied in the EWiDS project. We started with exploring experiences of crowd members using sensitizing booklets and group sessions. We then explored crowd management via ten crowd expert interviews. The data gathered from interviews were visualized and analyzed in a designerly way as well.

The paper is organized as follows: Section 2 introduces designerly ways of exploring the positive and negative experiences of crowd members. Three representative and distinct crowd situa-

tions were selected based on the results. Section 3 describes ten crowd expert interviews and designerly ways of analyzing and presenting the data. The results show the experts' opinions of the crowd typology and factors influencing crowd management. Section 4 presents an example of the visual scenarios that were introduced in a plenary meeting of the EWiDS project. In section 5, we reflect on the extent to which the visualizations helped in communicating ideas to other team members and in discussing them.

## 2. DESIGNERLY WAYS OF EXPLORING CROWD EXPERIENCE

Two group sessions were conducted with a total of ten participants (six participants in the first session, and four in the second). This study combined traditional focus group sessions (Morgan & Spanish, 1984) with generative techniques (Stappers & Sanders, 2002), which encourage participants to visualize their latent knowledge through making collages or artifacts (Sleeswijk-Visser et al., 2005). The goals of the group sessions were to map the positive and negative experiences of crowd members, to select representative, distinct crowd types for the EWiDS project to elaborate on, and to evaluate whether the visualizations and artifacts helped to communicate ideas.

### 2.1 Procedure

Inspired by Sleeswijk-Visser et al. (2005), the exploration of crowd experience involved three steps: (1) preparation and sensitizing participants (e.g. with a designed booklet); (2) group sessions; and (3) analysis and communication.

#### 2.1.1 Preparation and sensitizing

Participants received a booklet with two sets of open-ended questions three days in advance to help them prepare for the group session. Generally, researchers in crowd psychology have focused on the negative aspects of crowds (Kazdin, 2000). Due to these negative assumptions, participants

were requested to think equally about attractive crowd situations as well as the unattractive ones by answering the following questions posed in the booklet.

- (1) What crowds attract you to join them? Why do you want to join them? What do you do in an attractive crowd (please visualize on a timeline)?
- (2) What crowds make you uncomfortable and want to avoid? Why do you want to avoid them? What do you do in an unattractive crowd (please visualize on a timeline)?

Participants were encouraged to visualize their answers for each question by using hand-drawing or the 96 pictures provided in the appendix of the booklet. These pictures were selected for their ambiguousness, enabling people to interpret them differently in crowd contexts. For instance, a bottle of fruit jam reminded a participant of a jammed crowd.

Figures 1-3 show pages of booklet filled in by participants. Figure 1 shows a mindmap (Buzan & Buzan, 2000) created by a participant as the results of her brainstorming types of attractive crowds. Each participant filled in the booklets individually. Following Buzan & Buzan's (2000) mindmap guidelines, instructions about brainstorming and making a mindmap were provided at the beginning of the booklet: (1) draw branches, radiating outward from the center topic, e.g. crowds that attract me to join them; (2) add the crowd types coming across your mind to the mindmap following the branches; (3) write words on the branches as explanations; (4) wherever possible, add images to those words (make use of the 96 images at the appendix of this booklet); and (5) make sure that each element is connected to a branch. After making the mindmaps about attractive and unattractive crowd types, participants were requested to visualize their activities in a crowd on a timeline, and highlight the posi-

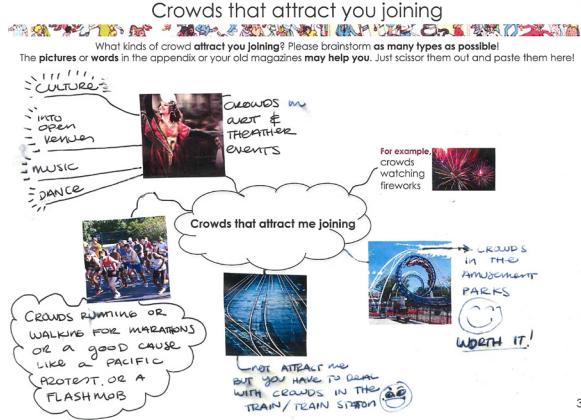


Figure 1. One page of booklet filled in by a participant, brainstorming about attractive crowds and presenting the results as a mindmap

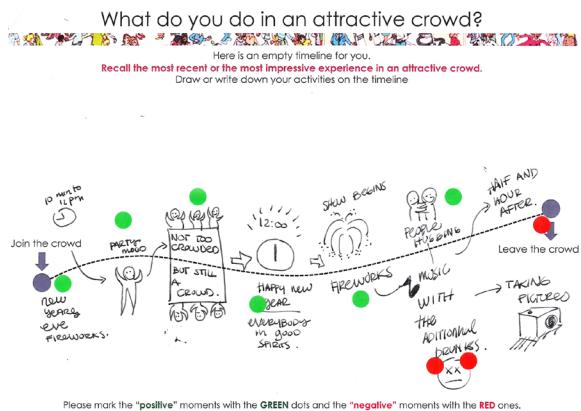


Figure 3. A participant visualized her activities in an attractive crowd, highlighted her positive (green dots) and negative (red dots) experiences

tive and negative experiences with green and red dots, respectively (Figure 3). Positive or negative experiences refer to the moments in a crowd that make you feel positive (i.e., happy, relaxed etc.) or negative (i.e., angry, bored etc.).

### 2.1.2 Group session

Two group sessions were conducted with four and six participants, respectively. Both were 50% male and 50% female. The average age was 29.4. Participants varied in occupations (e.g. master students, researchers in sociology, computer scientists, designers) and nationalities (e.g. Chinese, Dutch, New Zealander, Irish, and Mexican) and all

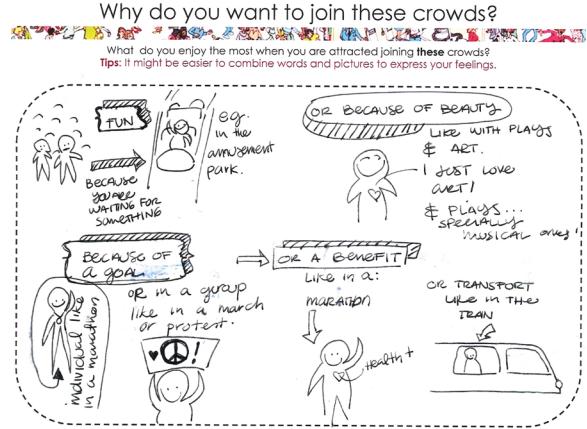


Figure 2. One page of booklet filled in by a participant, providing the reasons for joining attractive crowds



Figure 4. Example of collage making by a participant

had experience in crowds. In order to decrease the possibility of the dominant participants leading the group, two facilitators were present. Participants were asked to bring their booklet to the group session and discuss the contents with other participants. Each group session took about 80 minutes, including 20-minute peer discussions to compare their booklets, 20 minutes for presenting the differences and similarities of their answers in the booklets, 20 minutes for collage making using the pictures provided to express their needs and expectations in sustaining well-being in crowds (Figure 4), and 20 minutes for presenting their collages.

### 2.1.3 Analysis and communication

The analysis of the group sessions followed the three steps guideline from Sleeswijk-Visscher et al. (2005).

Step 1: Fixate on the data. All the booklets and collages were collected, and the sessions were videotaped and transcribed, as suggested by Rabiee (2004) to establish “a trail of evidence”, allowing for verification. The goal of analysis was to reduce data and search for patterns based on the questions asked in the booklet.

Step 2: Search and be surprised. A team of three researchers read through all the transcripts and booklets. Each researcher marked the interesting paragraphs in the transcript or the contents in the booklet with short phrases to emphasize on subjective interpretation.

Step 3: Find patterns and create an overview. All the selected content and the interpretations were compared and placed into five categories: (1) crowds that attract you to join them; (2) reasons for joining these crowds; (3) crowds that you want to avoid; (4) reasons for avoiding these crowds; and (5) expectations for sustaining well-being in crowds.

The “communication” of the analysis is presented in the following section.

### 2.2 Visualized Key Findings

The ten participants came up with 46 attractive crowds and 37 unattractive crowds. The crowd types mentioned by at least four participants are presented in Table 1. Attractive crowd types are those that attract people to join them, such as crowds watching fireworks. Unattractive crowds usually make people uncomfortable and want to stay away from them, e.g. violent crowds.

As can be seen in Table 1, most attractive crowds are quite specific (e.g. theater crowd, festival)

and event related, while unattractive crowds are abstract and described as problems.

Notably, public transportation is regarded as attractive as well as unattractive. Participants explained this dilemmatic situation as follows:

*I am usually not attracted to the crowds at the train station, but to a goal, [or] a destination (Anonymous, personal correspondence, July 20, 2012).*

*For some crowds, you have to join them to go to somewhere, like the train station. However, there are other crowds, which you would love to or volunteer to join them. Fireworks is one example that I enjoy a lot of people cheering around me. It is about sharing the experience (Anonymous, personal correspondence, August 7, 2012).*

Therefore, according to the explanations of two of the participants, it is the “goal” or “shared experience” that attracts people to join a crowd, for instance, going somewhere by public transportation, socializing with others, seeking knowledge in a conference or exhibition, enjoying the activities and so on. By contrast, frequently mentioned

**Table 1. Frequently mentioned attractive and unattractive crowds**

Mention Frequency	Attractive Crowds
6	Outdoor festivals/events
5	Friends/family gathering
4	Theater, cinema
4	Public transportation
4	Sports event
Mention Frequency	Unattractive Crowds
5	Disordered/ill-disciplined crowds
4	Crowds of unfamiliar people/culture
4	Violent/immoral crowds
4	Public transportation
4	Shopping crowds for cheap goods

unattractive crowds (Table 1) are usually the situations in which people find it difficult to keep safe, share experience, or obtain benefits.

Calculating the green and red dots placed on the timelines by ten participants (see Figure 3 as an example), we found that positive experiences outnumber negative ones in attractive crowds, and vice versa (Figures 5 and 6). This explains why participants identified a crowd as attractive or unattractive. Therefore, the well-being of crowd members is better supported in attractive crowds since they have a mainly positive experience (Li et al., 2013).

### 3. DESIGNERLY WAYS OF EXPLORING CROWD MANAGEMENT

After exploring crowd experiences, the next step was to interview crowd experts about managing crowds. The interviewees, all qualified crowd experts, are either crowd managers or professionals experienced in dealing with large crowds of at least 1000 people. To select the experts, three distinct and representative types of crowds were chosen based on the most frequently mentioned

crowds in two group sessions: public transportation (e.g. train station, airport), outdoor events (e.g. festival, sport event), and indoor events (e.g. conference, theater, museum). They are distinct according to Challenger et al.'s (2010) crowd typology dimensions (Table 2).

Sometimes, there is only a thin line between a well-organized crowd and a disorderly crowd, like the first example in the Introduction Section (i.e., Dutch National Remembrance Day in 2010). Therefore, we did not deliberately separate attractive or unattractive situations when selecting the representative crowd situations.

We conducted semi-structured interviews (Remington & Tyer, 1979) with ten crowd experts, all of whom were either working for outdoor events, public transportation, or indoor events in the Netherlands (Table 3). These interviews explored current crowd management in the three selected crowd situations in order to: (1) gather insights into the processes and methods of crowd management; (2) understand the factors that influence crowd event planning; and 3) understand how crowd experts classify crowd situations.

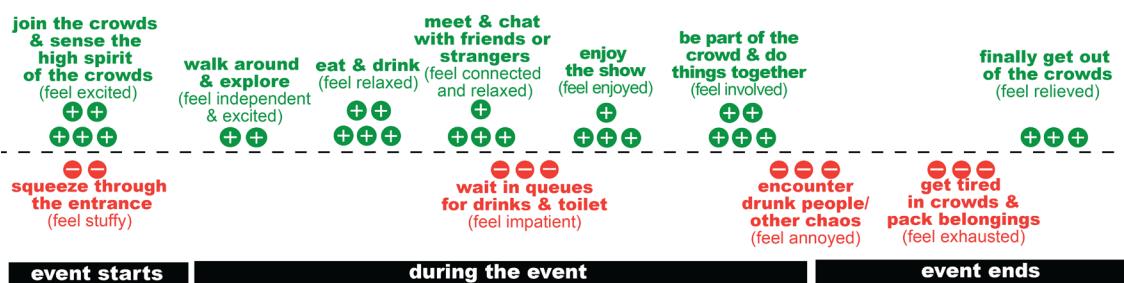


Figure 5. A summary of participants' timeline: positive experiences outnumbering negative ones in attractive crowds

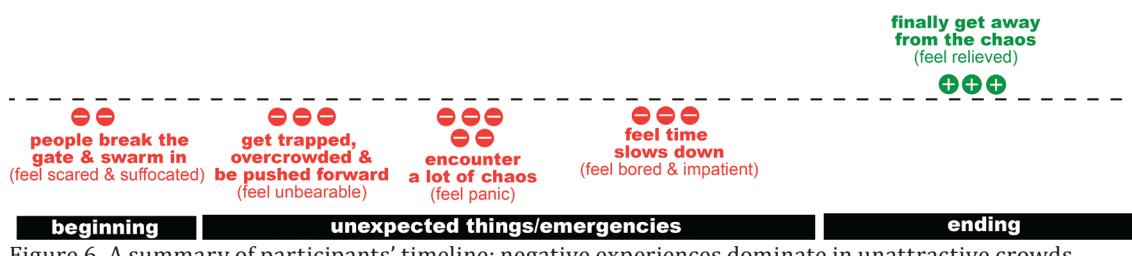


Figure 6. A summary of participants' timeline: negative experiences dominate in unattractive crowds

### 3.1 Procedure

Each interview was scheduled as a one-hour visit to the work place of the crowd expert, and was recorded with a voice recorder. During the interview, crowd experts were encouraged to sketch and to show the researchers around their work places. For instance, the manager of the stadium will bring the researchers on a tour to the central control room, and explained the evacuation process directly while in his routine environment.

By using this method, the experts were stimulated to share concrete stories rather than provide information about general and abstract things. All the artifacts discussed in the interviews, for example sketches, booklets, photos, or maps), were collected.

### 3.2 Designerly Way of Analyzing Data

The recorded conversations were transcribed into texts right after the interviews. A team of three researchers read all the transcripts and selected the relevant texts according to the three goals. These selected texts were cut out directly from the printed transcripts and pasted onto statement cards. Short descriptions were written on the cards to summarize the texts. Three researchers made 241 statement cards in total, which were categorized to find the patterns. Statement cards from different experts were made into different colors, making it possible to track back to the transcripts. There was no predefined category directing the sorting. The name of each category was developed during the sorting process.

**Table 2. Comparison of the three selected crowd situations based on the crowd typology of Challenger et al. (2010)**

Selected Crowd Situations			
Crowd Typology Dimensions (Challenger et al., 2010)	Outdoor Event (Festival/Sport Event)	Public Transportation (Train Station/Airport)	Indoor Event (Conference/Theater/Museum)
Purpose	Entertainment/Sports	Travel	Entertainment/Knowledge seeking
Duration	Medium <sup>1</sup> /Long <sup>2</sup> term	Transient	Medium/Long term
Start time	Fixed <sup>3</sup> /Variable <sup>4</sup>	NA <sup>11</sup>	Fixed/Variable
Event boundaries	Open boundaries/Fixed seat	Passing through	Fixed seat/Moveable
Event atmosphere	High <sup>5</sup> /Medium levels of conflict	Low levels of conflict	Non-existent conflict
Crowd membership identification	High <sup>6</sup> /Medium <sup>7</sup>	Low	Medium/Low
Level of interaction	High	Low	Medium/Low
Heterogeneity of membership	Medium	High <sup>8</sup>	Medium
Size of group unit	Mainly groups	Mixed <sup>9</sup>	Mixed
Amount of luggage	Medium <sup>10</sup>	Large	Non-existent

<sup>1</sup> Medium term (duration): a few hours, usually three to six hours

<sup>2</sup> Long term (duration): a day or several days.

<sup>3</sup> Fixed (start time): e.g. a sport event with an opening and an end.

<sup>4</sup> Variable (start time): e.g. a festival with a range of events.

<sup>5</sup> High levels of conflict (event atmosphere): e.g. a football match. Levels of conflict represent the tendencies that conflict is anticipated among crowd members, as a result of behavior at previous events.

<sup>6</sup> High (crowd membership identification): e.g. football fans.

<sup>7</sup> Medium (crowd membership identification): e.g. visitors of academic conferences.

<sup>8</sup> High (heterogeneity of membership): crowd members with different purposes.

<sup>9</sup> Mixed (size of group unit): e.g. some singles, some groups.

<sup>10</sup> Medium (amount of luggage): e.g. bags and tents.

<sup>11</sup> NA: Not Applicable

**Table 3. Working contexts of 10 crowd experts**

Working Contexts of 10 Crowd Experts	Crowd Size (Persons)	Crowd Duration
Indoor Music Festival	1700	6 hours
Indoor Conference	1000	12 hours
Central Train Station	250,000	4 hours
Police	700,000	8 hours
Security Company	1000-100,000	Several hours to days
Barrier Company	1000-100,000	Several hours to days
Outdoor Music Festival	60,000	3 days
Stadium	55,000	4-5 hours
Theme Park	40,000-60,000	12 hours
Central Train Station Crowd Flow Management	180,000	12 hours

### 3.3 Visualized Key Findings

Three main categories were identified based on 241 statement cards, namely “preparation before the events”, “operational measures during the events” and “comments and expectations in the future”<sup>2</sup>. Each category consists of several sub-categories. For example, the second category can be further divided into three sub-categories “current strategies”, “current technologies” and “work with a management team”. The following three sub-sections explain the key findings visually.

#### 3.3.1 Crowd management vs. crowd control

We understood from the interviews: there are four levels in dealing with crowds (Figure 7). Level 1 is preparation, which starts at least half a year before an event. Crowd experts come up with numerous possible scenarios based on the past experience and computer simulations of the crowd. They then prepare for these scenarios. For example, they predict that there will be chaos in front of the bars, so they prepare enough security personnel and barriers at that location. Level 2 happens during the event. They observe the crowd continuously through video cameras and communicate with the scouts who are monitoring from within the crowd. Once they identify some-

thing wrong, they will check whether the situation fits any prepared scenario and use strategies based on their preparations. The first two levels are known as crowd management, which account for 90% of the total effort and belongs to crowd managers’ responsibility. The last two levels, namely crowd control and riot control, are crowd control measures, which happen only when the situation starts getting out of control. Police will step in and take the lead.

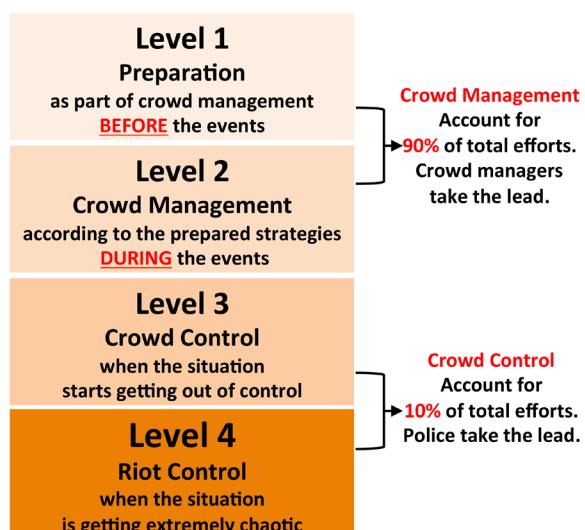


Figure 7. Four levels in dealing with crowds, developed based on crowd expert interviews

#### 3.3.2 Factors Influencing Crowd Event Planning

Two categories of factors were identified in the interviews, internal and external factors. Related inquiries for each factor are presented in Tables 4 and 5, which give typical questions asked during the planning. Internal factors relate to the crowd itself, such as (1) crowd size; (2) density; (3) mobility; (4) noise; and (5) visitor profiles. External factors include (1) weather; (2) location of the event; (3) client; (4) government; (5) personnel; and (6) event type.

Many of these factors are similar to those of Challenger et al.’s (2010) crowd typology dimensions (Table 2). For instance, purpose, duration, start

<sup>2</sup> The high-resolution version of Figure 9 is available online: <http://studiolab.ide.tudelft.nl/studiolab/jiei/files/2014/07/crowd-management-timeline.jpg>

time, and event boundaries are external factors, while event atmosphere, crowd membership, level of interaction, and size of group unit are related to the crowd itself (i.e. internal factors).

**Table 4. Internal factors influencing crowd event planning**

Internal Factors	Inquiries
Crowd Size	Is the size of the crowds very big? Is it above 10,000 or below 1,000?
Density	Is the density of the crowds very high? Is it a jammed crowd or free-movement crowd?
Mobility	Are the crowds moving a lot or staying still?
Noise	Is the level of noise or emotion intensity in the crowds very high?
Visitor Profile	Do the visitors tend to be aggressive or peaceful? Are they experienced visitors? Are they in groups or individuals?

**Table 5. External factors influencing crowd event planning**

External Factors	Inquiries
Weather	Will the weather influence the crowds/ event a lot? Is it an indoor or an outdoor event?
Location	Is it an indoor or an outdoor event? Are there sufficient emergency exits? Are there spaces for parking or any public transportsations around the location?
Client	Is there any famous celebrity who probably will cause chaos?
Government	What are the regulations from the government? Will any police present?
Personnel	What are the right personnel to hire?
Event Type	What is the event itself in terms of duration, activities? How is the historical level of conflicts? Is it a ticket-less event? Is the amount of people in the crowds predictable? Are the crowds mostly standing or sitting?

### 3.3.3 Types of crowd situations

Nine types of crowd situations were summarized from the interviews based on the analysis of the transcripts (Figure 8). The dots represent crowd

members, and the colors of the dots show the emotional arousal of crowd members: blue stands for calm and quiet people, and red represents very active and excited ones. The arrows on the dots indicate the movements and the directions of movements in crowds. The emotional arousal is based on the experts' perceptions.

We observed that most of the crowd experts did not speak of the crowds as music festival crowds or theater crowds. They divided each event into different periods or locations. A crowd event usually consists of several crowd types. For example, at the beginning of an outdoor music festival, the crowds are approaching the event field (see Crowd Type 1 in Figure 8). During the festival, people form queues, walk around, or stand in front of the stages (see Crowd Types 2, 4, and 9 in Figure 8). A crowded train station platform usually consists of queuing and arching crowd members (see Crowd Types 2 and 3 in Figure 8).

Most crowd experts considered Crowd Type 1, "crowds approaching the event field" as the most critical bottleneck in crowd management. Due to the difficulty in obtaining an overview of the crowd size and density, this is the most unpredictable moment, whether at a conference, a stadium, or a festival. By contrast, crowds sitting in an auditorium or theater (Crowd Type 5) are usually well behaved. The emotional intensity of an auditorium crowd is relatively low. The weather influence is small. Even the crowd size and density can be very large, but it stays manageable. Crowd Type 6 represents the flows of people in a train station hall. In this situation, people come and go and their emotional intensity is usually low. Crowd Type 7 is typically a crowd in a train, bus or airplane. This situation is quite similar to Crowd Type 5 (an auditorium crowd), but people might be slightly more active than the crowd sitting in an auditorium. The only difference between Crowds Type 4 and 8 is the boundary. The boundary of an outdoor event is

not fixed. Therefore, the evacuation plan for an indoor event is stricter than for an outdoor event. For example, the amount of crowd members in an indoor event is determined by the width of all the evacuation doors.

#### 4. DESIGNERLY WAY OF COMMUNICATION: SCENARIOS

Section 2 and 3 presents designerly ways of exploring crowd experience and crowd management. This section introduces another important designerly way of communication: scenarios. As described in the Introduction, scenarios used by designers generally aim at visualizing problems and possible solutions. They are usually presented in the form of storyboards and videos like a drama in theater, and include actors, the environment, background and facilities, and actions

(Laurel, 1993). In the case of crowd scenarios, the actors are mainly crowd members, the environments and backgrounds are different types of crowd contexts, facilities can be technologies that support better crowd experience, and the actions are crowd members' behaviors and experiences in the crowds. Based on these criteria, the current main activities in the three selected crowd situations (i.e. public transportation, outdoor event and indoor event) and possible solutions for improving crowd experience were sketched into scenarios. In this section, we only present part of these scenarios as examples.

Figure 9 shows some examples of the current activities in a train station, while Figure 10 illustrates some possible solutions for improving the crowd experience at a train station. Although these scenarios set a boundary, they still invite

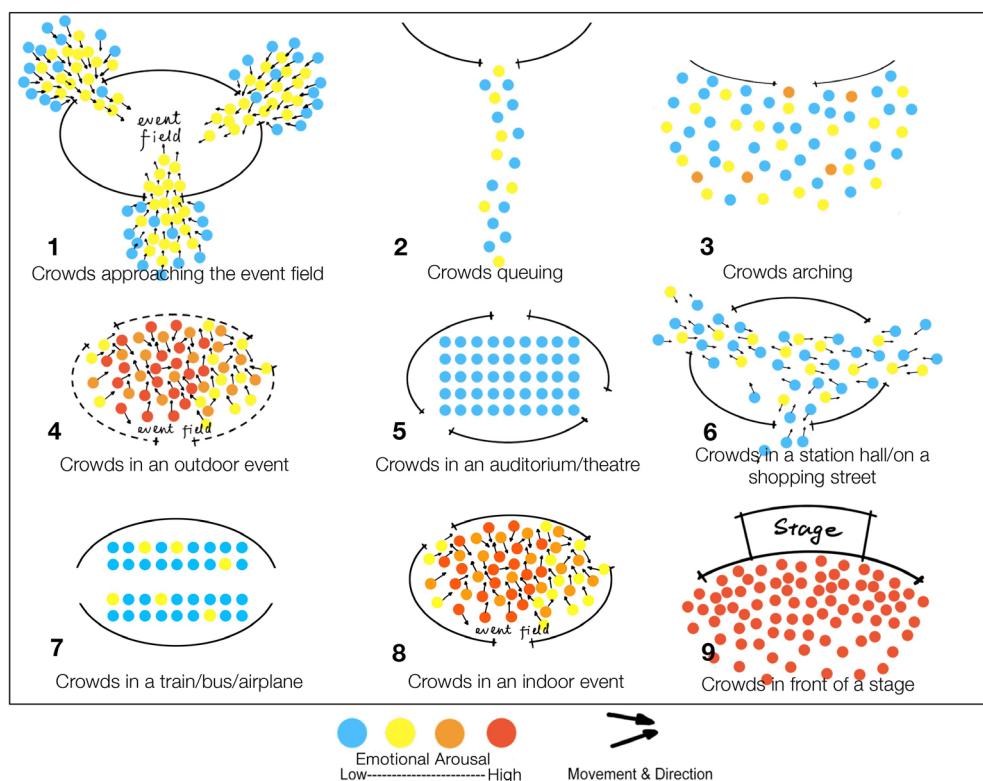


Figure 8. Nine crowd types summarized from expert interviews. The dots represent crowd members, and the colors of the dots show the emotional arousal of crowd members (i.e., blue=calm or quiet, red=active or excited). The arrows on the dots indicate the movements and the directions of movements in crowds

project members to interpret them based on their own expertise. For instance, some of the experts focused on technological feasibility, whereas others focused more on crowd flows, or on human-computer interactions. For example, one project member interpreted the scenario as follows:

*You buy a train ticket from an ATM. All needed information such as schedule, platform, and*

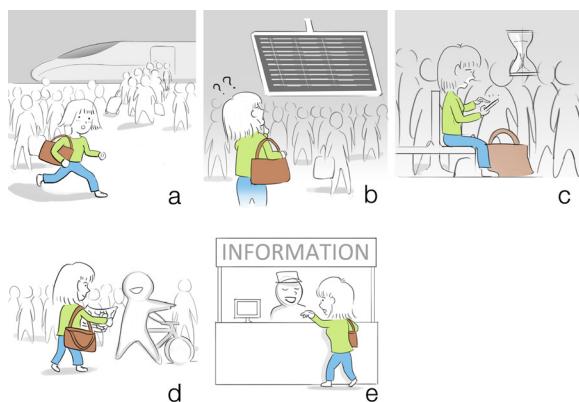


Figure 9. Current activities at train station (a) rushing & queuing; (b) searching; (c) waiting; and (d) and (e) asking

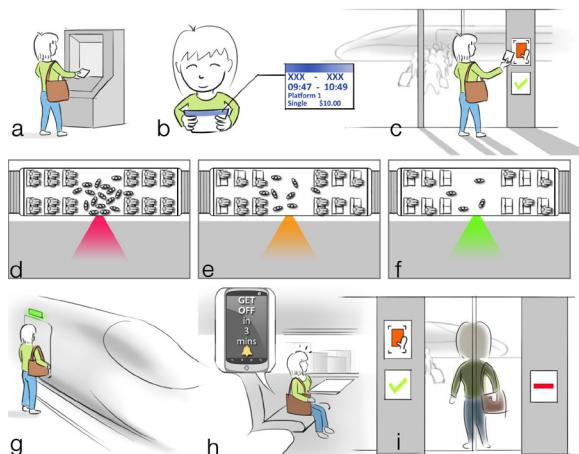


Figure 10. Possible solutions for improving crowd experience at train station: (a) buying a ticket; (b) the ticket shows all needed information (c) scanning ticket to open the screen door and go onto the platform; (d), (e), and (f) different colors of lighting indicating the crowdedness on the train (e.g. red=very crowded, green=not crowded); (g) waiting at the green-light area; (h) reminding to get off; (i) returning the ticket (recycled) and leaving the platform

duration of the trip is showing on the ticket. Sensors are embedded in the ticket as well. You scan your ticket to open the screen door and go to the platform. The colored lighting on the platform indicates where the train doors are, and the crowdedness on the train. That is to say, if you stand at the green-lighting area, you will have a larger chance of finding a seat on the train. The sensor on the ticket can connect with your phone to remind you to get off. You must return your ticket to the machine to open the screen door and leave. Therefore, the station can collect the sensors back and reuse them (Anonymous, personal correspondence, September 21, 2012).

## 5. CONCLUSIONS

This paper introduces a series of designerly ways of performing research, including group sessions with generative techniques (e.g. sensitizing booklet and collage making), semi-structured interviews of interviewees' routine environment, creative ways of analyzing qualitative research data (e.g. transcripts and statement cards), and scenarios. The group sessions and expert interviews generated very rich and diverse data (e.g. mind maps, timelines, collages), expressing much latent knowledge that is usually difficult to explain in words. Although many of the participants or experts were not skilled in drawing, they were able to freely express their ideas by visualizing them through abstract pictures provided in the booklet, or photos, maps about their working environments, or showing the researchers around their work places.

The visualizations and scenarios also successfully triggered the discussions in the first EWiDS plenary meeting. Project members immediately elaborated on the crowd situations and the feasibility of technologies, and even came up with solutions not originally presented in the scenarios. The visualizations indeed created a

shared terminology and a starting vision within EWiDS. For instance, project members immediately connected their crowd experiences with the nine types of crowd situations (Figure 8) and the influencing factors (Tables 4 and 5). In addition, these visualizations prompted project members to think and communicate visually. They directly sketched on top of the scenarios to show their opinions rather than using jargon.

The scenarios inspired the project members. During the meeting, they discussed the two main types of crowd members in a train station, namely commuters and tourists, and elaborated on their characteristics. They concluded that commuters are very familiar with some specific train schedules. They know exactly which platform they need to go, or even know which part of the train is less crowded at this moment, so they can stand at the right area at the platform. However, tourists are not familiar with the schedules. Thus, they often require more guidance. Thus, scenarios set boundaries and guide discussions.

This study shows how designers indeed can work as "primary generators" (Darker, 1979) and "integrators" (Grocott, 2010) in a cross-disciplinary project, assisting communication among project members from different fields and integrating ideas into solutions.

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