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Passenger Perception of Security – A Methodical Approach for Public Mass Transportation Systems

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Abstract

This paper points out the importance of research in the field of the perception of security. It starts with the lack of usability of state of the art methods for gathering passenger perception of security in public mass transportation. Based on defined problems and requirements, a new methodical approach for detecting and analyzing objective situation data and subjective passenger perception is described. Afterwards, the test run of this new approach at Cologne main station is described and findings on customer perception during events like soccer games are presented. Finally, the conclusion sums up the results of this research on the new approach for measuring passenger perception of security in public mass transportation systems.

Keywords: *perception of security, perception of customer, public mass transportation, security evaluation*

1. Introduction

Critical infrastructures, in this case public mass transportation, must kept safe and secure [1]. Night traffic, changing demographic environment conditions, attacks (e.g. through young people on platforms in Berlin, 2011) or even assaults (Madrid 2004, London 2005) have shown the vulnerability of public mass transportation [2-4]. In context of improving safety and security, data have to be gathered and interpreted permanently. Initially, the terms security and safety, whereat this paper focuses security, are defined: the term safety is used if "the hazard directs from one's own object to an exposed object within the environment. The occurrence of hazard is unintended and thus not foreseeable on a temporal basis" [5]. Whereas security "includes the intentional creation of hazard to create maximum damage with minimal effort" [5]. Therefore, the new methodical approach for measuring passenger perception of security is a chance to evaluate mass transportation security. Perception is a subjective factor, which is influenced by objective factors, *e.g.*, police presence. The measurement of subjective perception in real situations, in this case public mass transportation, is challenging.

Nowadays data collection in the context of perception of customer, for instance quantitative questionnaires and qualitative interviews applied within marketing mainstream, reach their limitation in dynamic situations like public mass transportation [6]. Measuring the subjective perception of security, while using public mass transportation, takes too much time. It does not link the real objective with the specific subjective perception. A new methodical approach, taking engineering and social science aspects into account, is appropriate to gain a measurement method for objective and subjective values. This differentiation between objective, situational data and subjective, perception of security is a

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basic demand in order to understand how public mass transportation customers feel in real situations [7]. A further reason is that perception of security change regarding the nationality of the customers [8]. Afterwards the problem of the measurement of perception of customer and its requirements are described. Based on these results, a new methodical approach, which can be used to measure the passenger perception of security in the subway, will be developed. Finally the results and conclusions of this method will be discussed critically following a test run at the Cologne main station.

Furthermore, the presented research shows the connection of video analysis and survey data for simulating customers' behavior, since the objective data of the camera recording can be coupled with the subjective security perception of passenger to be subsequently displayed in the simulation. In specific terms, the subjective statements of passengers will be quantified and connected to the detected video analysis data. These objectified sensitivities of passengers are used as a parameter in the simulation. The collected knowledge and the framework will be used as basic parameter and integrated into the digital planning manual.

2. Methodological Approach

In the age of major events such as public viewing, festivals and sporting events the perceived security of people becomes more and more a focus of science. Several studies have investigated perceived satisfaction in context of public transport services [8, 9].

Currently, there is small knowledge about the behavior of crowds. Data are only available from simulations created in laboratory tests [10] or by surveys that are not connected to the real situation the passenger is involved in [8]. However it is not always possible to transfer data into reality, because situational conditions can vary each time. Also laboratory tests cannot imitate real situations so that the respondent test behavior may differ from their real behavior and their feelings. Though, perception of security people or in this case passenger of public mass transportation is still inexplicable and therefore not predictable.

In this new methodical approach, technical and social science perspectives are combined to close this knowledge gap. With the help of engineering approaches some shortcomings of classical questioning methods are recorded and resolved. It has been difficult for existing questioning methods to capture the latent sense of security [11, 12, 13]. The reason for this fact is that the perception of people can only be captured within the situation. Surveys following a situation or hypothetical questions lead to inaccurate or even falsified results, because the situation is not comprehensible and the experience of customers cannot be assessed correctly [14].

Accordingly the "Research Group Product Safety and Quality Engineering" of the University of Wuppertal developed within the project VeRSiert [15] a new methodical approach which allows to assess the costumer as part of the situation and the customer-related processes according to his feeling of security. The new methodical approach enables an investigation of the basic need of "safety" (see Maslow's Hierarchy of Needs [16]).

The underground station of Cologne's main station was used as test field where the passengers (*i.e.*, the costumers) in terms of a high density of people on the platform (i.e. the customer related process "walking along the platform") were consulted about their sense of security. The theoretical basic considerations, the experimental setup, and the first findings are presented in the following chapter.

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2.1. Basic issues of the Security Surveys

To record the passengers' sense of security, fundamental considerations are required. It has to be figured out which factors make passengers feel secure or rather insecure. Certainly, the extent of influencing factors needs to be explored.

In contrast to previous surveys using questionnaires [8, 17] or telephone surveys, a recording in situ is required, regarding the sense of security, to obtain accurate data (impression of passengers). Therefore the survey must not restrict the passengers while using public mass transportation systems. This means, that the investigation must contain a very low effort in terms of time and distance for the passengers. Furthermore this survey method shall allow the survey of a large number of people within a very short time. In addition the subjective impressions of passengers have to be linked to the prevailing objective value which influences the perception of security.

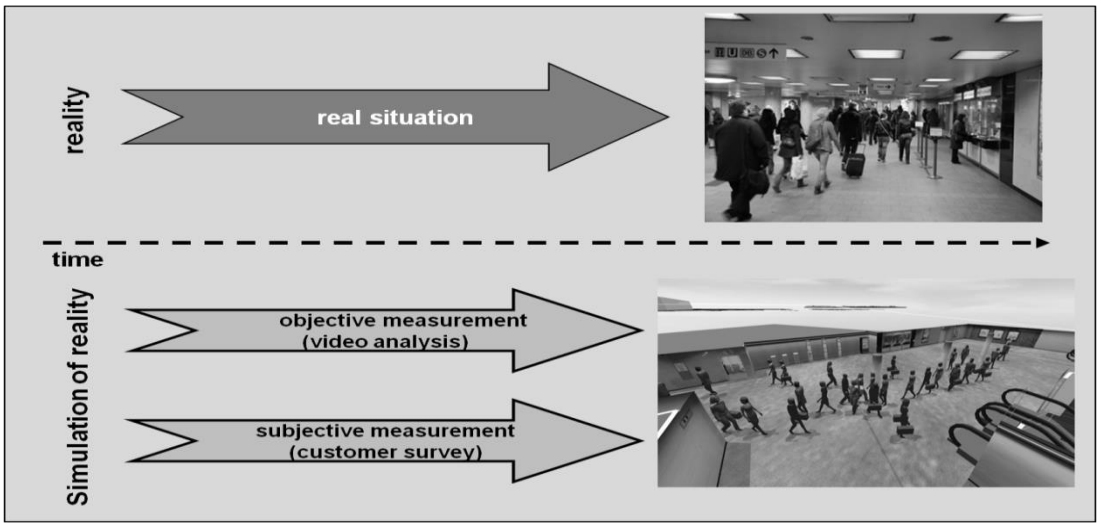

Figure 1. Simulating the Feeling of Security Combining Objective An Subjective Measurements

The latter leads to the conclusion that the processes, which a passenger needs to run through, have to be known for the measurement (see Figure 1). In order to illustrate the real situation by a simulation, the objective and subjective measurement data must be brought together. In addition to that, it must be determined which influences or characteristics have a bearing on the individual processes and lead passengers to change their perception of security. As a result it must be defined, which costumer-related processes (what?) at which measurement point (where?) by appropriate technology and methods (how?) are investigated as a basis for measurement.

2.2. Concept of the Security Surveys

The first step is a concept for identifying costumer-related processes. The respective processes for subway passengers in the main station of Cologne were analyzed with the help of Service Blueprinting. This event-orientated method was developed in the early 80s by Shostack [18]. The purpose of this method is to identify customer participation and contact points, which are often very different and divergent within processes [19, 20]. Therefore the enterprises', as well as customers' processes have to captured and

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afterwards visualized to bring them into a temporal, transparent, and logical exposure. Hence, the blueprint must be aligned to the specific application [21].

The Service Blueprint itself divides the processes (customer/enterprise) into different sub-categories and contact points, to make obvious which process an enterprise realizes (direct) as a customer contact point. For this subdivision different types of lines are used [22-25]. These lines are:

- Line of interaction: Distinction between customer and performance providers activity.
- Line of visibility: Separation between enterprises' activities which are invisible for customers and those which are visible.
- Line of internal interaction: Division between the activities of the customer contact personnel and those of other employees.
- Line of order penetration: Segregation among activities for market development which are not depending on customer orders.
- Line of implementation: Definition of implementation activities compared to planning and control activities.

The following Figure 2 visualizes the basic application of the service blueprint.

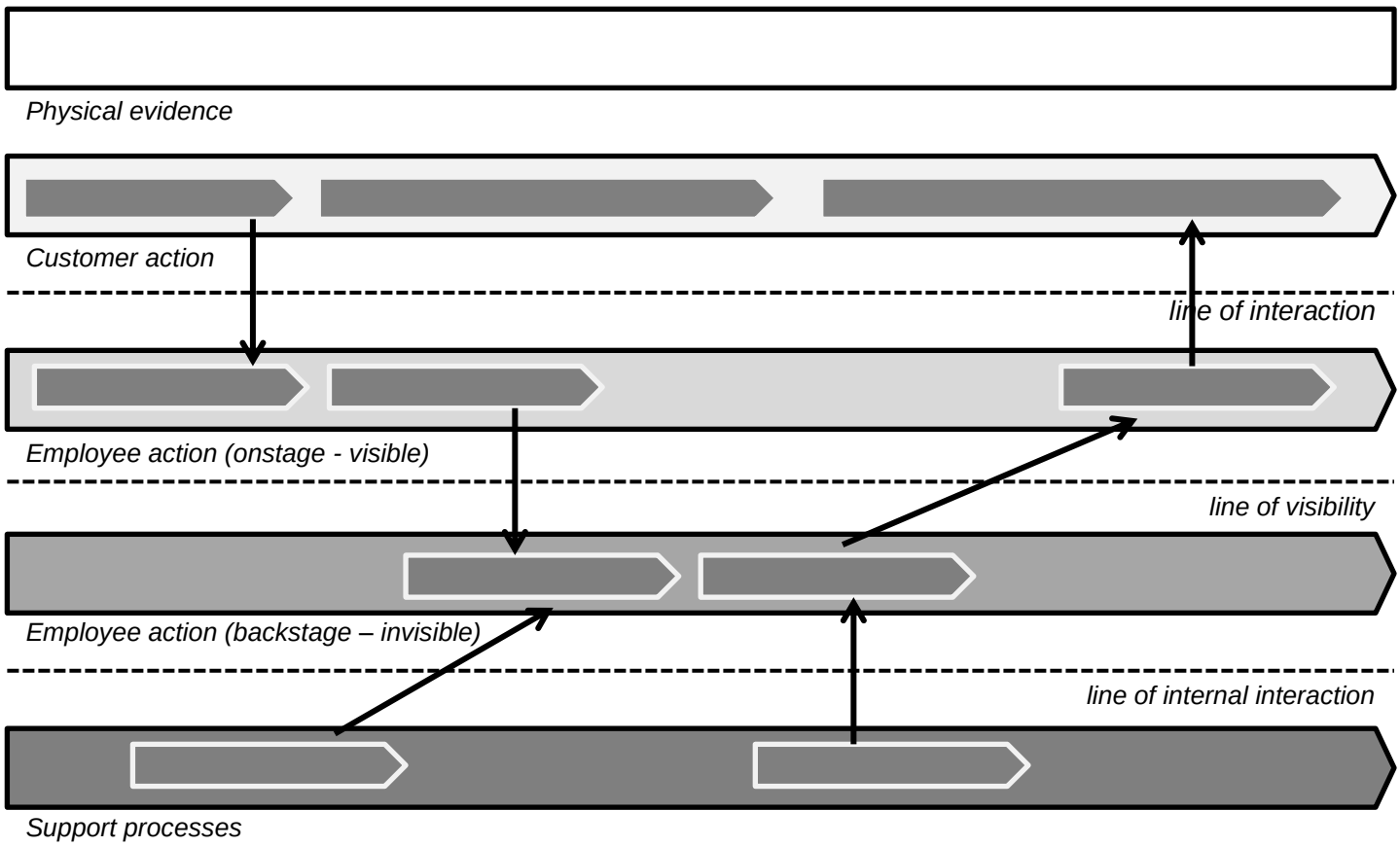

Figure 2. Service Blueprint, According to [21]

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At the identified customer contact points it is possible to measure customer perception of security, also regarding the provided performances through the enterprise processes. In addition, the appropriate influences on the perception of security could be detected and associated with the processes by performing literature research in the area of basic needs. The applicable measurement methods are derived from the type of exposure [26, 27]. The measurement concept (shown in Figure 3) represents the relationship between the costumers´ processes, the key points or customer contact points and their acting influences on the costumer. In the following, the influences of perception of security are referred as security indicators (SI). They were confirmed by qualitative surveys of passengers at the station and completed where necessary.

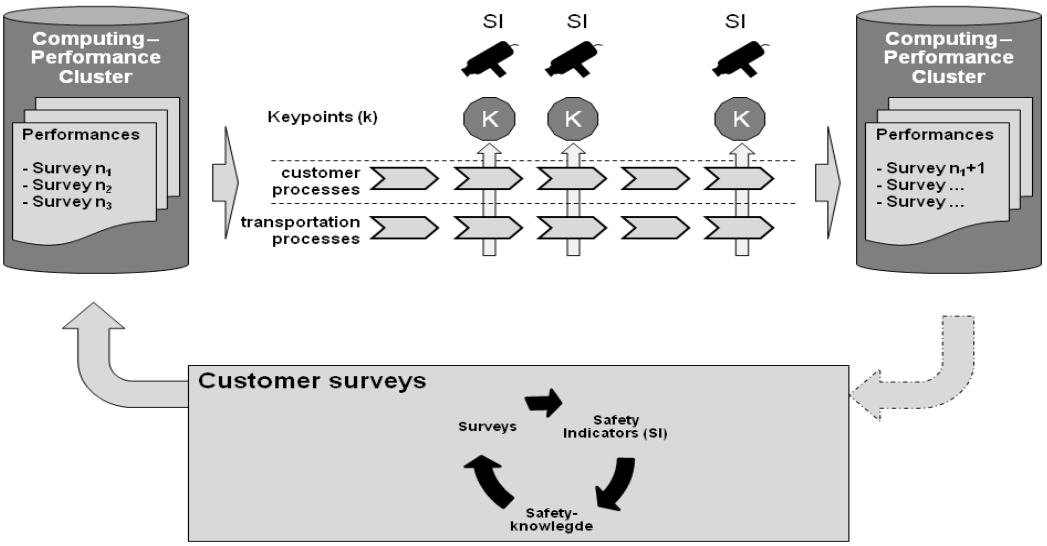

Figure 3. Measurement Concept for Perception of Security

The SI were measured objectively at appropriate points within the customer-related processes that were previously identified and documented with Service Blueprints. The subjective impressions of the customers have to be gathered at the same time by using the new methodical approach. The connection between the costumer-related processes and the objective and subjective measurements are documented in the performance-cluster.

The performance-cluster, as a data base, does not only show the SI and the effected processes, it also structures the various services and quality aspects, allowing a subsequent evaluation of measured data. Since a part of the measurement approach a large volume of data is generated, EDP-assistance is needed for the performance cluster [28]. On the one hand the software was loaded with the findings from the qualitative and quantitative surveys with all SI, and the customers´ processes were deposited on the other hand in order to assign data to the processes and SI.

This performance cluster does not only link the collected objective measurement data with the subjective data, but assigns the data to the respective security indicator that is queried and the involved processes the passengers go through. Thus, the perception of

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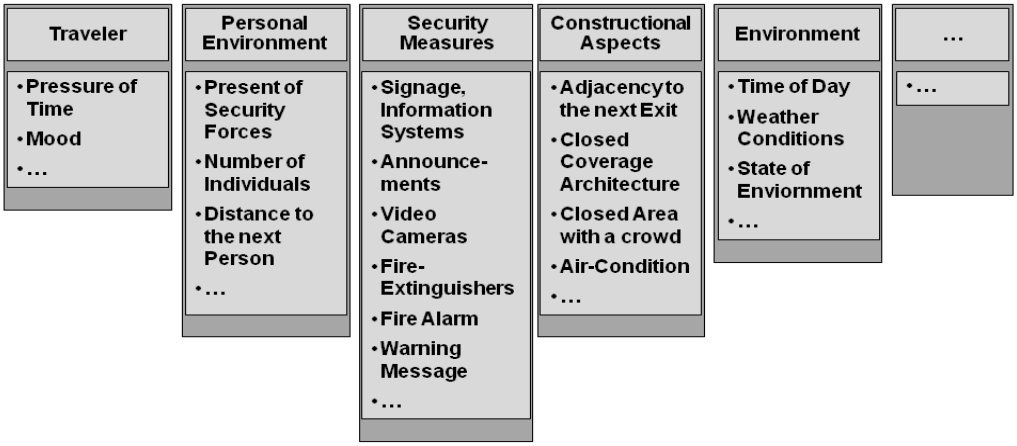
security of the passenger within the processes of public transport services can be seen [14]. In detail, the performance-cluster of public mass transportation, which is used in this case, displays the processes of the passengers when they leave the subway and go to the main station. These processes will be compared with the indicators that are relevant for the sense of security in a matrix. The relevant factors identified in the project are listed in Figure 4 as an example.

Figure 4. Exemplary List of Security Indicators for Subway Passengers



However, not all indicators for the subsequent measurement could be considered as time and financial resources were limited in the project. The project consortium agreed on the indicator “Proximity to the next person” in the context of the networking of the work packages with the aim to depict the security indicators in a simulation. The subsequent measurements of the sense of security were focused on this security indicator, because the distance to the next person regarding to the subjective feeling of security for the passengers is a key-factor and the passenger perception of the “space” represents a special stress trigger [29]. Furthermore conducted surveys in the framework of the project at Cologne Main Station delivered same findings. The subsequent measurements of the perception of security were focused on this security indicator.

Vertically-oriented cameras that were mounted on the ceiling of the subway station were used for the objective measurement. The cameras counted the number of people and thus delivered a statement about the density of people on the spot by taking the existing surface on the subway platform into account.

Moreover, the “Cards&Lights” method was used for not constraining the passengers within the survey of the subjective sense of security at their way from one place to the other. This procedure is based on the distribution of survey cards to the passengers, which have to be posted in a ballot box [14]. The survey cards, which contain the information “distance to the next person” in a statement that refers to a security indicator (in this case “Person density” at the platform), is posted in a ballot box. The ballot box is divided in three sections (red/yellow/green). Depending on the current situation, the passenger can throw the statement “with the current number of people around me, I feel good” or “with the current number of people around me, I feel secure” in green - “I agree”, yellow - “I abstain (from voting)”, or red - “I disagree” slots. By emptying the boxes corresponding to the time intervals of the incoming subways and

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the simultaneous counting of passengers disembarking from the subway it can be determined by which density of people the passengers feel secure or comfortable.

The measurements themselves took place at the Cologne main station during soccer games of the "1. FC Köln", "Cologne Lights" and during the Christmas market. The results prove that the developed measuring method for the detection of security feeling is suitable for passengers. In particular, the return rate of more than 35%, the usability of the survey results, the consideration of the given requirements, the survey of a large number of people in a short time without hindering their intentions (no stopping for passengers on their way to the place of destination), are the main advantages.

3. Permanent Measurement Concept

The general requirements for the measurement concept regarding the passenger perception of security was already fulfilled through the work described above, but some aspects of the potential users of the method have not been solved satisfactorily. The use of the described concept requires the assignment of a lot of personnel and therefore cannot be used permanently.

In a first approach, this continuous measurement concept was developed without a digitally media link between objective camera data and subjective passenger perception. The consolidation of camera and security perception data was done afterwards by statistical analysis and uploaded as basic information for the simulation in order to reduce personnel resources as well as media breaks. This led to two variants of permanent measurement, which differ by the costs of the measurement system that is used. As a result a "Low-Tech"- and a "High-Tech"- concept for the permanent measurement was evolved.

The "Low-Tech"-concept is based on electrical signals (for example a buzzer), which are coupled with a timestamp. The signals are digitally recorded and stored. They can be read out by using a laptop, as the following illustration shows.

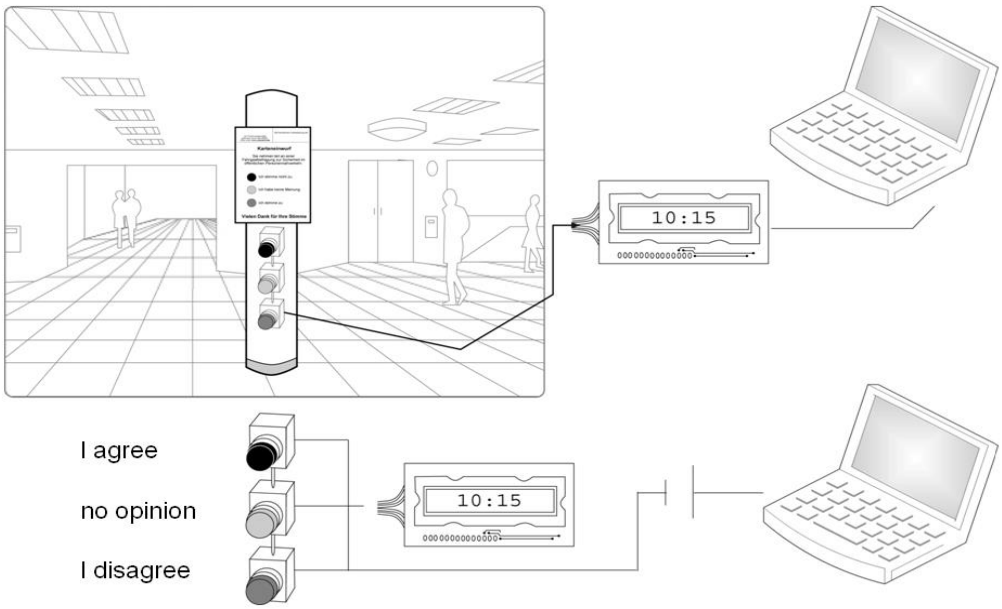

Figure 5. Concept Variant "Low-Tech" for Permanently Measurements

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The "High-Tech"-concept includes a touch screen, which shows the questions and an answer scale (red/yellow/green). The collected data is time stamped and forwarded by using a Wi-Fi connection directly to the interface which connects the camera's metering and evaluates the data to redirect it to the simulation (see Figure 6).

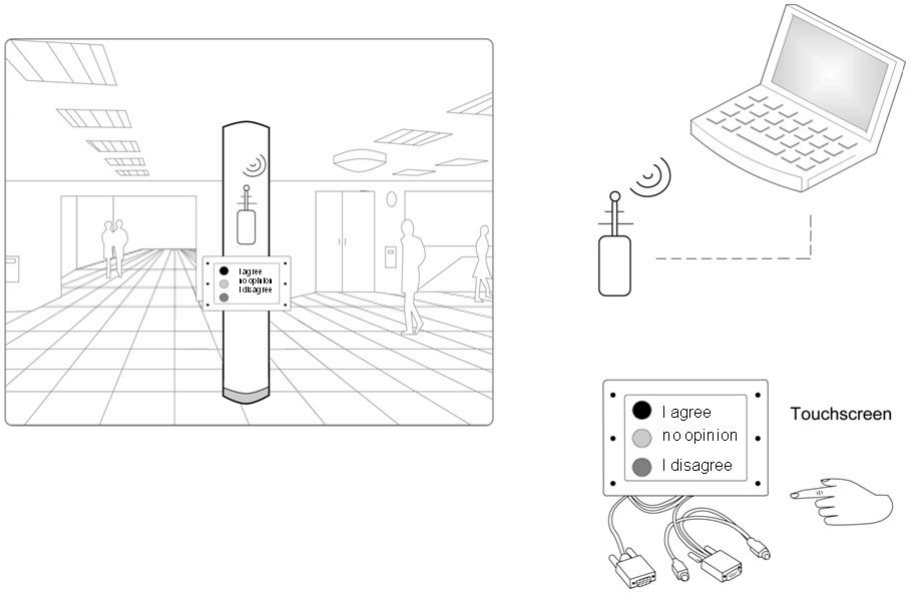

Figure 6. Concept Variant "High-Tech" for Permanently Measurements

Both concepts offer the opportunity of a permanent measurement. The more costly version also provides a direct feed of the data to the simulation. Which concept for the implementation of the measurement should be used, can be decided on the basis of the requirements concerning the measurement. The following Table 1 gives an overview of a comparison of the two permanent and the continuous measurement concepts.

Table 1. Comparison of the Measurement Concepts

Measurement Concept	Continuously	Low-Tech	High-Tech
Informational Value	+	+	+
Response Time	Days	Hours/Days	Seconds
Number of interviewed Persons	+	+	+
Low expenditure of time	+	+	+
No obstruction	+	+	+
Fixed costs	Low	Middle	High
Variable costs	High	Middle	Low

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4. Findings in Relation to the Security Indicator "People Density"

First findings about the influence of passenger perception of security by a crowd of people could be achieved with the continuous measurement concept in the context of the project VeRSiert. Therefore, the underground station of the Cologne transport services (Kölner Verkehrsbetriebe - KVB) at the Cologne main station was chosen as test field. A total of six measurements took place. A distinction was made by:

- Railroad lines (U18, U5, U16, special additional trains for soccer matches)
- Types of passengers (fans/no fans; female/male)
- Number of people present at the platform
- Events (soccer match, Cologne Lights, Christmas market)

First of all it must be noted that the survey concept “Cards & Lights” achieves a high response rate. The rate varies between 35% - 60%. Usually questionnaires only reach 10% to 20%. On this basis it can be assumed that the achieved results of the surveys are valid, according to statistical calculations. For example, the results of the measurement event on the day of the "Cologne Lights" on 17 July 2010 are explained in Figure 7. The measurements of the subjective sense of security with the "Cards & Lights" method at the Cologne main station “Main Station – Cologne Cathedral“ demonstrated gendered specific results.

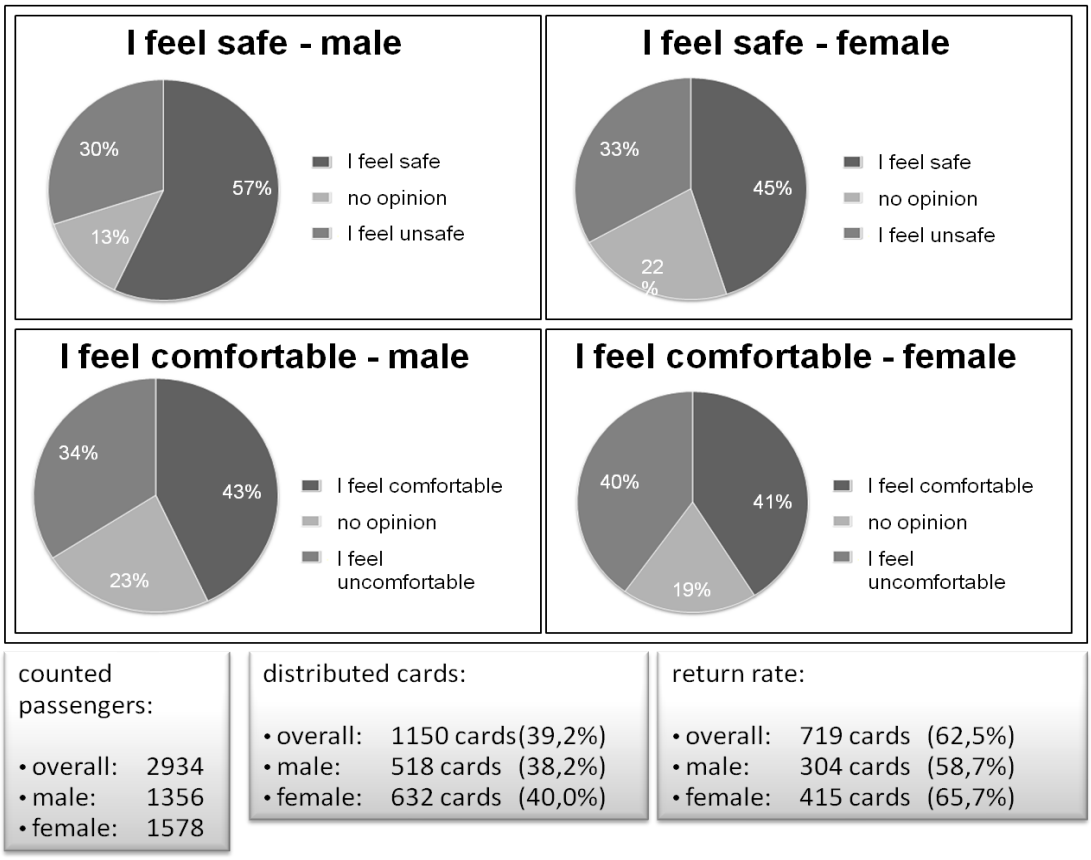

Figure 7. Evaluation of a Measurement Event

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The illustrated results show the positive subjective security feeling dominates among male respondents, while the percentage of votes to the question "I feel comfortable" are almost identical. The evaluation and analysis of all results have been carried out by statistical methods (regression analysis). This was intended to check the validity of the feature dependency between the percentage of votes of the measured sense of security and the total number of passing passengers on the platform [30]. Overall, it shows that for example football fans have a higher tolerance threshold for being comfortable than "normal" passengers of a train. Perhaps, football fans have a different sense of security or well-being because of the cohesiveness. It can be assumed that this group has an increased tolerance threshold for the well-being in the crowd, but no studies have been done specifically on this subject yet.

The results of the measurements mainly show that the passengers do not feel comfortable rather than unsecure. That means with a large number of people the well-being of the passenger tend to decrease. However, no comparable insecurity is reached for the passenger. With large number of people around, women tend to feel more uncomfortable than men. This applies only to the well-being, but not for the sense of security that remains apparently unaffected in the crowd of the passengers.

5. Conclusion

The presented method solves the issue of capturing emotions demonstrably. Thus, it offers an important addition to the usual marketing methods and new opportunities in security research. The new methodical approach enables not only the collection of perception of security. It also meets the requirements imposed on the survey of customers in a given situation without affecting or hindering. It was defined where (contact points), what (which customer relevant processes), and how (which technique and method) the measurement has to be done.

Furthermore, the exact situational coupling of the objective and subjective data at the key points enables an accurate statement about the perception of security in accordance with the degree of "threat". However, new issues relating to the costs and the analysis arise despite this success. The knowledge gained constitutes only a small area of the complex of perception. Not only the crowd on the platform, which was measured by the security indicator "Distance to the next person" affects passenger perception of security, but also many other factors such as temperature, presence of drunks etc. (further influences can be found in [9]). Only for tests of all security indicators and their correlations among themselves, a good understanding of the perception of security and the predicting of panics, using simulations, are possible. Thus, relevant indicators of the sense of security should be recognized objectively and query subjectively. To identify correlations, the acquired data has to be evaluated with various criteria, which therefore involves the creation of analytics to build complex correlations. Depending on the examination space, the use of modern technology for the realization of an efficient measure must be investigated.

Therefore an advanced approach has to be developed, with the help of the gained knowledge through the measurements [7]. This new approach must combine several scientific and industrial disciplines which should be interlinked together (quality management, acceptance measurements, regulatory frameworks for public mass transportation, sensor technologies etc.). Objective and subjective data measurement must be handled by two systems: the first gathers and handles objective detected data (*e.g.*, temperature, air humidity etc.), the second the subjective data which is gathered directly from customers' view. The development of such systems must include multi-criteria analysis to achieve the correlations

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of several parameters. Therefore the combination of process workflows, performances, influences, security and safety parameters require the above mentioned multi-criteria, empirical data analysis to examine effects and reasons of dangerous situations in the field of public mass transportation.

References

[1] Bundesministerium des Inneren (BMI), Nationale Strategie zum Schutz Kritischer Infrastrukturen (KRITIS-Strategie), **(2009)** http://www.bmi.bund.de/SharedDocs/ Downloads/DE/Themen/ Sicherheit/SicherheitAllgemein/kritis.pdf;jsessionid=9D01B9DB265867954494CA60ACCA6510.2_ cid295?__blob=publicationFile, Last Access: 25.04.2013.
[2] T. Petermann, H. Bradke, A. Lüllmann, M. Paetzsch and U. Riehm, "Was bei einem Blackout geschieht – Folgen eines langandauernden und großflächigen Stromausfalls", Edition Sigma, Berlin **(2011)**.
[3] H. R. Arntz and U. Kreimeier, "Erfolgreiches Risikomanagement in der Katastrophenmedizin", Notfall und Rettungsmedizin 4/2011, Springer Verlag, Berlin, **(2011)**.
[4] Bundesministerium des Inneren (BMI), Demografiebericht. Bericht der Bundesregierung zur demografischen Lage und künftigen Entwicklung des Landes 2012, Kurzfassung, http://www.bmi.bund.de/SharedDocs/Downloads/DE/Themen/Politik_Gesellschaft/DemographEntwicklung/demografiebericht_kurz.pdf?__blob=publicationFile, Last Access 25.04.2013, **(2012)**.
[5] E. Schnieder, "Towards a theory of safety", Proceedings of the SPDS 2012 (Society for Design and Process Science) conference, Berlin, Germany, **(2012)** June, 10-14.
[6] T. Degenhart and S. Fiedrich, "Wissensbasierte Unternehmensorganisation - Inhalte, Instrumente, Szenarien", Editor P. Winzer, Shaker Verlag, Aachen, **(2004)**, pp. 93-109.
[7] J.-P. Nicklas, N. Schlüter and P. Winzer, in N. Aschenbruck, P. Martini, M. Meier and J. Tölle, Editors. Future Security. Proceedings of the 7th Security Research Conference, Bonn, Germany. New York, Springer Verlag, **(2012)** September 4-6, pp. 1-4.
[8] M. Fellesson and M. Friman, in Journal of the Transporation Research Forum, (Public Transit Special Issue 2008), vol. 47, no. 3, **(2008)**, pp. 93-103.
[9] S. Srinivasan and H.-V. Chandra, "Empirical analysis of the impact of security perception on intercity mode choice: A panel rank-ordered mixed logit model", Transportation Research Record: Jounal of the Transportation Research Board 1942.1, **(2006)**, pp. 9-15.
[10] D. Helbing, F. Illés and T. Vicsek, Nature, vol. 407, **(2000)**, pp. 487-490.
[11] H. O. Mayer, "Interview und schriftliche Befragung – Entwicklung", Durchführung und Auswertung, Oldenbourg Verlag, München, vol. 5, **(2009)**.
[12] J. Raithel, "Quantitative Forschung- Ein Praxishandbuch", VS Verlag für Sozialwissenschaften, Wiesbaden, vol. 2, **(2008)**.
[13] M. Wohlrab, "Qualitative Sozialforschung- Ein Arbeitsbuch", Oldenbourg Verlag, München, vol. 2, **(2009)**.
[14] N. Schlüter, "Entwicklungen im Wuppertaler Generic-Management-Konzept", Berichte zum Generic-Management, Editor P. Winzer, Shaker Verlag, Aachen, vol. 1/2010, **(2010)**.
[15] Project VeRSiert: www.versiert.info, Last access, 26.04.2013, **(2011)**.
[16] M. R. Hagerty, Social Indicators Research, vol. 46, no. 3, **(1999)**, pp. 249-271.
[17] M. Benesch and D. Fragebogen – Von der Forschungsidee zur SPSS-Auswertung, UTB Verlag, Stuttgart, **(2008)**.
[18] G. L. Shostack, European Journal of Marketing, vol. 16, **(1982)**, pp. 49-63.
[19] S. Fließ, B Lasshof and M. Meckel, "Diskussionsbeitrag Nr. 362, Douglas-Stiftungslehrstuhl für Dienstleistungsmanagement, Fernuniversität Hagen, **(2004)**.
[20] E. M. Hefner, Marketing Review St. Gallen, vol. 2, **(2010)**, pp. 27-31.
[21] V. A. Zeithaml, M. J. Bitner and D. D. Gremler, "Services Marketing – Integrating Customers Focus Across the Firm", Mc Graw Hill, New York, vol. 5, **(2009)**.
[22] M. Benkenstein and A. von Stenglin, in Forum Dienstleistungscontrolling: Dienstleistungsmanagement, Editors M. Bruhn and B. Stauss, B., Gabler Verlag, Wiesbaden, **(2006)**.
[23] H.-J. Bullinger and P. Schreiner, "Service Engineering. Entwicklung und Gestaltung innovativer Dienstleistungen", Editors K. Schneider, H. J. Bullinger, A. – W. Scheer, Springer Verlag, Berlin, Heidelberg **(2006)**, pp. 53–84.
[24] M. Kleinaltenkamp, "Neue Aspekte des Dienstleistungsmarketing – Konzepte für Forschung und Praxis, Edited H. Woratschek, Springer Verlag, Wiesbaden, **(2000)**, pp. 3-28.

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[25] C. Lovelock and J. Wirtz, "Services Marketing – People, Technology, Strategy", Pearson, New Jersey, Vol. 5, **(2006)**.
[26] DIN EN 13816 (2002), Transport – Logistics and services - Public passenger transport; Service quality definition, targeting and measurement, Beuth Verlag, Berlin, **(2002)**.
[27] H. Koetsche, Kriminalitätsvorbeugung im öffentlichen Verkehrsraum: Kommunale Kriminalpolitik, Ansätze zur Erhöhung der Sicherheit, Arbeit mit gewaltbereiten Jugendlichen, Editor J. Jaeger, Institut für Landes- und Stadtentwicklung des Landes Nordrhein-Westfalen; ILS-Schriften 104, Dortmund, **(1996)**, pp. 11-13.
[28] T. Degenhart, S. Fiedrich and P. Winzer, in Qualitätsmanagement - Anspruch und Wirklichkeit, Editor J. Herrmann, Shaker Verlag, Aachen, **(2004)**, pp. 121-139.
[29] L. Kruse, Privatheit als Problem und Gegenstand der Psychologie, Huber Verlag, Bern, **(1980)**.
[30] L. Papula, Mathematik für Ingenieure und Naturwissenschaftlicher Band 3: Vektoranalysis, Wahrscheinlichkeitsrechnung, Mathematische Statistik, Fehler- und Ausgleichsrechnung, Vieweg+Teubner Verlag, Wiesbaden, vol. 5, **(2008)**.

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