

Research project Fieldlab Evenementen phase II: scale-ups

Data collection and monitoring of group dynamics between visitors of the Fieldlab Evenementen pilot events

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1. Introduction

The global COVID-19 pandemic poses major political, social and economic challenges to countries. Measures aimed at restricting (close) contact between individuals, gathering in large numbers, or in environments with reduced air quality in order to contain the spread of COVID-19 have had a major impact on society. The far-reaching measures, sometimes even lockdowns, have meant that various sectors have had to operate below their normal capacity, or have even been unable to operate at all.

One of the sectors that has been hit hardest by the effects is the events sector. After all, the spread of COVID-19 is facilitated by contact between people, and events are potential situations where people have a lot of contacts. Historically, sports, religious, music and other large-scale events have been the source of infectious diseases that have spread worldwide (Memish, et al., 2019). However, not organizing events is not a sustainable situation from a social and economic perspective (Fieldlab Evenementen, 2020). Little is known about the actual number of contacts of a visitor, the influence of visitor dynamics during an event and the associated risk.

The results presented in this report 'Research project Fieldlab Evenementen phase II scale-ups', are logically building further upon the research done in phase I. The research conducted in phase II differs in relation to the number of visitors to the events organized in phase I.

The research conducted in phase I provided insights and findings on the execution of 'safe' small-scale events. The results presented in this report are focused on the similarities and differences in visitor dynamics in 'small scaled' events in comparison to the events with a larger number of visitors (scale-ups).

Ultimately, this research aims to investigate if the alternative set of measures applied in phase I are still applicable and feasible when it regards events with a larger number of visitors. The conclusions and recommendations drawn can contribute to a situation in which events can take place safely and responsibly during a pandemic. These research activities are (partly) financed with the PPP allowance of the Ministry of Economic Affairs and Climate from CLICKNL. CLICKNL is the top consortium for Knowledge and Innovation (TKI) of the Creative Industry.

1.1 Research objective

The principles of the research into visitor dynamics remain the same as in phase I; the number of contacts a visitor has, at what distance these contacts are and how long these contacts last. Density was also measured at certain 'attraction points', such as the toilets, catering establishments and cloakrooms/ lockers.

The main question of the sub-study is formulated slightly different and is as follows: What is the potential impact of measures and/or interventions on the number of contact moments in the different categories that a visitor has during his/her stay at scaled up events?

1.2 The events

In a period of three months (March – May 2021), nine events initiated by Fieldlab Events took place for phase II of the research project. In this report, the results from five events are covered and elaborated, as these events were focused on scaling up. The following events are covered;

- **I. Indoor passive:** Residential Orchestra
- **II. Indoor active:** 3FM Awards, Raccoon concert, Eurovision Song Contest
- **III. Outdoor active:** international soccer match (NED-LAT)

1.3 Readers guide

The chapters of the report are structured according to the different event types; I (indoor passive), II (indoor active) and III (outdoor active), followed by a discussion. Per event type, the different pilot events are discussed. First, the event specifics will be given, followed by a risk profile and the safety measures. Next, the results are

presented. The conclusions will be given overall per type of event at the end of the chapter. A more elaborate introduction in the reporting per pilot event regarding the risk profile and safety measures is given below.

1.4.1. Risk profile

The building block, visitor dynamics, focuses on minimising the risk of infection at events. In order to map the profile of the event, a distinction is made between factors that normally play a role when analysing the risks at events in a non-covid situation. A distinction is made between the activity profile, the spatial profile and the public profile (van den Brand & Abbing, 2003).

Activity profile

The activity profiles came about through a brainstorming session with various stakeholders (Logistics Community Brabant, 2020). It concerns the processes at the event where visitors come together and where there is a possible risk of contamination. This involves visitors encountering each other at a certain location, for a certain length of time and at a certain risk. By localising, describing, and analysing the risks, processes can be optimised, and the spread of risks minimised.

Spatial profile

Not one event is like another. It is therefore useful to use general characteristics when classifying events. (van Rijn & van Damme, 2011) describe several general characteristics related to events in addition to the characteristics mentioned by Fieldlab. These general characteristics give direction to the expectations concerning the dynamics of visitors to events.

Before the events, clear and strict guidelines have been drawn up for all those directly involved. The main condition for participating in the event is the submission of a negative rapid test result at the entrance to the event site. This test must be taken at one of the affiliated test locations within 24 hours before the end of the event. Apart from this condition, additional conditions have been communicated through a developed app. For example, outside the event site, the RIVM guidelines apply to everyone involved and no specific measures or restrictions apply on the event site.

Public profile

It is essential to know the characteristics of the audience of a specific event in order to anticipate on their behaviour. Audience is inextricably linked to behaviour.

Before zooming in on behaviour and mood, the type of audience is mentioned. In addition to the distinction in audiences, social characteristics of audiences are indicated. Audiences display specific behaviour, but they are difficult to define and cannot easily be classified (Still, 2014).

1.4.2. Safety measures

The events took place in a protected and controlled environment. In order to realise this environment, different safety measures were taken, such as the requirement for a negative COVID-19 test for entrance, direct communication with the visitors and ventilation requirements. This report will focus on the measures regarding visitor dynamics, such as time slots. The use of time slots aims to achieve a gradual and controlled ingress and is directly related to the starting times and physical size of the starting areas. The design and organisation of the ingress/egress process and the allocation of time slots were achieved through intensive cooperation between various parties involved.

For the ingress process, process calculations were made to determine the capacity of the ingress process per entrance lane, in order to ensure a safe and regulated ingress with minimum contact moments.

2. Type I events

Event type I: indoor passive is characterised as an indoor event with a passive character. Visitors are calm, composed and/or business-like. Visitors have an assigned or free seat. This allocated seat is part of a specific bubble that each has explicit rules and measures (Fieldlab Evenementen, 2020).

2.4. Residential Orchestra, Zuiderstrandtheater (the Hague)

On Friday, May 7th, 2021 the third type I event, initiated by Fieldlab events, took place in the Zuiderstrandtheater, the Hague. The ingress started at 18.30h and the start of the concert was at 19.30h and ended at 20.40h.

2.4.1. The event

The risk profile of the event is described in Table 1, Table 2 and Table 3.

Table 1. Activity profile Residential Orchestra

Touchpoints (Ingress)		Zuiderstrandtheater
Parking		Nearby car park
Entrance		Ticket, negative test result and after receiving tag
Placing		Based on bubbles
Visitation		Not applicable
Touchpoints (Circulation)		
Beverage		Bars
Food		Not applicable
Toilets		At location
Entrance process		Through entrance gate manned by steward(s)
Exit process		Via exit gate manned by steward(s)
Routes		Via signage
Touchpoints (Egress)		
Parking		Nearby parking area
Exit		Accompanied by stewards and after return of tags

Table 2. Spatial profile Residential Orchestra

Event name	Residential Orchestra
Spatial Profile	
Event location	Zuiderstrandtheater
Event type	Indoor passive
Sort event	Public event
Event specification	Music event
Attractiveness	Regional/National
Duration	Evening
Location (indoor/outdoor)	Indoor
Accessibility	Fixed location - Existing
Size	Small sized (500 - 5.000 persons)
Access	Ticket sales

Table 3. Public profile Residential Orchestra

Cohesive	Crowd gathered for a specific purpose or reason; No leadership.
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The location can accommodate 1007 visitors; however, 516 tickets have been sold for this occasion. This leads to an occupancy rate of 51%. To the visitors in this event setting, passive behaviour applies during ingress and egress. Visitors for this event are to be typified as “cohesive”, meaning that no extra safety measures have been implemented other than in- and egress processes.

2.4.2. Safety measures

In order to realise a gradual ingress, arrival time slots were implemented. Table 4 shows the time slots and the number of visitors per timeslot.

Table 4. Time slots Residential Orchestra

Timeslots	Bubble 1 (Grey); 348p	Bubble 2 (Yellow); 209p
18.20h - 18.40h	116	70
18.40h - 19.00h	116	70
19.00h - 19.20h	116	69

2.4.3. Results

The total visitor group was divided into two separate ‘bubbles’ as an organizational measure to try and keep contacts to a minimum. Table 5 presents the general statistics of the event. On average the grey bubble had 6.7 unique contacts (IQR= 5-8) lasting more than 15 minutes cumulative within 1.5 meters. The yellow bubble had on average- a non-meaningful difference in the number of unique contacts; 6.6 (IQR= 4-8).

Table 5. General statistics Residential Orchestra

Bubbel	Bubble	N	Average participation time	Average amount of contacts (IQR)	Distribution
Residence orchestra	Grey	288	02:31:37	6,7 {5-8}	
	Yellow	228	02:28:08	6,6 {4-8}	

Figure 1 shows an overview of the total number of contacts over time. A clear spike in contacts can be noted during the in- and egress of the theatre hall. A smaller second spike can be noted around 22:00 as part of a second egress wave after the after-show drinks for the grey bubble.

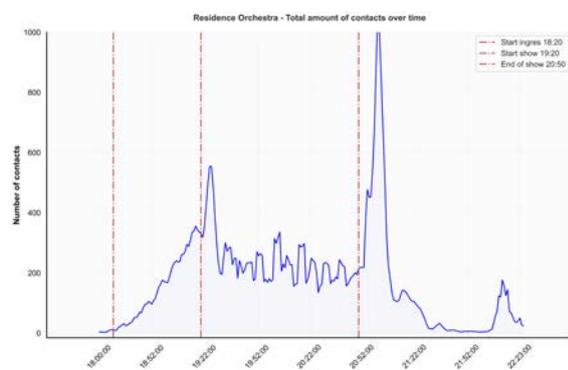


Figure 1. Total number of contacts over time Residential Orchestra

Video analyses shows, as illustrated in Figure 2, that this possibility for the grey bubble to have several drinks after the show leads to a higher number of contacts for a longer duration (bar area) than for the comparable areas of the yellow bubble (Level 1 bar). It can also be observed that contacts in the yellow bubble are evenly distributed amongst the two bars, whereas this is not the case for the grey bubble. However, as indicated by the results of the contact tracking device analyses, this does not lead to a higher number of critical contacts.

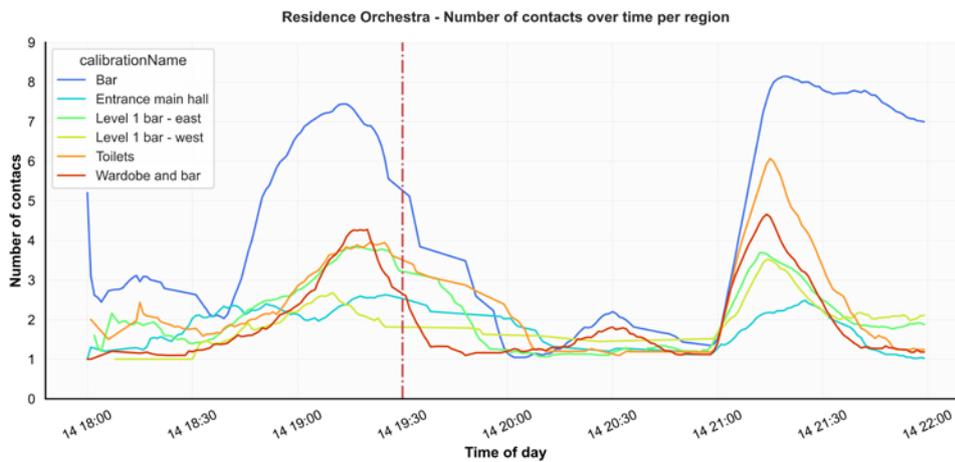


Figure 2. Number of contacts over time per area Residential Orchestra

2.5. Conclusion type I events

Figure 3 compares the findings of the type I pilot events as organized during phase 1 of the research program with those organized during phase 2. From this data, we can see that that the results are in line with previous conclusions. Increasing the maximum allowed number of visitors does not seem to have a significant impact on the number of critical contacts a visitor has during his attendance. As with pilot 1, the possibility for catering during the event increases the number of contacts slightly in comparison with pilot 2. However, as research, as conducted by TU Delft, indicates, no meaningful difference in risk level was found.

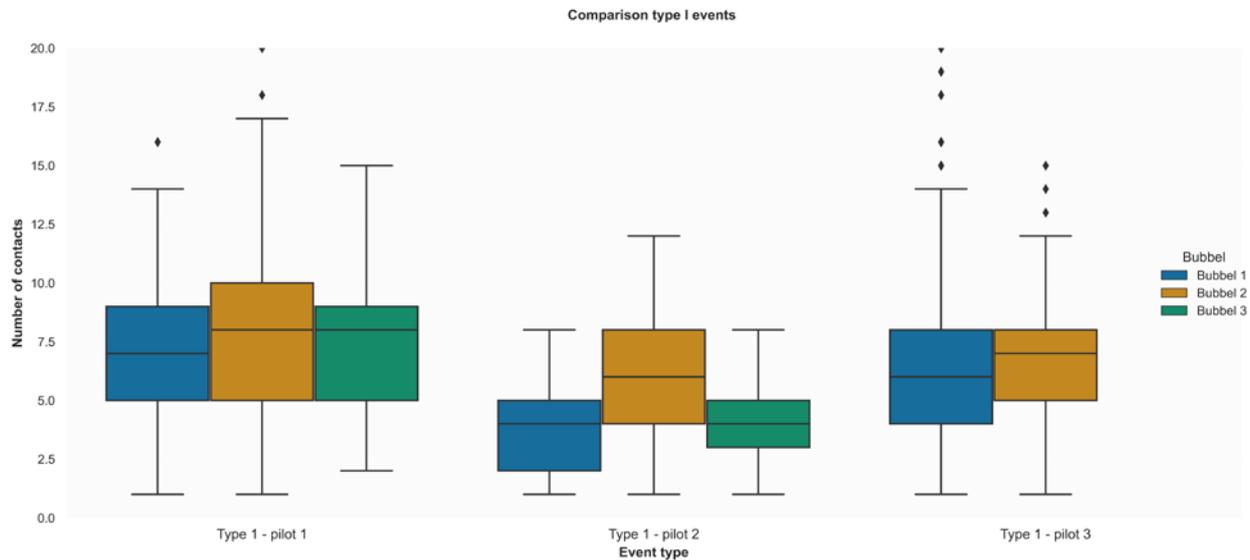


Figure 3. Comparison type I events

3. Type II events

The definition of event type II, as described in Pilots for 'Low-Contact Events (Fieldlab Evenementen, 2020); indoor active is characterised as an event that takes place inside and has an active character. Visitors are enthusiastic, sociable, and exuberant and have an 'assigned' place to sit/stand. This allocated seat/standing place is part of a specific bubble that each has explicit rules and measures.

3.4. 3FM Awards, Tivoli Vredenburg (Utrecht)

On Thursday, April 15th 2021, the third type II event, initiated by Fieldlab events, took place in Tivoli Vredenburg in Utrecht. The event was a music concert and award show. With the support acts during the evening. The ingress of the event started at 16.30h and the show ended at 20.30h.

3.4.1. The event

The risk profile of the event is described in Table 6, Table 7 and Table 8.

Table 6. Activity profile 3FM Awards

Touchpoints (Ingress)		3FM Awards
Parking		Nearby car park
Entrance		Ticket, negative test result
Placing		Based on bubbles
Visitation		Applicable
Touchpoints (Circulation)		
Beverage		Bars
Food		Snackbar
Toilets		At location
Entrance process		Through entrance gate manned by steward(s)
Exit process		Via exit gate manned by steward(s)
Routes		Via signage
Touchpoints (Egress)		
Parking		Nearby parking area
Exit		Accompanied by stewards and after the return of tags

Table 7. Spatial profile 3FM Awards

Event name	3FM Awards
Spatial Profile	
Event location	Tivoli theatre
Event type	Indoor active
Sort event	Public event
Event specification	Music event
Attractiveness	National
Duration	Evening
Location (indoor/outdoor)	Indoor
Accessibility	Fixed location - Existing
Size	Small sized (500 - 5.000 persons)
Access	Tickets sales

Table 8. Public profile 3FM Awards

Cohesive	Crowd gathered for a specific purpose or reason; No leadership.
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The Tivoli Theatre in Utrecht can accommodate 2000 spectators in a semi-seated setting. For this occasion, 1200 tickets have been made available, which represents an occupancy rate of over 60%. Visitors for this event are to be typified as “cohesive”, meaning that no extra safety measures have been implemented other than in- and egress processes.

3.4.2. Safety measures

At the 3FM Awards, three bubbles were created. One of these bubbles, the nominees for the awards, has not been included in the research. The other two bubbles were split between the ground floor and the first floor. Bubble 1 contained 472 seats, whereas bubble 2 contained 265 seats + space for 338 people on the dance floor.

3.4.3. Results

Approximately 1200 visitors attended an indoor concert. No contact tracking devices were utilized to collect data. Video analysis is performed to answer the main research questions.

Figure 4 shows the number of contacts per entrance; bubble 1 (Entree West Binnen) and bubble 2 (Entree Oost Binnen). Bubble 2 had slightly more visitors than bubble 1 (28% more), which may clarify the higher number of contacts at the entrance of bubble 2. The process in the field-of-view of the camera is the CoronaCheck, the execution of which was more “smooth” at bubble 2. Interestingly enough, this did not impact the number of contacts.

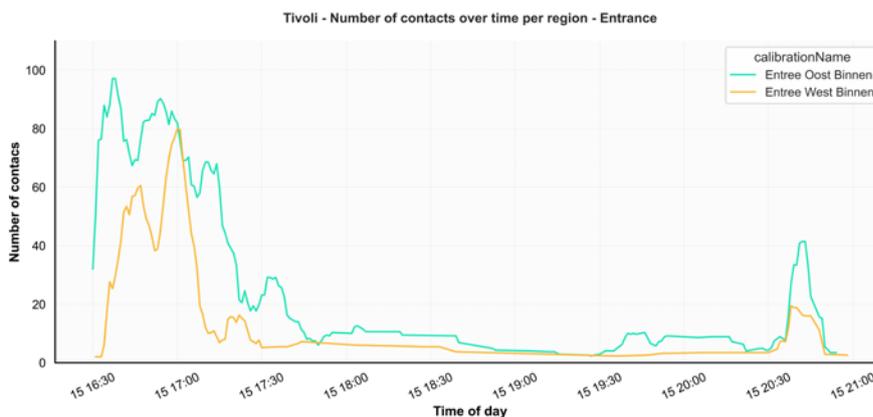


Figure 4. Number of contacts per entrance 3FM Awards

Figure 5 shows the number of contacts per wardrobe area. The wardrobe for bubble 1 (Wardrobe 0) was a regular, “open” wardrobe, whereas the wardrobe for bubble 2 (Doorloop 1e oost) had a queuing system. The wardrobe with the queuing system had considerably more contacts than the wardrobe without. However, this can partially be explained by the function of the areas in the field-of-view of the cameras. The wardrobe area for bubble 1 was solely utilized as a wardrobe area, however, the wardrobe area for bubble 2 was utilized as

circulation and hang-out area as well, explaining the peaks in contacts outside the times during which the wardrobe was visited.

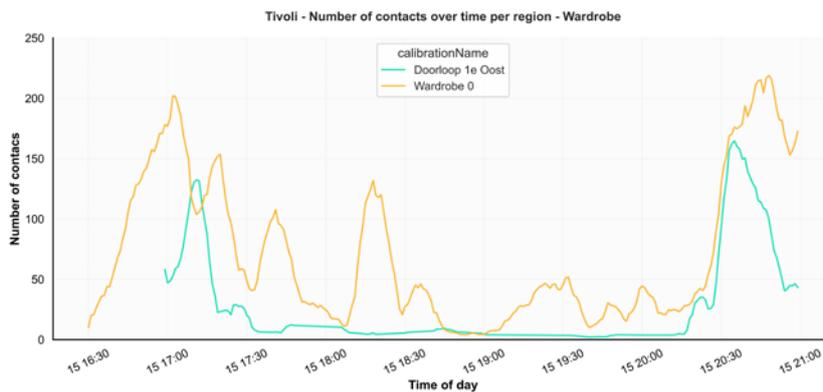


Figure 5. Number of contacts per wardrobe 3FM Awards

Figure 6 shows the number of contacts per bar area. The bar for bubble 1 (Horeca 0) was a bar with a queuing system, whereas the bar (Horeca 1-2) and food stand (Horeca 1-1) for bubble 2 had no specific queuing system. It can once again be observed that the queue with the queuing system has a higher number of contacts.

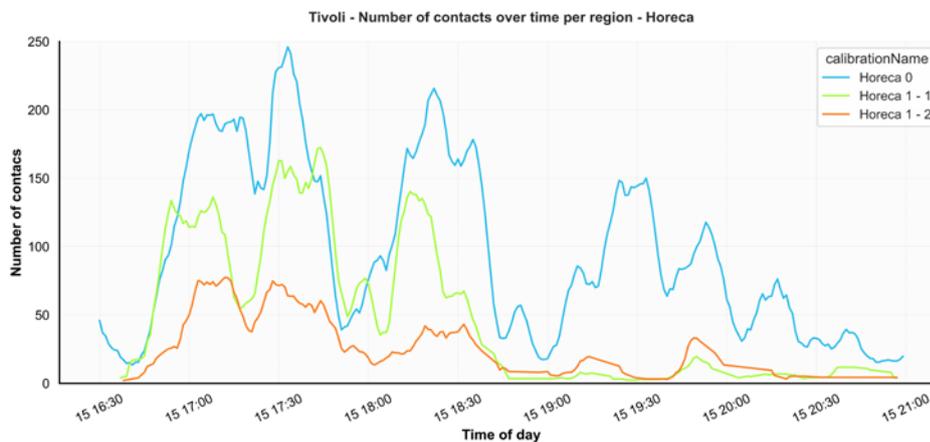


Figure 6. Number of contacts per bar 3FM Awards

The result regarding the higher number of contacts in areas where queuing systems were applied is somewhat counterintuitive. On the other hand, the area is designed to improve the flow and thus prevent the duration a visitor would have to spend in that area. The current result represents the number of contacts within 1,5 metres but does not include the duration of the contact. The queuing systems may still have a positive effect on the number of critical contacts (more than 15 minutes) a visitor has, however, this can not be determined.

Furthermore, the video images were manually observed to analyse the processing time for the execution of the CoronaCheck; the scanning of a QR code in an application on the visitors' phone. It is important to mention beforehand that the CoronaCheck procedure at the 3FM Awards did not include an ID check. The average processing time for bubble 1 was 10.6 seconds and for bubble 2 8.9 seconds, a significant difference. The results are influenced by whether visitors were informed before the check process; there was a steward in bubble 2, who informed visitors they would have to go through the CoronaCheck. As a result of this, visitors arrived prepared (QR code ready to be scanned), and the average processing time decreased.

3.5. Raccoon concert, Mainstage ('s Hertogenbosch)

On Friday, May 7th 2021, the 4th type II pilot event, initiated by Fieldlab events, took place in the Mainstage in the Brabanthallen in 's-Hertogenbosch. The event was a music concert by the band Raccoon, with a support act by Son Mieux. The ingress of the music concert started at 19.00h and the show ended at 22.45h.

3.5.1. The event

The risk profile of the event is described in Table 10, Table 11 and Table 12.

Table 9. Activity profile Raccoon concert

Touchpoints (Ingress)		Raccoon
Parking		Nearby car park
Entrance		Ticket, negative test result and after receiving tag
Placing		Based on bubbles
Visitation		Applicable
Touchpoints (Circulation)		
Beverage		Bars
Food		Snackbar
Toilets		At location
Entrance process		Through entrance gate manned by steward(s)
Exit process		Via exit gate manned by steward(s)
Routes		Via signing
Touchpoints (Egress)		
Parking		Nearby parking area
Exit		Accompanied by stewards and after return of tags

Table 10. Spatial profile Raccoon concert

Event name	Pop concert Raccoon
Spatial Profile	
Event location	Brabanthallen 's-Hertogenbosch
Event type	II. Indoor active
Sort event	Public event
Event specification	Music concert
Attractiveness	Regional/national
Duration	Daytime
Location (indoor/outdoor)	Indoor
Accessibility	Fixed location - existing
Size	Medium sized (5000 - 50.000 persons)
Access	Tickets sales

Table 11. Public profile Raccoon concert

Cohesive	Crowd gathered for a specific purpose or reason; No leadership.
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The Brabanthallen (Mainstage) in 's-Hertogenbosch can accommodate 4210 spectators in a regular situation. For this occasion, 3500 tickets have been made available, which represents an occupancy rate of over 80%. Visitors for this event are to be typified as "cohesive", meaning that no extra safety measures have been implemented other than in- and egress processes.

3.5.2. Safety measures

In order to realise a gradual ingress, arrival time slots were implemented. Table 13 shows the time slots and the number of visitors per timeslot.

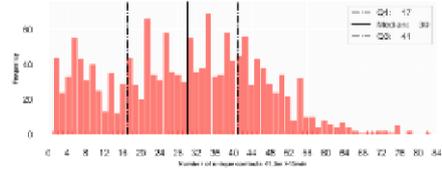
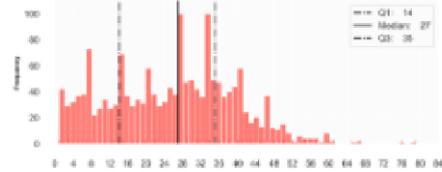
Table 12. Time slots *Racoon concert*

Timeslots	Blue	Red
19.00h - 19.15h	435	435
19.15h - 19.30h	435	435
19.30h - 19.45h	435	435
19.45h - 20.00h	435	435

3.5.3. Results

In total, 3252 visitors attended the 3-hour indoor concert. The total visitor group was divided into two separate 'bubbles' to test several different logistical processes regarding bars and wardrobes. Table 14 presents the general statistics of the event. On average the blue bubble had 29.6 unique contacts (IQR= 17-41) lasting more than 15 minutes cumulative within 1.5 meters. The red bubble had -on average- a non-meaningful difference in the number of unique contacts; 25.5 (IQR= 14-35).

Table 13. General statistics *Racoon concert*

Event	Bubble	N	Average participation time	Average amount of contacts (IQR)	Distribution
<i>Racoon</i>	Blue	1562	03:15:29	29.6 (17-41)	
	Red	1668	03:15:18	25.5 (14-35)	

The total number of contacts over time are shown in Figure 7. The most interesting aspect of this graph is that while no spike in contacts can be seen during the ingress phase of the event, indicating the spread of visitors using timeslots was very effective, a spike can be noted during the changeover from the preshow to the main show.

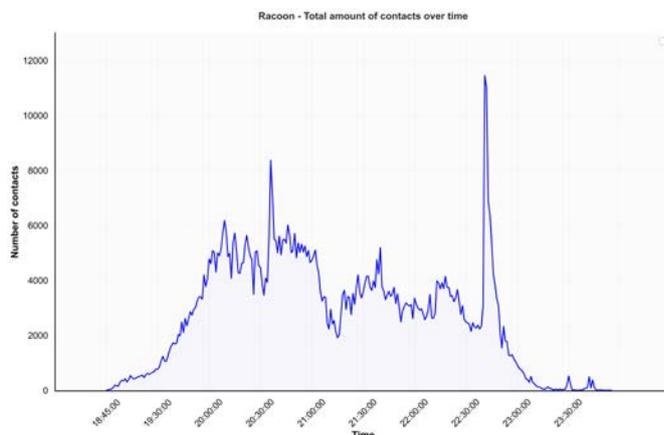


Figure 7. Total number of contacts over time *Racoon concert*

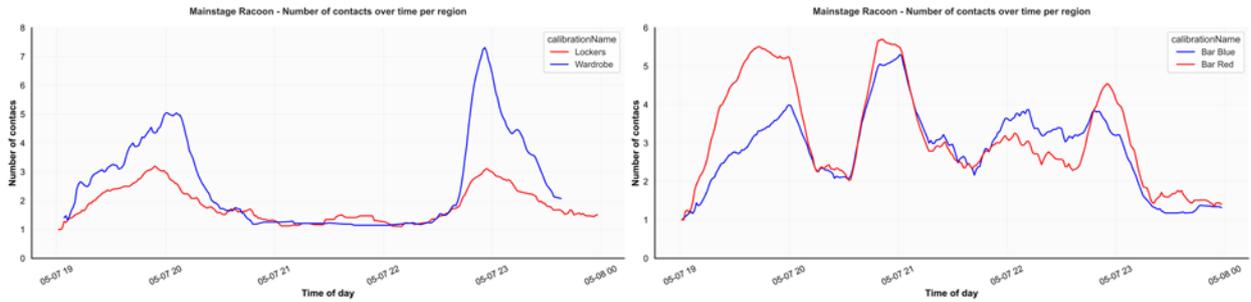


Figure 8. Average number of contacts per visitor over time for lockers/wardrobe (left) and bars (right) Racoon concert

To compare the difference between the use of self-service lockers versus a regular wardrobe regarding the number of contacts a visitor incurs video analysis is performed. Figure 8 illustrates the average number of contacts a visitor has within 1.5 meters within either the locker/wardrobe area (left) or the bar areas (right). The results obtained from this analysis seem to indicate that using self-service lockers has a beneficial effect on the number of contacts a visitor has. The difference in contacts between the two bar areas is negligible.

3.6. Eurovision Song Contest, Ahoy (Rotterdam)

ESC took place from Monday the 17th of May up to and including Saturday the 22nd of May 2021 and was hosted by Ahoy, Rotterdam. Multiple shows were organised with different starting times. In case it regards a family show (daytime), the ingress started at 12.30h, and the show started at 15.00h. In case it regards an evening show, the ingress started at 18.30h, and the show started at 21.00. The show lasted two hours and ended at respectively 17.00h (family show) or 23.00h (evening show), except for the 'grand final', which ended at 01.00h on Saturday night.

In this specific event, the visiting population was not divided into assigned bubbles. Though, the hosting location Ahoy was filled up according to a predefined principle to spread the audience over the stands.

3.6.1. The event

The risk profile of the event is described in Table 15, Table 16 and Table 17.

Table 14. Activity profile Eurovision Song Contest

Touchpoints (Ingress)		Ahoy Rotterdam
Parking		Several surrounding car parkings
Entrance		Ticket and negative test result
Placing		Based on a predefined structure
Visitation		Extended, organized by assigned security company
Touchpoints (Circulation)		
Beverage		Several bars
Food		Several take away points/snack bars
Toilets		Multiple fixed toilet locations
Entrance process		Through entrance gate manned by steward(s)
Exit process		Via exit gate manned by steward(s)
Routes		Via signage
Touchpoints (Egress)		
Parking		Several surrounding car parkings
Exit		Guided by stewards

Table 15. Spatial profile Eurovision Song Contest

Spatial Profile	
Event location	Ahoy Rotterdam
Event type	Indoor passive
Sort event	Public event
Event specification	Music event
Attractiveness	Mondial
Duration	Several days during daytime and evening
Location (indoor/outdoor)	Indoor
Accessibility	Fixed location – Existing
Size	Medium sized (5.000 -50.000 visitors)
Access	Tickets sales

Table 16. Public profile Eurovision Song Contest

Cohesive	Crowd gathered for a specific purpose or reason; No leadership.
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The event site in Rotterdam can accommodate 16.426 visitors. A maximum of 3.500 tickets has been sold for this occasion. In total, 9 shows were executed which computes to a total number of visitors of 31.500. This leads to an occupancy rate of 21%. However, visitors were placed in a setting representing a 100% occupancy rate. Visitors for this event are to be typified as “cohesive”, meaning that no extra safety measures have been implemented other than in- and egress processes.

3.6.2. Safety measures

In order to realise a gradual ingress, arrival time slots were implemented. Time slots had a duration of 15 minutes and the ingress was distributed over 1 hour and 45 minutes. Table 18 shows the time slots and the number of visitors per timeslot for the evening shows. The distribution of time slots was set up similar for the afternoon shows.

Table 17. Time slots Eurovision Song Contest

Time slots evening shows	First Ring	Second ring	Total
18.30h - 18.45h	300	154	454
18.45h - 19.00h	321	180	501
19.00h - 19.15h	369	93	462
19.15h - 19.30h	328	150	478
19.30h - 19.45h	372	117	489
19.45h - 20.00h	321	216	537
20.00h - 20.15	301	239	540
Total	2312	1149	3461

3.6.3. Results

Over the course of one week, 9 shows with a total of approximately 31.500 visitors were held (3.500 visitors per show). Due to the scale and level of production, the use of the UWB contact tracking devices was not possible. Therefore, video analyses are performed. Additionally, data was gathered using a mobile application operative on Bluetooth Low Energy, which visitors were requested to download. The results of this data collection method can be found in a separate report.

Several different in- and egress scenarios were tested throughout the events. In addition to this, adjustments concerning flow were suggested based on the near real-time analysis, to improve the circulation.

Ingress

For the first three shows, visitors were supposed to be guided on their route by the signage. However, signage at the outside of the venue referring visitors to the 1st and 2nd ring was barely eye-catching, which resulted in the routes not being utilized and thus ingress scenario test did not succeed. The filling of the grandstands was based on timeslots, filling the arena from back to front.

It was observed that one of the bars was specifically busy before the start of the show (Figure 9). This bar (bar level 3 – north) is a bar all visitors on the 2nd ring would pass on their way to their seat. Another bar (bar level 3 – south) was open to visitors, however, visitors would have to walk further along the circuit. It was advised to refer visitors in the early timeslots (and thus seated in the back of the arena, south) to the bar on the south of the circuit. The results of this management intervention can be observed in the third graph.



Figure 9. Number of contacts over time for show 7, 8 (before intervention) and 9 (after intervention) Eurovision Song Contest

Circulation

After the first three shows, the merchandise stand was relocated, since the stand on the 1st ring had caused a queue of over 100 visitors in the shows before. In addition, the video analysis dashboard had measured a negative sentiment. The location of the stand was not quite optimal; in a narrow hallway which was also a central point in the circuit. The merchandise stand on the 2nd floor was relocated to the ground floor, at the entrance of the building, to relieve the pressure from the stand on the 1st floor. The queues would still arise on the ground floor, but there was sufficient space to prevent crowding.

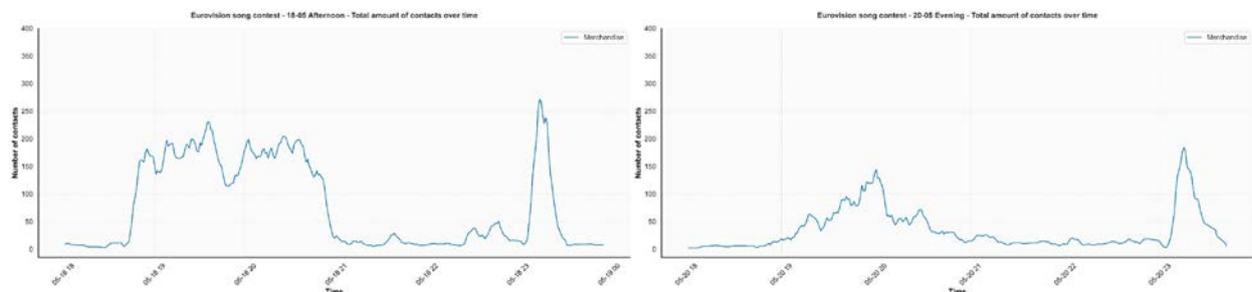


Figure 10. Number of contacts over time at 1st ring circuit for show 3 (before intervention) and 6 (after intervention) Eurovision Song Contest

Egress

As mentioned before, every show is executed three times. The first two shows have a dummy scoring, whereas the third live show is the actual scoring based on televoting. During the first two shows, it is noticeable visitors leave before the show ends, during the dummy scoring. The egress takes about 45 to 60 minutes, in contrast to the live show egress, which takes about 30 minutes.

It was observed that during egress, most of the visitors used the west exit, a logical occurrence since this was the shortest route for most visitors. It was advised to redistribute the crowd, by referring visitors to the east staircase when advisable, based on the real-time situation. This has resulted in a more evenly distributed crowd along the egress route.

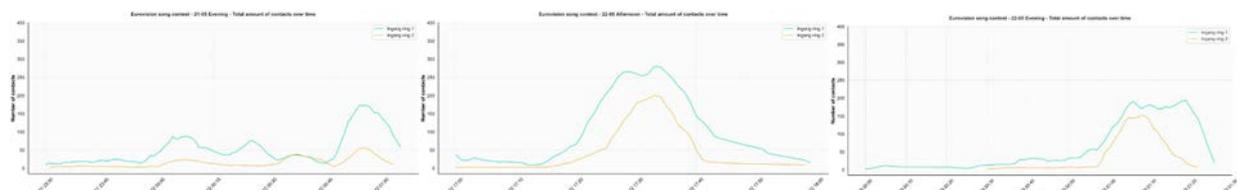


Figure 11. Number of contacts over time during egress per exit route (west/east) for show 7 (before intervention), 8 and 9 (after intervention) Eurovision Song Contest

3.7. Conclusion type II

Management interventions such as referring visitors to a different bar and/or exit have proven to have a positive effect on the number of contacts. Design interventions like queuing systems at facilities such as bars or wardrobes result in a higher number of contacts within 1,5 metres than an unstructured system would. However, the duration of the contacts is not measured and it might well be that queuing systems may still have a positive effect on the number of critical contacts (more than 15 minutes) a visitor has, since the area is designed to improve the flow and thus prevent the duration a visitor would have to spend in that area. As for the processes within the facilities, it is observed that using self-service lockers has a beneficial effect on the number of contacts compared to a manned wardrobe. Pre-ordering drinks via a QR code, however, has no impact on the number of contacts compared to ordering at the bar.

Regarding critical contacts (<1,5 metres, >15 minutes), which are only measured at the Racoon concert, visitors had on average 26-30 contacts. Compared to the type II pilot event in phase I with a somewhat similar type of music and an occupancy rate of 90%, visitors had an average of 39 contacts. Increasing the maximum allowed number of visitors does not seem to have a significant impact on the number of critical contacts a visitor has during his attendance.

4. Type III events

The definition of event type III, as described in Pilots for 'Low-Contact Events' (Fieldlab Evenementen, 2020); outdoor active is characterised as an event that takes place outside and has an active character. Visitors are enthusiastic, sociable, and exuberant and have an 'assigned' place to sit/stand. This allocated seat/standing place is part of a specific bubble that each has explicit rules and measures.

4.4. International match NED-LAT, Johan Crujff Arena (Amsterdam)

On Saturday, March 27th 2021, the third type II event, initiated by Fieldlab events, took place in the Johan Crujff Arena. The event was a sporting event organised by KNVB and UEFA. The ingress of the game started at 17.30h and the game ended at 19.45h.

4.4.1. The event

The risk profile of the event is described in Table 19, Table 20 and Table 21.

Table 18. Activity profile international soccer match

Touchpoints (Ingress)	Football Match NED-LET
Parking	Nearby car park
Entrance	Ticket, negative test result and after receiving tag
Placing	Based on bubbles
Visitation	Applicable
Touchpoints (Circulation)	
Beverage	Bars
Food	Snackbar
Toilets	At location
Entrance process	Through entrance gate manned by steward(s)
Exit process	Via exit gate manned by steward(s)
Routes	Via signage
Touchpoints (Egress)	
Parking	Nearby parking area
Exit	Accompanied by stewards and after return of tags

Table 19. Spatial profile international soccer match

Spatial Profile	
Event location	Johan Crujff Arena
Event type	II. Indoor active
Sort event	Public event
Event specification	Sports event
Attractiveness	national
Duration	Daytime
Location (indoor/outdoor)	Indoor / outdoor
Accessibility	Fixed location - existing
Size	Medium sized (5000 - 50.000 persons)
Access	Tickets sales

Table 20. Public profile international soccer match

Expressive	<p>Crowd gathered for a common purpose;</p> <p>Under loose leadership or following a specific motive;</p> <p>Not aggressive, but parts of the crowd become slightly antisocial;</p> <p>May require active involvement of authorities.</p>
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The Johan Cruyff Stadium in Amsterdam can accommodate 55.500 spectators in a regular situation. For this occasion, 5000 tickets have been made available, which represents an occupancy rate of about 9%. Visitors for this event are to be typified as “expressive”, meaning that during in- and egress processes extra security measures has been implemented, for example with stewards.

4.4.2. Safety measures

In order to realise a gradual ingress, arrival time slots were implemented. Table 22 shows the time slots and the number of visitors per timeslot.

Table 21. Time slots international soccer match

Timeslots	Entrance 3	Entrance 5
16.30h - 16.45h	250	250
16.45h - 17.00h	250	250
17.00h - 17.15h	250	250
17.15h - 17.30h	250	250

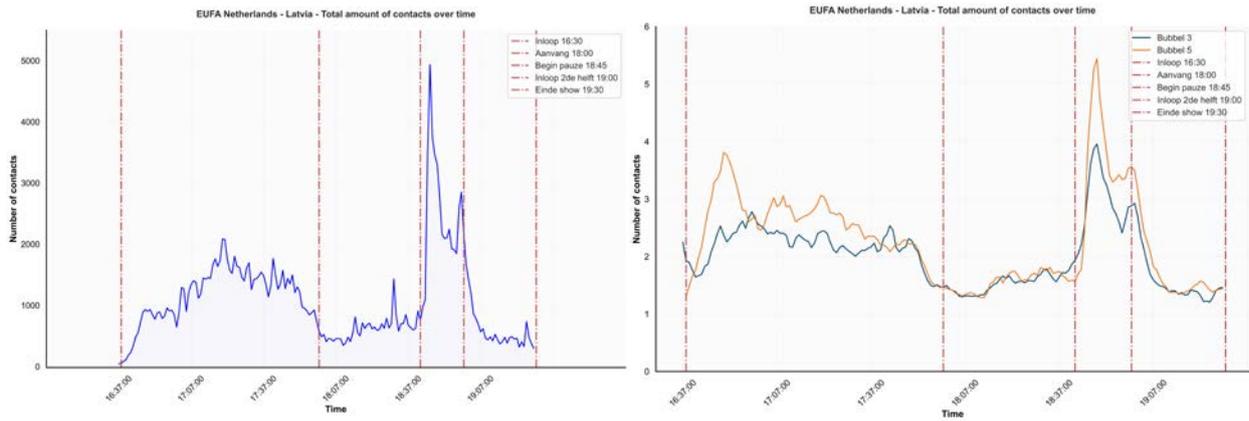
4.4.3. Results

On March 27th 2021, 5000 spectators were able to attend the UEFA soccer match between the Netherlands and Latvia. Out of these 5000 spectators two distinct bubbles of roughly 2000 spectators participated in our pilot event. Seating patterns as planned by UEFA were compared with the results of type III results of phase 1 of the research program. Bubble 3 will be seated by stewards in a chessboard pattern with 50% capacity, Bubble 5 will have a 75% capacity with assigned seating.

Table 22. General statistics international soccer match

Event	Bubble	N	Average participation time	Average amount of contacts (IQR)	Distribution
UEFA Netherlands - Latvia	Bubble 3	541	02:24:01	6.6 (4-8)	
	Bubble 5	698	02:26:17	8.7 (6-11)	

Table 23 presents the general statistics of the event. On average the bubble 3 had 6.6 unique contacts (IQR= 4-8) lasting more than 15 minutes cumulative within 1.5 meters. Bubble 5 had -on average- a slightly higher number of unique contacts; 8.7 (IQR= 6-11).



As shown in Figure 12, during the game itself, when all contacts are considered, the number of contacts is low. During halftime, the number of contacts rises. Further analysis of the total number of contacts over time shows that a visitor in bubble 5 has on average a higher number of contacts than a visitor in bubble 3 during ingress and halftime.

Video analyses (Figure 13) shows that the number of contacts at the bar areas is similar across both bubbles meaning these extra contacts occur elsewhere. When zooming in on the specific section (Figure 14) the difference in occupation rate is very much visible.

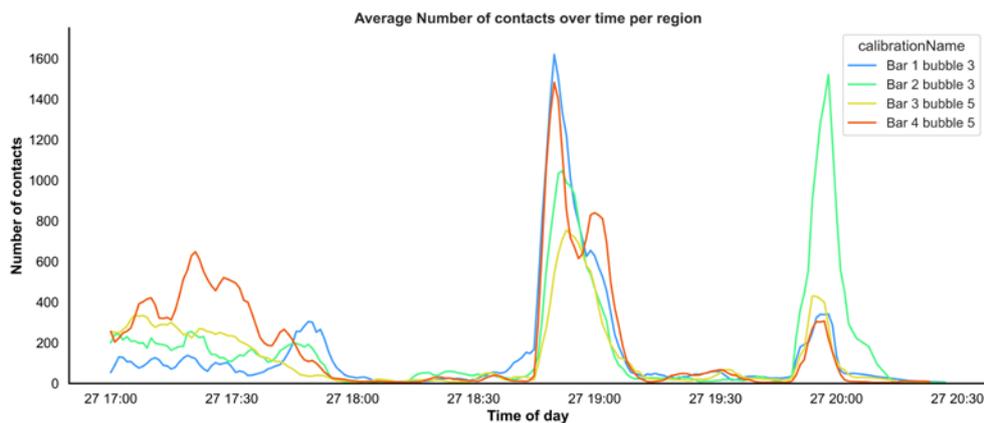


Figure 13. Number of contacts at the bar areas international soccer match

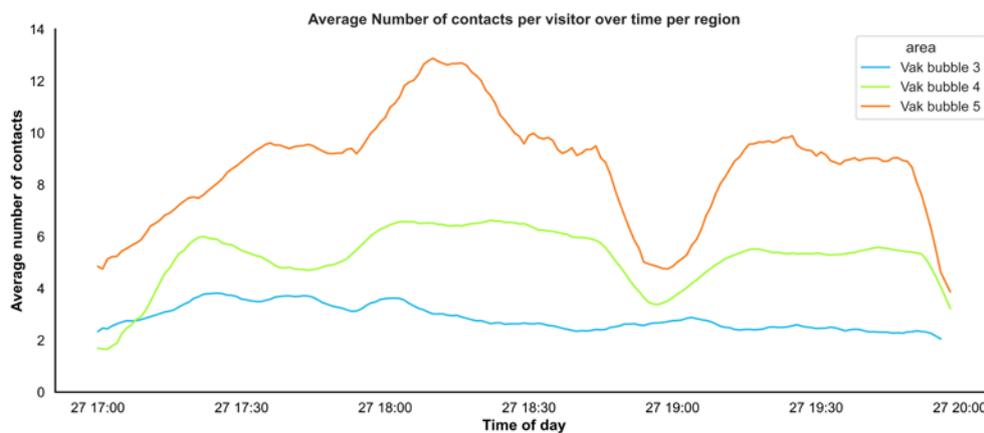
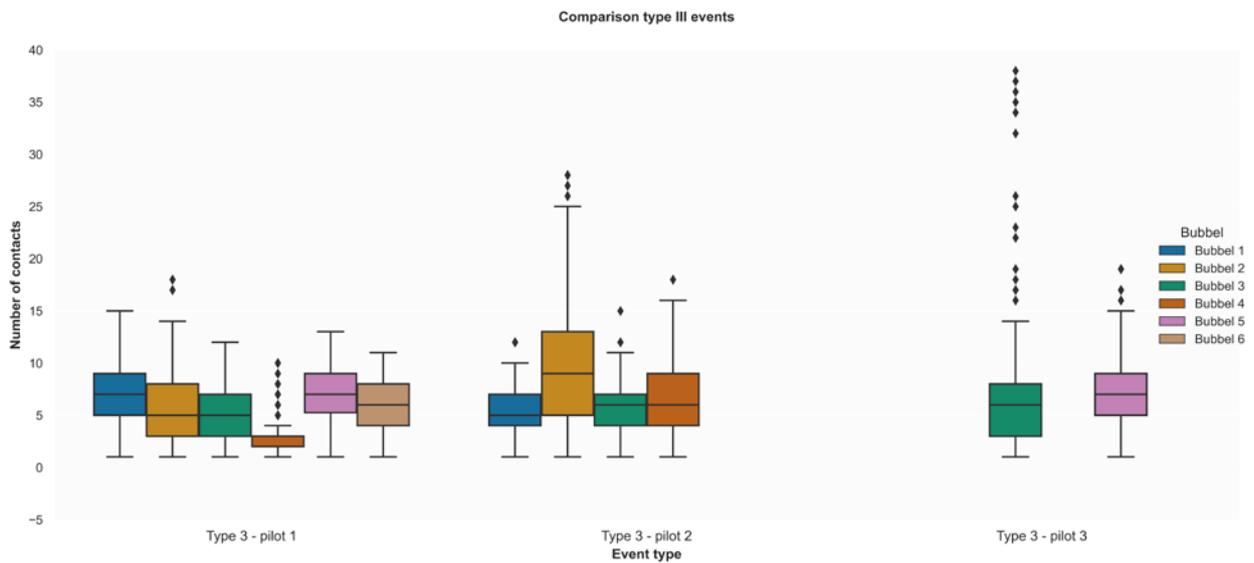


Figure 14. Number of contacts at the sections international soccer match

4.5. Conclusion type III

Figure 15 compares the findings of the type III pilot events as organized during phase I of the research program with those organized during phase II. From this data, we can see that the results are in line with previous conclusions. Increasing the maximum allowed number of visitors does not seem to have a significant impact on the number of critical contacts a visitor has during his attendance.



5. Conclusion

The results presented in this report are focused on the similarities and differences in visitor dynamics in 'small scaled' events, as executed in phase I of the research project, in comparison to the events with a larger number of visitors (scale-ups).

The scale-ups conclude that the results are in line with the research results from phase I. For type I, II and III events, the results indicate that increasing the maximum allowed number of visitors does not seem to have a significant impact on the number of critical contacts a visitor has during his attendance.

Two suggestions can be made to decrease the number of contacts. First, management interventions such as referring visitors to a different bar, route, etc., based on density as monitored in video analyses software. Second, self-service lockers are preferred to manned wardrobes. In general, the use of time slots and the prevention of bottlenecks by aligning processes is advised.

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