

Indicators for security and safety in public transportation platforms – a case study

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Abstract

Purpose:

During major events public transportation systems reach their maximum capacity. This entails in crowded trains and buses, gatherings at departure platforms and inside of railway buildings. These situations are badly manageable for involved security and safety officers - especially in the face of a mass panic. A mass panic effects uncontrollable human flows and interactions of involved individuals. In times of big events like concerts, football-games etc and the fact that terrorism becomes more and more present in European public transports this scenario needs to be analyzed to be prepared for it in the future.

The purpose of this research is to identify triggers for a mass panic at platforms of public transportation. Task forces in the area but also the primary control unit that controls safety and security activities during a big event should be able to analyze the situation correctly by the use of indicators and therefore act properly. Unnecessary actions like the close down of Cologne main station during the Protestant Church Day in 2007 should be prevented.

Task forces and control unit should have the possibility to prevent mass panics by the help of well defined indicators and their measurement results.

Approach / Methodology

Based on hypotheses on characteristics of mass panics in literature and actual surveys a list of indicators was generated. These indicators influence the behavior of public transportation customers and therefore make a contribution to a mass panic. These listed indicators are supplemented with results of qualitative interviews, accomplished at platforms in cologne metro-stations during normal business and big events (football game). By supplement of these results also latent indicators are considered.

By use of a questionnaire survey hypotheses like “elderly people feel more insecure than younger people in public transportation” were proofed right or wrong. Furthermore a measurement of indicators was gathered, so that it is possible to decide which indicators have most influence on the prevention of mass panic and which can be lost of sight.

Outlook

The next step is to explore in what extent the fulfillment of indicators cause insecurity of several stakeholders. By a permanent field-measurement data has to be collected that offer a detailed picture on the different indicator-influences on public-transportation-customers and their meaning in a mass panic. Therefore an IT-based concept has to be developed to realize an “on-time” measurement of real factors and parallel a comparison to the insecurity and satisfaction of customers.

Based on that results simulations can be compiled and prognoses can be given that support task forces and control units to act properly.

Keywords: safety sensation, safety indicator, customer satisfaction, public transportation, major events, quality

1. Introduction

The purpose to realize safety ideas within major events concerning local passenger transport postulates the investigation of safety sensation and therefore capturing of the customer voice. This aim will be implemented in the course of the research project “VeRSiert” (www.versiert.info). „VeRSiert“ is a project sponsored by the Federal Ministry of Education and Research within the program “Research for Civil Security” as a part of the High-Tech-Strategy of the Federal Government. The network intends to find out solutions to improve safety in local passenger transport particularly in case of major events.

Important quality criterions will be described by customer demands (**Norm DIN EN 13816, 2002**). One essential criterion regarding these demands is the safety and thereby specially the safety sensation of passengers. The availability of personal safety in transport infrastructure also means necessary quality of living for everyone (**Koetsche, 1996**).

It should be distinguished abstractly between subjective and objective safety. Former relates to the individual estimation capability (fear) and latter relates to the objective situation (real stress).

Safety sensations are special influenced by sensations of fear. Hence changes in the behaviour of affected persons arise due to panic. This occurs primarily on major events accompanied by threatening felt sense perceptions like auditory, visual, olfactory, gustatory and tactile stimuli. Neuralgic points at stops and stations like hindering objects, narrow ways, shoving areas as well as acustical and optical signals are alike triggering factors just as accidents, technical damages and fire.

Densely crowded people and deadlocks frequently lead to panic overreactions (**Schmid, 2002**). Notably the moment of panic mostly won't be aware comprehensible by the involved persons.

Cultural and sporting events like concerts or soccer games in covered halls or amphitheatres regular attract lots of people. Hotspots resulting by mass movement coupled with limited public transportation capacity are merely met with improvisation. Irritations in the run could come up due to scheduled and non-scheduled breaks. In addition excesses by means of alcohol and violence can happen.

Relevant for investigation of safety sensation are consequently critical transition areas in railway systems, e. g. doorways and exits as well as stairs and escalators.

2. Indicator Approach

The capture of the safety sensation takes place with methods of the customer satisfaction research. To this belongs particularly the capture of the customer voice. The norm DIN EN ISO 13816 describes processes to capture the customer voice in the public transportation:

- Performance appraisal by mystery shoppers (Mystery Shopping Surveys – MSS),
- Customer Satisfaction Surveys (CSS) and also
- Direct Performance Measures (DPM).

In doing so subjective felt quality underlies changeable criteria and depends on the expectations of customers (**Schulze, Schlag, 1999**). Thus the respective evaluation of the behaviour pattern based on an individual decision is only indirect measurable. So the pattern of behaviour has to be analysed and to be questioned in more detail. However objective characteristics of safety sensation and hence the resulting bearing of persons can be measured directly.

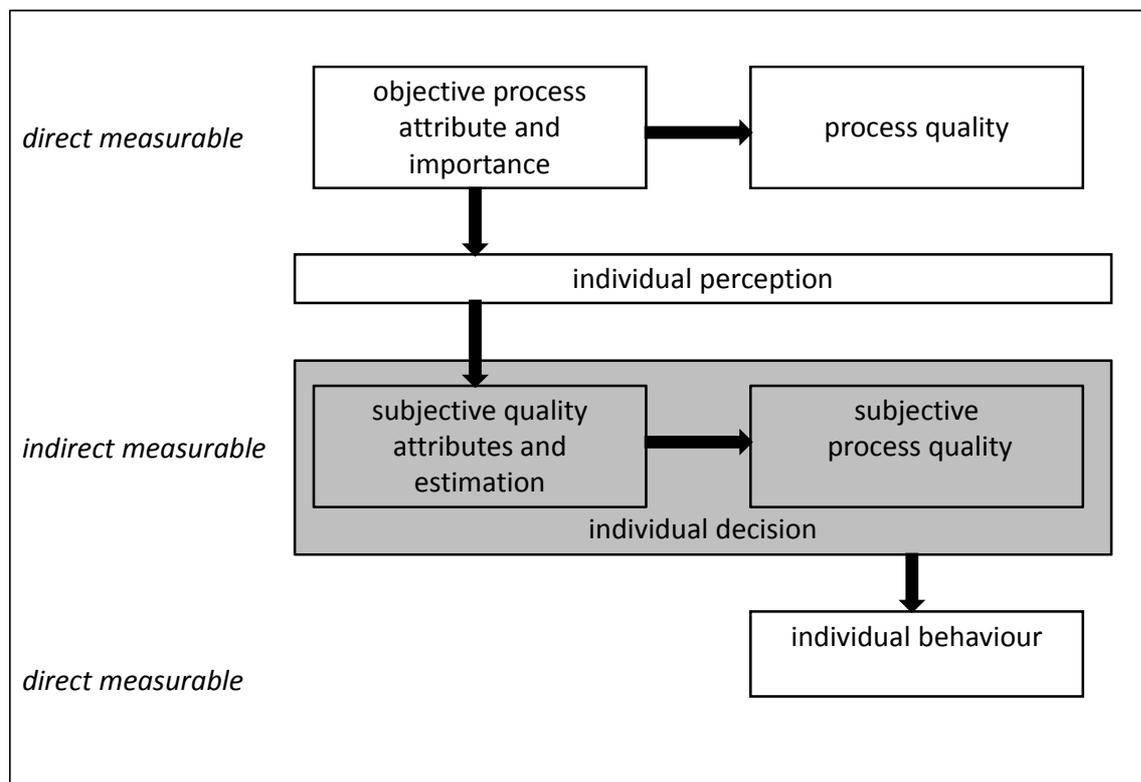


Figure 1: interdependency among quality, perception and behaviour (**Schulze et al., 1999**)

Even the process of an individual decision-making concerning a particular behaviour is causally associated with felt and mental impulses. These relevant stimuli bearing on safety sensation can be regarded as threshold values. Thereby behaviour can be influenced positive or negative. Specific outside influences or directed bearing of third parties, which is felt unpleasant by affected persons, will be described by “safety indicators”. If a threshold value reaches a certain level, pedestrians tend to sudden and uncontrolled changes in their behavior.

According to that, the following hypothetical derived factors determine the safety sensation (**Tiemann, 1995**):

1. Type of personage and attitude; primary and secondary type of experience as well as the situation itself and situational cognition.
2. Constructional and vehicular condition as well as staff
3. Potential offenders (stereotypes and real behavior), other passengers (stereotypes and real behavior) as well as areal and social environment (stereotypes and real conditions).

Visible safety measures can help to prevent and strengthen passenger's sense of security. Passengers should recognize that there are preventive measures available for emergency cases also in ordinary situations.

But by submission of potential dangers it is possible that opposite reactions are reached. Psychologically this effect is called „promotion of negative condition“ also known as „self-fulfilling prophecy“ (**Löbert, 1995**). It is also proved, that processes like recalling or thinking of dangerous situations causes fear (**Izard, 1994**). Among visible safety measures are numbered signales for emergency exits, extinguishers, fire detectors and video cameras. Beyond that acoustical annunciators and speakers (as warning announcements) belong to this category. Furthermore there are devices for controlling “passenger flows” which have to be considered. Annunciator panels, timetables and announcements don't only support passengers with information. They give passengers the feeling that the situation is under control and so the passengers are feeling safe.

For analyzing passenger's sense of safety in terms of the customer satisfaction, above mentioned influences must be reviewed. Which process in the respective surrounding passes the pedestrian or passenger?

As a first step the path of the passenger will be depicted within a flow chart for identification of contacts and influences.

To illustrate processes of service consumption and development of customer satisfaction, Shostack created a diagram with a description of mutual contact points between customer and company (**Fiedrich, Prange, Winzer, 2003**). These studies so called ‘Service Blueprinting’ shows the service performance process as a division in sub-processes within a flow chart. In a ‘Line of Service Evidence Visibility’ for customers, visible and not visible service performance processes are defined graphically. In the meantime contact-point identification is abbreviated called ‘Blueprinting’ in general just as ‘Line of Visibility’ in context to the visible and not visible process distinction.

In 1989 Kingman-Brundage and in 1993 Gummesson cultivated the Blueprinting under the new label Service Mapping (**Homburg, 2006**). Point of view is the customer respectively the description of the customer process as key differentiator. At this the path of the customer within the service interaction will be displayed. Direct and indirect contacts between staff and customer or independent activities of customers (e.g. reading information or self-service) are depicted due to a dividing line called ‘Line of External Interaction’. Alike the Blueprinting, for customers visible and not visible service performance processes are delimited by a ‘Line of Visibility’. In 1993 the Service-Map was extended by Bitner about additional experience oriented indications at the contact-points.

The aim is to gather the view and the voice of the customer with focus on safety and security and matching it with the view of the service provider. The chronologic procedure of the customer activities must preferably be described gapless. The contact-points between customers and service providers must be realized to make sure to gather the customer voice on different points of the process. Critical situations can also be identified. This gapless

mapping of customer activities allows a strategic positioning of detection tools to measure the safety sensation of passengers.

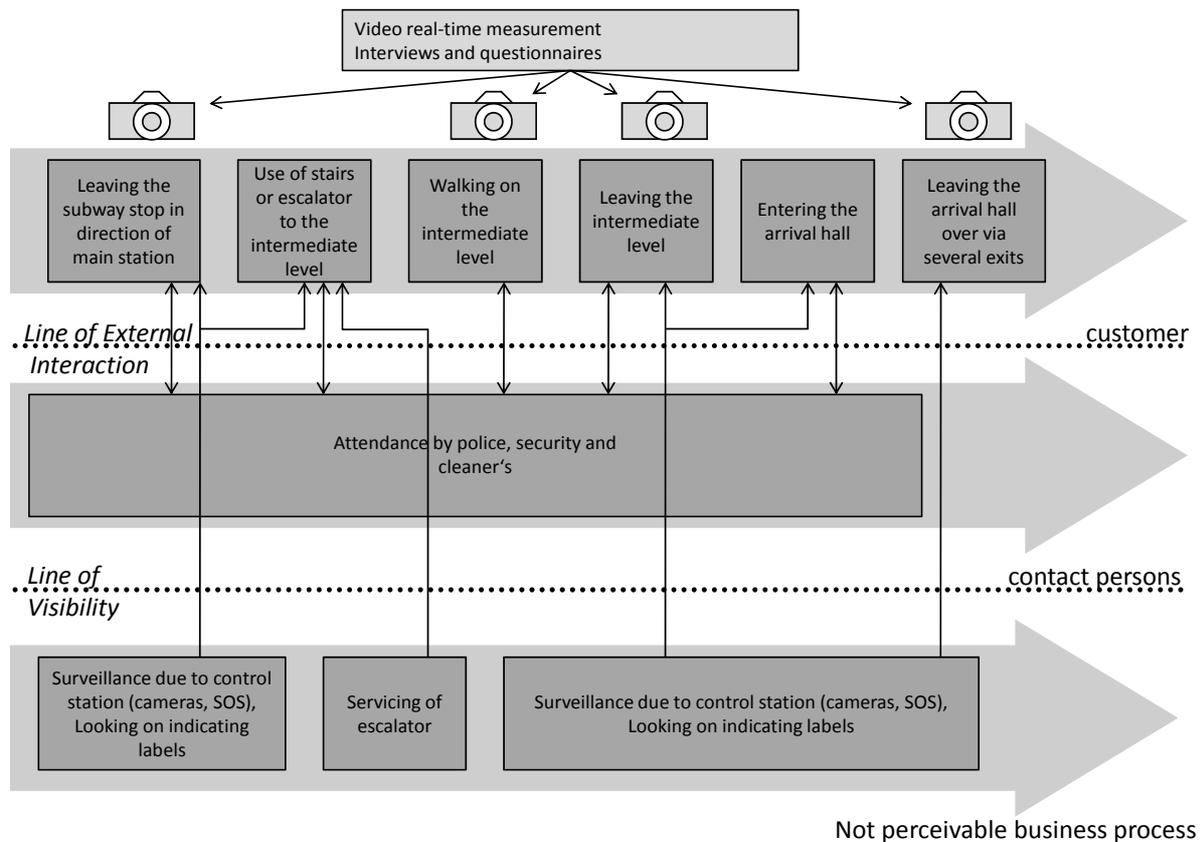


Figure 2: customer process as a service map (Homburg, 2006)

These defined detection tools at the process points are acting as a combination of questionnaires and real-time video measuring systems.

The particular sensitivities at the moment of measuring are figured out by in situ surveys. Surveys will be implemented by quantitative questionnaires and qualitative interviews (Bungard, 2000). The results of the questionnaires and the interviews enable a concretely overview about the passenger's most important safety indicators. This is basis for implementation a modular detection method of customer voice evaluation. The aim is to visualise current customer requirements as well as the long-dated development of the customer sensation. It is an intended permanent method based on the „Cards & Lights“ system. The methodology concerns content-related particular aspects of the service performance of transportation companies and it can be extrapolated due to interrogation from the service performance to the safety indicators.

Essential for the first interviews and questionnaires are the validity and significance due to interrogation to obtain an extensive safety indicator oriented atmospheric picture.

3. Carrying out of Questionnaires

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The realization of passenger surveys in public transportation takes place a priori due to stepwise execution of qualitative interviews and afterwards through spreading quantitative questionnaires. The aim of qualitative interviews is to identify potential, not yet considered aspects of the passenger's safety sensation. These latently or hidden safety perceptions could be integrated case-by-case in the quantitative questionnaire. To survey these aspects is pretty difficult because respondents are hardly not aware of them. At this point it is important, to

allow respondents a greatest possible latitude in the debate to avoid manipulation. Additionally the safety criteria won't explicitly be mentioned. They will be analysed by screening the conversation due to "reading between the lines" or estimation of gesticulation, facial expression and tone of voice. Besides safety indicators deduced from literature must be verified for validity and relevance.

In order to implement consistent and comparable interviews, at first it is to create a 'road map'. Content of this guide should be an introduction, the way of behaving with respondents and some information about topic and aim of the survey. There will be integrated queries into the guide that way, to lead to the topic and to avoid influence on the respondents. Afterwards there will be introduced the main part of the interview.

Within the identification of safety indicators, the respondent should express his current safety sensation beside welcome and information. When necessary respondents can outline a more precisely image due to requesting.

Bottom up on this approach the interviewer leads up the topic to a situation, where the respondent could have been felt uneasy on the rail platform, i.e. he describes factual and unemotional a fictive scenario, so that respondents give back their impressions unaffected and spontaneous.

The analysis of data a priori had taken place for the aspect "current safety perception" and separately for the aspect "scenario". The interviewed passenger was described the following situation: "You are located on the way back by subway of a soccer national league match from the Rhein-Energie stadium of cologne." – or: "You are here to see the social event Kölner Lichter."

Within the divided analysis into two questionings, the statements of respondents referred to the current safety sensation respective to the current perception regarding a specific scenario. These statements were gathered in context to personal indications like sex, age or civil status. The analysis followed into three steps. First, the personal indications were aggregated with the fact, if respondents felt safe or if they had a bad experience in a scenario (fig. 3).

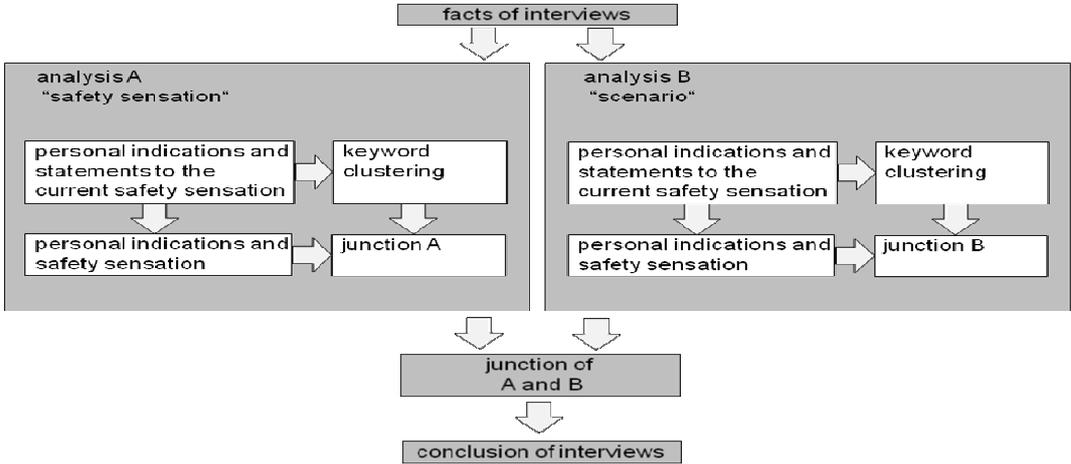


Figure 3: process of the analysis

In a second step, the reasons for the current safety sensation and scenario were clustered in keywords. In the completion personal indication were aggregated with the current safety sensation and scenario.

The two separate executed analyses finally were checked against each other to determine, if the statements due to scenario bear on the current safety sensation.

The following performed quantitative questionnaires act as validation of the previously compiled hypotheses relating to safety sensation of passengers. There are created queries on the basis of the safety indicators, where the influence of safety indicators on the safety sensation of rail customers should be measured by means of the answers. With the help of

these answers and the associated evaluation should be verified, if the assumptions up to now are correctly. Above, a quantifier about the safety indicators shall be implemented. Hereby negligible safety indicators with excessive measuring effort shall be excluded where appropriate.

Within the structure of the questionnaire, textual and formal aspects have to be considered. The content relates to the hypotheses of the safety sensation of Cologne passengers. From this hypotheses were derived safety indicators, which have to be quantified due to a four-stage scale to measure the degree of indicator influence. A more detailed scale would be too incomprehensible for the respondents. Additionally respondents have the option of abstention. Due to the request of personal indications, the constructed hypotheses as well as different requirements of men and women, young and old people, residents and foreigners etc. shall be described and verified.

The question paper is formally-oriented at the requirements of analysis software. It's a cost-effective available software with a specific bias on the indicator problem.

The distribution of the questionnaires to waiting passengers has taken place due to project employees directly at the subway-stop of the cologne central station. So passengers filled in the question papers in situ. The timing of entering the station is critical because of untimely fill-in abortion in many cases.

The evaluation of questionnaires constitutes a ranking of the promoted safety indicators.

4. Findings of the Questionnaires:

The evaluation of qualitative interviews as well as quantitative questionnaires provides some statements about safety relevant basic sensitivities of passengers and confirms the hypothetic derived safety indicators.

Table 1: list of safety indicators

safety indicators				
passenger	personel surroundings	safety measures	structural aspects	environment
time pressure	security forces present	labelling and digital signage	contiguity to the exit	day/night
temper	number of attendents	announce-ments	barred area/room	bad weather
	distance to the next person	video cameras	crowded area/room	grime
	surrounding people who are drinking alcohol	extinguisher	air-conditioned room	graffiti
	drunks	fire alarm		opaque windows
	Persons with animals	warning announce-ments		unpleasant odour
	psychic blazingly persons	alarm signals		stuffy air
				temperature
				ponding water
				running water
				smoke
				flames
				background music

As can be seen, men feel generally safer than women. However men are more concerned due to drunks and swearing people as women. Male respondents rather consider video cameras

and security forces as overdone. Moreover this significant refusal of safety measures rather leads to the assumption, that increased safety measures are not necessarily a warrant for a tendentially greater customer satisfaction. Women have major awareness of triggers of safeness absence.

These statements don't imply due to insufficient interviews to the general public. Nevertheless statements basically are represented due to the number of quantitative questionnaires.

As essential safety indicators with serious influence can be valued the following criteria in a range derived from the surveys:

1. realizing of open fire
2. realizing of smoke
3. drunks
4. persons, who starts to drink alcohol
5. presence of security forces
6. blazingly and abnormal bearing of persons
7. temper of other people
8. lack of means of escape from barred rooms
9. crowded rooms

Further criteria are losing increasingly brisance due to evaluation. They can be neglected for the "Cards & Lights" application.

5. Outlook

The described survey methods of customer voice establish a basis to process perceptions and with it coupled motion sequences as a pool of data. On the one hand the carried out surveys of safety sensations must be aggregated with sociodemographic data, e.g. configuration of correlations. On the other hand the data must be checked about plausibility and relevance for further investigations. There should be a specific context between the prompted safety indicators and the analysed performance cluster of transportation companies.

If there is visible a preference due to the ranking order of criteria of the quantitative questionnaires, focal points could be built to question the service performance cluster. Only passenger's really important criteria with an influence of the sensitivities as well as suddenly or uncontrollable behaviour due to the amount of responses will be considered in the below described "Poll-Light" system (**Degenhart, Fiedrich, Winzer, 2004**).

Then those performances will be marked, which could be perceived due to customers within the defined observation section. This selection of performances will finally be linked with the pre-defined safety indicators within the cluster. Hereby it will be visible, if one available characteristic of a safety indicator will have effects on the perception for the respective performance. Due to conjunction of the elements 'performance', 'safety indicator' and 'observation section', the 'Poll-Light' system will be able to display in situ the customer voices with regard to performances and safety sensations.

The customer simply has to vote about a pre-formulated statement according to the received service on a little card and has to insert the card into a ballot-box. The Ballot-boxes are shaped as traffic-lights.

Every signal-colour shows a judge-weight: positive, agree (green), middling, not sure (yellow) or negative, disagree (red) and each colour has a separate slit.

Arriving at the check-out, the customer gets a visiting card with one statement from the service-performance-cluster.

By leaving the train or station, customer drops the card into a slot of his choice.

Advantage: Good basis for a time critical election when leaving a train! Passenger only needs to drop the card with the pre-formulated statement in one of three optional slots of the ballot-box.



Figure 4: Measuring urn/ballot box with optional slots like a traffic-light

The release of the little reply cards will happen in the trains few minutes before stop at the getting off passengers. Passengers will be informed about the survey due to information boards within the trains. Thereby it will be indicated on the location of the ballot boxes. Several distributors per train will distribute the reply cards and will answer questions. The passenger has the availability to drop in the card at various focal points within the station building, e.g. doorways/exits and intermediate layers. The possibility that customers get rid of the card ahead of time will rise about the distance to the ballot box. This circumstance will be prevented through information in the trains.

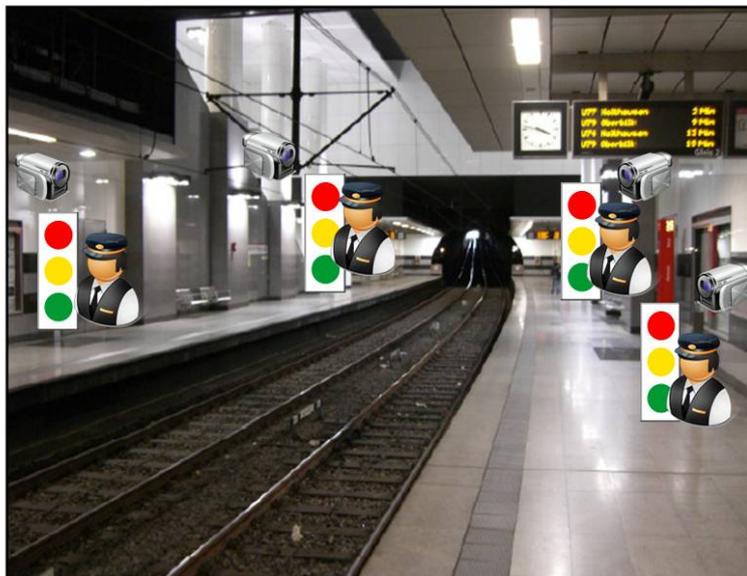


Figure 5: principle and setting of the “Poll-Light” method

Another utility entails, that potential sensitivities due to the surveys also could flow in a movie simulation like the real captured personal-streams due to real-time video measuring analysis. This kind of realistic depiction of passenger movements and the knowledge about their safety sensations provides a common basis, to encounter foresighted and effectively volatile situations in public transportation with regard to major events.

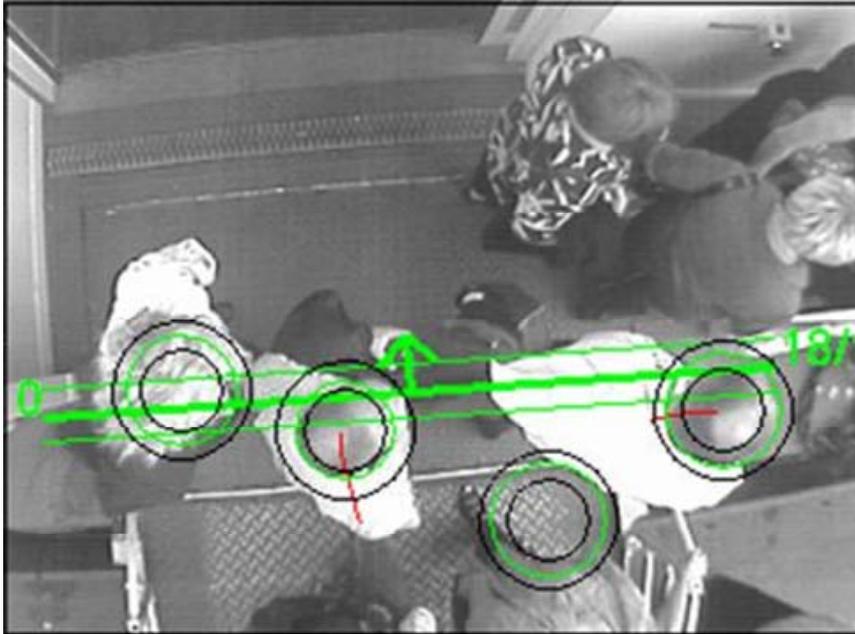


Figure 6: real-time video measuring of personel streams (source: Vitracom AG)

The gained qualitative findings about safety issues of affected people act especially as measurement to introduce the necessary organisation for safety guarantee and to improve the customer satisfaction and acceptance of public transport.

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